NORTHROP
AIRCRAFT, INC.

NORTHROP FIELD
HAWTHORNE - CALIFORNIA
U.S.A.

#20

HB-20

HANDBOOK OF
ERECTION & MAINTENANCE INSTRUCTIONS
FOR THE
XB-35 AIRPLANE
AAF 42-13603

1 JUNE 1947

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HAWTHORNE, CALIFORNIA

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NORTHROP

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ERECTION AND MAINTENANCE INSTRUCTIONS

FOR

ARMY MODEL

XB-35

HEAVY BOMBARDMENT AIRPLANE

Serial Number AAF 42-13603
(Northrop Number 1484)

Prepared by

NORTHROP AIRCRAFT, INC.
HAWTHORNE, CALIFORNIA

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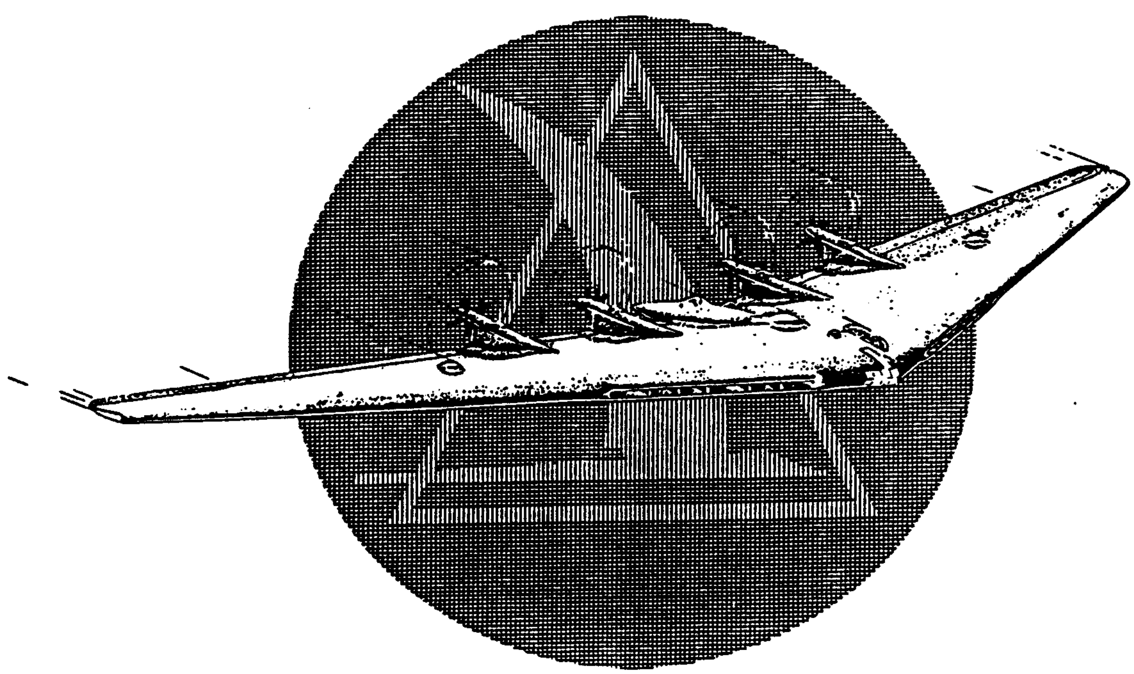


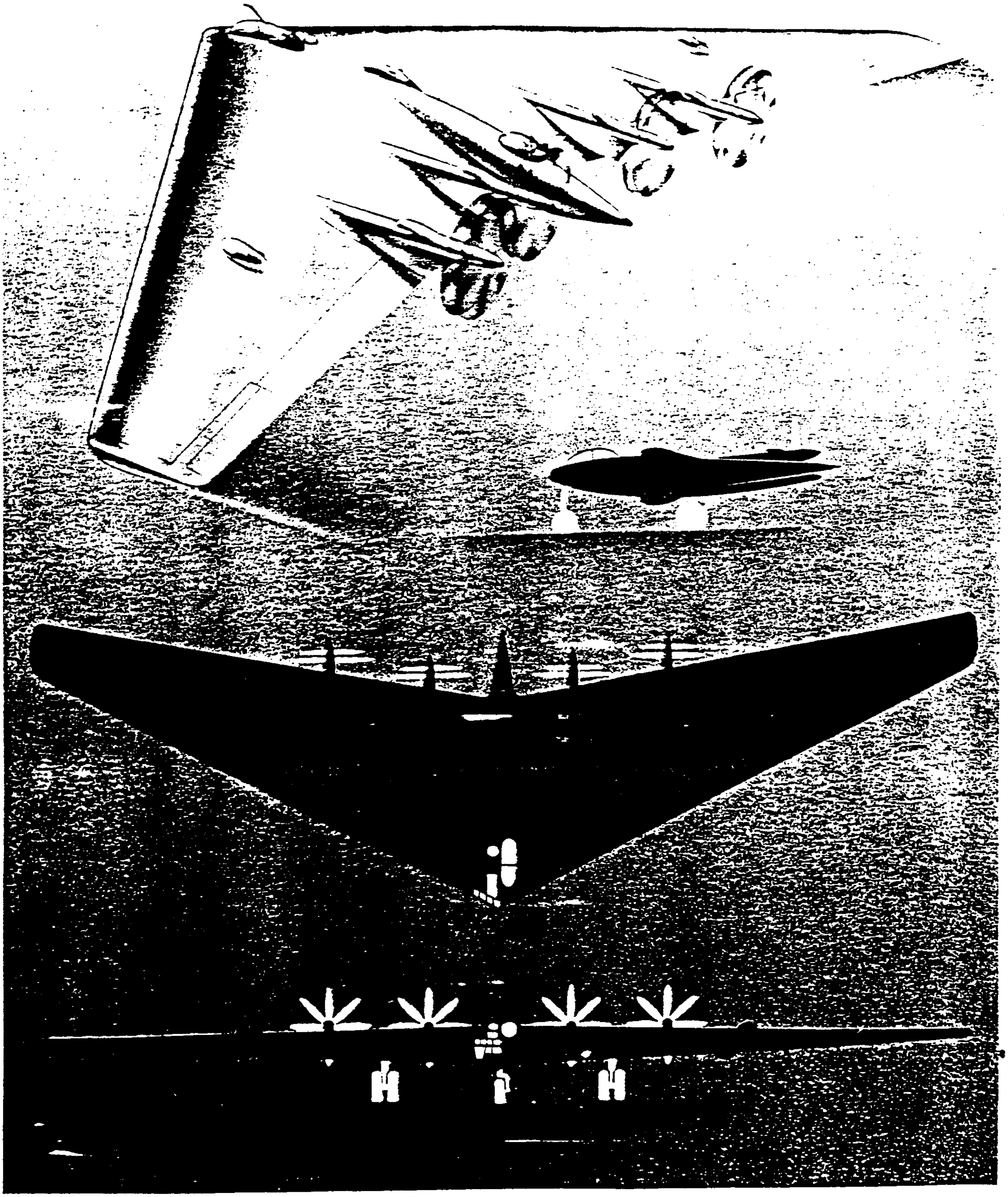


Figure 1. XB-35 Airplane

3. LEADING PARTICULARS.

a. SETTINGS AND RANGES OF MOVEMENT OF CONTROL SURFACES.

	Degrees	Inches
Elevons Up (from Neutral) total	35°	28.53"
Angular Movement as Aileron	15°	12.87"
Angular Movement as Elevator.	20°	17.01"
Elevons Down (from Neutral) total.	25°	21.02"
Angular Movement as Aileron	15°	12.87"
Angular Movement as Elevator.	15°	12.87"
Landing Flaps (total)	50°	71.26"
Trim Flaps Up (from streamline with wing)	30°	27.06"
Trim Flaps Down (from streamline with wing)	7½°	6.754"
Rudders (each surface from streamline).	60°	38.016"
Fully deflected total up and down	120°	76.032"

b. MAIN LANDING GEAR.

Type.	Electrically retractable
Tread: (width between strut centers)	41' 5"
Shock Struts Type:	Combination air-oil
Maker and Part No.	Bendix No. 69191
Fluid required: Specification	3580 Red color
Approximate maximum air pressure.	903 psi at a gross weight of 155,000 lbs. with normal C.G.
Wheels. Type.	Goodyear No. Pd-96, 65" smooth contour
Tires	65" smooth contour, 22 ply
Tire Pressure	70 psi at gross weight of 155,000 lbs. with normal C.G. Inflate to deflection marker.
Brakes. Type	Goodyear dual-disk, three spot, power operated.

c. NOSE LANDING GEAR.

Type.	Electrically retractable, steerable.
Shock Strut. Type.	Combination air-oil
Maker and Part No.	Bendix No. 67921
Fluid required: Specification	3580 Red color
Approximate maximum air pressure.	903 psi at a gross weight of 155,000 lbs. with normal C.G.
Wheel. Type.	Hayes No. H-3-252-M, 56" smooth contour
Tire.	56" smooth contour, 16 ply.
Tire Pressure	70 psi at gross weight of 155,000 lbs. with normal C.G. Inflate to deflection marker.

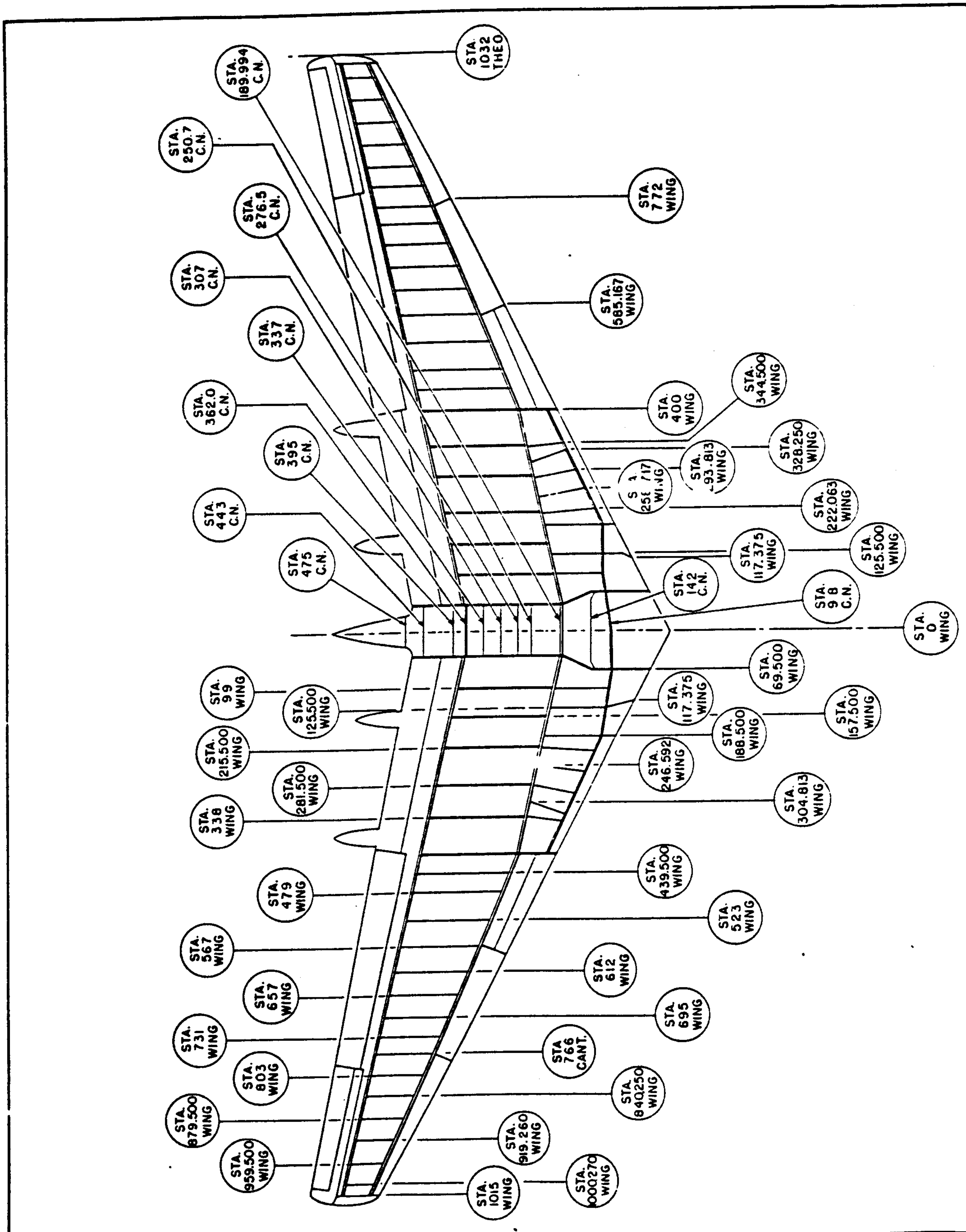


Figure 3. Stations Diagram

d. ENGINES.

Number	Four
Designation	R-4360-17 and -21.
Gear Ratio	.381
Fuel	Specification AN-F-28, 100/130.
Oil	Specification AN-VV-O-446a, Grade 1100 or 1120.

e. PROPELLERS.

Manufacturer	Hamilton Standard
Type	Eight-blade, dual-rotating, full feathering, reversible pitch.
Hub	No. 828060
Blade	Nos. 2C15-B2-0a7 and 2C15-B1-0a8
Diameter	Aft blades 15' 1", Forward blades 15' 3"
Control	Combination governor and control lock.
Pitch Settings.	
Low (fine)	13°
High (coarse)	60°

f. FUEL TANKS.

	Gallons
Main left outboard (two cells)	1239 US (1031.68 Imp.)
Main left inboard (two cells)	1201 US (1000.04 Imp.)
Main right inboard (two cells)	1321 US (1099.96 Imp.)
Main right outboard (two cells)	1239 US (1031.68 Imp.)
Total Fuel	5000 US (4163.36 Imp.)
A.P.U. (Each Tank)	42.5 US (35.50 Imp.)
Total A.P.U. Fuel	85 US (70.83 Imp.)

g. OIL TANKS.

	Gallons
Engine oil tanks (four)	85 US (66.78 Imp.) each
Total Oil	340 US (283.21 Imp.)
Propeller Gear Box Tanks (four)	3 US (2.50 Imp.) each
Total Oil	12 US (10 Imp.)

h. HYDRAULIC FLUID TANKS.

	Gallons
Boost System (four reservoirs)	3 US (2.50 Imp.) each
Total	12 US (10 Imp.)
Nose Wheel Steering and Brakes (one reservoir)	2.2 US (1.83 Imp.)

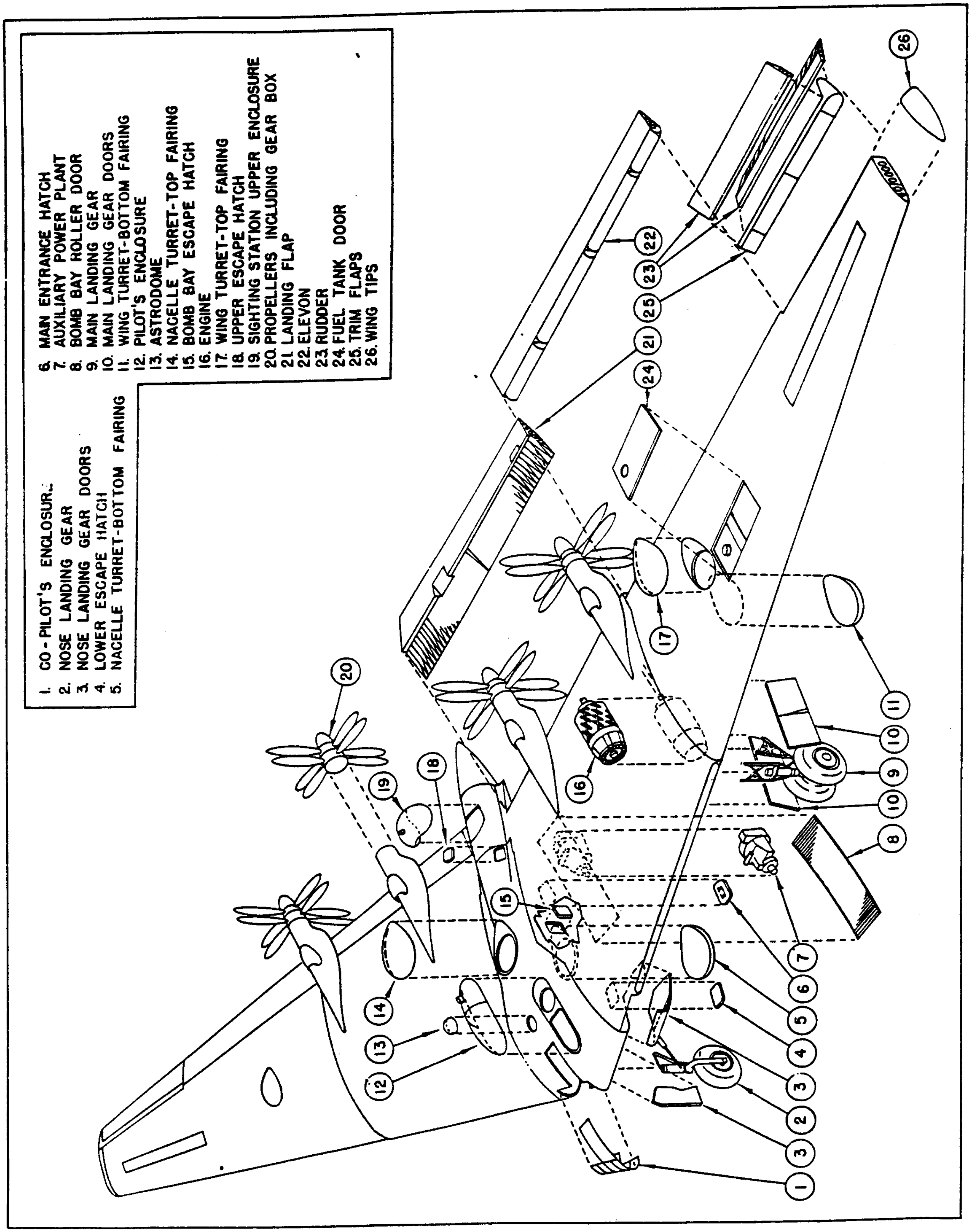


Figure 4. Major Assembly Breakdown

SECTION II

SHIPMENT AND ERECTION

II <u>SHIPMENT AND ERECTION.</u>-

1. The exceptionally long range of this airplane obviates the necessity of disassembly for shipment. It can be delivered by air to any destination.

SECTION III
HANDLING AND MAINTENANCE

1. ACCESS AND INSPECTION PROVISIONS.

a. DESCRIPTION.- All functional parts of the airplane, control systems, and installed equipment are accessible for inspection and maintenance. Access provisions are illustrated in figure 1. Each type door, cover, and removable panel is labeled with an identifying number. A corresponding number is painted on the adjacent structure.

b. WALKWAYS.

(1) INTERIOR.- All compartment floors and hatches may be used as walkways.

(2) EXTERIOR.- Figure 2 shows the location of all areas which will withstand normal walking.

2. GROUND HANDLING.

a. HOISTING PROVISIONS.- No provisions are made for hoisting the complete airplane.

(1) POWER PLANT.- An electric motor-driven hoist is provided for lowering and hoisting the engines. The hoist is placed on top of the airplane over the engine to be removed, and held in place by bolts. For further information on lowering and hoisting the engines, see Section IV, paragraph 7.

(2) ELEVONS, RUDDERS, AND FLAPS. (See figure 3.)- Hoist points are identified by decals. Eyebolts for attaching the hoists are stowed in the airplane tool kit.

(3) TURBOSUPERCHARGERS.- The turbosuperchargers require a special fixture for hoisting. The use of this fixture is described in Section IV, paragraph 14a.

(4) PROPELLERS AND GEAR BOXES.- Slings are required to properly handle these units, see Section IV, paragraph 10.

b. JACKING THE AIRPLANE.

(1) LOCATION OF JACKING POINTS.- The airplane is provided with seven jacking points; one immediately aft of the nose gear, four on the front spar, and two on the rear spar. See figure 4.

(2) JACKING INSTRUCTIONS.

NOTE

Maximum permissible gross weight for supporting the airplane on jacks is 119,000 pounds.

NOTE

The load taken by the nose jack must not exceed 32,600 pounds at any time.

NOTE

All jacks used must have a static load capacity of at least 32,000 pounds.

(a) The normal procedure for jacking the entire airplane is to use six jacks, four on the front spar jack points and two on the rear spar jack points. In all jacking procedures it is necessary to manifold the two front spar jacks on each side of the airplane, and manifold the rear spar jacks across the entire airplane, to insure proper distribution of jack loads. It is not recommended that the nose of the airplane be jacked without jacking the entire airplane, however, if for any reason it is necessary that only the nose of the airplane be lifted, a jack must be placed under each rear spar jack point. When any or all propellers, gear boxes, and propeller shafts are removed, an additional jack must be used on the crew nacelle nose jack point.

c. PARKING AND MOORING. (See figure 5.)- There are five mooring points on the airplane (see figure 4). In addition to the five mooring points above mentioned, mooring lines may be attached to the nose gear shock strut, and each main landing gear shock strut. Mooring lines used at all mooring points should be capable of withstanding a tension of 12,200 pounds.

(1) GENERAL.

(a) Head the airplane into the wind.

(b) Chock the front and rear of each set of main landing gear wheels, and lock the parking brakes.

CAUTION

Do not set parking brakes while they are hot.

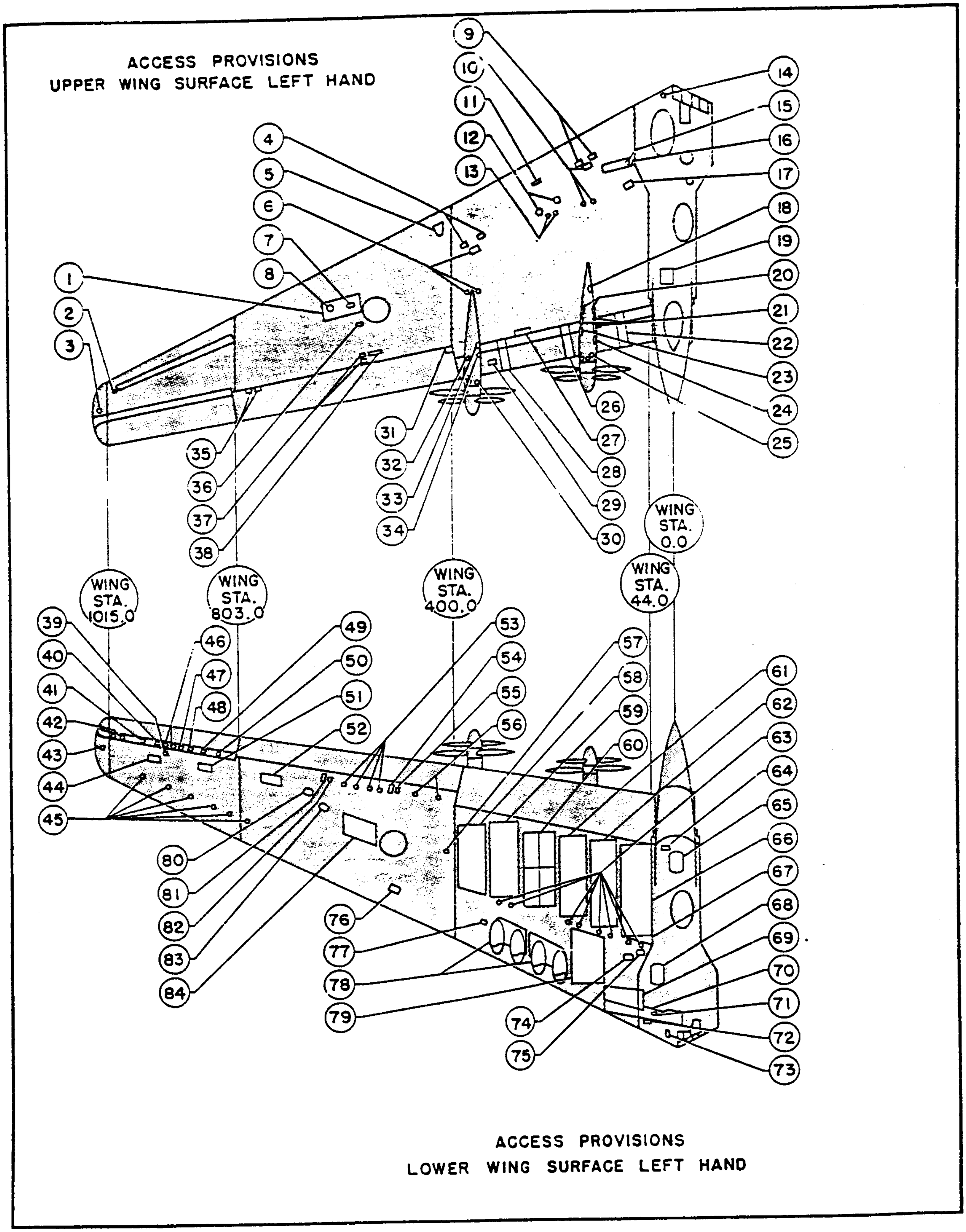


Figure 1. Access Provisions (Sheet 1 of 2 Sheets)

ACCESS PROVISIONS
UPPER & LOWER WING SURFACES

1. FUEL TANK OUTB'D.
2. TRIM FLAP ACTUATOR
3. RECOGNITION LIGHT
4. CARBURETOR CASTING
5. OUTER WING DE-ICER DUCT
6. ENGINE HOIST CABLES OUTB'D.
7. FUEL TANK HAND HOLD OUTB'D.
8. FUEL TANK FILLER OUTB'D.
9. CARBURETOR CASTING INB'D.
10. ENGINE HOIST CABLES INB'D.
11. CARBURETOR AIR DUCT
12. OIL FILLER
13. OIL VENT VALVE
14. STEERING & BRAKE HYD. RESERVOIR FILLER
15. FUEL TANK FILLER INB'D.
16. FUEL TANK INB'D.
17. FUEL LEVEL TRANSMITTER INB'D.
18. HOUSING INSTALLATION ACCESS DOOR
19. EMERGENCY ESCAPE HATCH AFT CABIN
20. PROP SHAFT BEARING INB'D.
21. HYDRAULIC PUMP & "V" BELT INB'D.
22. LANDING FLAP ACTUATOR DOOR INB'D.
23. HYDRAULIC RESERVOIR FILLER
24. PROPELLER SHAFT HOUSING
25. PROP GEAR BOX DOORS
26. LANDING FLAP ACTUATOR CENTER
27. COOLING FLAP ACTUATOR
28. LANDING FLAP ACTUATOR OUTB'D.
29. HYDRAULIC RESEVOIR FILLER OUTB'D.
30. PROP GEAR BOX DOOR
31. ELEVON HINGE INB'D.
32. "V" BELT ADJUSTMENT
33. PROP SHAFT BEARING OUTB'D.
34. HYDRAULIC PUMP
35. ELEVON HINGE OUTB'D.
36. FUEL LEVEL TRANSMITTER
37. EMERGENCY ELEVON CABLES
38. EMERGENCY ELEVON DRIVE MOTOR
39. TRIM FLAP ACTUATOR ATTACH
40. RUDDER MECHANISM
41. RUDDER CYLINDER OUTB'D.
42. TRIM FLAP ATTACH OUTB'D.
43. RECOGNITION LIGHT
44. POSITION TRANSMITTER & TRIM FLAP ACTUATOR
45. WING SLOT ACTUATING MECHANISM
46. TRIM FLAP ATTACH & RUDDER CABLES
47. RUDDER CABLES
48. RUDDER MECHANISM INB'D.
49. RUDDER CYLINDER
50. TRIM FLAP ATTACH INB'D.
51. SLOT DOOR CYLINDER
52. OXYGEN CYLINDERS & ELEVON MECH. INB'D.
53. ELEVON CABLE
54. ELEVON ATTACH INB'D.
55. ELEVON SEAL
56. CABLE ACCESS DOORS
57. LANDING LIGHT
58. ENGINE DOOR OUTB'D.
59. BOMB BAY (1)
60. MAIN LANDING GEAR DOOR
61. BOMB BAY (2)
62. BOMB BAY (3)
63. BOMB HOIST ATTACH
64. OXYGEN FILLER VALVE
65. MAIN ENTRANCE HATCH
66. BOMB BAY (4)
67. EXTERNAL POWER SUPPLY
68. EMERGENCY ESCAPE HATCH
69. NOSE GEAR DOOR
70. NOSE GEAR STRUT DOOR
71. GROUND CREW INTERPHONE
72. NOSE GEAR LIMIT SWITCH
73. CONTROL BELLOWS & STEERING MECHANISM
74. FUEL BOOSTER PUMP INB'D.
75. FUEL DRAIN INB'D.
76. FIRE EXTINGUISHER BOTTLES
77. HEAT EXCHANGER
78. TURBO DOORS
79. ENGINE DOOR INB'D.
80. FUEL BOOSTER PUMP OUTB'D.
81. ELEVON ATTACH CENTER
82. ELEVON SEAL
83. FUEL DRAIN OUTB'D.
84. AMMUNITION DOOR & ELEVON MECH. INB'D.

Figure 1. Access Provisions (Sheet 2 of 2 Sheets)

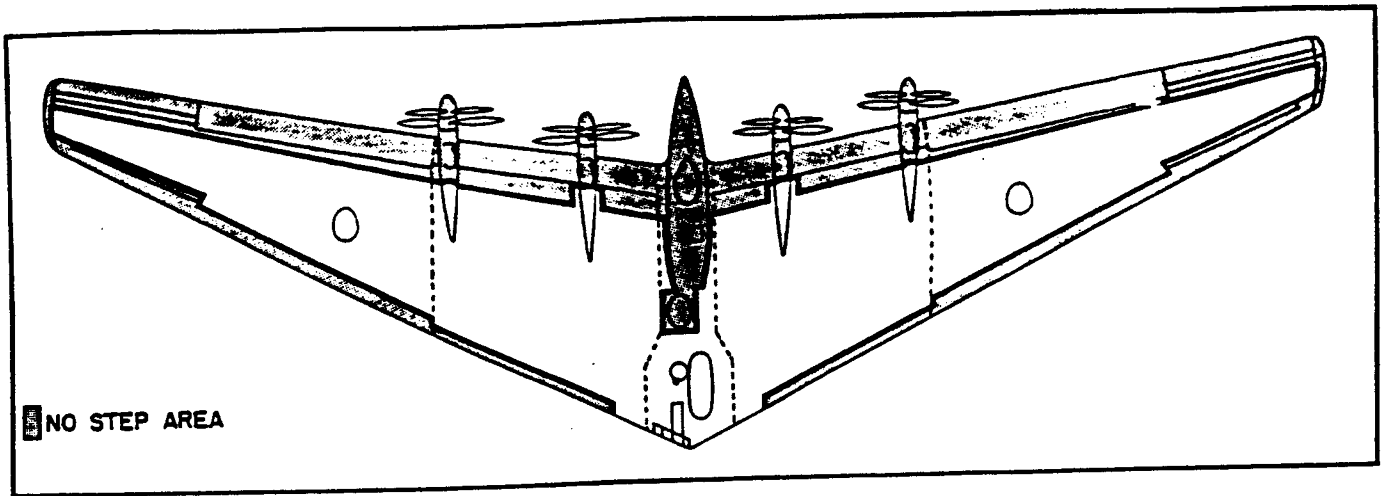


Figure 2. Walkways

(c) Be sure that all electrical controls and the "EMERGENCY FUEL AND OIL SHUT-OFF VALVES" are turned "OFF."

(d) Install dust covers over the intake ducts, pitot tubes, and wastegate stacks.

(e) Secure the fabric cover over the crew nacelle canopy.

(f) Close the entrance hatch, unless the airplane is standing in the sun where it is excessively hot.

(g) If the airplane is to be parked over night or for an extended period, moor it as shown in figure 5.

d. TOWING.- On a smooth, hard surfaced runway the airplane may be towed by means of a tow bar attached to the nose gear shock strut.

(1) Towing rings are provided on each main landing gear shock strut. A tow line attached to the main landing gear shock struts should pass over a pulley on the

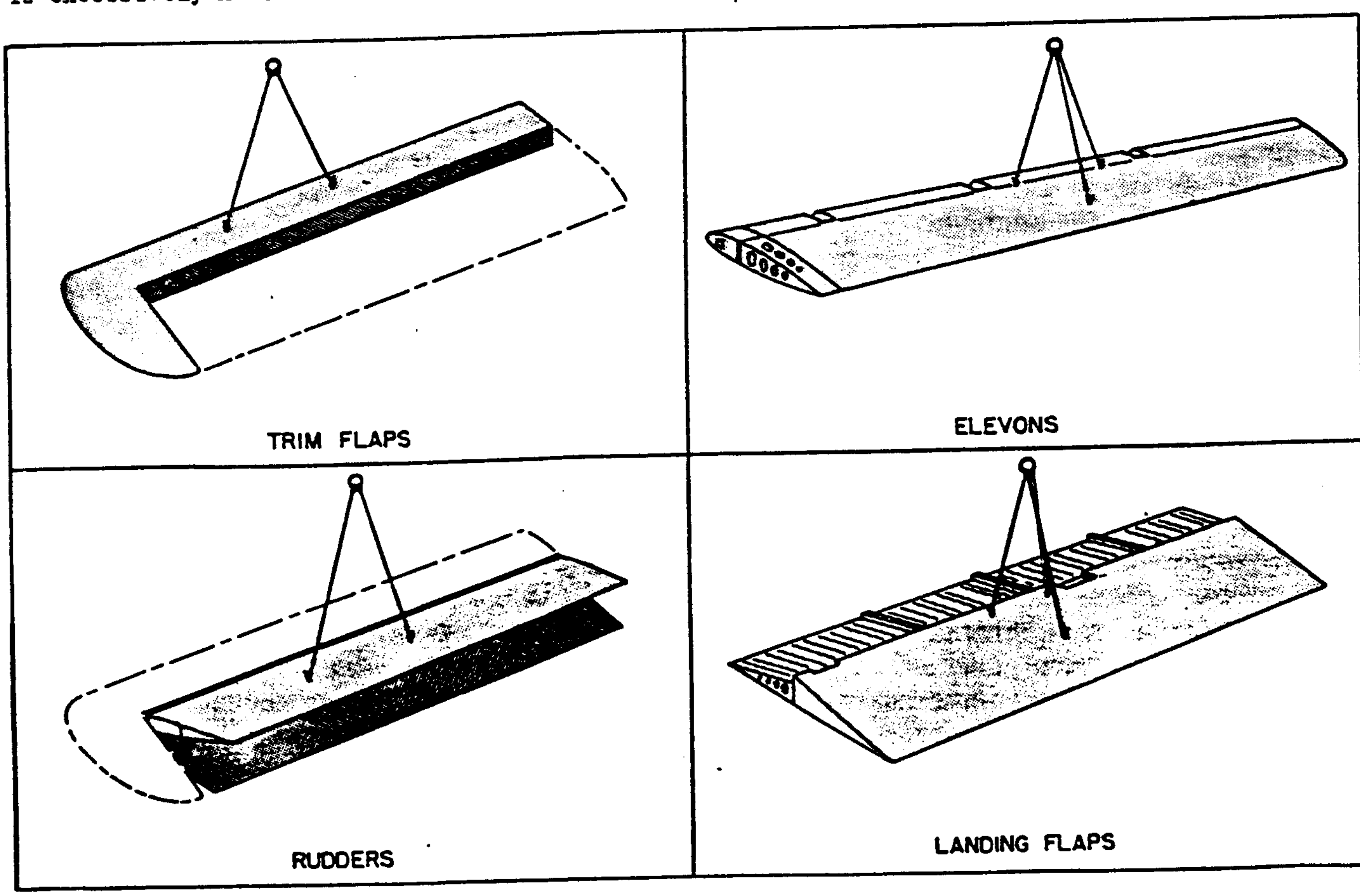


Figure 3. Hoisting Diagram

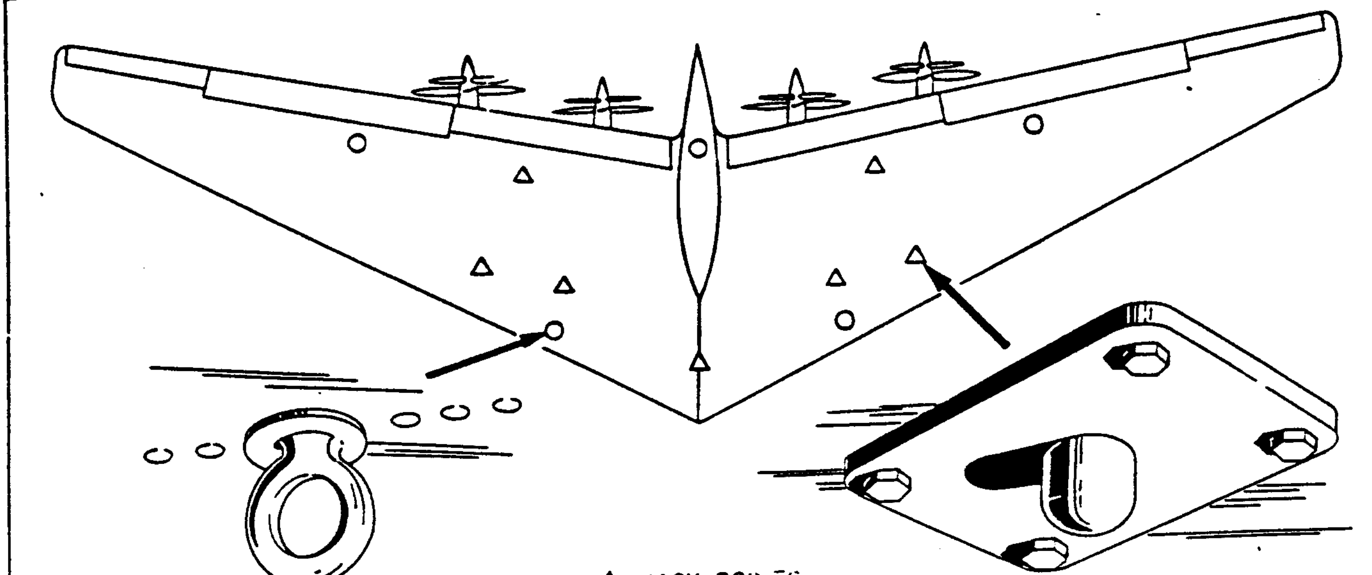


Figure 4. Mooring Points

tractor, for even distribution of the tow load during turning. A telescopic tow bar used for towing the airplane, may be attached from the nose gear shock strut to the tractor to steer the airplane when the tow line is used (see figure 6), or it may be used for hand steering as shown in figure 7.

CAUTION

Do not use nose gear to move the airplane backward. There is danger of upsetting the airplane.

(2) The airplane may be towed backward by use of a tow line, in which case a tow bar will be used for manual steering. See figure 7.

(3) It is recommended, due to the dangers of upsetting the airplane, that the hand parking brake be used for all braking when the airplane is being towed.

(4) Extreme care must be used in application of the brakes when the airplane is moving backward, to prevent upsetting.

NOTE

If the airplane has been parked for a length of time, sufficient hydraulic pressure may not remain in the system to operate the brakes.

e. LEVELING.- A calibrated leveling plate, and a bracket for suspension of a plumb line is installed in the number four bomb bay. See figure 8. The airplane may be leveled by inflating or deflating the shock struts, as the case may be; by deflating the tires, or by jacking the airplane. See paragraph 2 b.

(1) Suspend a plumb line from the bracket so that the plumb bob is centered over the leveling plate. The point of the plumb bob should be centered over the "LATERAL LEVELING LINE" and the "LONGITUDINAL LEVELING LINE."

3. SERVICING.

a. ACCESS PROVISIONS.

(1) Areas are designated for use as walkways when filling fuel and oil tanks. (See figure 1.) In order to maintain a smooth wing contour, there are no roughened surfaces on the walkways, and care must be taken to prevent slipping. Should it become necessary to walk on the designated "NO STEP AREAS," heavy protective padding should be placed on the wing.

(2) The top of the airplane is accessible through the upper escape hatch.

b. FUEL SYSTEM.

(1) The airplane has four sets of self-sealing fuel tanks. Each set of fuel tanks, consisting of two individual fuel cells is filled through one filler neck. The inboard forward sets of fuel tanks must be filled first, to avoid danger of upsetting the airplane. For servicing, small covers provide access to each fuel tank filler neck. Lift the handle and rotate the access cover counter-clockwise until it comes free. The fuel filler neck caps are retained by chains.

(2) Manual "EMERGENCY FUEL AND OIL SHUT-OFF VALVES" levers are located at the top of the cabin between the radio operator's and engineer's stations. See figure 9.

(3) Use Specification No. AN-F-28, Grade 100/130 aircraft engine fuel only.

1. CREW NACELE NOSE SECTION ENCLOSURE COVER-1 REQUIRED
2. TURBO FLIGHT HOOD COVER-8 REQUIRED
3. TURBO WASTE PIPE COVER-8 REQUIRED
4. TIRE COVER-5 REQUIRED
5. INBOARD LEADING EDGE DUCT COVER-4 REQUIRED
6. OUTBOARD LEADING EDGE DUCT COVER-4 REQUIRED
7. MOORING POINT. RIGHT & LEFT HAND-FORWARD
8. MOORING POINT. RIGHT & LEFT HAND-AFT
9. MOORING POINT. CREW NACELE-AFT

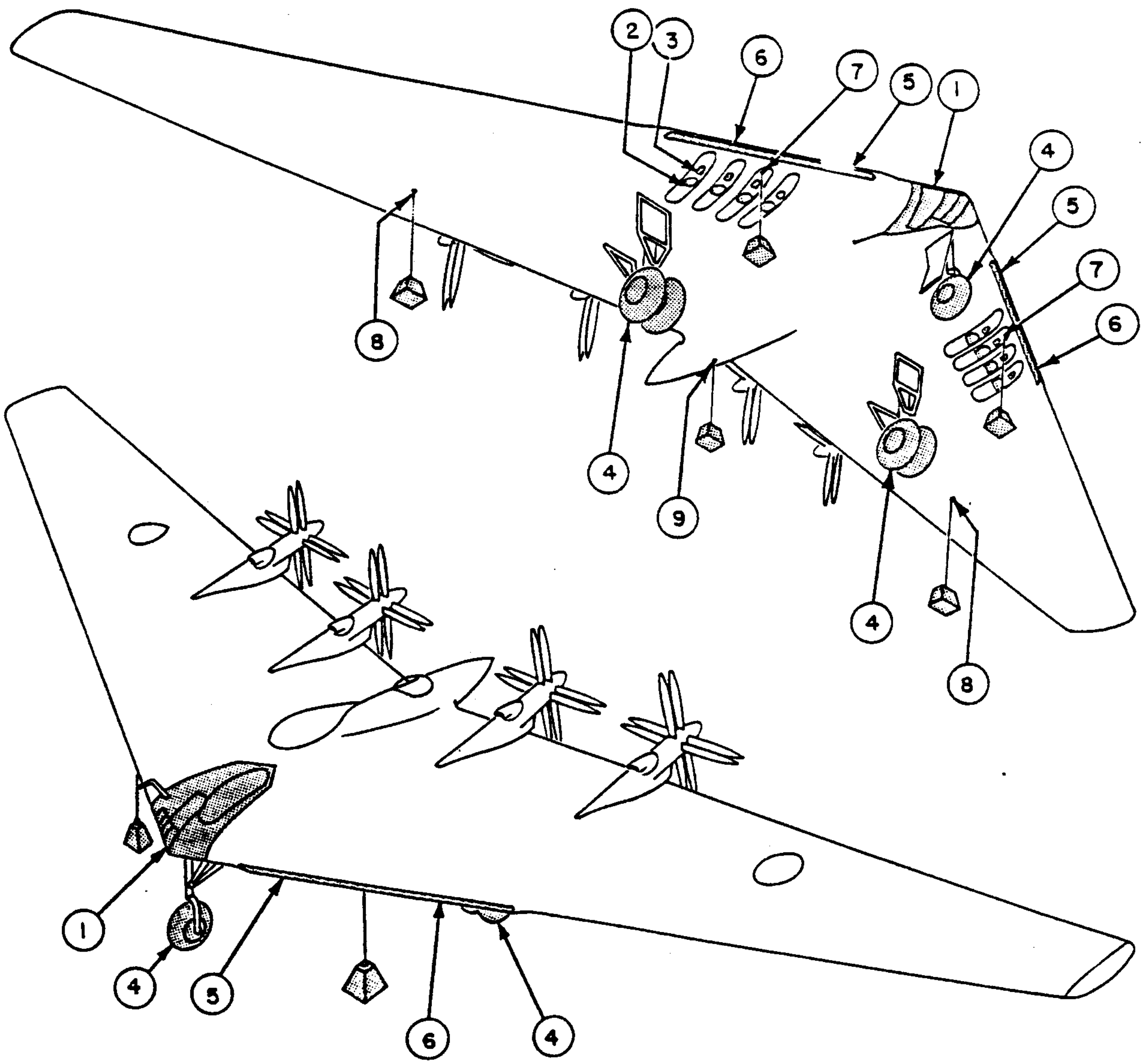


Figure 5. Airplane Moored Over Night

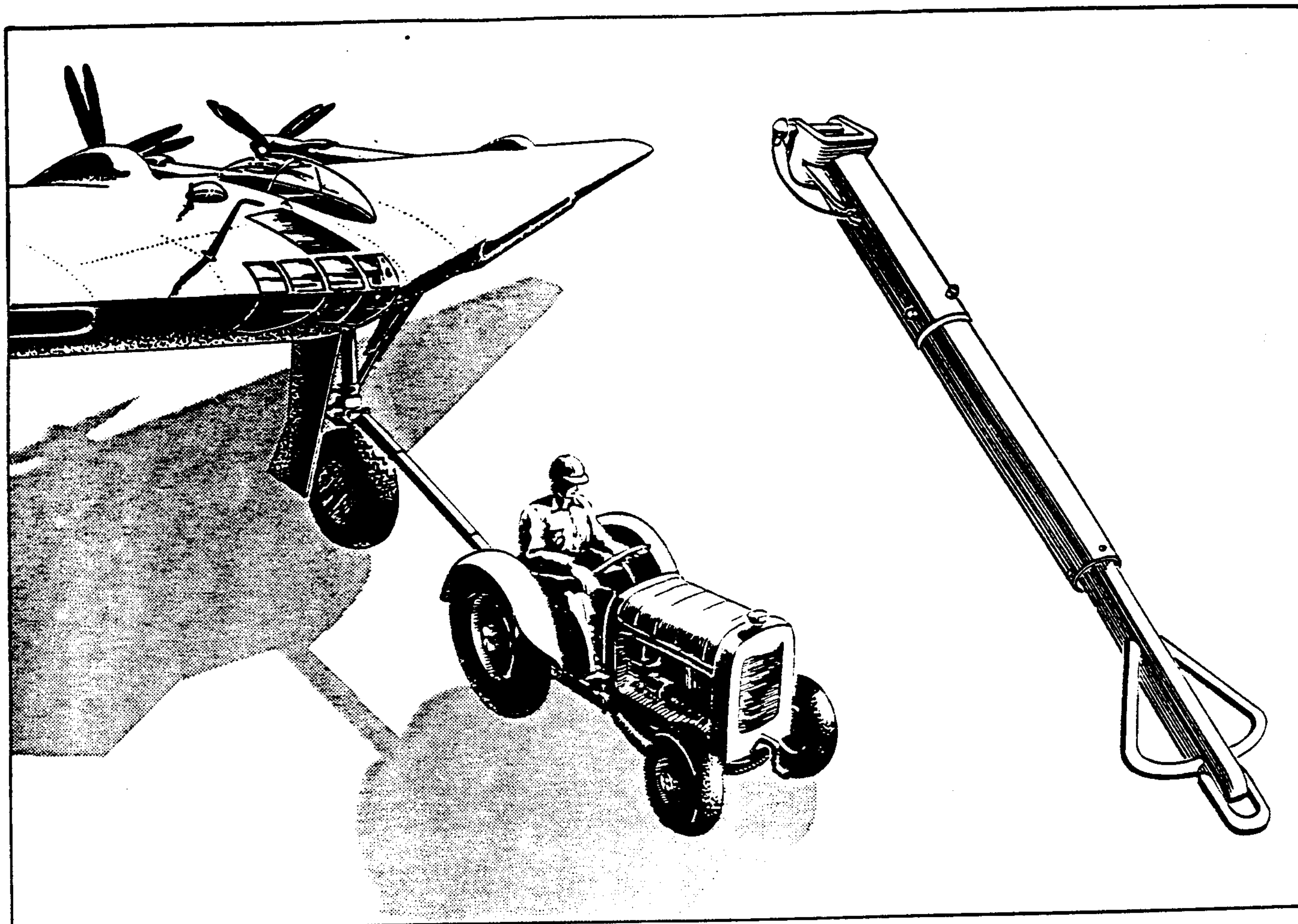


Figure 6. Towing Airplane - Tractor Steering

The fuel tanks and fuel lines have been treated for use of aromatic fuel.

c. OIL SYSTEM.

(1) Oil is carried in four 85 U.S. gallon oil tanks located in the leading edge of the wing, one just inboard of each engine. These oil tanks, on each side of the airplane, are connected together by an oil transfer line, in which a transfer pump is installed, making it possible to transfer oil from one tank to the other on the same side of the airplane. Emergency oil shut-off valves are incorporated in each oil system, between the oil tank and the engine. The emergency oil shut-off valves are manually operated by levers located in the forward cabin above the entrance doorway. These levers are labeled "EMERGENCY FUEL AND OIL SHUT-OFF VALVES." See figure 9. Closing the emergency oil shut-off valves does not prevent oil reaching the turbosuperchargers. Oil level transmitters are installed in each oil tank. The oil tank filler neck is closed by a screw cap, which is located under a circular cover held down by four screw-type fasteners.

(2) Use Specification No. AN-VV-O-446a, oil only.

(3) For location of oil drains, oil filters, and location of oil access filler caps for servicing the oil system, see Section IV, paragraph 12.

d. TURBOSUPERCHARGER OIL.

(1) Oil, Specification No. AN-VV-O-446a, from the main engine oil tanks is used to lubricate the turbosuperchargers.

(2) Four Purolator oil filters for the turbosuperchargers are located in each main landing gear wheel well. These oil filters must be turned on each daily inspection. See figure 10.

e. PROPELLER GEAR BOX.- An individual lubrication system for each propeller gear box consists of a three-gallon doughnut-shaped metal oil tank which encircles the propeller drive shaft, an oil pump which is driven by the propeller gears, an oil pressure regulator, and an oil cooler. Oil, Specification No. AN-VV-O-446a, is used to lubricate the propeller gear box. The tank must be checked after every engine run, and refilled as necessary. For location of oil drains, oil filters, and oil access filler caps for servicing the oil system, see Section IV, paragraph 12.

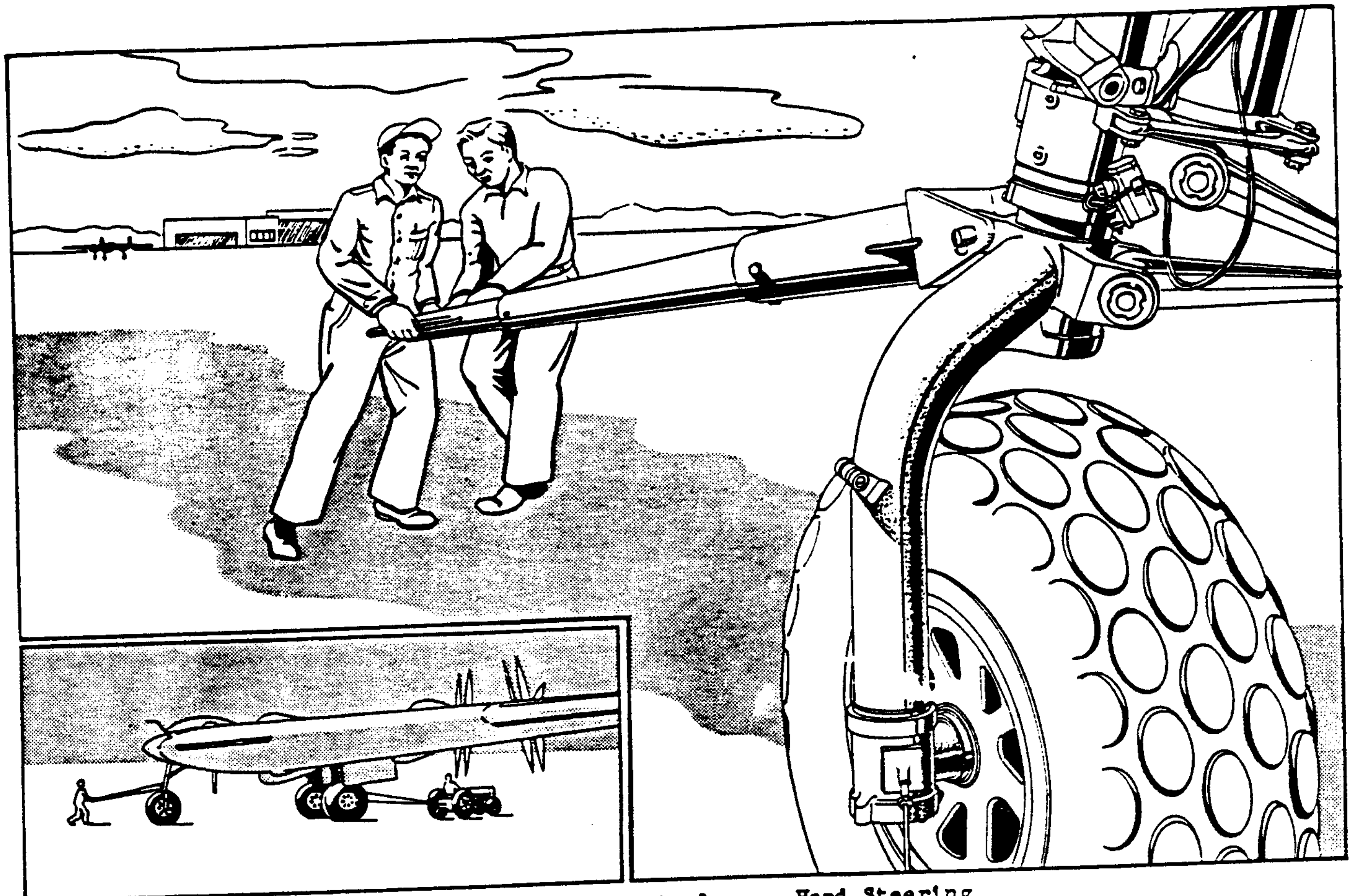


Figure 7. Towing Airplane - Hand Steering

f. HYDRAULIC SYSTEMS.

(1) SYSTEM RESERVOIRS. (See figure 1.)- Hydraulic fluid, Specification No. 3580 or AN-VV-O-366, Red, is carried in four pressurized, three-gallon reservoirs, and one 2.2 gallon, non-pressurized reservoir. Two three-gallon reservoirs are located, one inboard of each outboard driveshaft housing, and two three-gallon reservoirs are located, one in each inboard driveshaft housing. The 2.2 gallon, non-pressurized reservoir is located in the nose of the airplane. Sight gages on the two outboard reservoirs may be viewed by lowering the landing flaps. The sight gages on the inboard reservoirs may be viewed by removing the access covers on the driveshaft housing, and the sight gage on the reservoir in the nose of the airplane may be viewed from the bombardier's station. Access to the filler caps on the outboard reservoirs may be gained by removing the cover plates just inboard of the driveshaft housing, aft of the rear spar. The filler caps to the inboard reservoirs, located in the driveshaft housing, may be reached by removing the access covers on the outboard side of the driveshaft housing. The filler cap to the reservoir located in the nose of the airplane may be reached by removing the access cover located on the top of the nose of the airplane. Hydraulic reservoirs should be checked, and filled if necessary, with the pressure in the systems at "O" psi, on every daily inspection. The air pressure in the accumulator in the nose of the airplane should be checked at the same time the hydraulic reservoirs are checked. The accumulator pressure should be maintained at 600 psi.

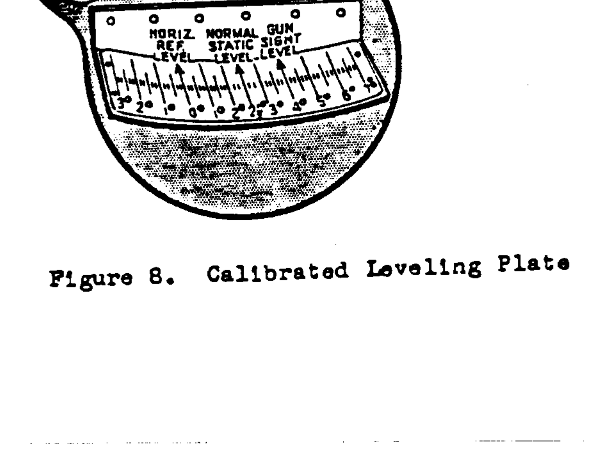


Figure 8. Calibrated Leveling Plate

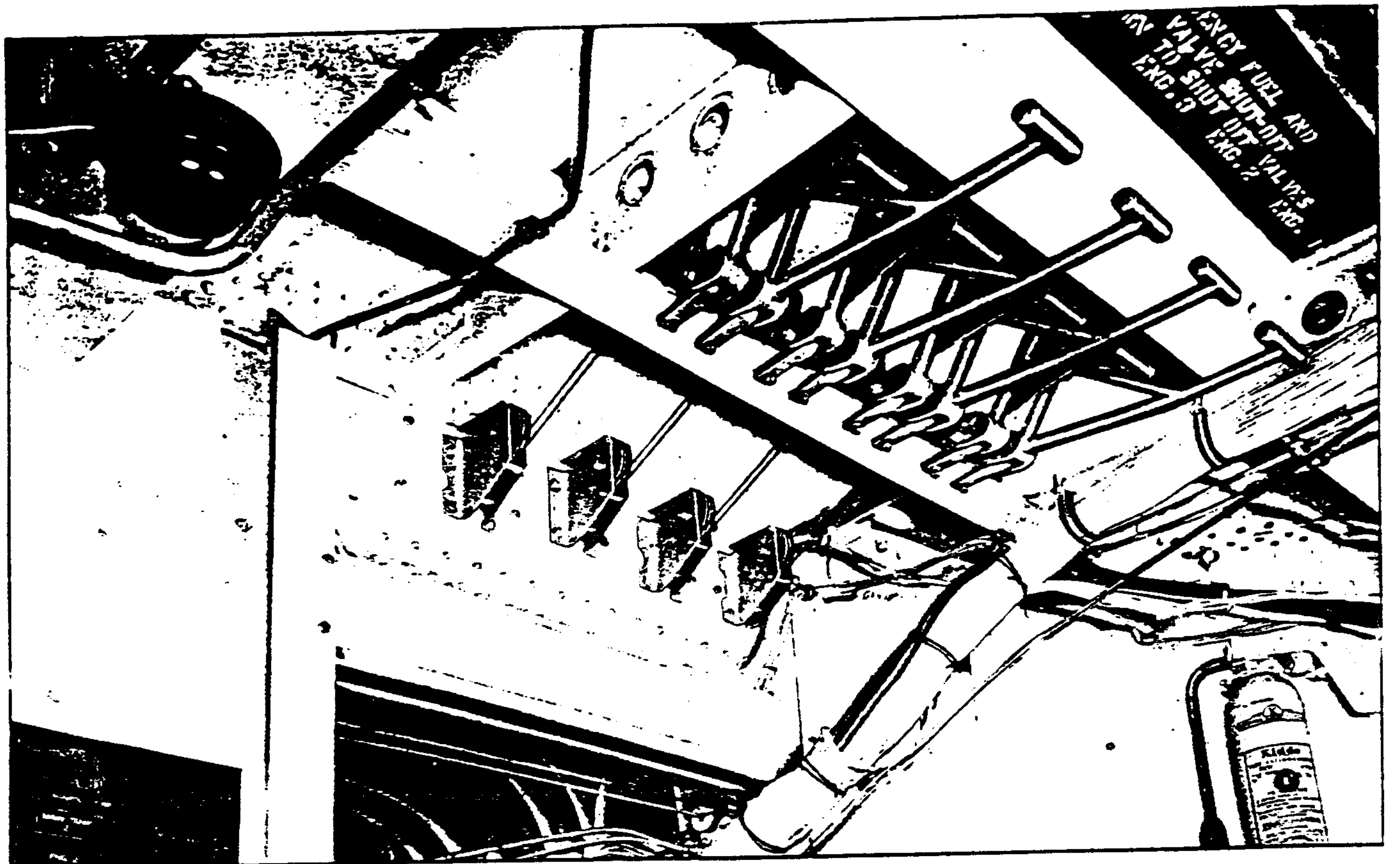


Figure 9. Emergency Fuel and Oil Shut-Off Controls

g. OXYGEN SYSTEM.

(1) The entire oxygen system is charged from a single filler valve, which is located under a cover just below and aft of the entrance hatch. See figures 1 and 11. The system should be filled slowly to a pressure of 425 psi.

(2) After filling the oxygen system the portable oxygen cylinders should be filled by plugging them into one of the filler stations in the airplane. After the four portable oxygen cylinders have been filled, the system oxygen pressure should again be brought up to 425 psi. See Section IV, paragraph 19.

h. ALIGHTING GEAR.

(1) TIRES.- Tire pressure for all tires at normal gross weight of the airplane, 155,000 pounds with normal C.G. is 70 psi air pressure.

(2) SHOCK STRUTS.- Hydraulic fluid, Specification No. 3580 or AN-VV-O-366, Red, and air are used in the landing gear shock struts. Hydraulic fluid should be level with the filler plug hole when the strut is fully compressed. To check fluid level, completely deflate the strut by slightly backing off the filler plug, with a wrench, and allowing the air to escape.

NOTE

Do not depress the valve core to deflate the strut, as this will cause damage by a sudden rush of air at high pressure past the valve seat.

When the strut is completely deflated, remove the filler plug and check the level of the hydraulic fluid, which should be at the level of the bottom of the filler hole. Refill, if necessary, and with the normal gross weight of the airplane on the strut, inflate with compressed air until the packing unit is 6.937 inches from the top of the axle fitting for the main landing gear, and 6.125 inches from the top of the axle fitting for the nose landing gear struts.

(3) BUNGEE AIR BOTTLES.

(a) MAIN LANDING GEAR.- A main landing gear bungee air bottle is located in the upper center portion of each main landing gear wheel well. The air bottles contain hydraulic fluid, Specification No. 3580 or AN-VV-O-366, Red, and air. To check the fluid level, completely deflate the air bottle by slightly backing off the filler plug, with a wrench, and allowing the air to escape.

NOTE

Do not depress the valve core to deflate the air cylinder, as this

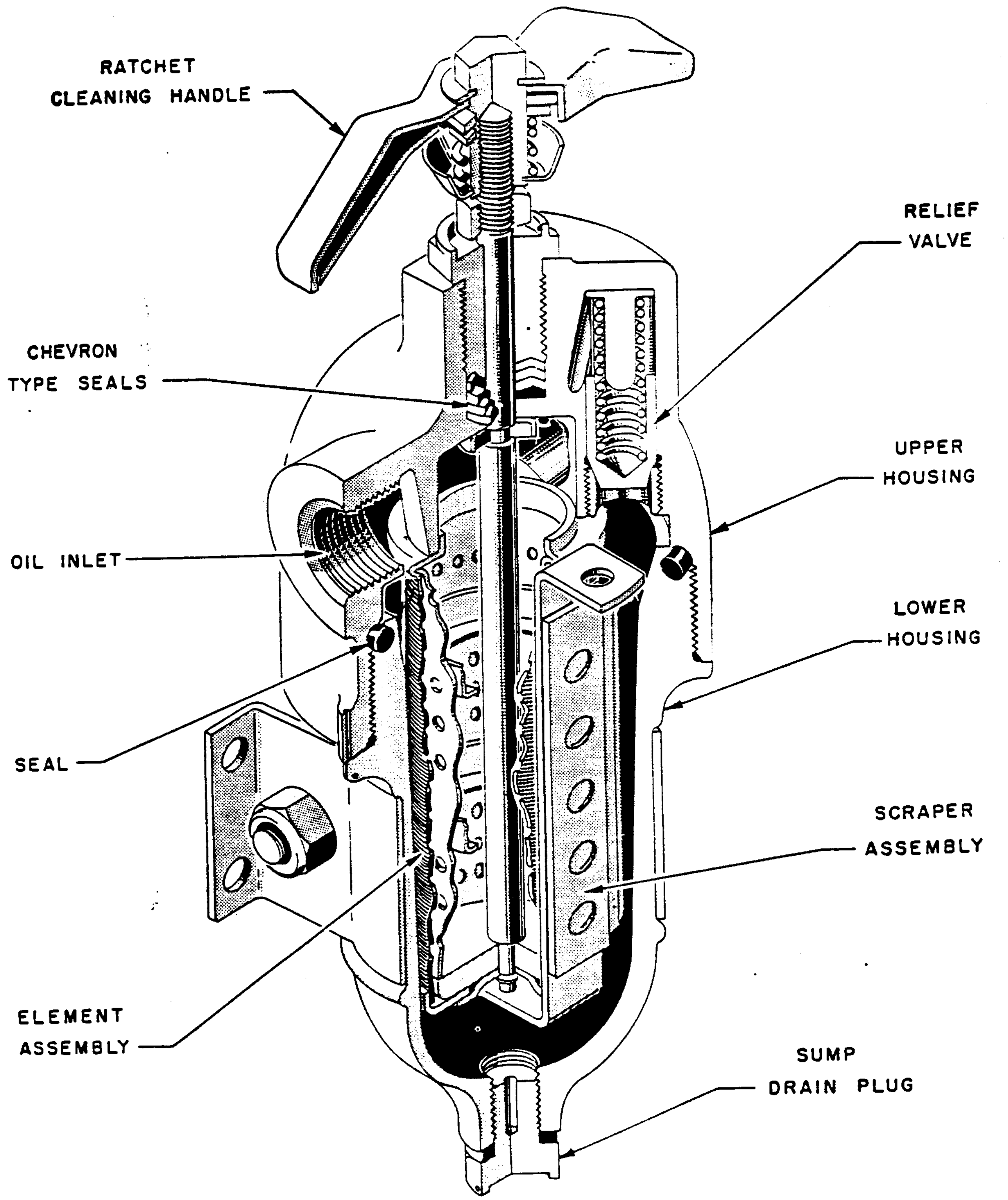


Figure 10. Turbosupercharger Oil Filters

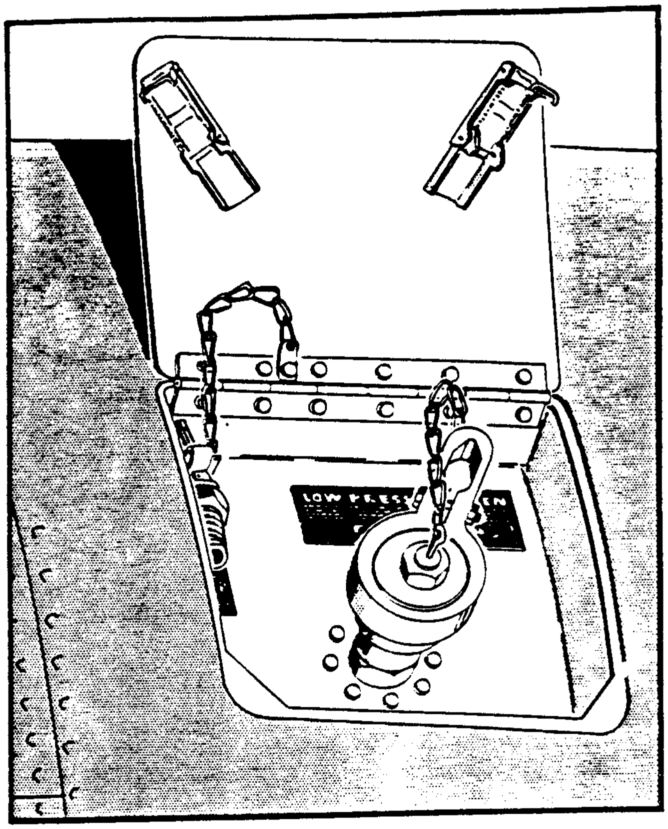


Figure 11. Oxygen Filler Plug

will cause damage by a sudden rush of air at high pressure past the valve seat.

When the air bottle is completely deflated, remove the filler plugs from the filler block, and the top of the air bottle, and check the fluid level at the filler block. See figure 12. Hydraulic fluid should be level with the

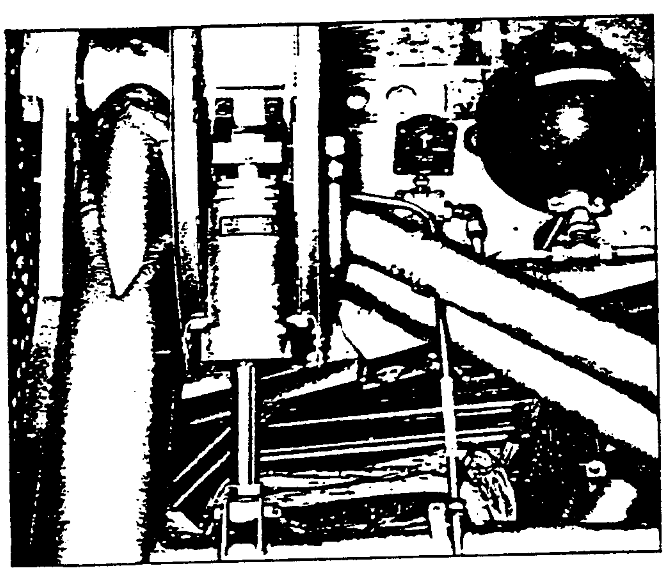


Figure 12. Bungee Air Bottles, Main Landing Gear

filler plug hole in the filler block. If hydraulic fluid is low in the filler block, refill by inserting a flexible tube in the filler hole in the top of the air bottle, and pumping fluid into the air bottle until it flows from the filler block. Replace and tighten the filler plugs, on both the filler block and the air bottle. Tighten the filler valve, and with the landing gear fully extended, inflate to 900 psi air pressure, for the main landing gear.

(b) NOSE LANDING GEAR.- A nose landing gear bungee air cylinder is located on the left-hand side of the nose landing gear shock strut, and is connected to the side brace and the structure of the airplane. See figure 13. The nose gear bungee air cylinder contains hydraulic fluid, Specification No. 3580 or AN-VV-O-366, Red, and air. To check the fluid level, completely deflate the air cylinder by slightly backing off the filler plug, with a wrench, and allowing the air to escape.

NOTE

> Do not depress the valve core to deflate the air cylinder, as this will cause damage by a sudden rush of air at high pressure past the valve seat.

Hydraulic fluid should be level with the bottom of the filler hole. If the fluid is low, refill the air cylinder with hydraulic fluid, Specification No. 3580 or AN-VV-O-366, Red, by inserting a flexible

Figure 13. Bungee and Emergency Air Brake Bottle, Nose Landing Gear

tube into the filler hole and pumping fluid into the cylinder until it is level with the bottom of the filler hole. Replace and tighten the filler plug. Tighten the filler valve, and with the nose gear fully extended, inflate to 400 psi, air pressure.

(4) EMERGENCY AIR BRAKES AIR PRESSURE BOTTLE.- An emergency-air-brakes air-pressure bottle is located in the upper left-hand side of the nose landing gear wheel well. By means of a filler valve located on the top of the air bottle, and with reference to the emergency-air-brake air-pressure gage, fill the air bottle with compressed air to a pressure of 1500 psi, air pressure. See figure 13.

i. LUBRICATION.- Refer to figure 14 for periodic lubrication requirements.

4. GROUND OPERATING INSTRUCTIONS.

a. See Pilot's Handbook applicable to XB-35 Airplane, Serial No. AAF42-13603.

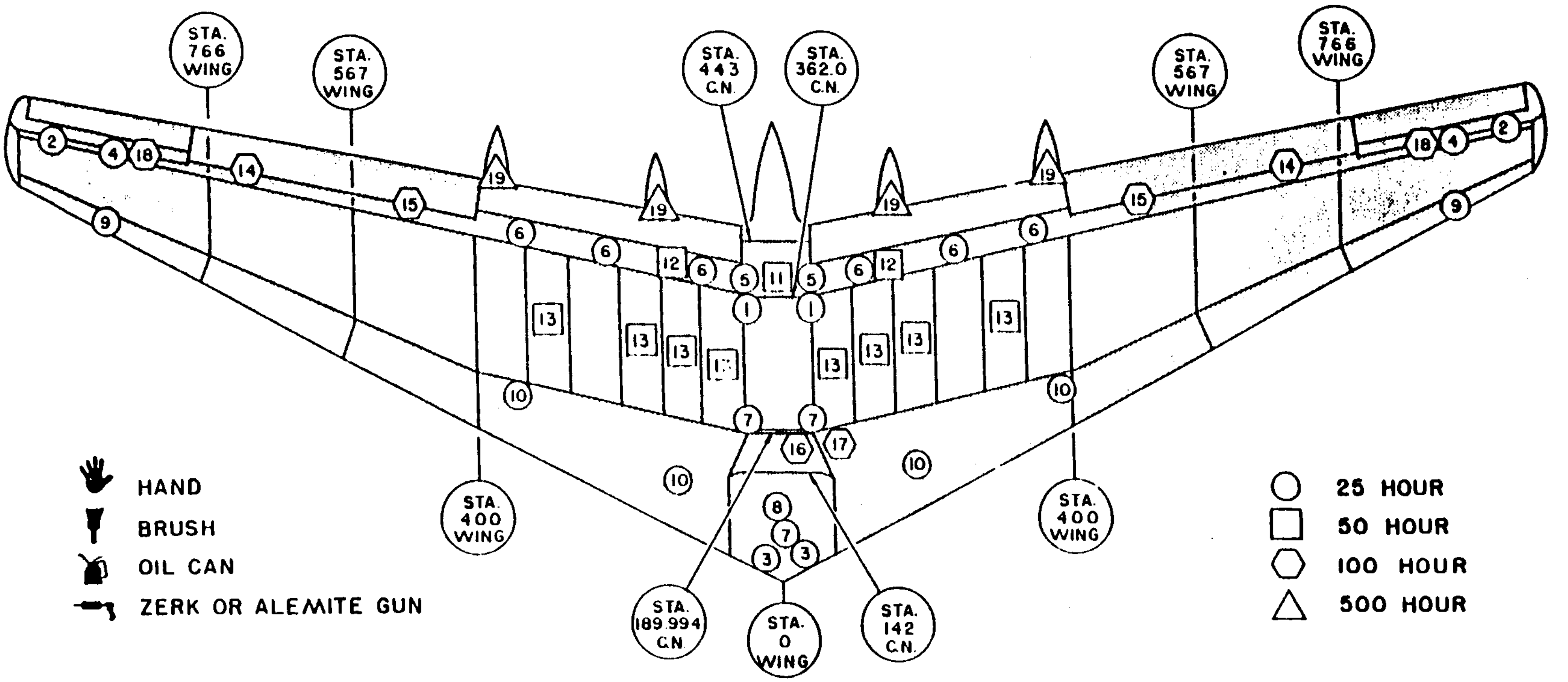
5. SPECIAL TOOLS AND GROUND HANDLING EQUIPMENT.- The following special tools and ground handling equipment have been provided for service and repair operations where standard tools cannot be used. These tools can be procured pending AAF approval:

a. GROUND HANDLING EQUIPMENT.

PART NO.	NAME	APPLICATION
N-307	Sling	Landing Flaps, Trim Flaps, and Elevons
N-308	Sling	Propellers and Shafts
N-309	Sling	Propeller Gear Boxes
N-310	Locking Device	Main Gear
N-311	Locking Device	Nose Gear
N-312	Handling Fixture	Turbosupercharger
N-313	Hoist	Engine
N-314	Landing Gear Skate	Main Gear
N-315	Bar	Towing and Steering

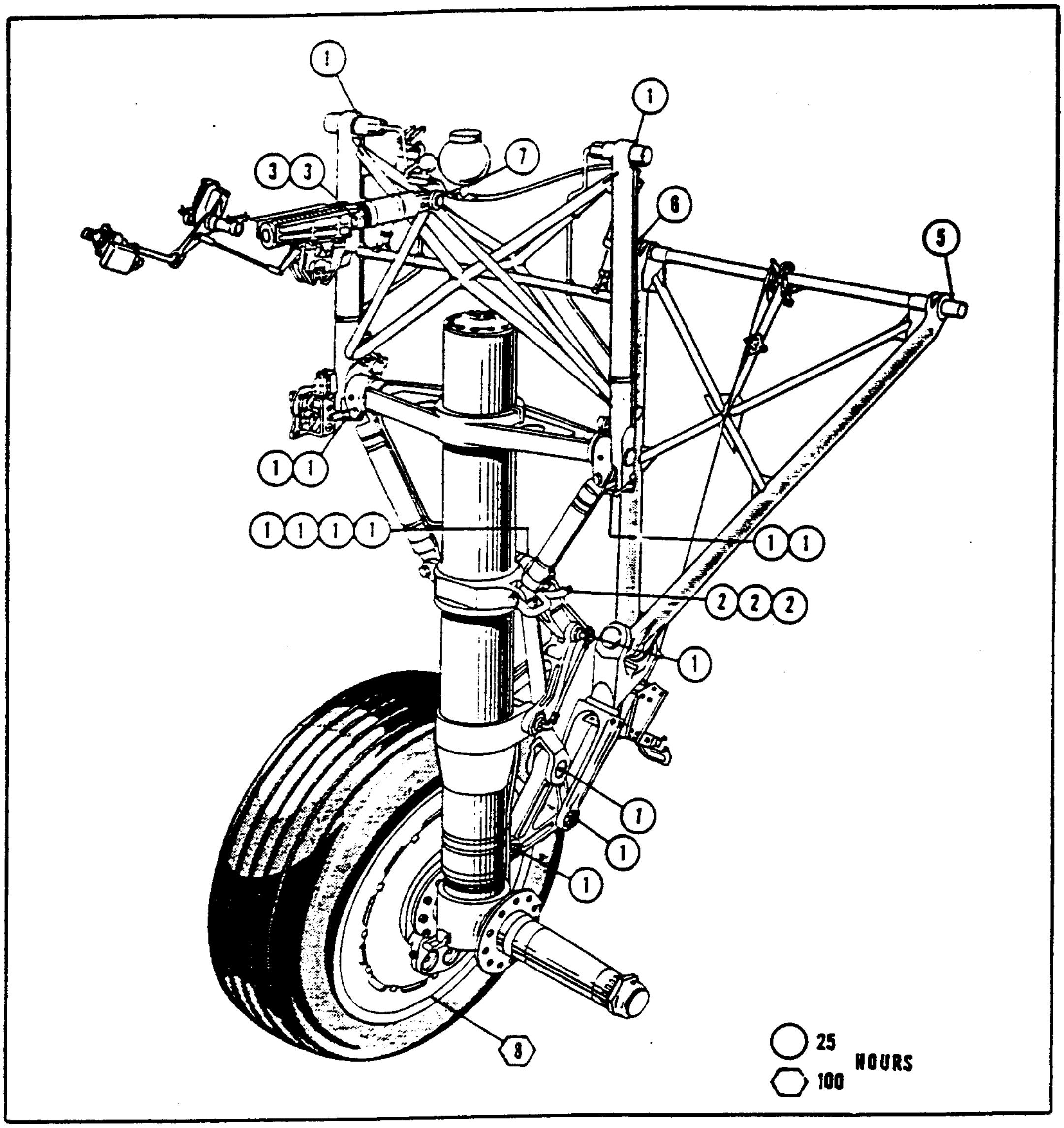
b. SPECIAL TOOLS.

PART NO.	NAME	APPLICATION
N-317	12 Point Open End Wrench	
N-318	Spanner Wrench	
N-319	Ball Retainer	Flap Actuator
N-320	Wrench	Exhaust
N-321	Wrench	Exhaust
N-322	Fixture	Propeller Hoist
N-323	Wrench	Retainer Nut - Nose Landing Gear
N-324	Wrench	Retainer Nut - Main and Nose Landing Gear
N-325	Crow Bar Assembly	Inboard Engine Door



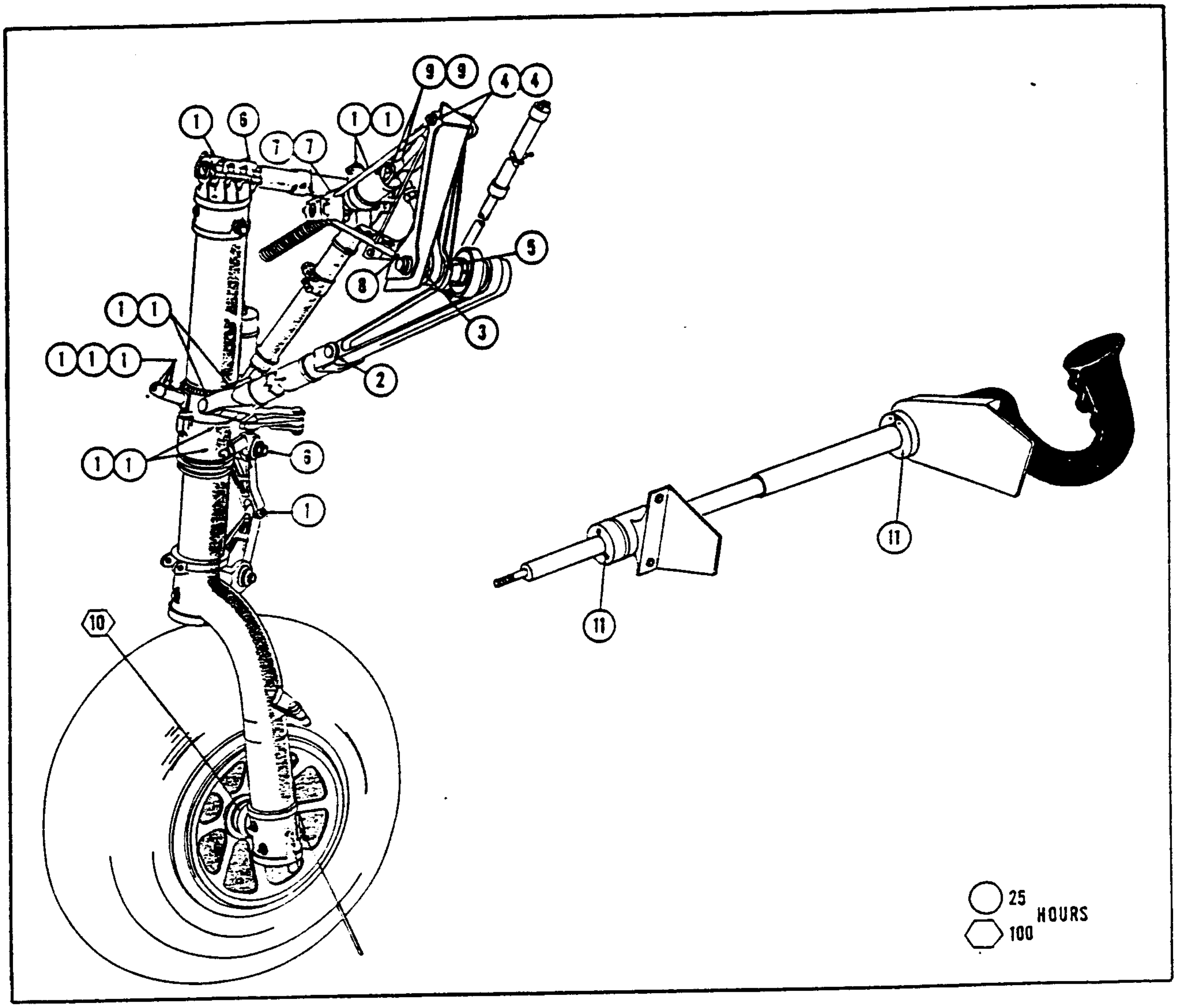
Nº	DESCRIPTION	APP.	LUBRICANT Nº
1	PRESSURE SEAL ASSEMBLIES	Oil can	AN-VV-366B
2	RUDDER CONTROL VALVE OPER. MECH.	Hand	AN-G-10
3	CONTROL COLUMNS	Brush	AN-G-10
4	TRIM FLAP ACTUATOR	Zerk or alemite gun	AN-G-10
5	LANDING FLAP CONTROLS	Hand	AN-G-10
6	LANDING FLAP ACTUATORS AND SCREW JACKS	Zerk or alemite gun Oil can	AN-G-10 AN-O-6
7	CABLE SEALS	Oil can	AN-VV-366B
8	LANDING GEAR CONTROL HANDLES	Oil can	AN-O-6
9	LEADING EDGE SLOT DOOR MECH.	Hand	AN-G-3
10	THROTTLE & MIXTURE CONTROL SHAFTS	Brush	AN-G-10
11	LANDING FLAP POWER UNIT	Zerk or alemite gun	AN-G-3
12	LANDING FLAP POSITION TRANSMITTER	Brush	AN-G-3
13	BOMB BAY DOOR CLOSING CHAIN	Brush	AN-C-52
14	ELEVON SERVO VALVE OPER. MECH. (OUT'BD.)	Hand	AN-G-3
15	ELEVON SERVO VALVE OPER. MECH. (IN'BD.)	Hand	AN-G-3
16	EMERG. FUEL & OIL SHUT-OFF HANDLES	Oil can	AN-O-6
17	TEMP. COMPENSATING SPRING	Hand	AN-G-3
18	TRIM FLAP POSITION TRANSMITTER	Hand	AN-G-3
19	OIL COOLER AIR FLAP ACT. GEAR BOXES	Zerk or alemite gun	AN-G-10

Figure 14. Lubrication Chart (Sheet 1 of 3 Sheets)



Nº	DESCRIPTION	APP.	LUBRICANT Nº	Nº PER PLANE
①	MAIN LANDING GEAR TORQUE LINKS & TRUNNIONS		AN-G-3	32
②	AFT DOORS CONNECTING ROD ASSEMBLY		AN-G-3	12
③	ACTUATOR SUPPORT FITTING		AN-G-3	4
④	DOOR BEAM ACTUATOR BOLT ASSEMBLY		AN-G-3	4
⑤	FITTING ASSEMBLY - STA. 215.5		AN-G-3	2
⑥	FITTING ASSEMBLY - STA. 281.5		AN-G-3	2
⑦	DELCO ACTUATOR		AN-G-3	2
⑧	WHEEL BEARINGS		3560	8

Figure 14. Lubrication Chart (Sheet 2 of 3 Sheets)



Nº	DESCRIPTION	APP.	LUBRICANT Nº	Nº PER PLANE
1	NOSE GEAR SHOCK STRUT		AN-G-3	12
2	NOSE GEAR SIDE BRACE & JACK SHAFT		AN-G-3	1
3	FITTING ASSEM. - JACK SHAFT AT STA. 65		AN-G-3	1
4	LINK ASSEMBLY		AN-G-3	2
5	STRUT ASSEMBLY		AN-G-3	1
6	FORWARD TORQUE TUBE SUPPORT		AN-G-3	1
7	NOSE GEAR TRUNNION SUPPORT		AN-G-3	2
8	NOSE GEAR DOWN LOCK HOOK		AN-VV-O-446	1
9	DELCO ACTUATOR		AN-G-3	2
10	WHEEL BEARINGS		3560	2
11	BRAKE & STEERING CONTROL HANDLE.		AN-G-3	2

Figure 14. Lubrication Chart (Sheet 3 of 3 Sheets)

SECTION IV

MAJOR COMPONENT PARTS AND INSTALLATIONS

1. WING

1. WING. (See figure 1.)

a. DESCRIPTION.- The wing is a full cantilever stressed skin structure of the laminar flow design; divided into the following sections: The crew nacelle, which forms the wing root, two center wing panels, and two outer wing panels. With the exception of the wing tips, the wing is constructed in one piece.

b. LANDING FLAPS. (See figure 2.)- The landing flaps are hinged to the rear wing spar, extending from each side of the crew nacelle to the outboard propeller housings.

(1) REMOVAL.- Each landing flap weighs approximately 225 lbs. Three nut plates are provided near the center of each flap. Eye bolts may be installed in these nut plates for hoisting the flaps.

(a) Lower the landing flaps. To lower the flaps, it is necessary to use an external power source or start one of the auxiliary power units.

(b) Place a stand below the flap to be removed.

(c) Remove the bonding wires at the flap hinges.

(d) Disconnect the flap actuator tie rods from the fittings on the flap.

(e) Disconnect the position transmitter. The transmitter is connected only to the right hand flap.

(f) Support the trailing edge of the flap. Then disconnect the tube assemblies which attach each actuator assembly to the flap.

(g) Support the complete flap, then remove the hinge bolts.

(h) See that the flap is free, then move it aft and lower it to the stand.

(2) INSTALLATION. (See figures 2 and 3.) Reverse the removal procedure to install a flap. In addition, tighten the tie rods at the actuators to 20-25 inch-pounds and safety the turnbuckles, after the flap is installed.

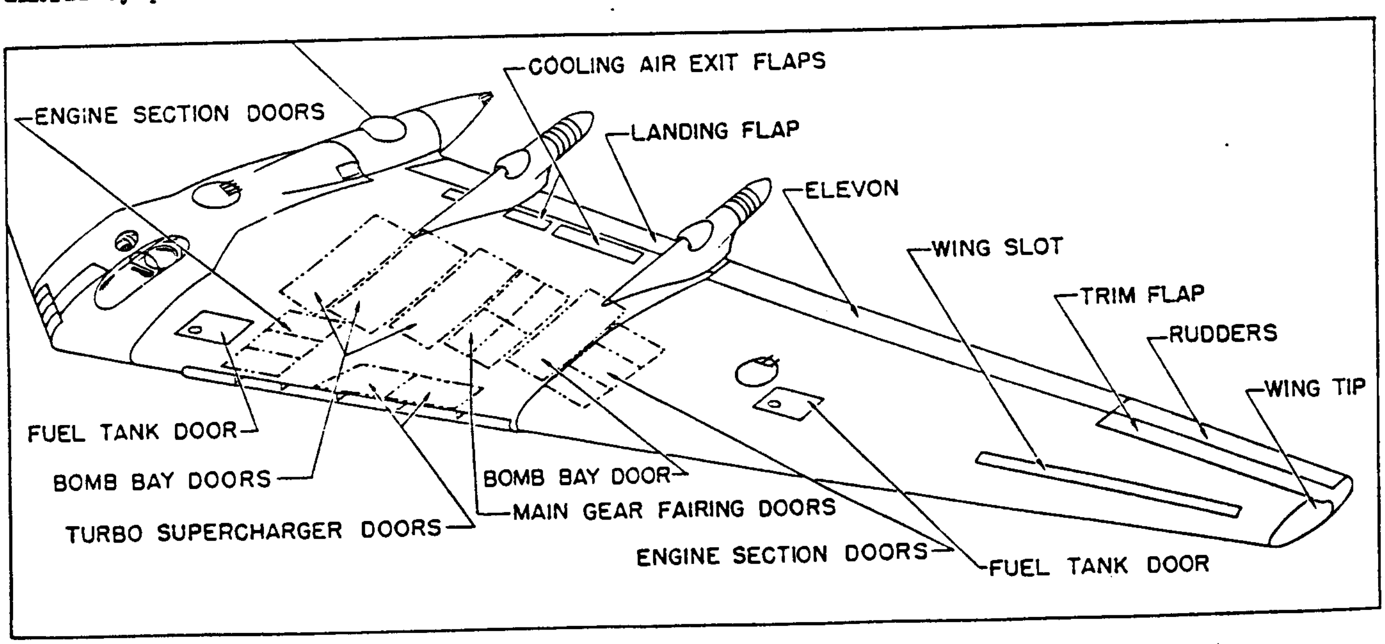


Figure 1. Wing

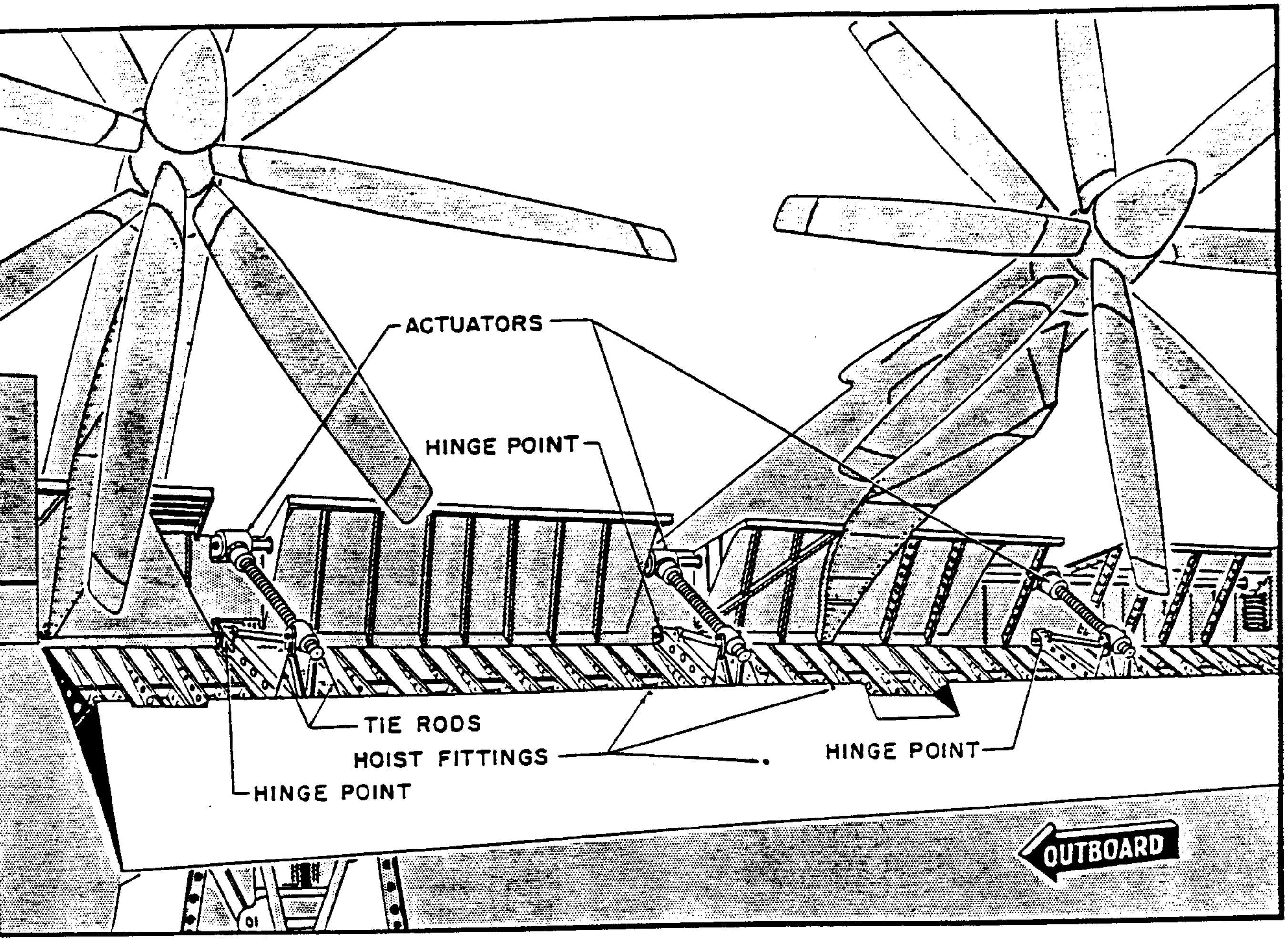


Figure 2. Landing Flap Installed

c. ELEVONS. (See figure 4.)- The elevons are fabric covered surfaces, which are installed on the trailing edge of the wing. They extend from the landing flaps to the rudder-trim flap combinations at the wing tips.

(1) REMOVAL.- Each elevon weighs approximately 290 pounds. It is recommended that a hoist be employed to support the elevons for removal.

(a) See that the elevons are in the neutral position. If it is necessary to move the elevons, a hydraulic test stand must be connected into the hydraulic system to supply power.

(b) Place a suitable stand beneath the elevon to be removed.

(c) Remove the two actuator access covers from the lower side of the wing and the coverplate from the top of the wing. Remove the cover from the top of the elevon that provides access to the emergency drive cable quadrants.

(d) Disconnect the emegency drive cables.

(e) Disconnect the servo valve operating rod from the valve attached to the side of each hydraulic actuating cylinder.

(f) Disconnect the tie rod from the inboard hinge.

(g) Remove the bonding wires at the hinge points.

(h) Install three eye bolts in the nut plates near the center of the elevon and attach a hoist to the elevon. (See Section III.)

(i) With "0" pressure on the hydraulic power boost system, disconnect and remove both hydraulic actuating cylinders.

(j) Remove the hinge bolts, and move the elevon aft far enough to reach the zipper on the fabric seal at the leading edge.

(k) Open the zipper and lower the elevon.

(2) INSTALLATION.- Reverse the removal procedure. After installing the elevon, connect and tighten the tie rod at the inboard hinge to 20-25 inch-pounds. Refer to Section IV, paragraph 3, for the installation and adjustment of the emergency drive cables.

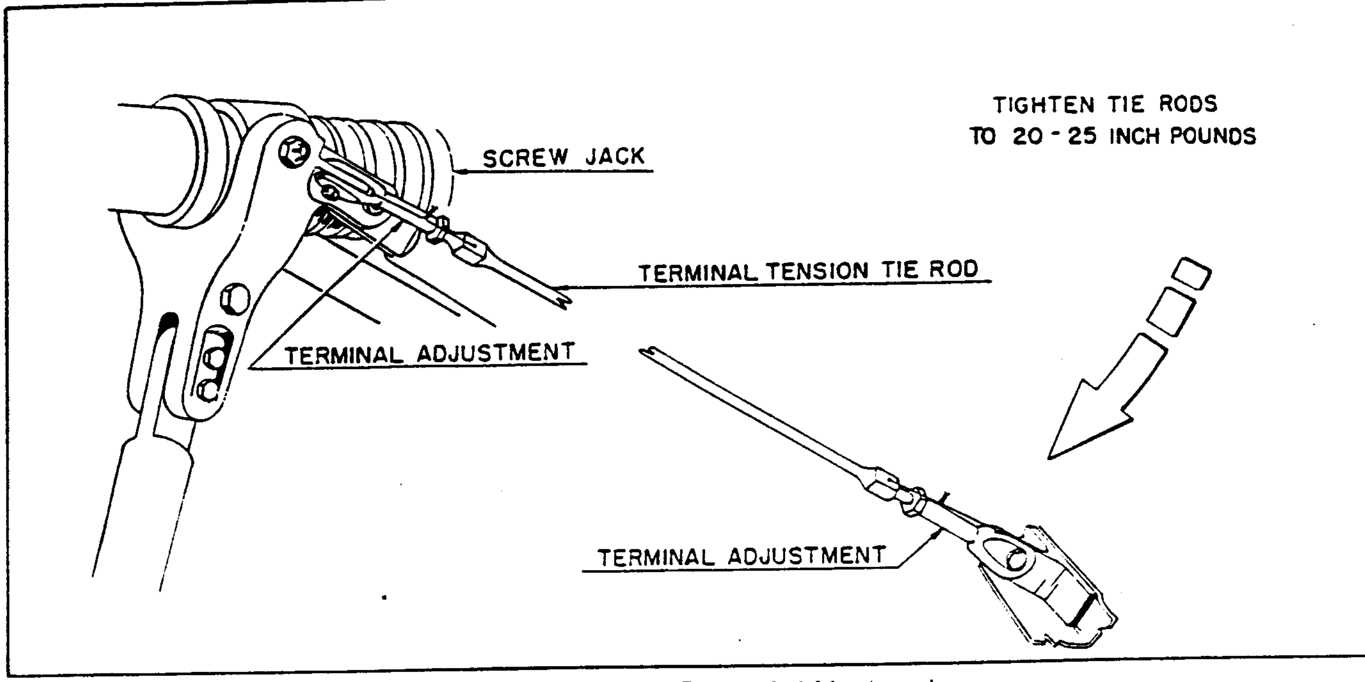


Figure 3. Flap Tie Rod Adjustment

d. RUDDERS. (See figure 5.)- Hydraulically operated split-flap rudders are hinged to the upper and lower surface of each trim flap; the outer ends of the trim flaps form the trailing edge of the wing tips. The rudders deflect above and below the trim flap surfaces for directional control of the airplane, but move with the trim flaps when the flaps are operated for trimming.

(1) REMOVAL.- A rudder and trim flap combination may be removed as a unit if desired, (see TRIM FLAPS, REMOVAL) or the rudders may be removed separately in the following manner:

(a) Raise the trim flaps to the full up position. It is necessary to apply external power or start one of the A.P. Units in order to operate the flaps.

(b) Remove the two rectangular covers from the lower surface of the trim flap. See figure 5.

(c) Disconnect the actuators from the upper rudder surface.

(d) Open the rudders and disconnect the interconnecting cables.

(e) Open the zippers which fasten the fabric cover at the leading edge of each rudder surface.

(f) Remove the bonding wires.

(g) Install three eye bolts in the nut plates provided near the center of the rudder, and attach a hoist.

(h) Remove the hinge bolts from the upper rudder surface first and hoist the rudder clear.

(i) Remove the lower rudder surface, see (h) preceding.

(2) INSTALLATION. (See figure 6.)- Reverse the removal procedure, except install the upper rudder last. Connect the interconnecting cables. See Section IV, paragraph 3 for cable adjustment instructions.

e. TRIM FLAPS.- The trim flaps are hinged to fittings along the top of the wing rear spars. The flaps are constructed of metal and the tip is removable.

(1) REMOVAL.- A rudder and trim flap combination may be removed as a unit. The combination weighs approximately 320 pounds. Use a hoist to handle the assembly.

(a) Place a stand under the flap to be removed.

(b) Open the trim flap actuator access covers. Two covers are near the center of the flap on the lower surface and the other is just forward of the trim flap in the lower surface of the wing. Remove the inboard hinge bolt cover from the top of the flap.

(c) Install three eye bolts in the nut plates near the center of the flap and attach a hoist.

(d) Reach through the access openings in the trim flap and disconnect the actuator from the trim flap.

(e) Disconnect the trim flap position transmitter.

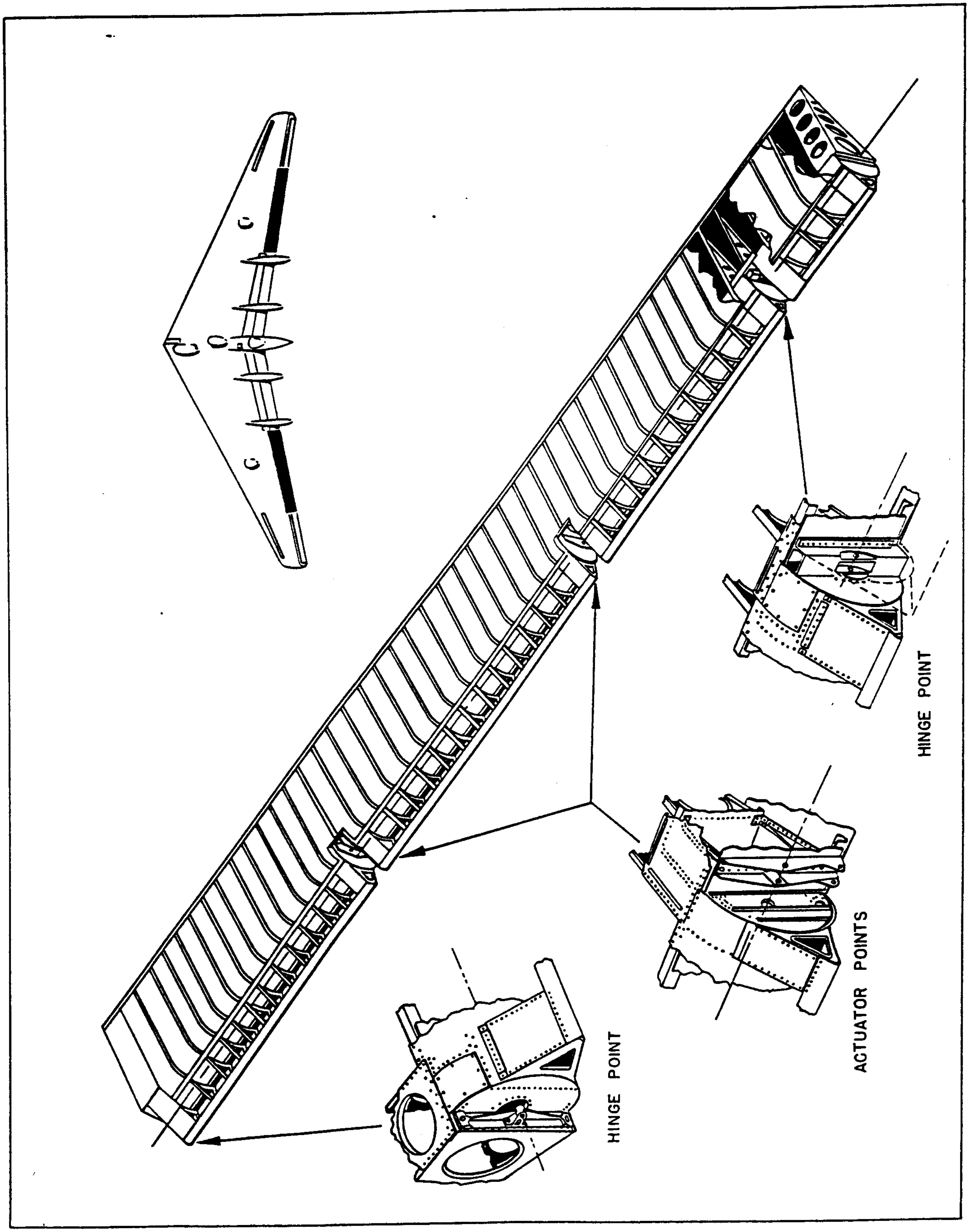


Figure 4. Elevon

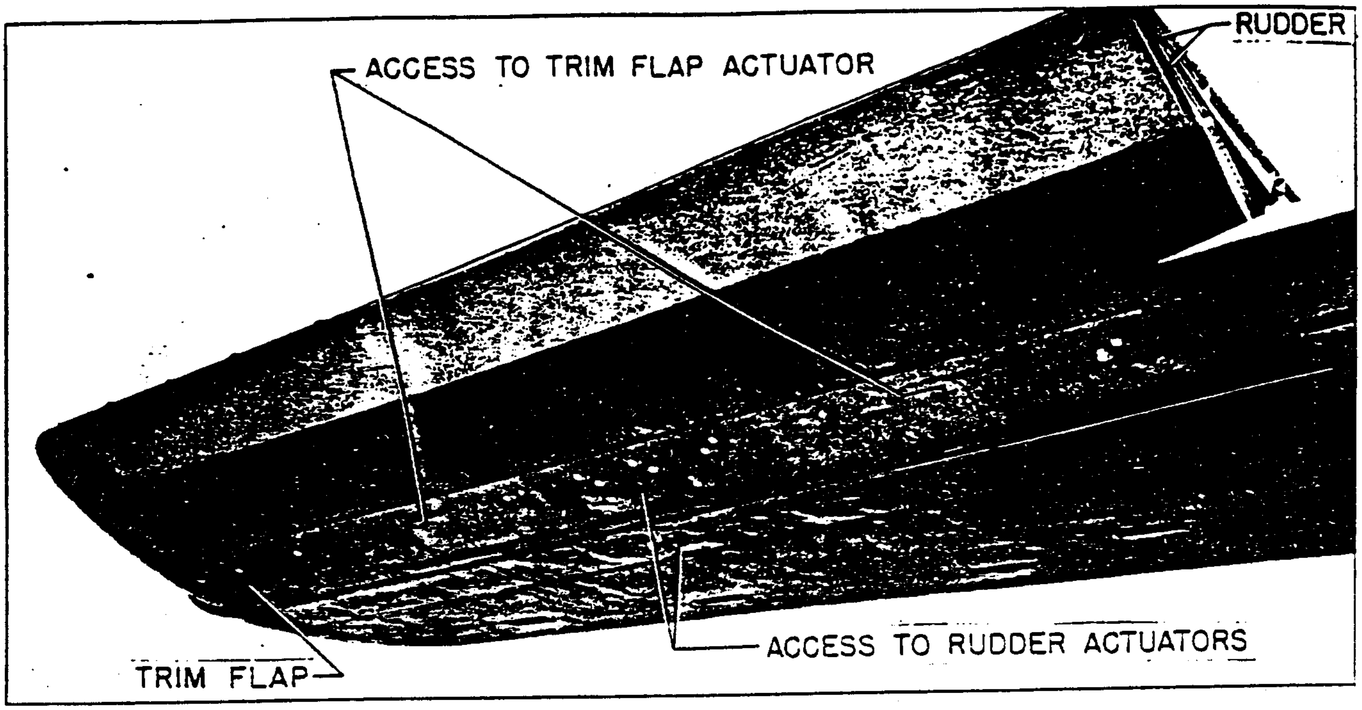


Figure 5. Rudder and Trim Flap

(f) Disconnect the rudder cables.

(g) Open the zipper at the leading edge of the flap.

(h) Remove the hinge bolts and hoist the flap clear of the airplane.

(2) INSTALLATION.- Reverse the removal procedure. See Section IV, paragraph 3 for information necessary to rig the rudder cables.

f. WING SLOT AND DOORS. (See figure 7.)- The wing slots are of the internal leading edge type, provided with an upper and lower door. The doors are held open automatically while the airplane is resting on the ground.

(1) REMOVAL.

(a) Disconnect both doors from the actuating mechanism.

(b) The hinge wire in the lower door is in two pieces, meeting at approximately the center of the door (see figure 8). Remove both hinge wires with the use of a drill motor.

(c) The hinge wire in the upper door is in four sections. The outer hinge wires may be removed from each respective end of the upper door and the two inner hinge wires may be removed at the center of the door. Access to the outboard end is gained by removing the cover plate on the upper wing surface. Remove all hinge wires with the use of a drill motor.

(2) INSTALLATION.- Reverse the removal procedure. See figures 8 and 9.

g. AIR EXIT FLAPS. (See figure 10.)- Eight dural constructed air exit flaps, are installed on the airplane. Six engine flaps and two plenum chamber flaps. Four of the engine air exit flaps are located on the top side of the wing aft of the rear spar on each side of each inboard propeller housing. The remaining two engine air exit flaps are located on the bottom side of the wing forward of the aft spar directly behind engines #1 and #4. The two plenum chamber air exit flaps are on the top side of the wing aft of the rear spar and directly behind each wheel well and bomb bay.

(1) REMOVAL OF ENGINE COOLING FLAPS.

(a) Disconnect the actuator rod from the flap.

(b) Remove the hinge wire on inboard flaps and on outboard flaps remove the three hinge bolts.

(c) Remove the flap.

(2) INSTALLATION.

(a) Insert the hinge wire or install the hinge bolts, connecting flap to wing structure.

(b) Attach flap actuating rod to flap.

(3) REMOVAL OF PLENUM CHAMBER FLAPS.

(a) Remove bolt, washer and nut attaching flap to actuator rod.

(b) Remove the two hinge covers, the hinge bolt, washer and nut on outboard flaps.

(c) Remove flap hinge wire.

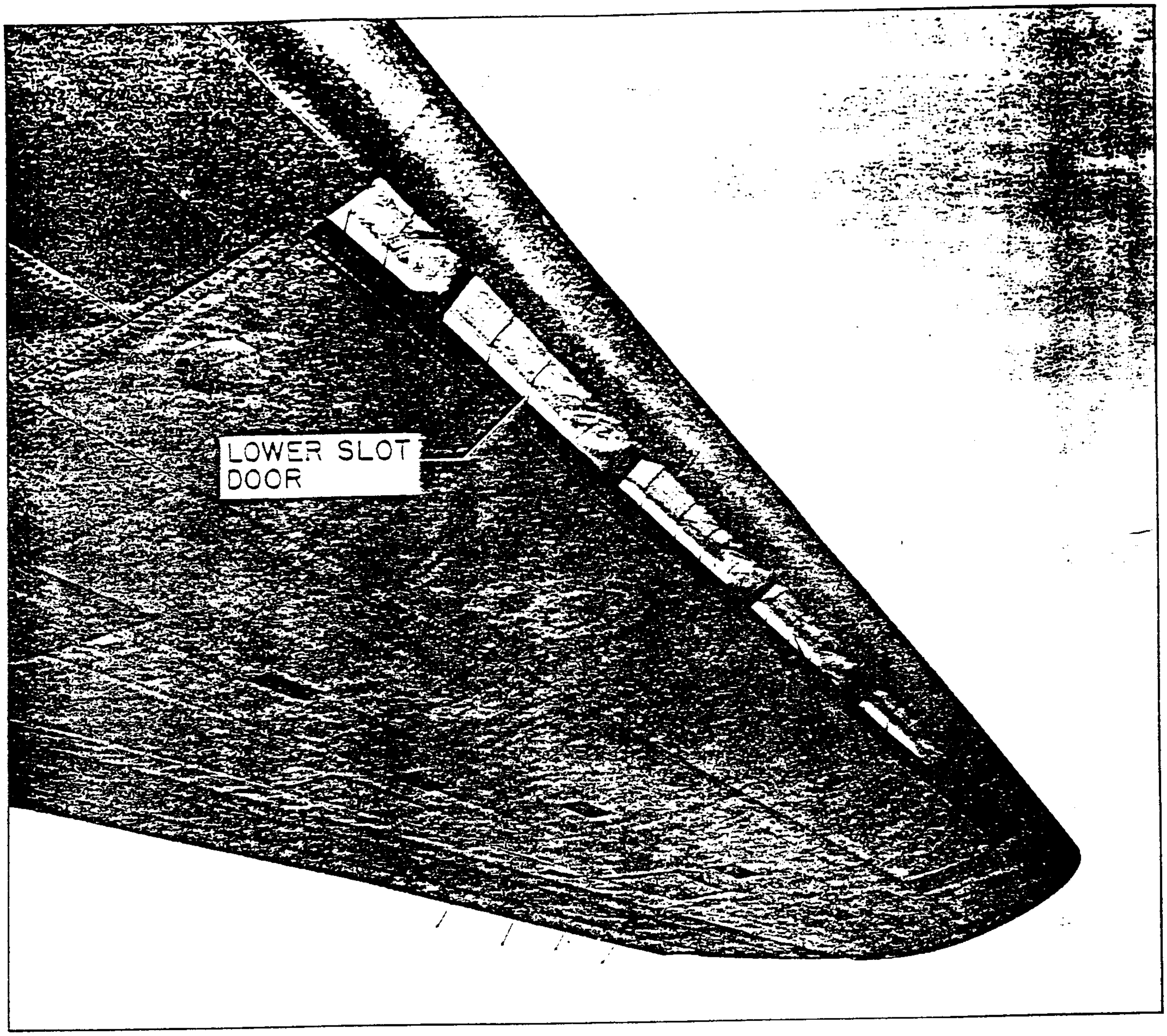


Figure 7. Wing Slots

(4) INSTALLATION.

(a) Attach the flap to wing with the hinge wire.

(2) REMOVAL.- Remove the access plates from the top and bottom of the wing tip. Remove the countersunk screws around the upper and lower forward and aft inner section

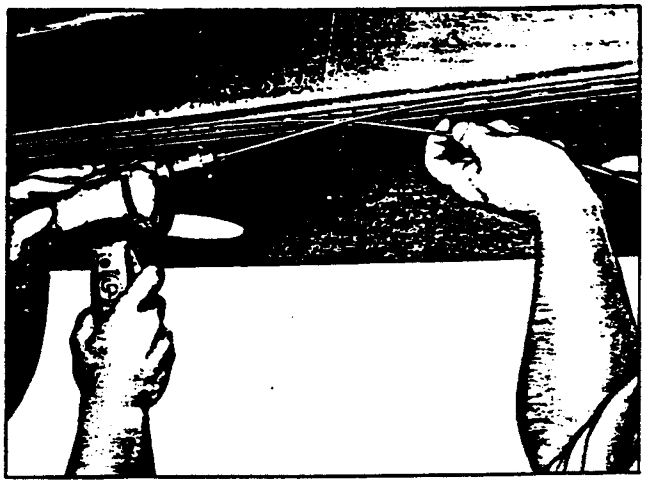


Figure 8. Hinge Wire Installation

(1) REMOVAL. (See figure 13.)

(a) Open the bomb bay doors.

(b) Disconnect the cables attaching the bomb bay door to the forward motor.

(c) Disconnect the chain connecting the aft motor to the bomb bay door.

(d) Remove the curved section of track in the aft bomb bay structure opening.

(e) Remove the bomb bay door through the section where the track was removed.

(2) INSTALLATION.

(a) Connect the door to the chain with the master links.

(b) Roll the door up on the drum.

(c) Install the curved track sections to the bomb bay structure.

(d) Connect the forward cables to the door.

j. ENGINE BAY ACCESS DOORS.- There are two inboard and two outboard engine access doors which are located on the bottom of the wing.

(1) REMOVAL.- Jack the airplane before removing the engine bay access doors. See Section III.

(a) INBOARD DOORS.

1. Disconnect the four Airloc fasteners from the engine breather in the center of the door.

2. Place a mechanic's stand under door to be removed and with about six men supporting the door, remove the attaching bolts.

3. When all the bolts are removed,

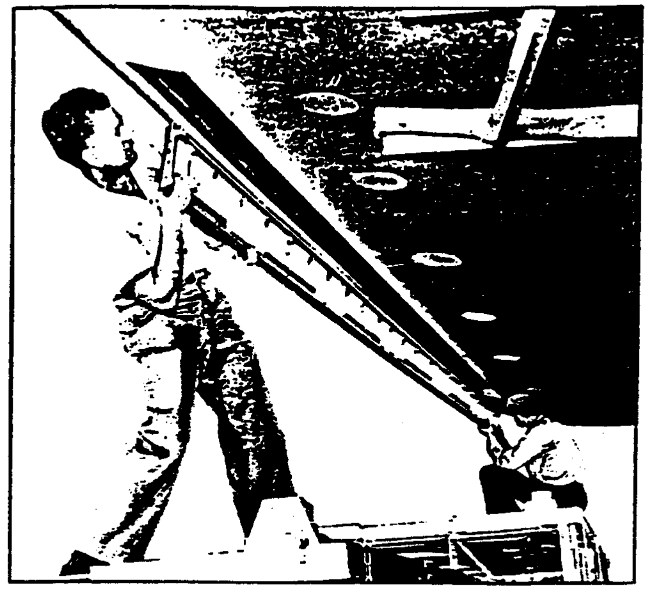


Figure 9. Wing Slot Door Installation

lower the door slightly then move it backwards before lowering it to the stand.

(b) OUTBOARD DOORS. (See figure 14.)- Open bomb bay door #1 or #8 corresponding to the engine door to be removed. Remove the door sections as follows:

1. Disconnect the four Airloc fasteners in the center section of the door from the engine breather. Remove the center section first.

2. Open the three small access doors on the inboard side. Remove three bolts connecting the center door section to the wing structure.

3. From within the open bomb bay, remove the flush head Phillips screws and remove the center panel.

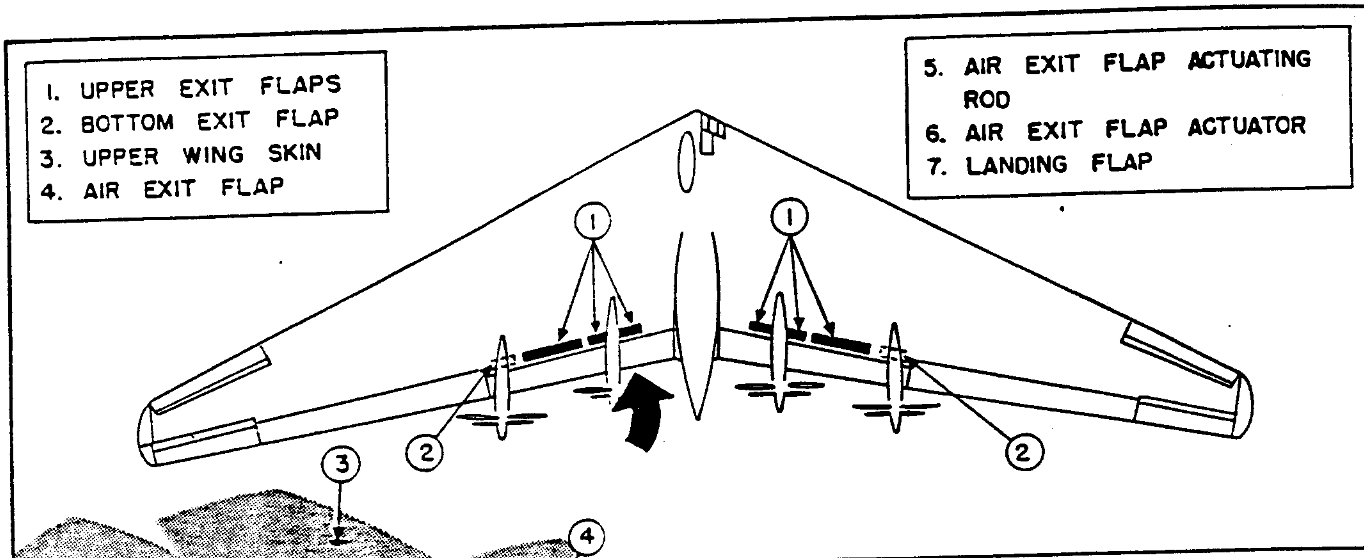
4. Remove the forward door section next by removing six flush Phillips head screws through the open bomb bay on the inboard side.

5. Drop the inboard side of the forward section and disconnect the de-icer and wastegate motor electric plug connections. Lower the door and remove it from the wing.

6. The aft door section is removed by removing one bolt through the access door and another bolt on the forward outboard side through the wing structure.

7. Through the bomb bay, remove the Phillips flush head screws on the inboard side of aft doors. Pull door down until clear of the air duct at the rear of the door section and remove from the wing.

(2) INSTALLATION.- Reverse the removal procedure.



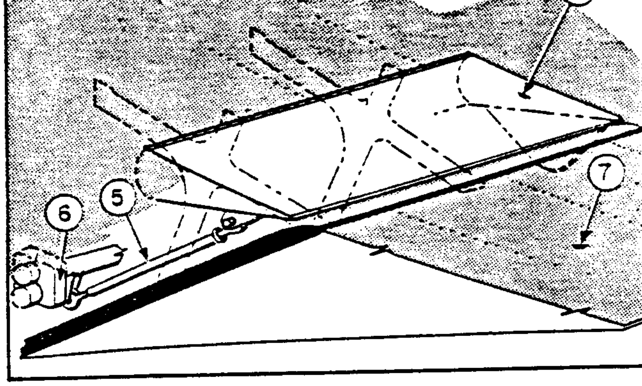


Figure 10. Air Exit Flaps

k. FUEL TANK DOORS.- There are six fuel tank doors and two access doors on the airplane. Each right and left wing contains four doors; one outboard structure door located on the top side of the wing directly above the two outboard fuel tanks which contain a fuel filler neck and cap; two inboard fuel tank doors located at the forward spar, forward of bomb bays #3, #4, #5 and #6. The inboard tanks also have an access door incorporating a fuel filler neck and cap. This door is located on the upper side of the wing above the two inboard fuel tanks.

(1) REMOVAL.

(a) OUTBOARD FUEL CELL DOORS.

1. Unfasten the six Airloc fasteners and remove the fuel filler cap.

2. Break the safety wire, remove the twelve fuel tank connecting bolts and washers which connect the fuel tank to the door.

3. Remove the door attaching bolts and lift the door from the top of the wing.

(b) INBOARD FUEL CELL DOORS.

1. Disconnect the necessary cables and fuel lines.

2. Remove the fuel cell hanger bolts. It is necessary to remove these bolts from within the fuel cell. See Section IV, paragraph 11.

3. Remove the bolts securing the door to the airplane structure.

(2) INSTALLATION.

(a) OUTBOARD FUEL CELL DOORS.

1. Insert door into position and connect the tank to the door inside the filler well with the twelve nuts, bolts and wahsers. Safety the nuts in pairs.

2. Install the door attaching bolts. Secure the door tightly.

3. Install filler cap by fastening the six Airloc fasteners with a Phillips screw driver.

(b) INBOARD FUEL CELL DOORS.- Install the doors in reverse of the removal procedure. See Section IV, paragraph 11, for installation of the hanger bolts.

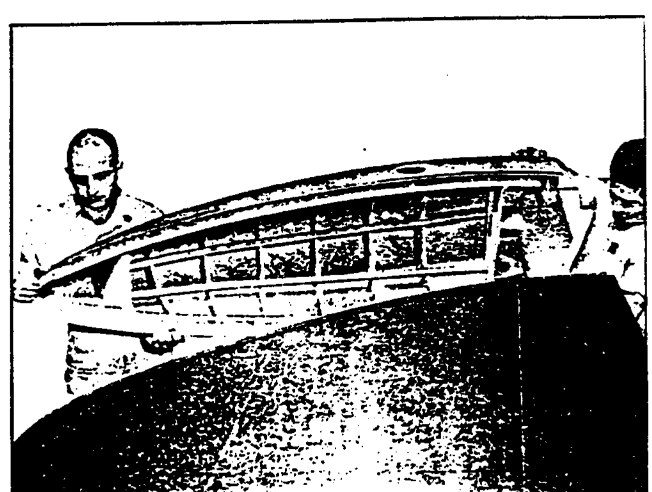


Figure 11. Wing Tip

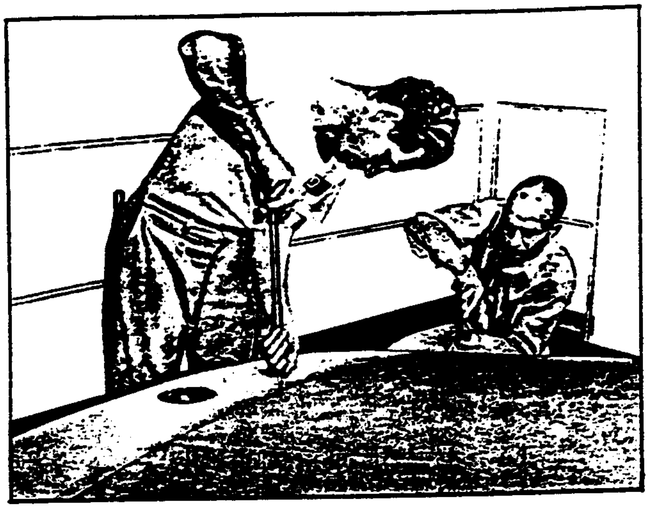


Figure 12. Wing Tip Installation

1. TURBOSUPERCHARGER DOORS.- There are four turbosupercharger doors on the airplane. Each door is of steel and dural construction, serving as an access cover for two turbosuperchargers.

(1) REMOVAL.

(a) Remove the right and left sections of the flight hood fairing.

(b) Remove safety wire, bolts, washers and nuts attaching shroud assemblies to the wing and the turbo door.

(c) Remove the seals.

(d) Remove the shroud assembly.

(e) Remove the fairing ribs.

(f) Remove the Phillips head screws to remove the door.

(2) INSTALLATION.- Reverse the removal procedure.

m. MAIN LANDING GEAR DOORS.

(1) GENERAL.- There are two sets of double doors for each main landing gear, the forward doors and the aft doors. Each set of doors operates separately. The forward doors are operated by an electric door actuator. The aft doors are attached to the strut with attaching rods and operate with the landing gear for opening and closing.

(2) REMOVAL.

(a) FORWARD DOORS.

1. Disconnect the actuator.

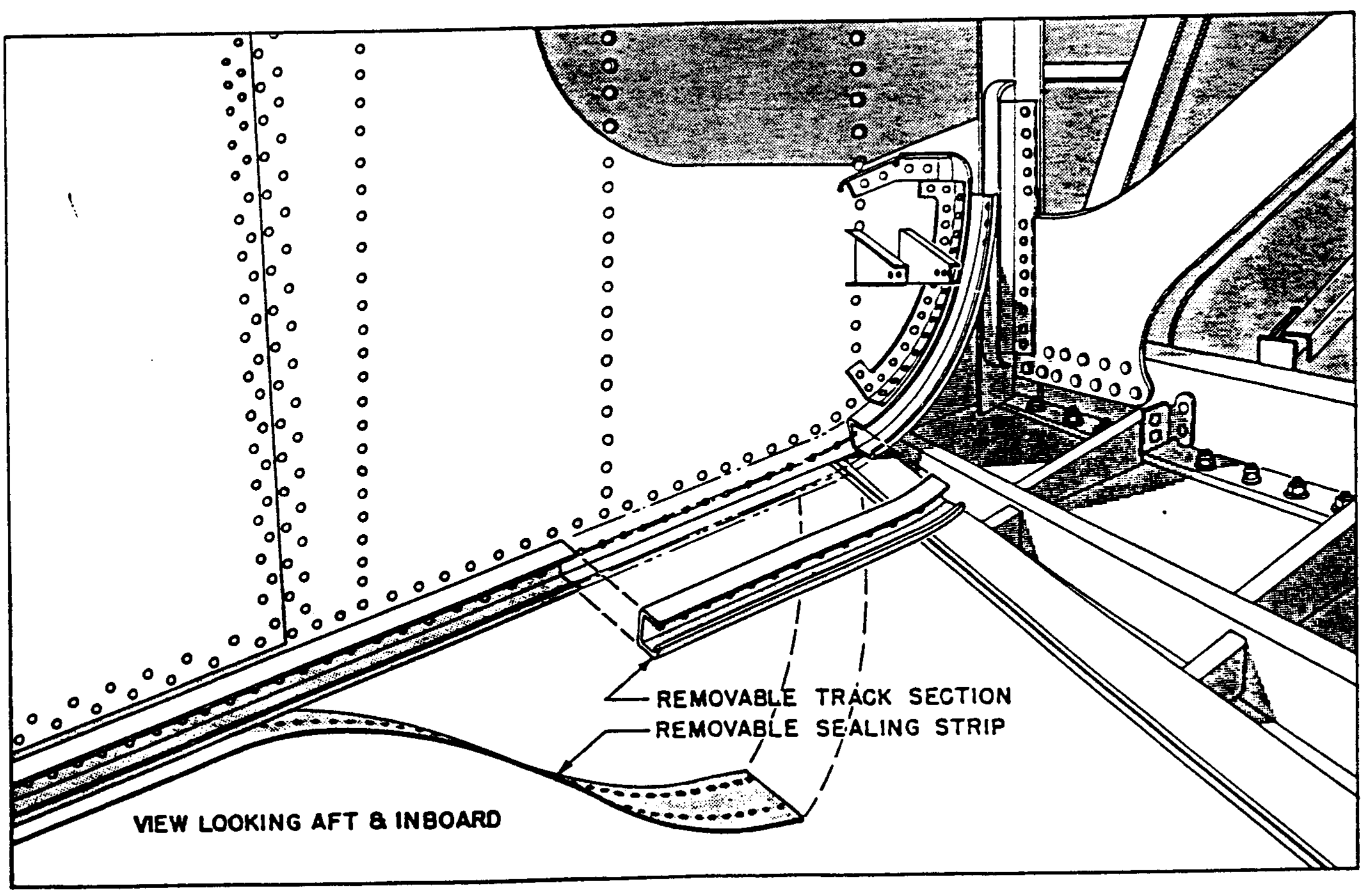


Figure 13. Bomb Bay Door Installation

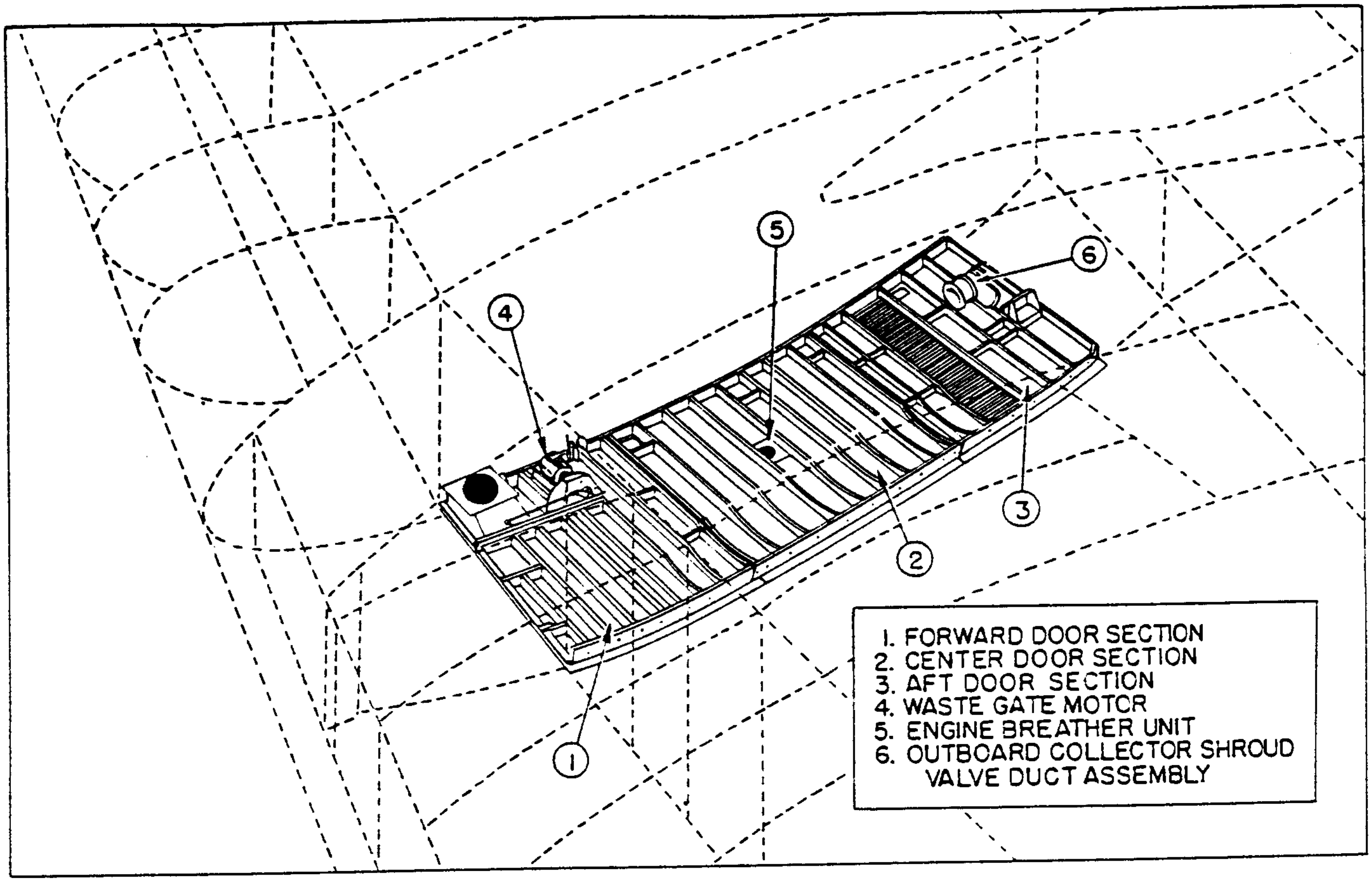


Figure 14. Outboard Engine Access Door

2. Disconnect the door lock.

3. Remove the hinge bolts, nuts and washers.

(b) AFT DOORS.

1. Remove the bolts, washers and nuts connecting the rods to the door.

2. Remove the hinge bolts, washers and nuts.

(3) INSTALLATION.- Reverse the removal procedure.

n. NOSE WHEEL DOORS.- Two nose wheel well doors are installed on the airplane.

(1) REMOVAL.

(a) Disconnect the actuator from the door.

(b) Disconnect the bonding wires.

(c) Remove the hinge bolts.

(2) INSTALLATION.- Reverse the removal procedure.

(3) ADJUSTMENT.- See Section IV, paragraph 5.

2. CREW NACELLE

2. CREW NACELLE.

a. DESCRIPTION. (See figure 1.)- The crew nacelle, forming the center section of the wing, is divided into three sections; the forward section, center section, and aft section. Windows are faired into the leading edge of the nacelle to provide vision for the copilot and bombardier, and a canopy is installed on the upper side for the pilot. An astrodome is provided for the navigator. Fairings are installed on the top and bottom of the nacelle to simulate gun turrets and sighting stations.

b. FLOORS.- Laminated wood floor sections are provided throughout the crew nacelle. The floor sections are secured to the nacelle structure with countersunk screws and washers.

c. WINDOWS AND CANOPY.- The forward windows are plexiglas with the exception of the bombardier's window which is made of laminated plate glass. The pilot's canopy and the astrodome are made of plexiglas.

(1) REMOVAL.- The forward windows are mounted in cork-rubber and held in place by retainer strips with countersunk screws. The astrodome is secured by a rubber extrusion that can be removed by pulling a thong attached to one end of the extrusion. The canopy can be removed in the following manner (see figure 2):

(a) Remove the fairing around the canopy.

(b) Remove the screws from the retainer strips on both sides of the canopy.

(c) Pry the nylon and balloon cloth from the filler.

(d) Remove the canopy.

(e) The canopy rail may be removed by removing the bolts securing it to the nacelle structure.

(2) INSTALLATION. (See figure 2.)

(a) If the canopy rail has been removed from the airplane, carefully clean the cement from it and the nacelle surface. Apply a coat of cement, Sherwin Williams Paint Corporation PV-410 or equivalent, to the nacelle surface and bottom of the rail. Secure the rail to the structure.

(b) Install two nylon webs, a balloon cloth strip, and a rubber tube on the canopy in the following manner:

1. See that the two nylon webs are prepared correctly. Both webs are to be doubled in the lengthwise direction and quilted with nylon thread. The quilting is spaced at 0.5 inch intervals in both lengthwise and crosswise directions. The first row of stitching in the lengthwise direction is located approximately 0.125 inch from the looped edge.

2. Mask both sides of the canopy and one side of each nylon web to a distance of 1.0 inch from the edge.

3. Immediately prior to the application of adhesive, clean all mating surfaces with naptha.

4. Apply a first coat of adhesive to one side of the canopy and to one nylon web. Use 100 parts of Penacolite G-1131A, 20 parts of G-1131B, and 20 parts of denatured alcohol. Penacolite is a product of the Pennsylvania Coal Products Company.

NOTE

This prepared adhesive must be used within three hours after mixing.

5. Starting at the aft end of the enclosure and at one end of the nylon web, apply one light brush coat of adhesive simultaneously to both mating surfaces.

IMPORTANT

Use only enough adhesive to completely cover the surfaces.

6. Mark down the time at which the adhesive is applied at intervals of three feet on the masking tape adjacent to the joint.

7. Allow exactly two hours open drying time before applying a second coat of adhesive. As the second coat is brushed on, observe the time marking on the masking tape so that the second coat will be applied exactly two hours after the first coat along the complete length.

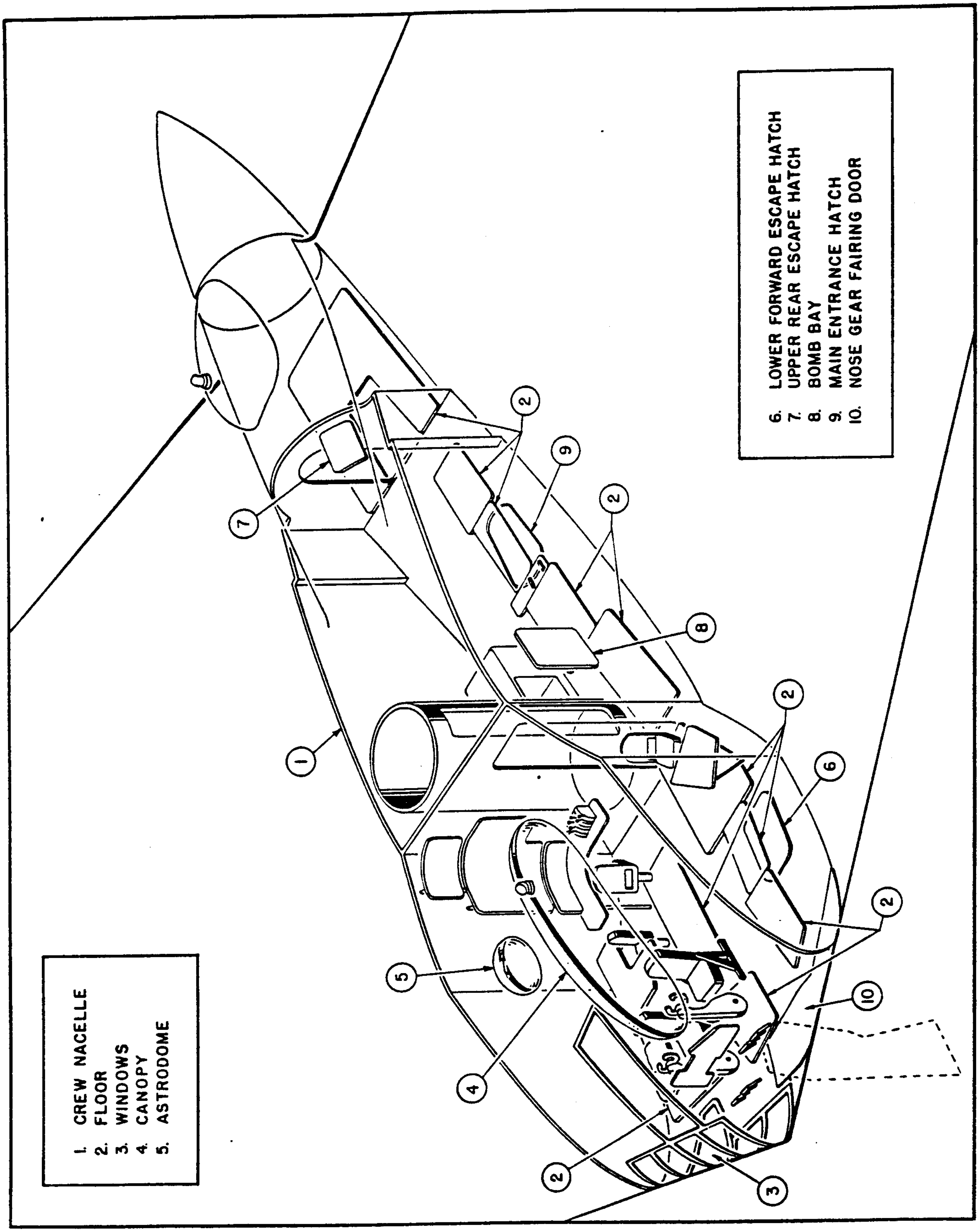


Figure 1. Crew Nacelle

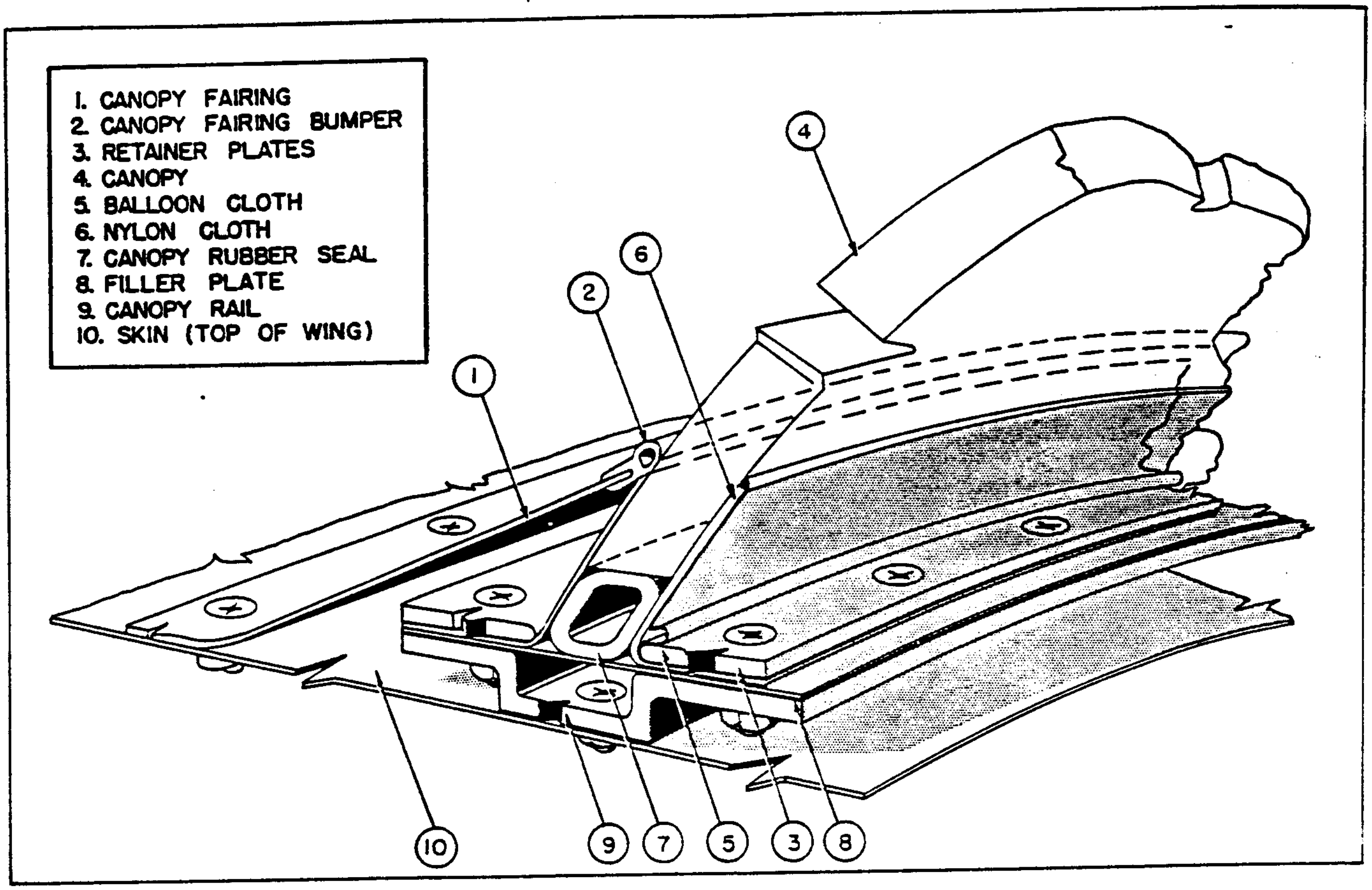


Figure 2. Canopy Installation

8. Mix the Penacolite in proportions of 100 parts of G-1131A and 20 parts of G-1131B.

NOTE

Use this mixture as soon as possible. It should be discarded when it has thickened to the point where it cannot be easily spread in a thin, even coat.

9. Apply the second coat, starting at the same point the first coat was started. Mark the time at three-foot intervals in the same manner as for the first coat.

10. Allow a 40 minute open drying time before assembling the joint.

IMPORTANT

While assembling the joint, do not touch the adhesive film with fingers or any object. Avoid sliding the surfaces once they have been joined.

11. Exert every effort to see that each part of the joint is assembled exactly 40 minutes after the second application of Penacolite. Check the time as marked on the masking tape to insure this. The strength of the joint depends principally upon the proper open assembly time.

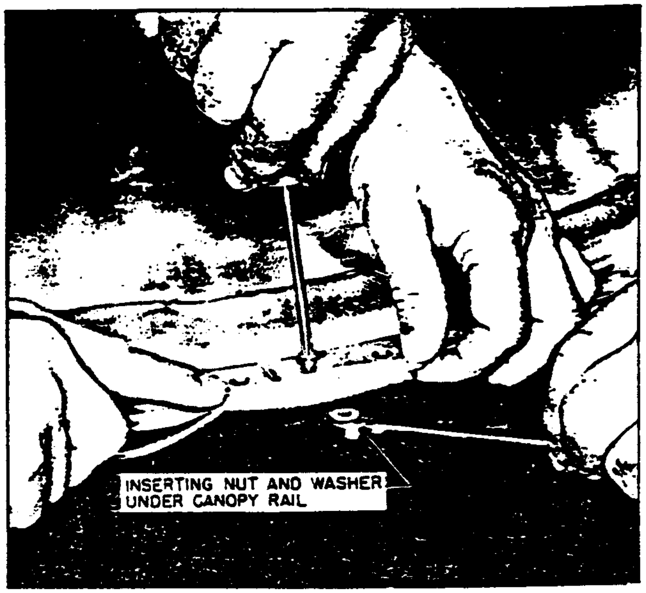
12. Press the nylon web firmly down on the canopy. Cover the nylon with a rubber strip. The rubber strip should be 50 shore, .125 inches thick, 260 inches long, and 1.5 inches wide. Place a strip of .040 24st aluminum, 260 inches by 1.5 over the rubber. Install a series of "C" clamps around the canopy edge to hold the rubber and aluminum pressure strips firmly against the nylon. Install the clamps 1.5 inches apart. Lap the nylon web 2-3 inches at the aft end of the canopy. Make sure that the pressure strips bear over the entire width of the joint.

13. Allow pressure to remain on the joint overnight.

14. Apply the second nylon web on the canopy in the foregoing manner. Allow a minimum spacing of 10 inches between the interior and exterior lap joints of the nylon webs.

(c) Coat the upper surfaces of the canopy rail with Sherwin Williams Sealer, Number PV-410 or equivalent. Press the filler in place on the rail while the sealer is wet.

(d) Brush a light coat of U.S. Rubber Company cement 6136 or equivalent on one side of the rubber tube. Allow a 10 minute drying period. Then press the cement coated side of the rubber tube against the canopy edge, between the two nylon webs.



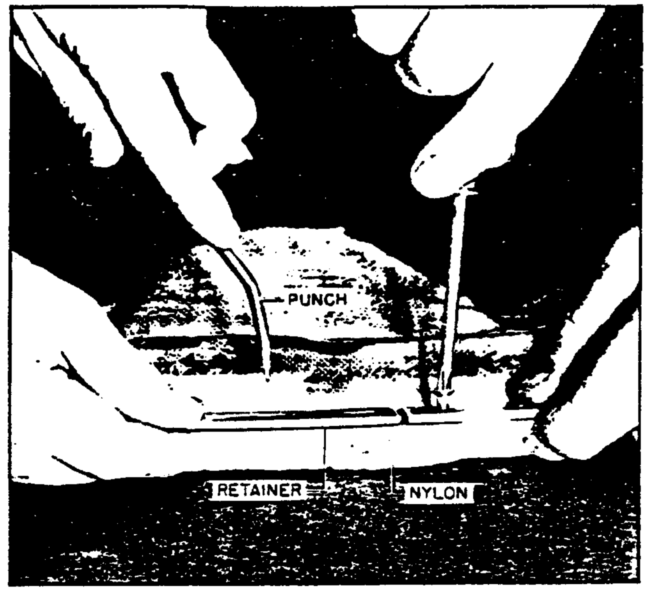


Figure 3. Installation Retainer Strip

CAUTION

Do not apply cement directly to the canopy edge, as the solvent contained in the cement will attack the plexiglas.

(e) Place the canopy in position.

(f) Coat the upper surface of the filler and the lower mating side of the nylon webs with U.S. Rubber cement 6136, or equivalent.

(g) Place a balloon cloth sealing strip in place around the inside of the canopy, and install the retainers. As the retainers are being installed, pull nylon webs into position so as to remove all wrinkles and align the threads as nearly vertical as possible. Do not pull the nylon down hard enough to compress the rubber tube. (See figure 3.)

(h) Cement the balloon cloth strip to the nylon web as shown in figure 2. Use U.S. Rubber cement 6136, or equivalent. Do not allow the cement to contact the plexiglas.

(i) Apply a small filet of sealer, Prestite Engineering Co. SKH-101C, or equivalent, to the top of the interior nylon web.

(j) Trim the nylon webs off flush with the retainers.

(k) Coat the exterior nylon web with enough PV-410, or equivalent sealer, to seal the pores of the web against the entrance of water.

(l) Install the fairing around the outside of the canopy.

d. ASTRODOME. (See figure 4.)- The astrodome is designed so that it can be used for emergency escape. The dome is held in a recessed mount by a rubber extrusion. Remove the dome by pulling on the thong, attached to the rubber extrusion. The dome releases inward.

e. HATCHES. (See figure 1.)- There are three escape hatches in the airplane; the lower escape hatch, bomb bay escape hatch, and the rear upper escape hatch. The lower and the bomb bay escape hatches can only be opened from inside the airplane. The main entrance hatch and the rear upper escape hatch can both be opened from either the inside or outside. The handles for opening the hatches fold so that they are flush with the surface of the hatches. A jettison handle is located at the forward side of the main entrance hatch.

(1) REMOVAL.- An escape hatch may be removed by raising and turning the handle. The main entrance hatch may be removed by opening the hatch, then by pulling up on the jettison handle. Support the hatch before pulling the jettison handle.

(2) INSTALLATION AND ADJUSTMENT.- All hatches are provided with panels which may be removed for access to the latch mechanisms.

(a) ESCAPE HATCHES.

1. Adjustable rods connect the handle to the latches. The rods must be adjusted to place all latches in the same relative position. The initial latch settings for the three escape hatches are as follows:

Lower Escape Hatch:	1-9/16 inches
Bomb Bay Escape Hatch:	1-11/16 inches
Upper Escape Hatch:	1-1/2 inches

NOTE

Measurements are taken from the edge of the hatch to the tip of the latches.

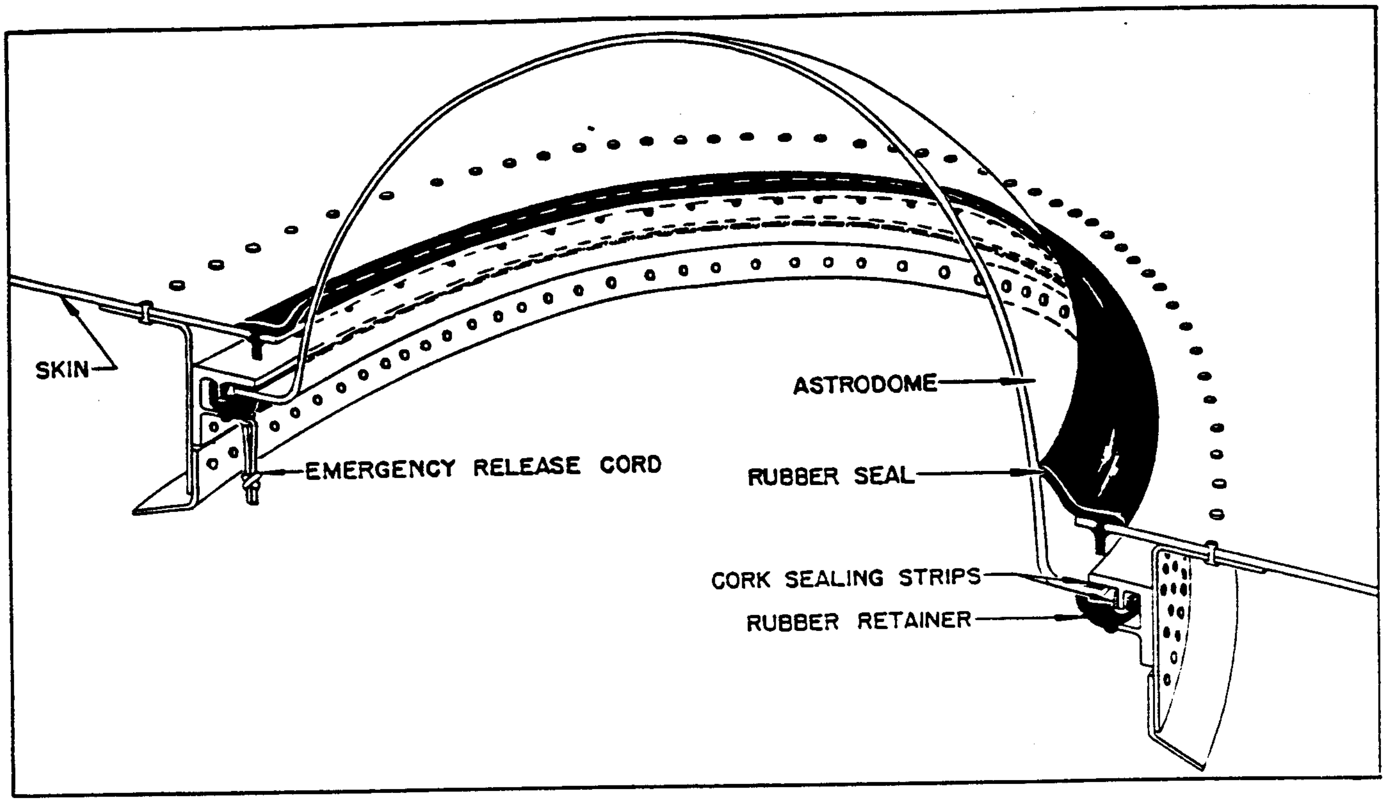


Figure 4. Astro Dome

2. Further adjust the rods so that the latches will clear the dogs, allowing the hatch to release properly.

3. Adjust the dogs that are secured to the structure around the opening. Loosen the screws and move the dogs as required so that the hatch fits snug against its rubber bumper and is faired to the outside contour. (See figure 5, view A.)

(b) MAIN ENTRANCE HATCH. (See figure 5.)

1. Raise the jettison handle, align the hinges, and press the handle down.

2. Check the operation of the hatch. If it is necessary to adjust the latches and dogs, follow the procedure outlined in paragraph (2) (a) preceding. This initial measurement for the latches on this hatch is 1-1/2 inches.

3. The rods connecting the bungees to the hinge arms should be adjusted to a measurement of 13-11/16 inches ± 1/4 inch. This measurement is to pin centers.

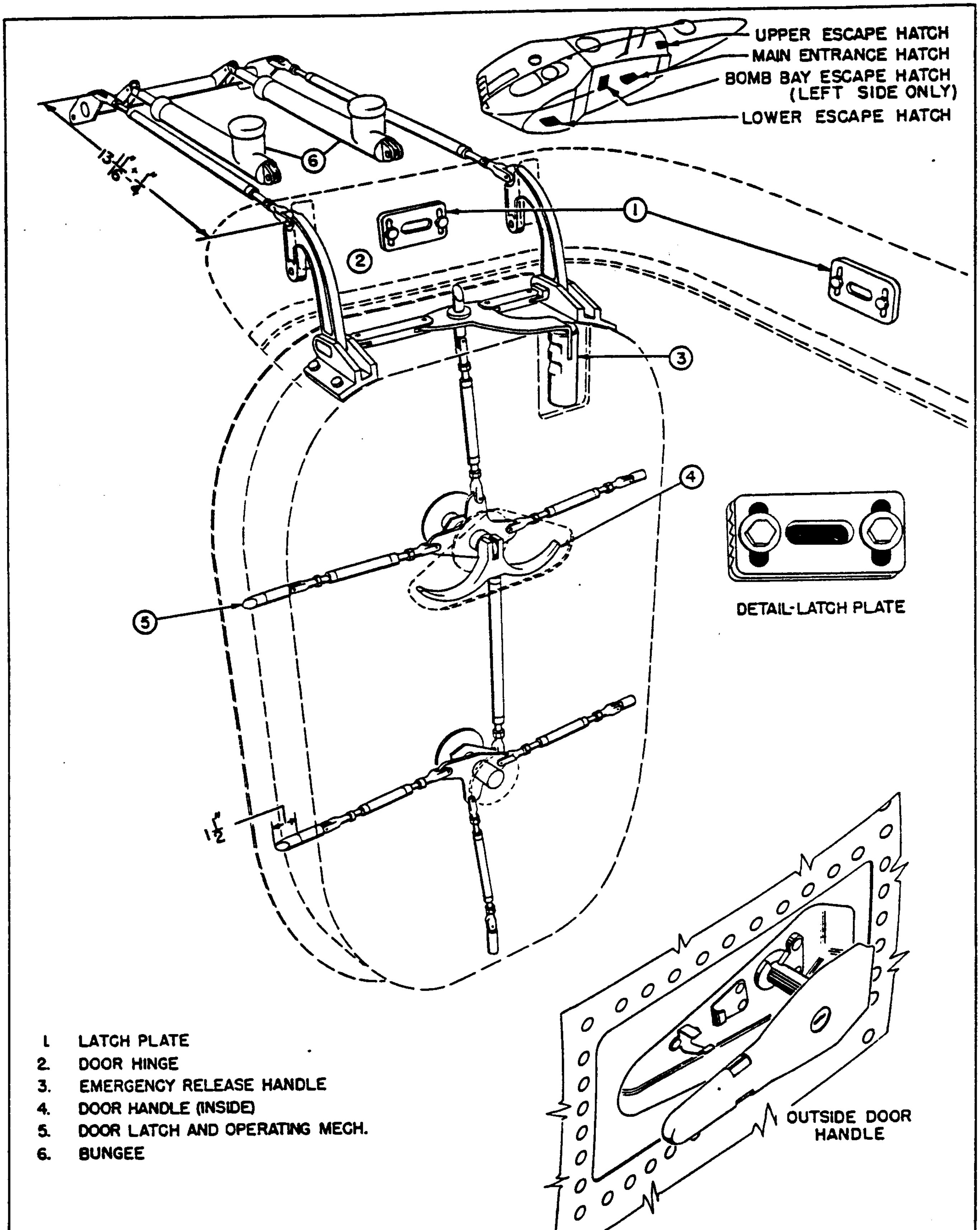


Figure 5. Main Entrance Hatch

3. FLIGHT CONTROLS

3. FLIGHT CONTROLS.

a. DESCRIPTION.

(1) ELEVON CONTROLS. (See figure 1.)- The elevons function as both elevators and ailerons. The control system is so designed, however, that the airplane is controlled laterally and longitudinally in the same manner as is an airplane with conventional ailerons and elevator. The control columns and wheels are connected to torque tube assemblies by cables enclosed in the columns. The torque tubes are connected to quadrants, and cable assemblies attached to the quadrants extend aft and outboard into each wing to two hydraulic control units at each elevon. A cable tension regulator installed at each hydraulic unit tends to maintain a nearly constant cable tension, regardless of temperature changes or structural deflections. Inasmuch as the elevons are actuated by hydraulic cylinders, "feel" has been inserted into the system by a control force bellows attached to the pilot's column and springs attached to the control wheel mechanism inside each control column. An electric motor assembly is incorporated in the system at each inboard hydraulic unit for use in the event of a hydraulic failure.

(2) RUDDER CONTROLS. (See figure 2.)- The rudders are cable-controlled and hydraulically-actuated. The pilot and copilot are furnished with toe pedals for control of the rudders and brakes. Push-pull rods connect the rudder pedals to torque tube assemblies, and cables extend aft and outboard along the rear wing spar to hydraulic units at each rudder. Preload spring units are attached to the copilot's rudder torque tubes. The preload units are used to return the pedals to the neutral position. Rudder trim is controlled by a dial knob mounted on the pilot's pedestal. Rudder trim is used to correct yaw by changing the neutral position of the rudder pedals, thus opening the selected rudder an amount corresponding to the dial setting. (See figure 3.)

(3) TRIM FLAP CONTROLS. (See figure 4.)- The trim flaps are electrically-operated by an eight-position switch located on the pilot's pedestal. Two indicators are installed on the pedestal immediately forward of the control switch.

(4) LANDING FLAP CONTROLS. (See figure 5.)- The landing flaps are controlled by a switch located on the pilot's pedestal, and a flap position indicator is installed on the copilot's side of the instrument panel. The landing flap power unit, consisting of two electric motors and a gear box assembly, is situated in the top of the crew nacelle just aft of the rear wing spar. Torque tubes, connected by universal joints, are used to transmit torque to the flap actuating mechanisms in each wing.

(5) WING SLOT DOOR CONTROLS. (See figure 6.)- Wing slot doors are electrically-controlled and hydraulically-actuated. They are controlled by a three position switch located on the pilot's pedestal and indicator lights are installed on the pilot's instrument panel to show the open position of the doors. Inasmuch as it is desirable to have the slot doors open during take-off and landing, a switch actuated by the main gear in its down position keeps the doors open until the gear is retracted.

b. TROUBLE SHOOTING.

TROUBLE	PROBABLE CAUSE	REMEDY
Brakes apply when rudders are operated.	Leaky brake solenoid valve.	Replace solenoid valve.
Excessive trimming required with normal load distribution.	Primary control surfaces out of adjustment.	Adjust the control system.
	Landing flaps nor properly adjusted.	Check the flaps in the up position and adjust the surfaces.

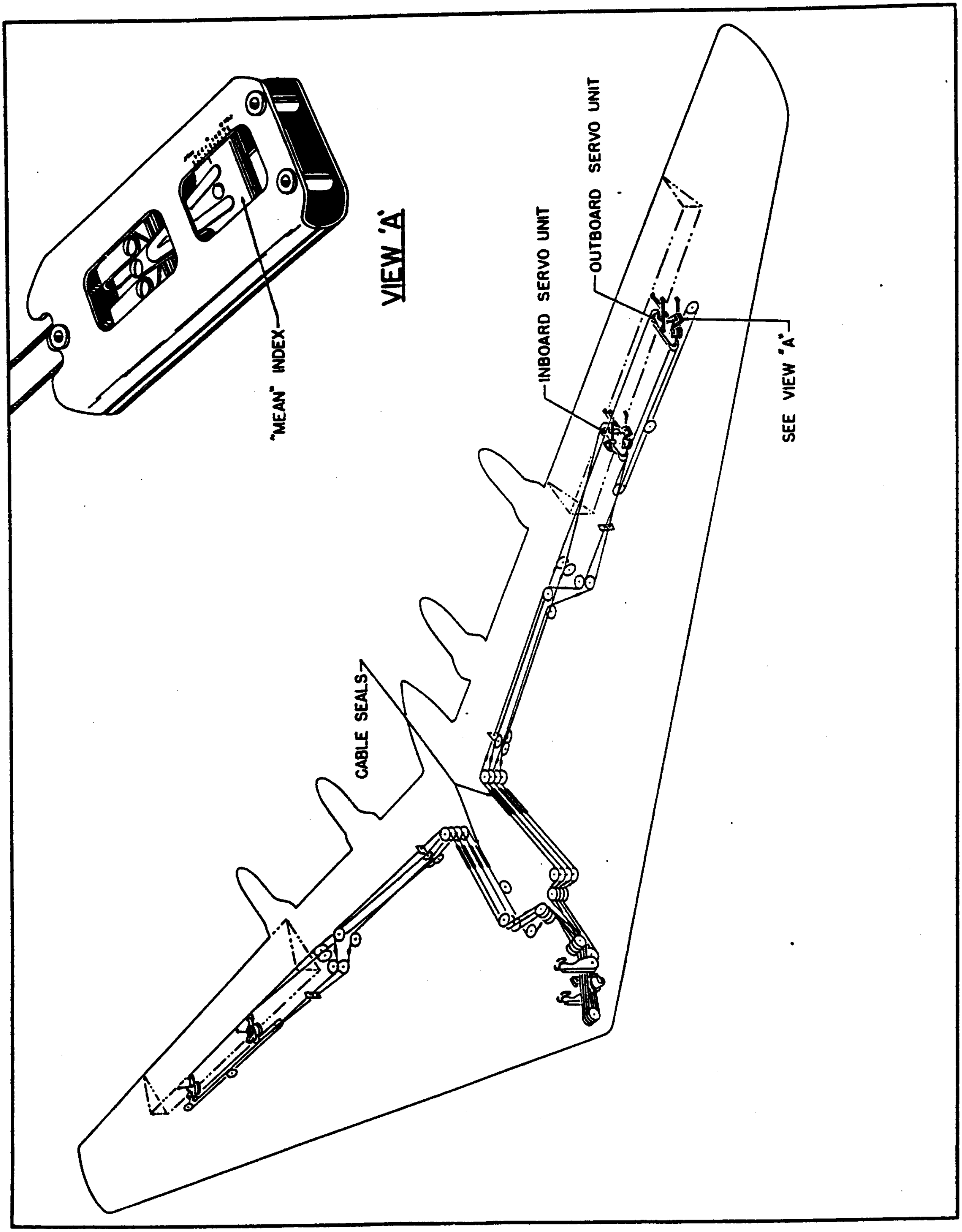


Figure 1. Elevon Control System

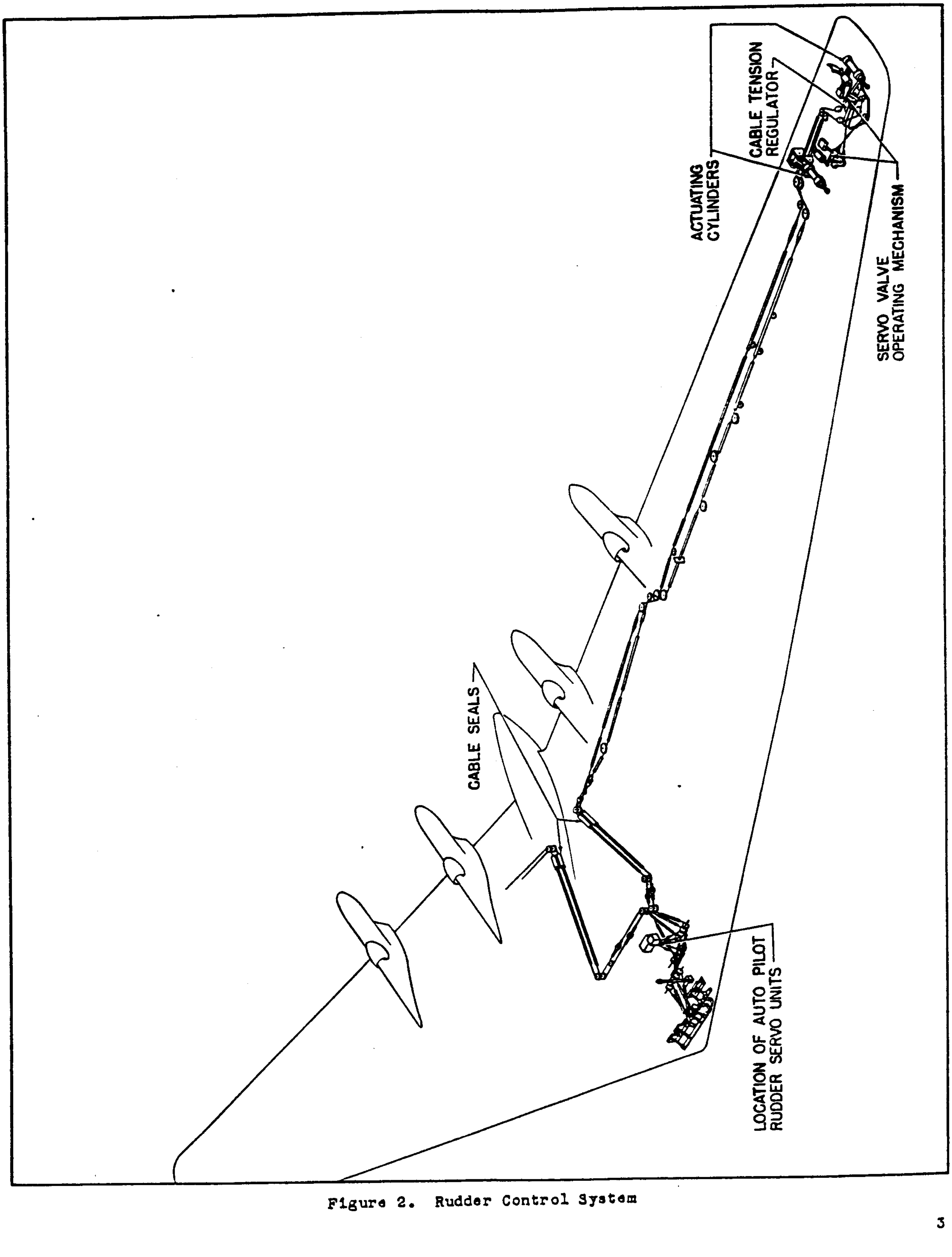


Figure 2. Rudder Control System

TROUBLE	PROBABLE CAUSE	REMEDY
Landing flaps inoperative.	Power unit not engaged.	Engage the unit.
	Circuit breaker off.	Reset circuit breaker.
	One electric motor inoperative and motor brake not engaged.	Test by using motor switches on the power unit, one at a time. Replace faulty motor.
Mechanical stop engages each time flaps are operated.	Limit switches improperly adjusted.	Adjust switches to stop flaps at proper travel.
	Faulty limit switches.	Replace and adjust switch.
	Motor brake not functioning correctly.	Repair brake or replace motor.

c. REPLACEMENTS.- 7x19 cable assemblies will be replaced if more than six broken wires appear in any one-inch length of cable. Frozen, binding, or rough operating pulleys will also be replaced.

d. CLEANING.- Pulleys and bearings are packed with lubricant and are not to be cleaned with any liquid that will disolve the lubricant. Use a damp cloth to clean these parts.

e. REMOVAL AND INSTALLATION OF CONTROL CABLES.- Turnbuckles and disconnect points are incorporated in the rudder and elevon control systems. If the cables are to be disconnected and one set removed from the airplane, identify each end to be disconnected. Secure the cables remaining in the airplane to some part of the airplane structure so that some tension will remain on them after they are disconnected. A piece of airplane shock cord is suitable for this purpose. The cables are clad with aluminum alloy tubing and in some instances it will be necessary to remove pulleys in order to remove the cable assemblies. After installing cables, be sure that all pulleys, fairleads, and cable guards have been reinstalled.

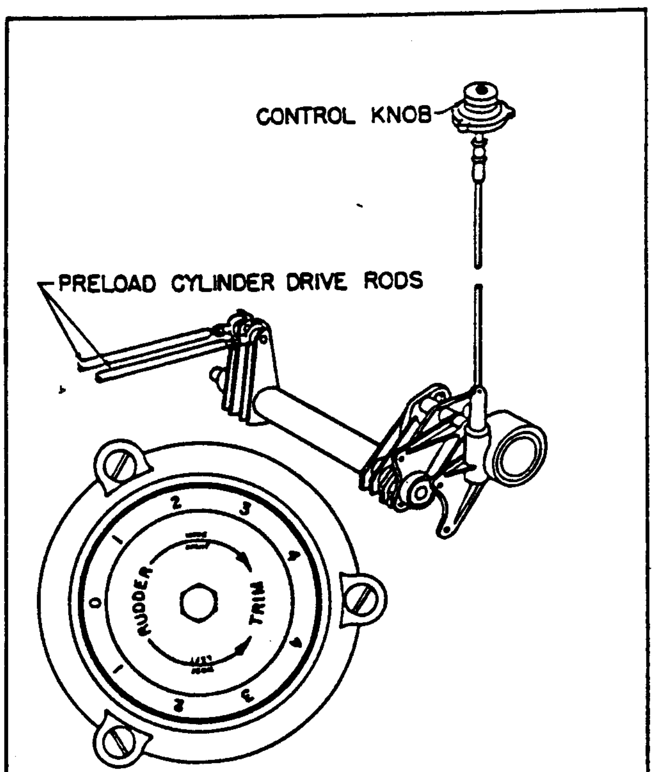


Figure 3. Rudder Trim Controls

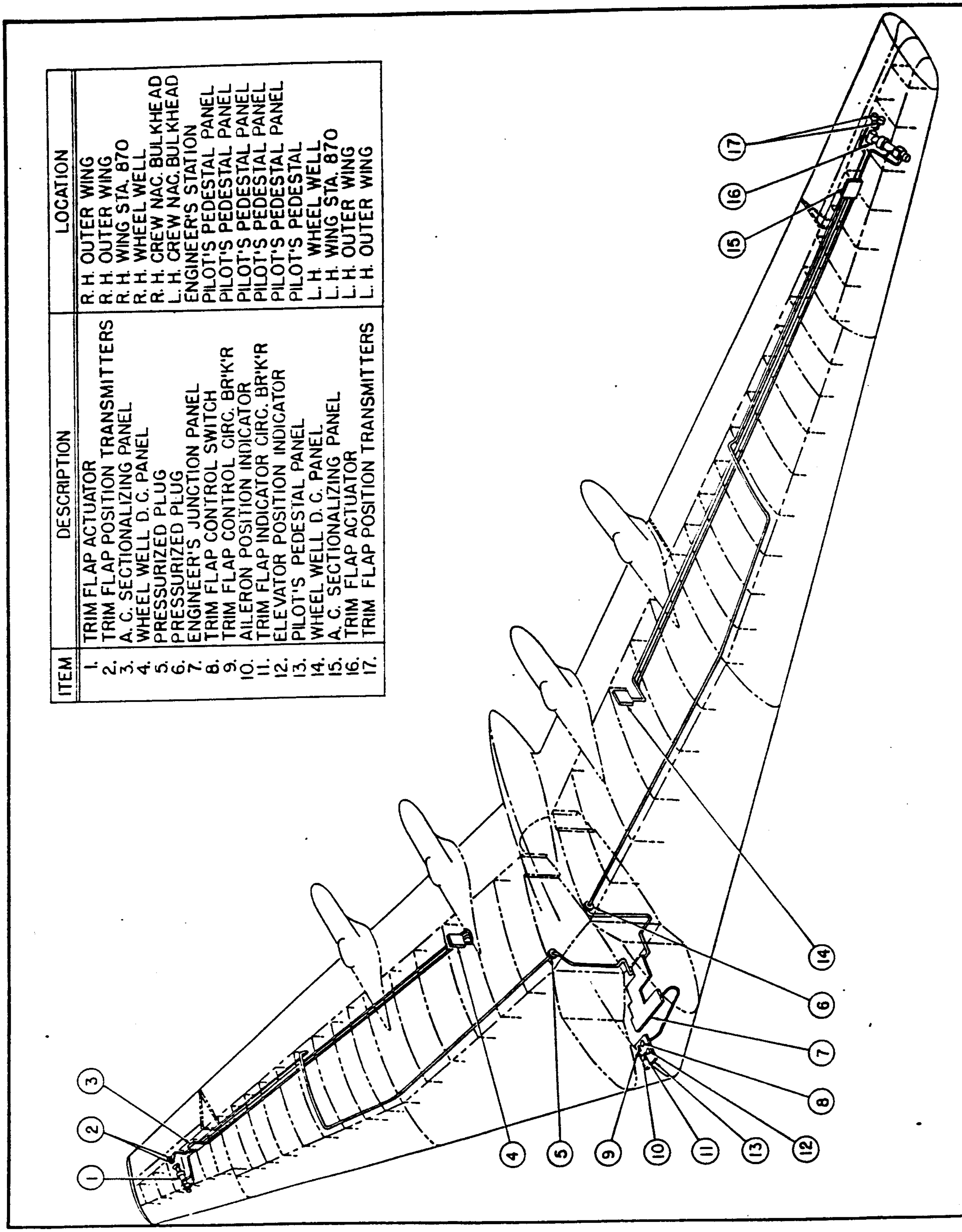
f. CONTROL COLUMNS. (See figure 7.)- Each control column is bearing-mounted on dual torque tubes and the ends of the torque tubes are supported by bearing assemblies that are bolted to the airplane structure. Cable quadrants, enclosed by the control column, are secured to the torque tubes. A chain, engaged with the control wheel shaft sprocket, is attached to the quadrants by means of cables and another set of cables from the quadrants are connected to pulleys at the center of the column. The manner in which these cables are attached enable the quadrants to be turned in opposite directions with the control wheel, or together in the same direction by moving the control column. Thus the control column may be moved and the control wheel turned at the same time, producing the same control effect with the elevons as that obtained with conventional ailerons and elevator. The control wheels are spring-loaded to the neutral positions and the columns are connected to a force bellows which provides "feel" to the operation of the columns.

(1) REMOVAL OF CONTROL COLUMNS. (See figure 7.)- Parts of either control column may be replaced without removing the column assemblies from the airplane. See paragraph (2) following. However, if removal of a column assembly is necessary, proceed as follows:

(a) PILOT'S CONTROL COLUMN ASSEMBLY.

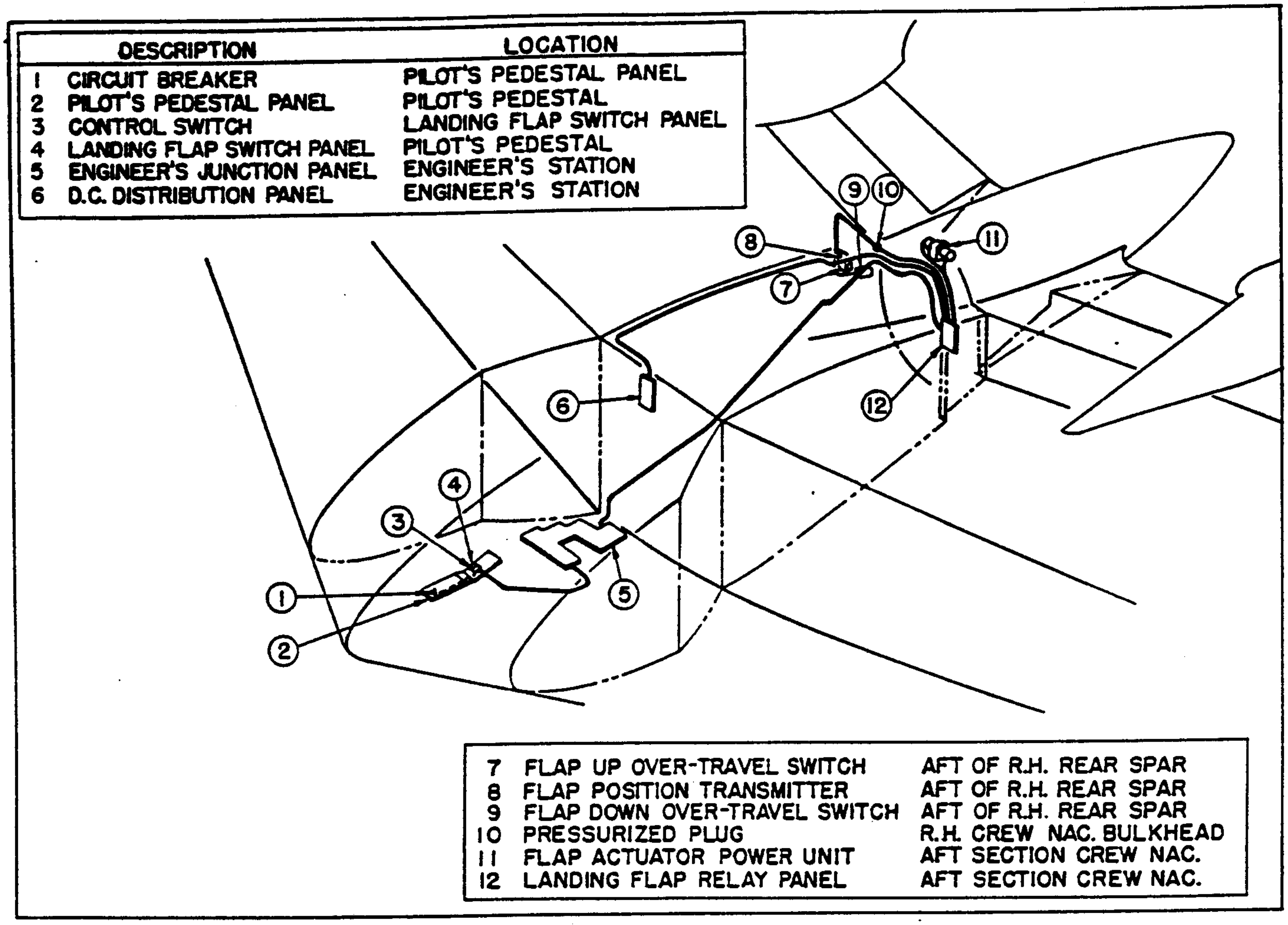
1. Remove the fabric cover from the copilot's side of the control pedestal.

2. Disconnect the push-pull rods from the horns of the torque tubes.



ITEM	DESCRIPTION	LOCATION
1.	TRIM FLAP ACTUATOR	R.H. OUTER WING
2.	TRIM FLAP POSITION TRANSMITTERS	R.H. OUTER WING
3.	A.C. SECTIONALIZING PANEL	R.H. WING STA. 870
4.	WHEEL WELL D.C. PANEL	R.H. WHEEL WELL
5.	PRESSURIZED PLUG	R.H. CREW NAC. BULKHEAD
6.	PRESSURIZED PLUG	L.H. CREW NAC. BULKHEAD
7.	ENGINEER'S JUNCTION PANEL	ENGINEER'S STATION
8.	TRIM FLAP CONTROL SWITCH	PILOT'S PEDESTAL PANEL
9.	TRIM FLAP CONTROL CIRC. BR'K'R	PILOT'S PEDESTAL PANEL
10.	AILERON POSITION INDICATOR	PILOT'S PEDESTAL PANEL
11.	TRIM FLAP INDICATOR CIRC. BR'K'R	PILOT'S PEDESTAL PANEL
12.	ELEVATOR POSITION INDICATOR	PILOT'S PEDESTAL PANEL
13.	PILOT'S PEDESTAL PANEL	PILOT'S PEDESTAL
14.	WHEEL WELL D.C. PANEL	L.H. WHEEL WELL
15.	A.C. SECTIONALIZING PANEL	L.H. WING STA. 870
16.	TRIM FLAP ACTUATOR	L.H. OUTER WING
17.	TRIM FLAP POSITION TRANSMITTERS	L.H. OUTER WING

Figure 4. Trim Flap Controls



	DESCRIPTION	LOCATION
1	CIRCUIT BREAKER	PILOT'S PEDESTAL PANEL
2	PILOT'S PEDESTAL PANEL	PILOT'S PEDESTAL
3	CONTROL SWITCH	LANDING FLAP SWITCH PANEL
4	LANDING FLAP SWITCH PANEL	PILOT'S PEDESTAL
5	ENGINEER'S JUNCTION PANEL	ENGINEER'S STATION
6	D.C. DISTRIBUTION PANEL	ENGINEER'S STATION

7	FLAP UP OVER-TRAVEL SWITCH	AFT OF R.H. REAR SPAR
8	FLAP POSITION TRANSMITTER	AFT OF R.H. REAR SPAR
9	FLAP DOWN OVER-TRAVEL SWITCH	AFT OF R.H. REAR SPAR
10	PRESSURIZED PLUG	R.H. CREW NAC. BULKHEAD
11	FLAP ACTUATOR POWER UNIT	AFT SECTION CREW NAC.
12	LANDING FLAP RELAY PANEL	AFT SECTION CREW NAC.

Figure 5. Landing Flap Controls

3. Disconnect the force bellows connecting rod at the forward side of the column.

4. Remove the clips securing the electrical wiring to the forward side of the column.

5. Pry the name plate from the control wheel hub and pull the wire cable out to clear the nut on the control wheel shaft.

6. Remove the nut and washer from the control wheel shaft, pull the wheel off and remove the spacer from the shaft. Leave the control wheel in the airplane to save disconnecting the wiring.

7. Remove the bearing cap from the inboard end of the torque tubes.

8. Remove the three bolts securing the bearing assembly at the outboard end of the torque tubes.

9. Remove the column assembly from its position on the pilot's floor.

(b) COPILOT'S CONTROL COLUMN ASSEMBLY.

1. Remove the fabric cover from the copilot's side of the control pedestal.

2. Remove the flooring around the base of the control column.

3. Secure the eight elevon cables so that when they are disconnected at the cable quadrant some tension will remain on the cables extending aft.

4. Loosen the turnbuckles, relieving the cable tension enough so that the cables may be disconnected from the torque tube quadrants. Access to the turnbuckles is gained by lowering the landing flaps. The turnbuckles, four on each side, are located outside the crew nacelle along the wing spar.

5. Disconnect the cables from the quadrants at the inboard end of the control column torque tubes.

6. Remove the cable guard from over the top of the quadrants.

7. Remove the three bolts from the bracket at the inboard end and the four bolts from the bracket at the outboard end of the torque tubes. To remove the column assembly, raise it up and move it outboard.

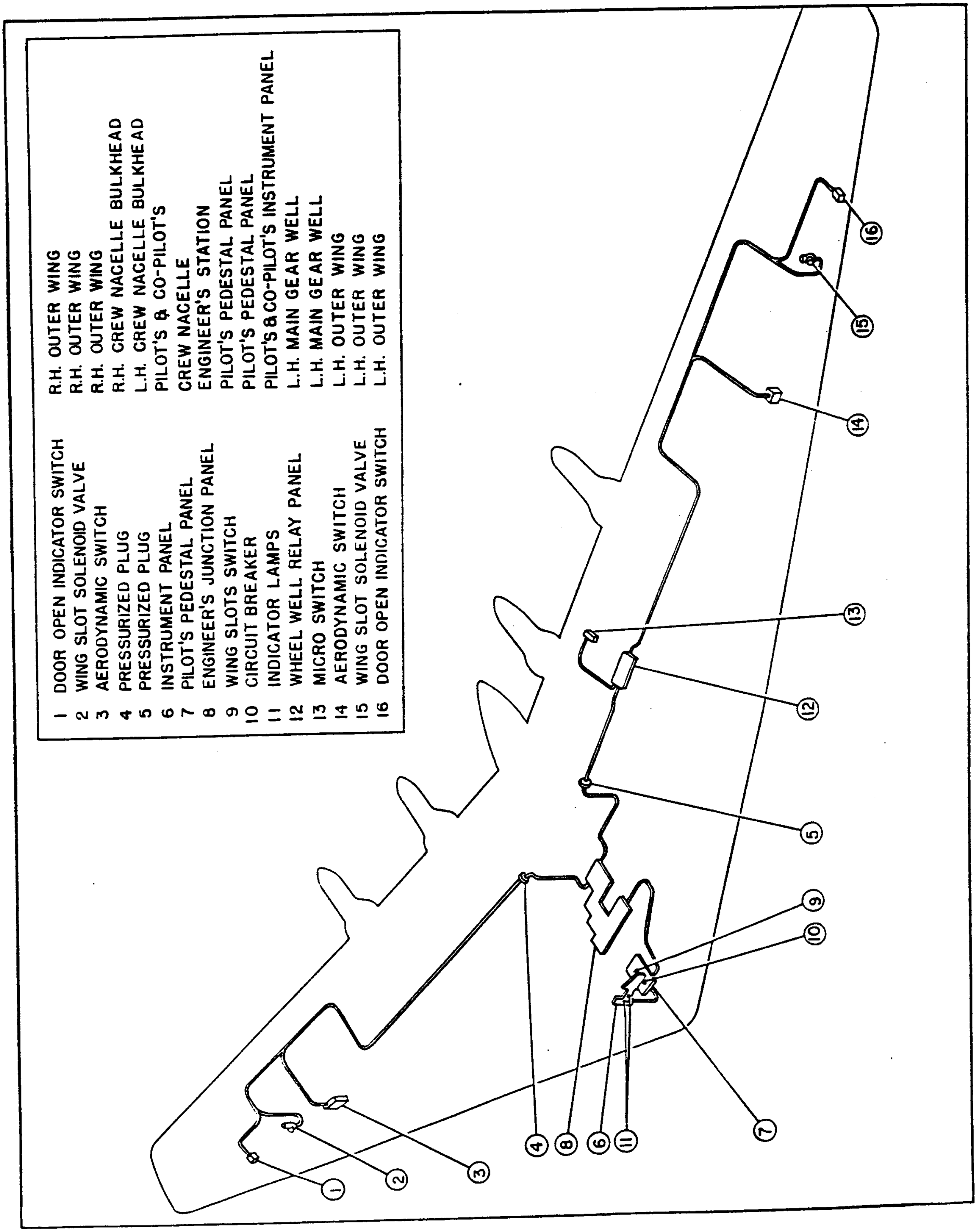


Figure 6. Wing Slot Door Control

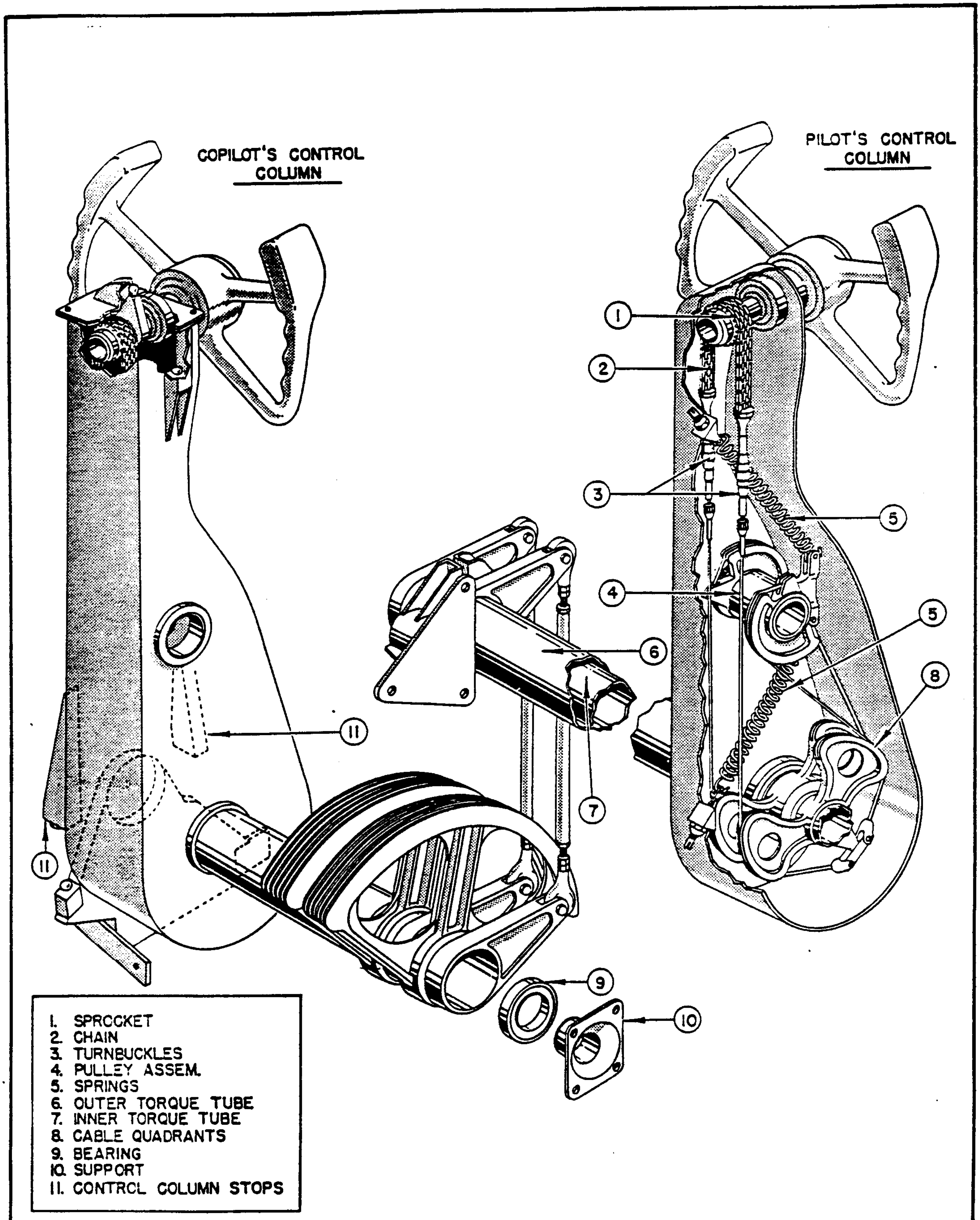


Figure 7. Control Columns

(2) DISASSEMBLY OF CONTROL COLUMNS. (See figure 7.)- The control wheel shaft, chain, cables, and pulley assembly may be disassembled from the column without removing a column assembly from the airplane.

(a) CONTROL WHEEL SHAFT AND CHAIN ASSEMBLY.

1. Remove the cover plate from the top of the column and the access cover from the aft side of the column.

2. Cut the safety wire and disconnect the turnbuckles at each end of the chain and lift the chain off the sprocket.

3. After removing the control wheel, remove the snap ring from the shaft at the forward side of the column. Then remove the snap ring that holds the bearing in the aft side of the column.

4. Pull the shaft aft, out of the column and at the same time, slide the sprocket and spacer off the shaft within the column. A stop cam is installed on the shaft in the copilot's column. Remove the cam at the same time the sprocket is removed.

(b) PULLEY ASSEMBLY.

1. Loosen the two spring adjustments at the forward side of the control column. Disconnect the springs from the pulley assembly in the column.

2. Cut the safety wire and remove the ball ends of the cables from the slots in the pulleys.

3. Remove the bolt which extends through the center of the pulley assembly, holding the retainer at each side of the column. Remove the retainers.

4. Remove the snap ring and slide the pulley shaft out of the right side of the column. Two spacers are installed on the shaft. Remove the spacers and the pulley assembly as the shaft is being removed.

(c) TORQUE TUBE AND COLUMN ASSEMBLIES. (See figure 7.)

1. Remove the nut and washer from the end of the torque tube.

2. Slide the bearing assembly and the spacer off the end of the tube.

3. Mark the position in which the quadrants are installed on the splined torque tube. Slide the inner torque tube out of the outer tube and column. As it is being removed, the quadrant, spacer, and retainer will slide off the end of the tube inside the column. Identify these parts for reinstallation.

4. Remove the snap ring from the end of the outer torque tube, within the column, and slide the tube out of the column. The quadrant and spacer will slide off the tube as it is being removed. Identify the parts.

5. Remove the snap rings from the sides of the column to remove the bearings.

(3) ASSEMBLY OF CONTROL COLUMNS. (See figure 7.)- Reinstall parts in the reverse order of their removal. Do not attempt adjustment of the columns until they have been installed in the airplane.

(4) INSTALLATION OF CONTROL COLUMNS.

(a) Install the control columns in reverse of their removal procedures. (See figure 7.)

(b) Do not connect the cables in the columns until the elevon cable system is to be adjusted. See paragraph g (1) (f) following.

g. ELEVON CONTROL SYSTEM. (NORMAL AND EMERGENCY)

(1) NORMAL CONTROL SYSTEM. (See figure 1.)

(a) DESCRIPTION.- Normally each elevon is actuated by two hydraulic cylinders which are controlled by servo valves, operated by dual cable systems. The control cables are attached to the quadrant-and-torque-tube assemblies upon which the control columns are bearing-mounted. The column and wheel mechanisms are connected to the torque tube assemblies in such a manner that fore-and-aft movement of the columns moves the quadrants together in the same direction, and movement of the control wheels produces a differential movement of the quadrants. Thus either aileron or elevator, or combined aileron and elevator control is possible.

(b) OPERATION.- Operation of the system may best be described by example: Moving the control columns aft with the wheels in neutral, displaces the servo valve spool, at each elevon cylinder, in the same direction. This opens to pressure that side of the cylinders that causes both elevons to rise. With the columns aft and the control wheels turned to the right, the servo valve spools will move in the opposite directions so that the left elevon will lower some and the right elevon will raise a little higher. In this position a combined elevator and aileron action is effected as used to make a climbing turn.

(c) CONTROL FORCE BELLOWS. (See figure 8.)

1. DESCRIPTION.- A control force bellows assembly is attached to the pilot's control column to provide artificial "feel" to the operation of the control columns. Ram air is directed into one side of the bellows and the other side is vented to atmosphere, therefore, the effect of the bellows may be felt only when the airplane is in flight. A heating element is incor-

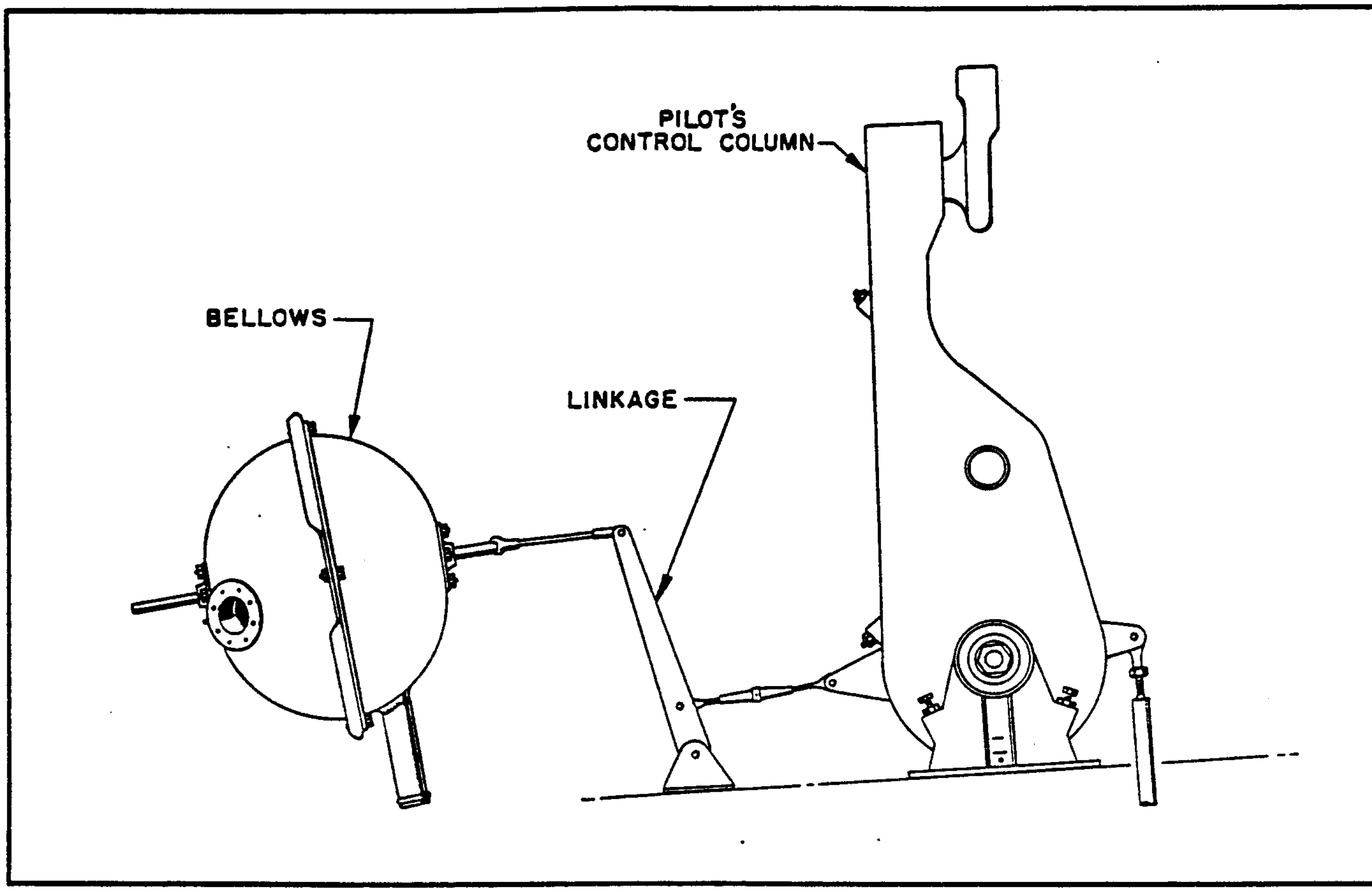


Figure 8. Control Force Bellows

porated in the bellows for anti-icing purposes.

2. HEATING ELEMENT CONTROL AND CIRCUIT. (See figure 9.)- The heater is operated by a circuit breaker type switch on the engineer's upper electrical control panel. This switch also controls the operation of the upper and lower pitot tube heaters. The heater operates on a 30 volt, grounded, a.c. circuit which is tapped from a transformer in the transformer panel which takes its current from the ring bus through a limiter.

3. REMOVAL OF THE CONTROL FORCE BELLOWS.

a. Disconnect the bellows shaft from the rod forward of the lever assembly.

b. Loosen the clamps and disconnect the hose from the ram air duct at the lower side of the bellows.

c. Remove the eight bolts from the flange of the bellows and the support bracket.

4. DISASSEMBLY AND ASSEMBLY OF THE CONTROL FORCE BELLOWS.- The control bellows housing is constructed in two half sections, bolted together about its perimeter. Bearing assemblies are bolted in each end to

ITEM	DESCRIPTION	LOCATION
1	UPPER PITOT TUBE	C.N. NOSE SEC.
2	LOWER PITOT TUBE	C.N. NOSE SEC.
3	ENG. UPPER SWITCH PANEL	C.N. NOSE SEC.
4	SW. TYPE CIRCUIT BR'K'R	ENG. UPPER SW. P'NL
5	TRANSFORMER PANEL	C.N. NOSE SEC.
6	ENG. JUNCTION PANEL	BENEATH ENGR'S FL.
7	CONTROL BELLOWS H'T'R	C.N. NOSE SEC.

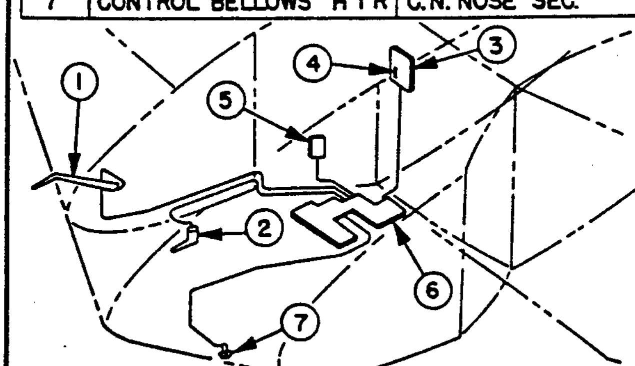


Figure 9. Control Force Bellows Heating Circuit

accomodate movements of the bellows shaft. The diaphragm is fastened to the shaft with bolts and the outer edge of the diaphragm is attached to a flange within the housing with screws. When a diaphragm is installed, it must be positioned on the shaft so that there will be a measurement of 9.88 inches between the aft end of the securing bolts and the center of the clevis end of the shaft.

5. INSTALLATION OF THE CONTROL FORCE BELLOWS.- Reverse the removal procedure.

6. ADJUSTING THE CONTROL FORCE BELLOWS LINKAGE.- See adjustment of the elevon control system, paragraph (f), following.

(d) SERVO VALVE OPERATING MECHANISMS. (See figures 10 and 11.)- Two servo valve operating mechanisms are mounted on the forward side of the rear wing spar in each wing, in line with the two hinge points of each elevon. A rod assembly connects each mechanism to its respective servo valve.

1. REMOVAL OF SERVO VALVE OPERATING MECHANISMS.- Access to the inboard mechanism may be gained by opening the ammunition access door in the lower wing surface and opening the zipper on the canvas cover. The outboard mechanism may be reached by removing the rectangular cover in the lower wing surface just forward of the rear wing spar and near the outboard end of the elevon.

a. Relieve the tension on the cables attached to the mechanism to be removed.

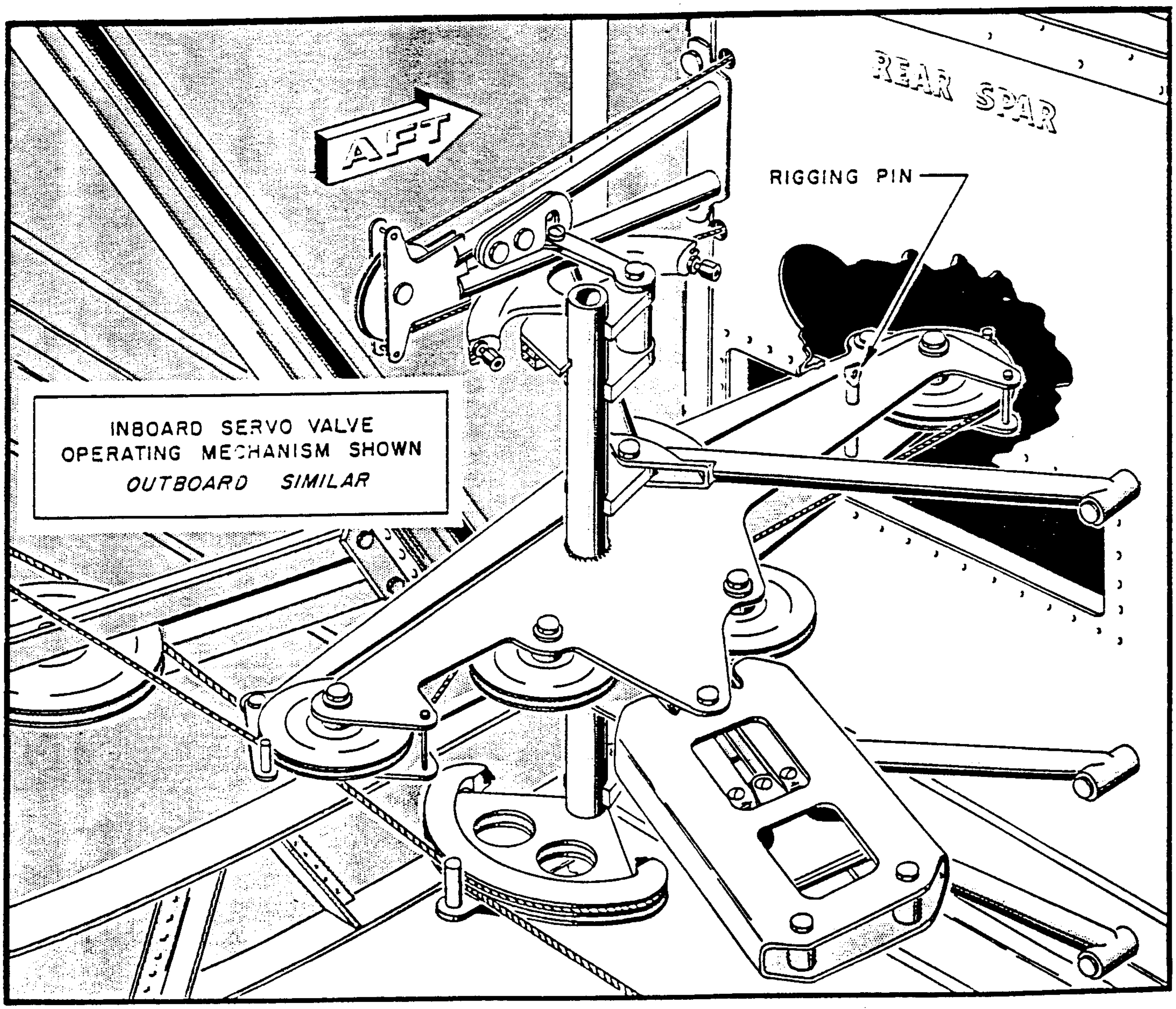


Figure 10. Rigging Pin Installed

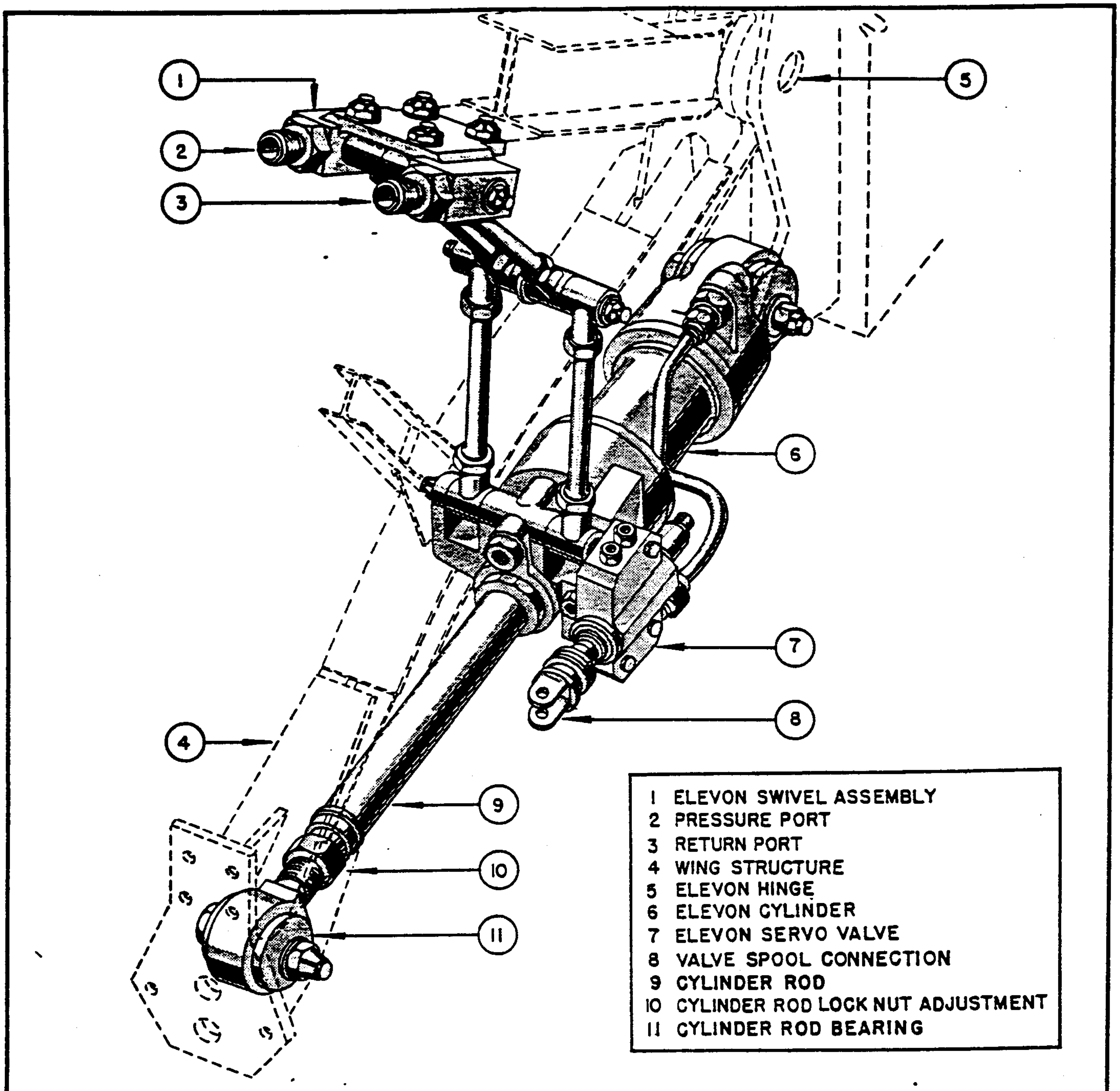


Figure 11. Elevon Actuating Cylinder and Servo Valve

b. Disconnect the cables from the mechanism.

c. Disconnect the servo valve operating rod from the lever beneath the lower quadrant on the mechanism.

d. Remove the bolts securing the mechanism brackets to the rear wing spar.

2. INSTALLATION OF THE SERVO VALVE OPERATING MECHANISMS.- Reverse the removal instructions. See paragraphs g (1) (f) and g (2) (d) for adjustment of the normal and emergency control systems.

(e) HYDRAULIC ACTUATING CYLINDER AND SERVO VALVE ASSEMBLIES. (See figure 11.)- Two actuating cylinder and servo valve assemblies are provided for the operation of each elevon. They are located in the leading edge of the elevons at the hinge points. Access covers are provided in the lower surface of the elevons.

1. REMOVAL AND INSTALLATION OF ACTUATING CYLINDER AND SERVO VALVE ASSEMBLIES.- Installation of these assemblies is made in reverse of the removal procedure.

a. Remove the access cover from the lower side of the elevon.

b. Disconnect the servo valve operating rod from the cylinder and valve assembly.

c. Disconnect the hydraulic pressure lines to the servo valve.

d. Disconnect the actuating cylinder from the rear wing spar and elevon. Remove the cylinder.

2. DISASSEMBLY AND ASSEMBLY OF ACTUATING CYLINDER AND SERVO VALVE ASSEMBLIES.- Refer to Section IV, paragraph 16, hydraulics.

(f) ADJUSTMENT OF THE NORMAL ELEVON CONTROL SYSTEM.- Use a bubble protractor to check degree settings. See paragraph 5 following, for determining the horizontal reference line of the airplane. The following operational sequence is intended for adjustment of the complete elevon control system:

1. SERVO VALVE OPERATING MECHANISM.

a. Disconnect the servo valve actuating rod from each of the four mechanisms.

b. Check each actuating rod for 56 ± 6 pounds preload. If necessary, adjust by loosening or tightening the cap at the end of the rod.

c. Install a 1/4-inch bolt or pin through the rigging hole in the bellcranks at each servo valve operating mechanism. (See figure 10.)

2. COPILOT'S CONTROL COLUMN. (See figure 12.)- Use a bubble protractor to determine settings of the column and torque tube quadrants in reference to the horizontal reference line of the airplane. A leveling plate is located in the forward inboard corner of number four bomb bay. By suspending a plumb bob from the fitting over the plate, the airplane's position may be determined.

a. Disconnect the control wheel cables.

b. Clamp the torque tube bellcranks so that they are parallel and 11½ ± 2° above a centerline parallel to the horizontal reference line.

c. Check the torque tube quadrant in the column. The inner torque tube quadrant centerline should be 53° above a line parallel to the horizontal reference line and the outer torque tube quadrant centerline should be 23° above a line parallel to the horizontal reference line.

d. Set the control column in neutral by inserting a pin through the rigging hole in the outboard torque tube support.

e. Adjust the springs attached to the pulley at the center of the column so that the rigging holes in the pulley and column are aligned. Insert a pin through the holes.

f. Connect the control column wheel cables. Clamp the wheel in neutral and adjust the turnbuckles to remove the slack in the cables.

g. Remove the clamps from the torque tubes.

h. Apply 96 ± 1 inch-pounds torque to the control wheel in either direction. Then tighten the wheel cable until the wheel returns to neutral. Remove the torque from the wheel and tighten the other cable to return the wheel to neutral again.

i. Move the control column and wheel to the neutral position. Check the torque tube bellcranks; they should be 11½° above a line parallel to the horizontal reference line.

3. PILOT'S CONTROL COLUMN. (See figure 12.)

a. Disconnect the bellows from the column at the turnbuckle link.

b. Place the control column in neutral and install a rigging pin at the inboard end of the torque tubes.

c. Move the control force bellows shaft .125 aft of its maximum forward position and clamp the actuating lever to the structure.

d. Adjust the bellows turnbuckle and connect it to the control column.

e. Adjust the pilot's control column in the same manner as the copilot's. See paragraph 2 a thru i.

f. Secure both control columns in neutral.

g. Adjust the torque tube interconnect rods so that they fit between the pilot's and copilot's torque tube bellcranks. Connect the rods.

4. ENTIRE CABLE SYSTEM.

a. Take up the slack and uniformly load the cable system until all tension regulators index to their "mean" position. (See figure 1, view "A.") Adjust the tension in the elevon up and elevon down cable system until the regulator wrist plates are evenly loaded, and not causing any braking action.

b. Adjust the interconnecting cables that extend between the two servo valve operating mechanisms to 75 ± 10 pounds tension. Adjust the tensions evenly so that the rigging pins are free in each bellcrank.

c. Adjust all fairleads to clear the cables.

d. Adjust the crew nacelle pressure seal clips so they will not deflect the cables.

e. Remove the rigging pins at the control column and at the servo valve operating

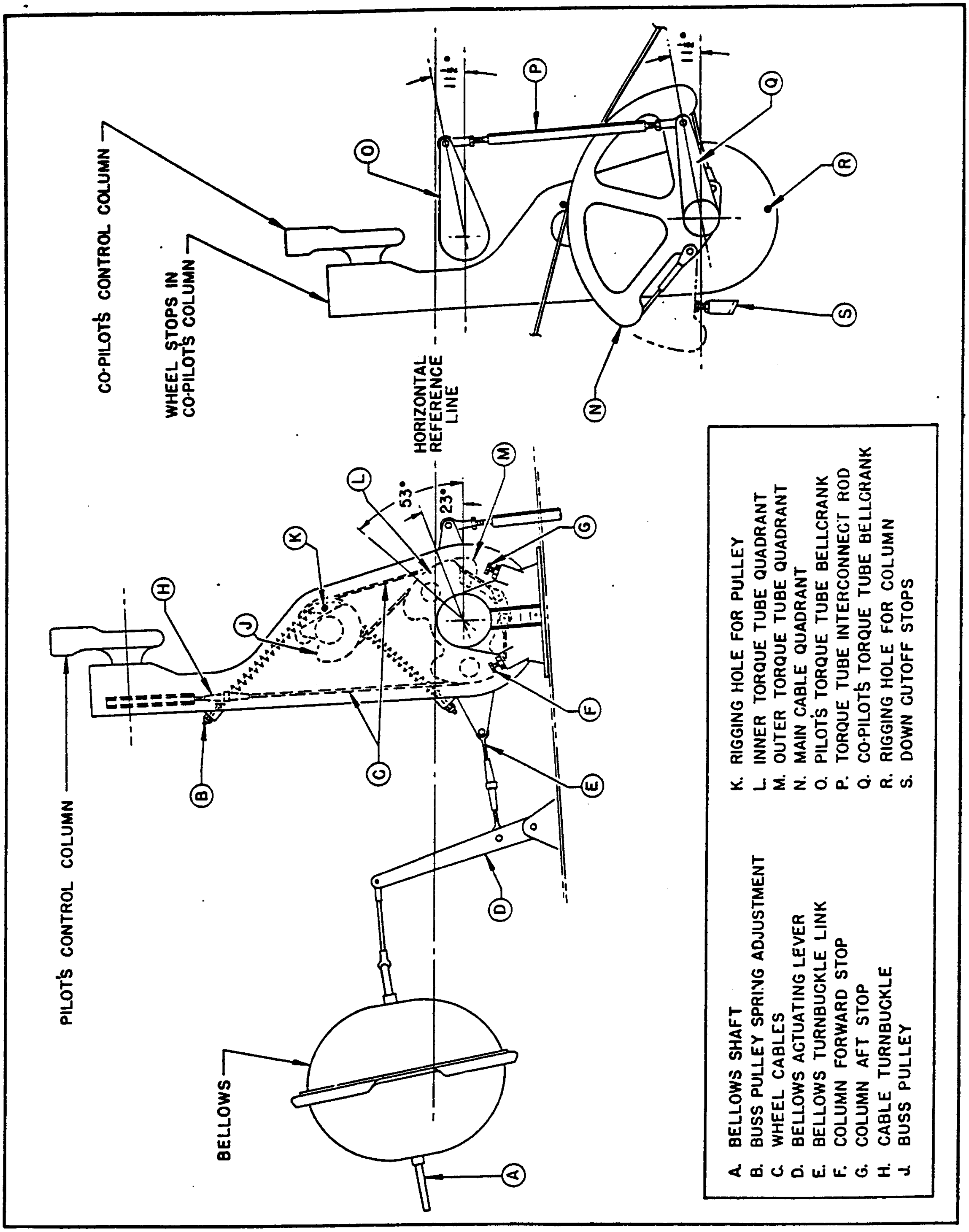


Figure 12. Control Column Adjustment

mechanism bellcranks. The system should remain in neutral, being adjusted so that all rigging pins can be easily removed.

f. Move the control wheel and column to check the cable system for freedom of movement. Return the system to neutral and reinstall the rigging pins.

5. ACTUATING CYLINDERS AND ELEVONS.

a. To set the elevon positions, use a bubble protractor. If the airplane is level adjust the protractor to 9° and place it on the elevon at elevon station 125.589. Check the level of the airplane by suspending a plumb bob over the leveling plate in number 4 bomb bay. If this indicates forward slant, subtract the number of degrees from the 9° and if it indicates a rearward slant, add the number of degrees to the 9°. For example; a one degree rearward slant is indicated. The protractor would then be set to 10° and placed on elevon station 125.589. Moving the elevon to center the protractor bubble, places the elevon in the approximate neutral position. From this point the protractor can be set to indicate the proper up and down limits of elevon movement.

b. Set both elevons in a maximum down position of 25 ± 1°. The maximum down position is determined by the point of interference with the wing structure. Raise the elevons 1/2°, plus 1/2°, minus 0°. Adjust the piston rods so that the pistons are bottomed in the cylinders at this elevon position.

c. Move the elevons to their maximum up position of 35 ± 1°. Lower the elevons 1/2°, plus 1/2°, minus 0°. Adjust the actuating cylinders and their caps until the pistons are bottomed.

d. Check all cylinders to see that the stroke does not exceed the dimension stamped on the cylinder name plates.

e. Clamp the elevons in the neutral position.

f. Connect the servo valve operating rods between the bellcranks and actuating cylinders. Adjust the rod so that the servo valve spool head gap is .125 ± .005.

CAUTION

Be sure that all valve spools are free to move in either direction before turning on hydraulic power.

g. Remove the clamps from the elevons.

h. Connect a hydraulic test stand into the airplane hydraulic system. Refer to Section IV, paragraph 16.

i. Turn on the hydraulic power and check the servo valve adjustments. Adjust the head gap clearance on the spools as necessary to bring elevon distortion or displacement within ± .25 inches of the true faired position at the extreme ends of the trailing edge.

j. Remove the bellcrank and control column rigging pins.

6. CONTROL COLUMNS AND ELEVONS.- The following adjustments are made with hydraulic power on.

a. Keep the control column in neutral. Adjust the control wheel stops in the copilot's column to limit elevon travel to 15 ± 1° either side of neutral.

b. Keep the control wheel in neutral. Adjust the forward control column stop (reference f, figure 12) to limit the elevon down travel to 15 ± 1°.

c. Turn the control wheel full right position and move the control column forward until the left elevon is 1/2°, plus 1/2°, minus 0°, above the piston bottomed position (25 ± 1°). See paragraph 5 b, preceding. Adjust the main cable cutoff stop at the copilot's column to limit the travel to this position.

d. Turn the control wheel to the full left position and move the control column forward until the right elevon is 1/2°, plus 1/2°, minus 0°, above the piston bottomed position (25 ± 1°). See paragraph 5 b preceding. Adjust the main cable quadrant cutoff stop at the copilot's column to limit the travel to this position.

e. Turn the control wheel to the full left position. Move the control column aft until the left elevon is 1/2°, plus 1/2°, minus 0°, below the piston bottomed position (35° ± 1°). See paragraph 5 c preceding. Adjust the column aft stop to limit travel to this position.

f. Turn the control wheel to the full right position. Move the control columns aft and check the right elevon. The elevon should be at least 1/2° below the piston bottomed position. See paragraph 5 c preceding. If clearance is less than 1/2°, adjust the copilot's wheel stop to provide a clearance of 1/2°, plus 1/2°, minus 0°.

g. With the control wheel neutral, move the column aft and check the maximum elevon up position. Both elevons should be up 20° ± 1°.

7. CABLE SEALS.- After the control system has been rigged, fill the cable seal housings with hydraulic fluid, Specification AN-VV-0-336a. Each housing is provided with a cork which must be replaced after the housing is filled.

(2) EMERGENCY CONTROL SYSTEM.

(a) DESCRIPTION.- The emergency elevon control system consists of two electrically-operated drive assemblies, follow-up mechanisms and related electrical equipment. (See figures 13 and 14.) A motor and gear box assembly, comprising the emergency drive, is situated on the aft side of the rear wing spar adjacent to the inboard actuator of each elevon. Dual cables connect the drive assemblies to elevon quadrants. The follow-up mechanisms, each consisting of a cable quadrant and switch assembly, are mounted on the top of each inboard hydraulic servo valve operating mechanism. The quadrants are operated by cables attached to the drive assemblies, and the switch assemblies are moved by normal operation of the elevon controls. Two switches are provided for engaging the emergency system, one on the pilot's control wheel that is used for momentary check of the system, and one on the pedestal that is used when permanent engagement is desired.

(b) OPERATION.- Operation of the system is as follows: When either "ELEVON EMERGENCY CONTROL" switch is closed, solenoid valves are energized causing the hydraulic cylinders at the elevons to become inoperative, and solenoid clutches engage the motors with the gear boxes in the drive assemblies. The normal flight control system then controls the emergency system by actuating the follow-up switches, which in turn control the direction of rotation of the reversible drive motors, and thereby the up or down movement of the elevons. Assuming that the follow-up switches are open, the motor brakes would be on, holding the elevons in position. Movement of the elevon controls will close the corresponding up or down follow-up switches, release the motor brakes, and start the motors driving the elevons. The follow-up switches are actuated by contact with cams on the follow-up quadrants. While the elevon controls are being moved, either the up or down follow-up switches will be actuated, following the movement of the follow-up quadrants, thus keeping the electrical circuit closed. When movement of the elevon controls is stopped, the elevons will continue to move only enough that the follow-up quadrants will lose contact with the follow-up switches. As soon as the follow-up switches are opened, the motor brakes are set, holding the elevons in position until further movement of the elevon controls is made. Should a predetermined maximum torque of 1200 ft. lbs. elevon hinge moment be reached before the elevons arrive at their indicated positions, a torque limit switch will be opened with the same results as are caused by opening the follow-up switches. If an electrical failure occurs, a relay will switch the control circuit over so that the system will operate for a limited time, from the airplane's battery.

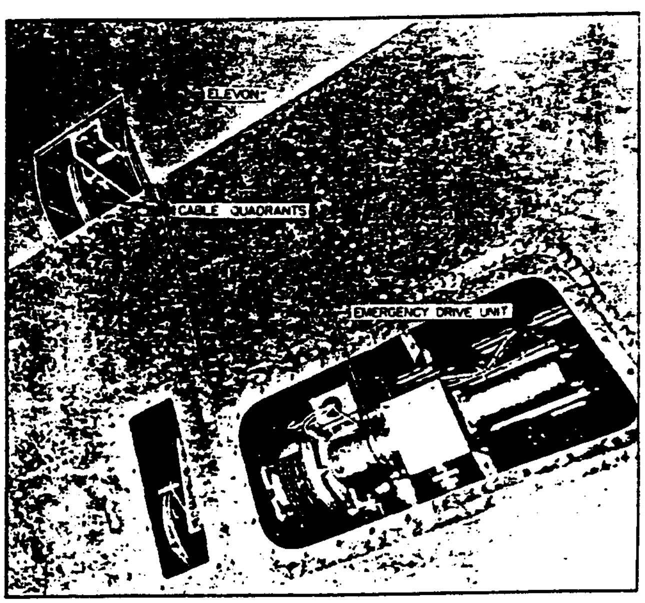


Figure 13. Elevon Emergency Drive Installed

(c) EMERGENCY DRIVE MECHANISMS.

1. REMOVAL AND INSTALLATION. (See figure 15.)- The emergency drive mechanism is supported by a bracket that is bolted to the rear wing spar. Four bolts secure the mechanism to the splined shaft of the pulley assembly.

(d) ADJUSTMENT OF THE EMERGENCY ELEVON CONTROL SYSTEM.- The normal control system must be correctly rigged before adjustment of the emergency system. Adjustment of both elevon emergency controls is the same and once adjusted both elevons are synchronized by the cable control system.

1. Install a rigging pin through the bracket and the drive pulleys.

2. Disconnect the hydraulic actuating cylinders from the elevon. See that the emergency drive cables are disconnected or are loosened.

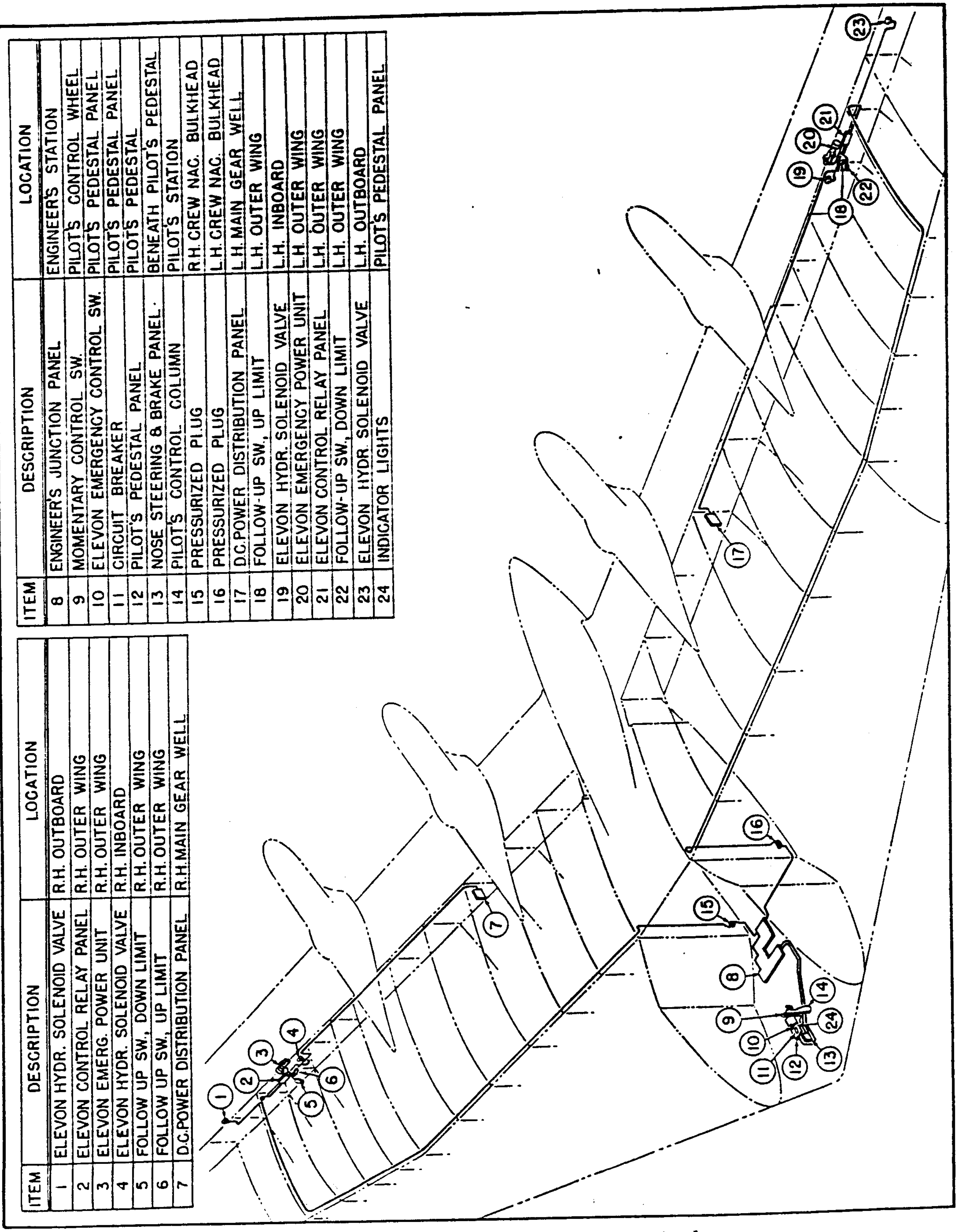
3. Adjust the length of one upper cable to raise the trailing edge of the elevon 1.60 inches, plus or minus .10 inches, above the faired position. Obtain this measurement at the actuator station. Allow the weight of the elevon to be supported by this cable.

4. Tighten the other upper cable assembly until the load is equal between the two cables. The weight of the elevon supported by these two cables will produce a load of approximately 50 pounds by a tensiometer reading. The elevon should now be approximately 1.85 $\pm$ .10 inches above the faired position.

5. Adjust one of the lower cable assemblies. Tighten the turnbuckle shaft until a load of approximately 875 pounds is placed on this cable.

6. Tighten the second lower cable assembly and readjust the first cable until a load of 600 pounds, plus or minus 15 pounds, is placed on each lower cable. This should return the elevon to within .25-inch of the faired position by dividing the free play of the rigging pins.

7. The load on the upper cables should now be checked at approximately 875



ITEM	DESCRIPTION	LOCATION
1	ELEVON HYDR. SOLENOID VALVE	R.H. OUTBOARD
2	ELEVON CONTROL RELAY PANEL	R.H. OUTER WING
3	ELEVON EMERG. POWER UNIT	R.H. OUTER WING
4	ELEVON HYDR. SOLENOID VALVE	R.H. INBOARD
5	FOLLOW UP SW., DOWN LIMIT	R.H. OUTER WING
6	FOLLOW UP SW., UP LIMIT	R.H. OUTER WING
7	D.C.POWER DISTRIBUTION PANEL	R.H.MAIN GEAR WELL

ITEM	DESCRIPTION	LOCATION
8	ENGINEER'S JUNCTION PANEL	ENGINEER'S STATION
9	MOMENTARY CONTROL SW.	PILOT'S CONTROL WHEEL
10	ELEVON EMERGENCY CONTROL SW.	PILOT'S PEDESTAL PANEL
11	CIRCUIT BREAKER	PILOT'S PEDESTAL PANEL
12	PILOT'S PEDESTAL PANEL	PILOT'S PEDESTAL
13	NOSE STEERING & BRAKE PANEL	BENEATH PILOT'S PEDESTAL
14	PILOT'S CONTROL COLUMN	PILOT'S STATION
15	PRESSURIZED PLUG	R.H. CREW NAC. BULKHEAD
16	PRESSURIZED PLUG	L.H. CREW NAC. BULKHEAD
17	D.C.POWER DISTRIBUTION PANEL	L.H. MAIN GEAR WELL
18	FOLLOW-UP SW., UP LIMIT	L.H. OUTER WING
19	ELEVON HYDR. SOLENOID VALVE	L.H. INBOARD
20	ELEVON EMERGENCY POWER UNIT	L.H. OUTER WING
21	ELEVON CONTROL RELAY PANEL	L.H. OUTER WING
22	FOLLOW-UP SW., DOWN LIMIT	L.H. OUTER WING
23	ELEVON HYDR. SOLENOID VALVE	L.H. OUTBOARD
24	INDICATOR LIGHTS	PILOT'S PEDESTAL PANEL

Figure 14. Elevon Emergency Drive Control

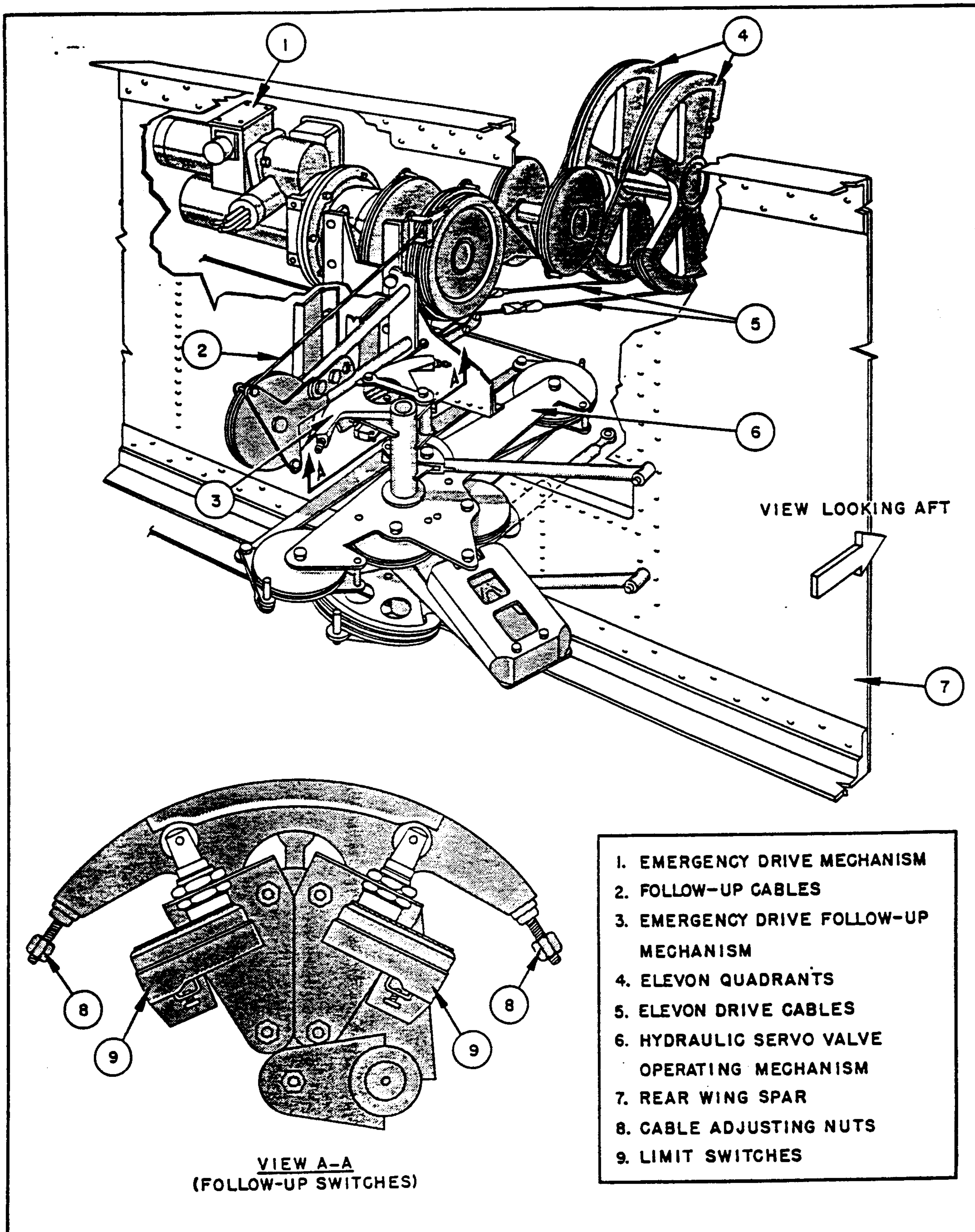


Figure 15. Elevon Emergency Drive Mechanism

pounds and should have no more than 100 pounds difference.

8. Remove the rigging pins and swing the elevons through full travel six or eight times. Check the rigging loads and adjust if necessary.

9. Connect the hydraulic actuators. Apply hydraulic power to the system using a hydraulic test stand.

10. Move the controls to the position that will allow rigging pins to be installed in the servo valve operating bellcrank. (See figure 10.) Cut off the hydraulic power.

11. Adjust the follow-up cable assembly to a tension of 35 pounds, plus or minus 5 pounds. Check the rigging pin in the bellcrank. It should be free.

12. Adjust the limit switch position (see figure 15) so that .09-inch, plus or minus .02-inch, tangential motion at the cam actuator maximum radius is required from the rigged position to make electrical contact at either the UP or DOWN limit switch.

13. Remove all rigging pins. Connect an external power source to the airplane. Engage the emergency control switch and check the operation of the system.

14. Cut the external power, and check to see that the system switches over and operates on the airplane battery.

h. RUDDER PEDALS AND TORQUE TUBES. (See figure 16.)

(1) DESCRIPTION.- The pilot and copilot are furnished with toe pedals, hinged to heel rests which are bolted to the floor. Each pedal is connected to a torque tube assembly, located just forward of the pedals. Each of the two torque tube assemblies consists of an inner and outer tube which turn on each other through ball-bearings. The torque tubes are secured to the airplane structure with bearing and bracket assemblies. A cable quadrant is fastened to the inboard end of each of the pilot's torque tubes, and the copilot's torque tubes are connected to the quadrant with push-pull rods. Brake valve linkage is connected to the pilot's torque tube assembly.

(2) REMOVAL.- Rudder pedals may be removed by disconnecting the push-pull rods from the pedals and removing the hinge bolts at the base of the pedals. Torque tube assemblies are removed as follows:

(a) PILOT'S RUDDER TORQUE TUBE ASSEMBLY.

1. Remove the cable shields from the side of the control pedestal.

2. Locate the rudder cables in the center section of the crew nacelle, two on each side of the nacelle. Secure the cables to some part of the structure and then loosen the turnbuckles, next to the flight engineer's station and the radio operator's station.

3. Remove the cable guard over the quadrants.

4. Disconnect the cables from the cable quadrants on the pilot's torque tube assembly.

5. Remove the bracket assembly at each end of the torque tube.

6. Disconnect the brake valve linkage and the push-pull rods from the pedals.

7. Lift the torque tube assembly up, turn to clear the quadrants and remove from the airplane.

(b) COPILOT'S RUDDER TORQUE TUBE ASSEMBLY.- The copilot's torque tube assembly may be removed without disturbing the cable system.

1. Disconnect the pedal and quadrant push-pull rods from the torque tubes.

2. Remove the bolt from each rudder pedal stop arm at the inboard end of the torque tube assembly. Slide the arms off the ends of the torque tubes.

3. Remove the bearing assembly from the structure at the outboard end.

4. Move the torque tube to the right to clear the inboard end and then lift the tube assembly up and remove it from the airplane.

(3) INSTALLATION OF RUDDER PEDALS AND TORQUE TUBES.- Clean all parts before installing. Installation of these assemblies is accomplished by reversing the removal procedure.

i. RUDDER CONTROL SYSTEM. (See figure 2.)

(1) DESCRIPTION.- Each rudder is actuated by two hydraulic cylinders, controlled by servo valves that are operated by the cable control system. A cable tension regulator is installed at each outboard servo valve operating bellcrank which compensates for temperature changes and structural deflections. One end of a preload spring cylinder is connected to each of the copilot's rudder pedal torque tubes and the other ends are connected to the rudder trim mechanism. These spring assemblies return the rudder pedals to the neutral position. They are also used to change the position of the rudder pedals for rudder trim and insert "feel" to the control system.

(2) OPERATION.- Movement of a rudder pedal changes the position of the servo valve operating bellcranks for the respective rudder. When the bellcranks are moved, they open the servo valves, allowing hydraulic pressure to flow to the actuating cylinders.

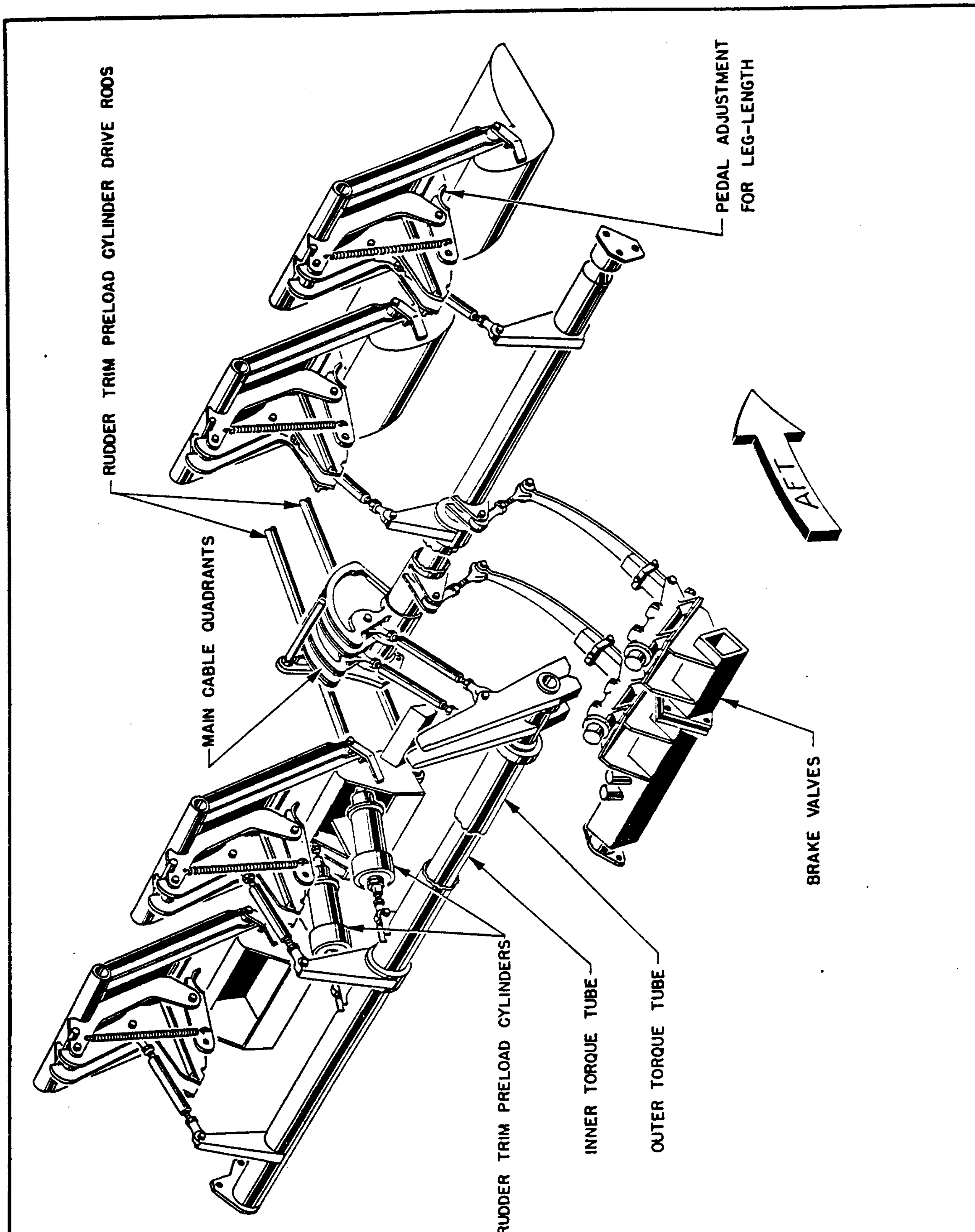


Figure 16. Rudder Pedals and Torque Tubes

As the rudder surfaces move, the valve control arm (see figure 17) moves to close the servo valve when the rudder has opened or closed an amount corresponding to the movement of the control system.

(3) ADJUSTMENT OF THE RUDDER CONTROL SYSTEM.- The rigging load in this system is controlled by the tension regulators and is approximately 45 pounds. To determine the relationship of control and surface settings to the horizontal reference line of the airplane refer to paragraph g (1) (f) 5 in this section. The following operational sequence is intended for adjustment of the complete rudder system:

(a) RUDDER SURFACES.

1. Clamp the rudder surfaces in the closed position.

2. Remove the slack and apply a preload of 20-inch pounds torque to all interconnecting cables. (See figure 18.)

3. Remove the surface clamps and check rudder surfaces for proper trail.

4. Tighten the lower interconnecting cable adjusting nuts to 40 inch pounds torque.

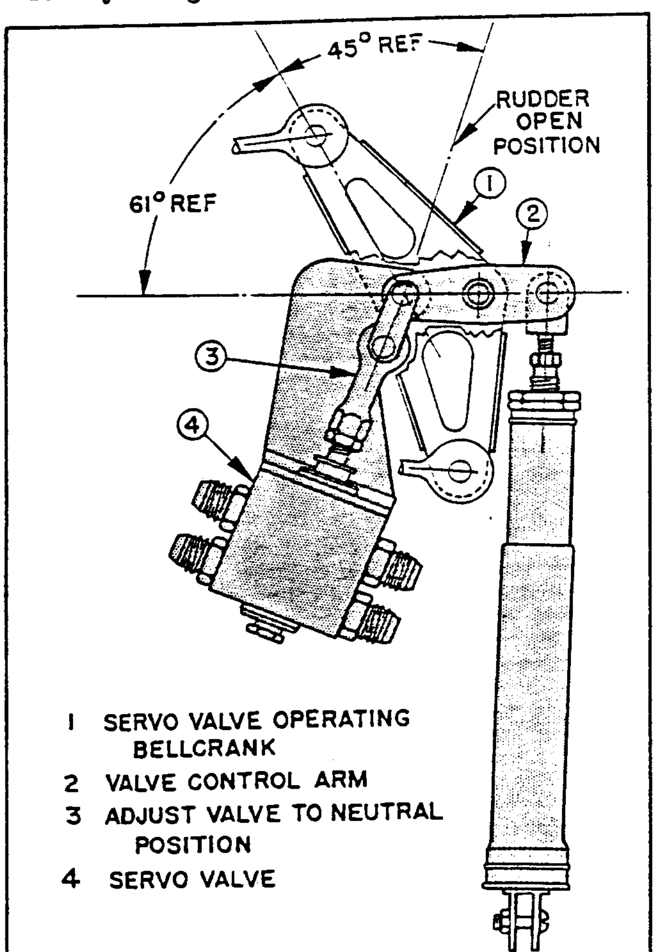


Figure 17. Rudder Servo Valve Operating Mechanism

5. Tighten the upper cable adjusting nuts to 60-inch pounds torque.

6. Readjust as necessary to bring surfaces into proper trail while maintaining 60-inch pounds of torque on all adjusting nuts.

(b) RUDDER PEDALS.

1. Adjust the rudder closed stops on the pulley bracket until the copilot's rudder torque tube preloader lugs (reference 6, figure 19) are 40 degrees, plus or minus 1 degree above the horizontal reference line. Clamp the torque tubes to the stops in this position.

2. With the copilot's pedals in neutral adjustment, adjust the pedal rod ends until the copilot's pedals are 72 degrees, plus or minus 1 degree, above the horizontal reference line.

3. Adjust the interconnect rods (see reference 5, figure 19) until the pedal lugs on the pilot's torque tubes are 78 degrees, plus or minus 1 degree, above the horizontal reference line.

4. With the pilot's pedals in neutral adjustment, adjust the pedal rods until the pilot's pedals are 62 degrees, plus or minus 1 degree, above the horizontal reference line.

(c) RUDDER TRIM MECHANISM. (See figure 19.)

1. Disconnect the preload cylinders from their respective bellcranks.

2. Adjust the preload adjustment nuts (see item 11, figure 19) to obtain a gap of .125-inch. Tolerance is plus .020, minus .000-inch.

3. Back off the preload check nuts to allow the shafts to bottom in the cylinders, then tighten the nuts until they are just flush with the preload adjustment nut.

4. Set the trim control knob to zero.

5. Adjust the preload drive rods until the bellcrank centers are 40 degrees, plus or minus 1 degree, above the horizontal reference line.

6. Adjust the rod ends of the preload cylinder shafts as necessary to connect them to the bellcranks on the torque tubes, so that the check nuts on the preloaders have moved from flush to .040 ± .010-inch gap.

7. Tighten the check nuts.

(d) CABLE SYSTEM.

1. Adjust the interconnecting cables between the servo valve operating bellcranks to a tension of 75-inch pounds at 70°F.

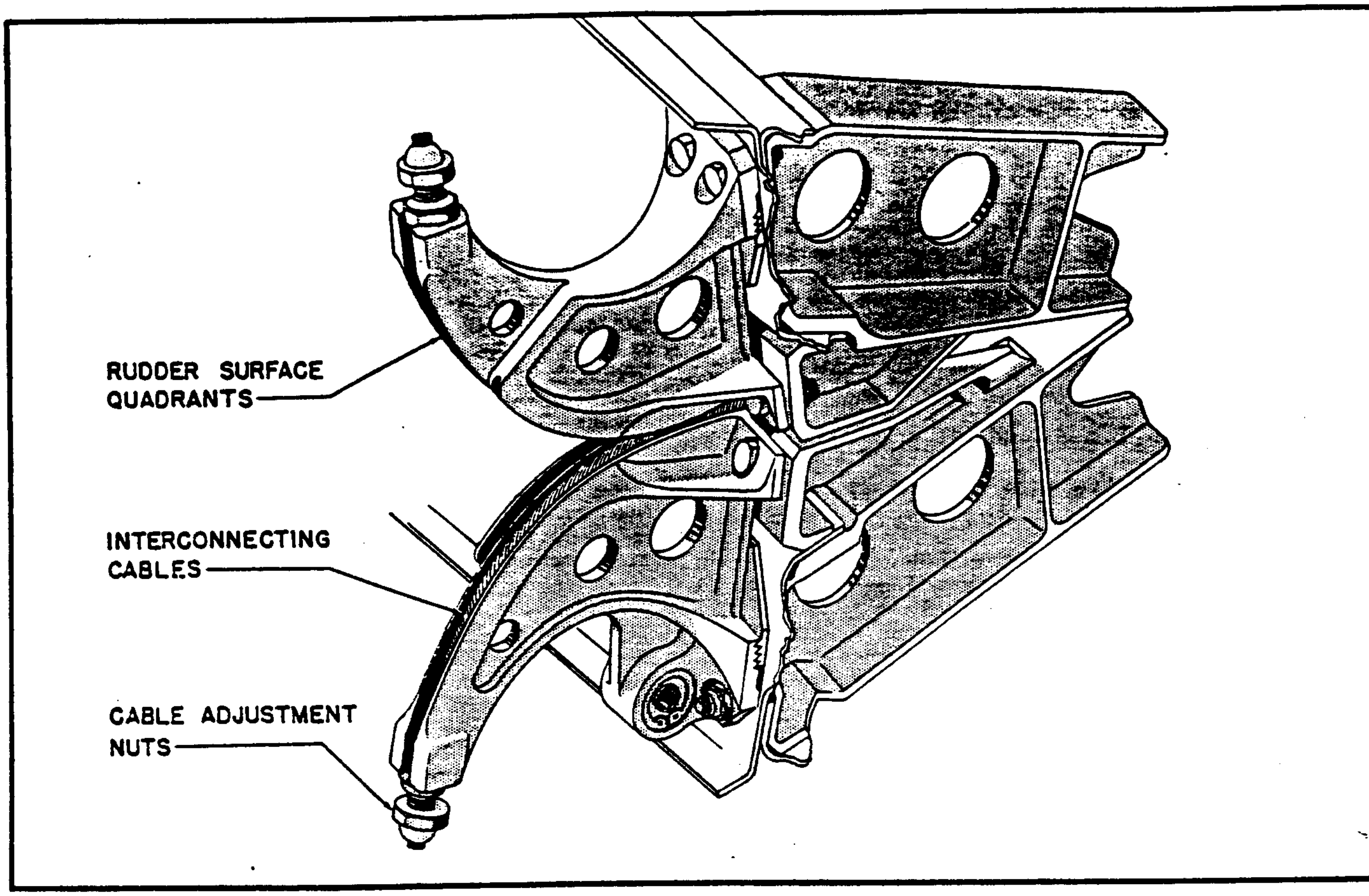


Figure 18. Rudder Surface Interconnecting Cable

2. Move the servo valve operating bellcranks to the "rudder closed" position and install a rigging pin through each bellcrank and support. (See figure 20.)

3. Adjust the cable system until the tension regulators index to their "mean" position, the center mark on the regulators. Further adjust the "open" and "close" cable system until the regulator wrist plates are evenly loaded and are not causing any braking action.

4. Remove the rigging pins at the bellcranks and the rudder "closed" stops at the copilot's rudder pedals.

5. Move the rudder pedals and check the system for freedom of movement, lack of correspondence, interference, or any other malfunctions.

6. Replace the rigging pins in the bellcranks and with the stop arms flush with the "closed" stops, clamp the torque tubes to the stops.

(e) RUDDER ACTUATING CYLINDERS AND BELLCRANK MECHANISMS.

1. Remove the rod assembly by disconnecting it from the rudder horn and from the arm at each of the inboard and outboard mechanisms. (See figure 20.)

2. Remove the bolt connecting the arm to the link. (See figure 20, view A-A.)

3. Install a special rigging pin through the arm, link, and into the head of the bolt holding the bellcrank to the support. The pin may be made out of an oversize bolt, turned to size. (See figure 20, view A-A.)

4. Space the aft heads of the servo valve spools .05-inch from the housing by adjusting the rods at the forward side of the valves.

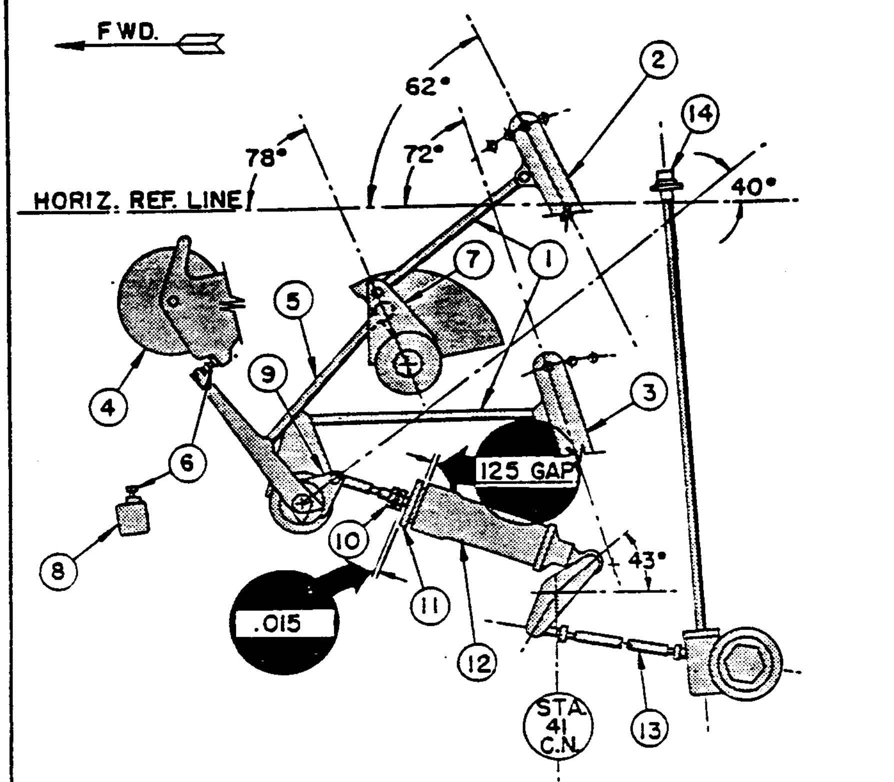
5. Remove the locking rings from the piston shaft of each rudder actuating cylinder, and adjust the piston rods to bottom the pistons with the rudders closed. The rudders must be closed so that the trailing edges are touching.

6. Adjust as necessary and connect the rod assemblies to the rudder horn fittings. (See reference 3, figure 20.)

7. Remove the rigging pins from the bellcrank and the special rigging pins from the arm and link assemblies.

8. Replace the bolt through the arm and link at each bellcrank.

9. Check to see that all servo valve spools are free to move.



1. PEDAL RODS
2. PILOT'S PEDAL IN NEUTRAL ADJUSTMENT
3. CO-PILOT'S PEDAL IN NEUTRAL ADJUSTMENT
4. PULLEY BRACKET
5. INTERCONNECT ROD
6. STOPS
7. PEDAL LUG
8. BRAKE SUPPORT
9. PRELOAD LUG
10. PRELOAD CHECK NUTS
11. PRELOAD ADJUSTMENT NUT
12. PRELOAD SPRING CYLINDER
13. PRELOAD DRIVE ROD
14. TRIM KNOB

Figure 19. Rudder Pedal and Trim Adjustments

10. Connect a hydraulic test stand to the hydraulic system, and turn the power on. See Section IV, paragraph 16.

11. With hydraulic power on, adjust the actuating cylinder piston rods so that the trailing edges of the rudders are separated as uniformly as possible with a maximum gap of .20-inch at the closest point. Insert the locking rings in the piston rods.

12. Adjust the servo valve rod assemblies so that the valves are one turn off neutral in the rudder "closed" direction. Tighten the check nuts on the rod assemblies.

(f) RUDDER PEDALS.

1. With hydraulic power on, depress the rudder pedals until the rudders open to the maximum, cylinders bottomed. Record the rudder surface angle. Operate the rudder pedals to open the rudders to within 0° 30' of the maximum open position. Set the pedal stops to limit the pedal travel to this position. Tighten the lock nuts on the stops.

(g) RUDDER TRIM MECHANISM.

1. Adjust the check nuts on the preload cylinders so that there is a gap of .015-inch between the check nuts and the adjustment nut.

j. TRIM FLAP CONTROL SYSTEM. (See figure 4.)

(1) DESCRIPTION.- Each trim flap is actuated by a screw-jack and a reversible electric motor assembly which incorporates an automatic brake, electric limit switches, and mechanical stops. The actuator is trunnion-mounted on the rear wing spar and the screw-jack is bolted to the flap. The flaps are controlled by an eight position switch located on the pilot's control pedestal. The switch is of the momentary type, spring loaded to the OFF position. Fore-and-aft positions of the switch operate the flaps together for elevator trim and the left and right positions of the switch moves the flaps in opposite directions for aileron trim. The other four intermediate positions of the switch are used for a combination of elevator and aileron trim. A position transmitter for each trim flap is bolted to the rear spar and connected mechanically to the flap. Two indicators, one for aileron trim and one for elevator trim are mounted on the pedestal forward of the control switch. Fittings are provided on the actuator trunnions for lubrication.

(2) REMOVAL OF TRIM FLAP ACTUATORS. (See figure 21.)

(a) Open the two access doors in the lower surface of the trim flap and the

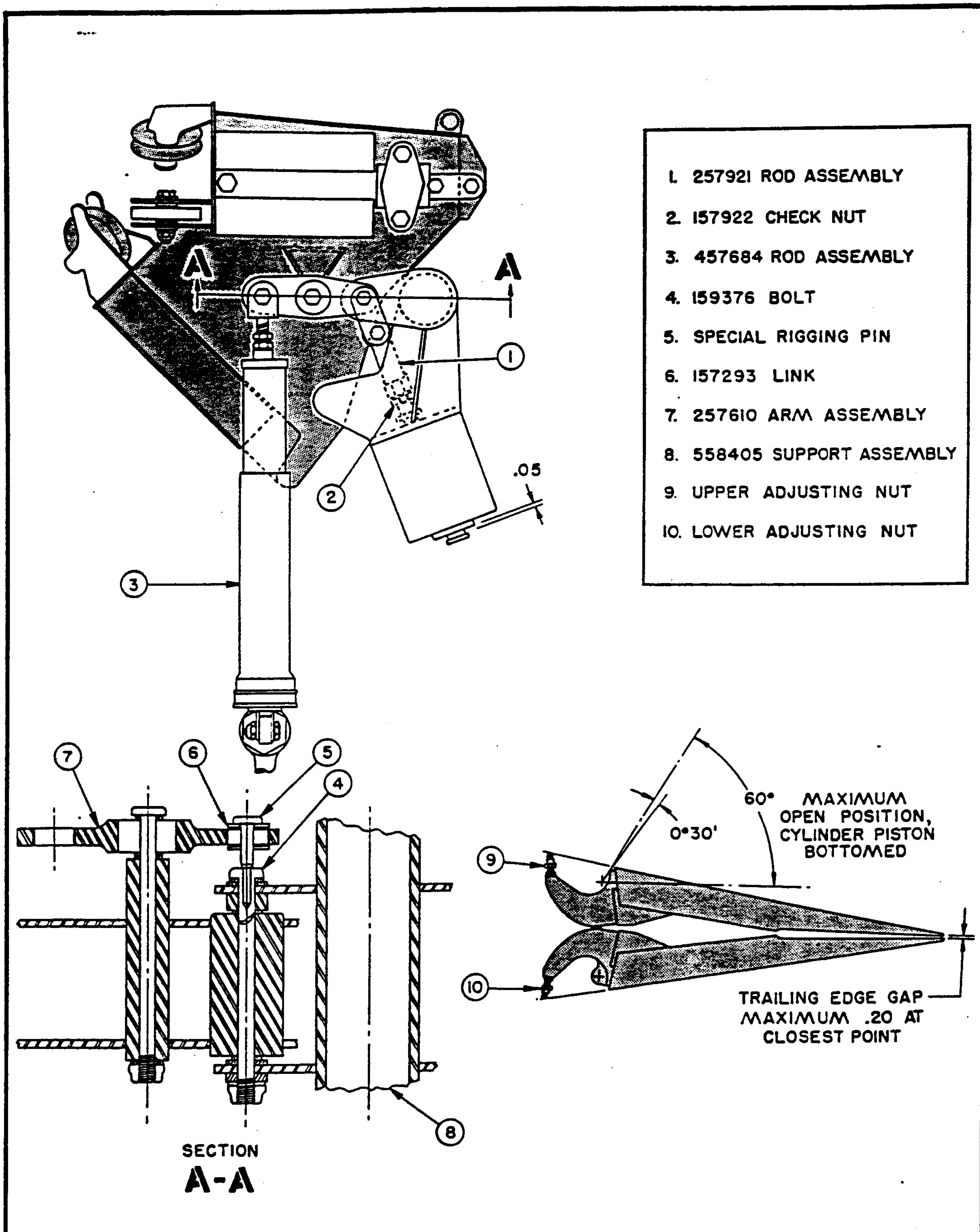


Figure 20. Rudder Rigging Positions

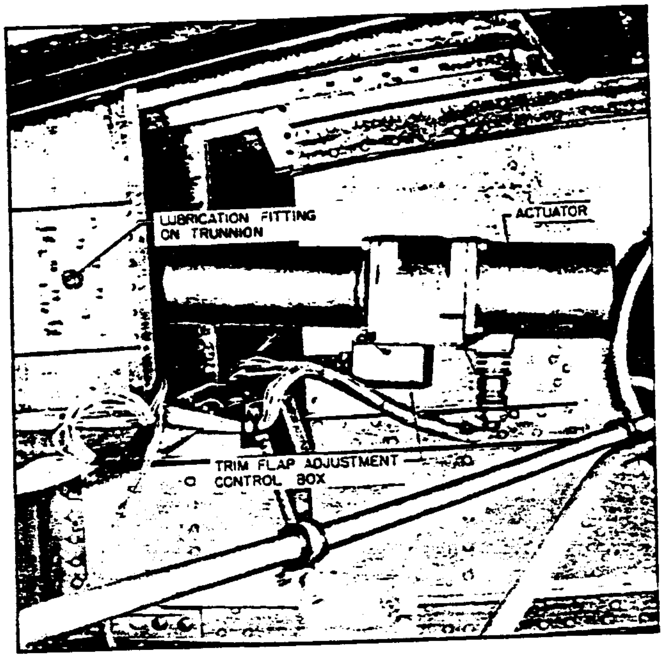


Figure 21. Trim Flap Actuator Installed

access door in the lower wing surface forward of the rear wing spar.

(b) Disconnect the electrical plug connections from the actuator.

(c) Disconnect the actuator from the flaps.

(d) Remove the actuator trunnion caps and lower the actuator from the wing.

(e) If the actuator is faulty, replace it. Do not attempt repairs.

(3) INSTALLATION OF TRIM FLAP ACTUATORS.- Reverse the removal procedure and lubricate the trunnion fittings.

(4) ADJUSTING TRIM FLAP RANGE AND POSITION TRANSMITTERS.- The trim flap movement is 30° ± 1/2° up and 7-1/2° ± 1/2° down. Adjust each flap individually as follows:

(a) Place a bubble protractor on the flap at station 190. Set the protractor to 8-1/2°. See paragraph g (f) 5, preceding. This will place the flap in neutral which is in streamline with the trailing edge of the wing.

(b) The trim flap range is controlled by two limit switches mounted on the flap actuator. Each switch has a cam and knurled adjusting knob. "RET" is stamped beside one knob and "EXT" is stamped beside the other which stands for Retract and Extend. (See figure 22.) To adjust the flap range proceed as follows:

1. With the flap in the neutral position, place a bubble protractor on the upper flap surface and set it to zero.

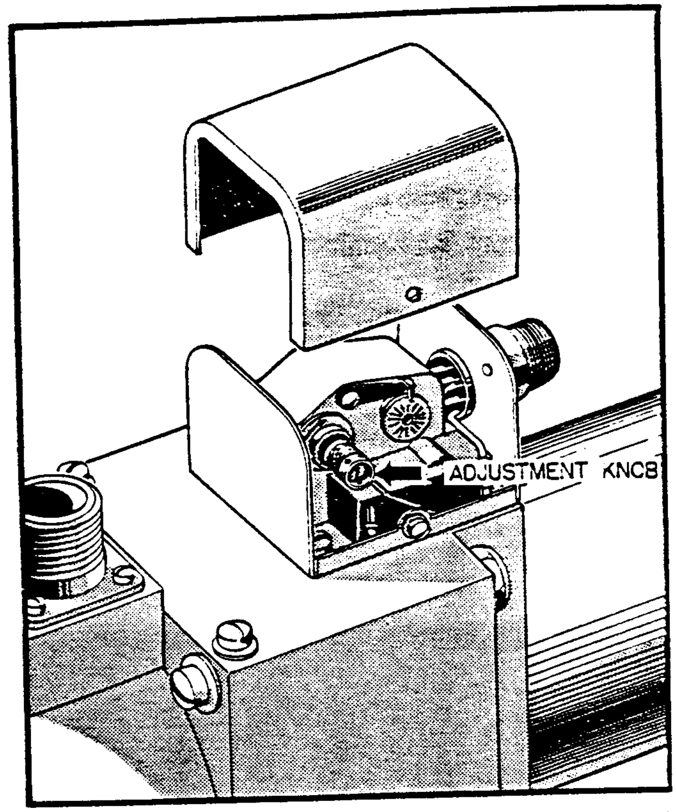


Figure 22. Trim Flap Limit Switch Adjustment

2. Remove the cover from the limit switch box on the actuator. This is accessible through the access door in the wing.

3. Hold the pilot's control switch in the "NOSE UP" position until the flap stops. If the flap stops before the full up position of 30° ± 1/2°, adjust the "EXT" limit switch as outlined in paragraph a following. If the flap contacts the mechanical stop which is approximately 33°, follow the procedure under b.

a. Loosen the set screw at the center of the "EXT" knurled adjustment knob. Hold the pilot's control switch to "NOSE UP" and turn the knob, allowing the flap to move until it is positioned at 30° ± 1/2° up. Then tighten the set screw in the knob.

b. If the flap moves past 30° up, move the switch to "NOSE DOWN" until the flap is at about 25° up. Turn the "EXT" adjustment knob until the cam contacts the limit switch. Then hold the control switch to nose up and adjust the knob as outlined in paragraph a preceding.

4. Hold the control switch at "NOSE DOWN" until the flap stops. Repeat the procedure outlined under paragraph a or b above, only adjust the movement of the flap by turning the "RET" knob. Down travel of the trim flap is 7-1/2° ± 1/2°.

5. Replace the limit switch box cover and safety the securing screw.

(3) Run the flaps to the neutral position and check the position indicators on the pilot's pedestal. Both indicators should register "0." If an adjustment is necessary, loosen the lock screw through the actuating arm of the position transmitter and turn the shaft with a screw driver until the indicator registers "0." Tighten the lock screw securely after making the adjustment.

k. LANDING FLAP CONTROL SYSTEM. (See figure 5.)

(1) DESCRIPTION.- The landing flaps are controlled by a switch located on the pilot's control pedestal and operated by two electric motors and a gear train comprising the power unit. The flap motors are connected together through a differential gear assembly so that in the event of a failure of one motor, the flaps may still be operated by the other. The complete power unit is installed in the top of the aft crew nacelle section. A mechanical emergency stop assembly and two electrical limit switches are incorporated in the power unit. Three actuators, connected to each flap, are installed along the rear wing spar. A series of torque tubes and universal joints connect the actuators to the power unit in the crew nacelle.

(2) FLAP POWER UNIT. (See figure 23.)

(a) DESCRIPTION AND OPERATION.- The power unit for the landing flaps is comprised of two, 208V a.c. 400 cycle, 3 phase, electric motors; mounted on a casting which houses a reduction gear train, a mechanical stop assembly, and two limit switches. Each motor incorporates a brake assembly which engages when the motors are stopped, thus holding the flaps in the position in which they are stopped. In the event of failure of an electrical limit switch, the mechanical stop assembly disengages the motors and applies a brake to hold the flaps. If the mechanical stop is engaged and the motors

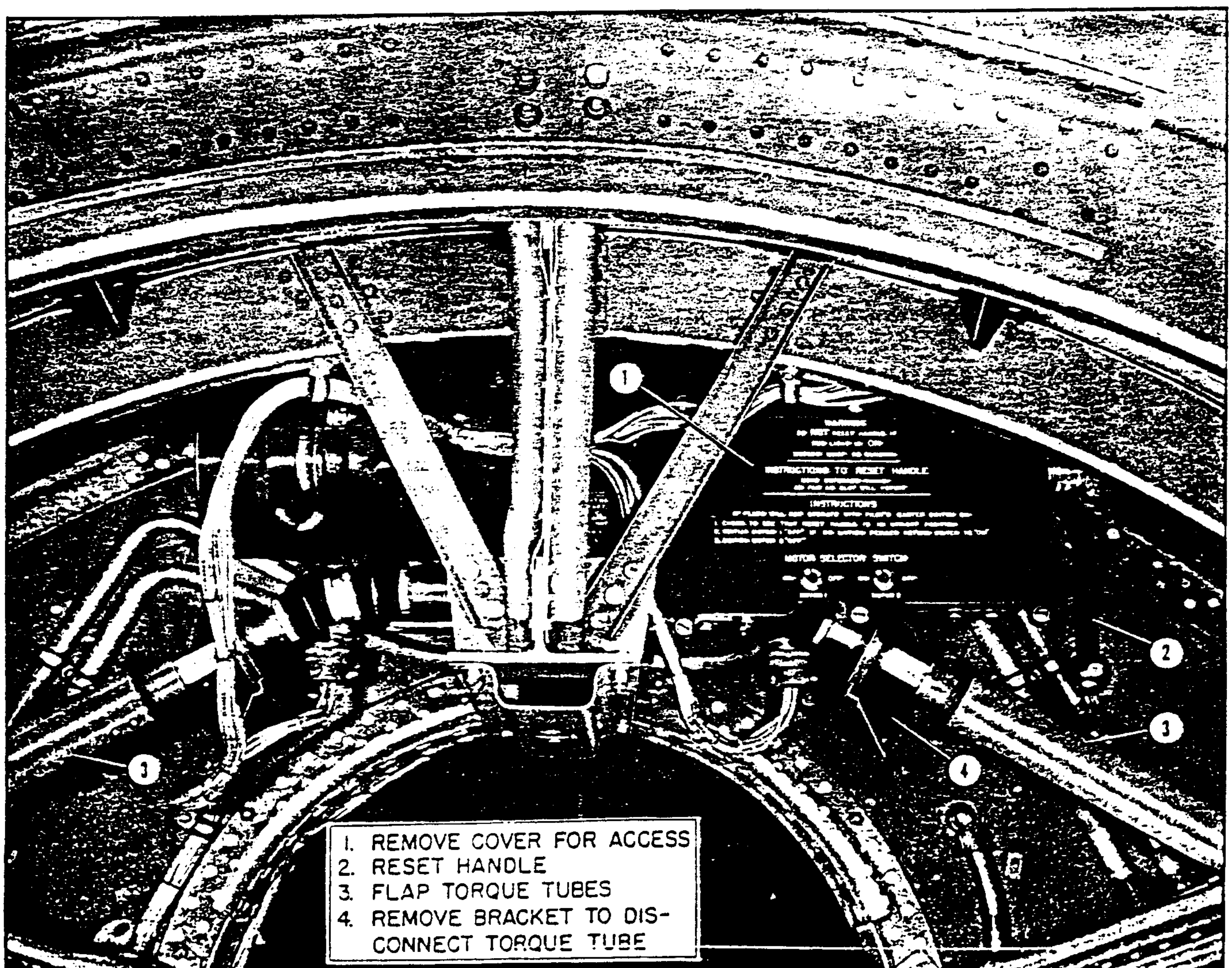


Figure 23. Landing Flap Power Unit Installed

are still operating in the same direction, the motors can be reversed with the master control switch and the unit re-engaged by following the instructions printed on the power unit. Toggle switches for testing the motors individually are installed on the unit next to the red indicator light.

(b) REMOVAL OF THE FLAP POWER UNIT. (See figure 23.)

1. Disconnect the electrical plug connections.

2. Disconnect the torque tube universal joints from the drive shaft ends.

3. Remove the four bolts securing the unit to the brackets and remove the unit.

(c) MAINTENANCE.- Repairs should not be attempted. In the event of failure, the landing flap power unit should be replaced.

(d) INSTALLATION OF THE FLAP POWER UNIT. (See figure 23.)

1. Place the unit in position and install the four nuts and bolts securing it to the brackets.

2. Connect the electrical plug connections.

3. Do not connect the torque tubes to the drive shaft of the power unit until the flaps are to be adjusted.

(3) LANDING FLAP ACTUATORS. (See figure 24.)

(a) DESCRIPTION.- Three actuators are attached to each flap and trunnion-mounted to the rear wing spar. A splined drive shaft extends through each actuator so that they may be connected together by torque tube assemblies. A bevel gear is mounted on the shaft within the actuator housing which engages with a gear on the actuator jack shaft. The actuators are interchangeable.

(b) REMOVAL.- An access cover is provided in the upper wing surface over each actuator. Remove the actuators in the following manner:

1. Open the access cover over the actuator to be removed.

2. Lower the wing flaps to the full extended position.

3. Disconnect the truss tie rods and attachment tubes from the flap.

4. Disconnect the universal joints from the actuator.

5. Support the actuator, remove the trunnion caps and lift the actuator out of its recess in the wing.

(c) INSTALLATION.- Each actuator has a lip protruding from the upper side which prevents it from being installed upside down. Reverse the removal procedure when installing the actuator. Loosen the truss tie rods so that they may be connected to the flap. After connecting the tie rods to the flap, tighten the tie rods evenly to a torque of 20-25-inch pounds.

(4) ADJUSTMENT OF THE LANDING FLAP CONTROL SYSTEM.- Information not available.

1. WING SLOT DOOR CONTROLS. (See figure 6.)

(1) DESCRIPTION AND OPERATION.- A three-position switch is provided for the pilot to control the wing slot doors. The three positions are "SLOTS OPEN," "SLOTS CLOSED," and "AUTOMATIC." A single hydraulic cylinder in each wing furnishes the power to actuate both doors. In addition to the hydraulic cylinders, two spring-bungees are installed in each wing capable of opening the doors and maintaining them in that position, in the event of a hydraulic failure. Each hydraulic cylinder is controlled by a solenoid operated valve. Normally the electric circuit is closed, keeping the solenoid energized and consequently the doors closed.

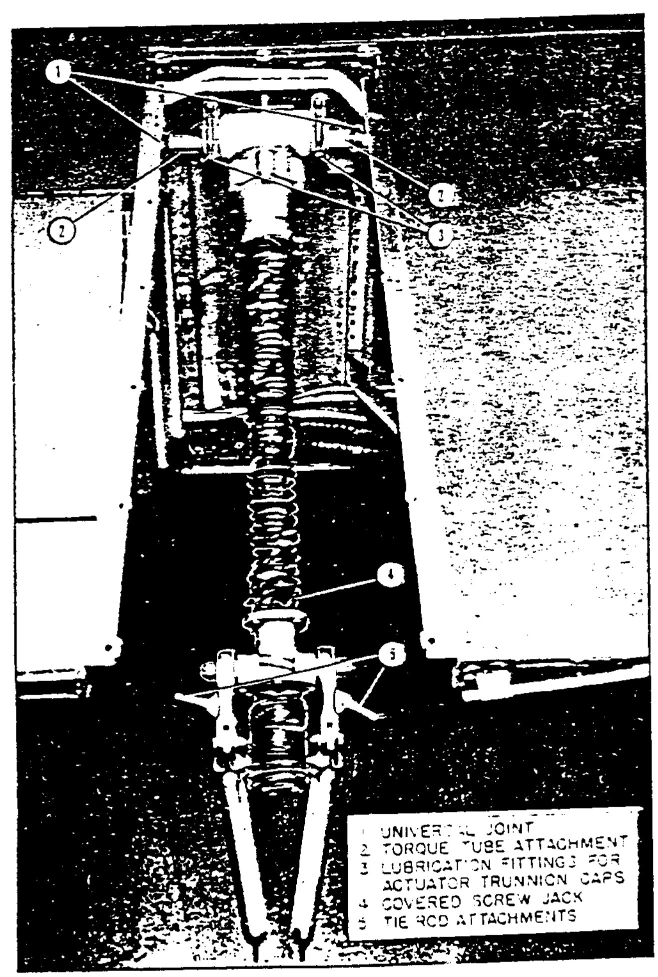


Figure 24. Landing Flap Actuator Installed

When the circuit is broken, a spring is permitted to open to pressure that part of the cylinder which causes the doors to open. The "AUTOMATIC" position of the control switch closes the electrical circuit through an aerodynamic pressure switch in each wing. The pressure switches measure the air pressures on the upper and lower wing surfaces corresponding to the lift coefficient. In this manner, the pressure switches control the solenoid valves to open or close the slot doors as conditions require. Since it is desirable to keep the slot doors open during landing and take-off operations, a landing-gear-actuated switch has been installed. When the gear is extended the switch opens the electrical circuit and when the gear is retracted the circuit is again closed. The hydraulic system is so designed that it is not possible to have failure on one side of the airplane without having failure on the other side. Also the aerodynamic switches are electrically interconnected so that pressure drop on one wing only, results in the doors opening in both wings. The pilot's three-position switch allows the doors to be operated, by-passing the aerodynamic pressure switches and the landing gear switch, to place both the left and right hand doors in the same position. Lights indicating the open position of the slot doors are provided on the instrument panel.

4. AUTOMATIC FLIGHT CONTROLS

4. AUTOMATIC FLIGHT CONTROLS.- An automatic pilot has not been installed in this airplane. However, provisions have been made to equip the airplane with a Type X-4 automatic pilot and formation stick.

5. LANDING GEAR

5. LANDING GEAR.

a. GENERAL. (See figures 1 through 5 and 15.)

(1) DESCRIPTION.- The airplane is equipped with a retractable, tricycle-type landing gear consisting of two dual-wheel main gears and a steerable single-wheel nose gear. Each main-gear wheel-well is equipped with two sets of doors; the forward set being electrically operated and the aft set connected to the landing gear strut. In operation, the doors open to allow the gear to pass, and when it is fully extended the forward doors close. When the gear begins to retract, the forward electrically-operated doors open, and when the gear is fully retracted, both sets of doors close to form the contour of the lower wing surface. The nose gear is equipped with three doors; two main wheel-well doors, and the strut-fairing door. The two main wheel-well doors are mounted to the wing and are electrically operated. The strut-fairing door hinges to the crew nacelle structure, and is connected to the nose-gear strut by an adjustable rod. When the nose gear is extending, all doors open. When the gear reaches the fully extended position, the wheel-well doors close. In retracting, the wheel-well doors open, and as the gear is retracting it brings the strut door to the closed position. When the gear is fully retracted, the two wheel-well doors close to form the contour of the forward part of the wing.

(2) OPERATION.- The landing gear is electrically operated. Its operation may be divided into three parts: extension, normal retraction, and emergency extension. There is no provision for emergency retraction of the landing gear. An air-oil bungee is installed at each gear to aid emergency extension.

(3) NORMAL EXTENSION.- For normal extension of the gear, the landing-gear-control handle is moved to the "DOWN" position. The handle unlocks the landing-gear doors by a cable system. When the door-locks are fully open, they contact electric switches which actuate the landing-gear-door motors, opening the doors. As the landing gear doors reach the open positions, the following operational sequences take place: (See figure 14.)

(a) Limit switches shut off the door motors and sequence switches actuate the landing-gear-lock motors to unlock the up-locks and set the down-locks. This action lights the red lamp on the pilots' instrument panel.

(b) Limit switches shut off the lock motors and sequence switches start the landing-gear actuators to move the gears to the down position.

(c) Down-locks are automatically actuated to the locked position by entry of lugs attached to the landing gear structure when the gears are fully extended.

(d) The locking action of the down-locks operates limit switches which shut off the landing-gear actuators, and operate switches to close the forward doors, and illuminate the green lamp and extinguish the red lamp on the pilots' instrument panel.

(e) The landing gear control handle remains in the "DOWN" position; there is no neutral position.

(4) NORMAL RETRACTION.- For normal retraction, the control handle is moved to the "UP" position, which closes switches actuating the door motors and opening the landing gear doors. As the doors reach their open positions, the following operational sequences take place:

(a) Limit switches are actuated to shut off the door motors, and sequence switches actuate the lock motors to unlock the down-locks and set the up-locks. This action extinguishes the green lamp and illuminates the red lamp on the pilots' panel.

(b) Limit switches shut off the lock motors and sequence switches start the landing-gear actuators to move the gears to the "UP" position.

(c) Up-locks are automatically actuated when the gear is fully retracted, and the red light goes out, indicating that the gear is up and locked. The locking action of the up-locks operates limit switches which shut off the landing-gear actuators, and sequence switches start the door motors to close. As the doors close, they automatically lock.

(5) EMERGENCY EXTENSION.- A ratchet handle is mounted on the side of the turret structure

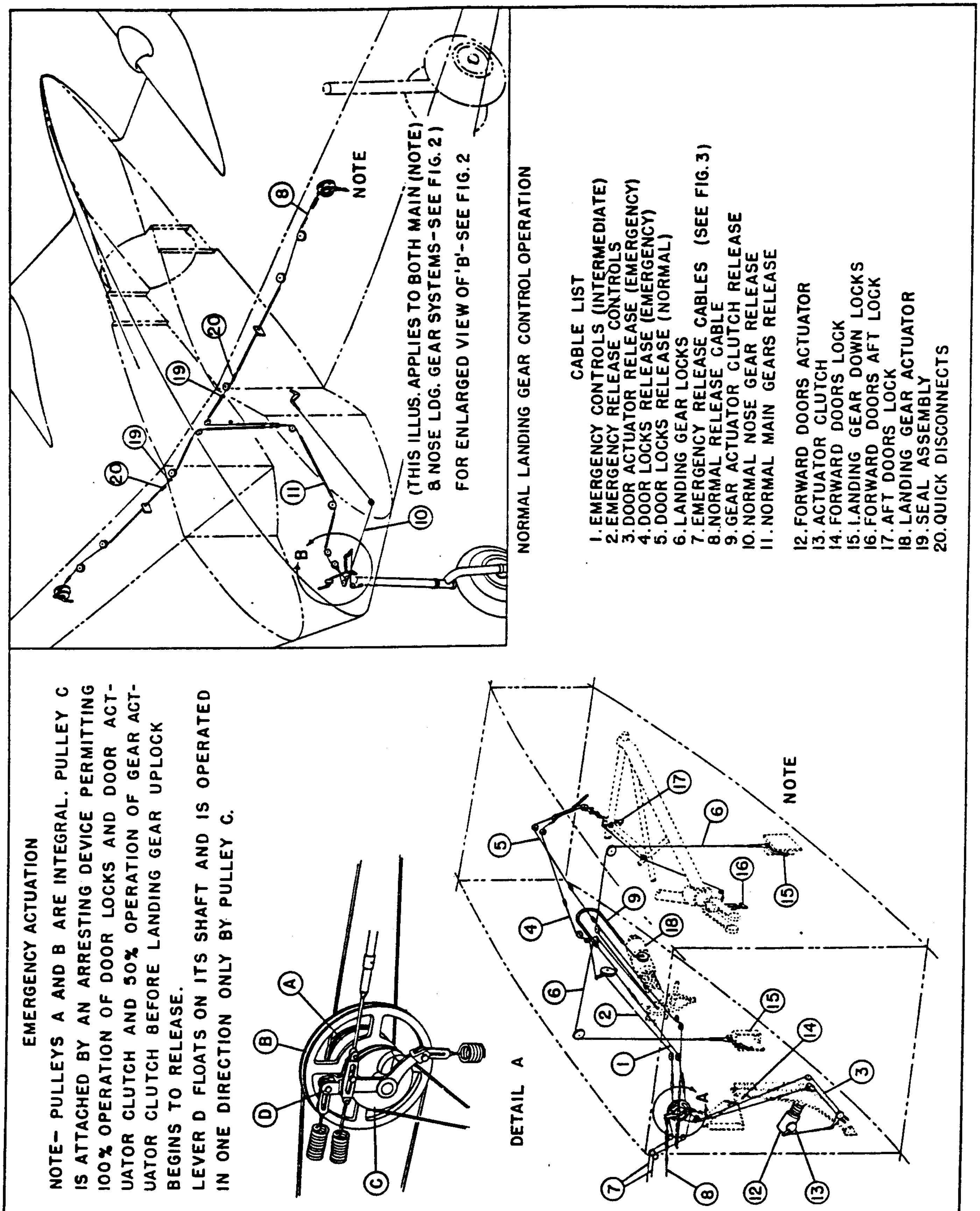


Figure 1. Main Landing Gear Control Cables

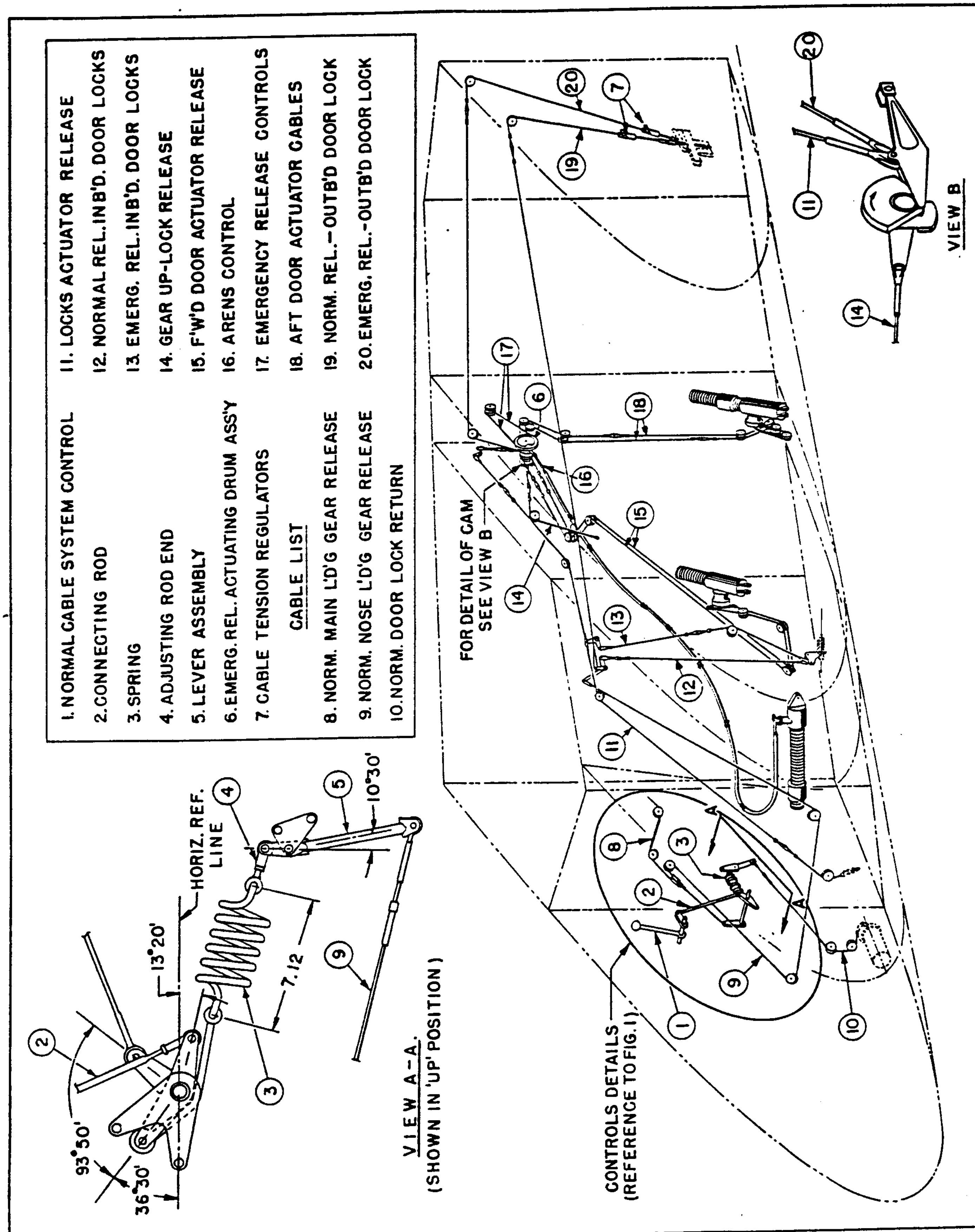


Figure 2. Nose Gear Control Cables

adjacent to the passageway into the forward cabin. Five 90° movements of the control handle are required to extend the gear. Operation is as follows:

(a) Action of the handle, as it is moved back and forth, unlocks the landing-gear-door locks, releases the door actuator-motor clutches, unlocks the landing-gear up-locks and sets the down-locks, and releases the clutches of the landing gear actuators.

(b) When the landing-gear actuator clutches are released and the up-locks unlocked, the gears will extend of their own weight to a point where the bungees operate to push the gears into the down-locks. The main-wheel doors are opened by wheel load. The fore and aft nose-gear doors are opened by the emergency bungee system.

(6) INDICATOR LIGHTS AND THROTTLE WARNING HORN.- The indicator light system, consisting of one green and one red light, is installed in conjunction with a throttle warning horn. The red light illuminates at any time the gear is moving and is not in the up and locked, or down and locked positions. The green light illuminates only when the gear is down and locked. The throttle warning horn will operate when the throttles are retarded below cruising rpm, and all three gears are not down and locked.

(7) LANDING-GEAR SAFETY CONTROL SWITCH.- A landing-gear safety-switch is installed on the left main gear. The switch is closed when the weight of the airplane is on the gear. A solenoid, actuated by the switch, blocks the movement of the landing-gear-control handle to the "UP" position when the airplane is resting on the ground.

b. TROUBLE SHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
Gear fails to extend or retract when operated electrically.	Faulty electrical connection in system.	Check electrical system. Repair or replace faulty connection.
	Gear actuator not operating.	Check actuator. Replace if necessary.
	Up or down locks not operating.	Check locks. See "Up or down locks not operating" following.
	Lack of lubrication.	Lubricate as required.
Shock strut remains depressed when gear is retracted.	Worn or scored piston bearings.	Replace bearings.
	Bent shock strut.	Replace strut.
	Deflated shock strut.	Inflate and check for leakage. Replace packings.
Shock strut leaking.	Lower inner cylinder scored or pitted.	Replace cylinder packing. Replace cylinder or strut if necessary.
Shock strut leaks air.	Valve core not seated.	Depress the valve and allow it to snap back.
	Valve core worn.	Replace the core.
	Filler plug gasket worn.	Replace the filler plug.
Excessive wear of torque arms.	Collar and link bolts loose.	Replace bushings in arms.
	Lack of grease.	Lubricate.
Gear fails to absorb shock.	Soft or flat tires.	Remove tire, inspect for damage. Repair or replace.
	Low pressure in shock strut.	Inflate shock strut. Be sure fluid is level with filler plug before inflation.
Gear vibrates during take-off and landing.	Wheel and tire assembly out of balance.	Remove, balance, and reassemble the tire and wheel.

TROUBLE	PROBABLE CAUSE	REMEDY
Gear Vibrates during take-off and landing.	Damaged down-locks.	Check operation of down-locks. Replace if necessary.
	Worn or frozen bearings.	Remove and replace bearings.
	Loose or broken torque arms.	Tighten or replace if necessary.
Nose wheel shimmy or vibration.	Improper tire inflation.	Inflate to 70 lbs.
	Wheel slightly loose.	Tighten the axle nut.
	Unbalanced wheel.	Align balance marks on tire and tube.
	Worn or loose torque-arm bushings or fittings.	Tighten bolts. Replace bushings if necessary.
	Air in steer-damp.	Re-bleed hydraulic system if necessary.
Gear fails to respond to emergency extension system.	Loss of air from bungee bottles.	Refill the main-gear bottle to 1000 psi and nose-gear bottle to 200 psi for correct emergency operation.
	Leaking or damaged bungee cylinder.	Repair or replace the cylinder if necessary.
Wheel fails to rotate freely.	Wheel bearings too tight or damaged.	Check, lubricate, or replace bearings. Adjust the axle nut.
Grinding noise coming from the wheel when it is in motion.	Loose axle nut	Tighten and safety axle nut.
	Worn bearings.	Replace bearings.
	Dry bearings.	Lubricate bearings.
Gear position indicator lights not operating.	Circuit breaker open.	Push to reset.
	Burned-out bulb.	Replace bulb.
	Faulty wiring.	Locate the damage and repair the circuit.
	Micro switches not actuated.	Adjust micro switch.
	Relay inoperative.	Replace relay.
Warning horn fails to blow.	Short circuit in wiring.	Check wiring.
	Throttle switch not operating.	Repair or replace.
	Damaged warning horn.	Replace horn.
Up or down locks not operating.	Lock actuator not operating.	Check the actuator. Repair or replace if necessary.
	Broken cable, or cables out of adjustment.	Check the cable system. Replace, repair or adjust.
	Broken spring on lock-actuating mechanism.	Check the springs. Check the operation of locks.
	Dirt or foreign matter in lock mechanism.	Clean locks.
Main-landing-gear doors out of adjustment.	Actuating rods improperly adjusted.	Adjust rods to bring door flush with wing structure.
Nose-gear doors out of adjustment.	Actuating rods improperly adjusted.	Adjust rods to bring door flush with wing structure.

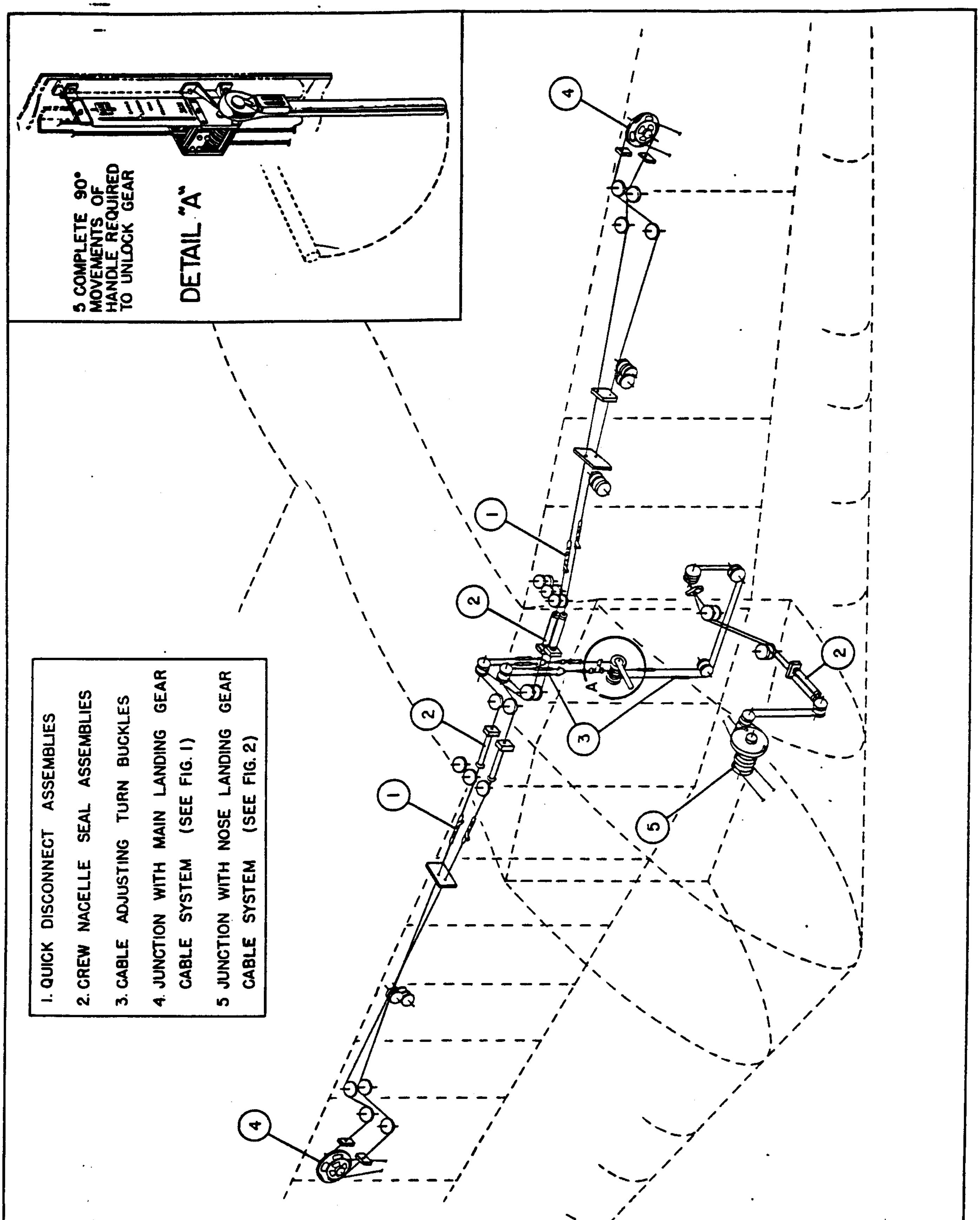


Figure 3. Landing Gear Emergency Release Cable System

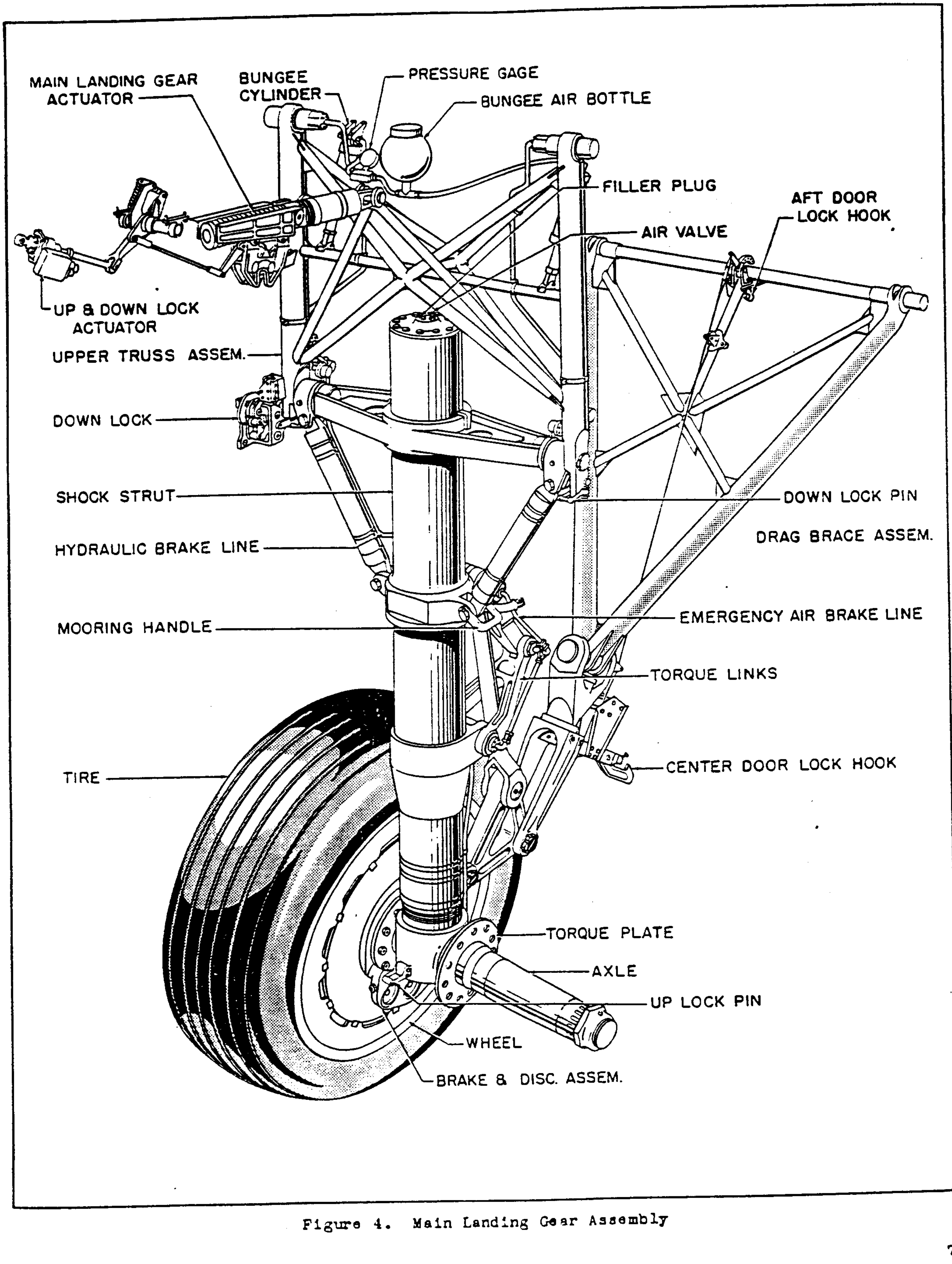


Figure 4. Main Landing Gear Assembly

c. MAIN GEAR. (See figures 4 and 5.)

(1) GENERAL.

(a) DESCRIPTION.- Each main landing gear (Type EV-1 Bendix) consists of a pneudraulic shock strut, upper truss assembly, drag brace assembly and the electrically operated actuator. The wheels are of the dual type, incorporating 65 inch smooth-contour tires, and Goodyear dual-disc three-spot hydraulic brakes. The complete landing-gear assembly is supported by two large pins on the outboard and inboard sides of the gear. Each pin is retained in a clevis containing a bearing to permit rotation of the truss assembly. The strut is attached to the upper truss assembly by two large pins, also mounted in bearings, allowing movement between the strut and the upper truss assembly during operation. Rear loads are absorbed by a drag brace, which is attached to the bottom of the strut, and hinged with bearings to the aft wheel-well structure. The two main gears are interchangeable.

(b) REMOVAL AND DISASSEMBLY.

NOTE

Each main gear weighs 3818 lbs. complete with wheels and brakes.

1. Raise the airplane with jacks until the weight is off the gears.

2. Hang a chainfall hoist to each support bracket, located inboard of the trunnion casting.

3. Attach each chainfall to the strut center cross-arm. Tighten the chain.

4. Release air pressure from the strut.

WARNING

Do not remove filler plug. Release air pressure of strut by slightly turning the filler plug, allowing air to escape slowly. This prevents damage to the valve core caused by a sudden rush of air past the valve seat. Use a wrench for installing and removing the filler plug.

CAUTION

Do not attempt to remove filler plug without first completely deflating strut, and until all fizzing of air and fluid stops.

5. Disconnect the door actuating rods from the strut.

6. Remove lower drag brace, yolk and fork, from bottom of strut, also disconnect drag brace from aft of wheel well.

7. Disconnect the landing gear actuator.

8. Release air from bungee system. Disconnect air lines from bungee cylinders.

9. Disconnect bungee cylinders from truss cross-bar.

10. Remove the bungee mounting brackets.

11. Disconnect emergency-brake air and hydraulic lines from upper Barco joints. Plug ends of lines.

12. Remove upper trunnion pins and fold truss assembly down.

13. Lower the chainfall slowly, allowing the gear to roll forward on wheels. Place a support or low platform under the strut when nearing the ground to avoid injury to the strut mechanism.

14. Remove the wheel assembly.

(c) ASSEMBLY AND INSTALLATION.

1. Hang a chainfall hoist to each support bracket, located inboard of trunnion castings.

2. Install the wheel assembly.

3. Line-up the gear assembly directly under the wheel well.

4. Attach a chainfall to each center cross-arm of the strut.

5. Raise the strut to position. Raise upper truss assembly forward into position.

6. Insert the trunnion pins and install the trunnion-pin locking bolts.

7. Attach lower drag brace and fork to strut, and aft wheel-well position.

8. Remove the plugs and connect the brake lines, both air and hydraulic, at the trunnion-pin Barco joint.

9. Install the bungee mounting brackets and the bungee cylinders.

10. Connect hydraulic lines to bungee cylinders. Attach cylinders to truss cross-arm.

11. Connect the landing-gear actuator.

12. Connect the door-actuating rods to the strut and adjust.

13. Inflate shock strut as outlined in paragraph c (2) (h).

(d) OPERATIONAL CHECK.

1. With the airplane jacked, test operation of the gear by lowering and retracting it several times. Extend the gear using the emergency actuating system.

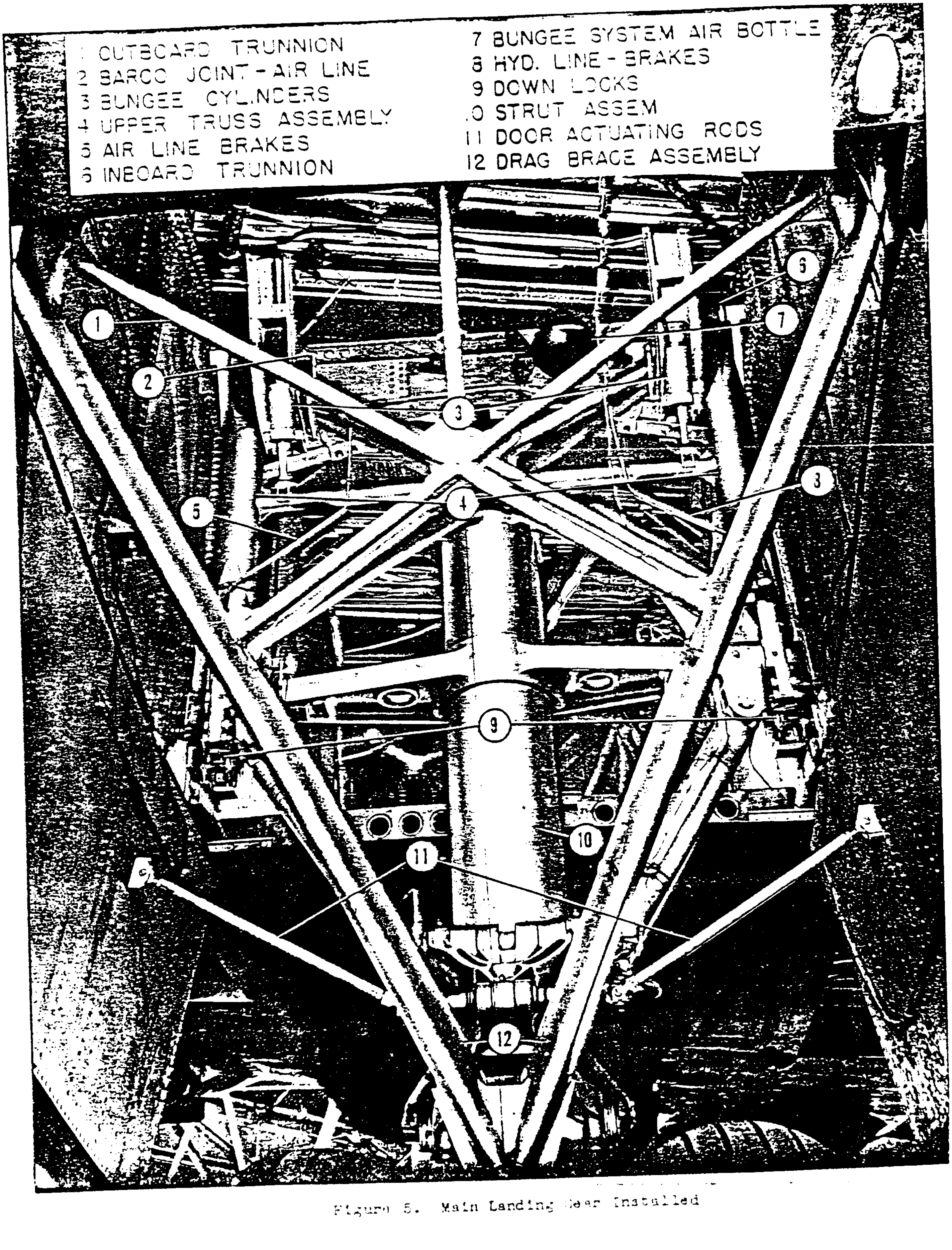


Figure 5. Main Landing Gear Installed

2. Check the accuracy of the position indicator and the operation of the warning horn.

(2) SHOCK ABSORBING STRUT. (Main Gear) (See figure 6.)

(a) DESCRIPTION AND OPERATION.

1. The main gear shock absorbing struts are the pneudraulic type (Bendix No. EV-1) which utilize both air and fluid to produce a controlled resistance. This type of strut employs two telescoping chambers, a metering pin, piston tube, a snubber valve on the inner cylinder, and a fixed packing gland. Only fluid conforming to AAF Specification No. AN-VV-O-366, red color, is to be used. The operation of the strut is conventional. The axle is attached to the lower, or inner, cylinder.

2. Torque arms are attached to the upper and lower cylinders.

3. A fitting, consisting of a filler inlet and an air-pressure valve, is located at the top of each strut to provide for filling and inflating the unit.

4. A packing gland, consisting of molded packing rings with an upper and lower aluminum spacer ring, is designed to seal the lower sliding joint between the upper and lower cylinders.

5. Bronze bearings, fitted to the outer and inner cylinders, maintain correct cylinder alignment and minimize friction at the bearing surfaces.

(b) MAIN-GEAR SHOCK-STRUT REMOVAL AND DISASSEMBLY.

1. Remove gear assembly as outlined in paragraph c (1) (b) preceding.

CAUTION

All air pressure must be relieved before removing the shock strut.

2. Remove the wheel and brake assemblies.

3. Remove the wire snap ring from the bearing packing nut.

4. Remove the lower drag brace, fork, triangular attachment and adjusting rods.

5. Loosen the bearing nut with a spanner wrench, but do not remove it.

6. Remove the filler plug and drain the fluid.

7. Eject all fluid by moving the inner cylinder through its full stroke two or three times.

8. Remove the bolt connecting the upper and lower torque arms.

9. Back the bearing nut completely off the outer cylinder.

10. Pull outward on the inner cylinder until it is completely removed. If necessary, use a light bumping action to break the packing rings loose.

11. Remove the lock screws holding the upper bearing of the inner cylinder.

12. Remove the snubber valve.

13. Remove the lock screws holding the stop nut; unscrew the nut and slide it off the cylinder.

14. Remove the bearing spacer, upper packing spacer, packing, and lower packing spacer.

15. Remove the lower bearing and packing gland ring wiper.

NOTE

If packing only is to be installed, this is all the disassembly required.

16. To remove the piston tube from the outer cylinder, unscrew the lock-nut and nut from the top of the piston tube.

(c) MAIN-GEAR SHOCK-STRUT ASSEMBLY CLEANING.

1. Where there is evidence of gumming of the fluid and collection of dirt on the external moving parts of the piston, remove it by cleaning with a cloth soaked in hydraulic fluid, Specification No. AN-VV-O-366, red.

2. Clean all internal parts with kerosene or naphtha.

(d) MAIN-GEAR SHOCK-STRUT ASSEMBLY INSPECTION.- Once the unit has been disassembled, a general visual inspection should be made of the various assemblies as follows:

1. Inspect all welded joints for evidende of cracks. If cracks are found, the part should be replaced.

2. Inspect the plating on the outer wall of the inner cylinder for deterioration or excessive wear at any place.

3. Inspect the inner wall of the outer cylinder for evidence of corrosion or scoring. Slight corrosion or scoring is not serious. It can be removed by polishing with emery cloth.

4. A dimensional inspection should be made to determine the serviceability of the bronze piston bearing, bronze upper bearing, and bronze lower bearing. If the diameter is less than the service tolerance, the bearing should be replaced. The following table lists the original dimensions and the allowable service tolerances for these parts.

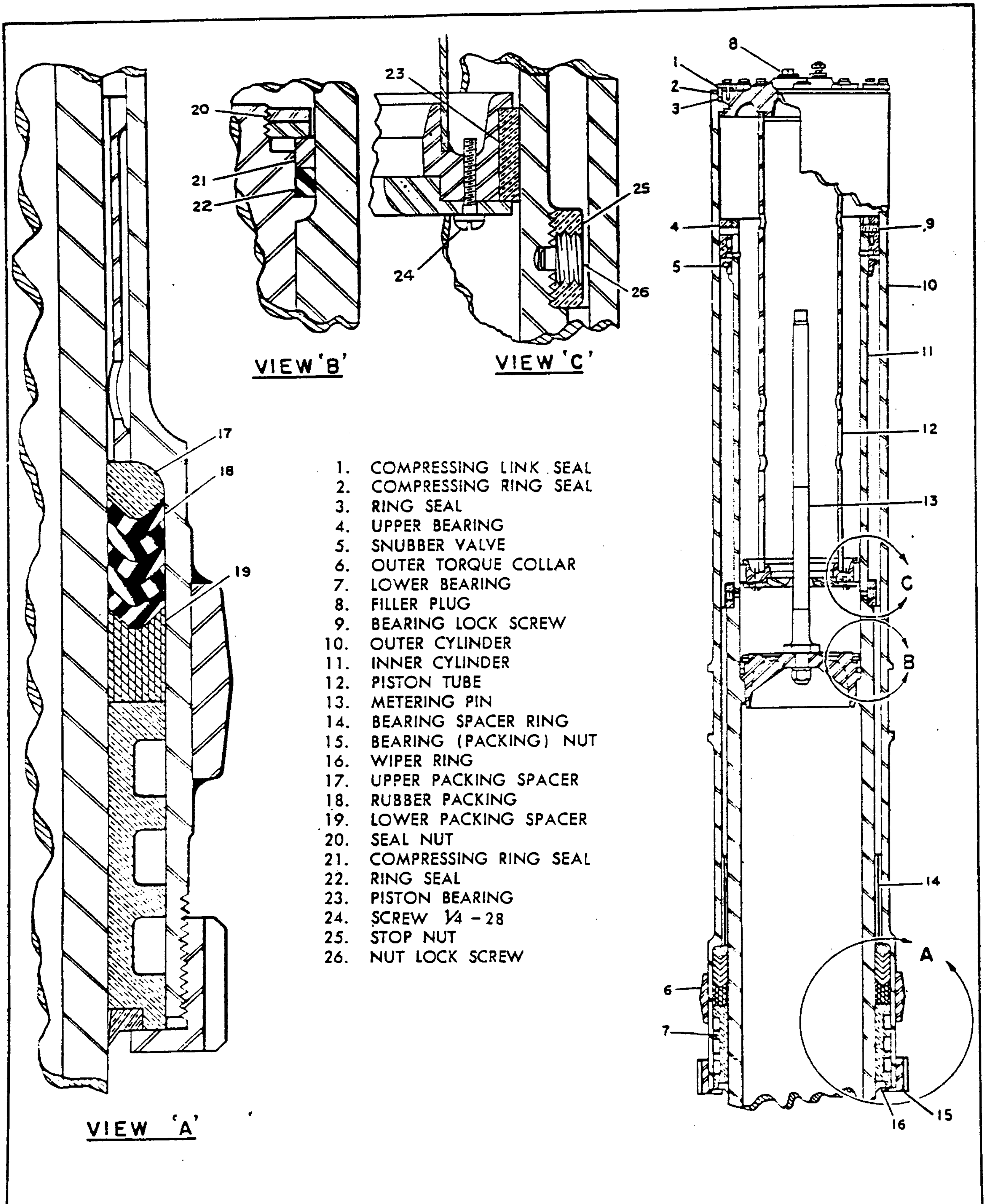


Figure 6. Main Landing Gear Shock Strut Diagram

UPPER BEARING	LOWER BEARING	PISTON BEARING
Original O.D.	Original I.D.	Original O.D.
10.496	10.007	8.872
10.493	10.004	8.870
Serv.Tolerance	Serv.Tolerance	Serv.Tolerance
10.481	10.022	8.867

(e) MAIN-GEAR SHOCK-STRUT ASSEMBLY PACKING REPLACEMENT.

1. Leakage of the packing gland ring wiper is indicated by air bubbles appearing when soapy water is applied to the bearing nut. Tighten the nut firmly.

NOTE

All air must be released from the strut before the nut can be tightened. If normal tightening does not stop the leakage, the packing must be replaced. If this is necessary, the cylinder should be carefully inspected for roughness, out of round, or bent condition when disassembled. Replace packing as follows:

2. Disassemble the shock strut as outlined in paragraph 5 c (2) (b).

3. Install new packing rings in the same order and arrangement as those removed. Wet packing rings with hydraulic fluid, Specification No. AN-VV-O-366, red color, before installing.

NOTE

Exercise care when replacing packings to prevent roughing or tearing the feather edge lip on the packing ring. The ability of the ring to prevent leaks depends upon the smoothness and good fit of the lip against the working parts of the strut.

4. Install the chevron-type packing with the point of the "V" down.

(f) MAIN-GEAR SHOCK-STRUT ASSEMBLY.

1. Replace the piston tube in the outer cylinder and install the lock nut on the top of the piston tube.

2. Place the bearing packing nut on the lower cylinder.

3. Replace the lower packing gland ring wiper and the lower bearing.

4. Replace the lower packing spacer, the packing, the upper bearing spacer, and the upper bearing spacer ring.

5. Replace the snubber valve, stop nut, and lock screws.

6. Replace the upper bearing and the bearing lock screw.

NOTE

Before assembling the inner and outer cylinders the packing must be compressed, with the "V" pointing down, by wrapping with **approximately .010-inch shim stock. The shim stock will then slide off as the outer cylinder goes on.**

7. Push the inner cylinder into the outer cylinder and screw on the lower bearing (packing) nut.

8. Attach the upper and lower torque links.

9. Place the wire snap ring on the bearing (packing) nut.

10. Press the shock strut head into place in the upper cylinder.

11. Replace the filler plug and valve.

(g) MAIN-GEAR SHOCK-STRUT INSTALLATION.

1. Attach the strut to the upper truss assembly.

2. Install the dual wheels, tires, and brakes. See paragraph 6.

3. Refill the strut as follows: Remove the filler plug and fill with hydraulic fluid (Specification AN-VV-O-366, red color) until the fluid is level with the filler plug hole, when the strut is fully compressed. Replace the gasket and filler plug.

(h) MAIN-GEAR SHOCK-STRUT INFLATION PROCEDURE.

1. The struts should be under the full normal load of the airplane before they are inflated.

2. Force air into each strut with a high pressure pump until it is 6-15/16 inches from the top of the axle fitting. Refer to the instruction plate on the strut.

NOTE

Do not reduce over-inflation by depressing the valve core. Release excess air by rapidly unscrewing and tightening the filler plug.

3. A variation of not more than 1/4-inch for a check reading is permissible.

4. After inflation, carefully test the valve, the valve core, and the filler plug for leaks, using soapy water.

5. Replace the valve cap.

NOTE

After the struts are properly inflated, readjustments will not be made for minor changes resulting from a slight change of load, position of the airplane, wind reaction, packing friction, movement of the airplane forward or backward, or similar causes.

(3) MAIN-LANDING-GEAR UP-LOCK. (See figure 7.)

(a) DESCRIPTION.- The up-lock mechanism is located directly under the main gear actuator, where it is mounted to the extensions of the wing supporting structure. The up-lock mechanism is a double-action open-hook type, and is operated by an electric-driven actuator of the screw jack type. When the landing gear is moved to the retracted position, the up-lock catches the shock strut assembly and holds the entire gear assembly in the retracted position independent of the electric actuating mechanism.

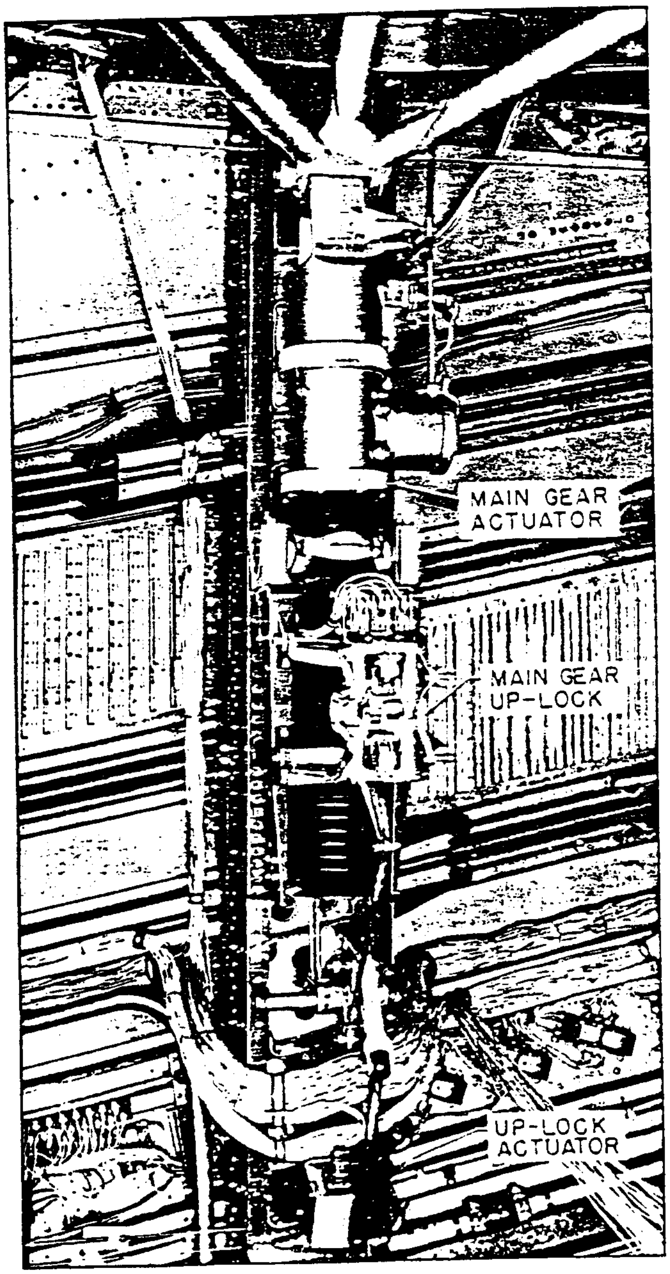


Figure 7. Main Landing Gear Up-Lock and Main Gear Actuator

(b) OPERATION.- The up-lock actuator releases the gear from the up-lock and automatically sets the down-locks. The up-lock actuator, through mechanical linkage, opens the up-lock to a position where a switch is operated to start the landing gear actuator. As the gear actuator moves the gear out of the up-lock, the lock actuator continues to operate until the up-lock reaches the full open position. Coil springs attached to the lock mechanism hold the lock open. When the up-lock is open the down locks are automatically set in the open position. The up-lock is closed by impact of the gear and is held in the closed position by the coil springs.

(c) REMOVAL AND DISASSEMBLY.

1. Disconnect the electrical plug from the up-lock actuator.

2. Remove the bolts attaching the up-lock to the acutator bracket.

3. Remove the springs from the arm and hook.

4. Disassemble up-lock mechanism.

(d) ASSEMBLY, INSTALLATION AND TESTS.

1. Assemble the lock assembly and attach it to the actuator bracket.

2. Install the springs into up-lock.

3. Connect the lock to the actuator.

4. Set the linkage arm adjustment to .10 clearance.

5. If possible, raise the airplane on jacks and check the operation of the up-lock.

(4) MAIN-GEAR UP-LOCK ACTUATOR. (See figure 7.)

(a) DESCRIPTION.- Each actuator is self-contained and consists of a gear housing and screw jack assembly, a motor assembly, and a control assembly. The actuator motor is reversible, incorporating a thermal protector and travel limit switches.

CAUTION

The motor is designed for intermittent duty and must not be operated continuously either with or without load. Operating time should not exceed the proportion of three minutes on, and seventeen minutes off.

The motor operates on 28 volts d.c. which is controlled by micro switches actuated by the wheel well doors.

(b) REMOVAL - MAIN-GEAR UP-LOCK ACTUATOR.

1. Disconnect the electrical plug from the actuator.

2. Remove the cotter pin, nut, washer, spacer and bolt, attaching the actuating arm to the bellcrank.

3. Remove the cotter pin, nut, washer, spacer and bolt, attaching the actuator to the mounting bracket.

(c) INSTALLATION.- Reverse the removal procedure.

(d) MAINTENANCE.- Any maintenance other than brush replacement should be done at a repair depot. Brushes can be changed by removing the two brush retaining caps from the motor housing. Brushes should be replaced when worn to .156-inch.

(5) MAIN GEAR DOWN-LOCKS. (See figure 8.)

(a) DESCRIPTION.- The main gear down-locks are constructed mechanically the same as the up-lock, with a slightly different shaped casting for mounting purposes. The down-locks, two for each main gear, are mounted to the wheel-well wing structure, one on each side of the strut. Down-locks are automatically actuated to the locked position by the entry of lugs on the landing gear structure when the gears are fully extended. The down-locks are operated through a cable system by the electrical actuator located forward of the up-lock.

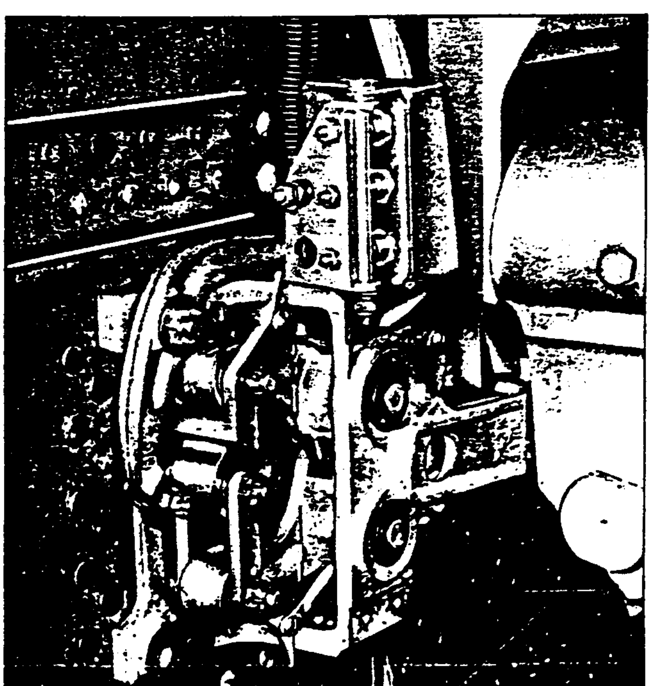


Figure 8. Main Landing Gear Down Lock

(b) OPERATION.- For sequence of down-lock operation refer to paragraphs 5 a (3), (4) and (5).

(c) MAIN-GEAR DOWN-LOCK REMOVAL AND DISASSEMBLY.

1. Disconnect the electrical wiring from the lock switches.

2. Disconnect the spring and attaching cable from the lock actuating arm.

3. Remove the bolts attaching the locks to wheel-well wall.

4. Disassemble the locks and attaching mechanism.

(d) MAIN-GEAR DOWN-LOCK ASSEMBLY AND INSTALLATION.

1. Assemble the down-locks.

2. Install on wheel-well wing structure with attaching bolts.

3. Connect spring and attaching cable to lock actuating arm.

4. Connect electrical wiring to lock switches.

5. Adjust roller clearance on down-lock actuator arm to .10 of an inch.

6. If possible check operation of down-locks visually before flying again.

(6) MAIN-LANDING-GEAR OPERATING MECHANISM.

(a) ACTUATOR. (See figure 7.)

1. DESCRIPTION AND OPERATION.- An electrically driven screw-jack type actuator is installed as part of the landing gear retracting mechanism. The actuator is composed of four main assemblies: motor and clutch, gear box, screw jack, and overload clutch and governor. Four bolts, washers and nuts, attach the actuator to the landing-gear-actuator-beam bracket, located in the upper wheel portion of the wing. The forward part of the actuator is attached to the upper truss assembly of the landing gear. The actuator is driven by a 208 volt, 400 cycle, 3 phase a.c. motor. The motor clutch is a single disc type, the driven disc being normally held against a friction material ring by a spring to prevent reversing of the actuator under load, and to provide a minimum over-travel of the actuator when the electrical power is interrupted. The clutch is energized by a 28 volt d.c. solenoid coil, which overcomes the spring force and causes the motor drive disc, and driven disc to operate as a unit. Protection against damage to the motor caused by too frequent cycling is provided by a thermatron in the d.c. control circuit. Micro switches operated by the up and down locks operate the actuator through relays. The clutch on the actuator disengages the actuator when the emergency lowering system is operated.

2. MAIN-LANDING-GEAR ACTUATOR REMOVAL.

a. Disconnect the electrical plugs.

b. Disconnect the cable from the clutch arm and move the arm to the "UP" position, to disengage the actuator.

c. Remove the four bolts attaching the actuator to the mounting bracket, ease pressure by turning the end of the screw-jack shaft.

d. Remove the pin attaching the actuator to the upper truss assembly, and at the same time, support the actuator. Remove the actuator.

3. MAIN-LANDING-GEAR ACTUATOR INSTALLATION.

a. With the clutch disengaged, insert the actuator into position and attach it to the mounting bracket with four bolts, washers, and nuts.

b. Turn the screw-jack part of the actuator until the actuator fits at the truss assembly connection. Insert pin and nut, attaching the actuator to the truss assembly.

c. Engage the clutch and connect it to the clutch operating mechanism.

d. Connect the electric plug to actuator motor.

e. Raise the airplane on jacks and check operation of the actuator and landing gear.

4. MAIN-LANDING-GEAR ACTUATOR MAINTENANCE.- All double shielded ball bearings are lubricated with Andok "C," and should require no repacking during the life of the unit. The loose balls supporting the reaction gear and also serving as thrust bearings are lubricated with AN-G-10. In the event disassembly and subsequent regreasing is necessary, only the amount of grease necessary to hold the balls in place during assembly need be used. All gears are lubricated with AN-G-10. The gear box itself should not be packed with grease. The correct method is to fill all gear tooth spaces only before assembly. A thin film of AN-G-10 on the ball bearing screw is all that is required.

(b) MAIN-LANDING-GEAR BUNGEE SYSTEM. (See figure 9.)

1. DESCRIPTION.- The main landing gear bungee system, one for each main gear, is installed in the top of each main-gear wheel well. The system is of the air-oil type, and consists of an air bottle used in connection with oil. A pressure line, incorporating an air gage, extends from the air bottle to each bungee cylinder. The bungee cylinders are mounted on brackets, one on each side of the upper truss assembly. The cylinder actuating arm is attached to the top cross bar of the upper truss assembly.

2. OPERATION.- The bungee system operates automatically under the constant air and oil pressure in the system. It is used as a booster for the landing gear actuators and, for emergency operation of the gears, forces the landing gear securely into the down position. The system is not connected to the main hydraulic system.

3. REMOVAL.

NOTE

The landing gear must be in the extended or down position.

a. Relieve the air pressure in the air bottle by backing off the filler plug a few turns.

CAUTION

Do not release air by depressing valve. The valve core may be damaged by the sudden rush of air past the valve seat.

b. Disconnect the line at the bottom of the air bottle.

c. Remove the bolts, washers, nuts, and clamps, attaching the air bottle to the mounting bracket. Remove the brackets if necessary.

d. Remove the air bottle.

e. Uncouple the line at the bungee filler blocks.

f. Remove the four bolts attaching the bungee cylinder to the mounting bracket.

g. Remove the lower connecting bolt, washer, spacer, and nut, connecting the bungee cylinder to the upper truss assembly.

h. Remove bungee cylinders.

4. INSTALLATION.- Reverse the removal procedure.

5. INFLATION PROCEDURE.

NOTE

Gear must be in the extended position.

a. Remove the air valve assembly from the fitting on the accumulator.

b. Fill with hydraulic fluid, (Specification AN-VV-O-366, red color) to top of filler block.

c. Replace the filler block plug.

d. Inflate with air to 900 psi.

(c) MAIN-LANDING-GEAR LOCK CONTROL CABLES. (See figure 10.)

1. DESCRIPTION.- The up and down locks are operated by an actuator and con-

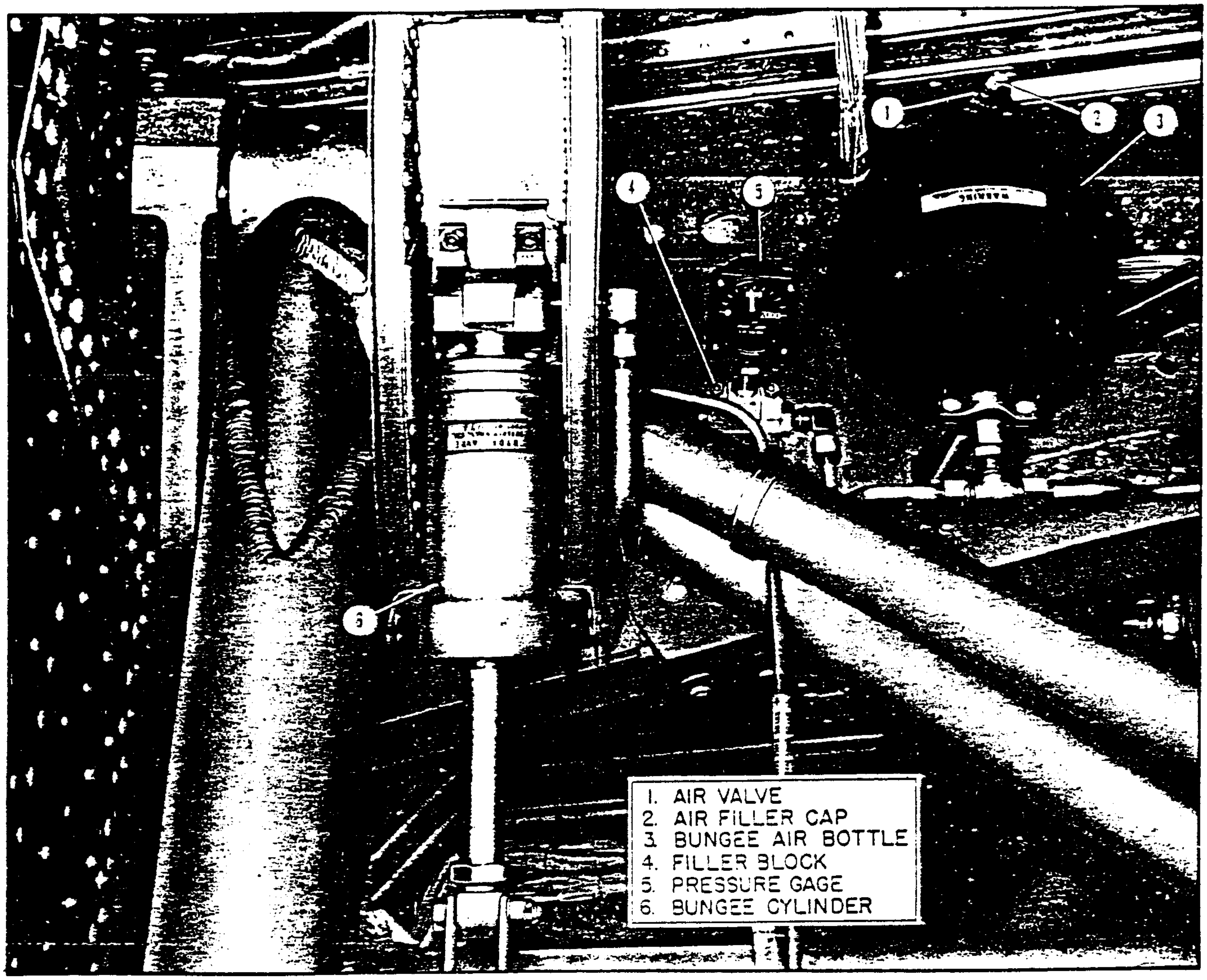


Figure 9. Main Landing Gear Bungee System

nected by cables and a rod, through a lock control mechanism. The up-lock is connected to the control mechanism by an actuating rod. Down-locks are connected to the control mechanism by cables, which extend aft over the gear actuator to pulleys, where one extends inboard, and one outboard to pulleys, then down to the respective locks.

2. OPERATION.- The main landing gear lock control cables are operated by the locks actuator, which is operated by a switch on the main gear forward doors. For normal extension, the actuator turns the lock control mechanism to a position where the rod connecting the up-lock actuates the lock to open position and the down-lock cables open the down-locks. For normal retraction, the actuator moves the control mechanism to a position where the cables unlock the down-locks and the connecting rod sets the up-lock.

3. REMOVAL.

a. Remove safety wire and disconnect turnbuckles connecting the down-locks in the wheel well.

b. Remove the cable pulleys in the top of the wheel well.

c. Disconnect the upper end of the cables at the lock control mechanism.

d. Remove the connecting rod from the up-lock and the lock control mechanism.

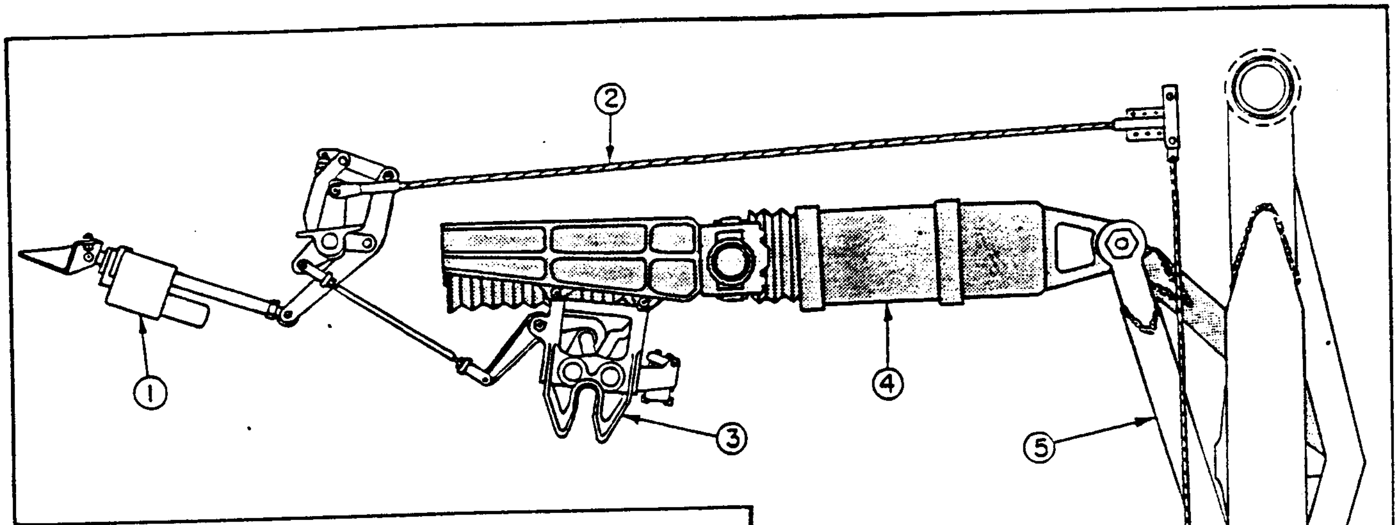
e. Disconnect the lock actuator from the lock control mechanism.

f. Remove the lock control mechanism.

4. INSTALLATION.

a. Install the lock control mechanism.

b. Connect the lock actuator to the lock control mechanism.



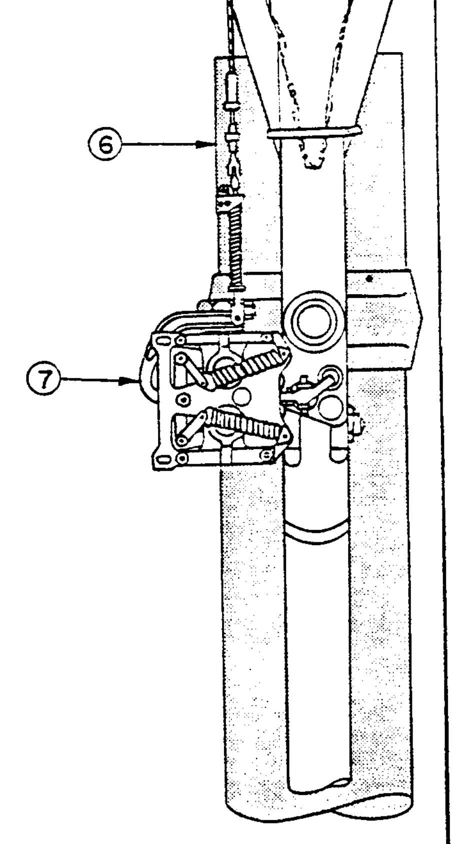


Figure 10. Main Landing Gear Locks Control Cables

c. Attach the connecting rod to the up-lock and lock control mechanism.

d. Connect the cable ends to the lock control mechanism.

e. Install the cable pulleys in the upper wheel well.

f. Extend the cables over the pulleys and connect the turnbuckles at the down-lock.

g. Safety the turnbuckles and adjust the clearance of the lock cams to .10 of an inch.

(7) MAIN LANDING GEAR DOORS AND OPERATING MECHANISM. (See figures 11, 12 and 13.)

(a) DESCRIPTION.- Each main gear wheel well is equipped with two sets of doors. The forward set is operated by a motor-driven actuator. This actuator connects to an arm that operates two rods attaching to the forward doors. The two aft doors are automatically operated by the landing gear during retraction or extension. They are attached to the strut by means of two attaching rods, one for each door. When extending the gear, all doors open, allowing the gear to pass to the down position. The forward doors then close but the aft doors remain open. When retracting, the forward doors open and when the gear is in the fully retracted position, both sets of doors close, forming the contour of the lower wing surface.

(b) OPERATION - FORWARD DOORS.

1. NORMAL EXTENSION.- The initial motion of the landing-gear-control handle to the "DOWN" position unlocks the door locks by means of a cable system and the final motion of the handle closes micro switches which supply current to the actuator motor for forward doors, opening the doors. When the gear is down and locked, micro switches on the down locks direct the current back to the door motor relay, which reverses the current to the door actuator motor, closing the doors. A limit switch shuts off the door motor.

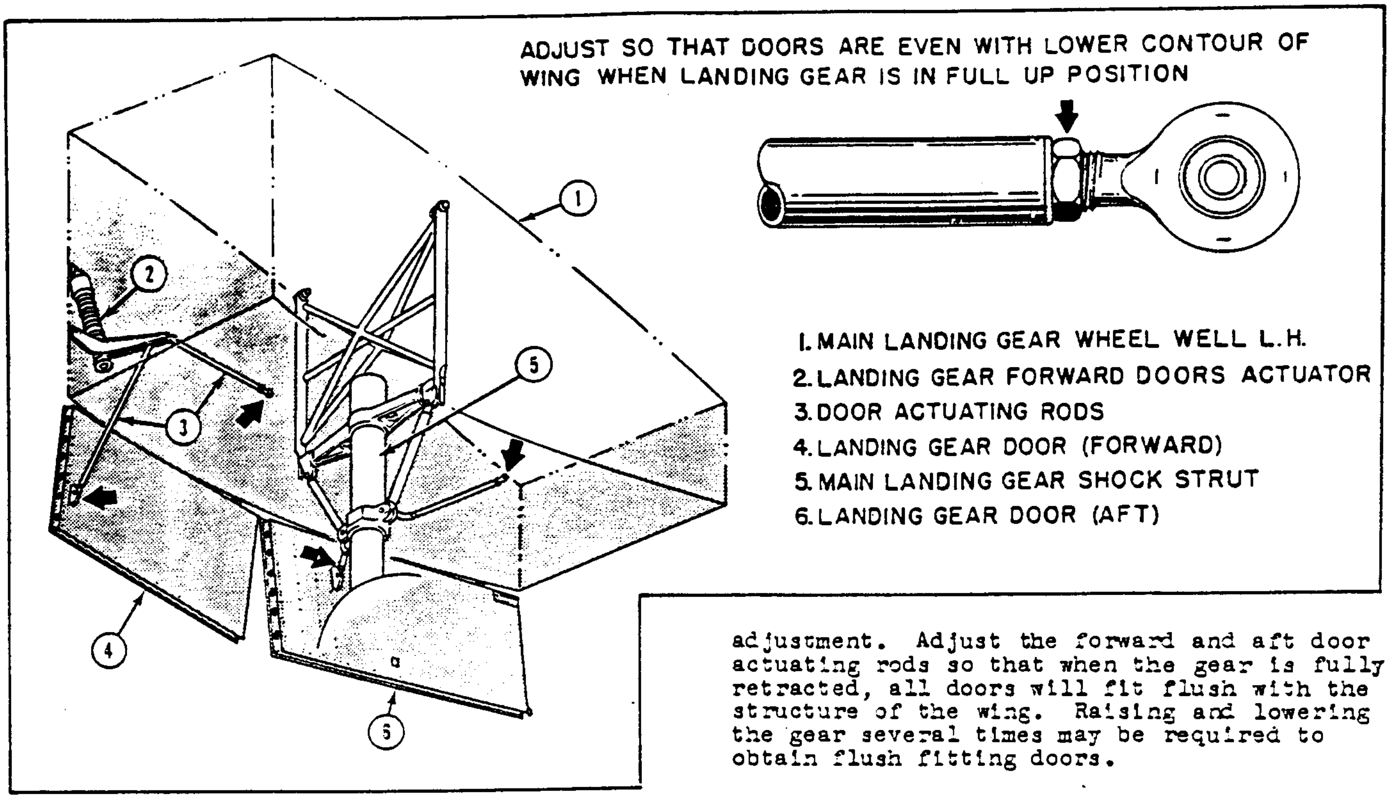


Figure 11. Main Landing Gear Door Mechanism Adjustments

2. NORMAL RETRACTION.- The control handle is moved to the "UP" position which closes switches actuating the door motor to open the doors. As the doors reach the open position limit switches shut off the actuator motor. The locking action of the up-locks operates a switch which actuates the motor to close the forward doors. As the doors are moved to their closed position they automatically lock in the "UP" position. When the actuator arm reaches the "UP" position it engages a micro switch which shuts off the actuator motor.

3. EMERGENCY EXTENSION.- The movement of the emergency release control handle operates the attaching cable system which unlocks the landing gear door locks, and releases the door actuator clutch. The main gear doors open by wheel and air loads, combined.

(c) MAIN-LANDING-GEAR DOORS REMOVAL.

1. Disconnect the actuating rods from each door.

2. Remove the hinge pins attaching each door to the wheel-well structure.

3. Remove the doors.

(d) MAIN-LANDING-GEAR DOORS INSTALLATION.- Reverse the removal procedure.

(e) MAIN-LANDING-GEAR DOORS ADJUSTMENT. (See figures 11 and 12.)- Support the airplane on jacks. Raise the gear requiring the door adjustment. Adjust the forward and aft door actuating rods so that when the gear is fully retracted, all doors will fit flush with the structure of the wing. Raising and lowering the gear several times may be required to obtain flush fitting doors.

(f) MAIN-LANDING-GEAR FORWARD DOORS ACTUATOR. (See figure 13.)

1. DESCRIPTION.- An electrically driven screw-jack type actuator is installed as part of the forward doors actuating mechanism. This actuator is attached to brackets on the forward inboard wheel-well wall. The actuator operates an arm, to which is attached the two door actuating rods. As the actuator moves the arm to the "UP" position, the hook on the end of the arm engages an up-lock, which is installed on the upper forward wheel-well wall. The locking action of the up-lock operates a limit switch which shuts off the actuator motor. The up-lock is mechanically operated and is controlled by a cable system connecting to the control lever.

2. OPERATION.- Four main assemblies comprise the actuator, motor and clutch, gear box, screw jack, overload clutch and release assembly. The actuator is driven by a 208 volt, 400 cycle, 3 phase, a.c. motor. The clutch is a single disc type, the driven disc being normally held against a friction material ring by a spring of sufficient strength to prevent reversing of the actuator under peak static load, and to provide a minimum overtravel of the actuator when the electrical power is interrupted. The clutch is energized by a 28 volt d.c. solenoid coil, which overcomes the spring force, and causes the motor drive disc and driven disc to rotate as a unit. Protection against damage to the motor caused by too frequent cycling is provided by a thermotron in the d.c. control circuit. The clutch on the actuator disengages the actuator when the emergency actuating system is applied.

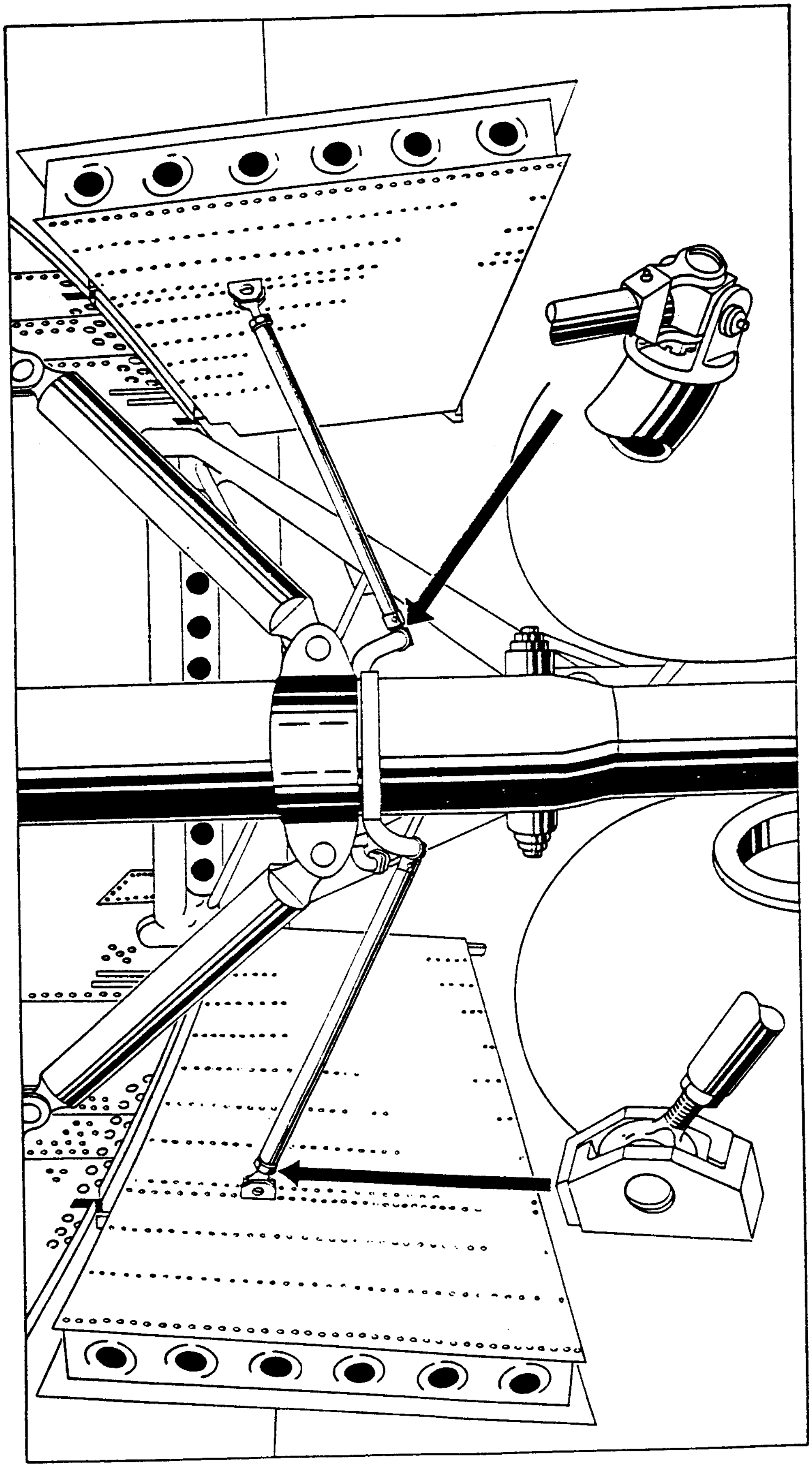


Figure 12. Main Landing Gear Aft Doors Installation

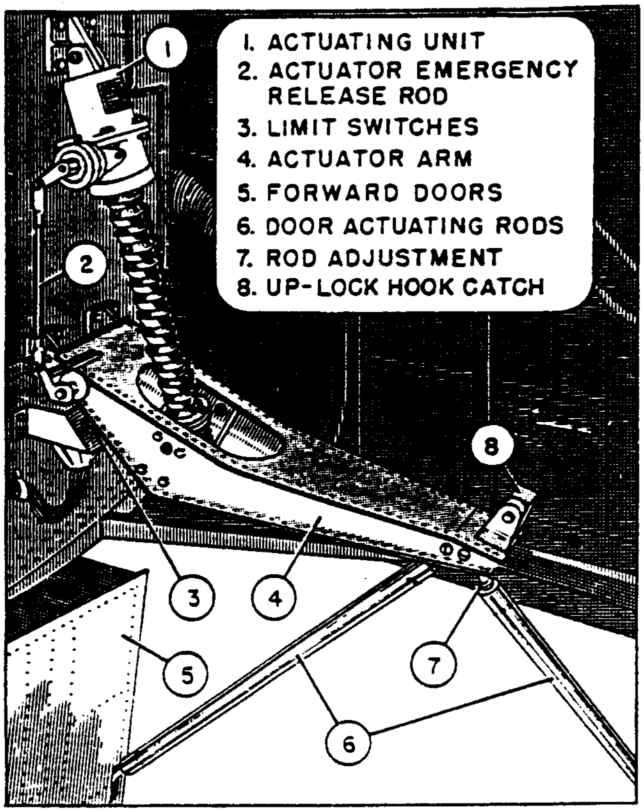


Figure 13. Main Landing Gear Foward Door Operating Mechanism

3. REMOVAL - FORWARD DOORS ACTUATOR.

a. Disconnect the electric plug from the actuator.

b. Remove the cable from the pulley on the emergency release rod.

c. Disconnect the actuator from the mounting bracket and door actuating arm. Remove the actuator.

d. Remove the two forward door support rods from the actuating arm.

e. Remove the actuating arm from the mounting bracket.

4. INSTALLATION - FORWARD DOORS ACTUATING MECHANSIM.

a. Install the actuating arm to the mounting bracket.

b. Attach the actuator to the actuator mounting bracket.

c. Attach the forward door support rods to the actuating arm.

d. Connect the actuator to the actuating arm.

e. Install the cable to the pulley on the emergency release rod.

f. Connect the electric plug to the actuator.

5. MAINTENANCE - FORWARD DOORS ACTUATOR.- All double shielded ball bearings are lubricated with Andok "C" and should require no repacking during the life of the unit. The loose balls supporting the reaction gear and also serving as thrust bearings are lubricated with AN-G-10. In the event disassembly and regreasing is necessary, only the amount of grease necessary to hold the balls in place during assembly need be used. All gears are lubricated with AN-G-10. The gear box itself should not be packed with grease. The correct method is to fill all gear tooth spaces only, before assembly. A thin film of AN-G-10 on the ball bearing screw is all that is required.

d. NOSE LANDING GEAR. (See figure 15.)

(1) GENERAL.

(a) DESCRIPTION AND OPERATION.- The steerable single-wheel, electrically-operated nose landing gear consists of a pneudraulic type shock strut, free swiveling, and a hydraulically operated steer damp. The strut is attached and braced to the upper trunnion shaft, which is part of the crew nacelle. A side brace supports the gear and is attached to the strut and the upper jack shaft actuating mechanism in the leading edge of the wing. Rear thrust is absorbed by a bracket connecting the strut and the upper trunnion shaft. The steer damp operates as a centering device and a steering unit combined. It is applicable for ground operations only. The steering range for ground operations is 98 degrees. An electrically driven actuator operates the nose gear to the up or down position. An emergency actuating system is installed for extending the gear only. Switches mounted on the landing gear assembly operate in connection with the up and down locks to indicate if the gear has locked in the up or down position. A static ground wire is attached to the left side of the strut.

(b) REMOVAL AND DISASSEMBLY.

NOTE

The nose gear weighs approximately 1500 lbs.

1. Assuming that the nose gear is in the down position, jack the airplane so that all three gears clear the ground.

2. Remove hydraulic lines and plug both ends.

3. Remove wheel assembly.

4. Remove side brace at strut connection (disconnect folding brace at elbow).

5. Release the air pressure from the shock strut by backing off the filler plug and allowing the air to escape slowly. This will prevent damage to the valve core by a sudden rush of high pressure air past the valve seat. Always use a wrench to remove or install the filler plug.

ITEM	DESCRIPTION	LOCATION
1	DOOR CLOSE LIMIT SW. BZ-3YT	R.H. MAIN L'D'G GEAR WELL
2	POWER RELAY PANEL	R.H. MAIN L'D'G GEAR WELL
3	L'D'G GEAR UNLOCK ACTUATOR	R.H. MAIN L'D'G GEAR WELL
4	UPLOCK SWITCH WZ-R31	R.H. LANDING GEAR
5	UP-LOCK SWITCH WZ-R31	R.H. LANDING GEAR
6	UP-LOCK SWITCH BZ-R31	R.H. LANDING GEAR
7	LANDING GEAR ACTUATOR	R.H. LANDING GEAR
8	AFT RELAY PANEL	R.H. MAIN L'D'G GEAR WELL
9	DOOR LOCK SWITCH YZ-R31	R.H. MAIN L'D'G GEAR WELL
10	D.C. DISTRIBUTION PANEL	R.H. MAIN L'D'G GEAR WELL
11	DOWN LOCK SWITCH BZ-R31	R.H. LANDING GEAR
12	DOWN LOCK SWITCH BZ-3YT	R.H. LANDING GEAR
13	DOWN LOCK SWITCH BZ-R31	R.H. LANDING GEAR
14	DOWN LOCK SWITCH BZ-3YT	R.H. LANDING GEAR
15	DOOR ACTUATOR	R.H. MAIN L'D'G GEAR WELL
16	DOOR OP'N LMT SW. BZ-3YT	R.H. MAIN L'D'G GEAR WELL
17	DOOR OPEN LIMIT SW. BZ-3YT	R.H. MAIN L'D'G GEAR WELL
18	PRESSURIZED PLUG	R.H. CABIN WALL
19	PRESSURIZED PLUG	L.H. CABIN WALL
20	ENGINEER'S JUNC. PANEL	CREW NACELLE
21	PILOT'S PED. SW. PANEL	CREW NACELLE
22	PILOT'S RELAY PANEL	CREW NACELLE
23	THROTTLE SWITCHES YZ-R31	TOP OF CREW NACELLE
24	L'D'G GEAR WARNING HORN	TOP OF CREW NACELLE
25	PILOT'S & COPILOT'S INS. PANEL	CREW NACELLE
26	L'D'G GEAR POSITION LTS.	PILOT & COPILOT INS. PANEL
27	L'D'G GEAR CONT. CIRCT BR'KR	PILOT'S PED. SW. PANEL
28	L'D'G GEAR POS. LTS. CIR'T BR'KR	PILOT'S PED. SW. PANEL
29	LANDING GEAR ACTUATOR	NOSE LANDING GEAR
30	GEAR DOWN SWITCH BZ-R31	BENEATH PILOT'S PED.
31	GEAR UP SWITCH BZ-R31	BENEATH PILOT'S PED.
32	GEAR UP LOCK SW. WZ-R31	NOSE WHEEL WELL
33	GEAR UP UNLOCK SW. YZ-R31	NOSE WHEEL WELL
34	GEAR UP LOCK SW. BZ-3YT	NOSE WHEEL WELL
35	NOSE WHEEL WELL A.C. PANEL	NOSE WHEEL WELL
36	PRESSURIZED PLUG	L.H. CREW NACELLE WALL
37	AFT DOOR ACTUATOR	NOSE WHEEL WELL
38	AFT DOOR OP'N LMT SW. BZ-3YT	NOSE WHEEL WELL
39	AFT DOOR OP'N LMT SW. BZ-3YT	NOSE WHEEL WELL
40	L'D'G GEAR UNLOCK ACTUATOR	NOSE WHEEL WELL
41	GEAR DOWN UNLOCK SW. YZ-R31	NOSE WHEEL WELL
42	GEAR DOWN LOCK SW. BZ-R31	NOSE WHEEL WELL
43	F'WD DOOR CLOSE L'MT BZ-3YT	NOSE WHEEL WELL
44	DOOR LOCK SWITCH YZ-R31	NOSE WHEEL WELL
45	F'WD DOOR OP'N L'MT SW. BZ-3YT	NOSE WHEEL WELL
46	GEAR DOWN LOCK SW. YZ-R31	NOSE WHEEL WELL
47	GEAR DOWN LOCK SW. BZ-3YT	NOSE WHEEL WELL
48	F'WD DOOR ACTUATOR	NOSE WHEEL WELL
49	AFT DOOR CLO. L'MT SW. BZ-3YT	NOSE WHEEL WELL
50	F'WD DOOR OP'N L'MT SW. BZ-3YT	NOSE WHEEL WELL
51	D.C. DISTRIBUTION PANEL	L.H. MAIN L'D'G GEAR WELL
52	LANDING GEAR ACTUATOR	L.H. LANDING GEAR
53	UP-LOCK SWITCH BZ-R31	L.H. LANDING GEAR
54	UP-LOCK SWITCH WZ-R31	L.H. LANDING GEAR
55	UP-LOCK SWITCH WZ-R31	L.H. LANDING GEAR
56	POWER RELAY PANEL	L.H. MAIN L'D'G GEAR WELL
57	GEAR UNLOCK ACTUATOR	L.H. LANDING GEAR
58	DOWN LOCK SWITCH BZ-R31	L.H. LANDING GEAR
59	DOOR CLO. L'M'T SW. BZ-3YT	L.H. MAIN L'D'G GEAR WELL
60	DOWN LOCK SWITCH BZ-3YT	L.H. LANDING GEAR
61	DOWN LOCK SWITCH BZ-R31	L.H. LANDING GEAR
62	DOOR ACTUATOR	L.H. MAIN L'D'G GEAR WELL
63	DOOR OP'N L'MT SW. BZ-3YT	L.H. MAIN L'D'G GEAR WELL
64	DOOR OP'N L'MT SW. BZ-3YT	L.H. MAIN L'D'G GEAR WELL
65	L'D'G GEAR SAF. SW. YZE7RNTN2	L.H. LANDING GEAR
66	DOWN LOCK SWITCH BZ-3YT	L.H. LANDING GEAR
67	DOOR LOCK SWITCH YZ-R31	L.H. MAIN L'D'G GEAR WELL
68	AFT RELAY PANEL	L.H. MAIN L'D'G GEAR WELL

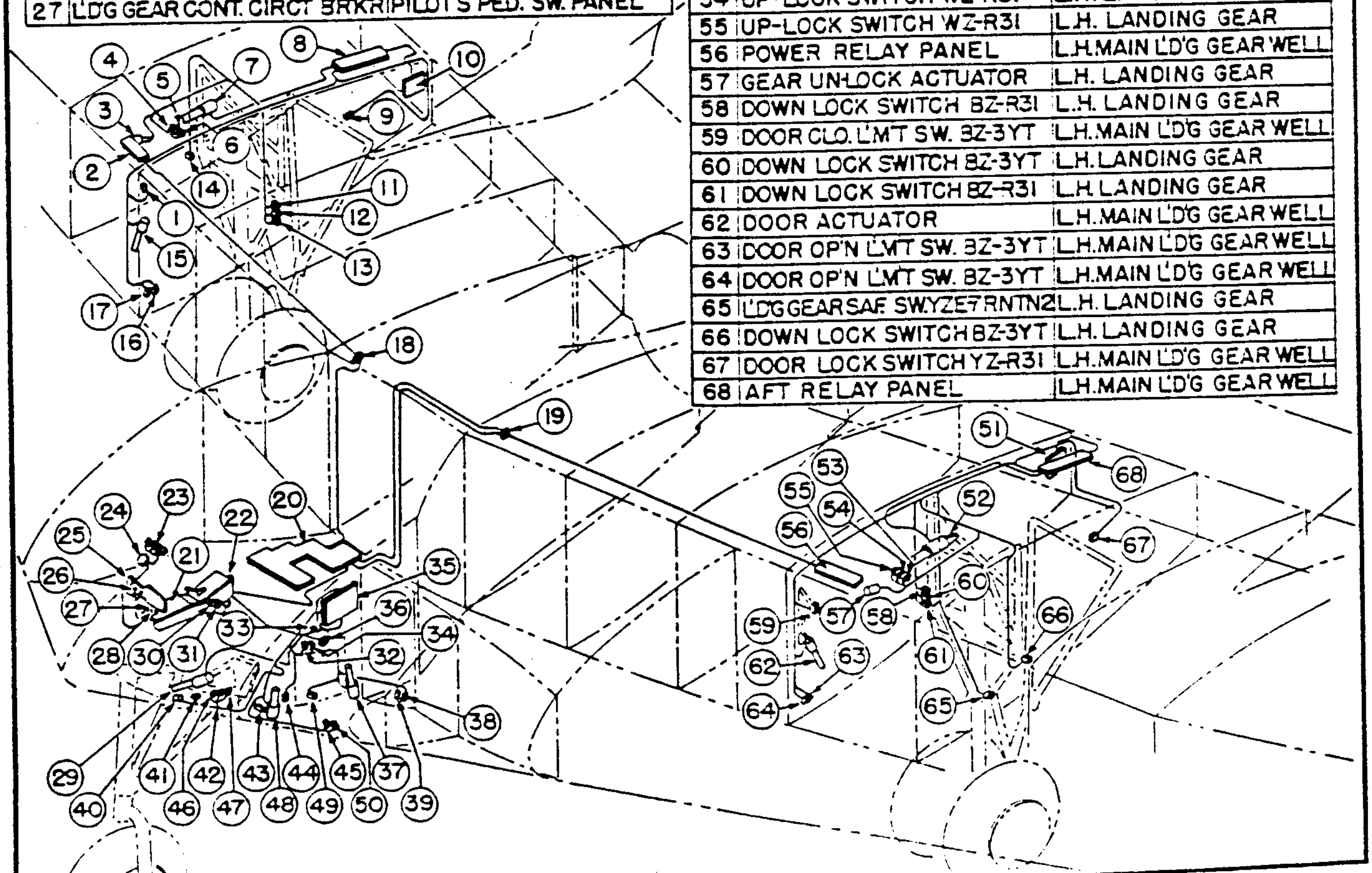


Figure 14. Landing Gear Electrical Controls

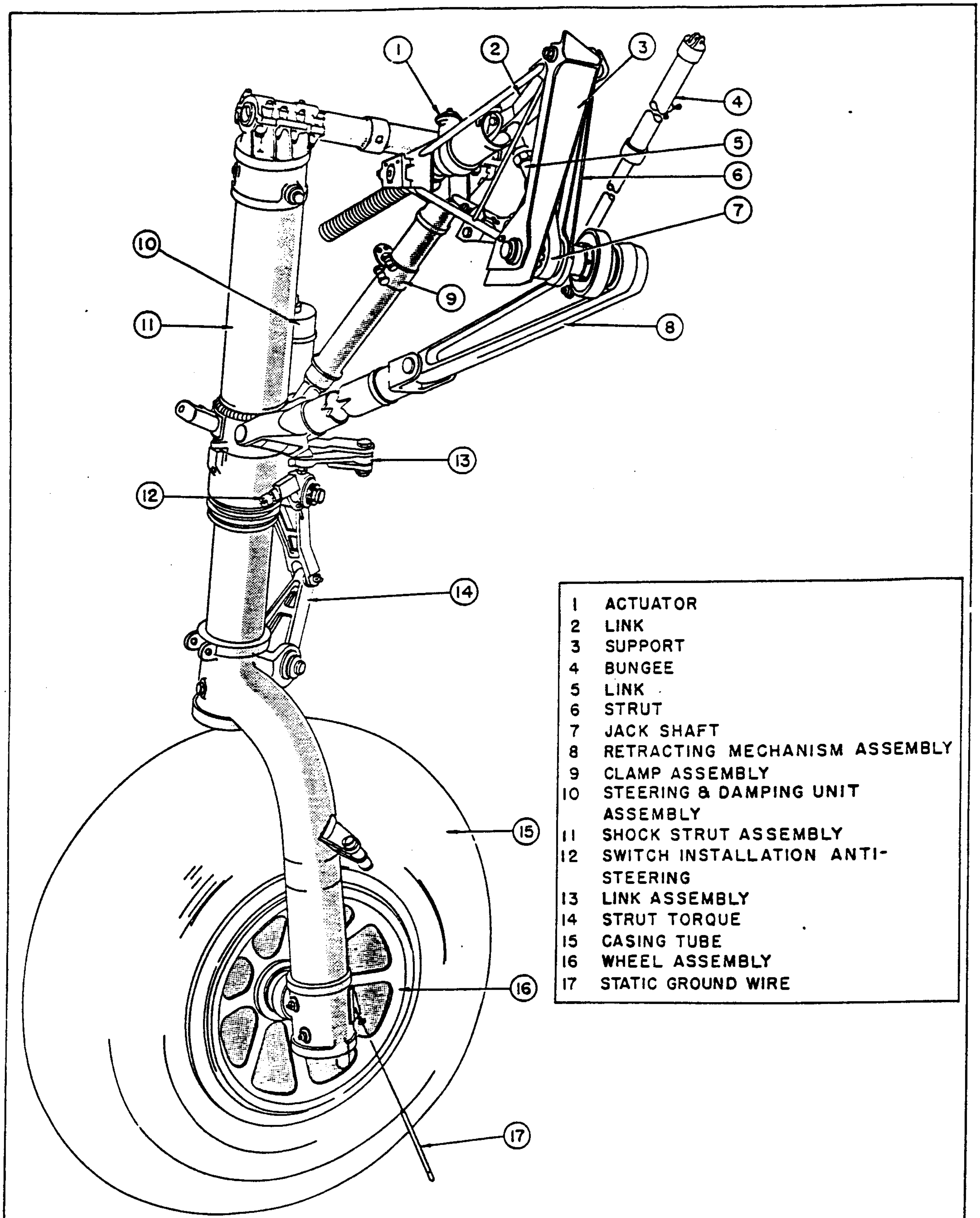


Figure 15. Nose Landing Gear Assembly

CAUTION

Do not attempt to remove the filler plug without completely deflating the strut. Wait until all fizzing of air and fluid stops.

6. Disconnect torque fitting switch (torque links).

7. Remove drag brace.

8. Remove bearing caps from trunnion pin. Remove gear.

9. Disassemble shock strut if necessary.

10. Remove steer damp from strut if necessary.

(c) INSTALLATION.

1. Assuming that the strut is completely assembled and the airplane is on jacks, compress the strut fully and raise into position on the trunnion pin. Attach bearing caps.

2. Attach drag brace.

3. Connect torque fitting switch on drag link torque fitting.

4. Install wheel assembly. Refer to Section IV, paragraph 6 following.

5. Attach the side folding brace to the strut.

6. Connect hydraulic lines to the steer damp.

7. Fill and inflate the shock strut as outlined in paragraph 5 c (2) (h) preceding. Refer to instruction plate on RH side of strut.

8. Check operation of gear before removing the jacks.

(2) NOSE GEAR SHOCK ABSORBING STRUT. (See figure 16.)

(a) DESCRIPTION AND OPERATION.- The shock absorbing strut for the nose gear is the pneumatic type (Bendix No. EQ-2). The working principle is conventional. Refer to paragraph 5 c (2) (a) preceding.

(b) MAINTENANCE AND REPAIRS.

1. The replacement and repair instructions given for the main landing gear shock strut in paragraphs 5 c (2) (c) and 5 c (2) (e) preceding also apply to the nose gear shock strut.

(c) REMOVAL AND DISASSEMBLY.- Removal and disassembly of the nose-gear shock strut is similar to that of the main-gear shock struts. Refer to paragraph 5 c (2) (b) preceding.

(d) ASSEMBLY AND INSTALLATION.

1. Assemble the nose-gear shock strut using the same procedure as outlined in paragraph 5 c (2) (f) preceding.

2. Replace the shock strut as outlined in paragraph 5 c (2) (g) preceding.

(3) NOSE-GEAR STEERING MECHANISM. (See figures 17 and 18.)

(a) DESCRIPTION.- The nose-wheel steering mechanism is controlled by the steering handle, located in the left front part of the pilots' compartment. The mechanism includes a combined mechanical and hydraulic system. The mechanical linkage serves as a control for the hydraulic steer damp which provides turning force for the nose wheel. As the nose gear is retracted, a self-centering device in the shock strut straightens the wheel from any position to which it may have been turned.

(b) OPERATION.

1. MECHANICAL.- When the steering handle (with the trigger compressed) is turned, the connecting mechanical linkage conveys the motion to the hydraulic selector valve in the steer damp, which turns the nose wheel in the direction desired. See paragraph d (3) (j) following, for description and operation of the linkage.

2. HYDRAULIC.- The nose wheel steering is operated by depressing the steering-handle button which energizes the solenoid valve (see figure 19) and supplies fluid to the steering unit. This valve has two cylinder ports, a pressure port and a return port. One of the cylinder ports is connected normally to the pressure port. When the solenoid is actuated the opposite port is pressurized and the first cylinder port is opened to the return port. When in the "OFF" position, the valve maintains a preload pressure in the shimmy damper. Energizing the valve cuts out the damper and supplies pressure for steering. The steering unit has an internal valve which is operated manually by turning the steering handle. Depressing the button on the steering handle also energizes the solenoid valve supplying pressure to the foot-brake valves. Thus the pilot can steer and energize his foot brakes at the same time. The nose-steering-and-brake system is operative only when on the ground. Cut-off switches are located on each main gear mechanism, so that the circuit is opened when the gears retract. The circuit to operate the solenoid valves is energized by the master battery switch. An anti-steering switch is located on the nose-gear strut so that the strut must be compressed before the steering unit can be used. The nose-steering hydraulic system is a part of the main hydraulic brake and steering system. Only the individual unit pertaining to steering operations is dealt with in this paragraph. Refer to paragraph 16 (a) 2 for complete system.

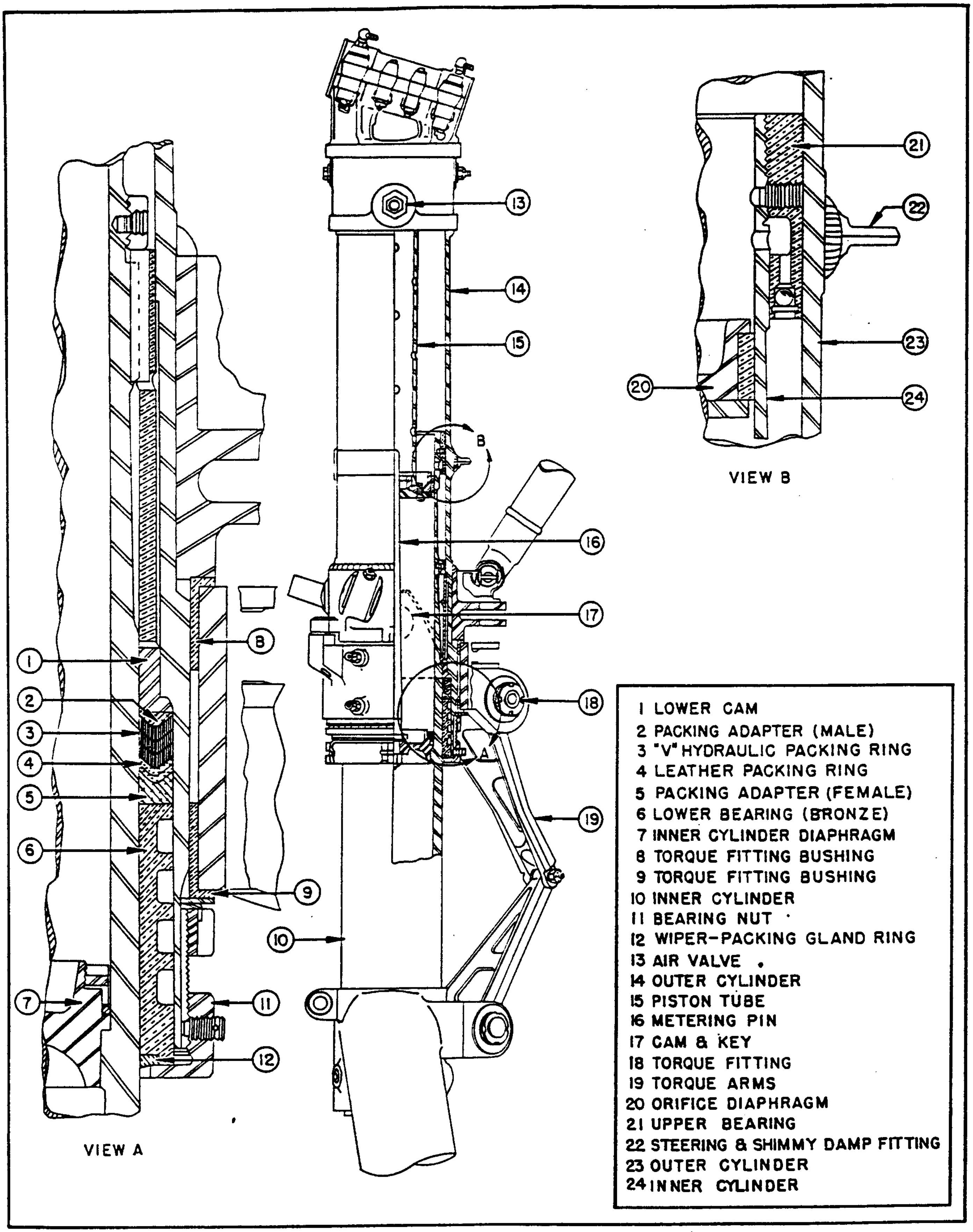


Figure 16. Nose Gear Shock Strut Diagram

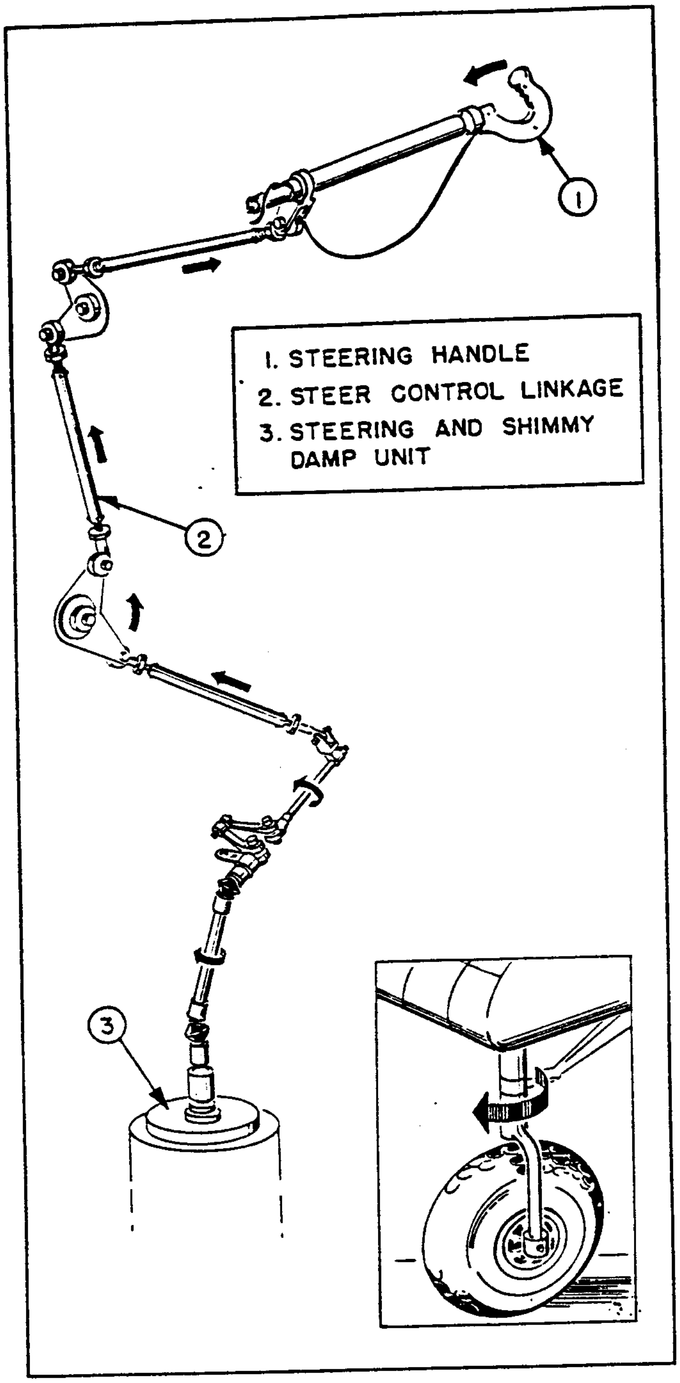


Figure 17. Nose Wheel Steering Mechanism

3. ELECTRICAL.- The current for the 28 volt, d.c. circuit that operates the hydraulic solenoid valve to permit nose wheel steering is wired through a circuit breaker on the pilots' pedestal panel to a relay on the nose-steering and brake-relay panel. This relay, which is controlled by the steering-handle switch, energizes both the brake and steering solenoids. The circuit from the relay to the steering solenoid is broken by a microswitch on the nose-gear strut when the nose wheel is off the ground. The pilot and copilot switches (on their respective control wheels) pick up the 28 volt d.c. from the nose-steering-and-brake relay panel and then pass the current through the same panel to the brake solenoid valve.

(c) TEST.- Refer to main hydraulic system, paragraph 16 i (2).

(d) REMOVAL.

NOTE

Only the removal of the four-way solenoid valve is pertinent to this paragraph.

1. Disconnect the electrical plug.

2. Disconnect and immediately plug the hydraulic lines.

3. Remove the four nuts, washers, and bolts, attaching the valve mounting bracket to the frame installation.

4. Remove the valve and bracket as a unit.

(e) DISASSEMBLY AND REPAIR.- The solenoid valve is of a complicated internal design and no disassembly or repair should be attempted. If the valve operates in a faulty manner, replace it.

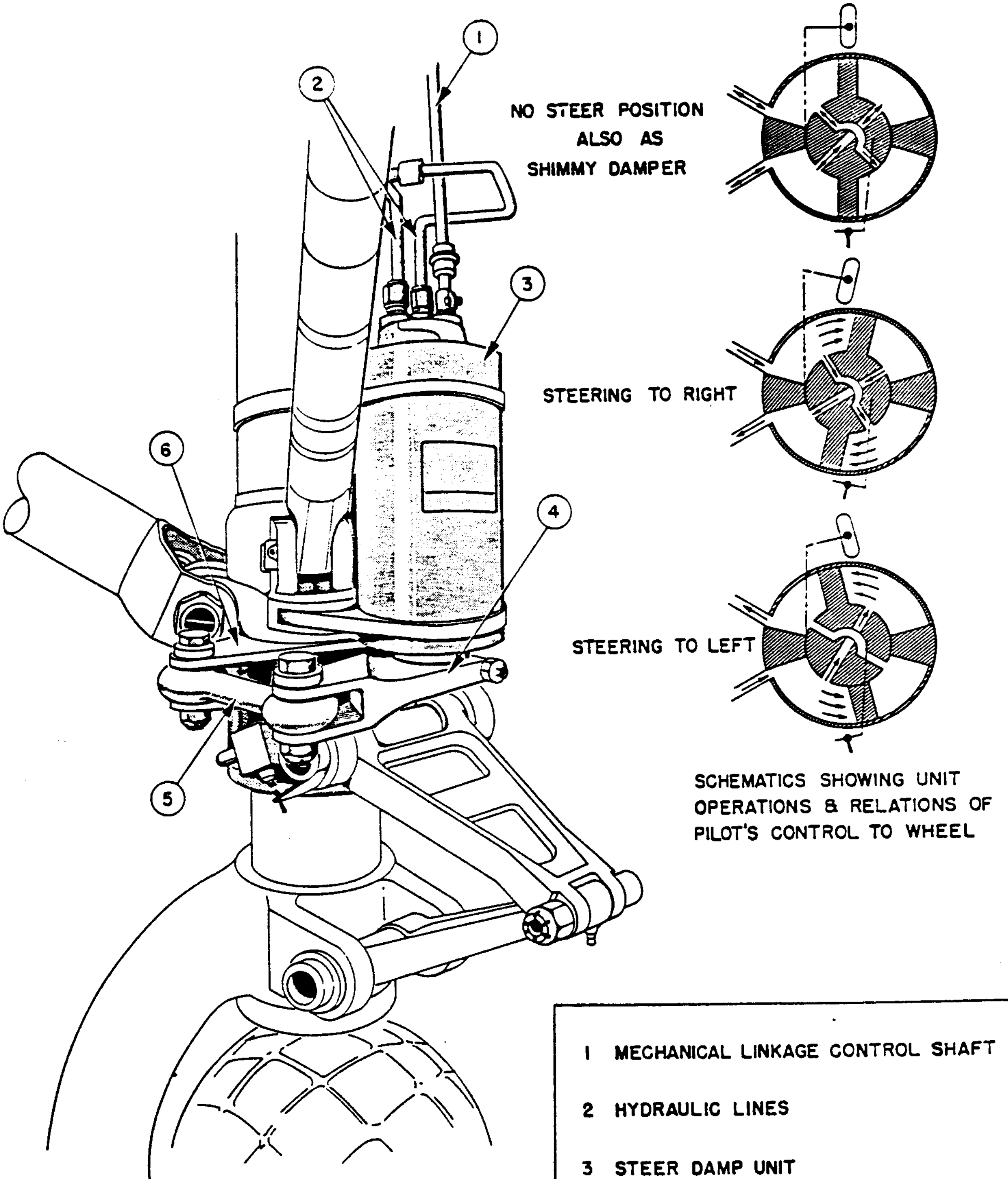
(f) TEST.- For testing procedure on the valve, refer to paragraph 16 j (9) (d).

(g) INSTALLATION.- Reverse the removal procedure. Bleed the lines as outlined in paragraph 16 c (2) (b).

(h) NOSE-STEERING AND PARKING-BRAKE CONTROL HANDLE. (See figure 20.)

1. DESCRIPTION.- The nose-wheel steering handle is located in the pilots' compartment on the left side of the instrument panel. The handle attaches to a shaft which is mounted to the crew nacelle. Nose-wheel steering is accomplished by squeezing the trigger on the handle and then turning the handle to the left or right.

2. OPERATION.- When steering the airplane in any direction, compress the trigger and turn the handle to the direction desired. The initial movement of the trigger operates a microswitch inside the handle, which actuates a solenoid valve releasing hydraulic pressure to the steer damp. The parking brake release unit inside the handle shaft also operates in connection with the trigger. The unit releases the steering handle from the brake "ON" position. When the steering handle is pulled directly aft, a hydraulic valve allows hydraulic fluid to flow to the two main wheels for equal braking and for application of the parking brakes The hand or parking brakes are released by compressing the trigger on the control handle and then allowing the handle to move to its full forward position. See figure 51 for wiring diagram of control circuit.



1	MECHANICAL LINKAGE CONTROL SHAFT
2	HYDRAULIC LINES
3	STEER DAMP UNIT
4	STEER DAMP LEVER
5	STRUT CONNECTING LINK
6	STRUT LINK CONNECTOR

Figure 15. Nose Gear Steer Damp Principle

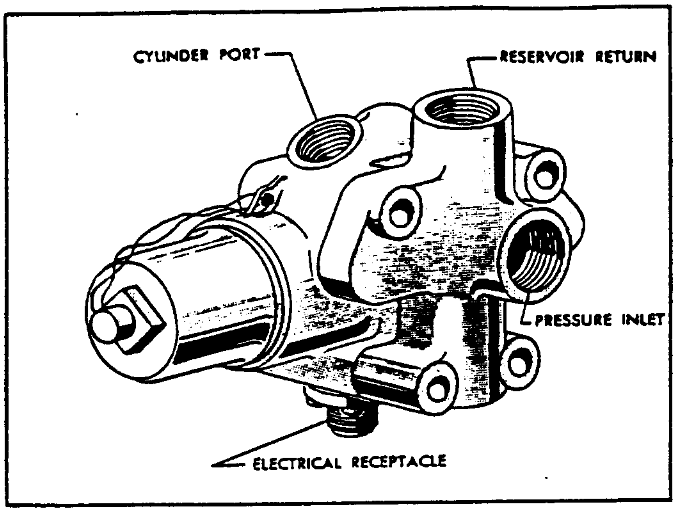


Figure 19. Hydraulic Steering Valve - 4-Way Solenoid

3. REMOVAL AND DISASSEMBLY.

a. Disconnect the electric wire from the solenoid valve.

b. Remove the linkage lever and the steering shaft from mounting support which is bolted to the crew nacelle structure.

c. Remove the cable assembly from the end of the shaft.

d. Remove the steering handle and the shaft as a unit.

e. Disassemble the handle.

4. ASSEMBLY AND INSTALLATION.

a. Assemble the handle and the shaft.

b. Insert the handle shaft into the support.

c. Attach the linkage lever to the shaft.

d. Attach the cable assembly to the end of the shaft.

e. Connect the electric wire to the solenoid valve.

(1) NOSE-WHEEL STEER DAMP. (See figure 18.)

1. DESCRIPTION.- A hydraulic operated Houdaille steer damp (Model A-12198) is used on the landing-gear nose strut of the XB-35 airplane. The unit is cylindrical in shape and is mounted to the outer cylinder of the strut. A lever and link at the bottom of the steer damp attach to the swivel torque fitting of the strut for steering the nose wheel. Hydraulic line connections and the selector valve connection are located at the top of the steer damp unit.

2. OPERATION.- The Houdaille steer damp consists of a rotating-vane type power cylinder with a protruding shaft on the lower end which is used to transmit steering motion to the nose wheel. A lever connects the shaft to the nose wheel strut torque fitting. A four-way selector valve at the top of the shaft is controlled by the steering-and-parking-brake handle in the cockpit. When turning the handle with the trigger compressed, mechanical linkage operates the selector valve allowing hydraulic pressure to enter the power cylinder. The control shaft for the selector valve is connected to a small shaft protruding from the port flange end of the unit. The port flange is drilled and tapped to receive the inlet and return connections from the hydraulic system and contains a spring loaded check valve in the inlet line and a pressure operated check valve in the return line. The check valve in the return line is controlled by the pressure in the inlet line and in event of failure of the hydraulic system, the steer damp becomes a self sealed unit continuing to operate as a shimmy damper. A spring loaded locking mechanism locks the selector valve in neutral when no pressure is applied for steering. When pressure is applied for steering, it actuates a piston which unlocks the locking mechanism, permitting the selector valve to be turned. Thus the steering handle always rotates with the nose wheel, showing the relative wheel position. The steering cannot be turned from the cockpit unless pressure is applied to the steering port. The complete operation of the steering mechanism is applicable to ground operations only.

3. REMOVAL.

a. Disconnect the hydraulic lines at the top of the steer damp.

b. Disconnect the selector-valve control shaft at the top of the steer damp.

c. Remove the steer-damp lever and link from the shaft at the bottom of the steer damp.

d. Remove the steer-damp mounting bolts.

e. Remove the steer damp.

4. MAINTENANCE AND REPAIR.

a. The steer damp utilizes hydraulic fluid from the nose wheel steering and brake hydraulic system. Changing fluid is not necessary unless a complete change for the system is required.

b. Air pockets may be eliminated by bleeding the hydraulic system. Refer to Section IV, paragraph 16 c (2) (b).

c. METERING ORIFICE ADJUSTMENT.- The orifice indicator is located at the lower end of the damper operating shaft, under the hex head plug at the bottom of the serrated shaft.

1. Cut the lock wire and remove the plug.

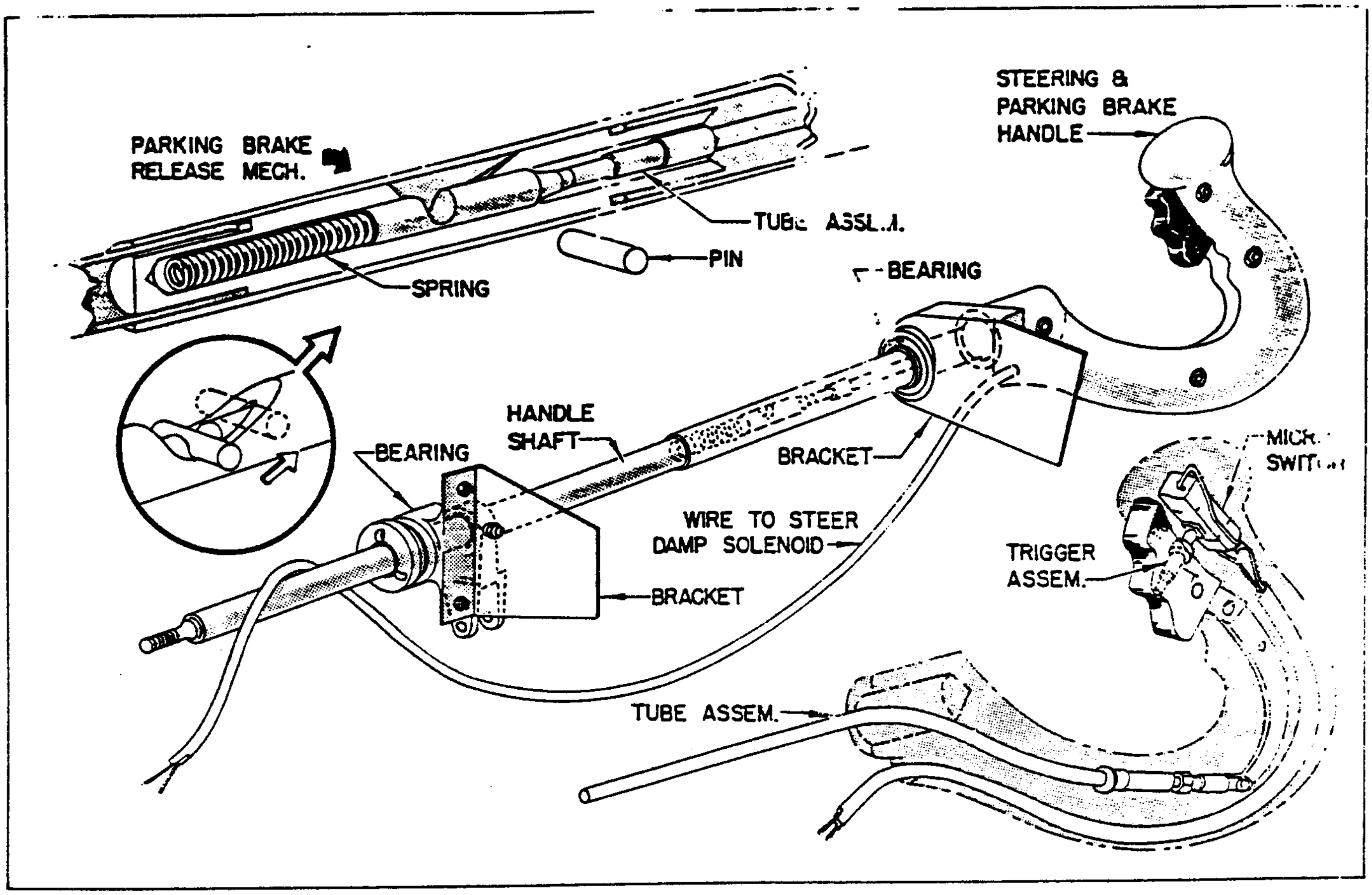


Figure 20. Nose Steering - Parking Brake Control Handle

2. The slot on the valve shaft end should be in line with the mark between the "O" and "S."

3. To increase resistance, move the valve shaft clockwise.

4. To decrease resistance, move the valve shaft counterclockwise.

5. If the steer damp is damaged beyond adjustments and repair mentioned above, replace the entire steer-damp unit.

5. INSTALLATION.

a. Mount the steer damp with the attaching bolts.

b. Install the lever and link to the shaft at the bottom of the steer damp.

c. Connect the hydraulic lines to their respective connectings at the top of the steer damp.

d. Connect the selector-valve shaft to the steer damp.

e. Bleed the forward hydraulic system and check operation of the steering unit. Refer to Section IV, paragraph 16 c (2) (b) for bleeding the lines.

(j) MECHANICAL LINKAGE. (See figure 17.)

1. DESCRIPTION.- The mechanical linkage connecting the steer damp and the steering handle conveys the motion from the steering handle to the selector valve in the steer damp. The linkage consists primarily of adjustable push-pull rods, bellcranks, brackets, a pulley and a cable. The linkage is actuated when turning the steering control handle to the right or left. The parking brake mechanism which also is operated by the steering handle, attaches to the end of the handle by means of a cable and a quadrant to the hydraulic valve for parking brake operation.

2. REMOVAL.

a. Disconnect and remove all the push-pull rods, bellcranks, and connecting rods between the steering handle shaft and the steer damp.

b. Remove the brackets if necessary.

c. Remove the parking brake cable and the quadrant from the end of the steering handle shaft and the brake valve.

3. INSTALLATION.

a. Attach the parking brake cable assembly and the quadrant to the steering handle and the brake valve.

b. Install the push-pull rods, connecting rods, and bellcranks. Connect to the steering handle shaft and the steer damp.

c. Check operation of the steer damp and the parking brake.

4. ADJUSTMENTS.

a. Adjust the length of push-pull rods if necessary. Steering handle should be vertical with nose wheel straight forward.

b. Adjust parking brake valve clearance on the top of the valve to approximately .20 clearance.

NOTE

Before any pressure is applied, adjust turnbuckle until 1300 psi is applied at brakes when handle is full out. Be sure brake pressure returns to "O" when the handle is pushed full in.

(4) NOSE-GEAR UP-LOCK. (See figure 39.)

(a) DESCRIPTION.- The nose-landing-gear up-lock is a spring-loaded open-hook type, and is operated by a lock actuator. It is located in the upper wheel-well, mounted to the structure of the crew nacelle. The up-lock is automatically actuated to locked position by entry of a lug on the landing gear leg, at the end of retraction.

(b) OPERATION.- When the nose gear doors reach the open position, a switch is closed, starting the lock actuator to open the up-lock. When the up-lock reaches the full open position, a switch is closed to start lowering the gear.

(c) REMOVAL.

1. Remove the screw attaching the control cable.

2. Disconnect the rod assembly.

3. Disconnect the microswitches from the lock.

4. Remove mounting bolts attaching the up-lock to the crew nacelle structure in the wheel-well.

(d) INSTALLATION.

1. Install the mounting bolts attaching the up-lock to the crew nacelle structure.

2. Connect wiring to the microswitches.

3. Attach the rod assembly.

4. Connect the cable control assembly to the up-lock.

(5) NOSE-GEAR DOWN-LOCK. (See figure 21.

(a) DESCRIPTION.- The nose-gear down-lock is used to hold the nose gear in the full extended position. The lock is a spring-loade open-hook type and is operated by the lock actuator. It is connected with the up-lock by adjustable connecting rods. The lock is attached to a brace, located beneath the nose-gear actuator.

(b) OPERATION.- The nose-gear down-lock and the up-lock operate together through the connecting rod linkage. When the down-lock closes, the up-lock opens, and vice-versa. The position of the locks is controlled by the reversible motor on the locks actuator. As the gear goes into the down lock, a switch is closed stopping the nose-gear actuator and starting the door actuators to close the nose gear doors.

(c) REMOVAL.

1. Remove the bolt connecting the actuator and the lock.

2. Remove the bolt directly above the attaching spring. Remove the spring.

3. Remove the lock supporting bolt.

4. Remove the lock and mechanism from the supporting bolt.

(d) INSTALLATION.

1. Assemble the lock mechanism and insert the lock supporting bolt. Attach the nut.

2. Fasten spring and attach bolt directly above.

3. Attach connecting bolt between actuator and lock.

(e) ADJUSTMENT.- Loosen the mounting bolt and nut. Rotate the eccentric to adjust centering of nose-gear side brace. The side brace attaches the nose strut and gear actuating mechanism, and must be perfectly straight when the gear is in the fully extended position.

(6) NOSE-GEAR LOCKS ACTUATOR (See figure 21.)

(a) DESCRIPTION AND OPERATION.- The nose-landing-gear locks actuator (Lear No. D400AH-1) is mounted to a support directly beneath the nose gear actuator. The actuator is connected to the down-lock mechanism and controls the action of the up and down locks. A cable is attached to the actuator for emergency operation of the locks. The actuator is self contained and consists of a gear housing and screw jack assembly, a motor assembly, and a control assembly. The actuator motor is reversible, incorporating a thermal protector and travel limit switches. The motor operates on 28 volts d.c. which is controlled by microswitches actuated by the wheel-well doors.

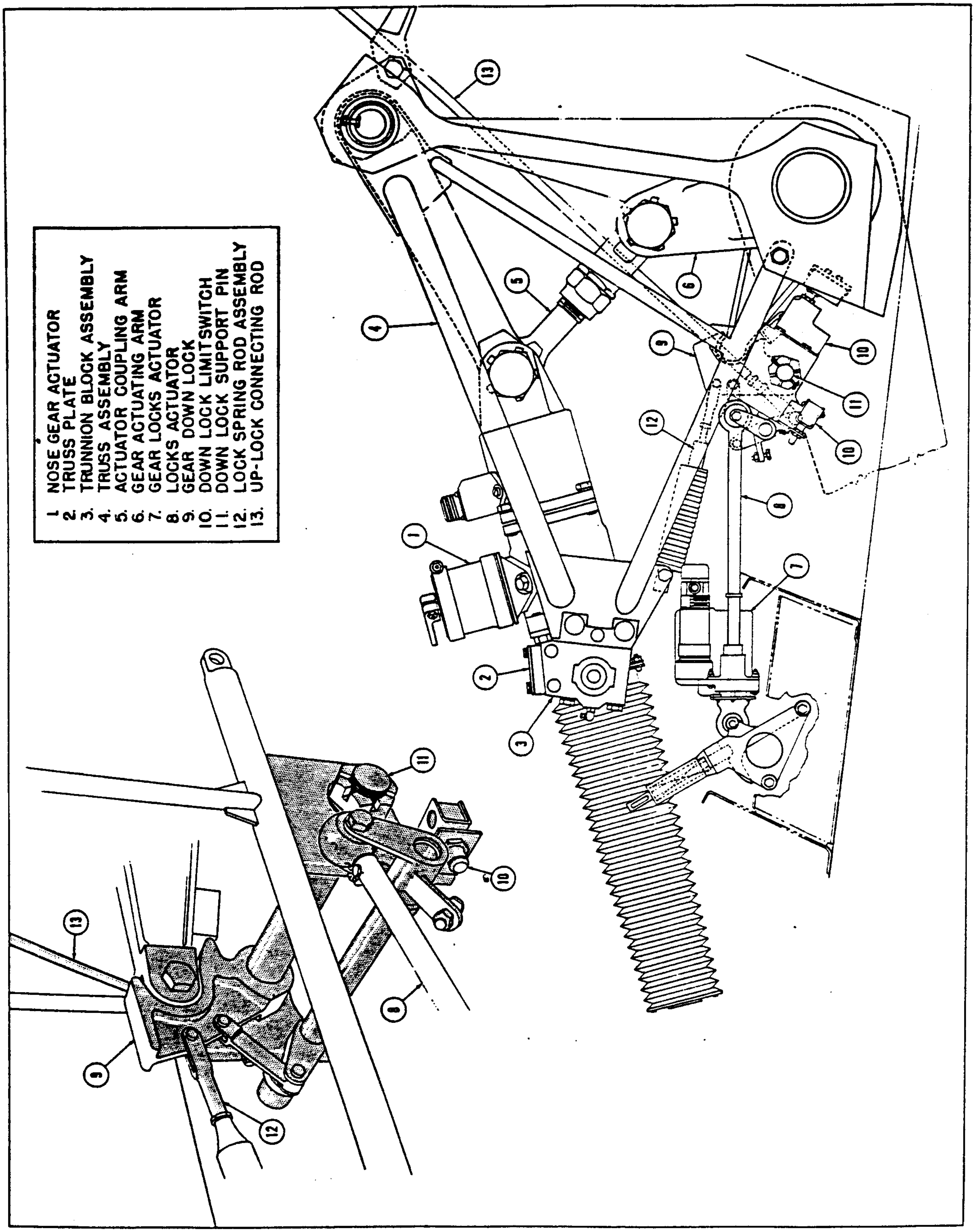


Figure 21. Nose Gear Actuator, Down-Lock and Locks Actuator

CAUTION

The motor is designed for intermittent duty and must not be operated continuously, either with or without load. Operating time should not exceed the proportion of 3 minutes on, and 17 minutes off.

(b) REMOVAL.

1. Disconnect electrical plug.

2. Remove the bolt attaching the actuator arm to the down-lock mechanism.

3. Remove the bolt attaching the actuator to the support assembly. Remove the actuator.

(c) INSTALLATION.- Reverse the removal procedure.

(d) MAINTENANCE.- Any maintenance, other than brush replacement, should be done at a repair depot. Brushes can be replaced by removing the two brush retaining caps from the motor housing. Brushes should be replaced when worn to .156-inch.

(7) NOSE GEAR UP AND DOWN-LOCK CONTROL MECHANISM. (See figure 23.)

(a) DESCRIPTION AND OPERATION.- The up-lock and the down-lock control mechanism consists of two rods linked between the two locks, in the nose-gear wheel-well. The operation of the connecting linkage is controlled by the locks actuator. The mechanism is so arranged that when the up-lock is open, the down-lock is closed, and vice-versa. The rods connecting the two locks are adjustable.

(b) REMOVAL.- Remove the rod connecting the up-lock and the link. Remove the rod connecting the link and the down-lock. Bolts, washers, and nuts, attach the two rods.

(c) INSTALLATION.- Connect one rod to the up-lock and the other to the down-lock. Attach the opposite end of each rod to the connecting link. Adjust rod lengths if necessary.

(8) NOSE-GEAR OPERATING MECHANISM.

(a) ACTUATOR. (See figure 21.)

1. DESCRIPTION AND OPERATION.- An electrically driven screw-jack type, nose gear actuator is installed on the XB-35 airplane. The actuator is attached to the retracting mechanism, and is equipped with a clutch arrangement which disengages the actuator when the emergency extension system is used. Microswitches operated by the up and down locks, direct electrical current to the actuator motor. The nose-gear actuator is coordinated with the main gear in normal and emergency operation. The actuator is composed of four main assemblies, motor and clutch, gear box, screw jack, overload clutch and governor. The actuator is driven by a 208 volt, 400 cycle, 3 phase a.c. motor. The clutch is a single-disc type. The driven disc is normally held against a friction material ring by a spring to prevent reversing of the actuator under load, and to provide a minimum overtravel of the actuator when electrical power is interrupted. The clutch is energized by a 28 volt d.c. solenoid coil which overcomes the spring force and causes the motor drive disc and driven disc to operate as a unit. Protection against damage to the motor caused by too frequent cycling is provided by a thermatron in the d.c. control circuit.

2. REMOVAL.- Jacking the plane is not necessary. Remove the actuator when the gear is extended.

a. Disconnect the electrical connecting plug and the ground wire.

b. Disconnect the clutch release cable.

c. Remove the coupling arm connecting the actuator to the nose-gear actuating arm.

d. Remove the lockwire, bolts, washers, and nuts attaching the truss plate and trunnion block to the truss assembly.

e. Remove the actuator from the truss assembly frame.

3. INSTALLATION.- Reverse the removal procedure.

4. MAINTENANCE.- All double shielded ball bearings are lubricated with Andok "C" and should require no repacking during the life of the unit. The loose balls supporting the reaction gear, and also serving as thrust bearings are lubricated with AN-G-10. In the event disassembly is necessary, only the amount of grease required to hold the balls in place during assembly need be used. All gears are lubricated with AN-G-10. The gear box itself should not be packed with grease. The correct method is to fill all gear tooth spaces only, before assembly. A thin film of AN-G-10 on the ball bearing screw is all that is required.

(b) AIR EXTENSION SYSTEM (BUNGEE). (See figure 22.)

1. DESCRIPTION.- The nose gear bungee system consists of a hydraulic cylinder incorporating an air gage. The cylinder is filled with red hydraulic fluid, Specification AN-VV-O-366, and used in connection with air. A minimum pressure of 400 psi should be maintained in the bungee cylinder. When the gear is working against the bungee, the pressure increases to 600 psi. The cylinder is attached to a bracket in the upper wheel-well, and to the gear retracting mechanism.

2. OPERATION.- To insure a continued extension of the gear into the down-lock, the

Figure 22. Nose Gear Bungee

air-oil bungee operates to push the gear securely into the down position. Retracting, it assists the gear slightly just before the gear reaches the up-lock.

3. REMOVAL.- Jacking is not necessary. With the nose gear in the down position, release the air pressure.

CAUTION

Release air pressure from the cylinder by turning the air filler plug slowly with a wrench.

Remove the nut and bolt attaching the upper end of the cylinder to the bracket. Remove the nut and bolt attaching the cylinder to the gear retracting mechanism. Remove cylinder.

4. OPERATIONAL CHECK AND TESTS (BEFORE INSTALLATION).

a. With the cylinder in normal extended length of 38.9 inches, and with axis of air filler valve in horizontal position with the piston end of cylinder down, fill cylinder with hydraulic fluid, Specification AN-VV-O-366, to level of filler valve opening.

b. Harness cylinder to a partly compressed position with the piston end down.

c. Apply 400 psi and 1400 psi to air filler valve and leave for five (5) minutes each.

d. There should be no air or oil leakage at any point, and no loosening or permanent deformation of the parts of the cylinder assembly at either pressure.

e. Inspect cylinder for correct stroke and compressed length.

5. INSTALLATION.- Install the upper and lower bolts and nuts attaching the cylinder. Fill the cylinder with air to 400 psi. See nameplate attached to the cylinder.

(9) NOSE GEAR DOORS AND OPERATING MECHANISM. (See figure 23.)

(a) DESCRIPTION.- The nose gear wheel-well is equipped with three doors; two main doors and a strut fairing door. The main doors are mounted to the wheel-well structure, and are operated by electrically driven actuators. A bungee system opens the main doors when the emergency release system is used. The strut fairing door hinges to the crew nacelle structure, and is connected to the nose-gear strut with an adjustable rod. The fairing door is automatically operated by the landing gear during retraction or extension. When the nose gear is extending, all doors open. When the gear reaches the fully extended position, the wheel-well doors close. As the gear retracts it brings the strut door to the closed position. When the gear is fully retracted the two wheel doors close, forming the contour of the forward part of the wing.

(b) NOSE-GEAR DOORS ACTUATORS.

1. DESCRIPTION AND OPERATION.- Each nose-wheel door is equipped with an electrically driven actuator. The actuator is the same type (Delco EX89012) as used on the main gear doors (see paragraph 5 c (7) (f)). The actuators are located inboard on both doors and are mounted to brackets on the wing and door structure. Emergency nose-gear release cables are attached to the actuators. When the emergency release handle is operated the cables release the actuator clutch, allowing the emergency bungee system to open the doors.

2. REMOVAL.

a. Disconnect the electric plug and ground wire.

b. Remove the cables and arm from the actuator clutch.

c. Remove bolts attaching the actuator to the door and upper mounting brackets.

3. INSTALLATION.- Reverse the removal procedure.

(c) NOSE-GEAR DOOR LOCKS. (See figure 23.)

1. DESCRIPTION AND OPERATION.- The two nose-wheel-well door locks are the spring-loaded, open-hook type, and operate to hold

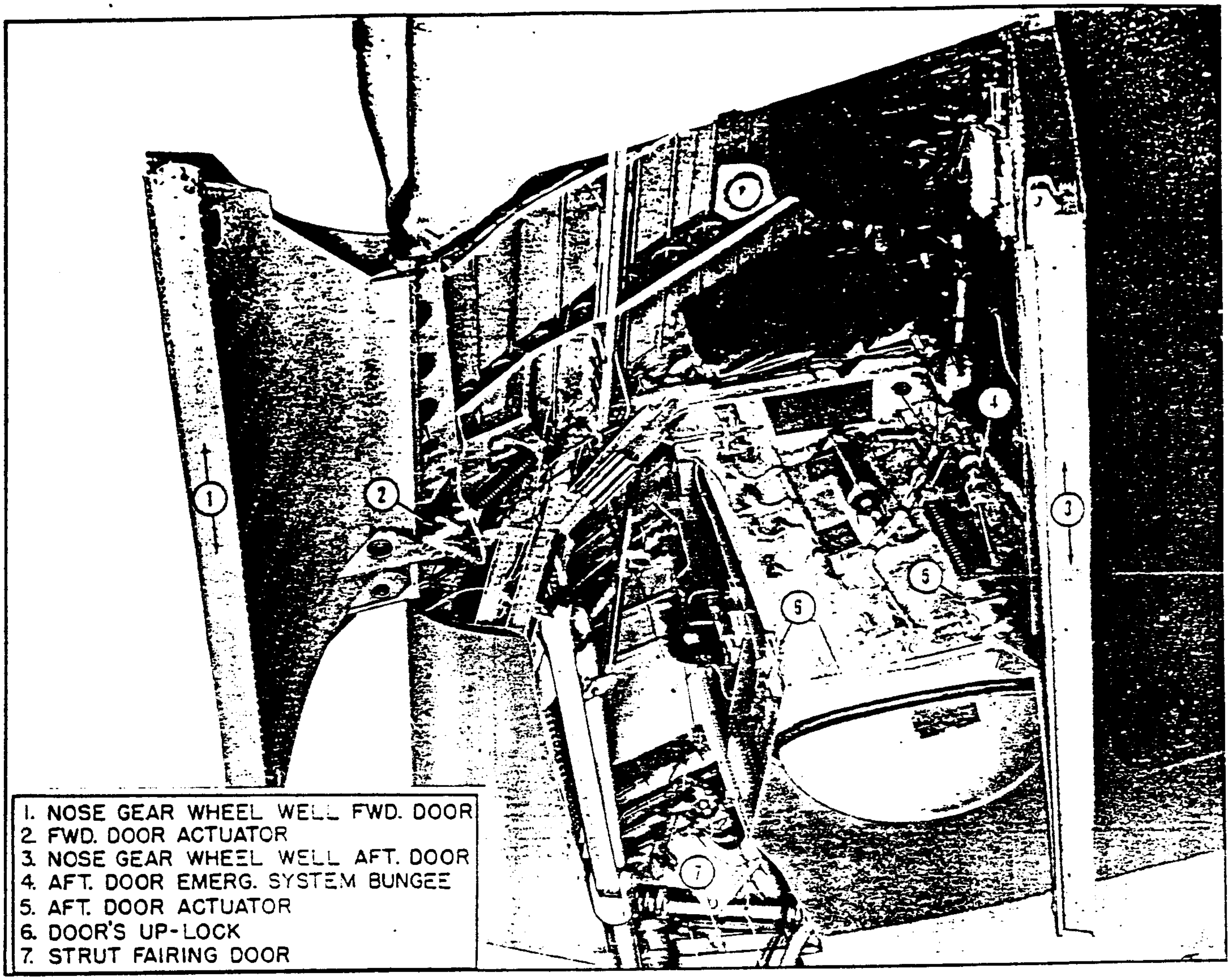


Figure 23. Nose Gear Doors and Operating Mechanism

the wheel-well doors in the closed position until the locks are released by the attaching cable systems. The inboard door lock is installed on the crew nacelle wall, and the outboard door lock is installed on the outboard wheel-well wall. Both locks are mechanically released by a cable system extending from the landing-gear control lever to the locks. An emergency lock release is provided by a cable system connecting the locks with the landing gear emergency release mechanism.

2. REMOVAL.

a. Remove the cotter pins, washers, nuts, and bolts attaching the cables to the locks.

b. Remove the cotter pins, washers, nuts, screws, and bolts attaching the locks mechanism to the brackets and wheel-well walls.

c. Remove the locks.

3. INSTALLATION.- Reverse the removal procedure.

(d) NOSE-WHEEL-WELL DOORS BUNGEE SYSTEM (See figure 24.)

1. DESCRIPTION.- The nose-wheel door bungee system is provided to assist in opening the doors when the emergency system is used. The system is the air type and consists of two bungee cylinders, one for each door, an air bottle, an air gage, a restrictor valve, and the connecting lines. The forward door cylinder is mounted to a bracket in the forward upper wheel-well, and is attached to a bracket on the forward door. The aft door cylinder is mounted to a bracket on the inboard wheel-well wall, and is attached to a bracket on the aft door. The air bottle is clamped to a bracket on the crew nacelle wall.

2. OPERATION.- The system is controlled by the valve assembly installed in the air lines, inboard of the air bottle. The valve arm assembly attaches to the land

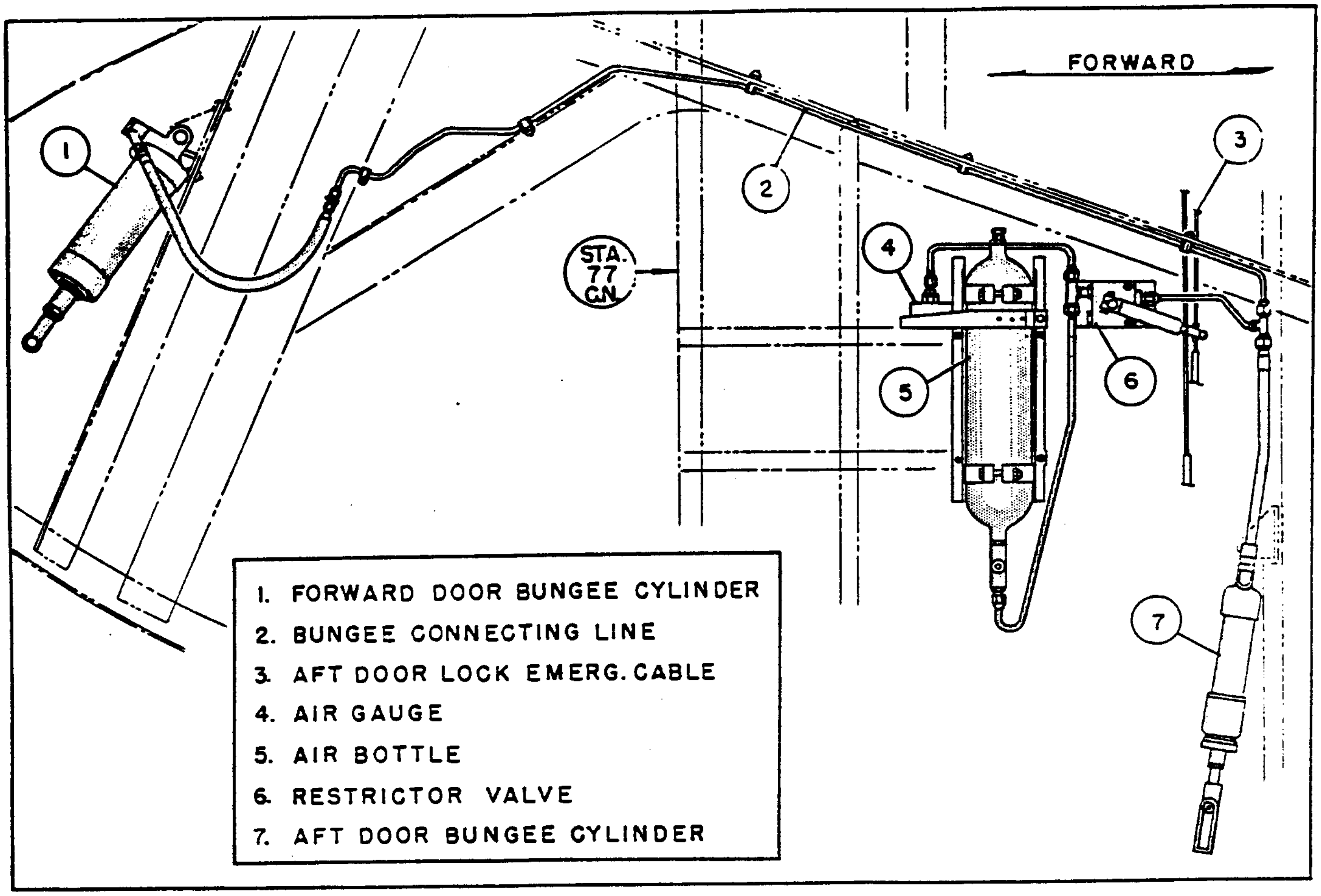


Figure 24. Nose Gear Doors Emergency Bungee System

gear emergency release cable. When the emergency release cable is pulled, the valve arm moves to the "UP" position; this action opens the valve, which releases air to the bungee cylinders, opening the doors. The air bottle is filled to a pressure of 1000 psi. See decal on wall by air bottle for instructions for setting bungee system.

3. REMOVAL.

a. Disconnect the hose lines from the top of both bungee cylinders.

b. Remove the nut, washer, and bolt, attaching the bungee cylinders to mounting brackets on the doors.

c. Remove the nut, washer, and bolt, attaching the bungee cylinders to the upper mounting brackets.

d. Remove the bungee cylinders.

e. To remove the air bottle, disconnect the air line from bottom connection, and remove the nuts and bolts clamping the bottle to the mounting bracket.

e. LANDING-GEAR CABLE CONTROLS.

(1) GENERAL.- This system includes the gears installed in the main wheel wells, the nose wheel well, cable controls within each well, and cable controls extending from the pilots' compartment to the wheel wells. Lowering or retraction of the gears, which operate simultaneously, is effected normally through actuation of a NORMAL control lever. In an emergency, however, if failure of the normal system occurs, lowering of the gears may be accomplished through actuation of an EMERGENCY control handle. In that event the gear can be retracted only by reversing the action of this handle and then actuating the NORMAL control lever.

(2) MAIN WHEEL WELLS. (See figure 1.)

(a) NORMAL OPERATION CONTROL CABLES. (See figures 25 through 27.)

1. REMOVAL.- Remove the applicable cable by disconnecting at the most convenient turnbuckle, rod-end, or quick disconnect. It is recommended that a follow-up cord or wire be attached to the cable being removed. This will facilitate reinstallation since the original pattern around pulleys and through fairleads will be preserved.

2. INSTALLATION.- Reverse the removal procedure. Rig the cables.

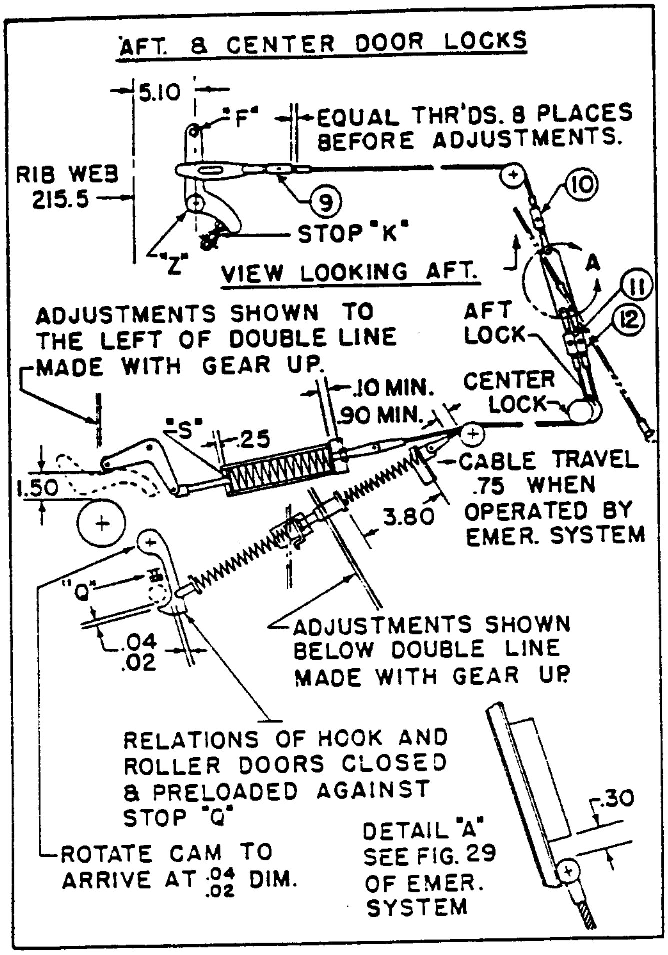


Figure 25. Rigging Main Gear Normal Control Cables

a. Make certain that the following conditions exist before and while making adjustments:

1. Gear down and locked (exceptions noted in figures 25 and 26).

2. Power source removed from all actuators.

3. Forward doors open.

4. Landing gear control lever (cockpit) at gear up position.

5. System inboard of rib 215.5 disconnected at "F", figure 25.

NOTE

For this procedure refer to figure 25.

b. Set stop "K" such that when crank "Z" is rotated clockwise against stop "K," "F" is 5.10-inches from rib web 215.5.

c. Set all turnbuckles equal as indicated.

d. Set normal and emergency controls interconnect-fitting assembly (Wing Sta. 248.5)

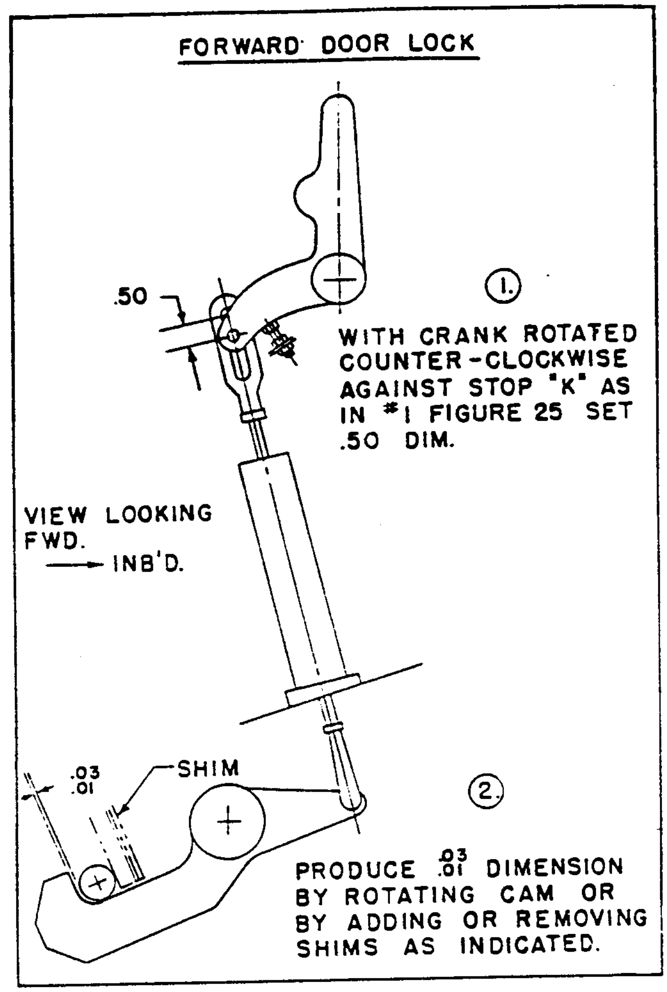


Figure 26. Rigging Main Gear Normal Control Cables

to .30 dimension (detail "A") by adjusting turnbuckles 9 and 10.

e. Arrive at 1.50 dimension by adjusting turnbuckle #11.

f. Adjust turnbuckle #12 to produce 3.80 spring dimension. Check .90 minimum dimension.

g. Adjust nut at point "S" to .25 dimension.

h. Re-check .30 dimension at detail "A."

i. All remaining adjustments should be made with landing gear retracted (as indicated).

(b) EMERGENCY OPERATION CONTROL CABLES.

1. REMOVAL.- These cables are removed in essentially the same manner as are the cables described in paragraph 5 e (2) (a) 1, preceding.

2. INSTALLATION.- Reverse the removal procedure indicated in paragraph 5 e (2) (a) 1 preceding. Rig as follows:

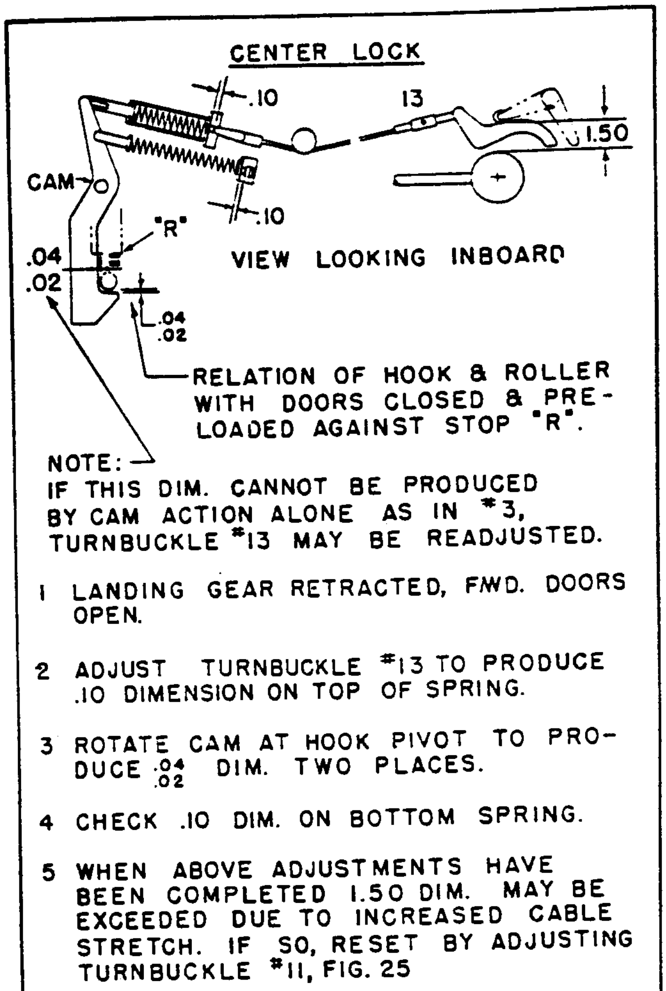


Figure 27. Rigging Main Gear Normal Control Cables

NOTE

It is assumed that all cables and operating mechanisms have previously been installed with the landing gear down and locked and that no adjustments have been attempted.

a. After completing all adjustments made in the gear down position, return landing gear up-lock actuator to up-lock open position and then open the up-lock manually. Correlate this information with figures 28 and 29.

1. Disconnect cable at "O" or at spring.

2. To produce 53° angle (figure 28), bring sighting holes into alignment by adjusting turnbuckles 3 and 4 equal and opposite.

3. To produce 1.60 dimension, adjust turnbuckles 3 and 5 equal and opposite.

4. Set as shown. Bring cable tension to approximately 150 lbs.

5. Re-check sight holes in Quad. A, figure 30.

NOTE

Coordinate figure 31 with steps b through i which immediately follow.

b. Tighten clamps "M" and "O" only sufficiently to prevent free movement of cable assembly.

c. Disconnect cable assembly at point "P."

d. Operate emergency system from cockpit to determine flex cable total travel.

e. Set distance "Y" equal to "Z" by moving cable through clamps "M" and "O" simultaneously.

f. Set clamp "M" securely.

g. Move cable assembly through clamp "O." Tighten clamp, repeating operation until fitting "T" at point "P" slips freely into clutch arm when arm is at extreme left position.

h. Move fitting "T" to the left on shaft until the connection of "T" at point "P" has to be made with force as shown in detail 2.

i. After completing above adjustments, disconnect cable assembly at point "P," rotate clutch arm to extreme right, and operate emergency system again from pilots' compartment. Overtravel as shown in detail 3 should then exist.

NOTE

Coordinate figure 32 with steps j through t which immediately follow.

j. Attach downlock cables at point "K" and adjust as shown on figure 33.

k. Place emergency release handle in gear up position with gear down and locked.

l. Remove power source to all actuators.

m. Disconnect downlock cables to all actuators.

n. Disconnect actuator at "N," figure 32, and extend to 13.86 inches long as indicated.

o. Connect actuator at "N." See figure 32.

p. Close up-lock manually.

q. Adjust rod "L," figure 32, to produce .06- to .10-inch dimension.

r. Disconnect emergency cable from forward door actuator clutch.

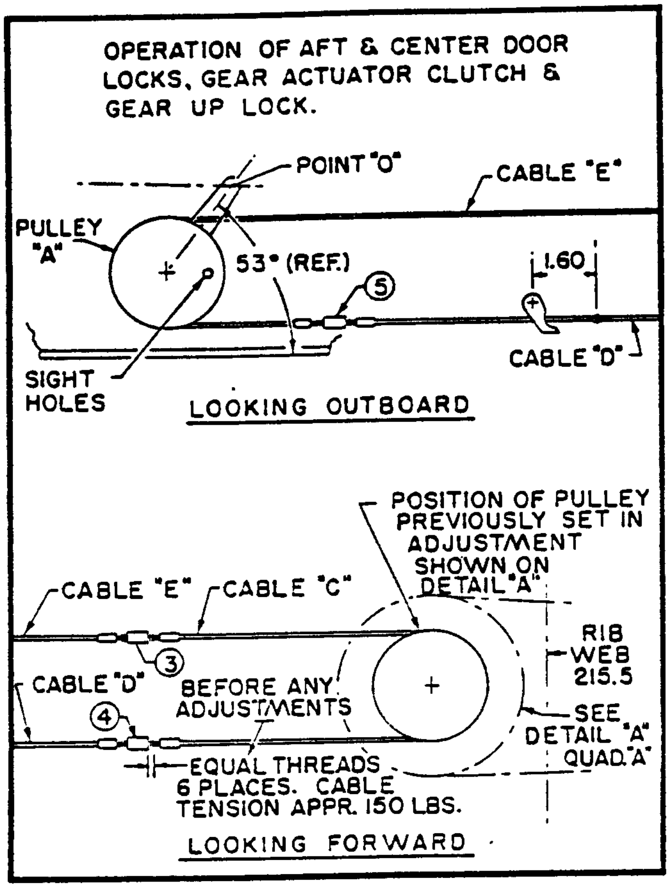


Figure 28. Rigging Main Gear Emergency Control Cables

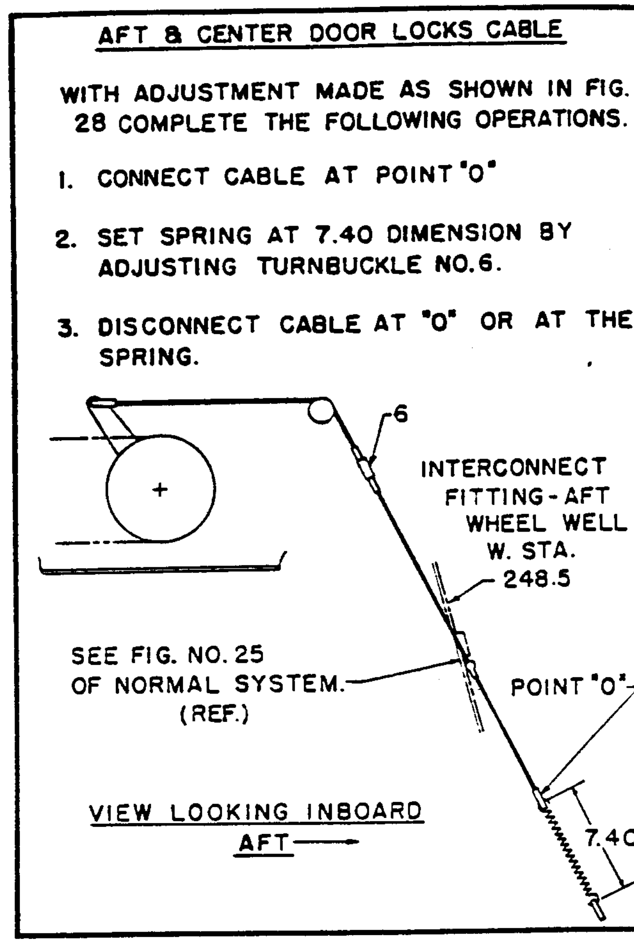


Figure 29. Rigging Main Gear Emergency Control Cables

s. Disconnect normal system at point "W." See figure 32.

t. Disconnect forward lock at point "V." See figure 32.

NOTE

Coordinate figure 34 with steps (1.) thru (8.) which immediately follow.

u. FORWARD - DOOR ACTUATOR-CLUTCH EMERGENCY CABLE.

1. PRELIMINARY.

a. Lower the landing gear.

b. Place emergency system in gear-up position.

c. Open forward doors.

(1.) Disconnect rod "K."

(2.) Rotate clutch face plate counterclockwise until it contacts stop "X."

(3.) Set arm "N" at 90° ± 1 serration.

(4.) Rig cables with arm "N" against stop in normal position. Tighten cable at "7" to 20 lbs. tension (minimum), and cable at "8" to 30-35 lbs.

(5.) Set 17° angle by adjusting turnbuckles 7 and 8 equally and opposite.

(6.) Install rod "K."

(7.) Operate system from pilots' compartment to gear-down position and reset to gear-up position.

(8.) If face plate does not return to stop "X," shorten cable "T" and repeat system operation until object is achieved.

(3) NOSE-WHEEL WELL. (See figure 2.)

(a) NORMAL OPERATION CONTROL CABLES.

1. REMOVAL.- These cables are removed in essentially the same manner as are the cable described in paragraph 5 e (2) (a) 1, preceding

2. INSTALLATION.- Reverse the removal procedure and rig as directed below:

a. Close aft door only. Position the pins completely back in the inboard door-lock hooks.

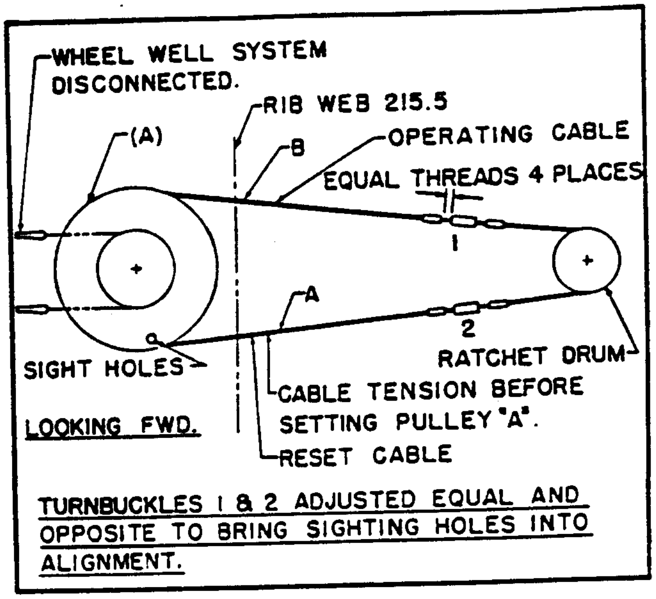


Figure 30. Rigging Main Gear Emergency Control Cables

b. Position the crank assembly (figure 35, references 1 and 2) as shown. Tighten lock nuts to hold in position.

c. Position the bellcrank (figure 36, references 1, 2 and 8) by inserting .187 dia. pin in holes provided for in mounting bracket. (See figure 36, reference 9.) Allow bellcrank to rest against pin.

d. Install cables assemblies to forward and aft door locks. (See figures 36 and 37, references 8 and 4; figures 36 and 37, reference 3 and 9; figure 37, reference 11.) Tighten turnbuckles to set cable guide spring. (See figure 38.)

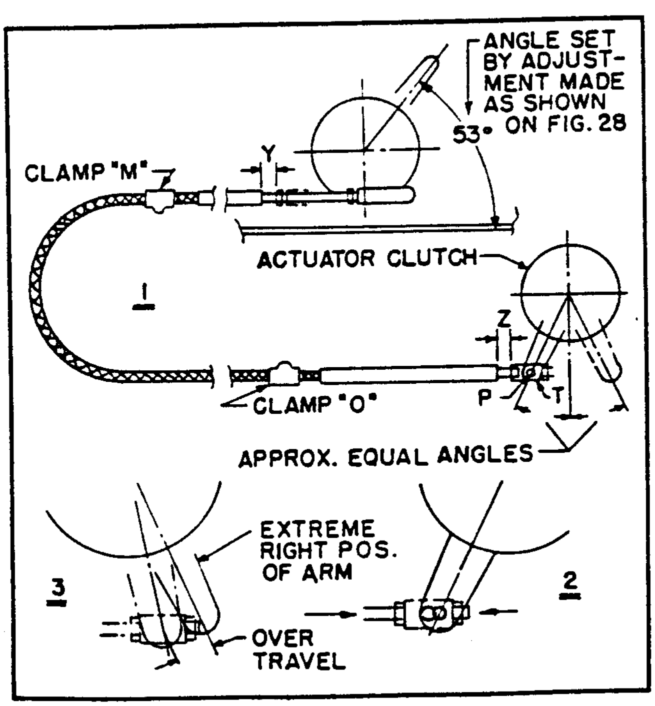


Figure 31. Rigging Main Gear Emergency Control Cables

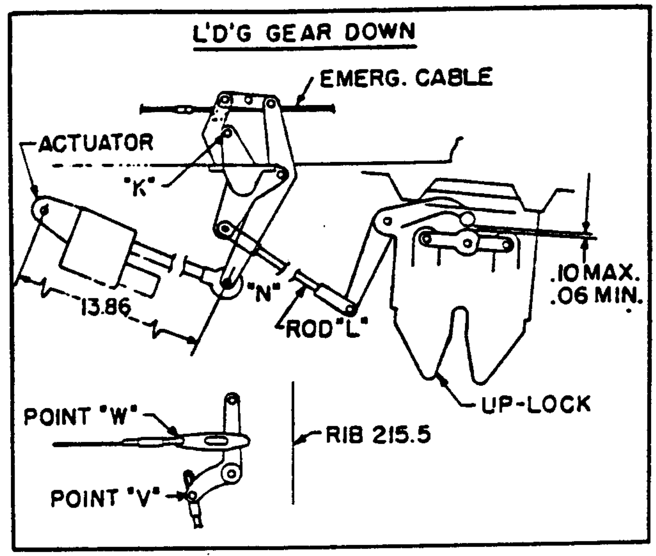


Figure 32. Rigging Main Gear Emergency Control Cables

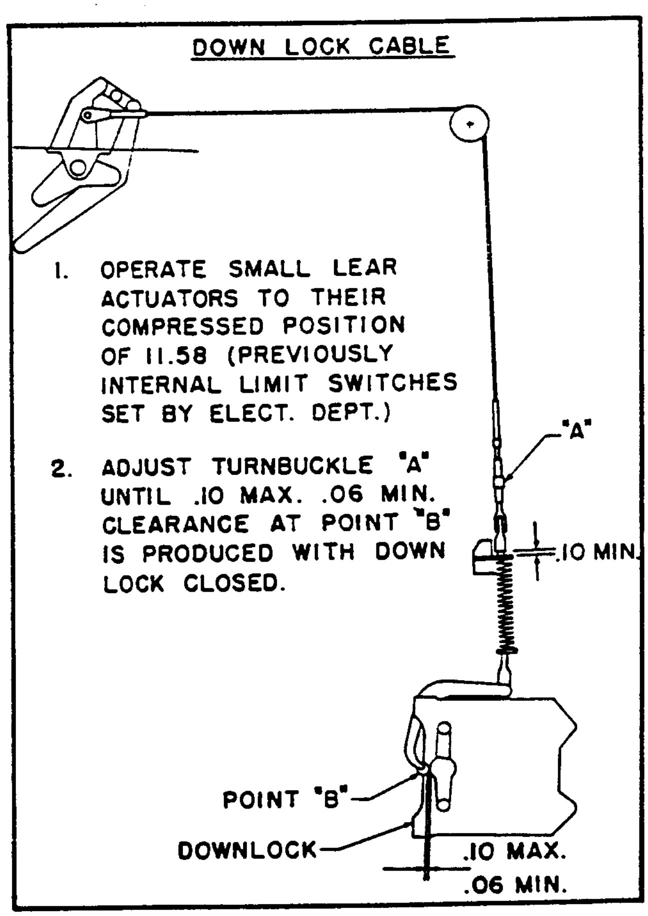


Figure 33. Rigging Main Gear Emergency Control Cables

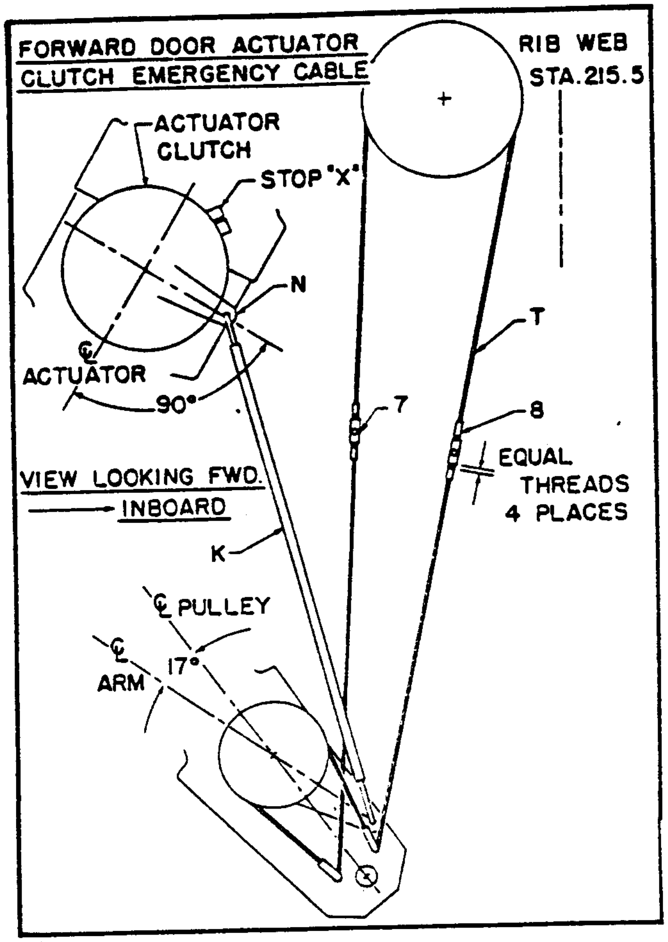


Figure 34. Rigging Main Gear Emergency Control Cables

e. Install cable assembly (figures 39 and 40, references 1 and 4) and adjust rod (see figure 39, reference 2).

f. Adjust crank assembly (figure 41, reference 1) to .625 dim.

g. For degree of segment see figure 42.

(b) EMERGENCY OPERATION CONTROL CABLES.

1. REMOVAL.- These cables are removed in essentially the same manner as are the cables described in paragraph 5 e (2) (a) 1.

2. INSTALLATION.- Reverse the removal procedure and rig as directed below:

a. Position the spindle (figure 40, reference 1) by lining up .187 dia. rigging holes and inserting .187 dia. bolt to hold in place.

b. Install cable assembly (figures 36 and 37, references 7 and 3). Tighten turnbuckles to compress cable guide spring to position shown in figure 38.

c. Install cable assemblies (figures 37 and 40, references 7 and 5; figures 36 and 37, reference 5). Tighten turnbuckles sufficiently to hold cables in place.

d. Position the crank assemblies (figures 43 and 44, reference 1) as shown.

e. Close aft door making sure door is locked in position.

f. Position the arm (figure 45, reference 1) on the forward-door Delco actuator.

g. Install cable assembly (figures 37 and 40, references 6 and 2) making four equally spaced turns around spindle (see figure 40, reference 1). Cable ends must come out even.

h. Install cable assembly (see figure 37, reference 13). Tighten turnbuckles to arrive at a cable rigging load of 20 lbs. Make sure spindle (figure 40, reference 1) is kept in correct position.

i. Close aft door only. Check to be sure door locks are fully closed.

j. Install cable assemblies (see figure 37, references 8 and 10). Tighten turnbuckles to compress cable guide spring as shown in figure 38.

k. Install cable assembly (figures 40 and 46, references 3 and 2) making four equally spaced turns around spindle (see figure 40, reference 1). While rigging, adjust cable balls at arm assembly (see figure 46, reference 1).

l. Install assembly (see figure 37, reference 12). Tighten turnbuckles to arrive at a cable rigging load of 20 lbs.

m. Position the control arm on the Delco actuator (figures 37 and 47, references 14 and 2) as shown.

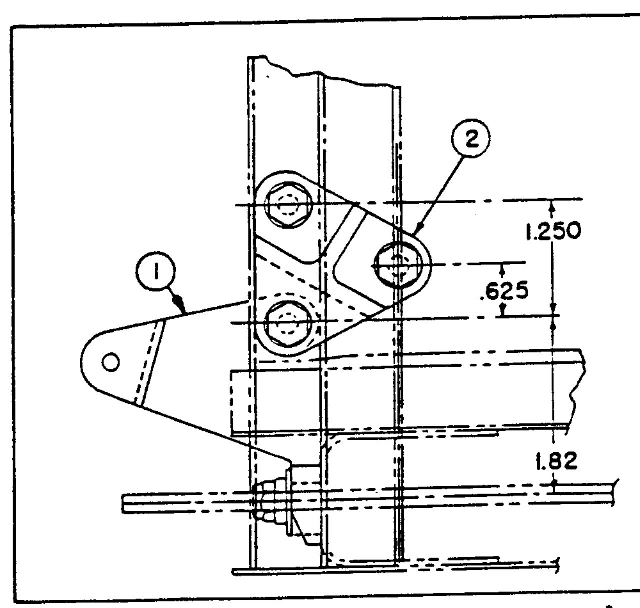


Figure 35. Rigging Nose Gear Normal and Emergency Control Cables

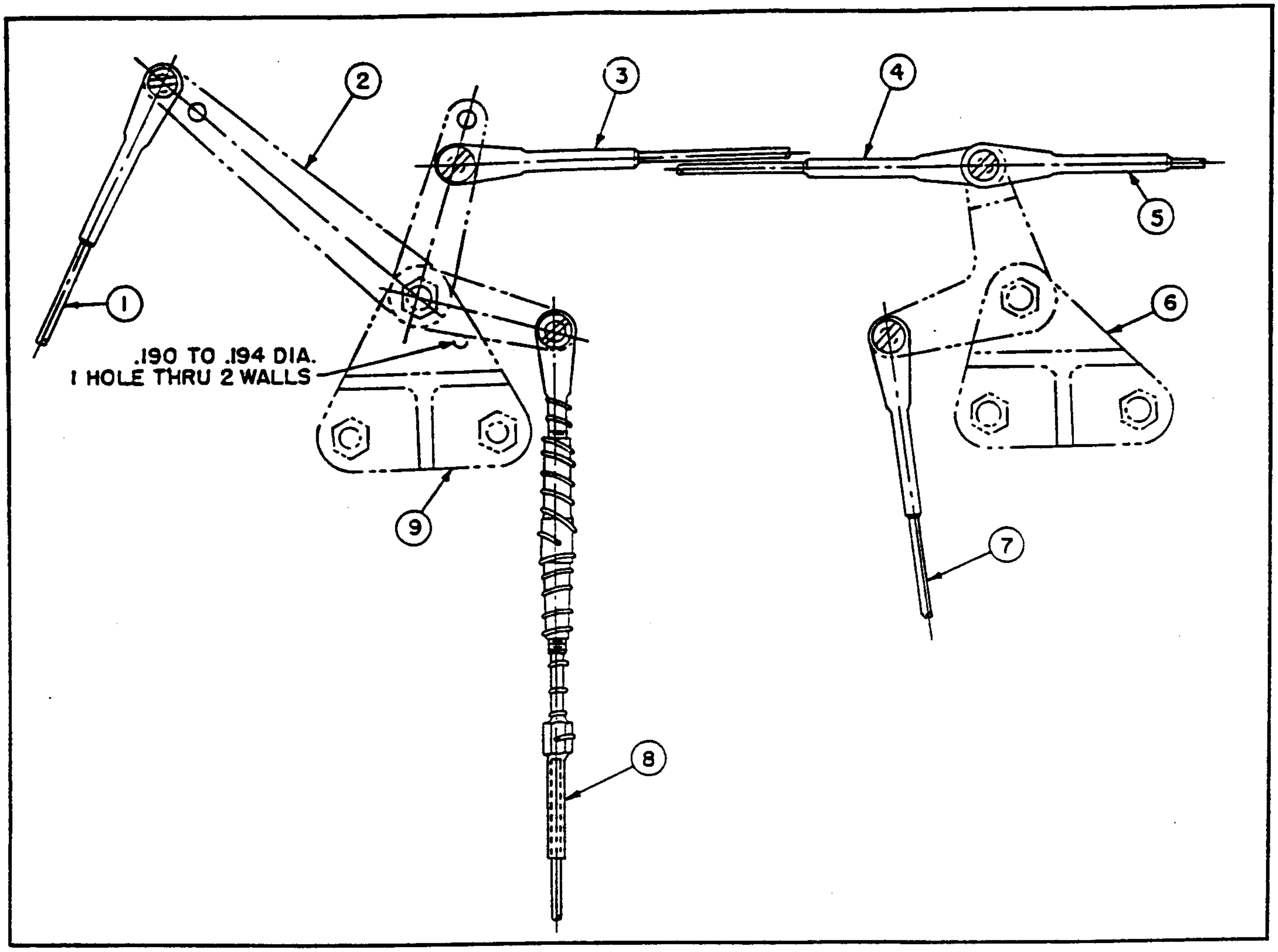


Figure 36. Rigging Nose Gear Normal and Emergency Control Cables

n. Install Arens control unit. (See figures 37 and 47, references 15 and 1.) Do not adjust to length until nose landing gear is up and locked in position.

o. Install cable assemblies (figures 36 and 37, references 4 and 2; figure 37, reference 1) from bracket installation (see figure 36, reference 6) to lock actuator. For adjustment of seat and housing, see figure 48, references 1 and 2.

p. Remove all rigging pins and clamps. Check position of all bellcranks, spindles, and actuating arms.

q. Place pilot's control and gear in the up position, and operate. Check timing of doors to see that the aft door engages the forward door.

(4) PILOTS' COMPARTMENT, INNER WING AREA.

(a) NORMAL OPERATION CONTROL CABLES.

1. REMOVAL.- These cables are removed in essentially the same manner as are the cables described in paragraph 5 e (2) (a) 1.

2. INSTALLATION.- Reverse the removal procedure and rig as directed below:

a. The normal controls in the main-wheel wells should be completely rigged first with the stop at the normal control bellcrank adjusted to bring the bellcrank into the vertical position with door locks closed. Refer to paragraph 5 e (2).

b. Disconnect electrical input wire to the master up switch in the cockpit with the landing gear down.

c. Set the control lever in the cockpit to the gear up position and adjust the lower end of the connecting rod to obtain the lever angles shown in figure 2, reference 2.

d. Install all cables between the cockpit mechanism and the controls in the wheel wells. Tighten turnbuckles until the bellcranks in the wheel wells are pulled from .002 to .010 off their stops at 70°F.

e. Install and rig nose-gear-door lock cables. Refer to paragraph 5 e (3).

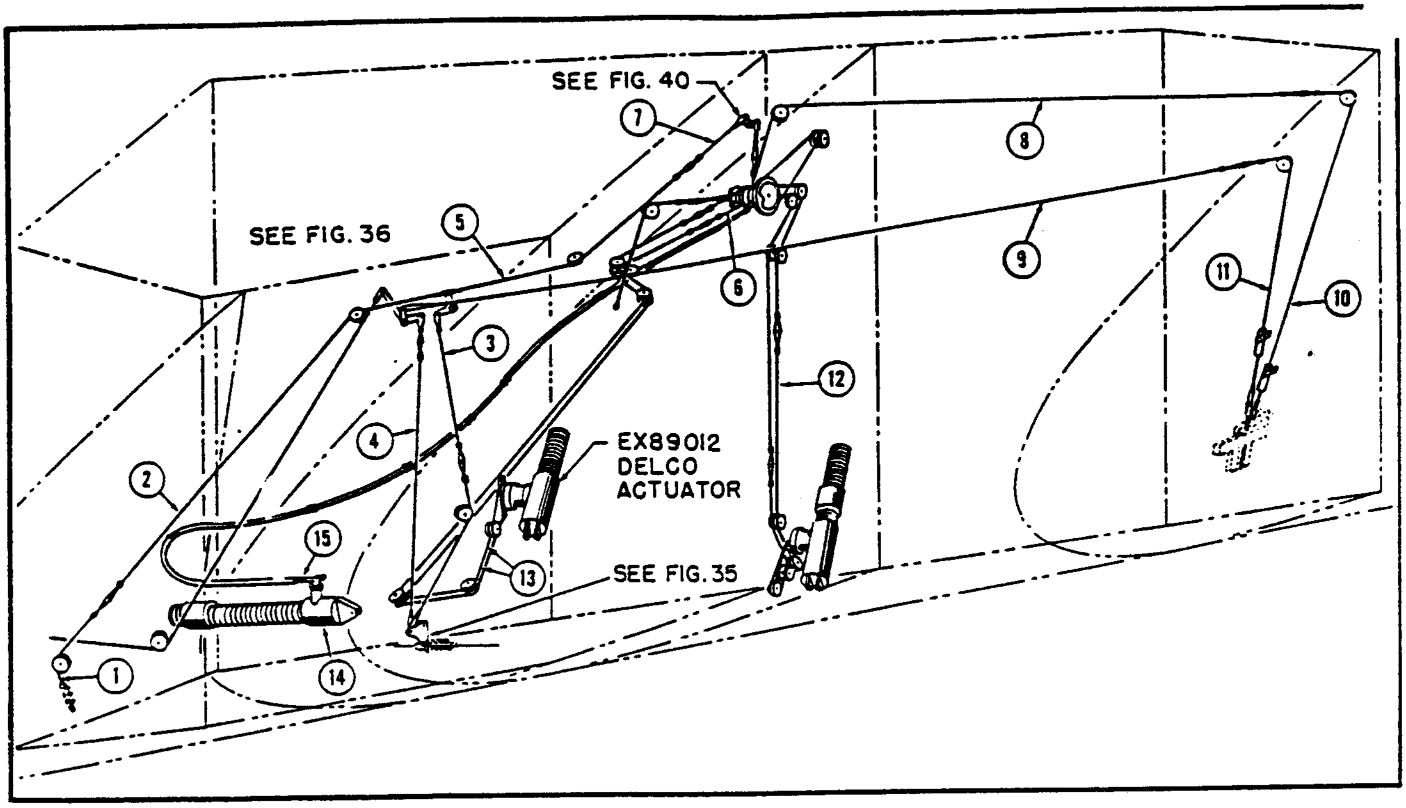


Figure 37. Rigging Nose Gear Normal and Emergency Control Cables

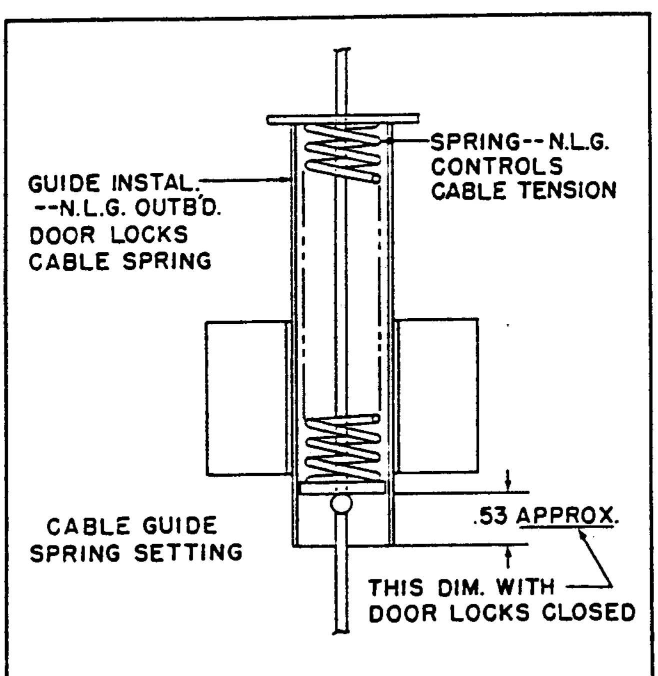


Figure 38. Rigging Nose Gear Normal and Emergency Control Cables

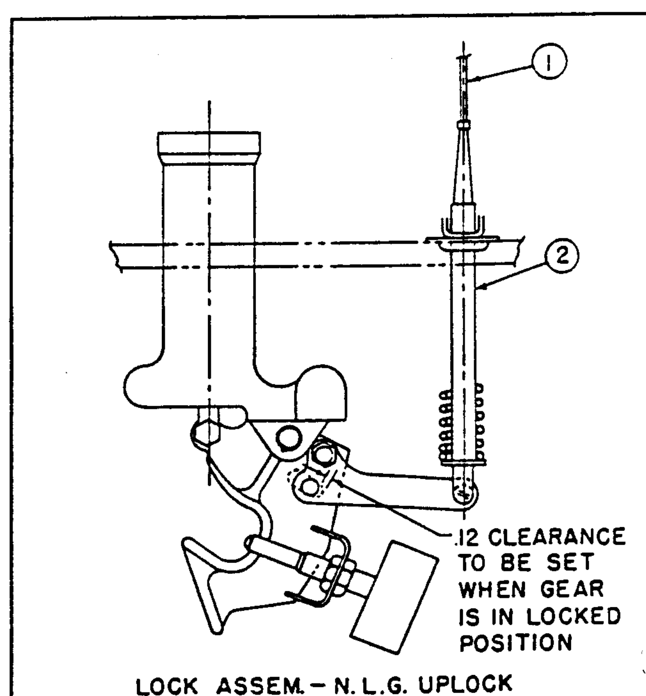


Figure 39. Rigging Nose Gear Normal and Emergency Control Cables

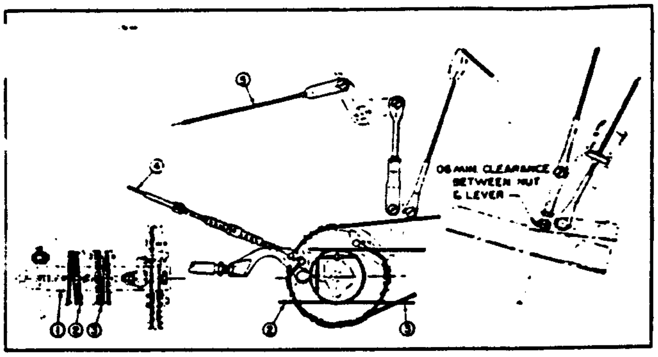


Figure 40. Rigging Nose Gear Normal and Emergency Control Cables

f. With handle in gear up position and nose gear up, install cable (figure 2, reference 9) and spring (figure 2, reference 3), adjusting rod end (figure 2, reference 4) as required to give 7.12 spring length with lever assembly (figure 2, reference 5) 10°-30' aft of the vertical position. Rigging load in cable (figure 2, reference 9) will be approximately 61 lbs.

g. Adjust master "UP" and "DOWN" switches to contact when the control handle is .36 ± .04 inches from the end of the slot in its quadrant.

h. Connect the master UP switch into the electrical circuit. The system is now ready for operation to check the rigging for proper functioning.

(b) EMERGENCY OPERATION CONTROL CABLES. (See figure 3.)

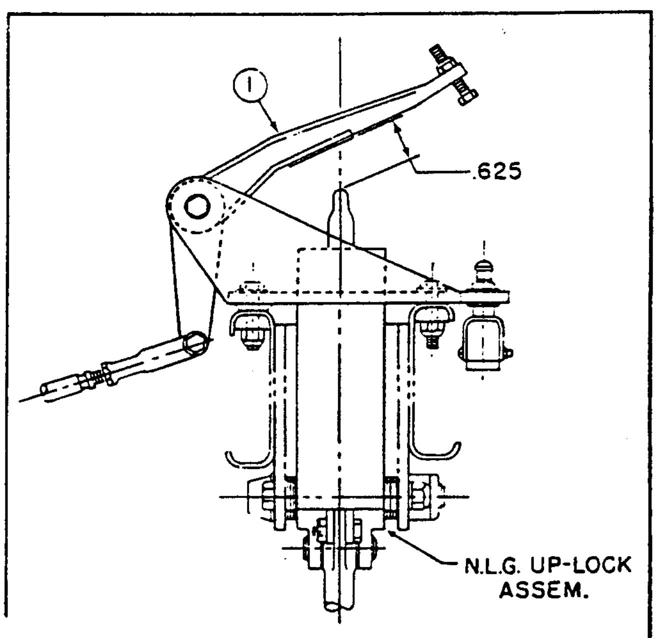


Figure 41. Rigging Nose Gear Normal and Emergency Control Cables

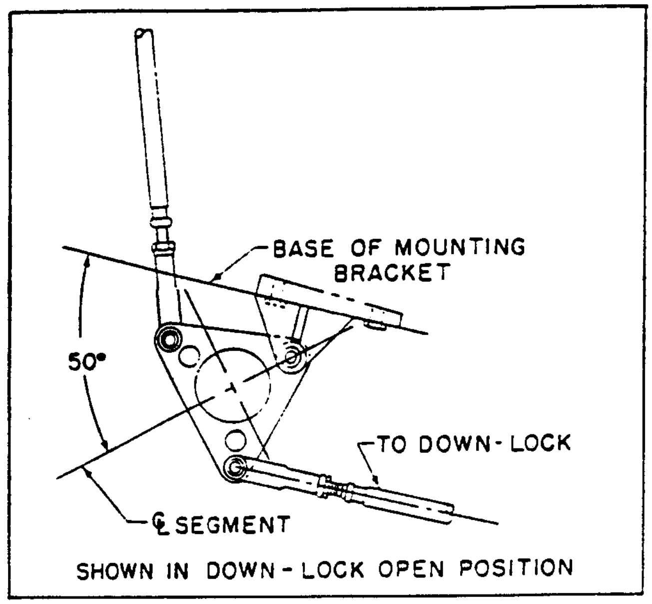


Figure 42. Rigging Nose Gear Normal and Emergency Control Cables

1. REMOVAL.- These cables are removed in essentially the same manner as are the cables described in paragraph 5 e (2) (a) 1.

2. INSTALLATION.- Reverse the removal procedure and rig as directed below:

a. PRELIMINARY.- Both main-landing-gear wheel-well controls installation and the nose-landing-gear wheel-well controls installation should be rigged before the cable systems from pilots' compartment to wheel wells are rigged. In the compartment at the landing-gear emergency-release control mechanism, adjust the stop on the emergency main-landing-gear release "reset" cable to the mid-position in its adjustment range, and rotate the mechanism until this stop seats in the locked position. With this position of mechanism maintained, make the following adjustments in the pilots' compartment: (See figure 3.)

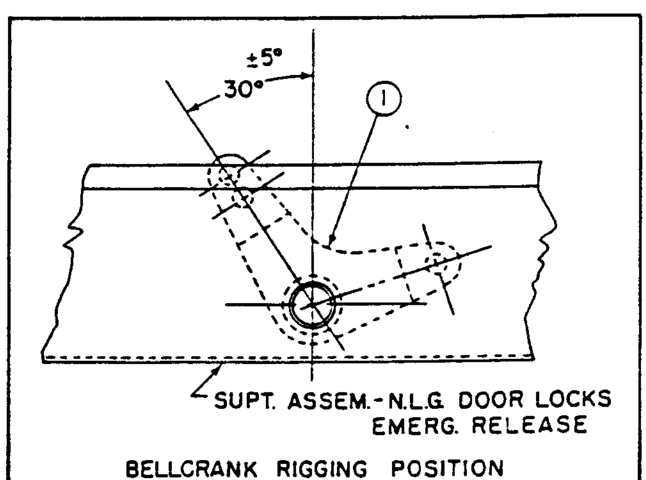


Figure 43. Rigging Nose Gear Normal and Emergency Control Cables

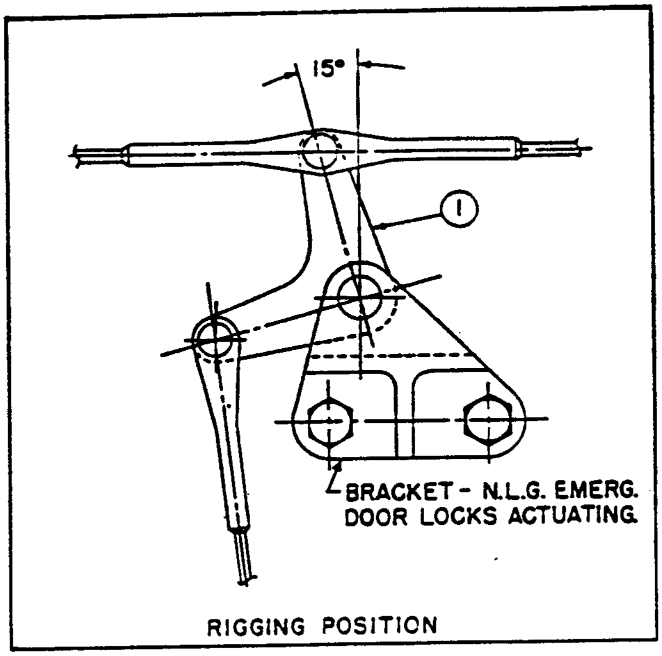


Figure 44. Rigging Nose Gear Normal and Emergency Control Cables

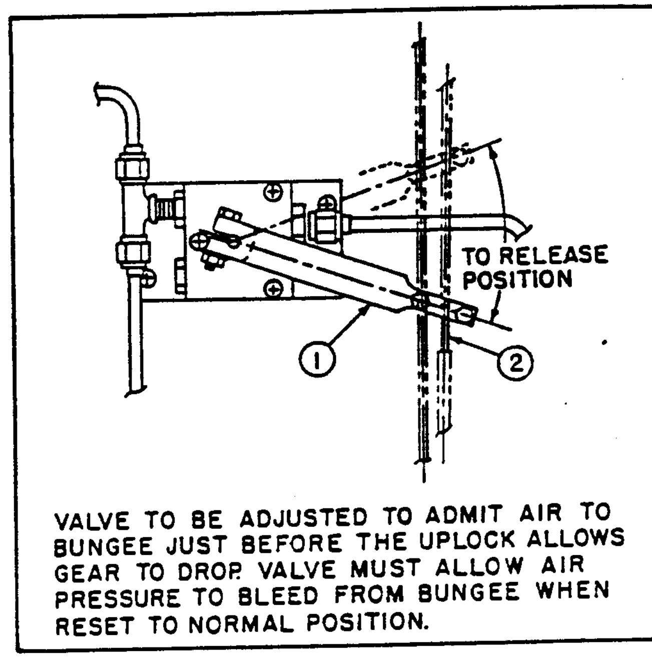


Figure 46. Rigging Nose Gear Normal and Emergency Control Cables

1. Adjust the turnbuckles on the nose-gear cables (below the mechanism) to position the nose-landing-gear emergency-release control in normal position, so as to rig the cables to 140 lbs.

2. Adjust the turnbuckles on the main-gear cables (above the mechanism) to position each main-landing-gear release mechanism in normal position, so as to rig each cable system to 60 lbs minimum and 80 lbs maximum, making a rigging load of 120 lbs minimum and 160 lbs maximum on the .125 dia. cable which carries the stop.

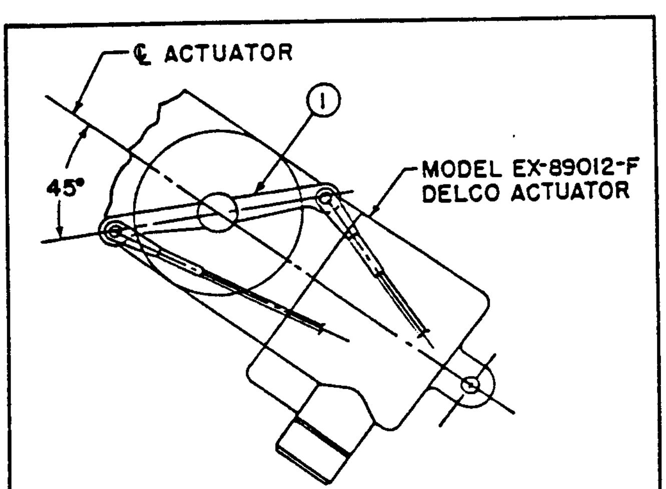


Figure 45. Rigging Nose Gear Normal and Emergency Control Cables

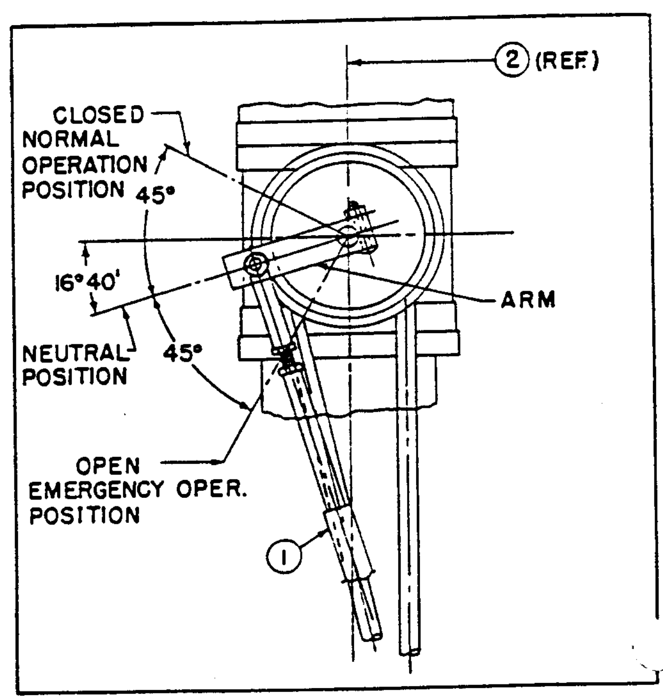


Figure 47. Rigging Nose Gear Normal and Emergency Control Cables

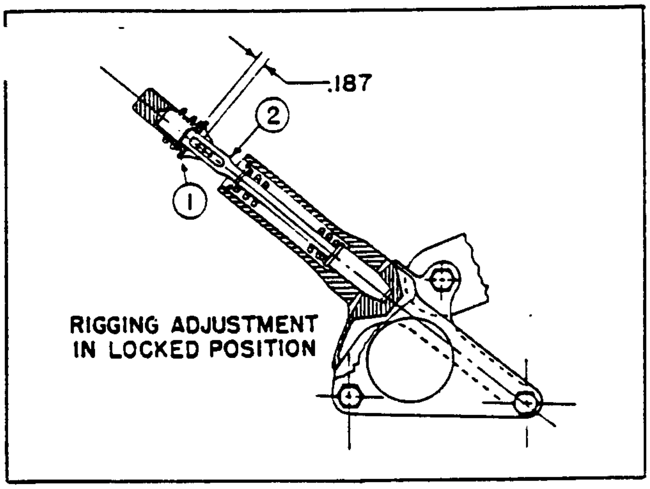


Figure 48. Rigging Nose Gear Normal and Emergency Control Cables

3. Operate the spindle of the landing-gear emergency-release control mechanism to the unlocked position and adjust the stop on the emergency main-landing-gear release operating cable so that full travel is obtained on nose-landing-gear emergency-release control (180° pulley travel) and on each main-landing-gear release mechanism (80° pulley travel).

4. Disengage the ratchet pawl n the landing-gear emergency-release control chanism, and operate the spindle to the locked position again. Re-adjust the stop on the emergency main-landing-gear release reset cable if necessary, so that full travel of nose-landing-gear emergency-release control and each main-landing gear release mechanism to original normal position is obtained.

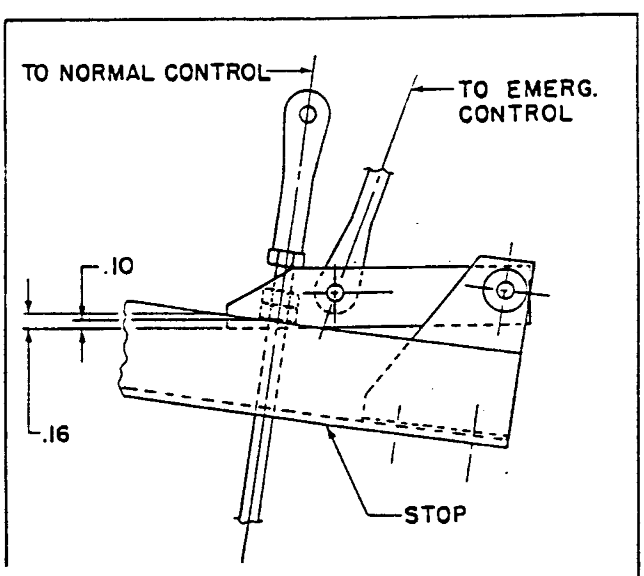


Figure 49. Rigging Nose Gear Normal and Emergency Control Cables

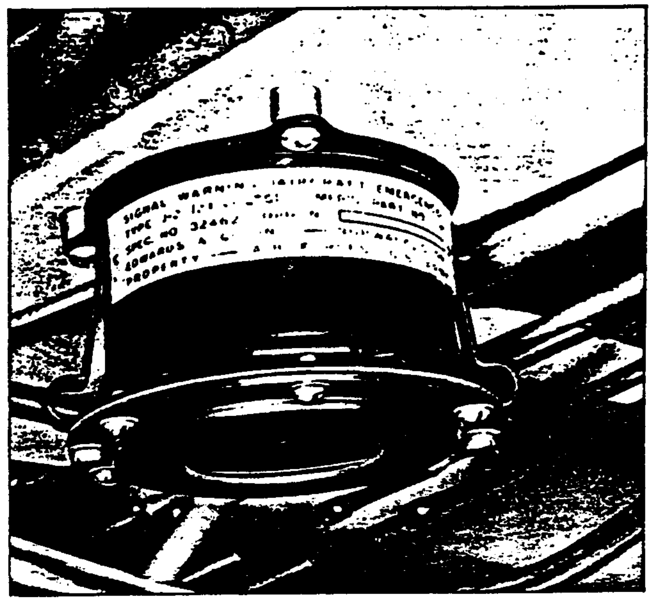


Figure 50. Landing Gear Warning Horn

5. The plate marked "gear locked" should be set to match the pointer with the mechanism rotated against the stop in this position.

b. EMERGENCY SYSTEM CONNECTION TO NORMAL SYSTEM - ADJUSTMENT. GEAR DOWN AND LOCKED.

1. Complete adjustments in emergency system.

2. Complete adjustments in normal system.

3. Make the connection adjustments between emergency and normal systems. See detail "A" (figure 25) of normal system.

4. To refine adjustment as in 3 above:

a. Operate emergency system slowly (from cockpit) checking cable travel between the interconnecting fitting assembly and aft locks. (See figure 25 of normal system.)

b. If travel is more or less than .75 in. (indicated) adjust turnbuckle #6, (See figure 29) of emergency system altering .30 dimension (detail "A", figure 25, normal system) until .75 dimension is achieved when operating emergency system.

(5) SYSTEM TEST AFTER INSTALLATION.

(a) PRELIMINARY.

WARNING

During all test runs, a man who knows and understands the sequence of both up and down runs should be stationed at each gear.

ITEM	DESCRIPTION	LOCATION
1	D.C. PANEL	R.H. MAIN GEAR WELL
2	HYDRAULIC PUMP SWITCH	R.H. MAIN GEAR WELL
3	WHEEL WELL RELAY PANEL	R.H. MAIN GEAR WELL
4	GEAR DOOR LIMIT SWITCH	R.H. MAIN GEAR WELL
5	PRESSURIZED PLUG	R.H. CREW NACELLE BULKHEAD
6	PRESSURIZED PLUG	L.H. CREW NACELLE BULKHEAD
7	ENGINEER'S JUNCTION PANEL	ENGINEER'S STATION
8	PILOT'S BRAKE SOLENOID SWITCH	PILOT'S WHEEL
9	PILOT'S PEDESTAL PANEL	PILOT'S PEDESTAL
10	CIRCUIT BREAKER	PILOT'S PEDESTAL PANEL

ITEM	DESCRIPTION	LOCATION
11	COPILOT'S BRAKE SOLENOID SW.	COPILOT'S WHEEL
12	HYDRAULIC PRESSURE SWITCH	CREW NACELLE NOSE SECTION
13	BRAKES SOLENOID VALVE	CREW NACELLE NOSE SECTION
14	STEERING SOLENOID VALVE	CREW NACELLE NOSE SECTION
15	A.C. SECTIONALIZING PANEL	CREW NACELLE NOSE SECTION
16	PRIMARY HYDRAULIC PUMP RELAY	CREW NACELLE NOSE SECTION
17	PRIMARY HYDRAULIC PUMP	CREW NACELLE NOSE SECTION
18	SECONDARY HYDRAULIC PUMP SW.	NOSE WHEEL STRUT
19	NOSE STEERING SAFETY SWITCH	NOSE WHEEL STRUT
20	NOSE STEERING & BRAKE RLAY PNL	CREW NACELLE NOSE SECTION
21	SECONDARY HYDRAULIC PUMP	NOSE WHEEL WELL
22	STEERING HANDLE SWITCH	NOSE STEERING HANDLE
23	NOSE STEERING HANDLE	CREW NACELLE NOSE SECTION
24	PRESSURIZED PLUG	CREW NACELLE NOSE SECTION
25	SECONDARY HYD. PUMP RELAY	NOSE WHEEL WELL
26	A.C. SECTIONALIZING PANEL	NOSE WHEEL WELL
27	GEAR DOOR LIMIT SWITCH	L.H. MAIN GEAR WELL
28	WHEEL WELL RELAY PANEL	L.H. MAIN GEAR WELL
29	HYDRAULIC PUMP SWITCH	L.H. MAIN GEAR WELL
30	D.C. PANEL	L.H. MAIN GEAR WELL
31	PRESSURIZED PLUG "P" R.H.	CREW NACELLE NOSE SECTION
32	ENG. LOWER INSTRUMENT PANEL	ENGINEER'S STATION
33	OVER-RIDE SWITCH	ENG. LOWER INSTRUMENT PANEL
34	ENG. LOWER SWITCH PANEL	ENGINEER'S STATION
35	CIRCUIT BREAKER	ENG. LOWER SWITCH PANEL

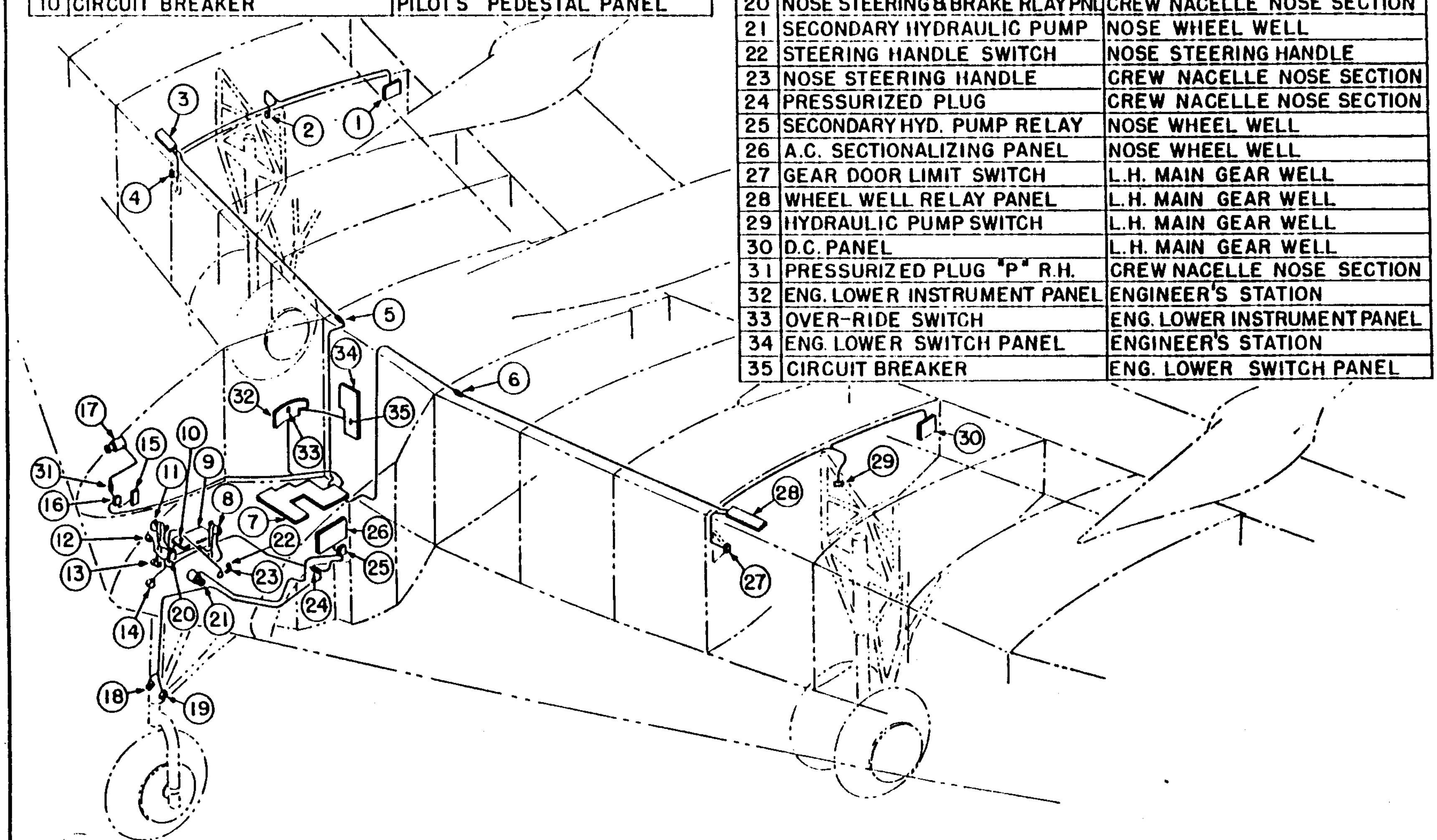


Figure 51. Landing Gear Brakes and Nose Wheel Steering Electrical Diagram

~~1~~. When operating cable systems initially, do so slowly, checking tension in all cables to insure against possible damage due to overlooked interference.

(b) RUN SEQUENCE.

1. To gear up position:

a. The forward main-gear door and outboard nose-gear doors should open fully to energize the microswitches.

NOTE

Check the main-gear down-lock depressor arm position.

b. The gear retraction actuators should cause gears to travel to the up position, then lock.

c. The forward main and outboard nose doors should close and lock.

2. To gear down position:

a. The forward main and outboard nose doors should unlock. The actuators should run the doors to the fully open position, energizing the microswitches and causing lock actuators to operate.

NOTE

Check the position of main down-lock depressor arm.

b. The main and nose-gear actuators should cause the gears to release from the up-locks, then travel to full down lock position.

c. The forward main and outboard nose doors should close. The final position should be fully faired and unlocked.

NOTE

Check that the normal landing-gear control-handle-mechanism spring-knuckle does not snap over center until all landing gears are operated together.

f. LANDING-GEAR INDICATOR LIGHTS AND WARNING HORNS. (See figures 14 and 50.)

(1) DESCRIPTION.- Indicator lights, mounted on the pilots' instrument panel, indicate the up and locked, down and locked, or unsafe condition of the gears. The red light is on when the gears are moving, or not in the locks. The green light is on when the gears are down and locked. Both lights are off when the gears are up and locked. Two warning horns, installed in the crew nacelle, operate when the throttles are retarded below cruising rpm and all three gears are not down and locked. Provision is made for turning off the horns by pressing the button located on the switch just aft of the pilots' throttles. To re-engage the warning horns, the throttles must all be advanced above the cruising position.

(2) OPERATION.- The indicator lights and warning horns operate on 28 volt d.c. The circuit incorporates three interconnected relays which are wired to a bus in the pilots' pedestal. Current for the indicator lights and horn circuit is taken from contacts on the relays which, in their normal position, furnish current to operate the systems. Each relay coil is wired to microswitches on the up and down locks in each gear well. The microswitches on the up-locks will close the circuit (red light illuminates) when any one of the landing gears is unlocked. The red light will remain on until each relay is actuated by the microswitches on the down locks. As soon as all three relays have been actuated, the circuits for the red light and the horns are broken and the circuit for the green light is completed.

g. LANDING-GEAR SAFETY CONTROL. (See figure 14.)- In order to prevent inadvertent retraction of the landing gear while the airplane is on the ground, a safety switch is installed on the torque links of the left main gear. When the weight of the airplane is on the gear, the switch is closed and a plunger blocks any movement of the landing-gear control lever to the "UP" position. 28 volt d.c. for the safety circuit is taken from the d.c. distribution panel in the left main-gear wheel-well and wired to the switch on the torque links. When the switch is closed, current is sent through the forward relay panel, the engineer's junction panel, and to the safety solenoid plunger in the pilots' control pedestal.

6. WHEELS, TIRES AND BRAKES

6. WHEELS, TIRES, AND BRAKES.

a. GENERAL. (For schematic drawings of complete hydraulic system, see paragraph 16, figures 1 and 2.)

(1) MAIN WHEEL ASSEMBLIES.- The airplane is equipped with 65-inch smooth-contour wheels which are of split-type magnesium construction. The wheels are dual assemblies, two wheels to each strut. The tires are 65-inch smooth-contour 14-ply nylon construction. The tubes are conventional 65-inch smooth-contour type. The brakes consists of one brake per wheel and are of the dual spot type. The main power brakes are automatically adjustable and require no adjustment after the original installation. System components applying to normal and emergency controls are described in this paragraph.

(2) NOSE WHEEL ASSEMBLY.- The nose wheel is of magnesium alloy construction. The wheel is equipped with a 56-inch smooth-contour tire with a single tube. The wheel is mounted on roller bearings.

b. TROUBLE SHOOTING.

TROUBLE	PROBABLE CAUSE	REMEDY
Insufficient braking action or excessive pedal action.	Worn linings.	Replace with new set of linings if necessary.
	Leak in the hydraulic system.	Check for leaks. Replace worn, deteriorated or damaged piston seals.
	Air in system (spongy pedal action).	Bleed the hydraulic system.
	Lack of fluid.	Reservoir must be kept full, i.e. to the "A" mark on the reservoir gage.
	Reservoir vent clogged.	Open the vent.
	Improper adjustment of brake linkage mechanism.	Check mechanism for proper adjustment.
Dragging brakes.	Dirt in system.	Disassemble and clean the brake cylinders and the parking brake valve. Flush lines and reservoirs with hydraulic fluid AN-VV-O-366.
	Brake piston binding.	Remove piston and brake parts. Clean with Stoddard solvent or equivalent.
	Improper adjustment of parking brake.	Be sure parking brake handle is disengaging properly. Adjust parking brake valve and mechanical linkage if necessary.
	Adjusting-pin packing nut out of adjustment.	Adjust nut to 25 ft-lbs. torque.

TROUBLE	PROBABLE CAUSE	REMEDY
Slow brake.	Worn lining, insufficient brake pressure, clogged brake valve.	Check hydraulic system for leaks. Check hydraulic pressure. Clean the hydraulic brake lines. Dismantle brake valves and check for dirt and dirt-clogged passages or plugged pressure ports.
	Brake valve not seating properly.	Dismantle brake valve and check condition of seat. Reseat or replace the valve if necessary.
Slow releasing of brake evidenced by dragging brake when pedal is released.	Brake return spring not operating.	Replace spring.
	Dirt accumulated in brake valve.	Dismantle brake valve, clean thoroughly and replace worn parts if necessary.

c. WHEELS.

(1) REMOVAL.

(a) MAIN WHEELS.

1. Raise airplane on all jack points.

2. Remove the axle-nut safety-bolt, wheel nut, washer, outboard bearing and retainer, grease retainer and the outboard wheel bearings.

CAUTION

Apply the parking brake to hold the brake discs in position when removing the wheel.

3. With an adequate movable support under the wheel, remove the wheel slowly from the axle.

4. Remove the inboard bearings, grease pad, and retainer if necessary.

(b) NOSE WHEEL.

1. Raise the airplane on all jack points.

2. Remove the axle-nut safety-bolt, axle nut and washer.

3. Remove the grease felt pad retainer.

4. Remove bearing retainer and the roller bearings.

5. Remove the wheel.

(2) DISASSEMBLY.

(a) MAIN WHEELS.

WARNING

Deflate the tire before attempting to disassemble the wheel.

1. Remove the wheel from the airplane.

2. Remove the bolts attaching the two sections of the wheel.

3. Remove the valve-stem extension, the two sections of the wheel, and the tire and tube.

(b) NOSE WHEEL.

1. Remove nose wheel.

2. Remove the nose-wheel lock-ring and the wheel flange. Press the flange inward to simplify removal.

3. Remove the tire and the tube. Use water as lubricant if necessary.

(3) CLEANING, REPLACING AND REPAIRING.

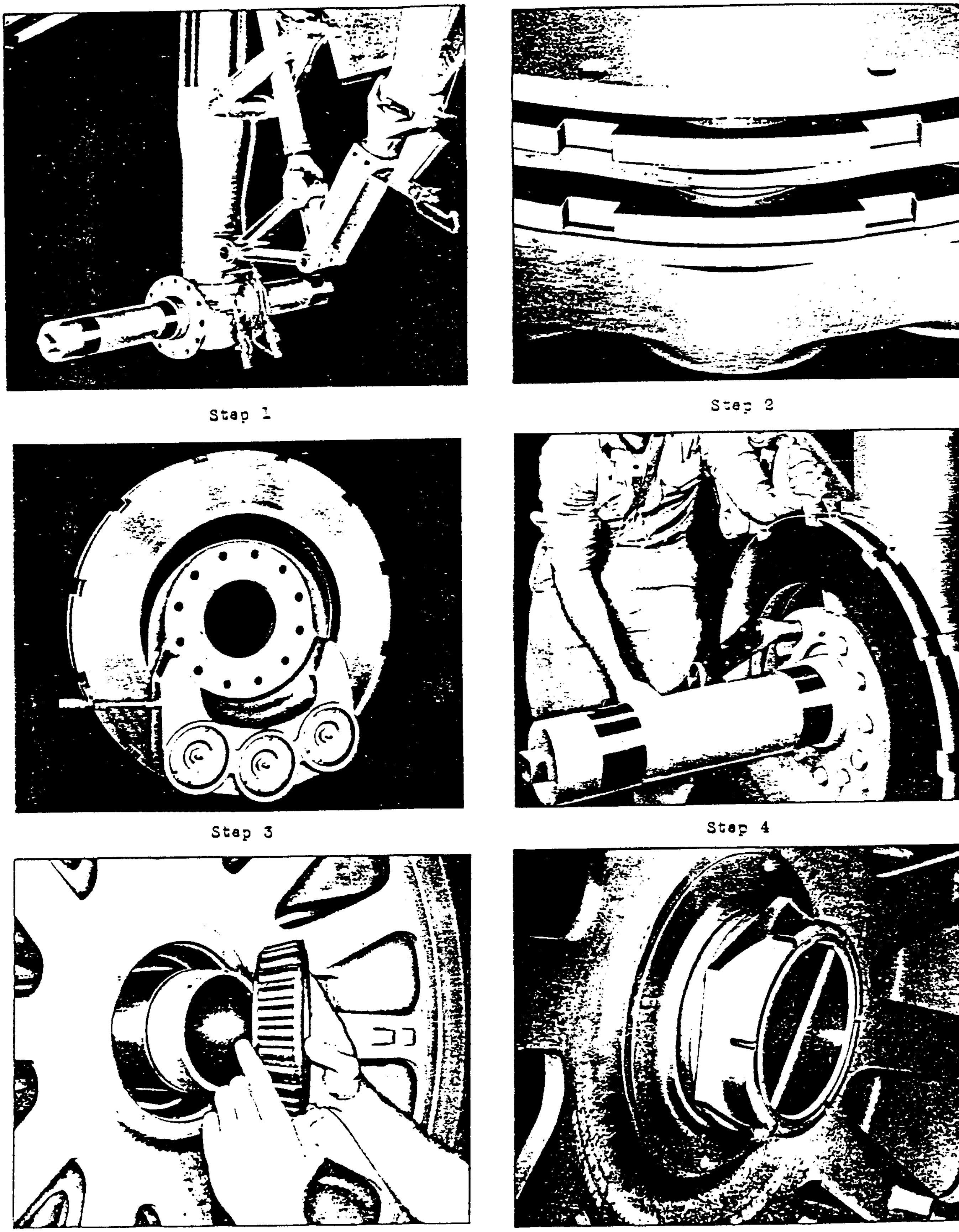
(a) Clean and replace bearings as necessary.

(b) Visually check interior condition of the wheel.

(c) Replace grease-soaked felt grease retainers.

NOTE

If the wheel is damaged so that excessive distortion or large cracks appear in the casting, the wheel casting must be repaired or replaced.



Step 1

Step 2

Step 3

Step 4

Step 5

Step 6

Figure 1. Main Gear Wheel and Brake Installation

(4) ASSEMBLY AND INSTALLATION OF WHEELS. (See figure 1.)

NOTE

With the tire and tube mounted in position, put the two halves of the wheel castings together so the balance marks coincide. These balance marks are small letters "B" stamped on two of the bolt bosses on the wheel. Be sure the same bolt goes thru the two marked bosses. Insert the wheel assembly bolts and lock nuts. Inflate tire to 70 psi air pressure.

(a) Repack bearings with high-melting-point grease, Specification AN-G-5. Insert inboard bearings, being sure caps are clean.

(b) Wash felt bearing closure rings in gasoline, lubricate lightly with light machine oil, Specification No. VV-O-581, Grade 10, and reseat against bearings. Install inboard retainer.

(c) See that the thread protector is on the threaded end of the axle shaft.

(d) Insert brake discs in the brake assembly and align the discs to fit into the wheel. Apply pressure to hold discs securely.

(e) Apply zinc chromate paste to both faces of the brake castings and the axle fitting.

(f) Attach brake assembly to axle with bolts and nuts. Tighten with torque wrench to 190-220 ft-lbs. Cotter the nuts.

(g) Slide the wheel on the axle with the key side toward the brake and slide the wheel drive keys into the slots of the brake discs.

(h) Install the outer bearings, and bearing retainer. Install retainer key in spline.

(i) Install the wheel washer and nut, tighten the axle nut until the wheel no longer turns freely, then back off the axle nut one adjustment hole and insert safety lock bolt. Safety the nut on the lock bolt with cotter key. Check to be sure there is no side play in the wheel.

CAUTION

Too tight an adjustment of the bearings may cause cracked bearing cups or wheels. Make sure bearings are not too tight.

d. TIRES AND TUBES.

(1) DESCRIPTION.

(a) The main-landing-gear tires are 56-inch smooth contour 22-ply nylon rib thread casing. The tubes are conventional.

(b) The nose wheel tire is 56-inch smooth contour 16-ply nylon all-weather tread. The tube is conventional.

(2) REMOVAL OF TIRES AND TUBES.

(a) Jack up the airplane on all jack points and remove the wheel.

CAUTION

Before loosening bolts to disassemble a wheel or change tires, remove valve core completely and be certain that tube is deflated. If this is not done, the tire will blow out, damage the wheel and injure the mechanic.

(b) Remove the tire.

(c) Remove the tube.

(d) Remove nose-wheel tire as follows:

1. Remove nose wheel.

2. Deflate the tire by removing the valve core.

3. Force the tire bead inward until it is broken loose from the retainer flange.

4. Remove the retainer and the flange.

5. Remove the tire and the tube.

(3) MAINTENANCE AND REPAIR OF TIRES AND TUBES.- Each time the tires and tubes are removed either for replacement or inspection, a careful examination should be made of the following:

(a) CASINGS.

1. Rupture or breaks inside carcass.

2. Physical damage to the beads extending through the outside rubberized chafer fabric.

3. Breaks, cuts, blisters and loose cords or other physical damage to the sidewalls inside or out.

4. Cuts which are through the tread or which expose the fabric carcass to moisture or dirt.

5. Tread which exposes the fabric carcass.

(b) If any of the defects or damage listed in paragraph (a), preceding, are present, do not reinstall the casing until repairs have been made. If tread cuts are present, but do not affect the fabric, the cuts should be cleaned and filled with commercial tire-cut filler and cemented into place.

(c) TUBES.

1. Physical damage to the valve, or faulty attachment to the tube.

2. Wrinkles or creases in the tube.

3. Thin spots, cuts or punctures.

4. Tube chafing from the tire bead.

5. Damaged areas resulting from casing breaks.

(d) If any of the defects listed in paragraph (c), preceding, are found, the tube will be repaired if possible; otherwise it must be replaced.

1. Tube repairs should be restricted to damage resulting from punctures, cuts and casing breaks, providing that the damaged area is not larger than one inch in its longest dimension.

2. Tubes having extra wall thickness at the point of contact with the wheel rim need not be replaced if wrinkles appear at that point providing that there is no evidence of damage due to chafing.

3. Make repairs with a standard regulation repair kit.

4. Tubes with a damaged area greater than one inch, should be sent to a repair depot.

(4) INSTALLATION OF TIRES AND TUBES.

(a) MAIN GEAR TIRES AND TUBES.

NOTE

Main wheels must be assembled with the tire and tube on the inboard wheel casting.

1. Insert the tube into position and put the two wheel halves together with the wheel casting bolts. See paragraph c(4), preceding.

NOTE

Use water only as a lubricant for installing tires. Use only when necessary. Wipe off all excess water after installation.

2. Add the valve extension to the valve stem.

3. Inflate tire to 70 psi air pressure.

(b) NOSE GEAR TIRE AND TUBE.

1. Slide the tire and tube onto the nose wheel.

2. Secure the tire to the wheel with the lock ring and the wheel flange.

3. Inflate the tire to 70 psi air pressure.

e. BRAKES. (See figure 2.)

(1) GENERAL.- The airplane is equipped with Goodyear dual-disc hydraulic spot brake operated by depressing the rudder pedals. Two brake valves, one connected to each rudder pedal, supply pressure to the brake assemblies. Each main landing gear is equipped with two sets of brakes, one for each wheel. A parking brake handle is located on the left side of the instrument panel and is also included in the brake system. The brake valves receive fluid under pressure from a normally closed solenoid valve teed off the system pressure line. The brake valves, connected to the rudder pedals, may be applied simultaneously or individually. The hydraulically operated dual-disc spot brakes have three pistons in each inboard brake housing. When either brake pedal is applied, pressure released by the brake valves moves the pistons, which in turn press the inboard brake disc. brake linings against the inboard disc, the As the linings press the inboard disc, the disc moves away till it contacts the center brake linings which contact the outboard brake disc. Increased pressure will then result in equal clamping action for both discs. To set the parking brake, pull out the handle (see figure 3). When the handle is pulled, a hydraulic valve is actuated, which sets the brakes. To release the parking brake, depress the trigger near the top of the handle and push forward.

(2) REMOVAL OF BRAKES.

NOTE

Set the parking brakes by pulling the parking brake handle aft. By doing so, brake discs are held in position simplifying wheel and brake removal.

(a) Jack up the entire airplane and remove the wheel.

(b) Support the brake discs and release the parking brake inside the pilot's station.

(c) Remove the brake discs and linings from the brake housing.

(d) Unfasten the hydraulic connection from the brake inlet port and plug the brake line.

(e) Unfasten the torque bolts and remove the brake housing from the axle torque plate.

(f) Remove the brake.

(3) DISASSEMBLY OF BRAKES. (The three brake cylinders in each brake housing are identical.)

(a) Remove the wheel.

(b) Support the brake discs and release the parking brake.

(c) Remove the linings and the discs.

(d) Disconnect and plug the brake line.

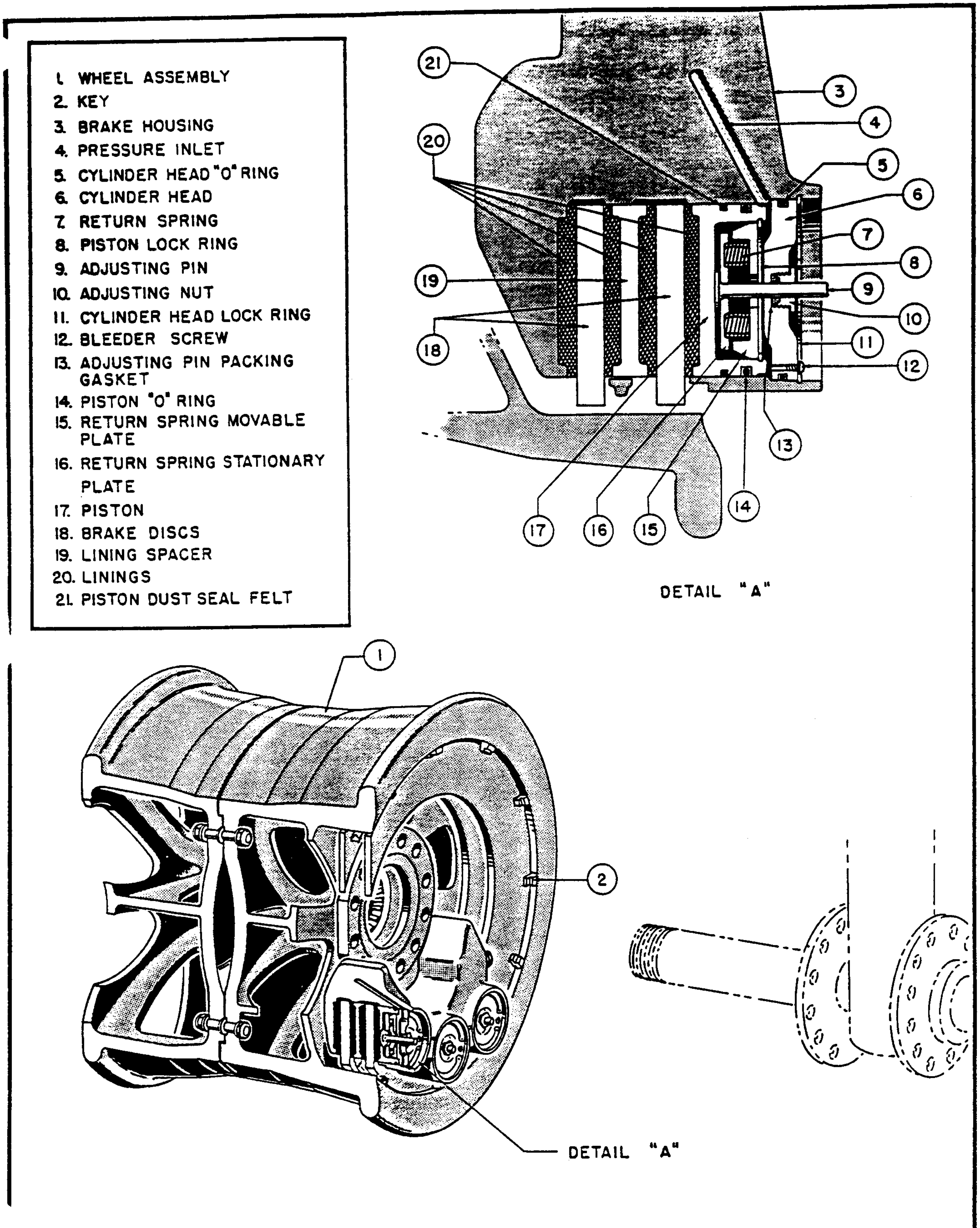


Figure 2. Main Gear Brake Assembly

(e) Unfasten the torque bolts and remove the brake from the axle torque plate.

(f) Remove the true-arc lock rings.

(g) Remove the three cylinder heads.

(h) Remove the piston assembly.

(4) CLEANING, INSPECTION, TESTING AND REPAIR.

(a) Use filtered compressed air to blow dirt or foreign matter out of housing. Wash the brake piston seals and all brake parts thoroughly in Stoddard solvent or equivalent.

CAUTION

Never use gasoline to wash seals as it will injure rubber parts.

(b) Inspect the entire brake for corrosion or broken parts. Inspect piston seals and replace if shrunk or damaged.

(5) REASSEMBLY OF BRAKES.

(a) Dip "O" ring seals in hydraulic fluid and install on the piston and cylinder head.

(b) Lubricate cylinder walls with hydraulic fluid and install piston, small end first.

(c) Install cylinder head. Bleeder screws must be in the top position when brake is installed on the airplane.

(d) Install the lock rings. Be careful to insure proper seating of the rings in the grooves.

(e) Install bleeder screws and washers.

(f) Place pressure plate next to piston by inserting it through disc slots.

(g) Install the linings in the cavities.

(h) Insert the discs between the brake linings.

(i) Install adjusting pin packing.

(j) Install adjusting pin packing nut and torque to 25 ft-lbs.

CAUTION

Cylinder head must be held stationary during this operation.

(6) INSTALLATION OF BRAKES.

(a) Install a hydraulic pressure line to the inlet port of the brake assembly.

(b) Insert the inboard and outboard brake linings in their respective cavities and place the discs between the linings.

(c) Align the two discs with the al[illegible] ing marks on the brake housing.

NOTE

When aligning brake discs be sure the discs do not extend beyond the bottom of the brake casting.

(d) Apply sufficient hydraulic pressure (200 psi) to hold discs securely in position.

(e) Fasten the assembled brake to the axle torque plate of the landing-gear-strut axle with the proper size torque bolts and nuts. (Safety torque bolts with cotter pins.)

(f) Install the airplane wheel on the axle, sliding the wheel drive keys into the slots of the brake discs. Guide the brake discs over the keys to make sure the discs move freely after wheel installation is complete.

(g) All brakes are interchangeable.

(7) BRAKE BLEEDING.

(a) Start the nose-steering-system pump.

(b) Loosen all bleed screws, and remove the bleed plug at the forward end of the brake housing. Connect a hose and needle valve to each bleed plug.

(c) Pull the parking brake handle f[illegible] on. Tighten bleed screws after trapped air has escaped.

(d) Open each needle valve in turn, allowing oil and air to escape. Catch oil in a clean container.

NOTE

During this operation, the oil level in the reservoir must be observed closely and oil added as required to maintain a safe operating supply of oil for the pump.

(e) Bleed approximately one gallon of oil from each brake, or until oil runs clear with no air bubbles apparent.

(f) Release parking handle and stop pumps.

(8) BRAKE OPERATING CHECKS.

NOTE

The following checks can only be applied when the brakes are installed on the airplane.

(a) Raise the airplane on jacks.

(b) Check to see that the brake discs are free to rotate in the wheel brake flange.

(c) Check to see that the wheel is free to rotate when the pedal pressure is released.

NOTE

This type brake requires more force than can be applied by hand to break loose after applying pressure. Once loosened, however, the wheel can be rotated by hand.

(d) With brakes applied, check all hydraulic connections and fittings in the brake system for leaks.

NOTE

Be sure the wheel rolls free. The wheel must be properly adjusted, not so tight that the wheel drags and not so loose as to permit side play.

(9) PARKING BRAKES.

(a) DESCRIPTION.- The parking-brake-and-steering handle (see Section IV, paragraph 5, figures 20 and 51) incorporates one microswitch and trigger which, when compressed, operates the handle release mechanism. At the same time, it actuates the microswitch which operates the steer damp solenoid and normally closed solenoid valve which supplies pressure to foot-brake valves. A cable, attached to the end of the handle shaft, travels about a quadrant mounted to a bracket directly forward of the handle. See figure 3. The end of the cable is connected to the parking-brake valve. To set the parking brakes, pull the handle directly aft. Compress the trigger and push completely forward to release. The cable assembly is adjusted at the quadrant for cable slack and neutral position of brake valve.

(b) PARKING BRAKE VALVE.

1. REMOVAL.

a. Relieve system pressure.

b. Disconnect cable and hydraulic lines. Plug hydraulic lines.

c. Remove four bolts attaching the valve to its mounting bracket.

2. LEAKAGE TEST.

a. Apply 500 psi to pressure port. Adjust set screw until oil starts to flow from brake port. Back off set screw two turns. The leakage from the brake port shall not exceed one drop in five minutes. No external leakage is allowable.

b. Increase pressure to 4500 psi. Leakage from the brake port shall not exceed one drop in five minutes. No external leakage is allowable. Release pressure.

c. Connect a 2000 psi pressure gage to the brake port. Turn adjusting screw in four turns.

d. Apply 1500 psi to the pressure port and obtain 1000 psi on the gage by turning the adjusting screw as required. Leakage from the return port shall not exceed one drop in five minutes. No external leakage is allowable. Release pressure.

e. Plug pressure and brake ports. Apply 100 psi to the return port. No external leakage in three minutes is allowable.

3. FUNCTIONAL TEST.

NOTE

The valve must be mounted in a test fixture so that the load and deflection of the lever arm can be measured. The use of a small hydraulic cylinder to apply the load is recommended.

a. Mount the valve and connect the pressure port to a flow source and hand pump supply. Use this flow to bleed the valve of all air.

b. Adjust the lever arm to obtain the longest arm possible (not to exceed 6-1/8 inches).

c. Connect the lever arm to the hydraulic cylinder and adjust the sliding stop on the fixture so that the lever arm stop has approximately .020 to .030-inch gap between the stop and body of the valve.

d. Apply 500 psi to the pressure port of the valve and adjust the set screw until oil starts to flow from the brake port. Back off the set screw one turn and lock.

e. Connect a calibrated 2000 psi gage to the brake port.

f. Apply 3000 psi to the pressure port by hand pump. Maintain 3000 ± 25 psi throughout the test.

g. Connect a hand pressure pump and a calibrated 400 psi gage to the hydraulic load cylinder.

h. Apply pressure until the lever arm is deflected .65-inch toward the on position. Bring the lever arm pin up slowly so that it just touches the stop on the fixture. Pressure indicated on the 400 psi gage must not exceed 344 psi (270 lbs. direct force) when the brake pressure is 1250-1300 psi.

i. If the pressures noted above are not obtained, the settings may be corrected as follows:

1. Release pressure in the load cylinder.

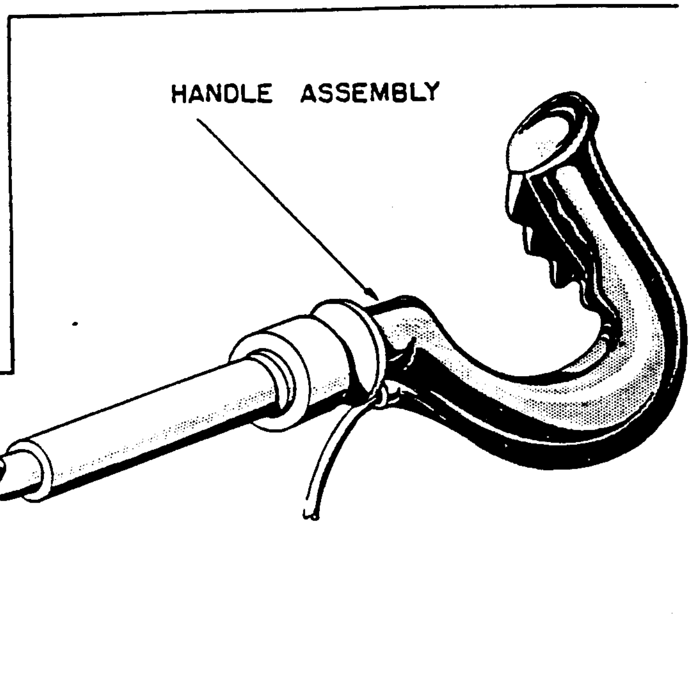
2. Return the lever arm to the stop.

3. Measure the distance from the center-line of the rate adjustment shackle to the center-line of the lever arm pivot.

4. Loosen the palnut on the shackle set screw and loosen the set screw.

5. Loosen the nut holding the 3/16 bolt through the shackle.

6. To increase brake pressure, move the shackle away from the pivot. To decrease brake pressure, move the shackle toward the pivot.



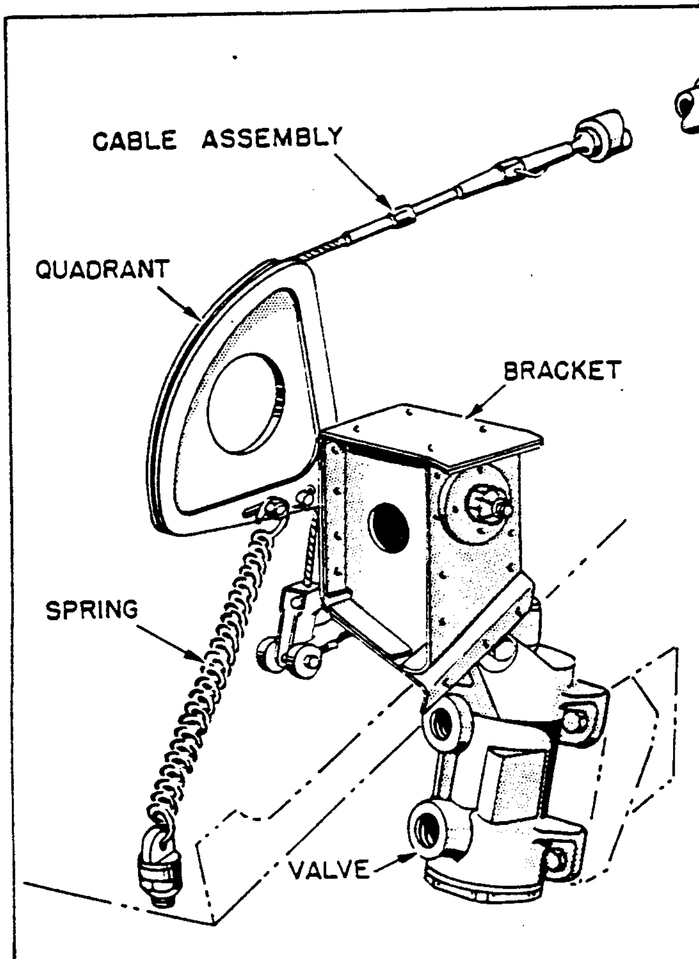


Figure 3. Parking Brake Handle and Mechanical Linkage

7. Tighten the set screw making sure the shackle is square with the lever arm.

8. Tighten the 3/16 nut on the shackle bolt.

j. Repeat items h and i until proper readings are obtained.

4. INSTALLATION.- Reverse removal procedure. (See paragraph (9) (b) 1, preceding.)

(10) EMERGENCY AIR-BRAKE SYSTEM. (See figure 4.)- In the event of hydraulic brake system failure, the brakes may be applied by the emergency air-brake system. The system employs a pressure tank (or bottle), pressure gage, air-brake valve, shuttle valve and the necessary air lines connecting the units to the brake shuttle-valve located at the bottom of each main-landing-gear strut. The emergency air-brake system operates each brake individually or both brakes simultaneously for uniform braking. Two control levers are located between the pilot and copilot and mounted on the upper structure of the crew nacelle. Either pilot or copilot can operate the system. The hydraulic system must be bled after each emergency brake application.

(a) AIR PRESSURE TANK (OR BOTTLE). (See figure 5.)- The air pressure tank is located in the nose gear wheel well. The tank is spherical in shape, white in color, and mounted to the tank support assembly which is attached to the wing structure. A filler valve and air pressure gage are located at the top of the tank. AIR PRESSURE SHOULD BE CHECKED BEFORE EVERY FLIGHT. The tank air pressure should be maintained at 1500 psi.

1. REMOVAL.

a. Relieve air pressure by backing off the filler plug a few turns.

CAUTION

Do not release air by depressing the valve. The sudden rush of high pressure air past the valve seat may damage the core.

b. After all air is released, disconnect the air-pressure line from the bottle.

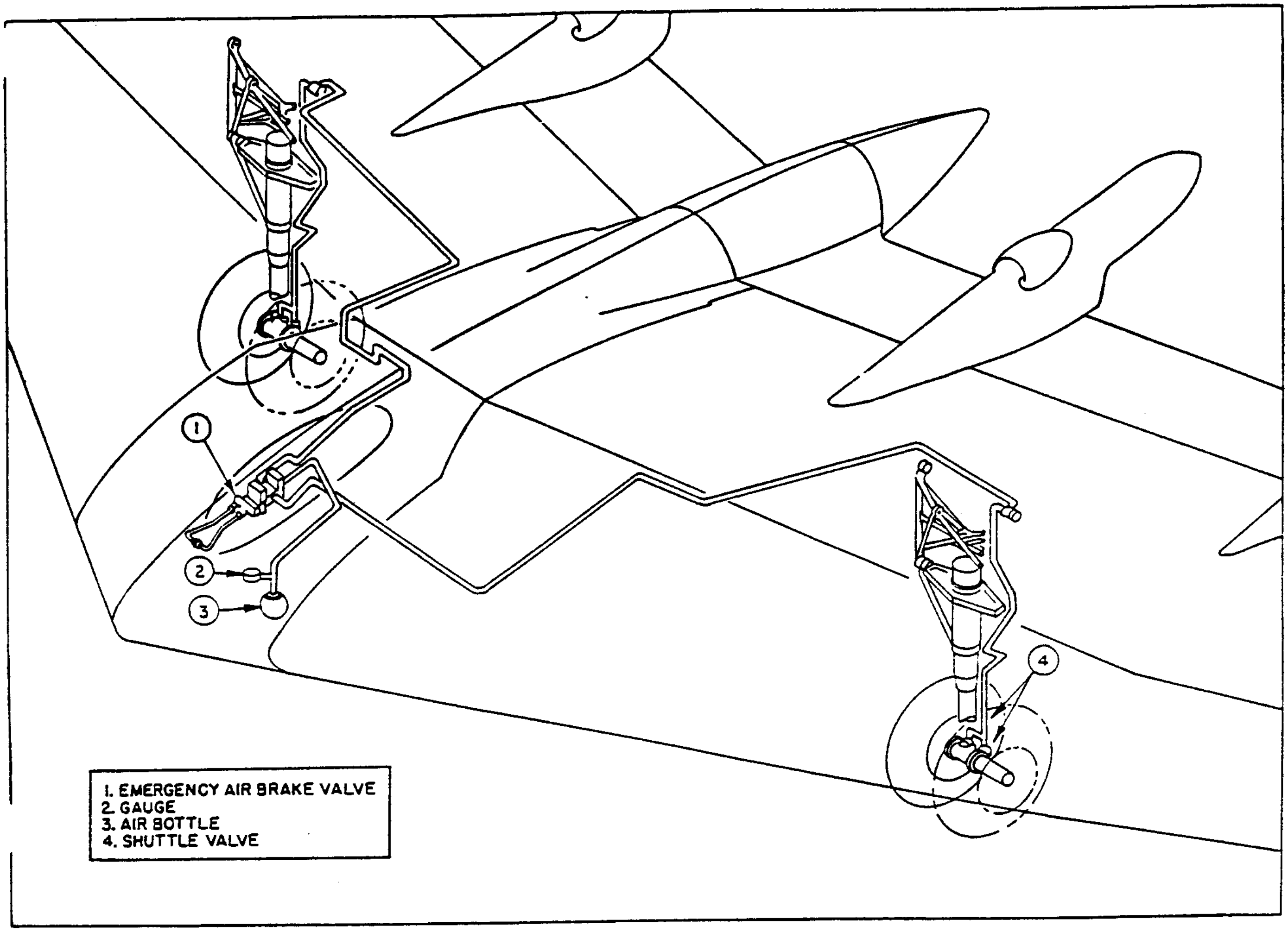


Figure 4. Emergency Air Brake System

c. Remove the two clamps, and the attaching bolts.

d. Remove the air pressure tank.

2. TEST.

a. With the air valve installed, apply 3000 psi hydraulic pressure to the fluid port for 3 minutes. No leakage or signs of failure are allowable.

b. Install a shut-off or check valve in the fluid port. With all fluid exhausted apply 600 psi air pressure, then apply 1500 psi to the fluid port for 3 minutes. There should be no signs of air or fluid leakage. Release pressure and drain all oil.

3. INSTALLATION.

a. Replace the bottle in the mount, and secure with the attaching bolts.

b. Connect the air pressure line to the bottle.

c. Replace the air filler plug and inflate the tank to 1500 psi.

(b) AIR PRESSURE GAGE.- (See figure 5.) The air pressure gage, type AN5769-1, is located in the nose-gear wheel well on top of the air pressure tank.

1. REMOVAL.

a. Relieve air pressure.

b. Disconnect gage at T fitting.

c. Plug or cap the fitting and gage connections.

2. INSTALLATION.

a. Assuming that the air tank is empty, remove caps or plugs from fitting and gage connections.

b. Wipe gage and connection clean, and apply a little hydrualic fluid to the threads.

c. Connect the gage to the fitting.

d. Refill air tank to 1500 psi.

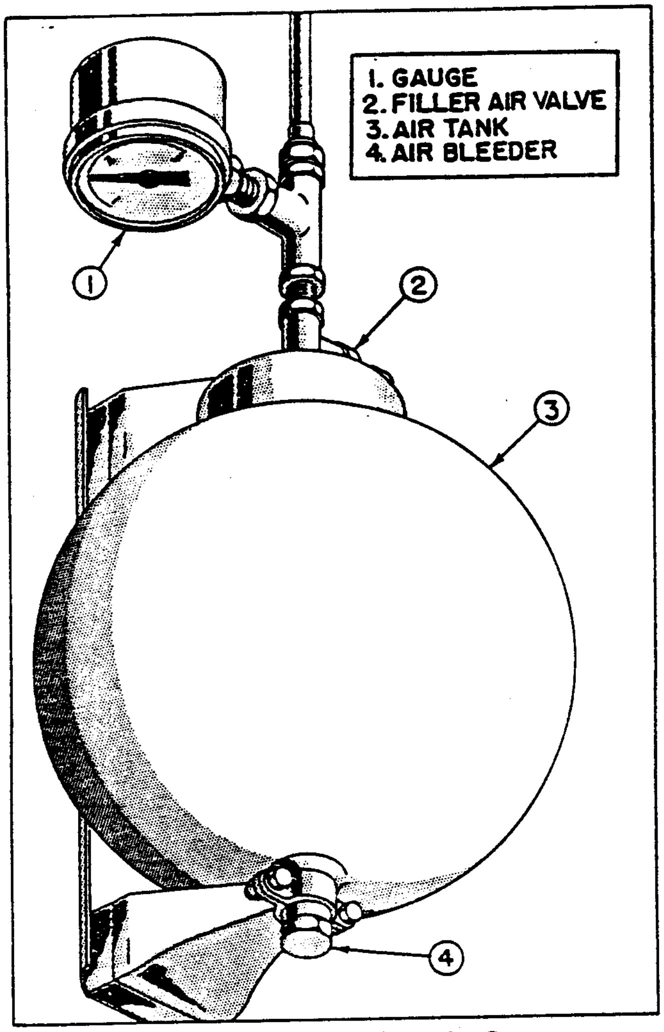


Figure 5. Emergency Brake Air Pressure Bottle and Gage

(c) EMERGENCY AIR BRAKE VALVE. (See figure 6.)- A Bendix-Westinghouse (Model SA-3005-88) emergency air-brake valve is used on the XB-35 airplane. The air-brake valve is a metering differential and load feel type. Varying pressure from zero to 625 psi may be applied to the individual brake, or for uniform braking, to both wheels simultaneously.

1. REMOVAL.

a. Release air from emergency air pressure tank.

b. Disconnect the brake and pressure lines at the valve.

c. Plug or cap valve and air lines.

d. Remove the bolts attaching valve to bracket attached to upper crew nacelle structure.

e. Remove the valve.

2. TEST.

a. Make test set-up as shown in figure 11.

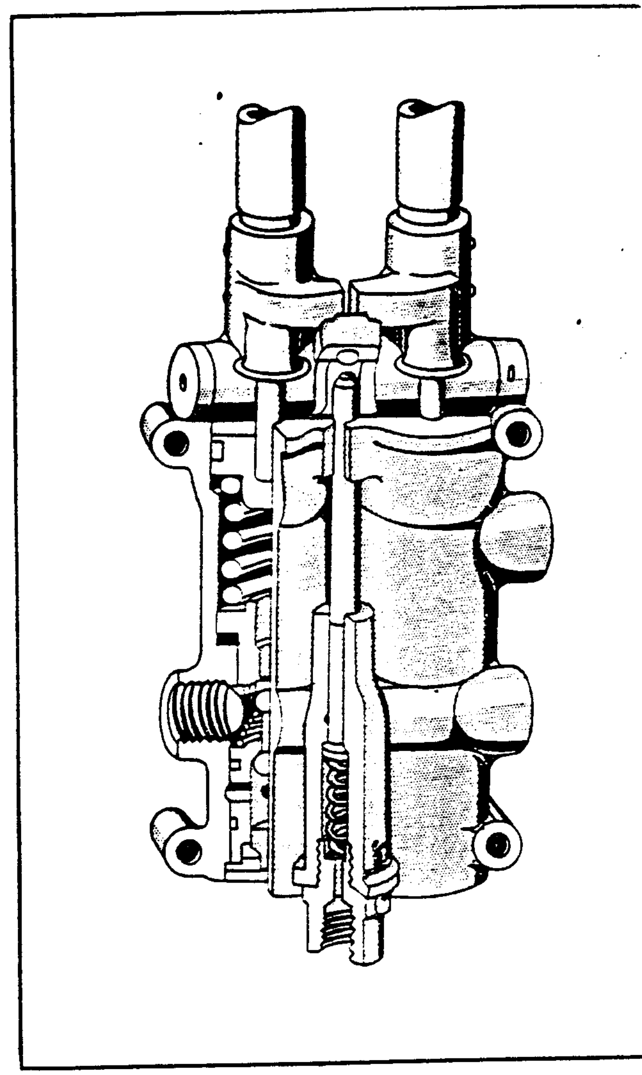


Figure 6. Emergency Air Brake Valve

b. Apply 1500 psi to inlet port. Check external portion of valve under pressure by coating with soapy water and noting any possible bubbles. No leakage is allowable.

c. Slowly pull both handles to full open position. Both gages should read 600 ± 30 psi. The valve may "creep" to a maximum pressure of 675 psi. Conduct leakage test by coating valve, when under pressure, with a soapy water solution and noting any possible bubbles. No leakage is allowable. Release handles.

d. Pull both handles to full open position and coat the exhaust port with a soap solution. A 1-inch bubble per second is the maximum allowable leakage.

NOTE

Make the above bubble test immediately after application, i.e. before the pressure builds up the maximum creep pressure of the valve.

release both handles.

e. Pull one handle to full open position. Conduct soap solution test. A 1-inch bubble in 2 seconds is the maximum allowable leakage.

f. Repeat test e with the other handle. Release the handle.

g. Insert a flat tool between the bottle seal actuating stem and the lever bottom. Pry open the bottle seal valve. Coat the exhaust port with a soap solution. A 1-inch bubble in 3 seconds is the maximum allowable leakage.

h. Slowly pull both handles to full open position. Both gages should follow within 50 psi of each other throughout full handle travel.

NOTE

Do not introduce any hydraulic oil into this unit.

3. INSTALLATION.

a. Attach the emergency air-brake valve with the 4 bolts to its bracket on the upper structure of the crew nacelle.

b. Remove caps or plugs and connect the brake and pressure lines.

c. Refill the tank. Refer to paragraph e (10) (a) preceding.

(d) BRAKE SHUTTLE VALVE. (See figure 7.)- The brake shuttle valve is mounted to the bottom of the strut. Both the hydraulic and the emergency-air lines connect to the shuttle valves. In the event of hydraulic failure, the emergency air-brake system is applied from the cockpit to open the shuttle valve and allow air from the pressure tank to operate the brakes. The valve prevents air from escaping through the hydraulic lines.

1. REMOVAL. (Relieve hydraulic and air pressure.) Disconnect and plug hydraulic and air emergency lines. Remove mounting bolts.

2. TEST.

a. Plug the swivel connection port. Apply 15 psi to the outlet port for three minutes with the emergency port open. No leakage is allowable.

b. Repeat test a at 2250 psi. No leakage is allowable.

c. Apply pressure to the emergency port with the outlet port open. The valve must shuttle at 12 psi or less. Apply 100 psi for three minutes. No leakage is allowable.

d. Repeat test c at 2250 psi. No leakage is allowable.

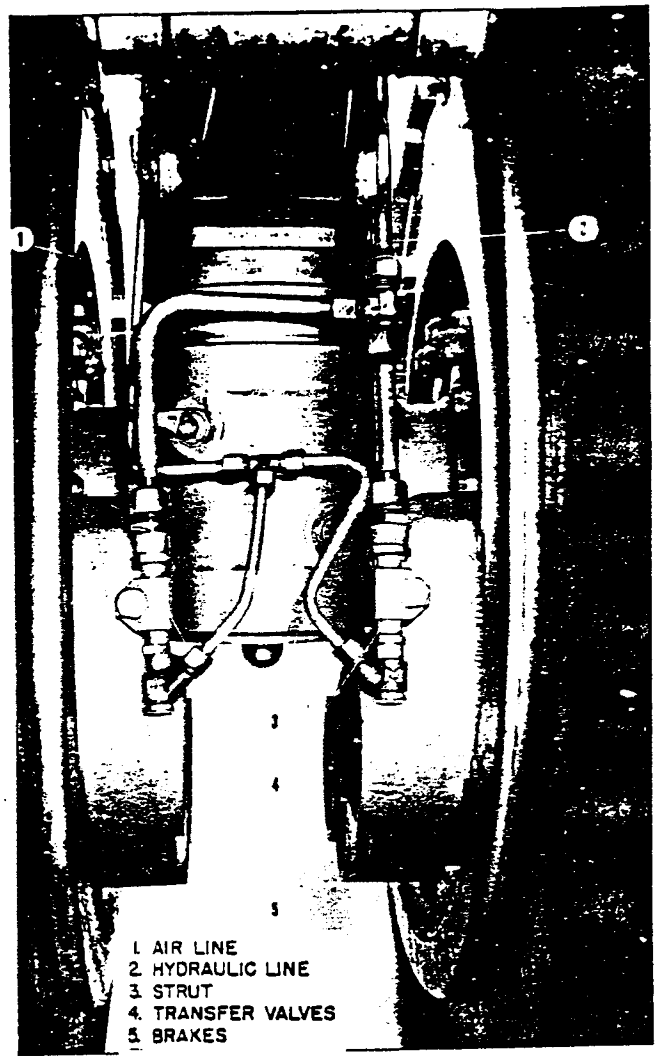


Figure 7. Emergency Air Brake Transfer (Shuttle) Valve

e. Apply pressure to the outlet port with the emergency port open. The valve must shuttle at 12 psi or less.

NOTE

Step e must be made in order to return the shuttle to its normal position as this unit does not use a spring for return.

3. INSTALLATION.- Mount shuttle valve on strut bracket with mounting bolts and aluminum washers. Connect the hydraulic and the emergency-air lines to the valve. Check for hydraulic leaks.

(11) BRAKE VALVES.

(a) MAIN BRAKE VALVES. (See figure 8.)- The power brake valves (Bendix 405431 and 2) are mechanically operated hydraulic units which direct a variable pressure flow of fluid to the brakes between zero and 1300 psi. The valve

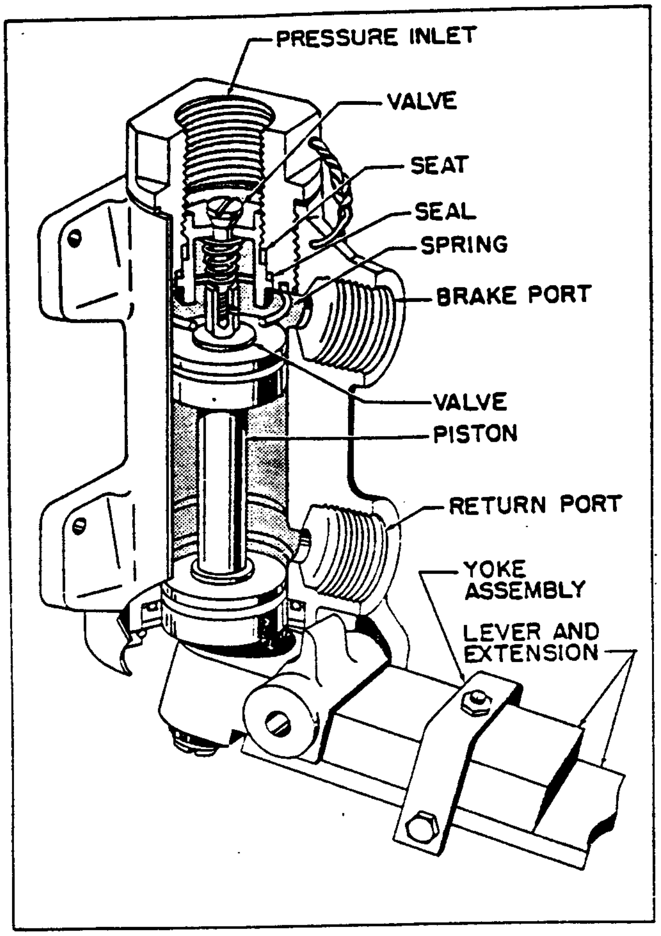


Figure 8. Main Landing Gear Brake Valve

consists of a cast aluminum body with an external leaf spring which, when actuated, operates a piston and valves inside the unit.

(b) REMOVAL.

NOTE

Kill the system pressure in the lines by pumping brakes until the hydraulic pressure is reduced to zero.

1. Disconnect and plug the three hydraulic lines at each valve.

2. Remove the lever attaching screw, nut, and four valve-mounting bolts. Remove the valve.

(c) DISASSEMBLY.

1. Break the safety wire and remove the adapter and gasket from the valve body. The valve seat is threaded into the adapter and may be removed by a large screw driver. The seat contains the upper valve, the spring, and the lower valve which is secured by a cotter pin. An O-ring packing prevents leakage past the valve seat.

2. Remove the cotter pin and unscr the lower valve from the stem of the upper valve. Remove the inner spring.

3. Remove the outside spring. The piston assembly with the O-ring packing may be pushed out from the operating lever. Remove the push-rod between the piston and screw.

NOTE

The piston assembly is a brazed steel cylinder and therefore cannot be disassembled.

4. Remove the lock ring and pin holding the operating lever. The inside washer may be removed when the lever pin is removed. Remove the Torrington sleeves.

5. If necessary to remove the extension lever, break the safety and remove the bolt and the yoke by loosening the lock nut and set screw, and taking out the bolt and nut at the bottom of the yoke.

NOTE

It is not necessary to remove the extension lever and operating lever to disassemble the parts of the valve in the body. When reassembling the valve however, removal of the operating lever will facilitate replacing the piston assembly.

(d) INSPECTION.

1. Inspect the O-ring packings on the piston for cracks or deterioration. Replace if necessary.

2. Inspect the valve seats of the upper and lower valves and the valve slot piston assembly. If leakage by these valves is evident, the seat on the piston and the valve seat may be lapped as follows:

a. Use a piece of 5/16-inch round brass rod with the end ground to the same angle as the valves. This angle is 90°.

b. Both the seat and the piston may be lapped without assembling in the body. It is necessary however, to provide a suitable guide in order to lap a concentric seat.

c. Apply lapping compound to the lapping tool and carefully lap the seat. It is recommended that the seat not be cut wider than .032. If the lapping tool shows any marks across the 90° face, it should be resurfaced in order to obtain a good seat.

d. If the upper and lower valves show evidence of wear or scoring, they should be replaced. DO NOT ATTEMPT TO LAP THE VALVES IN THE SEAT ON THE PISTON OR VALVE SEAT.

NOTE

After lapping any valves, the parts should be washed thoroughly with solvent or cleaner to remove any trace of lapping compound before reassembly.

3. Before reassembly, the brake-valve body should be washed with an approved cleaning solvent and blown out with filtered air to remove any foreign particles that might cause the valve to malfunction.

(e) REASSEMBLY. (See figure 9.)

1. In the operating lever end, replace in the following order: Insert O-ring packings onto the piston assembly and slide piston into the valve body. Lubricate rings and mating parts with hydraulic fluid.

2. Replace the upper and lower valve in the valve seat in the following manner: Push the upper valve through the valve seat from the threaded end. Replace the small spring to the inside and screw on the lower valve to hold the spring. Line up the holes of the valve stems and insert a cotter pin. Replace the seal on the valve seat and thread into the adapter. Tighten with a large screw driver.

3. Replace the outside spring on the front of the adapter and screw the adapter into the body.

4. Insert needle bearing sleeves in body and fasten operating lever to the body with the pin. Lubricate bearings with AN-G-3 grease. Lock the pins with snap rings. Replace the push rod between the piston and the screw.

5. Replace the extension lever and secure with bolt to the operating lever. Adjust to obtain longest arm possible. Safety the bolt with safety wire. Replace the yoke on the lever and operating lever, and secure with bolt and nut. Tighten set screw on top of yoke and lock with lock nut.

(f) LEAKAGE TEST.

1. Apply 500 psi to the pressure port. Adjust the set screw until oil starts to flow from the brake port. Back off the set screw two turns. Leakage from the brake port should not exceed one drop in five minutes. No external leakage is allowable.

2. Increase pressure to 4500 psi. Leakage from the brake port should not exceed one drop in five minutes. No external leakage is allowable. Release pressure.

3. Connect a 2000 psi pressure gage to the brake port. Turn the adjusting screw in four turns.

4. Apply 1500 psi to the pressure port and obtain 1000 psi on the gage by turning the adjusting screw as required. Leakage from the return port shall not exceed

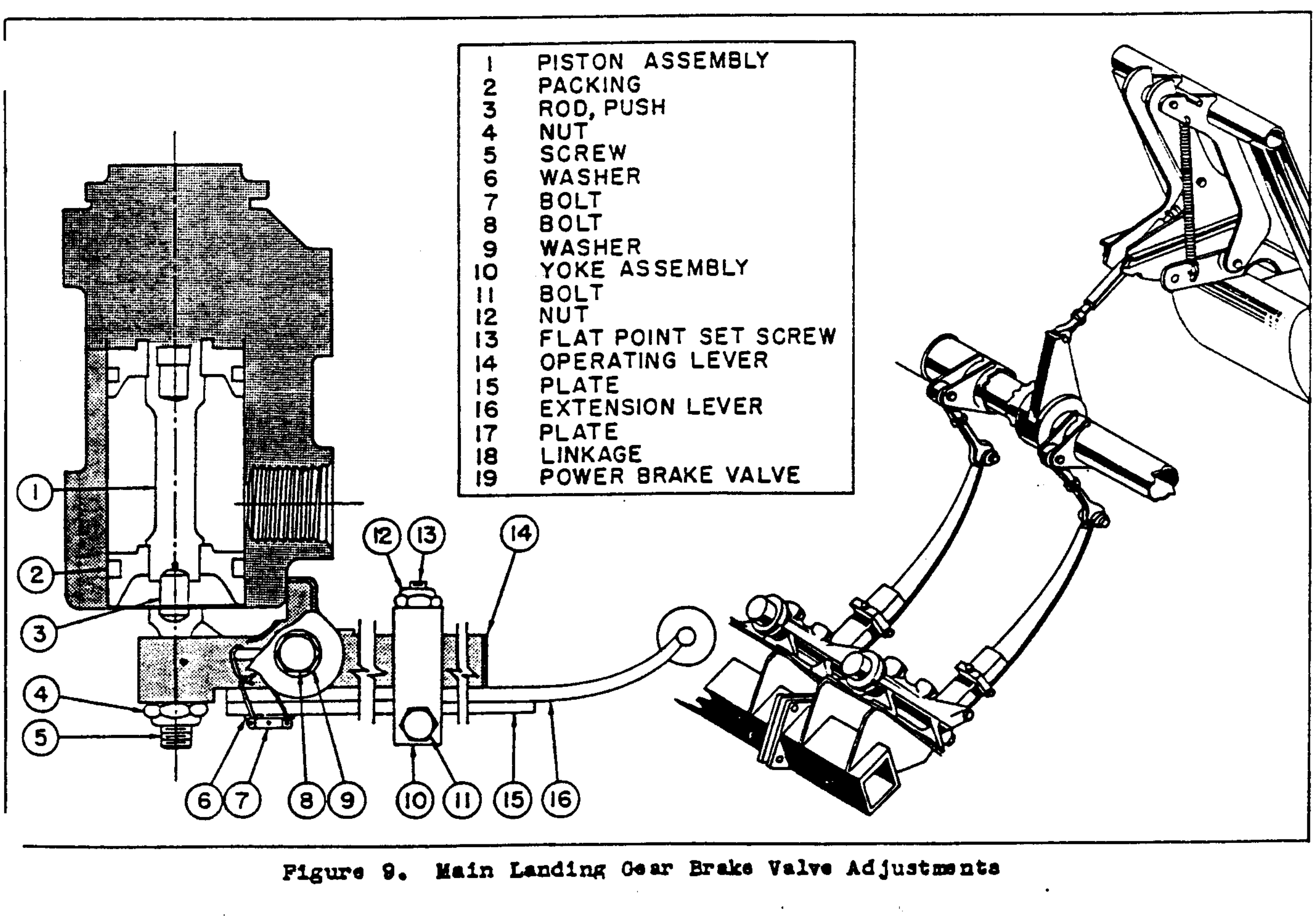


Figure 9. Main Landing Gear Brake Valve Adjustments

one drop in five minutes. No external leakage is allowable. Release pressure. Remove pressure gage.

5. Plug the pressure and brake ports. Apply 100 psi to the return port. No external leakage in three minutes is allowable.

(g) FUNCTIONAL TEST.

NOTE

The valve must be mounted in a test fixture so that the load and deflection of the lever arm can be measured. The use of a small hydraulic cylinder to apply the load is recommended.

1. Mount the valve and connect the pressure port to a flow source and hand pump supply. Use this flow to bleed the valve of all air.

2. Adjust the lever arm to obtain the longest arm possible (not to exceed 8-1/4 inches).

3. Connect the lever arm to the hydraulic cylinder and adjust the sliding stop on the fixture so that the lever arm stop has approximately .020 to .030-inch gap between the stop and body of the valve.

4. Apply 500 psi to the pressure port of the valve and adjust the set screw until oil starts to flow from the brake port. Back off the set screw one turn and lock.

5. Connect a calibrated 2000 psi gage to the brake port.

6. Apply 3000 psi to the pressure port by hand pump. Maintain 3000 $\pm$ 25 psi throughout the test.

7. Connect a hand pressure pump and a calibrated 400 psi gage to the hydraulic load cylinder.

8. Apply pressure until the lever arm is deflected 1.52-inches toward the "ON" position. Bring the lever arm pin up slowly so that it just touches the stop on the fixture. Pressure indicated on the 400 psi gage must not exceed 280 psi (220 lbs direct force) when the brake pressure is 1250-1300 psi.

9. If the pressures noted above are not obtained, the settings may be corrected as follows:

a. Release pressure in the load cylinder.

b. Return the lever arm to the stop.

c. Measure the distance from the center-line of the rate adjustment shackle to the center-line of the lever arm pivot.

d. Loosen the palnut on the shackle set screw and loosen the set screw.

e. Loosen the nut holding the 3/. bolt through the shackle.

f. To increase brake pressure, move the shackle away from the pivot. To decrease brake pressure, move the shackle toward the pivot.

g. Tighten the set screw, making sure the shackle is square with the lever arm.

h. Tighten the 3/16 nut on the shackle bolt.

10. Repeat items 8 and 9 until proper readings are obtained.

(h) INSTALLATION.- Reverse removal procedure. (See paragraph (11) (b), preceding.

(12) SOLENOID VALVE (NORMALLY CLOSED). (See figure 10.)

(a) DESCRIPTION.- This valve is a two-way valve in which a solenoid supplies power for moving the shuttle.

(b) OPERATION.- The inlet side of the valve is connected to the regular pressure system, and will remain closed so long as the solenoid is not energized. This is accomplished by leakage around the outside of the poppet guide which builds up a pressure on the top of the poppet, holding it against its seat. When the solenoid is energized, a ball pilc valve is released, permitting release of pressure from the top side of the poppet which allows the poppet to lift and permit flow of fluid through the valve.

(c) REMOVAL.- Disconnect hydraulic lines and electrical cable. Plug hydraulic lines. Remove four bolts which secure valve to bracket

(d) DISASSEMBLY.

1. Secure the valve body in a suitable clamp or vise.

2. Unscrew the solenoid retainer housing from the valve body.

3. Lift up the solenoid body and solenoid assembly.

4. Remove the plunger and return spring.

5. Remove the pilot-valve seat.

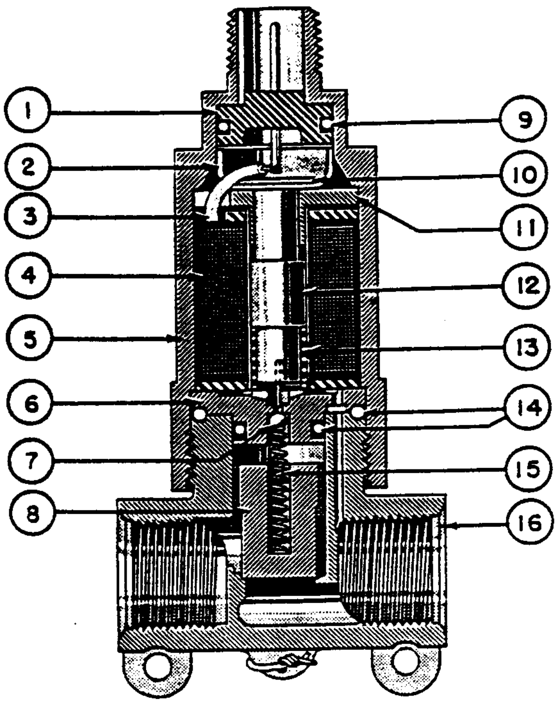
6. Remove the pilot-valve ball, spring and poppet.

7. Press out the contactor pin assembly which will in turn press out the solenoid.

(e) ASSEMBLY.

1. Secure the valve body in suitable clamp or vise.

2. Install poppet and pilot-valve spring.



1. CONTACT ASSEMBLY
2. SPACER
3. SLEEVING
4. COIL ASSEMBLY
5. RETAINER ASSEMBLY
6. SEAT
7. STEEL BALL
8. POPPET ASSEMBLY
9. PACKING RING
10. ELECTRIC INSULATOR
11. PLATE-SOLENOID END
12. PLUNGER ASSEMBLY
13. PLUNGER SPRING
14. PACKING RINGS
15. POPPET SPRING
16. BODY

Figure 10. Solenoid Valve - Normally Closed

3. Install AN6227-8 O-ring on pilot-valve seat.

4. Install AN6227-18 O-ring in place on top of the body.

5. Insert the pilot-valve ball in its seat and secure with vaseline.

6. Set the pilot-valve seat in place on top of the housing.

7. Place the plunger return spring on the plunger and set the plunger in place on top of the pilot-valve seat, taking care to see that the pin on the bottom of the plunger lines up with the orifice in the pilot-valve seat.

8. Set the solenoid coil with lead wires up in place.

9. Place the solenoid end-plate on top of the coil with lead wires passing through the slot provided.

10. Place the cup-shaped spacer, open side up, on top of the solenoid end plate with lead wires extending through the hole.

11. Place the flat insulator in the bottom of the cup and solder the two lead wires respectively to the two poles of the contactor pin assembly.

12. Install O-ring AN6227-12 in the groove on the contactor pin assembly.

13. Slide this entire sub-assembly inside the solenoid housing taking care that the contactor-pin assembly engages properly in the spline inside the thread contactor shell.

14. Carefully assemble this entire unit of extending solenoid plunger and screw in place.

(f) TEST.

1. Connect a 24 volt d.c. power supply to the valve through an "On and Off" switch. Connect a hydraulic pressure line to the inlet port.

2. Operate the valve several times at reduced flow and pressures. With the valve "ON," set the flow at 3 gpm.

3. Apply 3000 psi for 3 minutes with the valve "OFF." Leakage from the open port must not exceed 5 drops per minute. Operate the valve and repeat leakage test. Results must be the same.

4. Apply 40 psi for 3 minutes with the valve "OFF." Leakage from the open port must not exceed 5 drops per minute.

5. Cap outlet port. Apply 4500 psi for 2 minutes with the valve "ON." No external leakage is allowable.

6. Repeat item 5 at 25 psi for 2 minutes. No external leakage is allowable.

(g) INSTALLATION.- Reverse the removal procedure. See paragraph (12) (c), preceding.

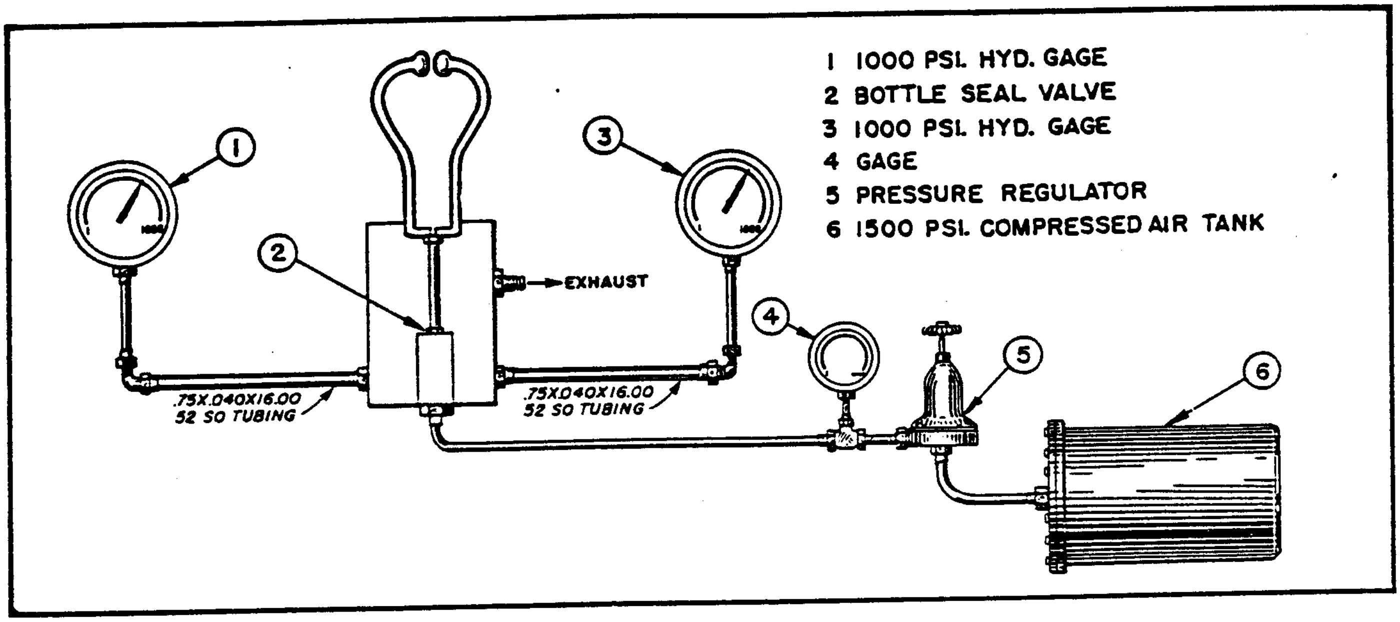


Figure 11. Emergency Air Brake Valve Test

7. ENGINES AND ACCESSORIES

7. ENGINES AND ACCESSORIES. (See figures 6 thru 17 inclusive.)

a. GENERAL.- Four engines and two auxiliary power units are provided for the XB-35 airplane. The engines, through a system of reduction gearing, supply power to applicable eight-bladed, dual rotating, Hamilton Standard propellers. The two auxiliary power units, each of which is comprised of an engine, an alternator, and accessory equipment, supply the airplane with 208 volt, 400 cycles, 3 phase alternating current. Refer to paragraph 7 b for a description of the engines, and to paragraph 7 c for a description of the auxiliary power units.

b. ENGINES. (See figures 1 thru 4 inclusive

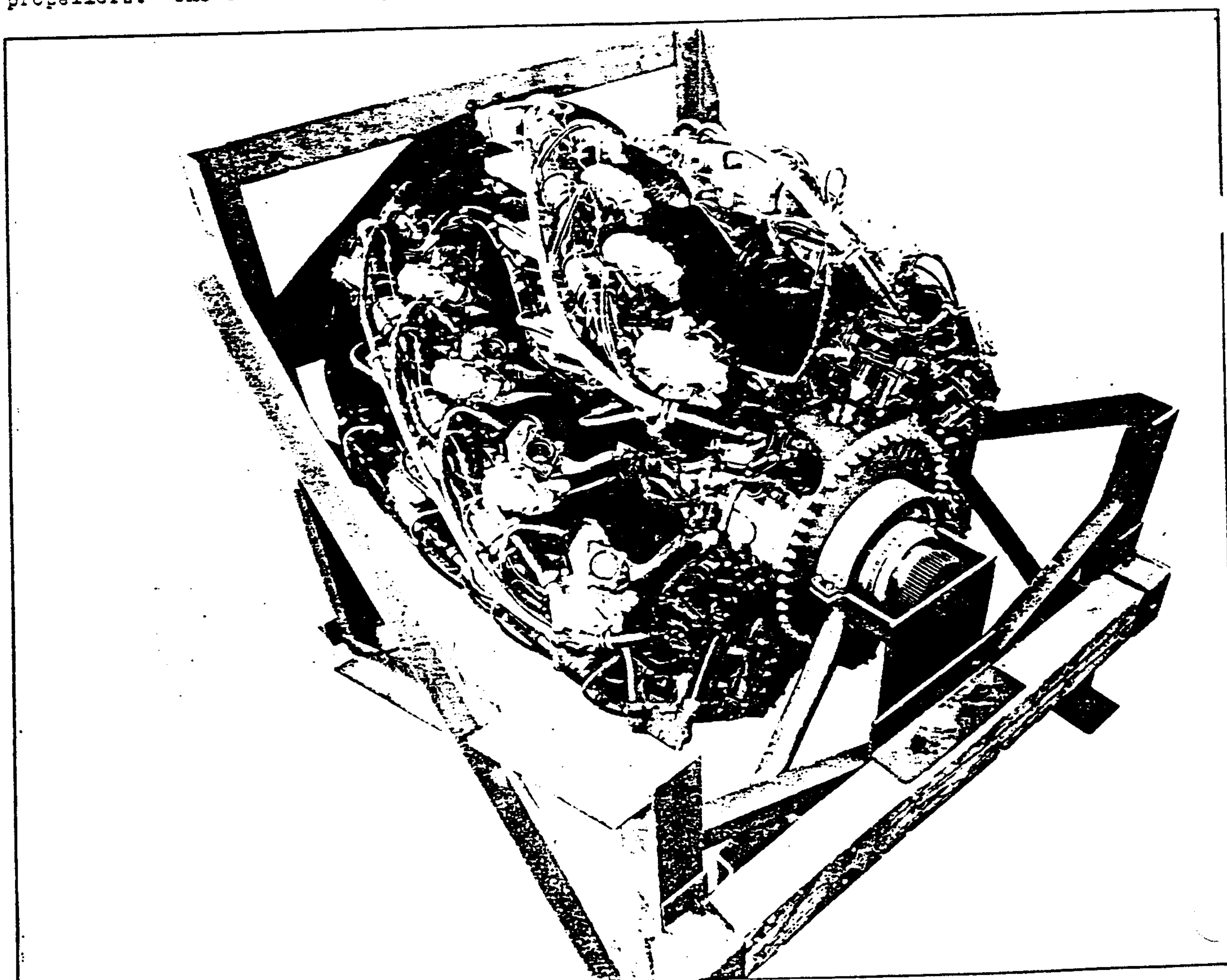


Figure 1. Engine - Front Left Side View

(1) DESCRIPTION.- The XB-35 airplane is powered by four pusher type Pratt and Whitney Wasp Major engines which deliver a total of approximately 12,000 BHP at 2700 rpm. Each engine is of the radial, multi-bank, air-cooled type. They have 28 cylinders which are helically arranged around the crankcase in four rows and seven banks. The five major sections of the engine case are, front to rear, the propeller shaft case section, the reduction gear case section, the magneto drive case section, the crankcase section; cylinders, blower case section, accessory drive case section, and fan drive case section. Right and left, clockwise and counterclockwise, upper and lower, and similar directional references apply to the engine as viewed from the rear with the crankshaft in the horizontal position and with No. 1 cylinder at the top of the engine. The normal direction of propeller shaft rotation is clockwise. The direction of rotation of accessory drives is specified as it appears to an observer facing the accessory mounting pad. In all cases, the propeller end of the engine is designated the front and the anti-propeller end the rear. The cylinders are arranged in four rows and seven banks. The rows are identified alphabetically, A through D from rear to front. The banks are identified numerically, one (the number of the bank in which the top cylinder is located) through seven, clockwise as viewed from the rear. Each cylinder is identified by a letter and a number. The letter identifies the row and the number indicates the bank in which the cylinder is located. Viewed from the rear of the engine, each cylinder to fire will be located four banks clockwise from, and one row in front of, the cylinder which has just fired. (See Section IV, paragraph 8, figure 2.) If the cylinder which has just fired is in the front row, the next cylinder to fire will be in the rear row. Starting with A1 cylinder, then, the firing order is as follows (read across):

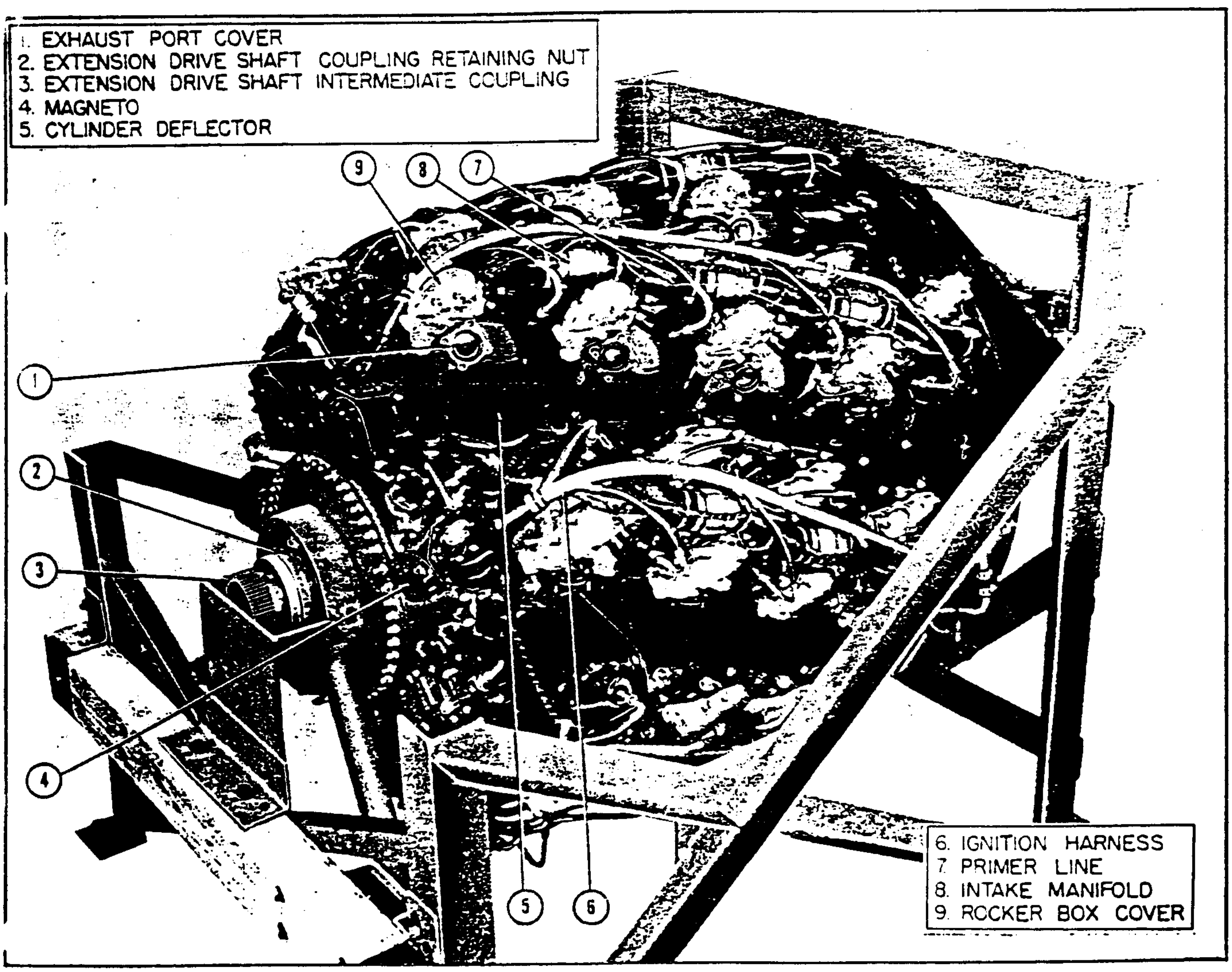


Figure 2. Engine - Front Right Side View

A1	B5	C2	D6
A3	B7	C[illegible]	D1
A5	B2	C[illegible]	D3
A7	B4	C[illegible]	D5
A2	B6	C3	D7
A4	B1	C5	D2
A6	B3	C7	D4

Ignition is furnished by seven magnetos with integral distributors whose timing is controlled by a two-position spark advance system. In addition to the integral, single-speed, single stage superchargers, fuel air induction is supplemented by means of auxiliary, exhaust driven, turbosuperchargers, located in the leading edge of the wing. Refer to Section IV, paragraph 14 a and b for a description of the turbosuperchargers. Although all basic engines (R-4360) are identical, necessary accessories which complete the engine assembly (as asse[illegible] immediately prior to installation), prevent interchangeability. However, for purpose of differentiation, the inboard engine assemblies are designated as R-4360-17 engines, and the outboard engine assemblies as R-4360-21 engines. Accessory installations include the engine cooling fan and supplementary components exhaust collector ring, headers, and cooling shroud assemblies; tail pipe and aspirator (outboard engines only), engine mounting equipment, starter, fuel pump, fuel flowmeter, and various control mechanisms and instrument installations. A location of these accessories may be ascertained by referring to figures 1 thru 17 inclusive. Likewise additional information, as applicable, will be found in Section IV, paragraphs 8 to 14 inclusive.

(a) CYLINDER HEADS AND BARRELS.

1. An aluminum muff in which barrel cooling fins have been machined, and an aluminum head with integral braced cooling fins are shrunk onto each of the 28 cylinder barrels.

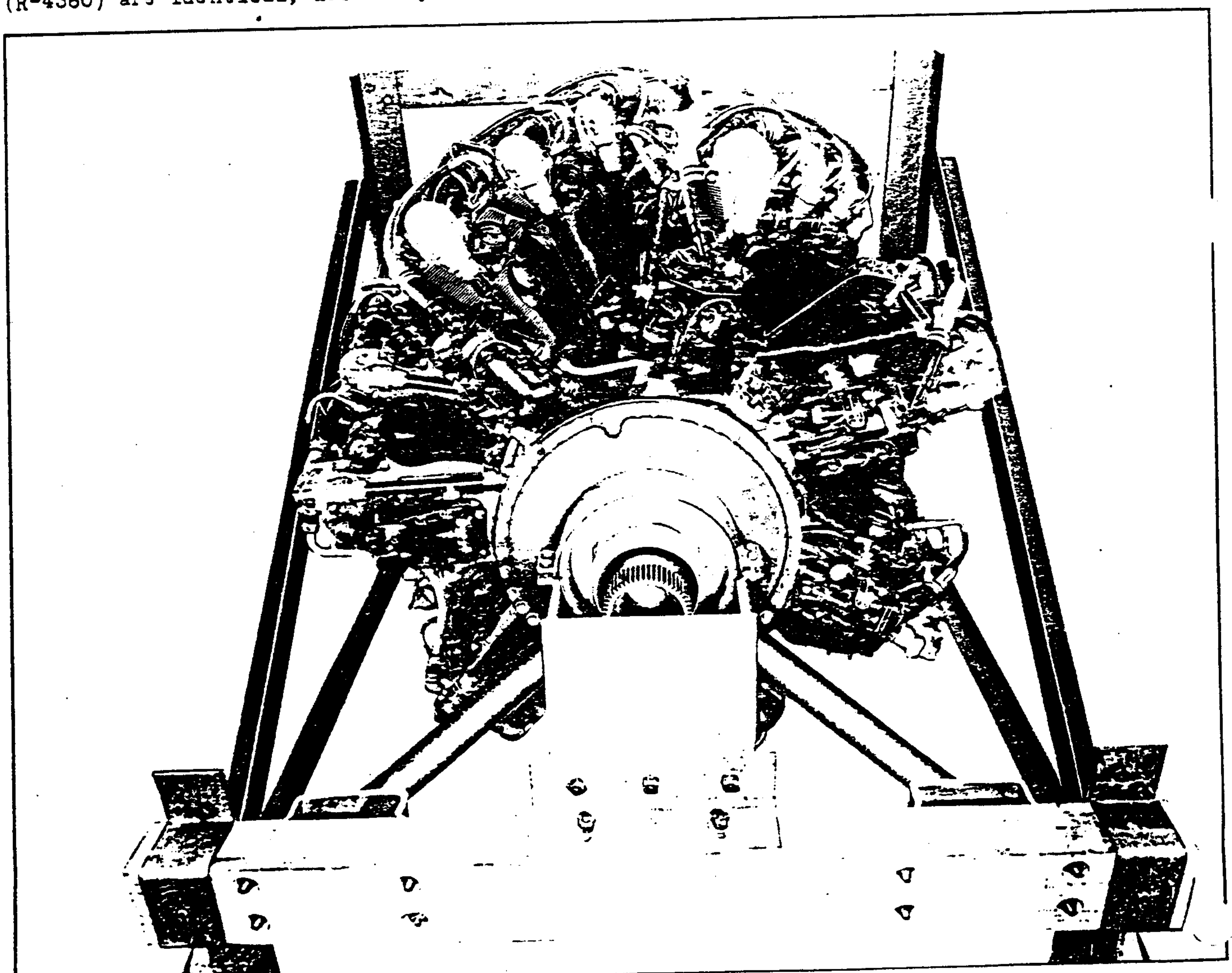


Figure 3. Engine - Front View

2. Each of the 28 identical cylinders secured to the 1[illegible] studs in the corresponding inder mounting pad on the crankcase. These studs project from the mounting pad through the holes in the flange integral with and near the base of the cylinder barrel.

3. The rocker box covers are secured by washers and self-locking nuts to their studs in the rocker boxes. Each rocker box is equipped with a push rod cover nut adapter.

4. The exhaust pipe coupling in the exhaust port of each cylinder is equipped with a steel liner and four studs for securing the exhaust pipe. The intake port is located between the rocker boxes and has four studs for intake manifold attachment. A bronze inlet valve seat, a steel exhaust valve seat, and two bronze valve guides are installed in each cylinder head.

5. Two stainless steel helicoil spark plug inserts are screwed and staked into the spark plug openings, located in the left and right sides of each cylinder head. The insert in the recess at the top of the cylinder head, between the intake port and the exhaust rocker box, is for a cylinder head thermocouple attachment.

(b) PUSH RODS AND COVERS.- The tubular push rods have hardened steel ball ends. Single piece tubular covers enclose the push rods and are secured to the tappet guides in the crankcase and the unions in the rocker boxes by special nuts. The push rods and covers connected to the inlet rocker boxes are slightly shorter than those connected to the exhaust rocker boxes, and the nuts securing the push rod covers to the unions in the rocker boxes are slightly larger than those securing the push rod covers to the tappet guides.

(c) VALVE ROCKERS.- Each valve rocker is supported on its rocker shaft by a bronze bearing in its bore and by a removable steel sleeve which fits around the shaft. A valve clearance adjusting screw and lock nut are provided in the valve end of each rocker.

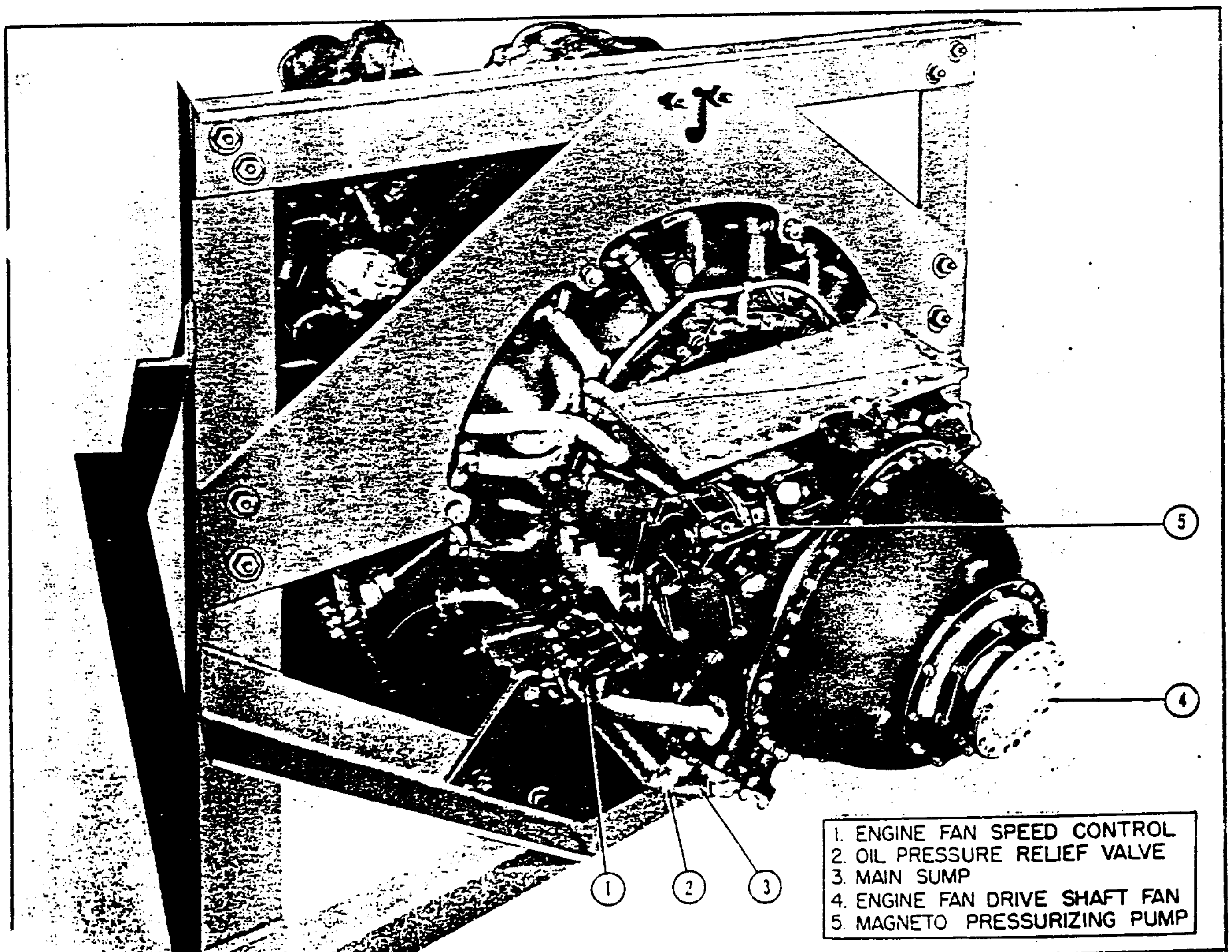


Figure 4. Engine - Rear Right Side View

(d) VALVES.- Each cylinder has an inlet and an exhaust valve. The solid inlet valve is the smaller of the two. The hollow exhaust valve is partially filled with sodium for improved cooling characteristics and has a stellite coated seating surface to prolong its life.

(e) PISTONS.- The piston travels through a 6 inch stroke to afford a 7 to 1 compression ratio. The internal faces of the piston are provided with cooling fins. Cast iron piston rings with butt type gaps are installed in the five grooves in the piston skirt. The rings in the top three grooves are wedge type compression rings. The top compression ring is chromium plated on the face which bears against the cylinder wall. The two bottom grooves are provided with oil drain holes. Two oil control rings are installed in the fourth ring groove and an oil scraper ring is installed in the bottom groove.

(f) ROCKER BOX SUMPS.- All the lower rocker boxes drain through interconnecting external pipes into two rocker sumps. The front sump, which is attached directly to C4 cylinder exhaust rocker box in place of

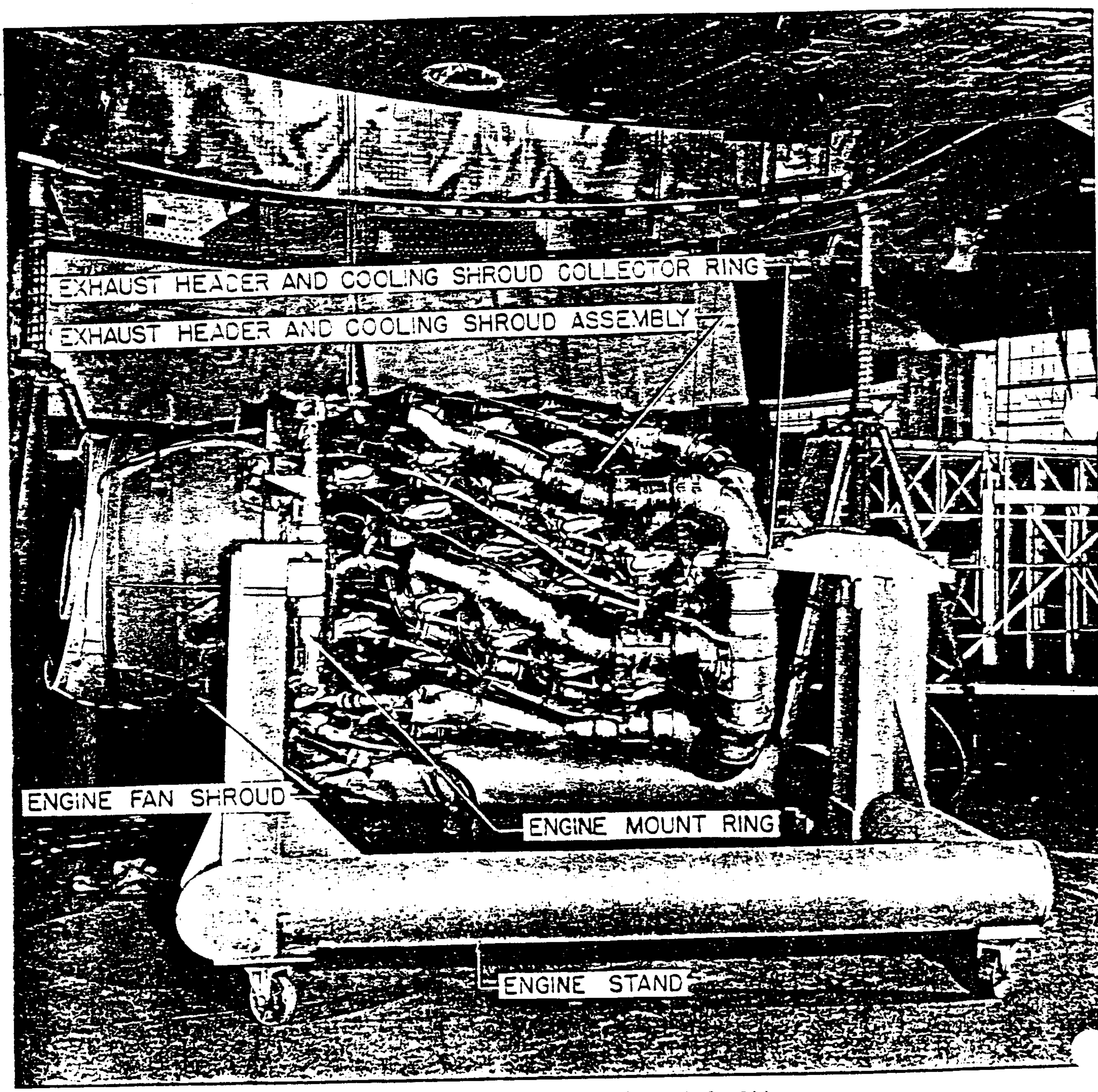


Figure 5. Engine Assembly - Left Side

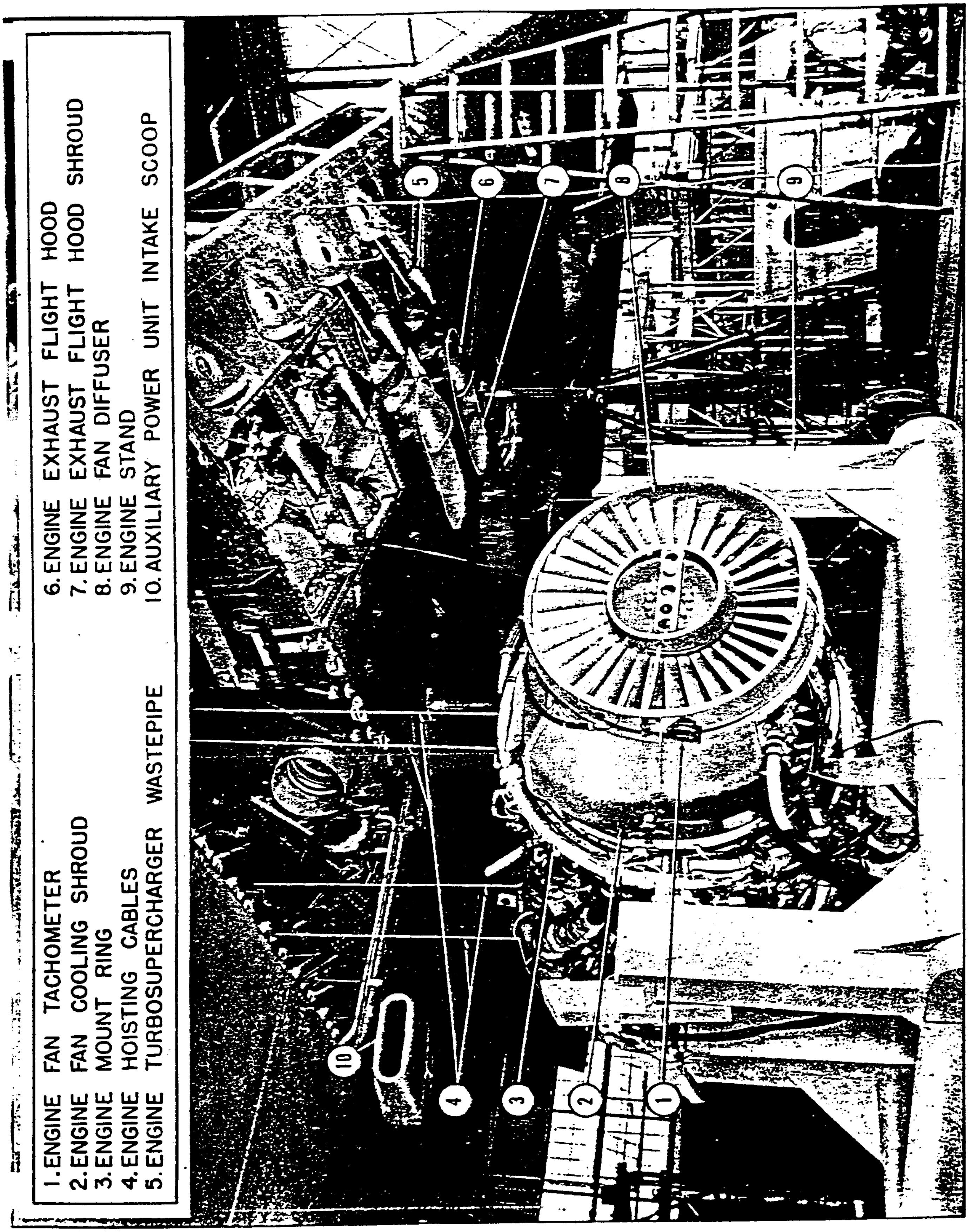


Figure 6. Engine Assembly - Fan Drive Case Section

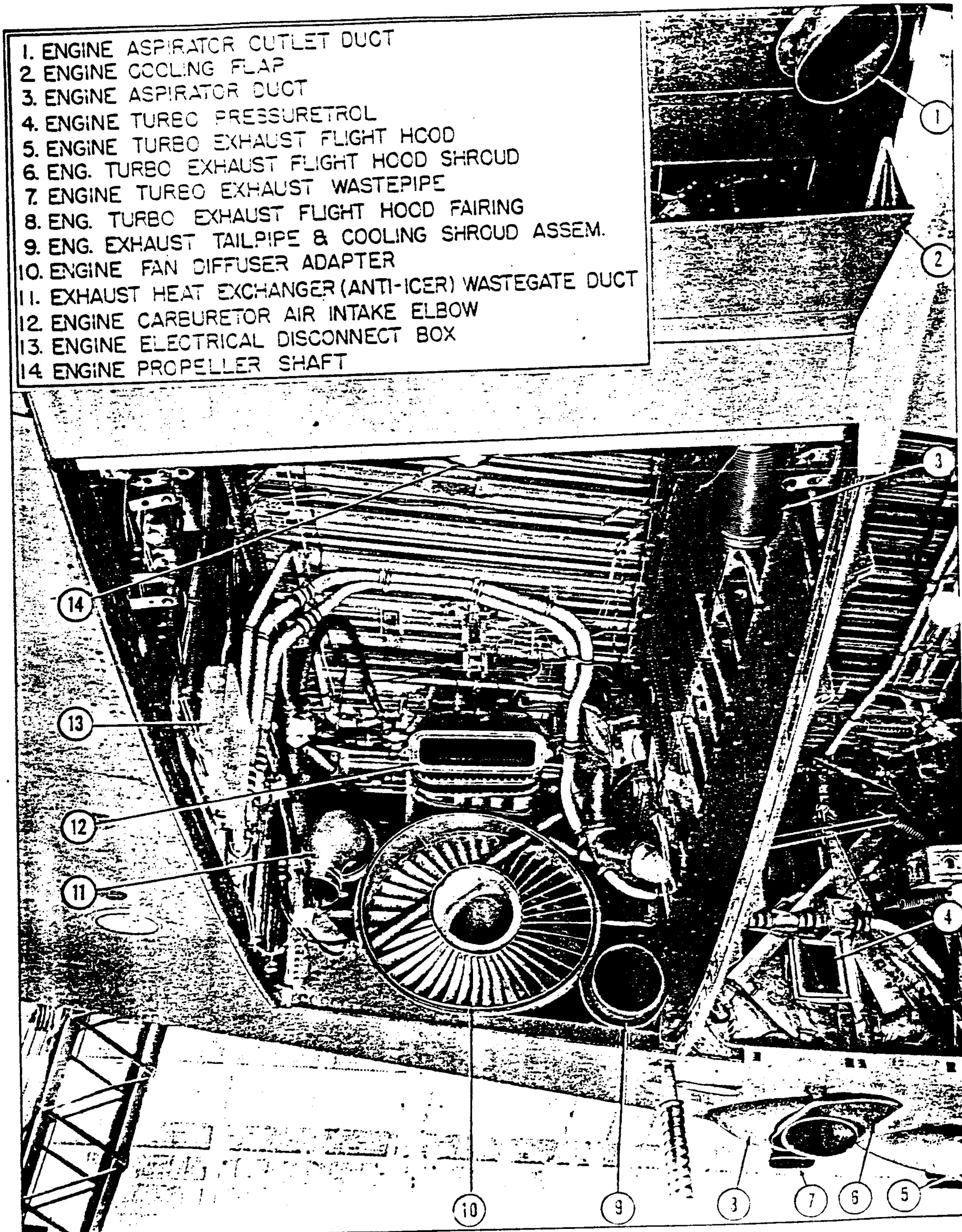


Figure 7. Engine Bay - Outboard (Fwd. View

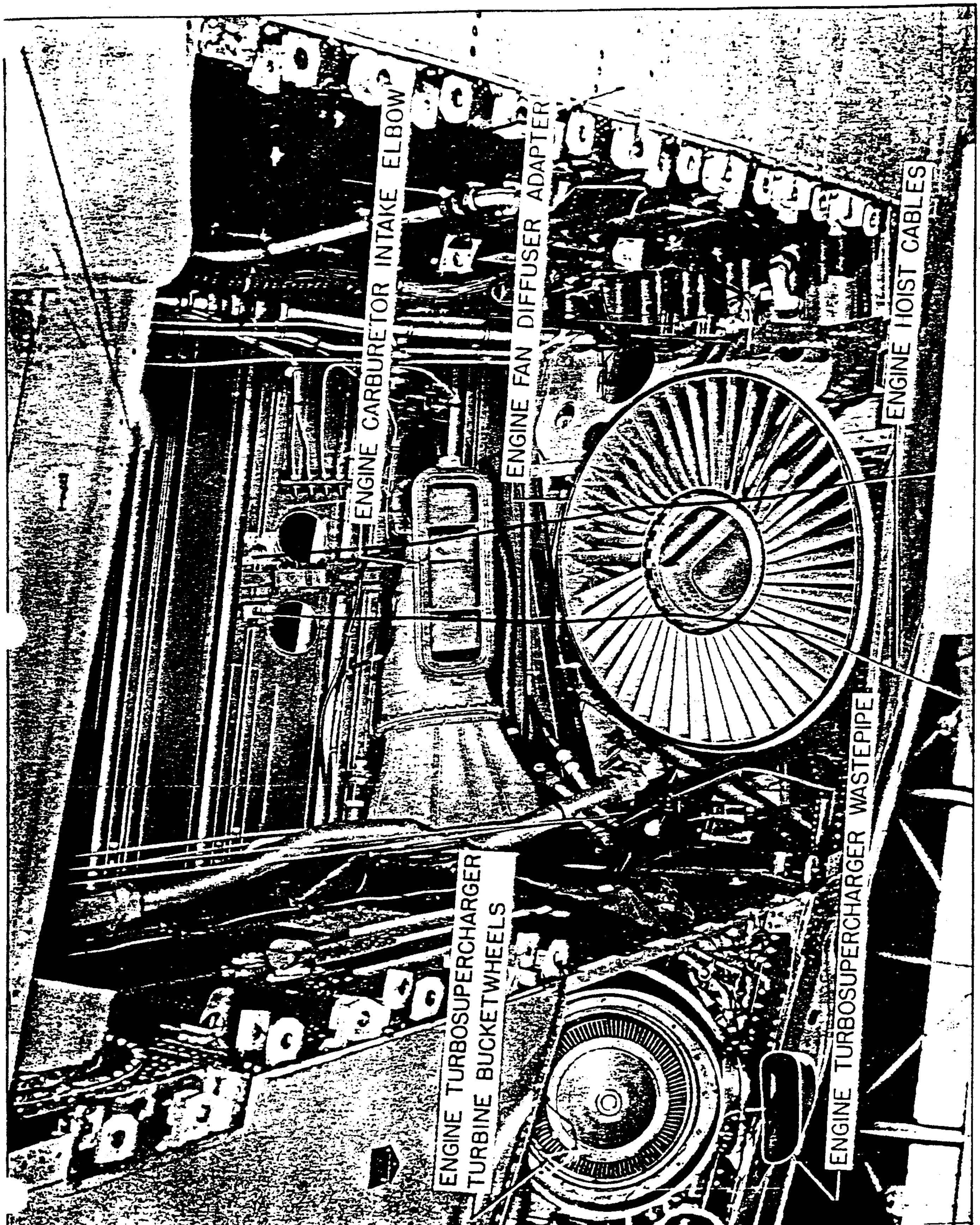


Figure 8. Engine Bay - Inboard (Fwd. View)

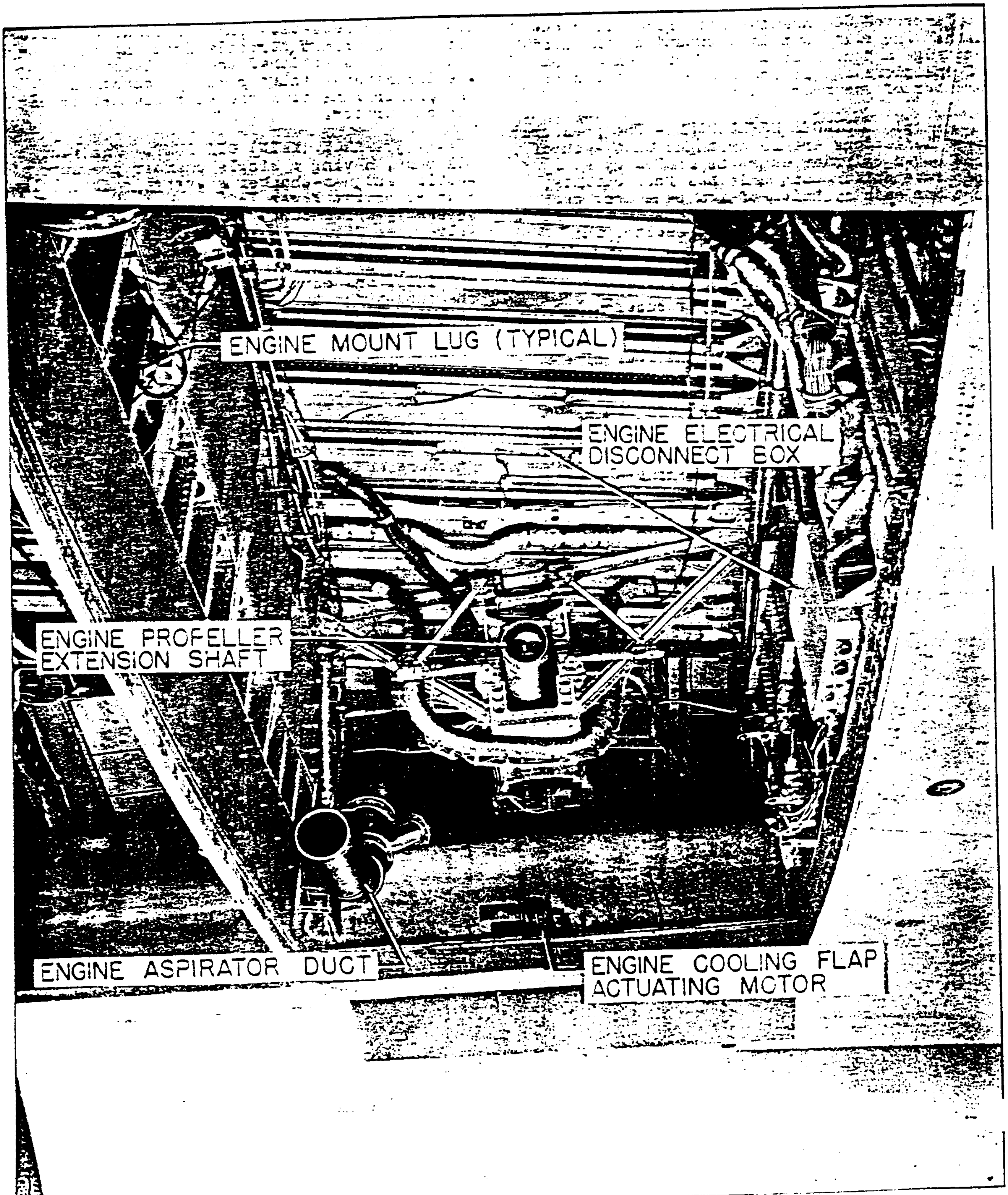


Figure 8. Engine Bay - Outboard (Aft View)

rocker box cover, is scavenged by the forward chamber of the magneto drive case oil pump. A removable basin in the rocker box end of the front sump provides a pool of oil for improved C4 exhaust valve guide lubrication. The rear sump is attached to the leading edge and main deflectors between A4 and A5 cylinders and is scavenged by the center chamber of the rear oil pump.

(g) CYLINDER DEFLECTORS.- The pressure type deflectors are so arranged that each of the seven cylinder banks is cooled by a separate unit. Each unit has four outlets, one for each cylinder of its bank, and each cylinder has two tight fitting side plates. Top plates almost completely enclose the cooling system.

(h) INTAKE MANIFOLDS.- Attached to each of the seven supercharger case outlet ports is a sectional intake manifold which carries the fuel and air mixture to a bank of four cylinders. Each of the four pipe sections of each manifold is coupled to its adjacent section by a steel sleeve-shielded neoprene coupling which is secured in place with two steel clamps. The three bottom manifolds serve the No. 3, No. 4, and No. 5 cylinder banks and are provided with automatic drain valves for discharging any excess fuel or oil which may accumulate while the engine is idle or being started.

(i) PRIMING SYSTEM.- A primer line is clamped to each of the top three intake manifolds, which serve the cylinders in the No. 7, No. 1, and No. 2 banks. The cone ends of the primer line tubings are connected to jet tees and elbows screwed into the intake manifold bosses adjacent to the inlet ports of the cylinders. The rear ends of the three primer lines are connected by union nipples to the distributor outlets. The supercharger collector rim is primed directly from the distributor which is attached to the blower case. The distributor inlet port is connected to the primer line from the electric primer on the carburetor.

(j) REAR (MAIN) OIL PUMP.- The rear oil pump, having a single chamber pressure section and two-chamber scavenge section, is mounted on the lower left side of the accessory drive case. A pressure relief valve (see figure 18) and an oil screen by-pass valve are screwed into the pump body. The pump has square mounting pads for the oil inlet and outlet connections, a pad above the outlet for the connection of the oil line from the blower case, and a fitting for the connection of the oil line from the rear rocker sump. The two oil pump drive gears outside the pump body, which are driven by the spur gear at the outer end of the rear oil pump intermediate drive gear, are splined onto the pressure section and scavenge section drive shafts. The gears integral with these shafts mesh with the corresponding pressure and idler gears. These idler gears are mounted on the bronze idler shafts, each of which is pinned to its section of the pump body. The larger scavenge gears scavenge the main sump and are housed within the scavenge section body which separates the scavenge section of the pump into two chambers. The smaller of the two chambers, located between the scavenge body and the pump body, houses the smaller scavenge gears which scav-

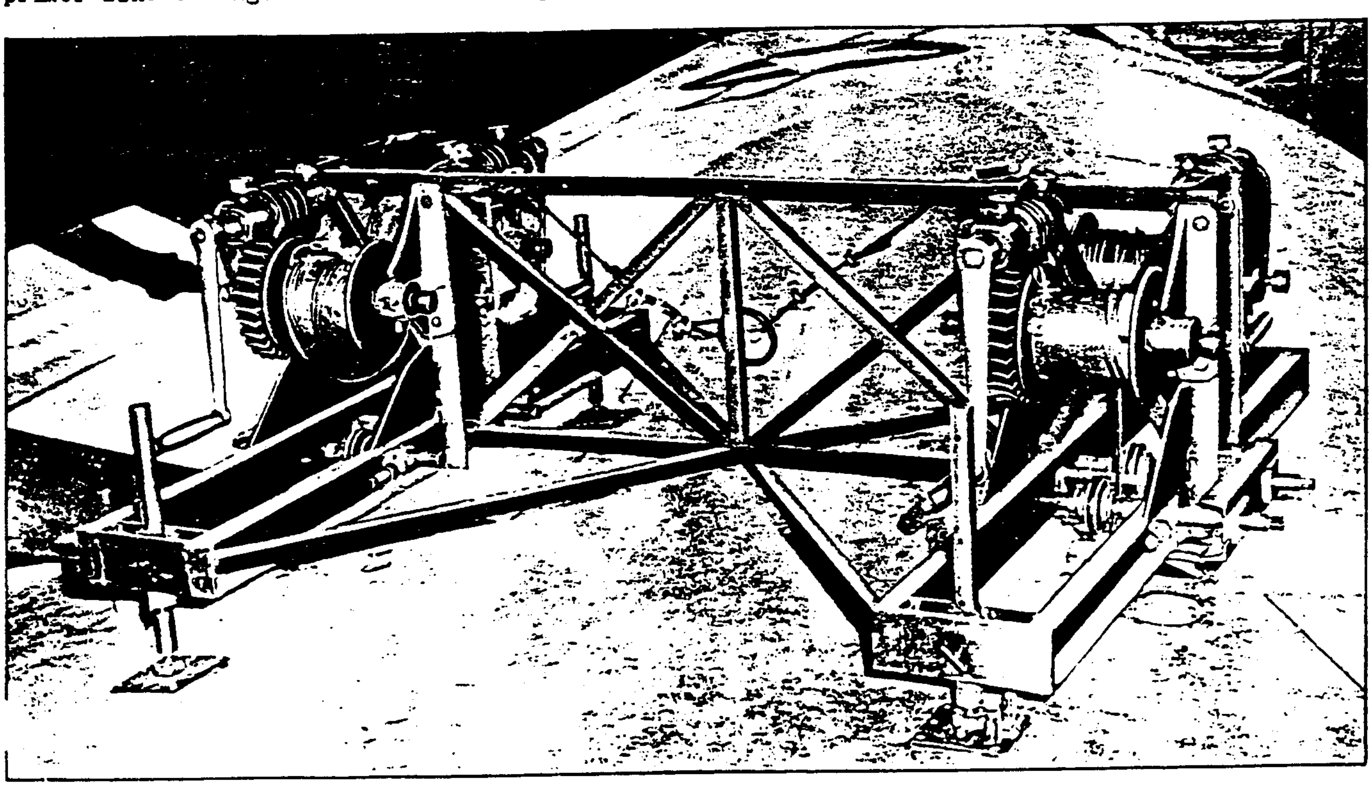
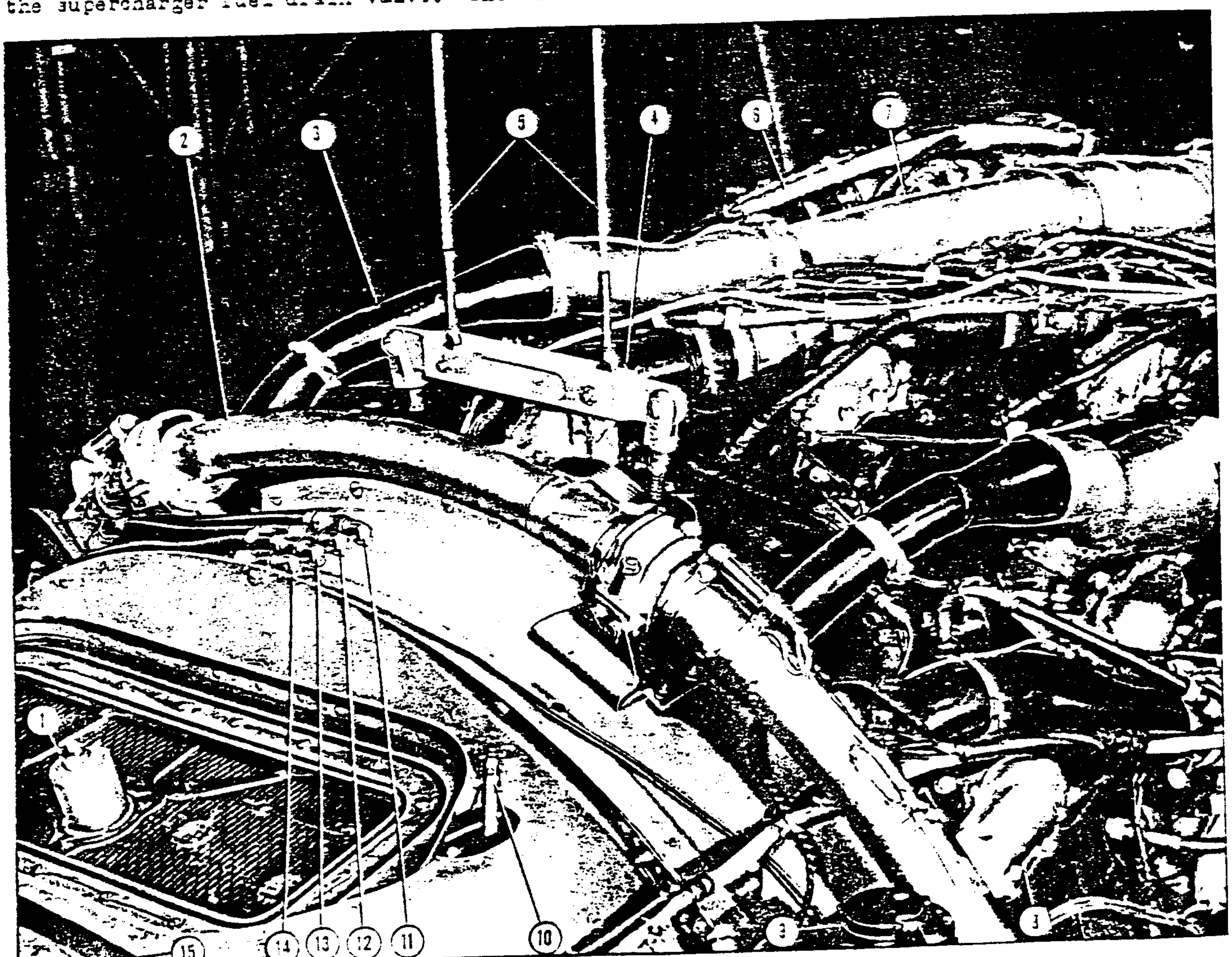


Figure 10. Engine Assembly Hoist Mechanism

enge the rear rocker sump. One of the smaller scavenge gears is keyed to the outer end of the scavenge section drive shaft. The inner ends of all the pump shafts are supported by the rear oil pump shaft support. (See figure 19.)

(k) MAIN SUMP ASSEMBLY.- The main sump, which collects drain oil from the rear crankcase, the blower case, and the accessory drive case sections, is mounted on a pad at the bottom of the accessory drive case and houses an oil strainer, an oil screen assembly, and the supercharger fuel drain valve. The oil screen assembly consists of two concentric, cylindrical oil screens which are installed in the center chamber of the sump. This chamber is continuous with a cavity in the sump mounting pad into which the oil return check valve is screwed. The oil screens are retained within the sump by a cover and oil drain plug assembly.

(l) SUPERCHARGER FUEL DRAIN VALVE.- The supercharger fuel drain valve is contained within, but is functionally independent of, the main sump. This valve drains excess fuel which may accumulate in the in-



1. ENGINE CARBURETOR PRIMER
2. ENGINE MOUNT RING
3. ENGINE FAN SCOOP DUCT
4. ENGINE LIFT STABILIZER
5. ENGINE HOIST CABLES
6. ENGINE MAGNETO HARNESS
7. ENGINE EXHAUST AND COOLING SHROUD ASSEMBLY
8. ROCKER BOX COVER
9. ENGINE FUEL FLOWMETER TRANSMITTER
10. ENGINE THROTTLE CONTROL PUSH ROD
11. ENGINE FUEL PRESSURE VENT LINE
12. ENGINE MANIFOLD PRESSURE LINE
13. ENGINE OIL PRESSURE LINE
14. ENGINE FUEL PRESSURE LINE
15. ENGINE FAN SHROUD

Figure 11. Engine Assembly Cable Attachment - [illegible]

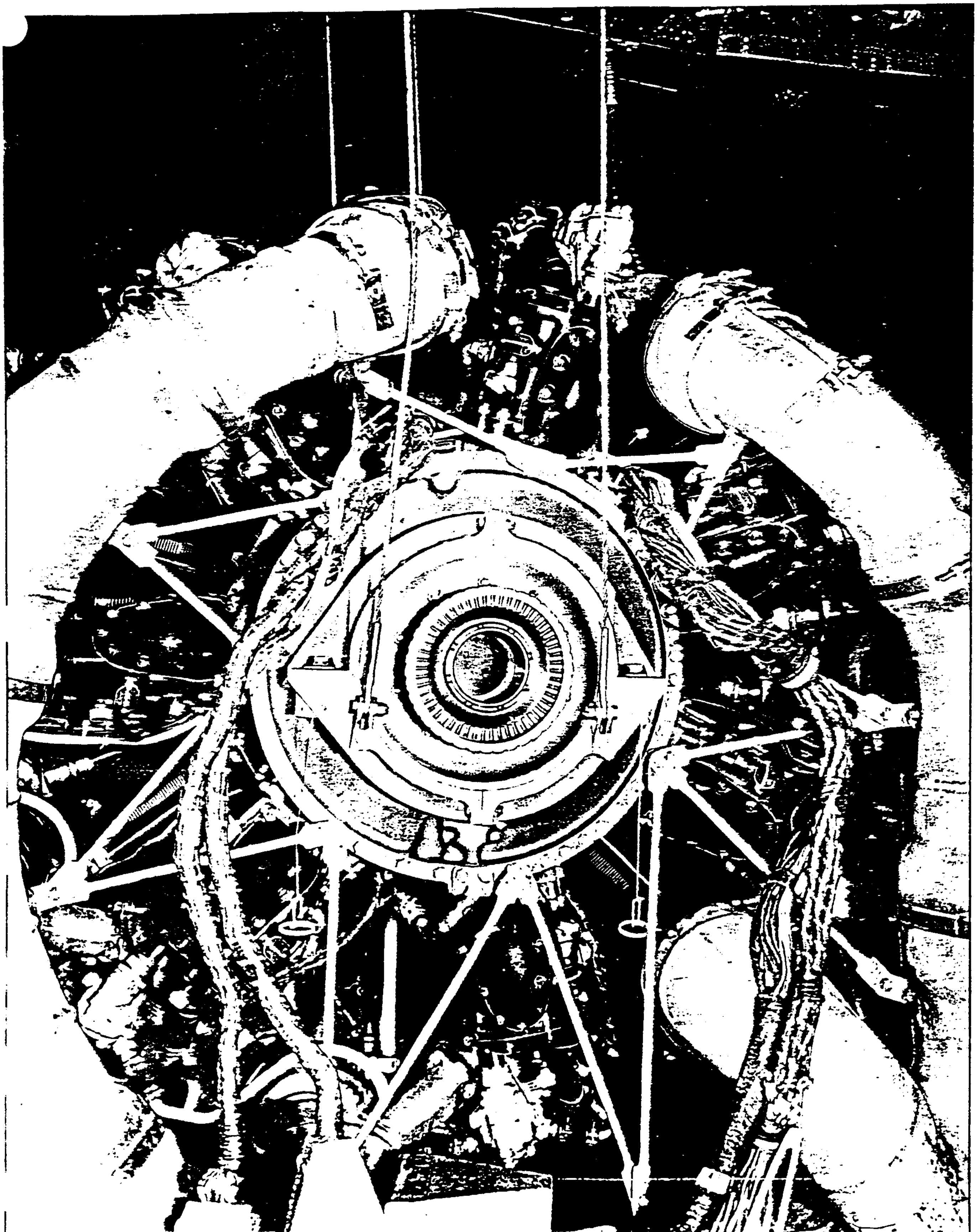


Figure 12. Engine Assembly Cable Attachment - Outboard (Magneto Drive Case Section)

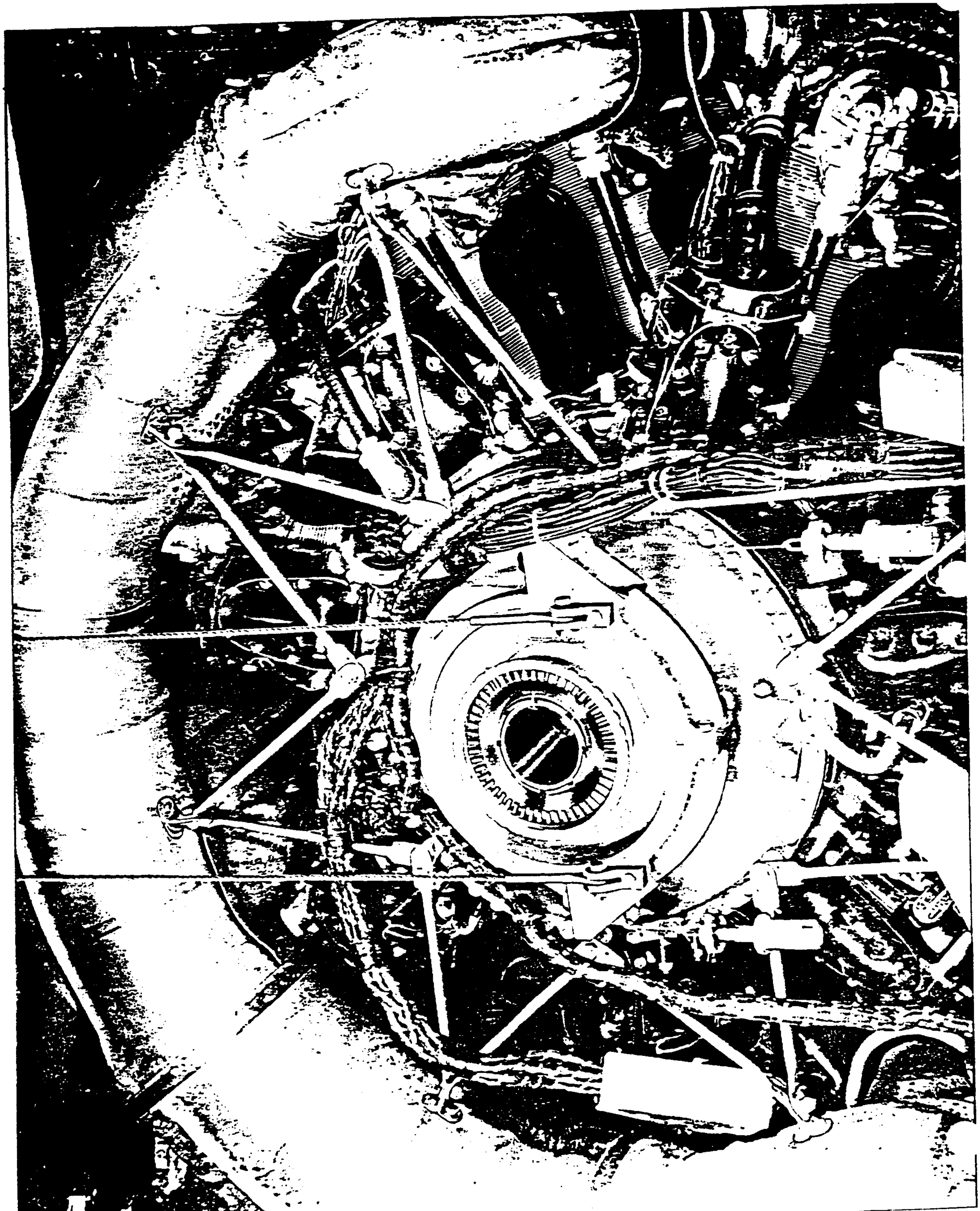


Figure 13. Engine Assembly Cable Attachment - Inboard (Magneto Drive Case Section)

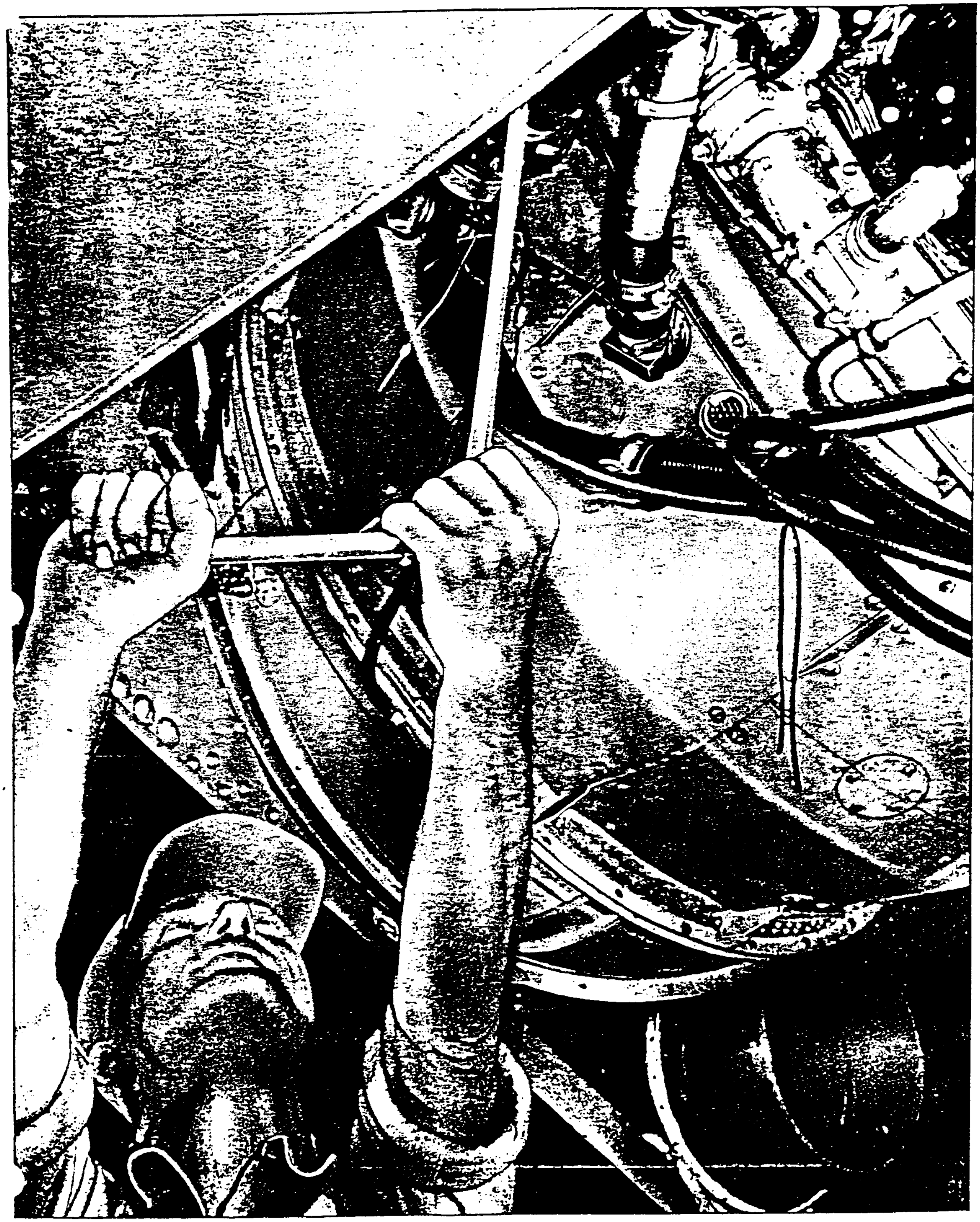


Figure 14. Tightening Engine Assembly Mount Bolts - Typical

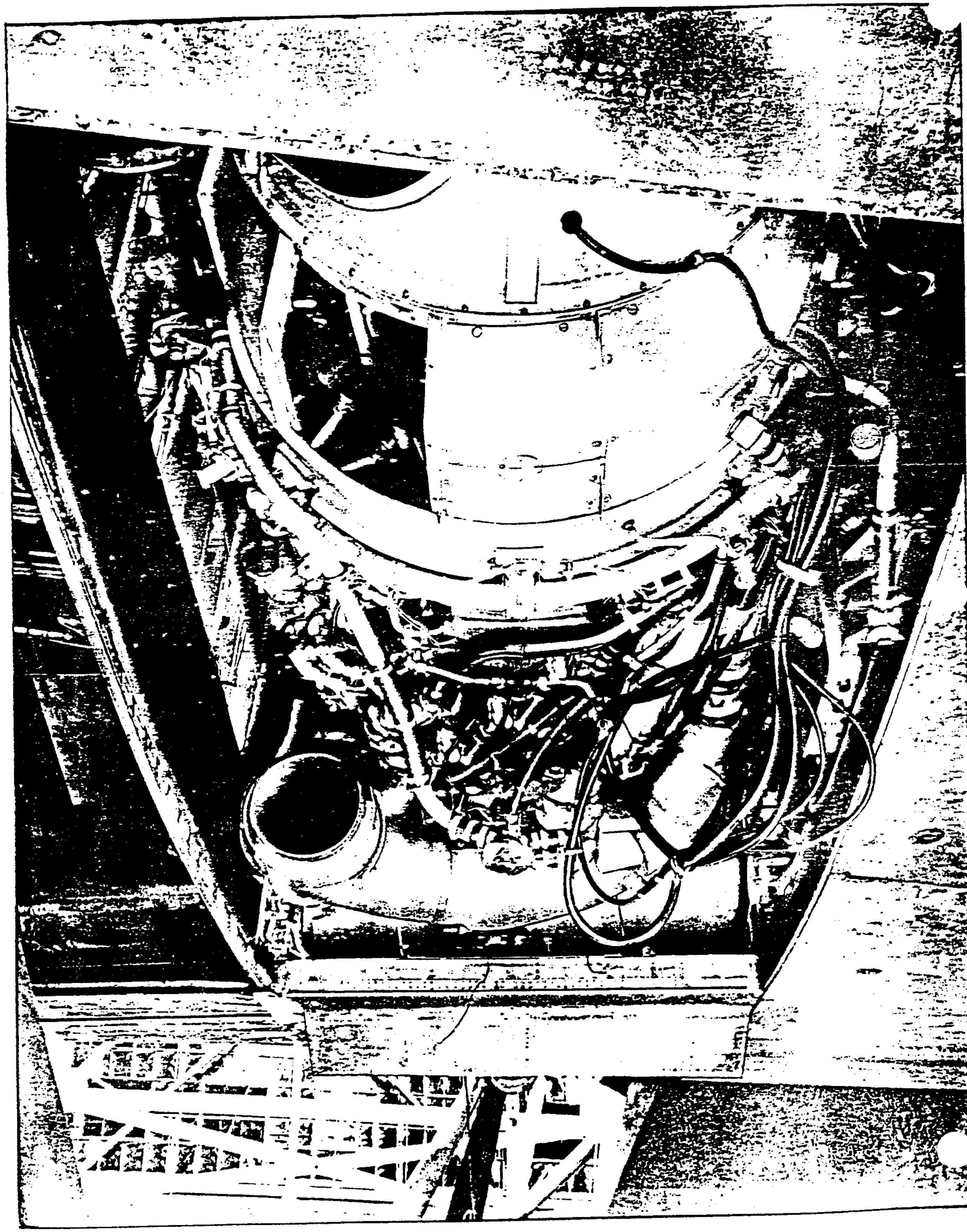


Figure 15. Engine Assembly in Place - Outboard

take duct and diffuser when the engine is being started. The valve closes automatically after the engine is started.

(m) FUEL FEED VALVE.- Fuel is conducted into the fuel feed valve housing through a passage in the accessory drive case which connects with the external fuel feed pipe from the carburetor. While the pressure of the fuel exerted outwardly against the valve diaphragm is less than the force exerted by the valve spring inwardly against the diaphragm, the valve remains seated against the discharge end of the valve housing, thereby shutting off the fuel flow. When the fuel pressure exceeds the force of the spring, the diaphragm lifts the valve off its seat and fuel flows to the fuel slinger.

(n) STARTER. (See figure 20.) The JH10160 starter is of the direct cranking type for operation from alternating current. Jaw meshing is accomplished automatically by means of flyweights which cause the jaw to move into engaging position when the rotor reaches a pre-determined speed.

(o) ENGINE FUEL PUMP. (See figure 21.) The engine driven fuel pumps are of the rotary, four vane, positive displacement type and will operate equally well for either direction of rotation. Each pump consists essentially of a cast aluminum alloy housing containing a shrunk-in sleeve with an eccentric bore in which a rotor with four vanes is driven by means of a drive shaft coupled to the engine drive gear. A "floating" center pin keeps the outer edges of the blade in contact with the bore of the sleeve. At higher operating speeds, when centrifugal force is sufficient,

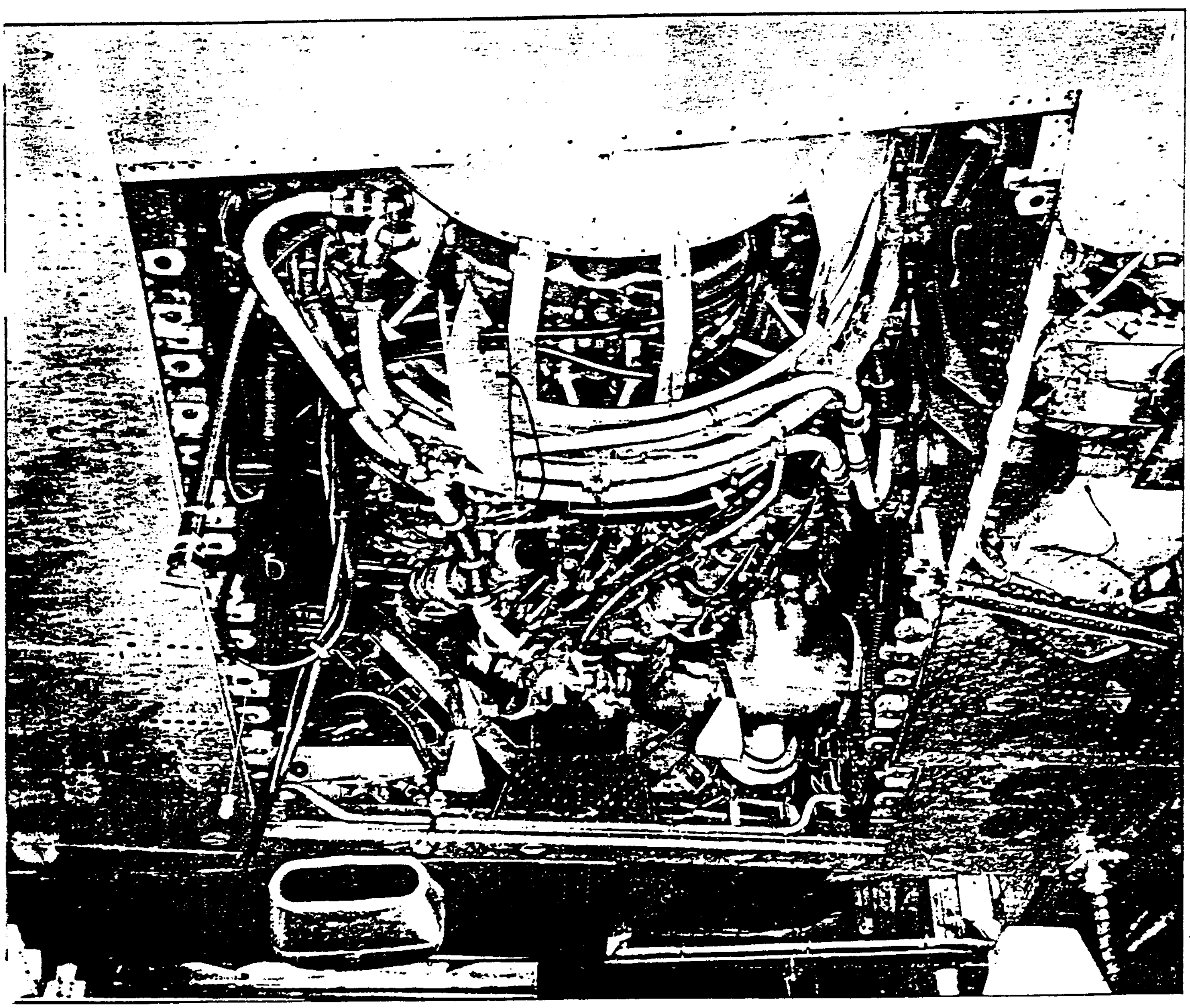


Figure 16. Engine Assembly in Place - Inboard

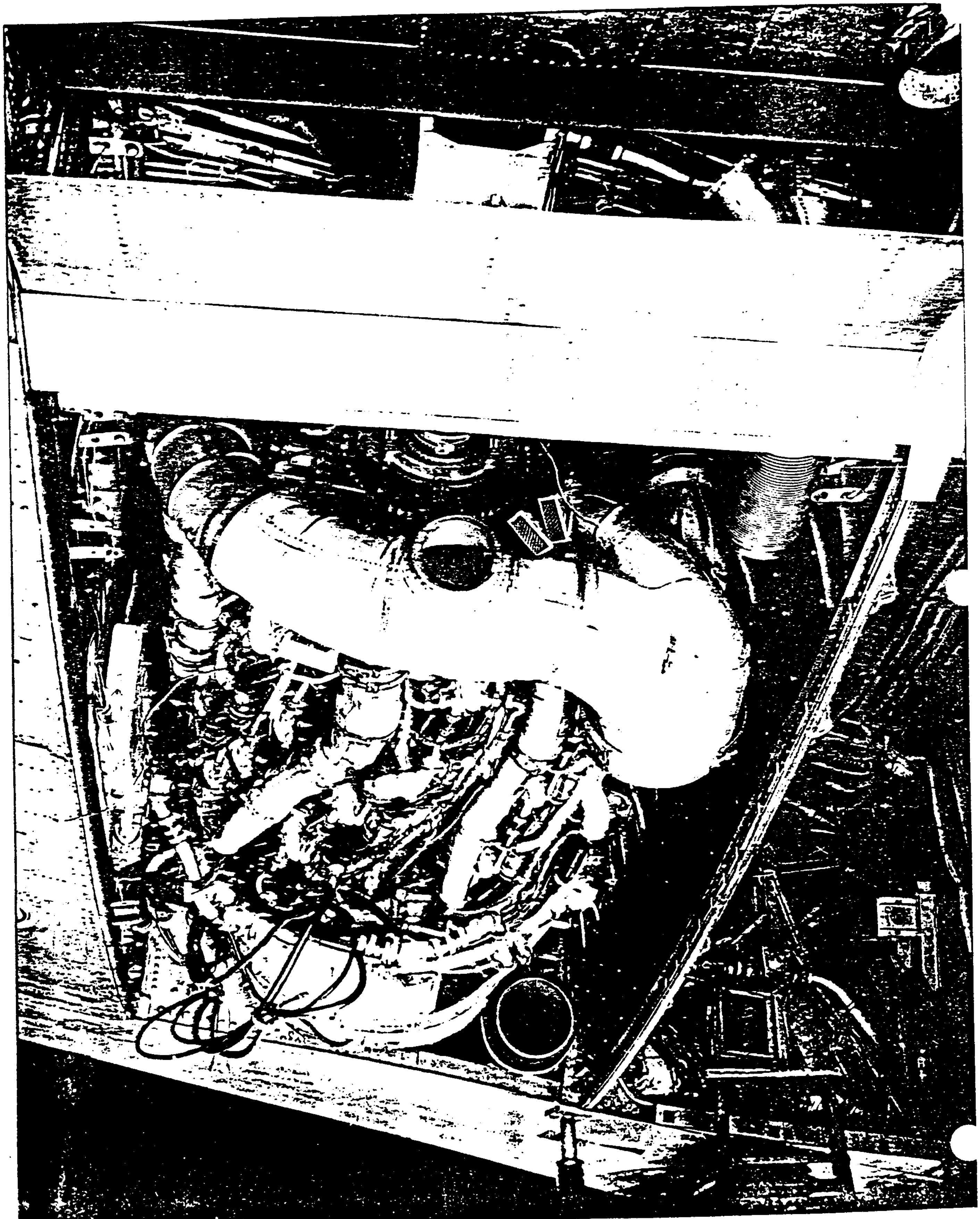


Figure 17. Engine Assembly in Place - Outboard (Magneto Drive Case Section Adjacent to Cooling Flap)

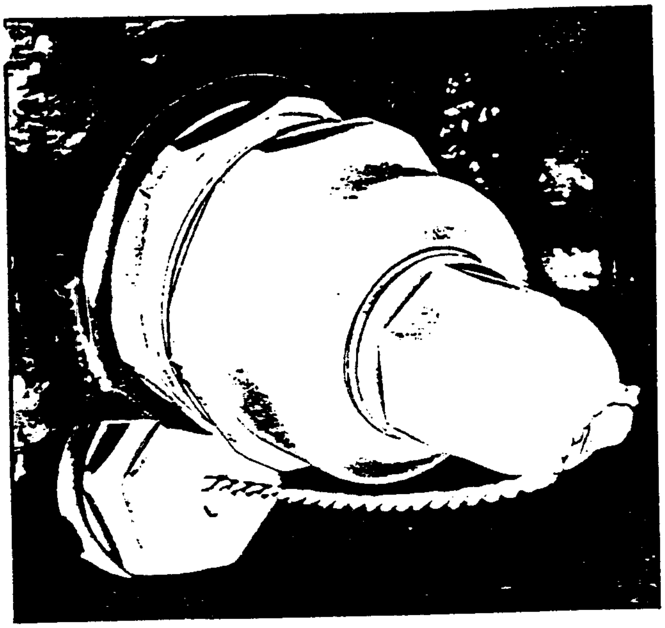


Figure 18. Oil Pressure Relief Valve

the blade retains contact through this force. A seal is incorporated in the pump to minimize leakage around the rotor shaft. The relief valve is of the poppet type and is controlled by a spring whose tension can be varied by means of an external adjusting screw to provide any desired fuel pressure within the range of adjustment. This diaphragm is made of rubber impregnated and coated with a synthetic rubber material which is suitable for use with all types of fuel. A by-pass valve to allow fuel flow through the pump when the pump is inoperative is also provided.

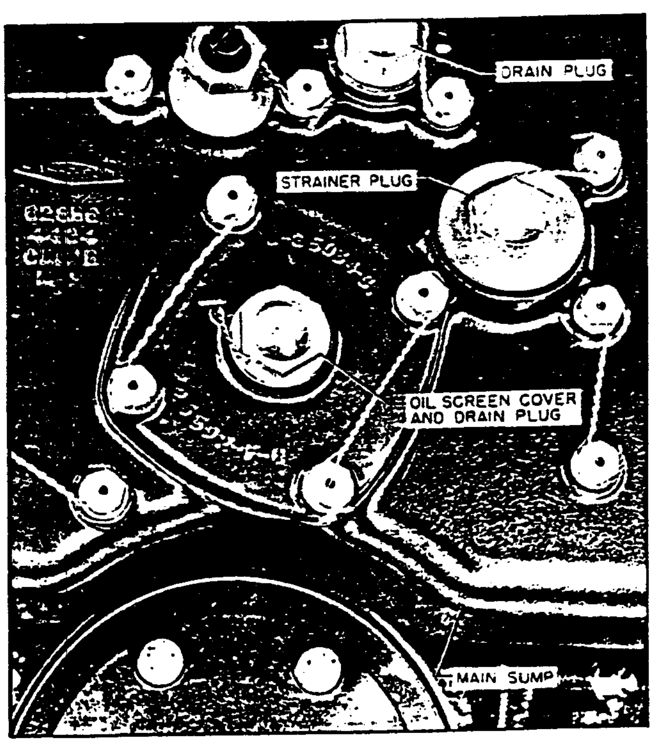


Figure 19. Main Sump

(p) FUEL FLOWMETER TRANSMITTER. (See figure 11, item 9.)- The fuel flowmeter transmitter is composed of an autosyn unit magnetically coupled to a fuel-measuring mechanism. It measures the rate at which fuel flows to the carburetor and electrically transmits the measure of that rate of flow to a remote indicator equipped with a dial graduated in pounds per hour. A relief valve provides an internal by-pass for the fuel.

NOTE

This instrument measures the rate at which fuel is being consumed and not the amount of fuel. In carburetors which have a vent or "bleed-back" that returns some of the fuel to the tank, actual fuel consumption is indicated only when the vent is closed.

(q) TACHOMETER GENERATOR (ENGINE).- The three phase alternating current generator transmits power to a synchronous motor, which is a part of the indicator. Refer to Section IV, paragraph 23. The frequency of this power is proportional to the engine speed. The generator is mounted on the engine accessory drive case section.

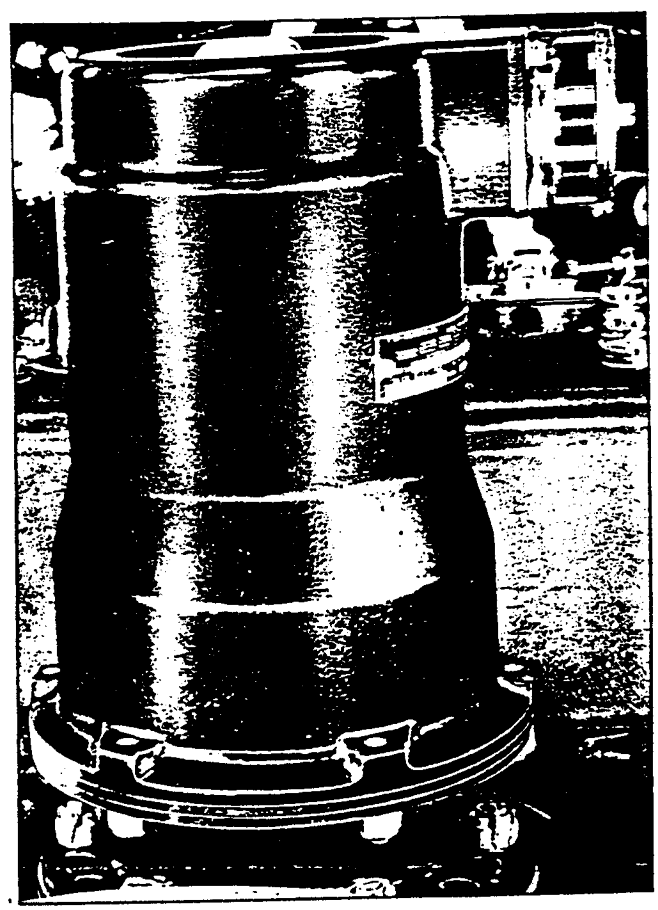


Figure 20. Starter - Front View

(r) CARBURETOR.- Refer to Section IV, paragraph 9.

(s) IGNITION EQUIPMENT.- This equipment (magnetos, ignition harness, spark plugs, electrical wiring provisions), although constituting a part of the engine assembly, is discussed separately in Section IV, paragraph 8. However, the removal and assembly procedures, when necessary, are included in this paragraph.

(t) This equipment, although included as parts of the engine assembly, is discussed in Section IV, paragraph 13. However, most of the removal and assembly procedures are contained in this paragraph.

(u) ENGINE EXHAUST EQUIPMENT.- Refer to paragraph 14 a.

(2) ENGINE ASSEMBLY TROUBLE SHOOTING.

TROUBLE	PROBABLE CAUSE	REMEDY
Engine fails to start or does not continue to run after starting.	Incorrect starting procedure.	Check starting instructions in XB-35 Pilot's Handbook.
	No fuel in tank.	Fill tank with proper grade of fuel. Check fuel gage.
	Underpriming.	Increase length of priming time. Clean clogged priming lines and repair leaks in priming system.
	Overpriming.	With ignition off, open throttle fully and rotate propeller shaft several times in normal direction of rotation.
		Decrease length of priming time.
	Insufficient fuel flow.	Check booster pump. Repair or replace defective pump. Check fuel screens and lines. Clean clogged screens and lines.
	Insufficient cranking speed.	Check batteries and starter.
	Induction vibrator inoperative.	Check induction vibrator operation. Install a new induction vibrator, if necessary.
	Lead from a magneto ground connection to switch grounded.	Check wiring between ground manifold and switch.
Rough running.	Improper valve clearances.	Adjust valves as directed in paragraph 7.
	Sticking valves.	Lubricate valve stems. If necessary, replace cylinder.
	Propeller retaining nut loose.	Tighten loose nut.
	Propeller not tracking evenly.	Install a propeller which tracks evenly.
	Propeller out of balance.	Install a propeller which is in balance.
	Engine mounting brackets loose or broken.	Check all bolts and cap screws to see that they a tightened to correct torque. Replace broken bracket assemblies. See Section IV, paragraph 7 b (6).

TROUBLE	PROBABLE CAUSE	REMEDY
ough running.	Loose air ducts.	Thoroughly examine all air duct connections and supports. Tighten where necessary.
Engine does not idle, or idles improperly.	Cold engine.	Warm up engine thoroughly before permitting it to idle.
Oil foaming from breathers or oil tank vent.	Water or impurities in oil.	Drain engine and tank. Refill with new oil (Specification No. AN-VV-O-446, Grade 1100 or 1120).
	Oil splashing into tank from incorrectly installed oil return line.	Install oil return line correctly.
	Oil tank filled too full.	Drain a sufficient amount of oil from tank.
Low power	High power output in auto lean causing detonation.	Operate engine according to instructions in Pilot's Handbook.
	Faulty operation or improper setting of propeller governor.	Replace governor, if necessary.
	Incorrect propeller blade pitch setting.	Install a propeller known to be adjusted correctly.
	Wrong grade of fuel.	Use fuel conforming to Specification No. AN-F-28, Grade 100/130.
	Restrictions in the induction system.	Check air scoop for obstructions. Clean air screen.
Low oil pressure.	Defective oil pressure gage.	Repair or replace gage.
	Congealed oil in pressure gage line.	Disconnect line and clean out congealed oil.
	Incorrect grade or insufficient quantity of oil.	Oil should conform to Specification No. AN-VV-O-446, Grade 1100 or 1120. Check oil supply.
	Obstructions or leaks in the oil lines.	Check for and remove any obstructions. Repair any leaks.
High oil pressure.	Defective oil pressure gage.	Repair or replace gage.
Low oil temperature.	Oil temperature gage not functioning properly.	Repair or replace gage.
High oil temperature.	Diluted or contaminated oil.	Drain engine, lines, cooler, and tank. Fill with new oil (Specification No. AN-VV-O-446, Grade 1100 or 1120).
Engine does not accelerate properly.	Wrong grade of fuel.	Use fuel conforming to Specification No. AN-F-28, Grade 100/130.
	NOTE The following troubles must be checked with the engine removed.	

TROUBLE	PROBABLE CAUSE	REMEDY
Engine fails to start or does not continue to run after starting.	Internal trouble with magnetos.	Turn the engine over by starter and check spark jump. A strong spark should jump when a wire from high tension terminal is held 1/4 to 3/8 inch from a grounded surface. Replace magneto if there is no spark or if spark is weak.
	Spark plugs wet, fouled, incorrect gaps, or cracked ceramic insulation.	Install new or reconditioned plugs.
	Spark plug lead connectors oily, dirty, or cracked.	Clean dirty connectors with acetone or carbon tetrachloride. Replace damaged connectors.
	Burned spark plug leads.	Make continuity and high voltage tests on harness. Replace harness if necessary.
	Primer inoperative.	Disconnect primer line from primer distributor and operate primer. If fuel does not flow from primer line, repair or replace primer.
	Air in carburetor fuel regulator.	Check vapor eliminator float mechanism. Remove vent plug, place mixture control in auto rich, and operate boo pump until fuel spurts from vent.
	Air leaks or restrictions in induction system.	Remove air scoop from carburetor air intake duct. Check air screen for foreign matter. Make sure that air scoop is clean. Check security of carburetor on engine and see that all intake manifold nuts are tight. Examine intake manifolds to see that no primer lines are loose or disconnected.
	Restrictions in the exhaust manifold system.	Remove any obstructions in the system.
	Sticking valves.	Lubricate sticking valves. Replace cylinder, if necessary.
	Improper valve clearances.	Adjust valve clearances. Refer to paragraph 7 b. (5) (g).
	Moisture or oil on distributors.	Clean distributor fingers and blocks with acetone, using a clean cloth. Wipe clean with a dry cloth.
Rough running.	Loose or defective spark plugs.	Tighten loose plugs to a torque of 300 to 360 inch pounds. Replace defective plugs.

TROUBLE	PROBABLE CAUSE	REMEDY
Rough running.	Improper operation of magnetos.	Check breaker points and magneto timing. Refer to Section IV, paragraph 8 c (6). Remove all dirt and moisture from distributor blocks and housings.
	Defective ignition wire.	Make continuity and high voltage tests on harnesses. Replace a defective ignition harness.
	Mixture too rich:	
	Fuel pressure too high.	Adjust fuel pump.
	Fuel feed valve housing rubber seal rings leaking.	Remove fuel feed valve housing and install new seal rings.
	Primer valve leaking.	Repair or replace valve.
	Carburetor control linkage not adjusted correctly.	Adjust linkage so that movement of cockpit control results in corresponding movement of throttle and mixture control levers on carburetor.
	Mixture too lean:	
	Fuel pressure too low.	Check for clogged fuel lines or strainer. Check operation of booster and engine fuel pumps, and make adjustments if necessary.
	Air leaks in induction system.	Check all joints, connections, clamps, and nuts in the induction system for tightness.
	Vapor lock or air in carburetor.	Remove vent plug, place mixture control in auto rich, and operate booster pump until fuel spurts from vent. Reinstall plug.
	Fuel pressure loss or fluctuation.	Check fuel pump and connections. Replace pump if necessary.
Engine misfiring.	Defective spark plugs, ignition harnesses, or magnetos.	Check magneto operation and spark plugs. Make continuity and high voltage tests on the ignition harnesses. Replace defective plugs, harnesses, and magnetos.
	Excessively lean or rich mixtures.	Check mixture control setting and control linkage to the carburetor.
	Improper valve clearances.	Check valve clearances and valve operation. Refer to paragraph 7 b. (5) (g).
	Sticking valves.	Lubricate valve stems; replace cylinder if necessary.
	Broken valve springs.	Replace springs.
	Air leaks in the induction system.	Check intake pipes for cracks or leaks at the packing nuts. Check carburetor gasket for leaks.

TROUBLE	PROBABLE CAUSE	REMEDY
Engine misfiring.	Fuel feed valve not operating properly.	Remove fuel feed valve assembly and check for broken diaphragm. Make sure that vent from fuel feed valve to carburetor is not blocked.
	Internal trouble with carburetor.	Install a new carburetor. Return carburetor for overhaul.
	Carburetor control linkage incorrectly adjusted.	Adjust linkage so that movement of cockpit controls results in corresponding correct movement of lever arms on carburetor.
	Magnetos incorrectly timed to engine.	Time magnetos to engine. Refer to Section IV, paragraph 8 c (7).
Engine does not idle, or idles improperly.	Incorrect carburetor idle adjustment.	Adjust carburetor idle mixture and speed.
	Carburetor not functioning properly.	Replace carburetor with one known to be operating correctly.
	Defective spark plugs or ignition wires.	Locate defective plugs by magneto check and replace with reconditioned plugs or new plugs. Make continuity and high voltage tests on ignition harnesses
Engine exhaust smoking.	Mixture too rich:	
	High fuel pressure.	Adjust fuel pump.
	Fuel feed valve leaking.	Remove fuel feed valve housing and install new seal ring.
	Primer valve leaking.	Repair or replace valve.
	Carburetor control linkage not adjusted properly.	Adjust linkage so that movement of cockpit control results in corresponding correct movement of throttle and mixture control levers on carburetor.
Oil foaming from breather or oil tank vents.	Excessive oil dilution.	Check oil dilution valve.
Low power.	Faulty ignition.	Check ignition system as described in Section IV, paragraph 8 c (5),(9) and (10).
	Carburetor not functioning properly.	Check and readjust control linkages. Replace carburetor, if necessary.
	Improper valve clearances.	Check valve clearances and valve operation.
	Carburetor air heater shut-off valve not functioning properly.	Repair or replace valve.
	Sticking valves.	Lubricate sticking valves; replace cylinder if necessary.

TROUBLE	PROBABLE CAUSE	REMEDY
Low power.	Broken valve springs.	Replace springs.
	Loose spark plugs.	Tighten loose plugs to a torque of 300 to 360 inch pounds.
Low oil pressure.	Defective oil dilution valve.	Repair or replace valve.
	Main oil screen clogged.	Remove and clean main oil screen. If metal particles are found in the screen it may indicate serious engine trouble.
	Oil pressure relief valve not functioning properly.	Remove, clean, and inspect relief valve. When a relief valve has once been set correctly for the engine, do not readjust to remedy variations in oil pressure.
High oil pressure.	Low oil inlet temperature.	Check oil cooler shutter control operation.
Low oil temperature.	Oil cooler shutter control not operating correctly.	Replace control unit.
High oil temperature.	Obstructions of airflow through oil cooler.	Remove obstruction or replace cooler.
	Oil cooler pipes clogged.	Clean or replace cooler.
	Oil cooler shutter control not operating properly.	Repair or replace control.
	Automatic oil temperature control unit not operating correctly.	Repair or replace control unit.
	Improper oil scavenging.	Check oil scavenge lines for leaks and obstructions.
Engine does not accelerate properly.	Leaking fuel discharge nozzle.	Check operation of discharge nozzle. Repair or replace nozzle.
	Accelerating pump not operating properly.	Replace pump.
	Fuel leaking in chamber of carburetor fuel regulator unit.	Replace carburetor.
	Carburetor economizer not operating correctly.	Replace carburetor with one known to be operating correctly.
	Improper valve clearances.	Check valve clearances and valve operation. Refer to paragraph 7 b. (5) (g).
	Sticking valves.	Lubricate valve stems; replace cylinder, if necessary.

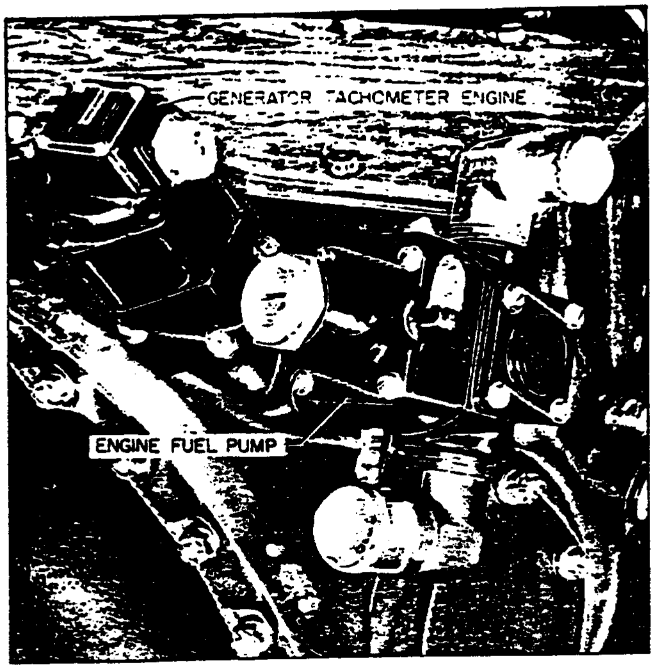


Figure 21. Engine Fuel Pump

(3) ENGINE REMOVAL. (See figures 5 thru 17 inclusive.)

NOTE

An engine assembly weighs approximately 3800 pounds.

(a) Make certain that all engine controls are in the OFF position.

(b) Remove the engine bay access door (inboard), or door sections (outboard) as instructed in Section IV, paragraph 1. Disconnect hose to breather fitting on door or door section. Detach intake manifold drain fitting on door section by means of Dzus fasteners. Also detach cable from anti-icer wastegate motor on forward section of outboard door.

WARNING

The outboard engine door sections must not be removed while bombs are installed on center rib 338. These door sections support the lower wing chord laterally, and if removed while bombs are installed, excessive bending stresses would be applied to the lower chord.

(c) Remove panels on wing, over engine, which permit passage of cables.

(d) Place engine hoist assembly on wing, over engine, and secure as instructed by the decalcomania.

(e) Connect the engine hoist assembly to an auxiliary source of power.

(f) Observe the following procedure in lowering and securing hoist cables to engine:

1. Place two men, with switch box which control two cables each, in position next to hoist.

2. Connect interphone system between ground crew and men on wing.

3. Lower forward cables to engine spreader bar assembly and attach. Lower aft cables to whipple-tree type stabilizer and attach. Secure stabilizer cables to engine collar mount lugs.

(g) Disconnect propeller shaft from engine as follows:

1. Remove screws from knurled packing nut on the adapter which fits between engine and propeller shaft. Unscrew packing nut and slide toward engine.

2. Remove cotter keys from serrated coupling retainer nut. Unscrew retainer nut and move to the rear. This will allow face plates to disengage.

(h) Disconnect aspirator duct (outboard only) by removing clamp. Disconnect collector ring (inboard only) from duct leading into wing by removing external and internal clamps.

(i) Disconnect electrical plugs (ignition, starter, pull box) from adjacent junction box.

(j) Disconnect oil-in and oil-out lines by means of quick disconnect. (See figure 22.)

(k) Disconnect fuel line by means of quick disconnect.

(l) Remove segment of fan adapter adjacent to tail pipe ball joint by removing screws (Outboard only). Disconnect tail pipe at ball joint by removing internal and external clamps. Disconnect tail pipe from engine at collector ring by removing internal and external clamps. Remove tail pipe from engine by removing bolts from tail pipe support brackets.

(m) Detach ground cooling duct by means of Dzus fasteners. Disconnect plug to motor.

(n) Disconnect throttle and mixture linkage at engine by means of quick disconnects. In the inboard engine an arm arrangement extends through either side of the cooling air diffuser shroud, while in the outboard engine carburetor control arms extend through the top.

(o) Disconnect oil vapor vent line by removing hose connection.

(p) Disconnect carburetor vapor vent line by removing hose connection.

(q) Loosen two captive bolts attaching carburetor intake elbow to carburetor.

(r) Disconnect instrumentation as follows:

1. Detach hose connections at fuel pressure, oil pressure, and manifold pressure lines. Also detach hose connection at fuel pressure vent.

2. Detach fire detection equipment around engine mount ring by disconnecting wiring from terminal strip.

3. Disconnect C1 cylinder thermocouple from junction box.

4. Unscrew plug connector at engine fan tachometer.

5. Remove engine mount bolts and sway brace at rear of engine bay. Shove rear engine mount outward to clear upper collector ring.

6. Lower engine to engine stand. Forward end of engine must be lowered slightly in advance of aft end.

(4) ENGINE DISASSEMBLY AND INSPECTION.

NOTE

Engine disassembly, further then is defined by the limits of TOP

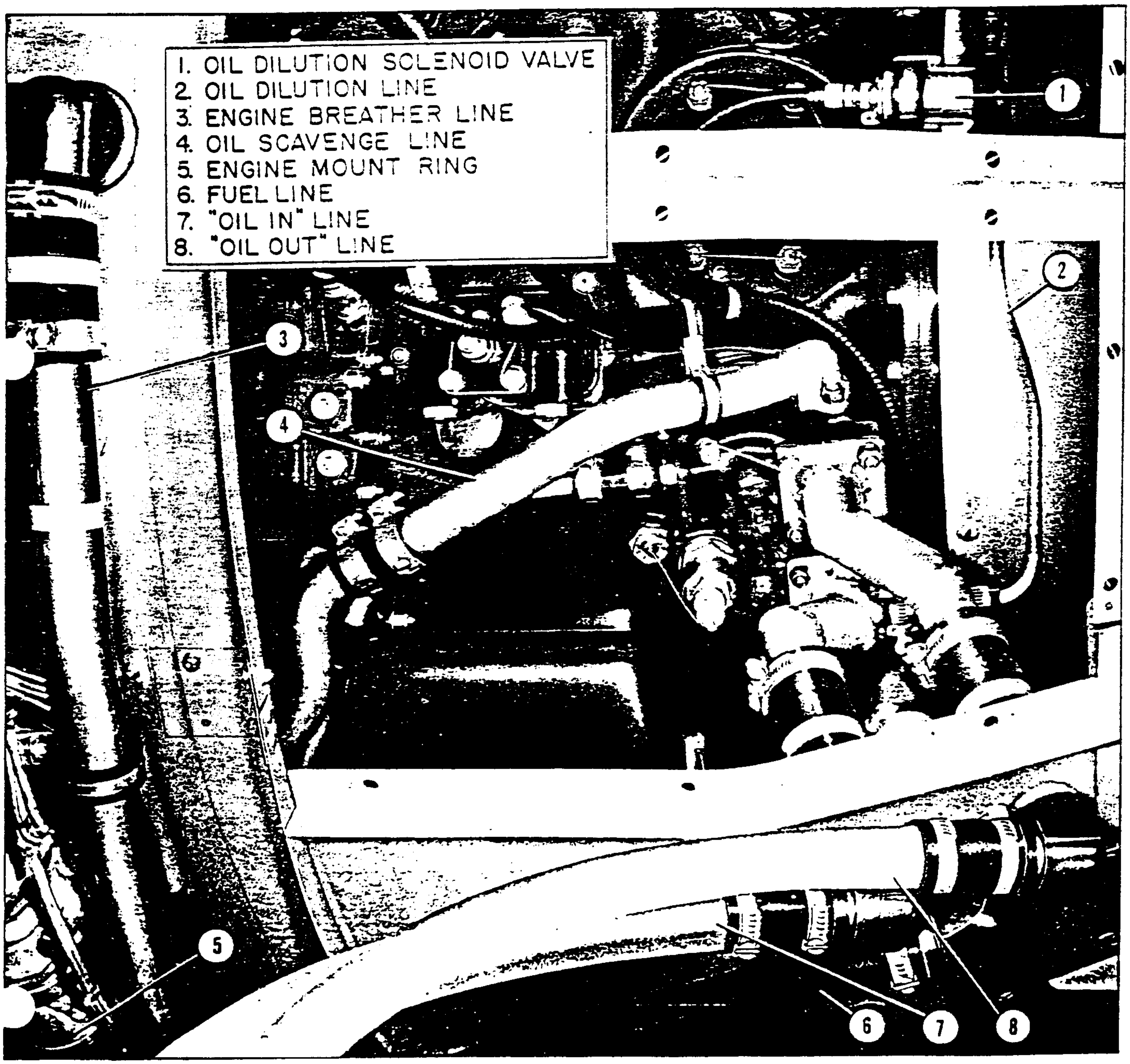


Figure 22. Engine Fuel and Oil Installations

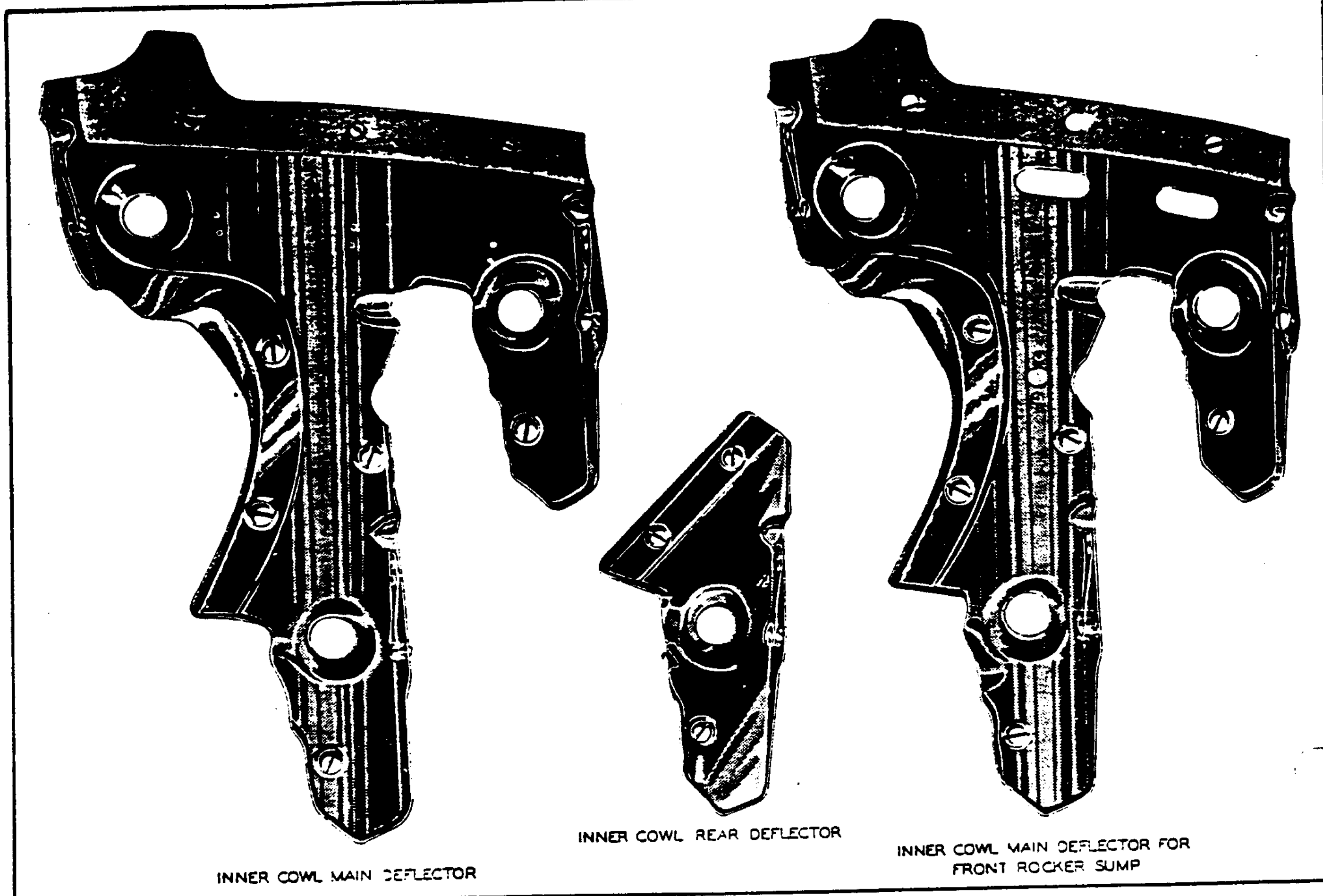


Figure 23. Inner Cowl Main and Rear Deflectors

OVERHAUL, is not to be performed by field personnel. Other repairs or replacements in excess of this definition must be accomplished at an Air Technical Service Command Depot.

(a) Remove all grease and foreign matter from the external surfaces of the engine by spraying with kerosene or white furnace oil. Make certain that there is positive ventilation to the outside and that the cleaning fluid is not allowed to contact the spark lead assemblies or magnetos.

(b) Remove the exhaust headers and collector ring cooling shrouds as described in Section IV, paragraph 14 a.

(c) Remove the engine fan cooling shroud and diffuser adapter, if necessary, as described in Section IV, paragraph 13.

NOTE

Directions for the removal of safety wire, cotter pins, rivets, nuts, palnuts, washers, table lock washers, and gaskets are not given in the following sub-paragraphs, inasmuch as it is assumed that these items will be removed when necessary. Also inspection instructions, where damage is easily ascertainable, is not given. Place each part in a parts rack or a suitable container to prevent possible damage. Tag parts which must be assembled in sequence.

(d) OIL DRAIN PLUGS AND SCREENS REMOVAL.- Provide suitable receptacles for collecting the drain oil. Unscrew the oil drain plugs from the main sump, the rocker box sumps, and the pressure oil screen chamber in the accessory drive housing. Remove the pressure oil screen chamber cover, and withdraw the oil screen assembly from the chamber. Remove the oil return check valve from the chamber, using the oil return check valve wrench. Remove the main sump support bolt and screen from the lower left side of the sump. Examine the oil screens and sump drain plugs for the presence of metal chips or foreign matter which would indicate a failure or some other unsatisfactory condition in the engine.

(e) MAIN SUMP REMOVAL.- Remove the main oil screen chamber drain plug, the sump drain plug and strainer, the accessory drive section drain plug, and allow the oil to drain. If it is desired to remove the supercharger fuel drain valve, do so before removing the sump from the engine. Disconnect the up scavenge pipes at their sump ends. Remove the main oil screen chamber cover and withdraw the main oil screen assembly. Unscrew the 10 cap screws which secure the sump to the accessory drive case and remove the sump.

(f) FEED VALVE REMOVAL.- In order to remove the fuel feed valve from the accessory drive case, it is necessary to remove the carburetor and place a wooden protective cover over the carburetor mounting pad. Refer to Section IV, paragraph 9. Remove the screws in the feed valve outer cover and lift off the cover. Remove the screws from the inner cover, install PWA-4168 Puller, and withdraw the feed valve assembly from the case. Remove the screws located in back of the inner cover and lift off the cover and spring; then withdraw the valve assembly from the valve housing. Inspect the valve diaphragm and ascertain whether or not the valve is seating properly.

(g) SUPERCHARGER (BLOWER) FUEL DRAIN VALVE REMOVAL.- Unscrew the supercharger fuel drain valve from the sump.

(h) ENGINE FUEL PUMP REMOVAL.- Disconnect fuel lines. Remove bolts which attach pump to engine accessory section.

1. INSPECTION.- In case of difficulty with the relief valve, remove the valve cover and valve and inspect for foreign matter which may have lodged between the valve and valve seat. Wash out the housing with unleaded gasoline before replacing the parts.

2. MAINTENANCE REPAIR.

a. The vent hole in the restricted fitting on the air balance side of the fuel pump diaphragm must be kept open to insure proper functioning of the valve adjustment. Should the vent hole become blocked, the result would be a fluctuation of discharge pressure and a general increase of pressure with altitude. Clean the vent hole as needed, but do not apply an air blast to the vent hole because the excessive pressure might damage the diaphragm. Do not enlarge the vent hole in the restricted fitting.

b. A worn or sheared drive coupling can be replaced by removing the lock plate and the assembly seal retainer. Before replacing the retainer, put enough oil on the seal surfaces to provide a film of lubricant, but do not oil excessively. Tighten the retainer carefully and secure it with the lock plate.

c. As it is often necessary to remove the cover from the valve body of the fuel pump in order to reposition the cover, or to install a new diaphragm, the following procedure is recommended:

1. DISASSEMBLY.- Remove the lock nut, then remove the adjusting screw by turning the adjustment nut counterclockwise. This will also allow the removal of the valve spring. Remove the cover screws and washers and carefully lift off the cover so as not to injure the diaphragm. If the cover tends to stick, replace the lock nut "finger tight" and then tap the assembly lightly with a wooden block or mallet to loosen the cover.

2. ASSEMBLY.

a. Install the cover and replace the cover screws "finger tight", then install the spring and adjusting screw. Turn the adjusting screw about half way down with the adjusting nut. This will centralize the relief valve seat. Tighten the screws and secure them with safety wire.

CAUTION

> Do not screw the pressure adjusting screw tight before the final tightening of the cover screws, as this may prevent the cover from seating equally.

b. The diaphragm may have a tendency to stick to the cover and relief valve body. Care must be taken when breaking the cover loose from the body so as not to injure the diaphragm. Do not remove the diaphragm from the valve body except for replacement. If, after repair or replacement of parts, the fuel pump operates improperly, it should be replaced.

3. ADJUSTMENT AND TESTS (AFTER INSTALLATION).

a. ADJUSTMENT.- To alter the adjustment, loosen the lock nut and turn the adjusting nut clockwise to increase pressure or counterclockwise to decrease pressure. Tighten the lock nut and secure with safety wire.

b. TEST.- With the engine operating at 2400 rpm, check to make sure that the normal fuel pressure of 16 to 18 psi is maintained without assistance from booster pumps.

(i) ENGINE FUEL FLOWMETER TRANSMITTER REMOVAL.- Disconnect adjoining lines which lead to fuel pump and carburetor. Disconnect electrical cable. Remove bolts which secure transmitter to bracket.

(j) STARTER REMOVAL.

1. Disconnect electrical connection from terminal post.

2. Remove six mounting bolts which secure starter to engine accessory section.

3. Examine the unit for external evidence of damage.

4. Remove the armature. Brush the field pieces and the armature lightly with crocus cloth to remove accumulation of gum or rust.

(k) TACHOMETER (ENGINE) REMOVAL.- Disconnect electrical cable. Remove four bolts which secure tachometer to engine accessory section.

(l) REMOVAL AND INSPECTION OF SPARK PLUG LEAD CONNECTORS AND SPARK PLUGS.- Unscrew the spark plug lead elbow nuts with the PWA-3315 Wrench, holding the elbow firmly so that damage to the wires or leads will not occur. Withdraw the connector from each plug and install a protector cap over each connector. Remove the spark plugs with the PWA-3254 Wrench. For additional information refer to Section IV, paragraph 8.

(m) FRONT AND REAR ROCKER BOX SUMP CONNECTING AND SCAVENGE PIPES REMOVAL.- Disconnect and remove the rear (deflector mounted) rocker box sump connections.

(n) FRONT (C4 EXHAUST MOUNTED) ROCKER BOX SUMP REMOVAL.- Unfasten the front rocker box sump from C4 cylinder exhaust rocker box, and remove the sump and its basin.

(o) ROCKER BOX SUMP REMOVAL.- Remove the screws and loosen the fasteners which secure the sump to the deflectors; then remove the sump and the support bracket attached to the rear.

(p) INNER COWL DEFLECTORS (Figure 23) AND IGNITION CABLE ASSEMBLIES REMOVAL.- Remove the nuts which secure the inner cowl leading edge deflectors; then remove the deflectors from the engine. Disconnect the leads from the spark plugs and remove the screws which secure the distributor covers to the magnetos; then lift off the cable assemblies; being careful not to damage the magnetos or the distributor blocks. Install a protective wooden cover over each distributor block. Unfasten and remove the inner cowl main deflectors and the inner cowl rear deflectors.

(q) PRIMER LINES AND CYLINDER HEAD THERMOCOUPLES REMOVAL.- Disconnect the primer lines at the primer distributor and at the rear tees on the No. 1 and No. 2 intake manifolds. Unfasten the rear clamps which secure the primer lines to the intake manifolds and remove the rear lines from the engine. It is not necessary to disconnect and remove all sections of the primer lines from the manifolds. To remove a cylinder head thermocouple, push it in and turn it approximately a half turn counterclockwise. Remove the clamps and the thermocouple cables from the intake manifolds.

(r) INTAKE MANIFOLDS REMOVAL.- Remove the four nuts around each cylinder intake port; then loosen the nut which holds the intake manifold to the blower case, using a PWA-1786 Wrench. Lift off the intake manifold in one piece. If more than one manifold is removed, tag each one to facilitate installation on the proper bank. Disassemble the individual manifolds into their component parts by loosening the two retaining clamps which secure each of the manifold couplings to its corresponding manifold sections. Collapse the neoprene coupling in order to remove it from the steel coupled shield.

(s) CARBURETOR REMOVAL.- Refer to Section IV, paragraph 9.

(t) ROCKER BOX COVER REMOVAL.- Remove the nuts which secure the covers to the rocker boxes; then remove the covers and all connecting pipes, hose, and clamps. Check the rocker box covers for flatness, using a .002 feeler gage and a surface plate. If necessary face off the covers on a lapping plate, using a small amount of lapping compound.

(u) BULKHEAD DEFLECTORS REMOVAL.- Loose the spring fasteners which secure the bulkhead deflectors to the cylinder deflectors, and remove the fillister head screws which secure the deflectors to the crankcase bolt washer. Lift out the bulkhead deflectors.

(v) STARTING COIL AND GROUND WIRE MANIFOLD REMOVAL.- Remove the special fittings which secure the coil and ground wire manifold on the magnetos; then remove the brackets and cap screws which secure the manifold to the engine.

(w) CYLINDER AND INLET ROCKER BOX DEFLECTORS REMOVAL.- Remove the nuts and bolts which secure the cylinder and inlet rocker box deflectors to the cylinders. Lift the deflectors from the cylinders. Remove the cylinder deflector retaining band from the bas of each cylinder.

(x) ROD COVER NUTS REMOVAL.- Loosen the nut at the crankcase end of each push rod, using PWA-3639 Wrench.

(y) CYLINDERS, PISTONS, AND PISTON PINS REMOVAL.- In order to prevent scraper rings in other locations from pulling out of the cylinder skirts as the crankshaft is turned, remove each master rod cylinder last in its row. The master rod cylinders are D1, C4, B4, and A7. Each piston should be at top dead center when its cylinder is removed. Remove the cylinder holddown nuts, using PWA-3918 Wrench and PWA-341 Handle. Carefully pull off the cylinder, taking care that the piston pin and the push rods do not drop out. Remove the push rods from the push rod covers and lift off the cylinder deflector retaining band. Place the cylinder on a special rack to prevent damage to the barrel, fins, and push rod covers. Remove the piston pin, using PWA-4251-10 Pushe if necessary. Cover the cylinder opening with moisture-proof paper (Specification No. AN-P-1 Place a PWA-2488 Holder over the link rod and attach it to the hold down studs to prevent the rod from striking the crankcase.

(z) CYLINDER DISASSEMBLY AND INSPECTION

1. PUSH ROD COVERS.- Unscrew the nut at the rocker box end of the push rod covers with PWA-3639 Wrench and remove the covers.

2. ROCKER SHAFTS AND ROCKERS.- Remove each rocker shaft nut. Remove the shaft and rocker from the rocker housing, withdraw the sleeve from the bore of the rocker and uns the adjusting screw and lock nut from the valve end of each rocker.

3. VALVES, SPRINGS, AND WASHERS. (See figure 24).- Place the cylinder on a

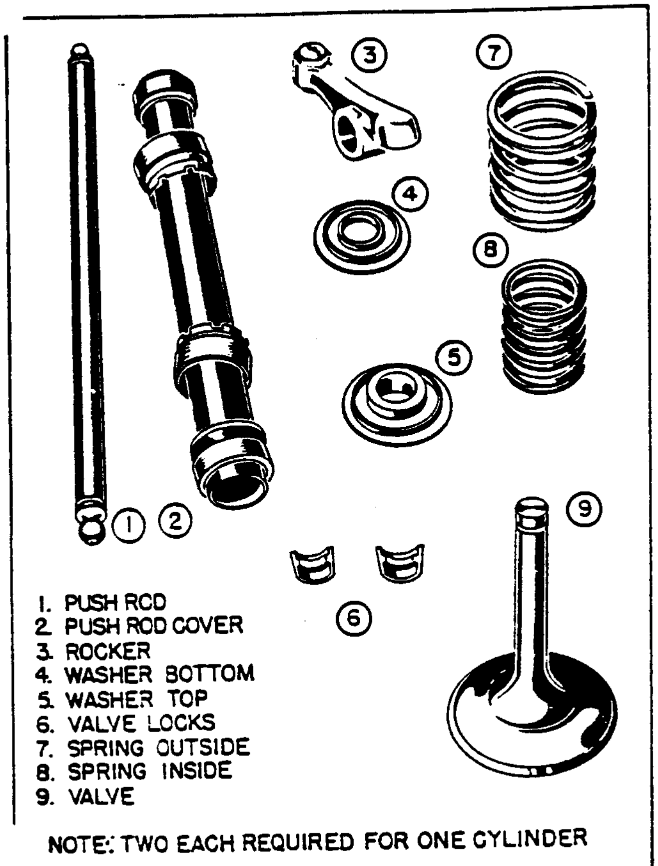


Figure 24. Valve Mechanism, Rockers, and Push Rods

block shaped to fit the contour of the inside of the cylinder head. Compress the valve springs with PWA-3664 Compressor, remove the valve locks, and withdraw the upper valve spring washer and valve springs, and the lower valve and spring washer. Place a rubber band around the valve stems to prevent the valves from dropping when the cylinder is removed from the stand. Remove the cylinder from the block and place it in a horizontal position. Remove the rubber band and withdraw the inlet and exhaust valves.

4. PUSH RODS.- Examine the push rods for straightness by rolling them on a plane surface. (See figure 25.) Check the oil holes to see that they are clear. Replace loose or excessively worn ball ends.

5. PISTONS.- Inspect the pistons for cracked heads or skirts, broken or distorted ring lands, scored or worn piston pin holes, excessive carbon deposits, broken rings, and rings in grooves because of excessive carbon. Inspect the condition of the fins on the underside of the piston.

6. CYLINDERS.- Examine the fins for cracks and dents, and see that the fin braces are securely anchored. Look for signs of valve spring chafing and cracks inside the rocker boxes. Inspect the spark plug inserts to see that they are secure and in good condition. Check the barrel for scoring, out of roundness, and other damage.

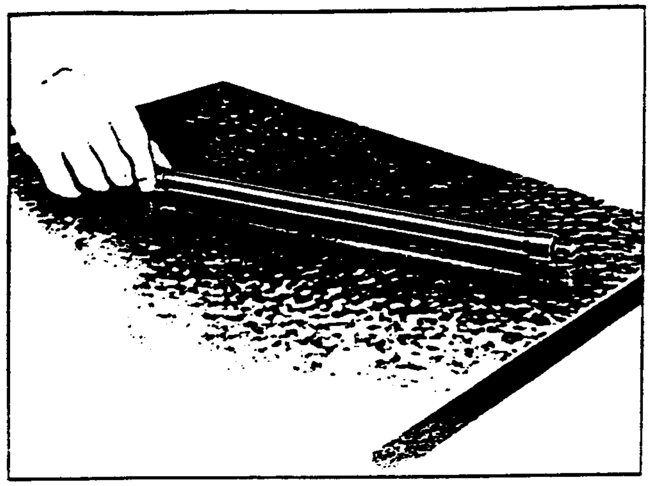


Figure 25. Checking Push Rod for Staightness

7. VALVE SEATS.- Examine for signs of pitting, burning, warping, or looseness.

8. VALVE SPRINGS.- Check for cracks or broken ends.

9. INLET VALVES.- Inspect the stem and lock groove for excessive wear. Check the valve head for excessive pitting.

10. EXHAUST VALVES.- Inspect for wear and pitting. Examine the valve stem and lock groove for galling, scoring, or burrs. If the tip of the valve stem shows signs of cupping, stone it flat to prevent chipping around the end. Examine the valve stem for excessive taper. Signs of swelling, stretching, and creases are cause for replacing the valve at once.

(5) ENGINE ASSEMBLY AND ADJUSTMENT.

(a) CYLINDER ASSEMBLY.

1. VALVES.- Insert the inlet and exhaust valves in their guides. The cylinder number of a valve will be found etched at the end of the stem just above the lock groove. Taking care that the valves do not drop into the barrel, place the cylinder on a wooden block shaped to fit the inside contour of the cylinder head. Install the lower valve spring washer, the inner and outer valve springs, and the outer valve spring washer. Compress the valve springs with PWA-3774 Compressor and install the valve locks.

2. ROCKER SHAFTS AND ROCKERS.- Install the adjusting screw and lock nut in the threaded end of each rocker and slide a steel sleeve into the bore of each rocker. Holding the rocker in position in the rocker box, install the rocker shaft. Intake valve rocker shafts are inserted from the exhaust port side of the cylinder; exhaust valve rocker shafts from the opposite side. Install the rocker shaft nut and tighten it to a torque of 500 to 600 inch pounds.

3. PUSH ROD COVERS.- Assemble the nuts on the push rod covers and install the asbestos ring and the rubber packing in each push rod cover nut. Loosely attach the covers to the cylinder. The crankcase end of each cover is slightly "belled". Attach the long cover to the exhaust rocker box.

(b) CYLINDER INSTALLATION.

1. CYLINDERS, PISTONS, AND PISTON PINS.

a. A position number is marked on the front of the hold-down flange of each cylinder, on the bottom of the skirt of each piston, and on one of the piston pin plugs. Fit the rubber seal ring around the flange radius under each cylinder hold-down flange and smooth it into place. Coat the piston pin with oil (see figure 26); then install the piston and pin so that the position numbers are toward the front of the engine. Arrange the rings so that the gaps are staggered around the piston.

b. One of the ball ends of each push rod is marked to indicate the proper position of the rod. Place the push rods in their covers with the numbered ends toward the cylinder hold-down flange. Install the cylinder deflectors retaining band over the cylinder hold-down flange.

c. If the master rod cylinder is to be installed along with others in the same row, install the master rod cylinder first. Bring the piston of the cylinder to be installed to top center and compress the outer piston

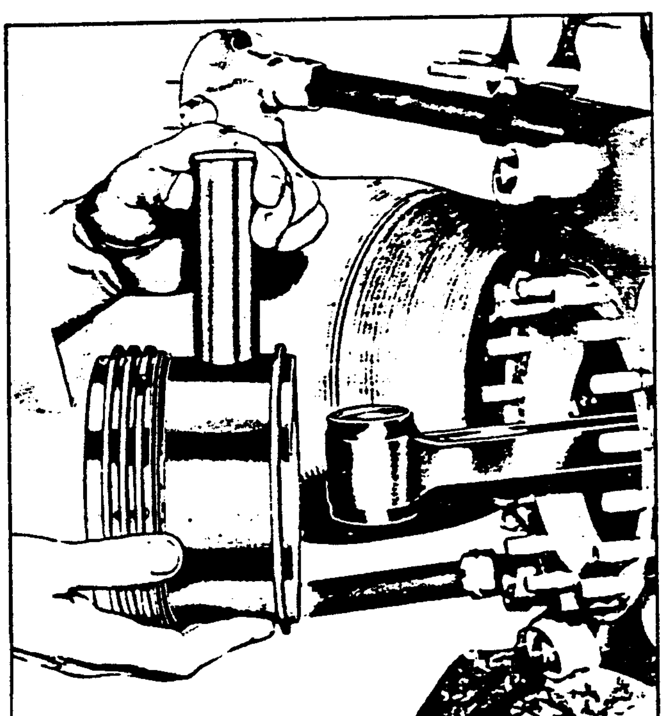


Figure 26. Installing Piston and Piston Pins

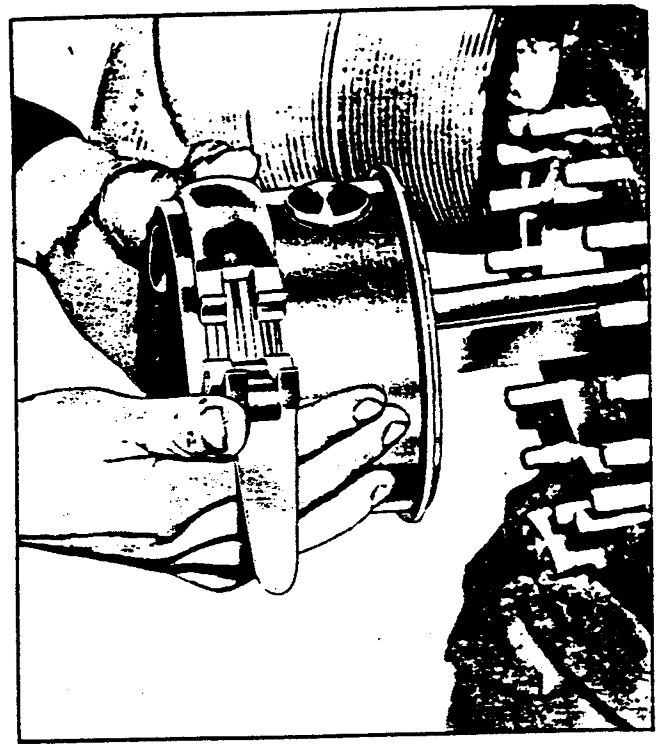


Figure 27. Compressing Piston Rings

rings with PWA-13 Clamp. (See figure 27.) Carefully push the cylinder on over the out rings and the piston pin; then place the clamp over the scraper ring (see figure 28) and push the cylinder into place on its mounting pad, fitting the push rod ball ends into their sockets in the valve tappets. Secure the cylinder with hold-down nuts and tighten the nuts to a torque of 400 to 450 inch pounds using PWA-3918 Wrench, PWA-2239 Wrench, and PWA-2240 Adapter.

d. Install a palnut over each hold-down nut. Turn the palnut finger tight, then tighten it a quarter turn with PWA-1609 Wrench. Tighten the push rod cover nuts to a torque of 125 to 150 inch pounds, using PWA-3639 Wrench. Safety the inner nuts to the adjacent cylinder hold down studs, and the outer nuts to their unions and then to the rocker shafts and nuts.

2. CYLINDER AND INLET ROCKER BOX DEFLECTORS INSTALLATION.- Install the deflectors on the inlet rocker boxes and hold each pair in place with a nut and bolt. (See figure 29.) Do not tighten the bolt at this time. Place the cylinder deflector retaining band around the cylinder and install the cylinder deflectors. (See figure 30.) Secure each pair of deflectors with the retaining band at the hold-down flange of the cylinder. Secure each pair of inlet rocker box deflectors and cylinder deflectors with the long bolt, two washers, and nut, inserting the bolt through the drilled hole in the cylinder head. (See figure 31.) Secure the cylinder deflectors to the studs on the sides of the cylinder with the nuts; then tighten each inlet rocker box deflector nut.

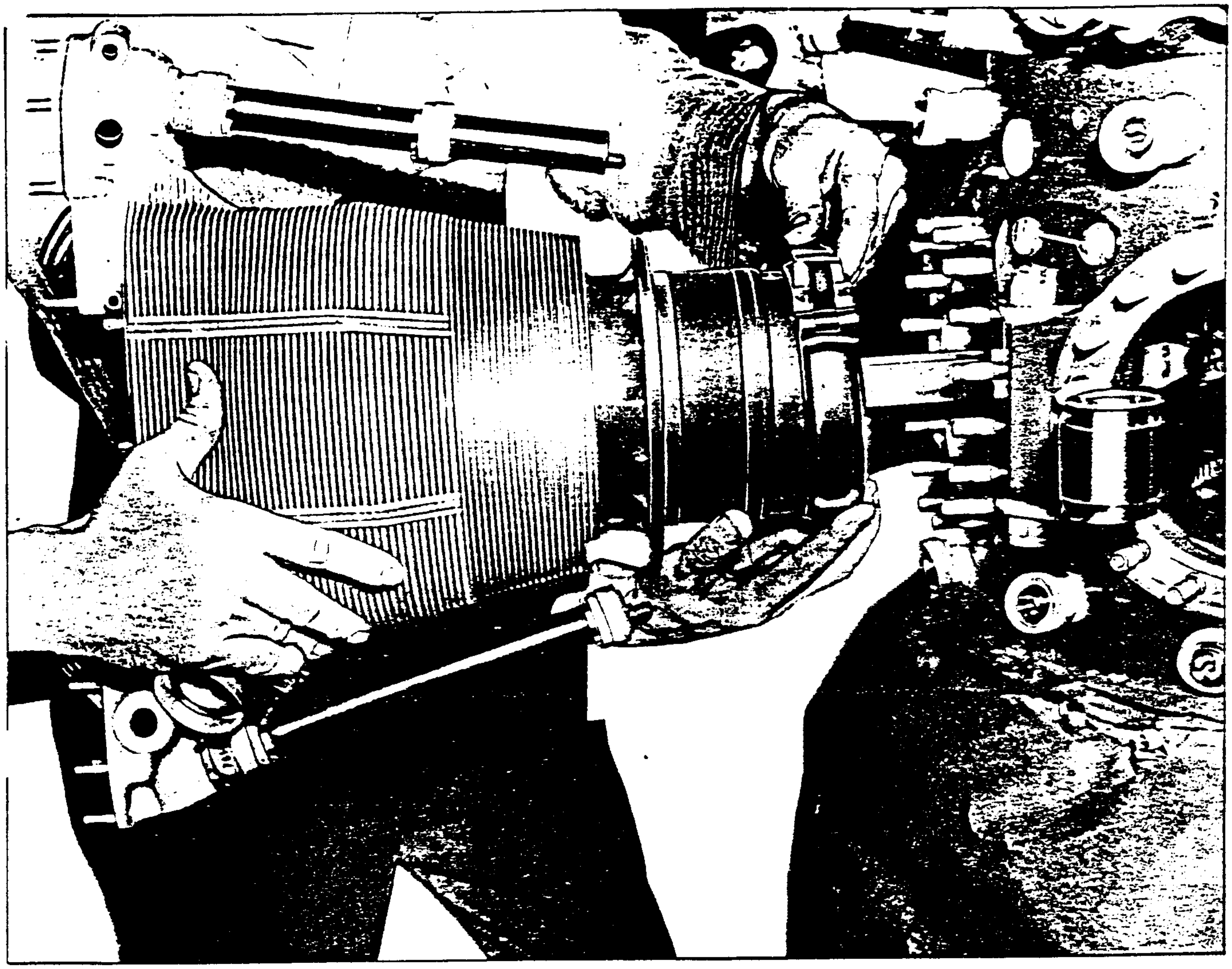


Figure 28. Installing Cylinder

3. STARTING COIL AND GROUND WIRE MANIFOLD INSTALLATION.- Place the starting coil and ground wire manifold in position on the front crankcase; then attach it with the bracket, screws, nuts, and washers. Place the rear extension between Nos. 2 and 3 cylinder banks.

4. BULKHEAD DEFLECTORS INSTALLATION.- Install the bulkhead deflectors and secure them to the special crankcase bolt washers and to the cylinder deflectors. (See figure 32.)

5. INSTALLATION AND ADJUSTMENT OF INTAKE MANIFOLD.- Place the copper gasket on each intake port; then install the intake manifold in one piece over its studs. Secure in place with washers and castellated nuts, tightening the nuts down evenly and safety them in pairs. Secure the manifold to blower case, using PWA-1786 Wrench. (See figure 33.) Tighten the hose clamps.

6. INSTALLATION AND ADJUSTMENT OF PRIMER LINES AND CYLINDER HEAD THERMOCOUPLES.- (See figures 34, 35, and 36.) Install the clamps and thermocouple cables on each intake manifold. Insert each thermocouple into its adapter in the cylinder head and push the thermocouple nut down so that its slot engages the pin in the adapter. Turn the nut clockwise to secure it. Assemble the primer lines and clamps to Nos. 7, 1 and 2 intake manifolds.

7. STUD REPLACEMENT.- Replace studs which are stretched, loose, or have damaged threads, with the proper oversize studs. If an oversize stud requires replacement, install the next oversize. When the threads of a stud hole are damaged or stripped, it is possible to drill and retap the hole for a special stepped stud, provided there is sufficient material around the hole.

8. CYLINDER PAD STUDS.- If one or more cylinder hold-down studs have failed or if the cylinder has become loose, replace all the studs in that particular pad.

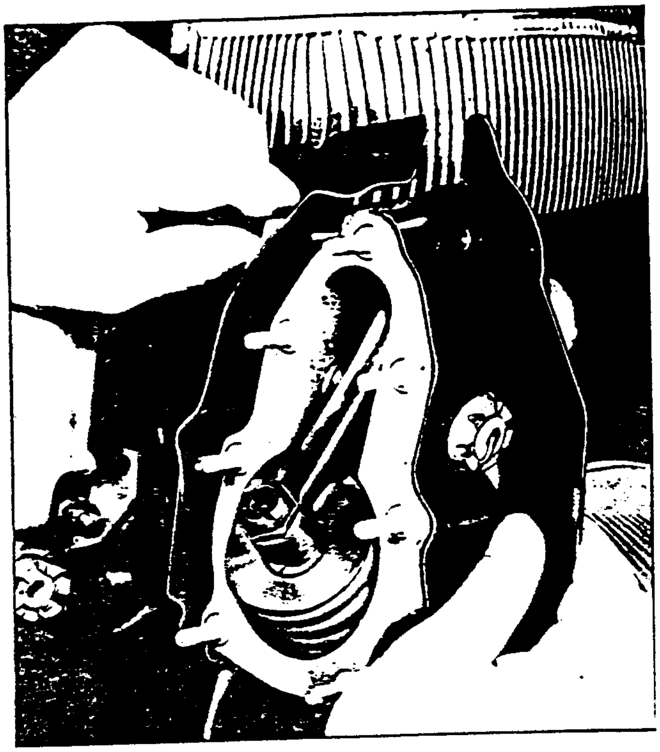


Figure 29. Installing Rocker Box Deflector Bolt

(c) REAR ROCKER BOX SUMP INSTALLATION.- Install the sump, securing the sump support bracket to the main deflector, and the front of the sump to its inner cowl leading edge deflector, using cap screws. Install the rocker box drain connections and pipes.

Figure 30. Installing Cylinder Deflector

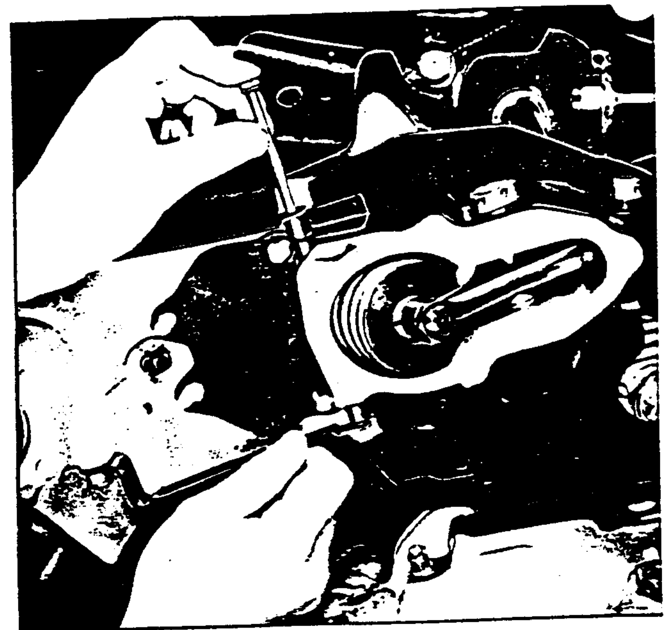


Figure 31. Installing Rocker Box and Cylinder Deflector

(d) FRONT ROCKER BOX SUMP INSTALLATION.- Place the gasket, basin, and gasket on C4 cylinder exhaust rocker box; then assemble the sump to the rocker box. Install the rocker box to magneto case oil pump pipe and secure it to the sump with the washers and nuts; then install the remaining connecting pipe to the sump.

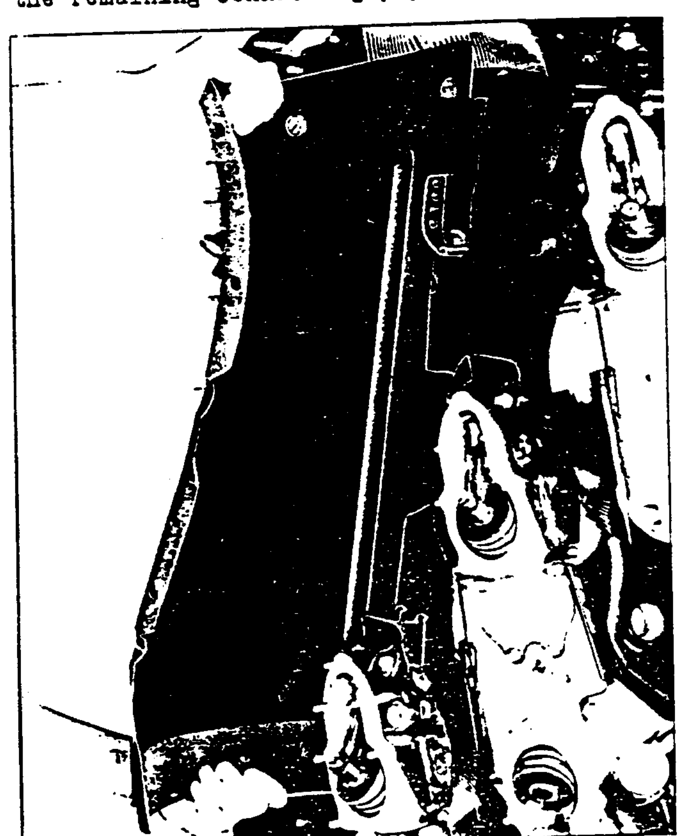


Figure 32. Installing Bulkhead Deflector

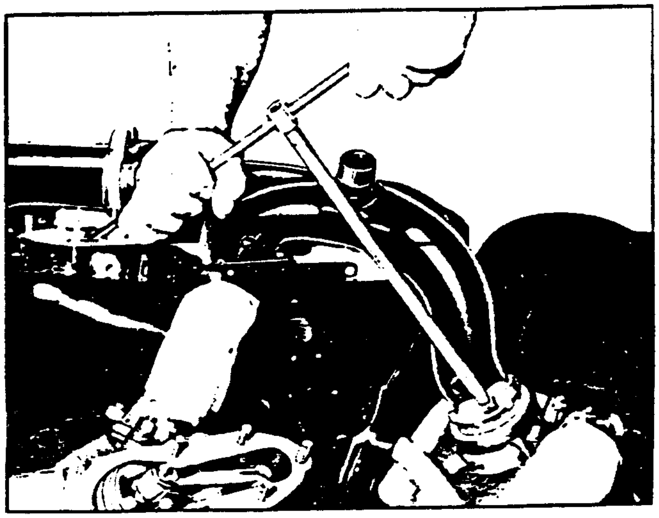


Figure 33. Tightening Intake Pipe Nut

(e) MAIN SUMP INSTALLATION.- Place a gasket on the sump mounting pad and attach the sump to the engine with the ten cap screws. Safety wire the cap screws. Install the main oil screen assembly and attach the cover with the four cap screws. Install the plug in the main oil screen chamber cover. Insert the strainer in the case and secure it with the plug. Install the accessory drive section drain plug. If the supercharger fuel drain valve has been removed, replace it at this time. Connect all scavenge pipes to the sump and safety all screws and plugs.

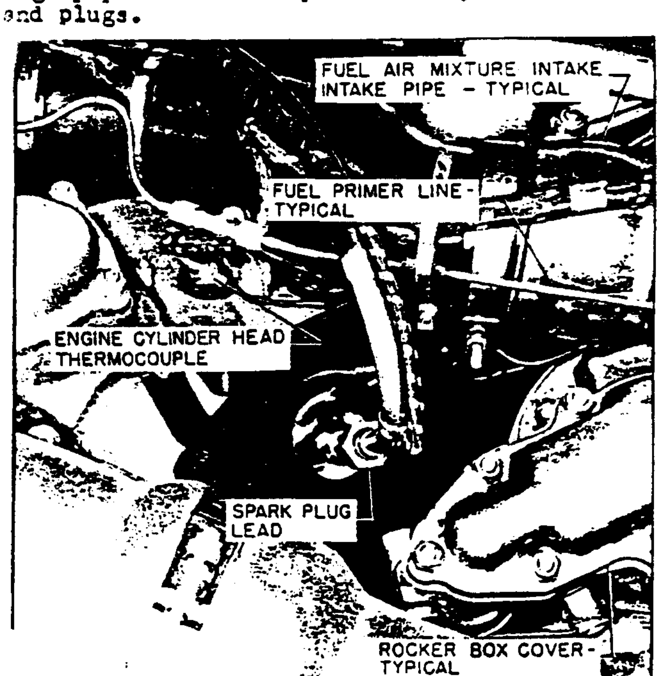


Figure 34. Cylinder Head Thermocouple

(f) SUMP PLUGS INSTALLATION.- Install the drain plugs in the front and rear rocker box sumps, and safety the plugs.

(g) VALVE CLEARANCE ADJUSTMENT.

1. Remove the magneto distributor cover from any convenient magneto and install PWA-3414 Fixture with the side marked PUSHER VALVES facing upward. Unscrew the distributor finger retaining screw and install the pointer support stud detail of the fixture.

2. Remove the rocker box covers where the valves are to be adjusted, and remove one spark plug from each cylinder, replacing the plug with PWA-3252 Vent Plug. Replace the remaining plug in D1 cylinder with PWA-2537 Indicator; then bring the piston of this cylinder to top dead center of its compression stroke by rotating the engine crankshaft in the normal direction of rotation.

3. Fix the pointer at the zero mark on the fixture plate; then rotate the engine crankshaft in the normal direction of rotation until the pointer aligns with the degree mark of the first valve to be set. The valve locations are marked on the fixture plate. ("N" indicating an inlet valve and "X" an exhaust valve.) If A6 cylinder has been removed, for example, and its valves are to be

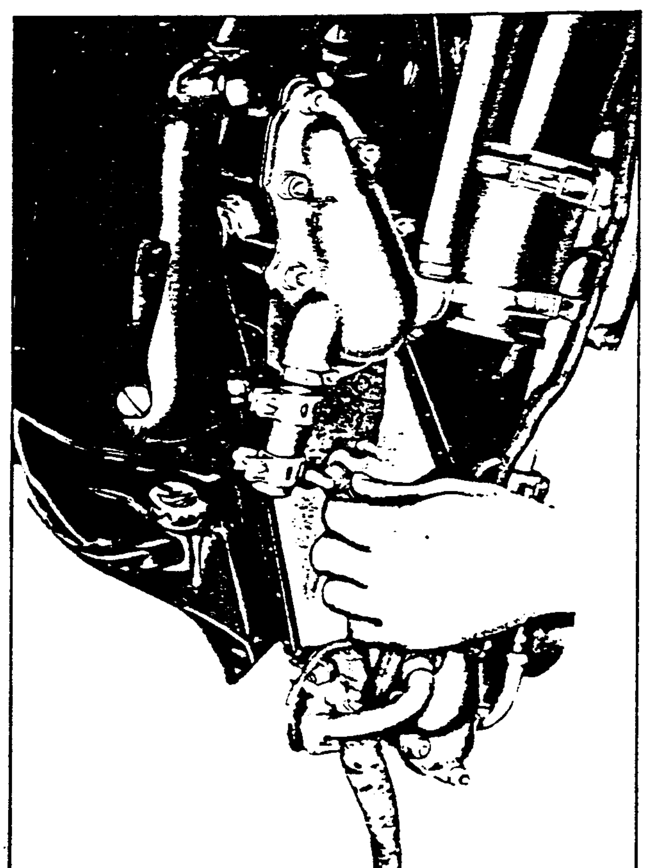
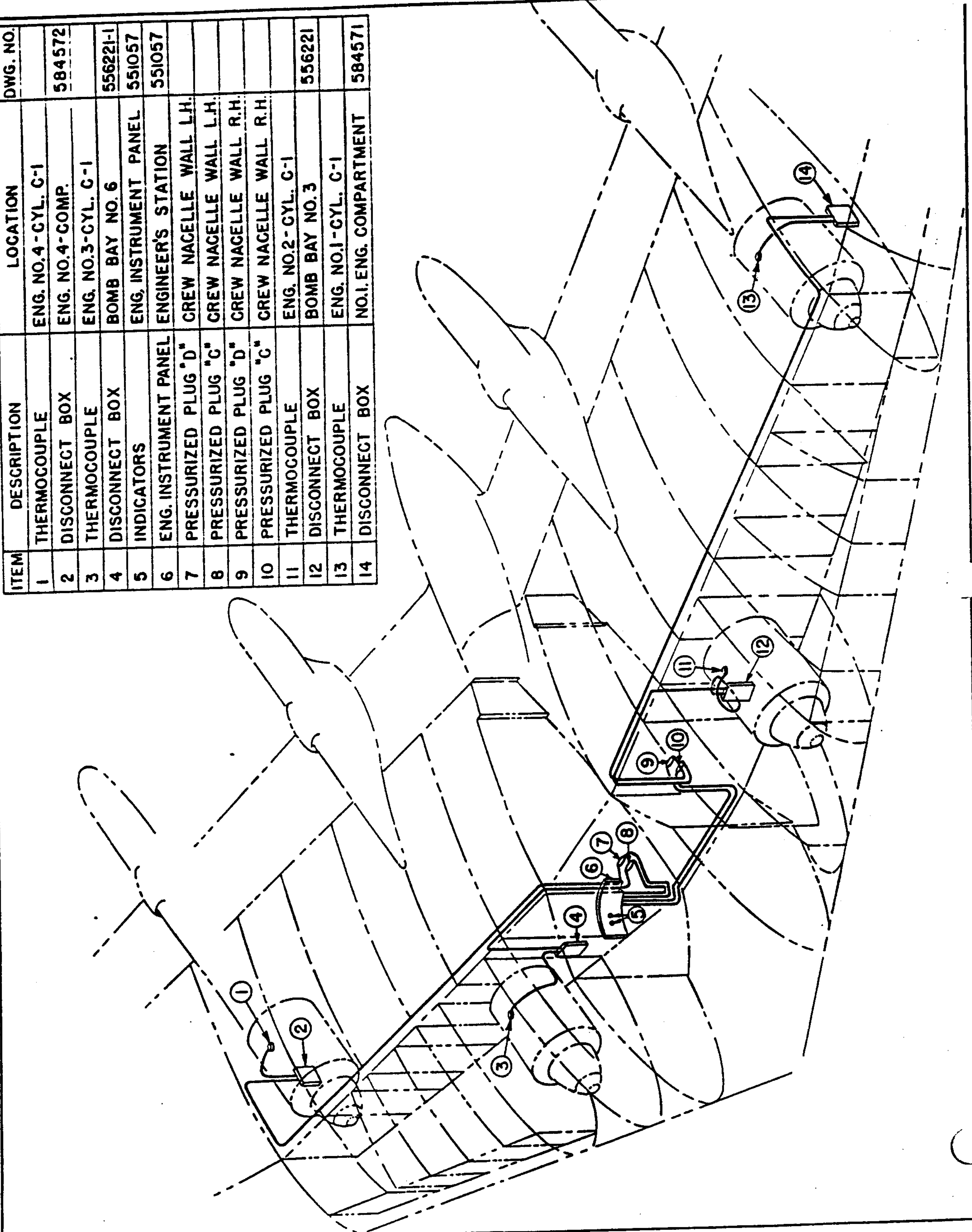


Figure 35. Installing Cylinder Head Thermocouple



ITEM	DESCRIPTION	LOCATION	DWG. NO.
1	THERMOCOUPLE	ENG. NO.4-CYL. C-1	
2	DISCONNECT BOX	ENG. NO.4-COMP.	584572
3	THERMOCOUPLE	ENG. NO.3-CYL. C-1	
4	DISCONNECT BOX	BOMB BAY NO.6	556221-1
5	INDICATORS	ENG. INSTRUMENT PANEL	551057
6	ENG. INSTRUMENT PANEL	ENGINEER'S STATION	551057
7	PRESSURIZED PLUG "D"	CREW NACELLE WALL L.H.	
8	PRESSURIZED PLUG "C"	CREW NACELLE WALL L.H.	
9	PRESSURIZED PLUG "D"	CREW NACELLE WALL R.H.	
10	PRESSURIZED PLUG "C"	CREW NACELLE WALL R.H.	
11	THERMOCOUPLE	ENG. NO.2-CYL. C-1	
12	DISCONNECT BOX	BOMB BAY NO.3	556221
13	THERMOCOUPLE	ENG. NO.1-CYL. C-1	
14	DISCONNECT BOX	NO.1 ENG. COMPARTMENT	584571

Figure 36. Engine Cylinder Head Temperature Diagram - Electrical

justed, rotate the crankshaft until the pointer aligns with the 347 degree mark in order to adjust A6 exhaust valve. After adjusting this valve, rotate the crankshaft in the normal direction to the 553 degree mark and adjust A6 intake valve.

4. The valve adjustment is made by inserting the .030 inch feeler of PWA-2803 Gage between the adjusting screw insert and the valve stem. Use a box wrench and a screw driver to set the adjusting screw so that there is a slight drag on the feeler gage, then lock the adjusting screw in this position by tightening the lock nut to a torque of 300 to 350 inch pounds. (See figure 37.)

5. When the valves have been adjusted, replace the rocker box covers and their gaskets. Tighten the rocker box cover nuts to a torque of 60 to 75 inch pounds.

(h) ROCKER BOX COVER INSTALLATION.- After the valve clearances have been adjusted, install the rocker box cover gaskets and covers. (See figure 38.) Tighten the rocker box cover nuts to a torque of 60 to 75 inch-pounds.

(i) MAGNETO INSTALLATION.- Refer to Section IV, paragraph 8.

(j) INNER COWL DEFLECTORS AND IGNITION CABLE ASSEMBLIES INSTALLATION.- Install the inner cowl rear deflectors and main deflectors placing the main deflector which incorporates support bracket fasteners between Nos. 3 and 4 cylinder banks. The seven ignition cable assemblies are identical and interchangeable. Place the assemblies in position, and attach each distributor cover with cap screws and lock washers. Install the inner cowl leading edge deflectors.

(k) SPARK PLUG CERAMIC CONNECTOR INSTALLATION.- Place the ceramic connector over the lead wire threaded extension, and seat it properly against the insulating sleeve. Screw the connector spring onto the threads of the extension, thereby securing the ceramic connector to the lead.

(l) SPARK PLUGS AND SPARK PLUG LEAD CONNECTORS INSTALLATION.- Apply a mica base lubricant (Specification No. AN-VV-C-566) to the first two or three threads of the plugs; then install the plugs, using PWA-3254 Wrench, and tighten them to a torque of 300 to 360 inch pounds. Make sure the inside of the spark plug barrel is clean and dry; then fill it approximately half full with Dow Corning No. 4 compound, using PWA-2796 Injector Gun. A half turn of the plunger handle is usually sufficient. Inspect the ceramic connector for dirt, oil, cracks, or chips. Remove dirt or oil with unleaded gasoline, and do not touch the ceramic after cleaning. Work the connector in and out of the spark plug barrel until it assumes its correct position and the compound has worked well up around the connector. Do not force the connector into the barrel. Remove any excess compound which may have spread to the threads on the spark plug barrel

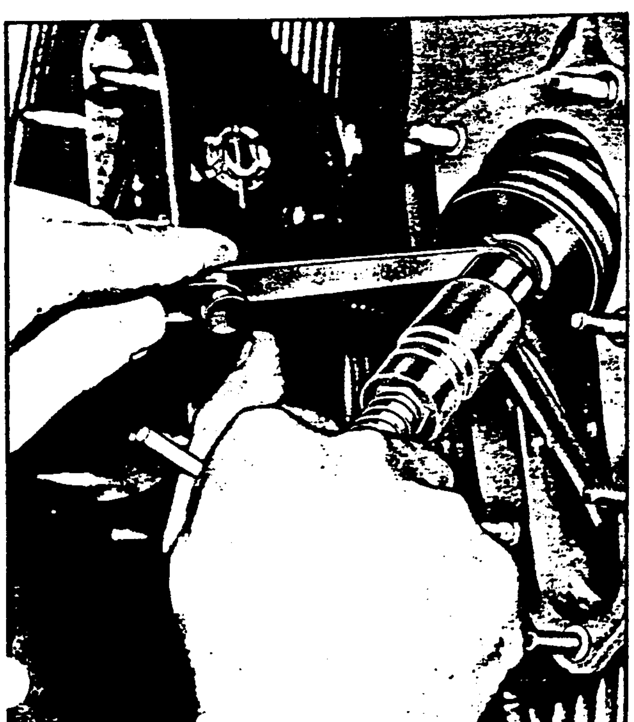


Figure 37. Setting Valve Clearance

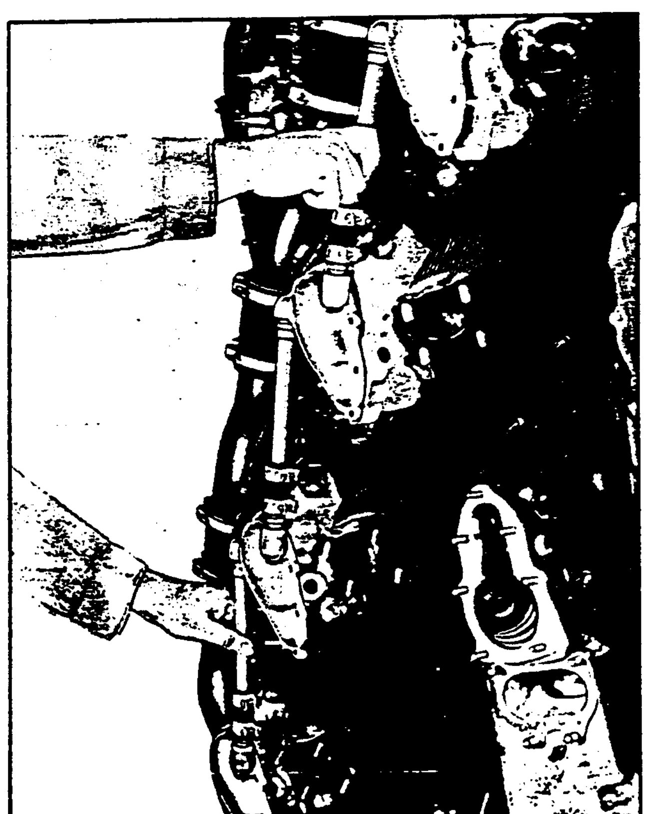


Figure 38. Installing Rocker Box Covers

or the spark plug lead elbow nut. Tighten the lead nut finger tight; then tighten it an additional half turn with PWA-3315 Wrench.

CAUTION

When tightening the spark plug lead elbow nuts, care should be taken to keep the elbows from turning. Turning or twisting may cause damage to the elbows as well as possible failure of the spark plug lead insulation.

(m) CARBURETOR INSTALLATION.- Refer to Section IV, paragraph 9.

(n) ENGINE FUEL PUMP INSTALLATION.- (See figure 21.)

1. Secure pump to engine accessory section by means of four bolts.

2. Connect fuel lines.

(o) ENGINE FUEL FLOWMETER INSTALLATION.

1. Secure flowmeter transmitter to bracket.

2. Connect two fuel lines.

3. Connect electrical cable to base of transmitter.

(p) FUEL FEED VALVE INSTALLATION.- Install new rubber seals on the valve housing. Assemble the fuel feed valve into the valve housing, place the spring in position, and secure the valve and housing assembly to the inner cover with the three screws. Insert the entire assembly into the accessory drive case and position it by turning in two cover screws a few turns. Do not attempt to pull the valve assembly into the accessory drive case by tightening the screws. Screw PWA-3615 Puller onto the inner cover and push the fuel feed valve assembly into place. Secure it by tightening and safetying the screws. Install the outer cover and secure it with the screws. Remove the wooden protective cover and replace the carburetor.

(q) TACHOMETER GENERATOR (ENGINE) INSTALLATION.- Align the key on the generator shaft with the engine keyway. Secure to engine accessory section by four bolts. Connect electrical cable. After the engine is started check tachometer for clockwise movement of pointer. If the pointer turns counterclockwise, reverse two of the three leads at the plug.

(r) STARTER INSTALLATION.

1. Make certain that starter and engine jaws are properly matched.

2. Check to see that gasket is correct for use with starter.

3. Mount starter in proper axial position.

4. Secure starter to engine accessory section by six bolts.

5. Connect three electrical wires to terminal post. If starter runs in the wrong direction of rotation, this may be corrected by reversing any two of the three connecting leads.

NOTE

Check the fuel pressure immediately before hoisting an engine into its bay. This may be accomplished by the use of two lines, each ten feet in length. One line, an inch and one quarter in diameter, extends from the applicable fuel tank to the fuel inlet on the engine. The other line which is one-quarter inch in diameter extends from fuel pressure line aft of the carburetor to the transmitter at the top of the engine bay. The fuel booster pump is then placed in operation and a reading is transmitted to the applicable fuel pressure gage in the flight engineer's compartment. This test should be made at low throttle, with the carburetor in idle adjustment. For additional information refer to Section IV, paragraph 11 e.

(6) ENGINE ASSEMBLY INSTALLATION.- Reverse the REMOVAL procedure described in paragraph 7 b (3). Torque the engine mount attach bol to 1100-1300 inch pounds.

c. AUXILIARY POWER UNITS. (See figures 39 and 40.)

(1) DESCRIPTION.- Two auxiliary power units, one located in bomb bay number three and the other in bomb bay number six, supply the XB-35 airplane with a.c. power. Each unit consists of a four cylinder, aircooled Franklin engine; a 208 volt, 400 cycle, three phase alternator; and an integral d.c. starter-exciter. Necessary controls and instruments are located i a control box adjacent to the auxiliary power unit. In addition, remote controls and instruments are located on the flight engineer's auxiliary power control panel. Ordinarily both units operate continuously while the airplane is in flight but in an emergency a single unit will deliver adequate electrical power. For other information refer to the XB-35 Pilot's Handbook and to Section IV, paragraph 17.

(2) REMOVAL.

(a) Remove flexible duct between engine fan scroll and wing air exit opening.

(b) Detach unit from fan air inlet scoop.

(c) Remove four bolts from engine mount platform.

(d) Lower entire unit assembly by mea of a hydraulic jack or a crane hoist.

(3) INSTALLATION. (See figure 40.)- Reverse the removal procedure described in paragraph 7 c (2).

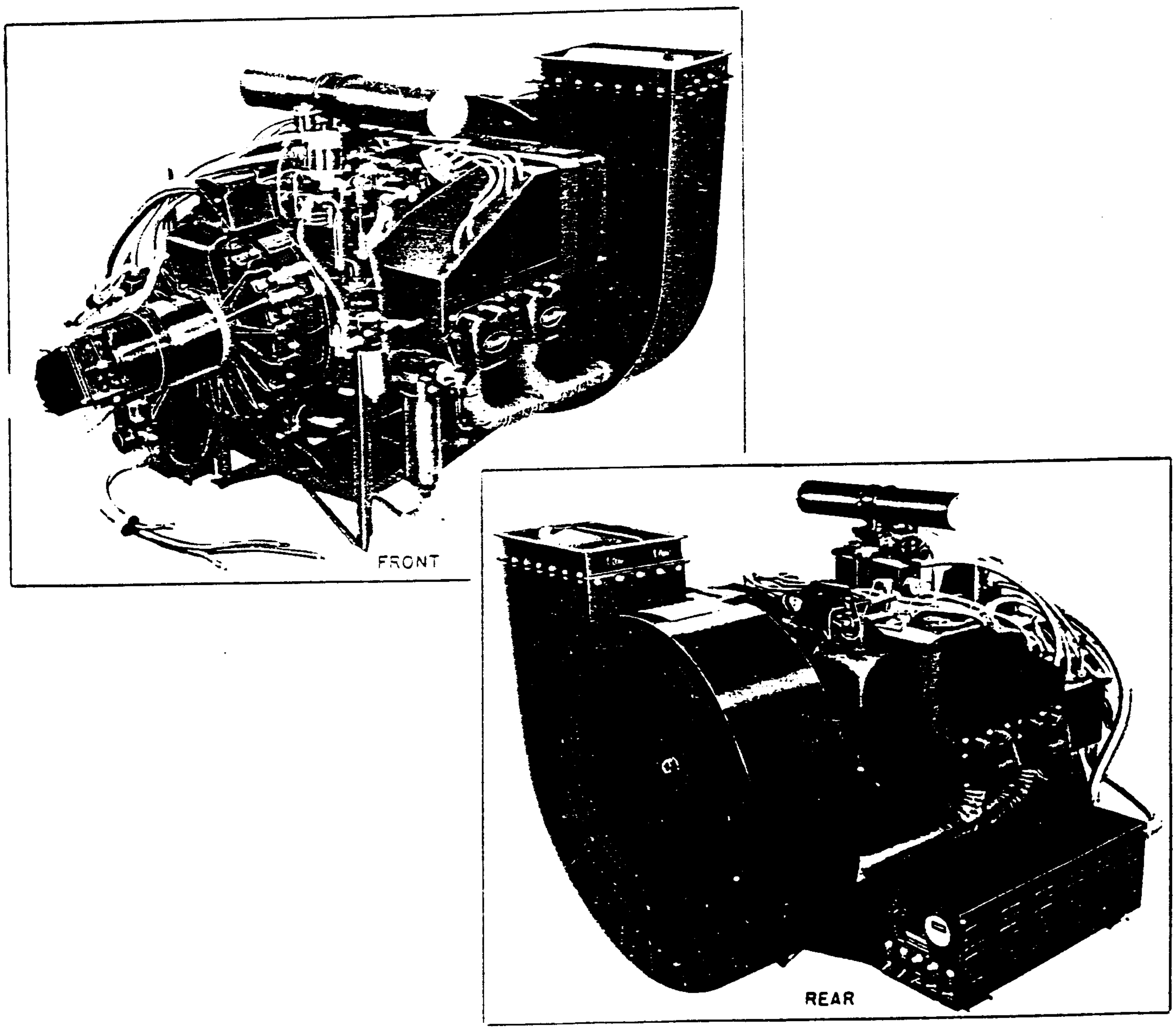


Figure 39. Auxiliary Power Unit.

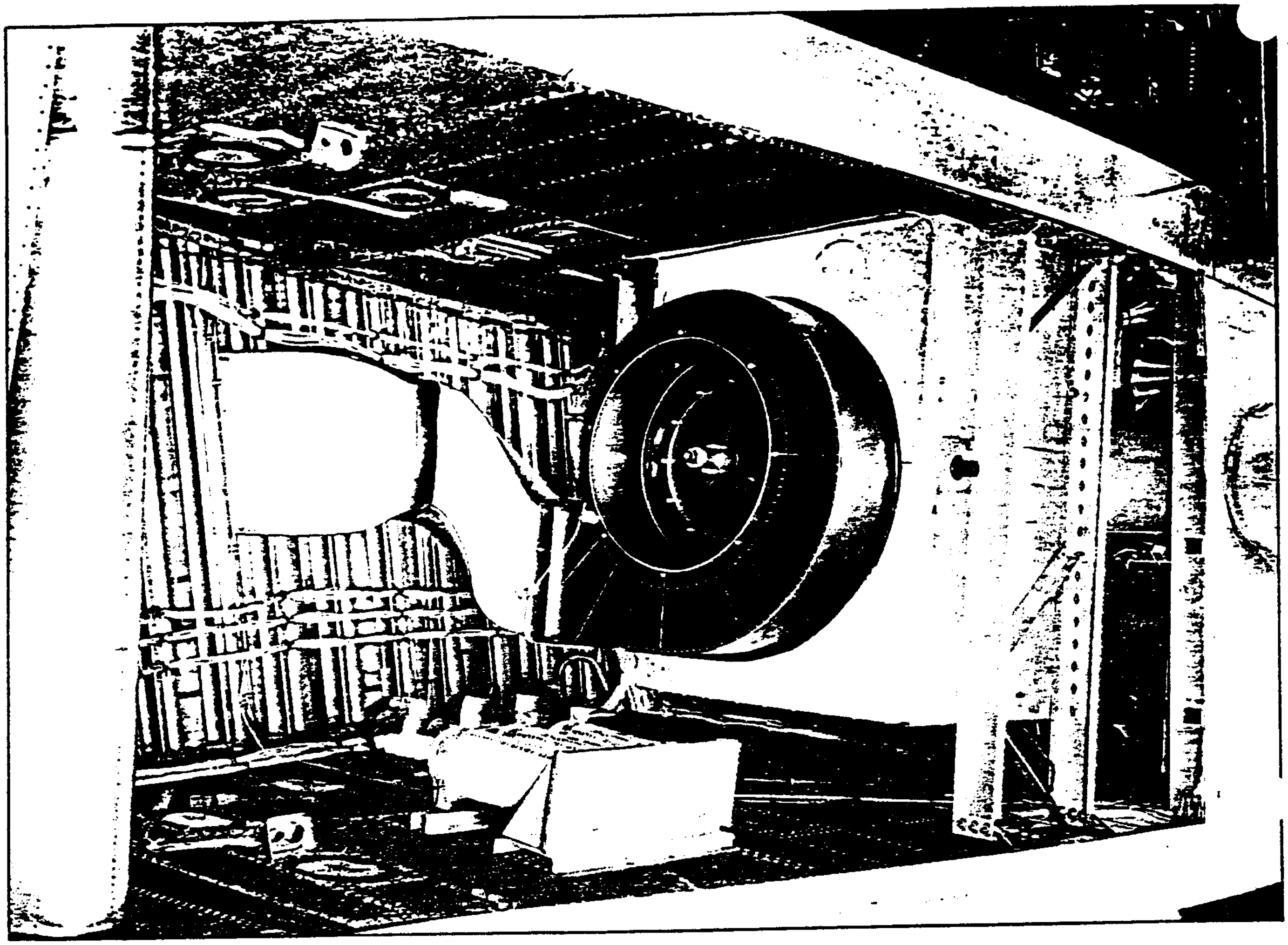


Figure 40. Auxiliary Power Unit - Installed

8. IGNITION SYSTEM

8. IGNITION SYSTEM. (See figure 1.)

a. GENERAL.- The radio shielded ignition system consists of seven separate Scintilla D4RN-2 magneto and integral distributor units (one complete unit for the four cylinders in each of the seven banks), spark plug lead and distributor block harness, spark plugs; triple unit, single spark, starting coils; pressurizing equipment, Joseph Pollak Corporation control units, a spark advance mechanism, necessary circuits and circuit breakers. Each lead harness directs the high tension impulses generated by its magneto to the eight spark plugs in the bank of four cylinders just behind the magneto. The engine firing order (see figure 2) is as follows:

A1	B5	C2	D6
A3	B7	C4	D1
A5	B2	C6	D3
A7	B4	C1	D5
A2	B6	C3	D7
A4	B1	C5	D2
A6	B3	C7	D4

The firing order for any particular row is 1-3-5-7-2-4-6, and the firing order for any particular bank is D-C-B-A. After a cylinder has fired, take the next letter in alphabetical order and add 4 to the number of that cylinder to determine which cylinder will fire next. If B2 has just fired, the next cylinder to fire will be C6; if D5 has just fired, the next will be A2.

NOTE

An engine must be removed or suspended as instructed in paragraph 7 b (3) before work can be performed upon the majority of ignition system components. This preliminary step is necessary inasmuch as the recessed position of the engine, when installed, does not permit sufficient accessibility. Likewise all tests, with the exception of those described in paragraph 8 c (9) and (10), and paragraph 8 d (3) must be accomplished with the engine lowered from its bay.

b. TROUBLE SHOOTING.- Refer to paragraph 7 (2).

c. MAGNETO. (See figure 3.)

(1) DESCRIPTION.- Each of the seven magnetos is flange mounted on one of the seven pads radiating from the magneto drive case and is of the four pole rotating magnet type. Each magneto has a compensated cam with two tracks of four lobes each, two sets of breaker points, and a distributor rotor with four jump gap pickup and two distributing electrodes. With the exception of the cams, which are timed to the front cylinders of the corresponding banks, all seven magneto units are identical and interchangeable. A coupling of the engine end of each magneto shaft is splined into the outer end of the corresponding magneto drive shaft in the magneto drive case. A ratchet ring between the coupling and magneto shaft provides a vernier adjustment of the shaft when timing the magneto to the engine.

(2) REMOVAL.- Disconnect the special fitting which secures the starting coil and ground wire manifold to the magneto, then remove the ignition manifold and distributor cover assembly. Remove the nuts which secure the magneto to the magneto drive case and lift off the magneto.

(3) DISASSEMBLY.- Field personnel should not attempt to disassemble a magneto further than is necessary to accomplish breaker point cleaning or replacement, and then, only if it is absolutely certain that the trouble has been correctly diagnosed. For this information refer to paragraph 7 (2). Under normal conditions, the wear or the burning of the breaker points is balanced by the wear on the cam follower and, therefore, the spark timing remains approximately at its original setting. If it becomes necessary to clean the points proceed as directed in paragraph 8 c (4), immediately below.

(4) INSPECTION AND CLEANING OF BREAKER POINTS.

(a) Remove the ignition manifold positioning screw and disconnect the spark plug leads from the spark plugs. Install protec caps on the spark plug leads to prevent dam to the ceramic connectors. Loosen the distributor cover screws and then remove the entire ignition manifold assembly. Unscrew the distributor finger retaining screw (see

ITEM	DESCRIPTION	LOCATION
1	POWER RELAY PANEL	NO.4 ENGINE COMPARTMENT
2	INDUCTION VIBRATOR	NO.4 ENGINE COMPARTMENT
3	MOTOR BLOCK UNIT	NO.4 ENGINE COMPARTMENT
4	ENGINE DISCONNECT BOX	NO.4 ENGINE COMPARTMENT
5	STARTER	NO.4 ENGINE
6	IGNITION HARNESS PLUG	NO.4 ENGINE
7	POWER RELAY PANEL	BOMB BAY NO.6-AFT
8	STARTER	NO.3 ENGINE

ITEM	DESCRIPTION	LOCATION
9	IGNITION HARNESS PLUG	NO.3 ENGINE
10	MOTOR BLOCK UNIT	BOMB BAY NO.6
11	INDUCTION VIBRATOR	BOMB BAY NO.6
12	ENGINE DISCONNECT BOX	BOMB BAY NO.6
13	IGNITION CONTROL SWITCH	ENGINEER'S UPPER SWITCH PANEL
14	STARTER SWITCHES	ENGINEER'S UPPER SWITCH PANEL
15	CIRCUIT BREAKER	ENGINEER'S UPPER SWITCH PANEL
16	ENGINEER'S UPPER SWITCH PANEL	ENGINEER'S STATION
17	PRESSURIZED PLUGS	R.H. CREW NACELLE BULKHEAD
18	ENGINEER'S JUNCTION PANEL	BENEATH ENGINEER'S FLOOR
19	PILOT'S PEDESTAL PANEL	PILOT'S PEDESTAL
20	CIRCUIT BREAKER	PILOT'S PEDESTAL PANEL
21	EMERGENCY CRASH SWITCH	PILOT'S PEDESTAL PANEL
22	PRESSURIZED PLUGS	L.H. CREW NACELLE BULKHEAD
23	INDUCTION VIBRATOR	BOMB BAY NO.3
24	ENGINE DISCONNECT BOX	BOMB BAY NO.3
25	MOTOR BLOCK UNIT	BOMB BAY NO.3
26	IGNITION HARNESS PLUG	NO.2 ENGINE
27	STARTER	NO.2 ENGINE
28	POWER RELAY PANEL	BOMB BAY NO.3-AFT
29	STARTER	NO.1 ENGINE
30	IGNITION HARNESS PLUG	NO.1 ENGINE
31	ENGINE DISCONNECT BOX	NO.1 ENGINE COMPARTMENT
32	INDUCTION VIBRATOR	NO.1 ENGINE COMPARTMENT
33	MOTOR BLOCK UNIT	NO.1 ENGINE COMPARTMENT
34	POWER RELAY PANEL	NO.1 ENGINE COMPARTMENT

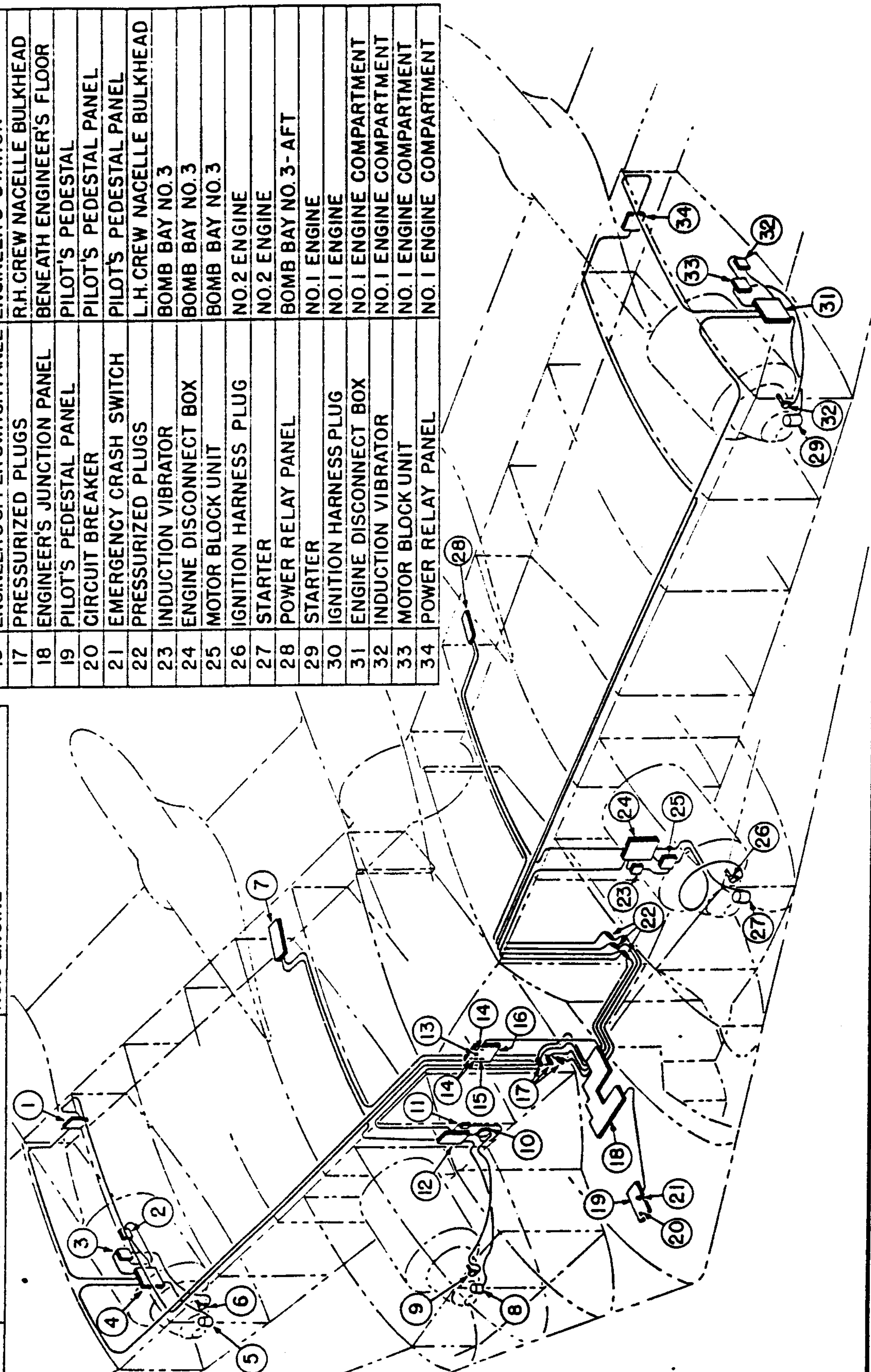


Figure 1. Starter and Ignition - Electrical

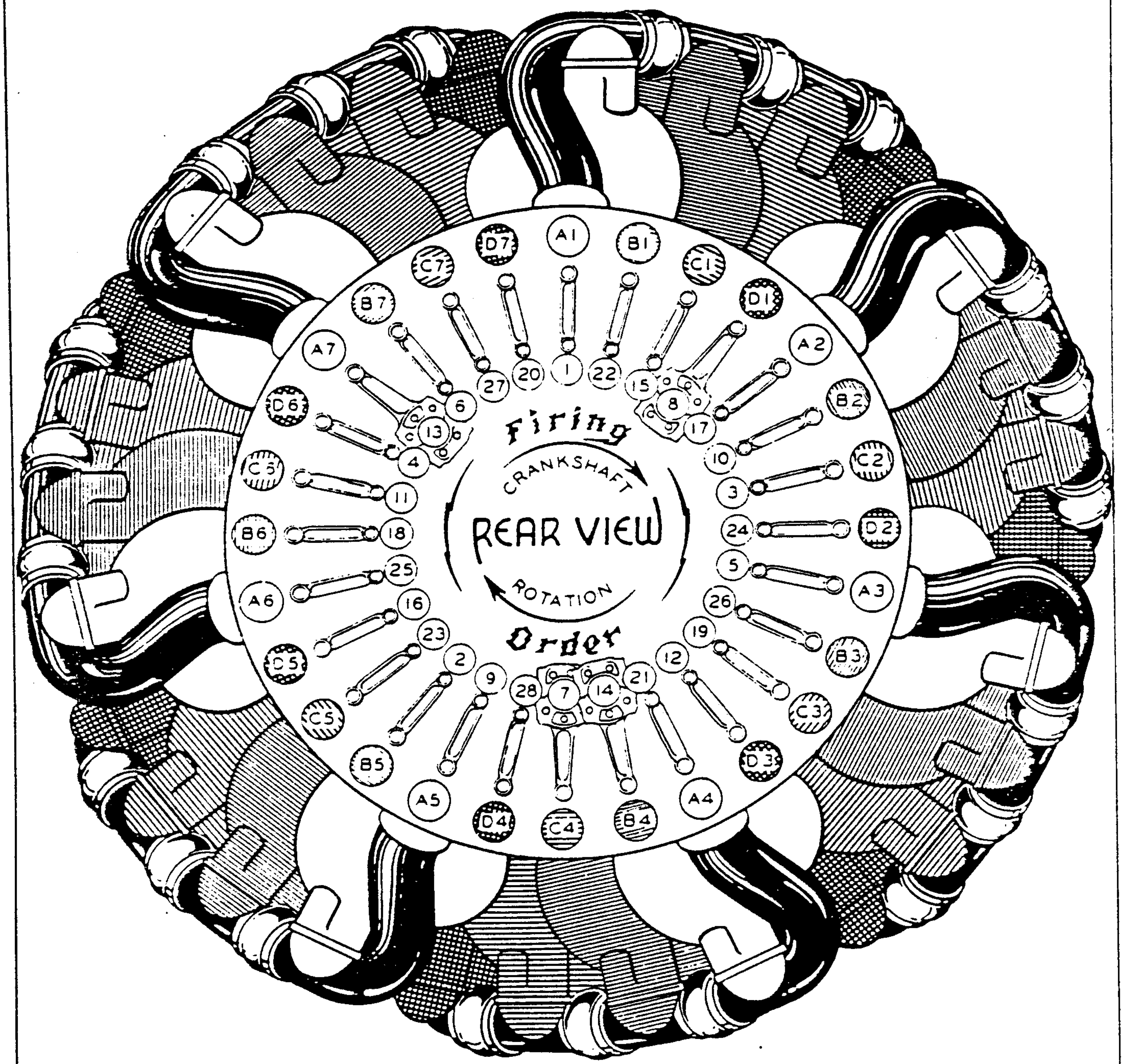


Figure 2. Cylinder Numbering Diagram

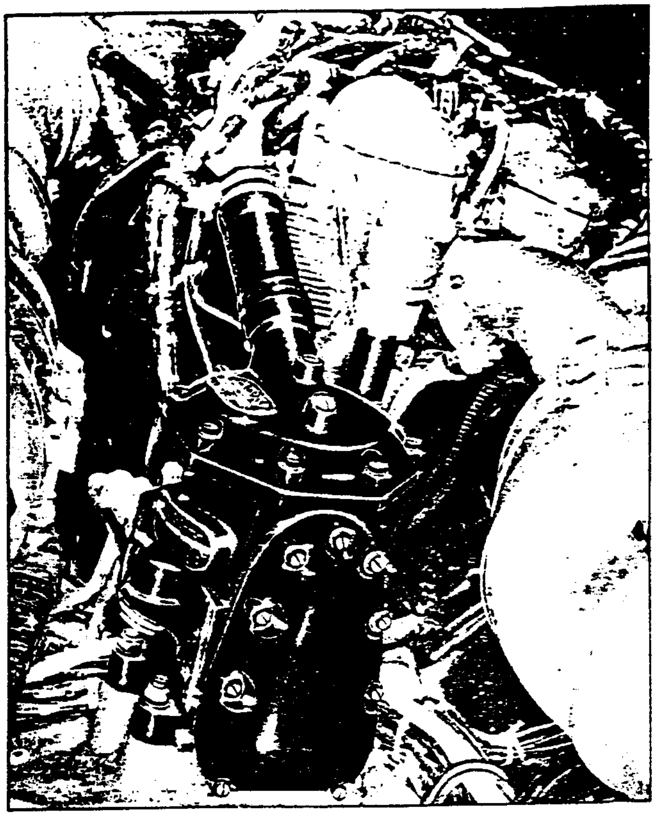


Figure 3. Magneto Installed

figure 4) and lift out the finger. (See figure 5.) Remove the four cap screws (see figure 6) and lift out the insulating bowl. (See figure 7.) Separate the breaker points by inserting a screwdriver between the breaker point arm and the fiber block on cam follower. (See figure 8.)

(b) Do not open the points more than one sixteenth inch in making the inspection as the spring may take a permanent set. Inspect the breaker point contact surfaces for oil, carbon, or any foreign matter that would prevent the points from making good electrical contact when they are closed. A small flashlight and an inspection mirror will prove useful when performing this task. Points which are operating correctly have clean, dry contact surfaces which are slightly frosted in appearance. There should be no surplus oil on or around the points. A little dry dirt on the side of the points is not harmful, nor are slight pits or mounts on the surfaces. (See figure 9.) Any points that are dirty, badly pitted, or corroded must be removed for servicing.

(c) Do not attempt any cleaning or refacing of the contact surfaces while the breaker points are in the magneto. When inspecting the breaker points, do not raise the breaker main spring beyond a point giving .0625 inch clearance between the contact points. Any further tension on the main spring caused by raising it beyond this point will weaken it and result in unsatisfactory magneto performance. Do not attempt any

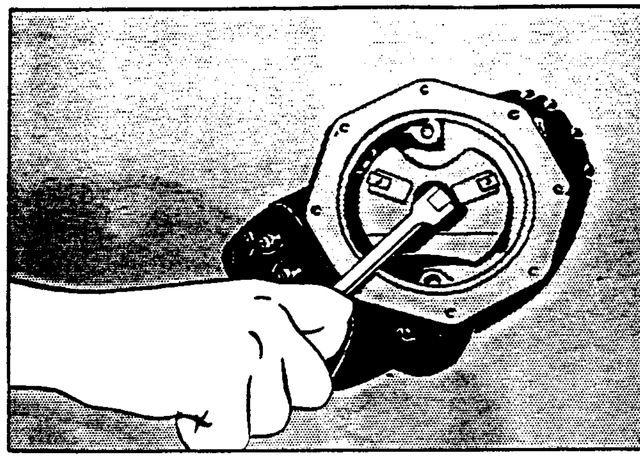


Figure 4. Removing Finger Screws

cleaning of the contact surfaces while the points are in the magneto. If it is necessary to clean the points, remove the two set screws and lift out the breaker assembly. Use only acetone (Specification No. O-A-51) or clear unleaded gasoline (Specification No. AN-F-22) as a cleaning agent on the breaker points. After cleaning the points, reinstall the breaker assembly in the magneto and secure it with the two set screws.

(d) Inspect the insulating bowl for traces of carbon and if any threadlike trails are visible, wipe the bowl clean with a dry lint free cloth. If a crack is found, replace the bowl. Install and tighten the four insulating bowl screws. Wipe the distributor finger clean; then install the finger and secure it with the washer and screw.

(5) TEST FOR BREAKER POINT ADJUSTMENT.

(a) Before replacing the ignition manifold assembly check the synchronization of the two sets of breaker points. Install PWA-3827 Adapter on the magneto (see figure 10) and attach PWA-2417 Indicator in a suitable position. Connect one red wire of the indicator to each of the ground wires on the adapter (see figure 11) and ground the black wire of the indicator to the magneto housing.

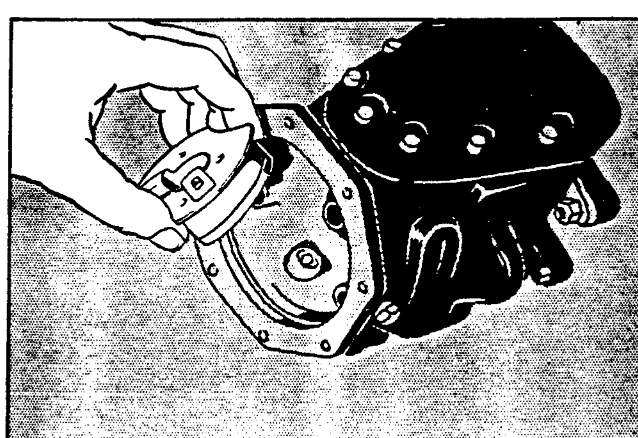


Figure 5. Removing Distributor Finger

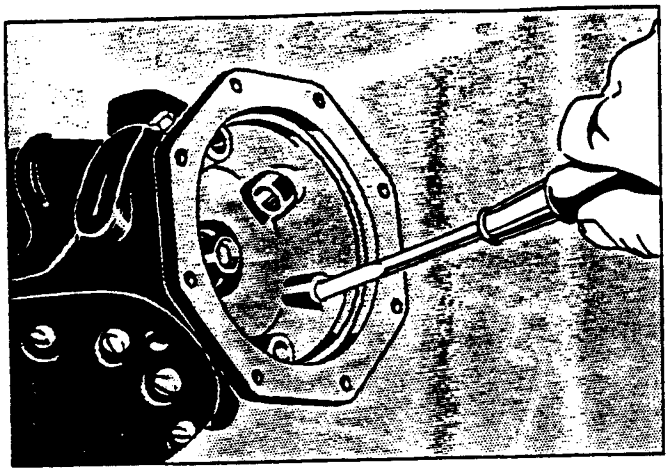


Figure 6. Loosening Bowl Screws

(b) Fit PWA-3311 Turning Bar to engine crankshaft. Turn engine in normal direction of rotation until indicator lights just flash on.

(c) Using a straightedge, note whether or not the timing mark on the distributor rotor aligns with the timing marks on the magneto housing. (See figure 12) If the timing marks do not align when the marks just flash on, the breaker points are in need of adjustment.

(6) ADJUSTMENT OF BREAKER POINTS.

(a) If adjustment is necessary, remove the distributor finger and lift out the insulating bowl, then replace the finger on the shaft and take out all play in the magneto drive mechanism by maintaining a clockwise torque on the finger. Turn the engine in the normal direction of rotation until the timing mark on the finger and the marks on the magneto housing are in perfect alignment;

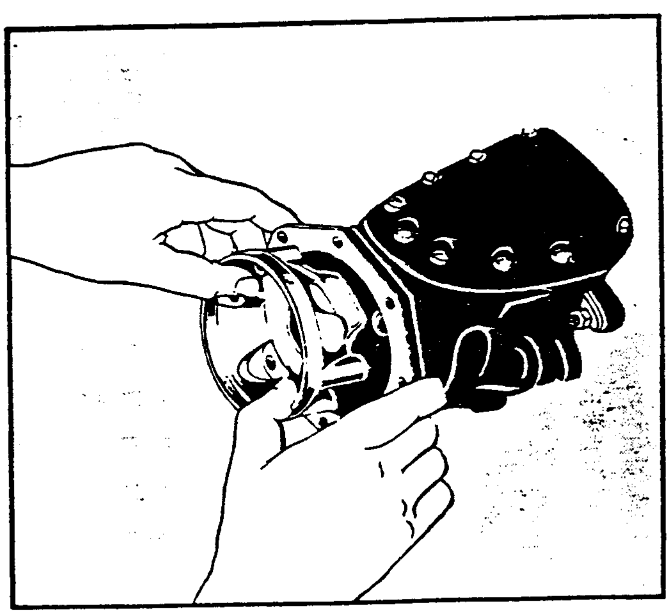


Figure 7. Removing Bowl

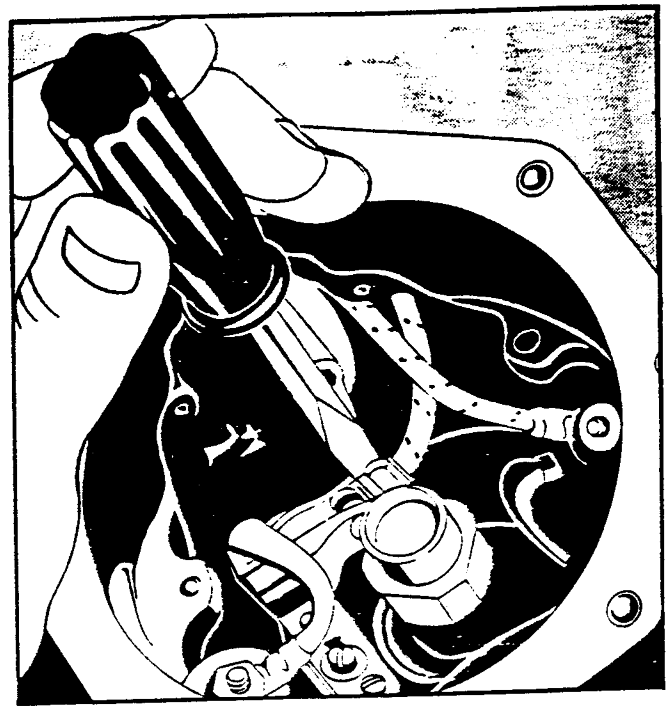


Figure 8. Spreading Contact Points

then remove the finger while it is in this position. Loosen the two set screws which secure one of the breaker point assemblies to the breaker plate (see figure 13); then tighten the screws just snug enough to keep the breaker point from slipping. Turn the eccentric adjustment screw (see figure 14) until the timing light just flashes on, indicating that the points are just opening. Lock the breaker point assembly in position by tightening the set screws, place the finger on the magneto shaft. Make sure that the timing light flashes on just as the timing mark on the finger and the marks on the housing come into alignment. Make the adjustment of the other breaker point assembly in the same way.

(b) Lift off the finger again and install the insulating bowl and screws. Secure the finger, distributor gasket, and cover, and connect the spark plug leads. Tighten the ignition manifold positioning screw.

(7) TIMING MAGNETO TO ENGINE.

(a) Install PWA-3414 Fixture on any convenient magneto in the following manner: Place the timing plate on the magneto housing, aligning the scribe marks at the holes in the mounting flange of the plate with those on the magneto housing, and secure it with two screws. Remove the distributor finger retaining screw and install the pointer support detail of the fixture (see figure 15); then secure the pointer arm and pointer to the stud with the wing nut. (See figure 16.)

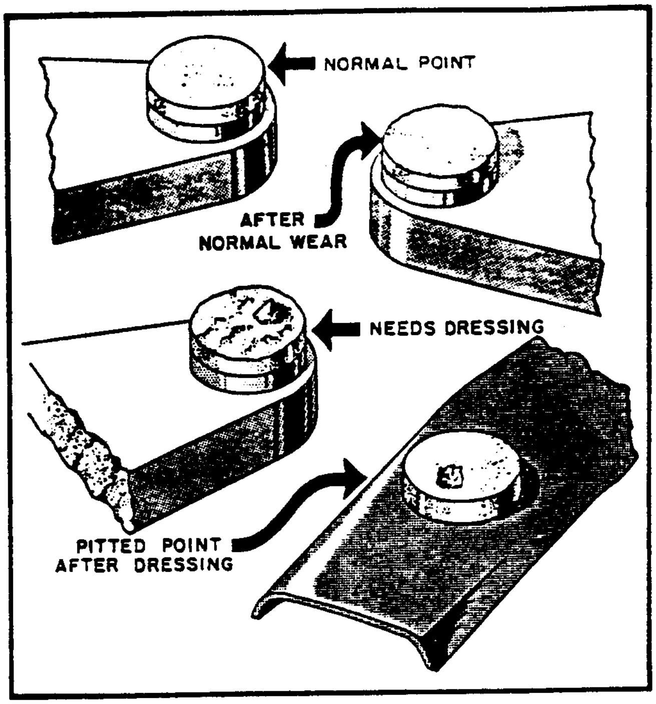


Figure 9. Breaker Point Conditions

(b) Install PWA-2537 Indicator in one of the spark plug holes of D1 cylinder. Locate top center of the compression stroke of D1 piston as follows: Remove the rocker box covers from D1 cylinder and turn the engine in the normal direction of rotation until the indicator light just flashes on. (See figure 17.) When D1 piston is at the top center of the compression stroke, there is clearance between each D1 rocker and its valve, assuming that the valve clearance setting has not been disturbed. This clearance can be readily detected by joggling each D1 rocker. If there is no valve clearance, D1 piston is on its exhaust stroke.

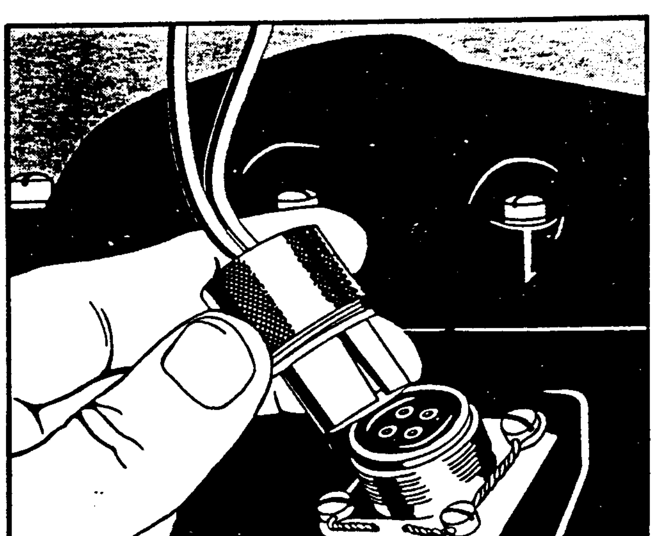


Figure 10. Installing Adapter

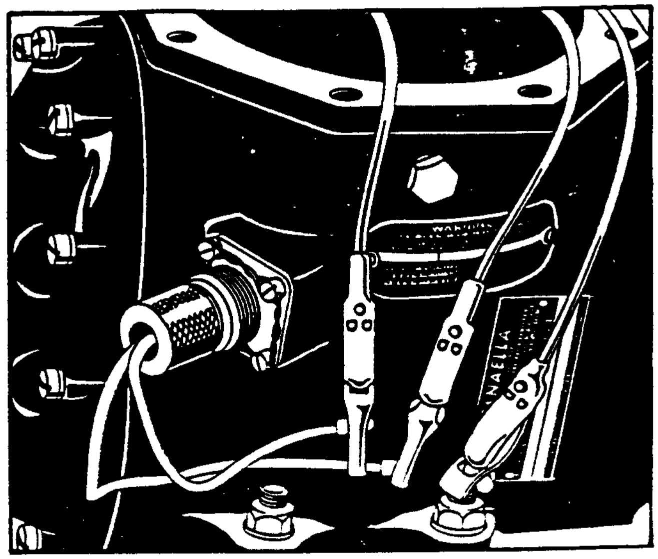


Figure 11. Indicator Attachments

Continue turning the engine until the indicator light just comes on again, and check the rockers for valve clearance.

(c) Turn the engine until the indicator light just comes on and mark the timing plate with a line. (See figure 18, reference 1.) Continue turning the engine until the indicator light just goes out and mark the timing plate with a second line. (See figure 18, reference 2.) Measure halfway between these two marks and mark the timing plate with a third line. (See figure 19, reference 3.) This mark indicates the top dead center position of D1 piston. Back off the engine at least a quarter revolution; then bring it up in the normal direction of rotation until the pointer aligns with this top center mark.

(d) With D1 piston on top dead center, loosen the wing nut, move the pointer to the zero mark on the timing plate (see figure 19), and secure it in this position. Turn engine opposite the normal direction of rotation about a quarter turn; then bring it up in the normal direction until the pointer is on the proper degree mark for the firing position of the proper magneto to be installed. Refer to the following table:

MAGNETO NO.	POINTER POSITION ON FIXTURE PLATE
1	715.00 degrees
3	101.85 degrees
5	198.30 degrees
7	302.65 degrees
2	407.35 degrees
4	511.70 degrees
6	608.15 degrees

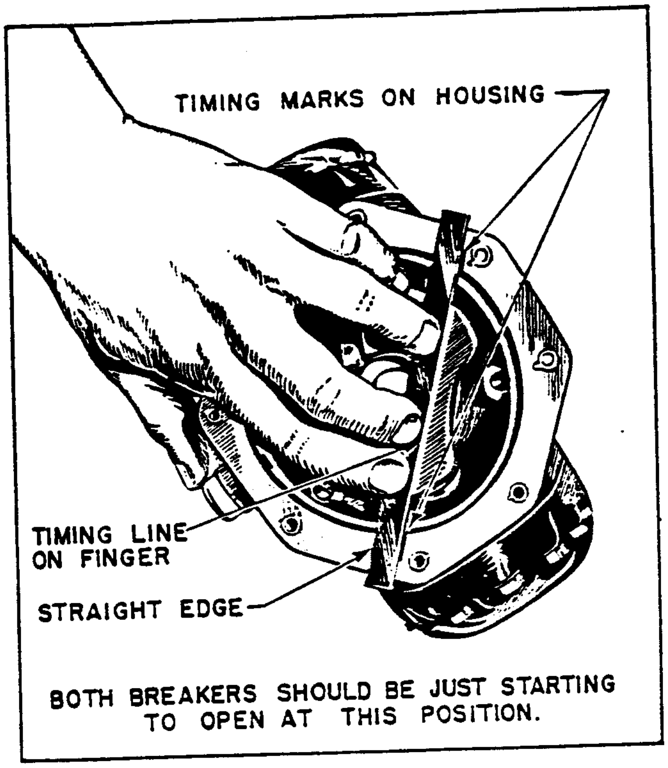


Figure 12. Aligning Mangeto Timing Marks

(e) Remove the cotter pin and, using PWA-3921 Holder and a box wrench, loosen the nut at the splined end of the rotor shaft about two turns (see figure 20); then place the magneto on its mounting pad. Bring the timing mark on the distributor finger into approximate alignment with the timing marks on the magneto housing by turning the distributor finger first one way, then the other.

(f) Remove the magneto and tighten the lock nut finger tight. Replace the magneto on its mounting pad, checking the alignment of the timing marks. Attach the red wires of PWA-2417 Indicator to each of the wires on PWA-3827 Adapter and ground the black wire to the magneto housing. Back off the engine to take out the back-lash in the magneto drive gears; then bring it up in the normal direction of rotation until the timing lights just flash on. Observe the position of the pointer where the points should open, according to the table.

(g) Remove the magneto and if the magneto is in time, tighten and cotter pin the drive shaft nut. If the magneto is not in time, loosen the drive shaft nut about two turns. Correct the timing according to the chart (see figure 21), holding the distributor finger and twisting the magneto splined drive coupling (see figure 22) the exact number of notches clockwise and counterclockwise indicated on the chart. When the correction has been made, tighten and cotter pin the nut. Secure the magneto in place on the magneto drive case. Attach the timing

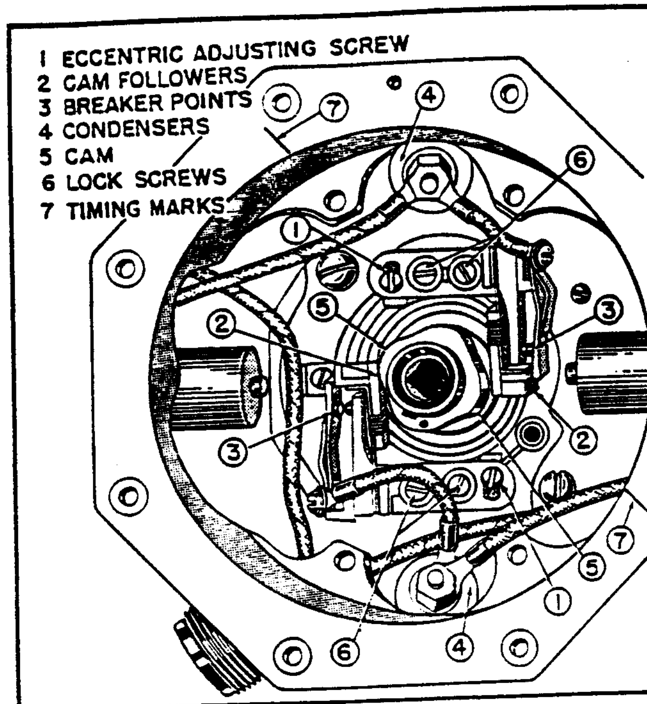


Figure 13. Breaker Compartment

lights and check the timing, making sure that the timing mark on the distributor finger lines up with the marks on the housing.

(8) INSTALLATION.- Secure the magneto to the magneto drive case with four nuts. Insert the prongs of the starter coil and ground wire lead into the magneto and tighten and safety the nut. Install the ignition manifold, the cover gasket and screws, the spark plug leads, and the manifold positioning screw.

NOTE

> Make use of the Joseph Pollok test unit in conducting the following tests. Connection is made to an engine tachometer and to the applicable Joseph Pollok remote control motor block unit. The engine must be in operation at the time the test is conducted.

(9) INDIVIDUAL TEST OF MAGNETOS. (See figure 23.)- With switch in the neutral position, short out the No. 1 magneto in the left bank by pushing upward "L". Note tachometer reading. Continue test with other numbered levers.

(10) BANK TEST AND MAGNETO TEST BY BANKS OF SEVEN.- Turn switch from neutral to "R", thereby shorting right bank. Then push lever No. 1 upward to "L" causing "L" bank No. 1 magneto to short. Continue test with other numbered levers. Proceed in reverse for right bank, that is, turn switch to "L" and push buttons down to short "R" magnetos.

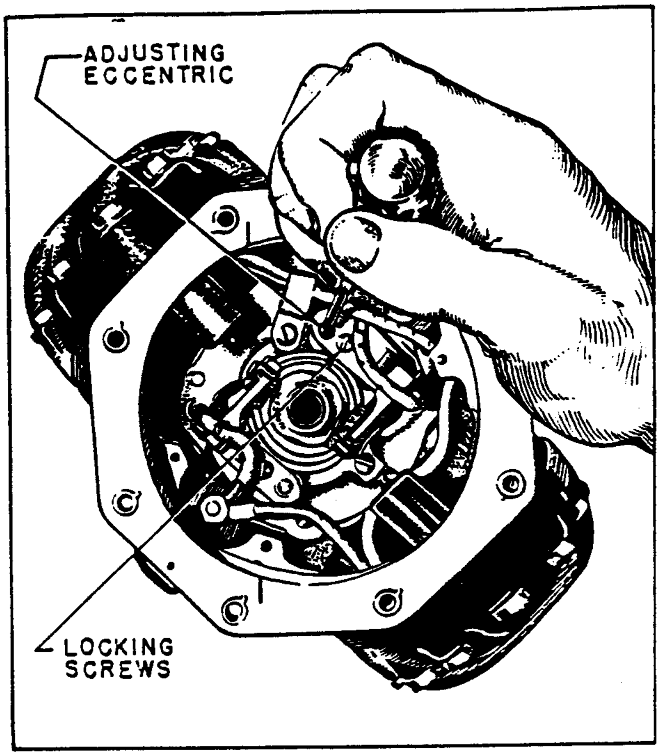


Figure 14. Turning Adjusting Screw

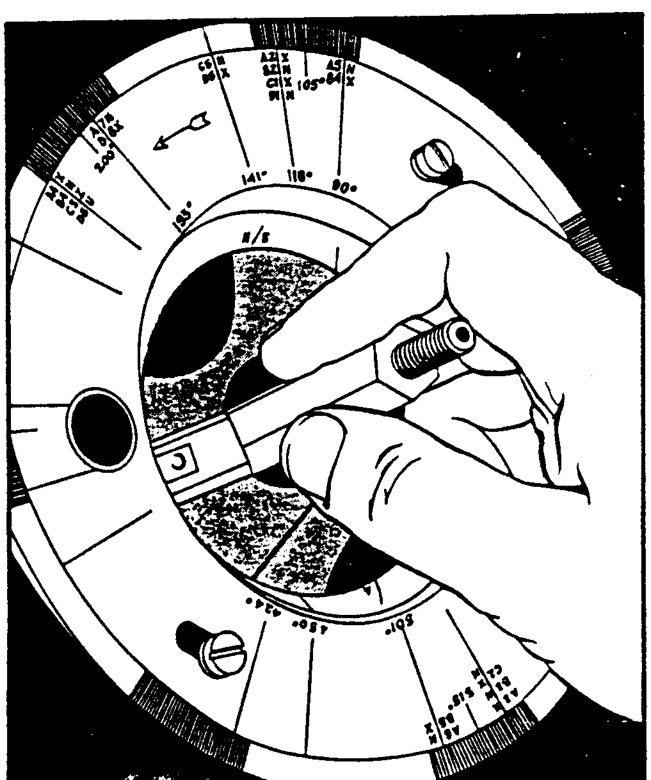


Figure 15. Installing Support Stud

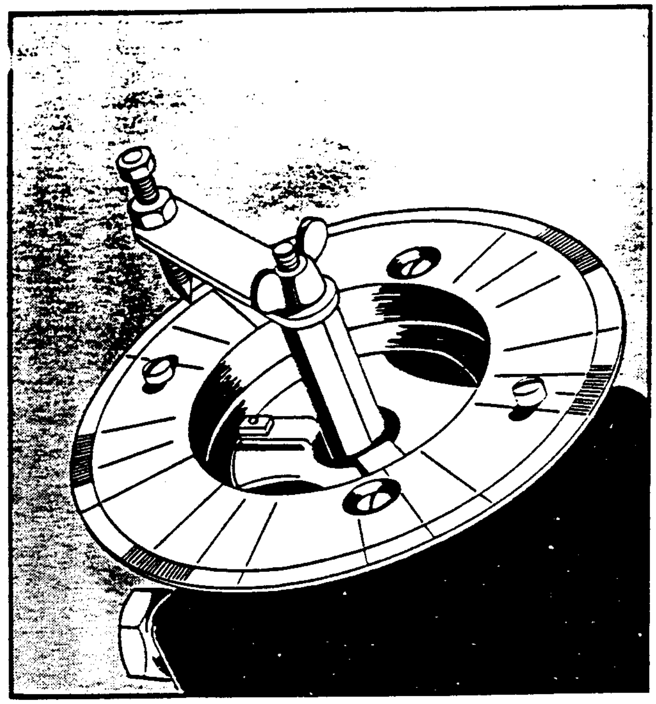


Figure 16. Installing Pointer Arm and Pointer

d. STARTING COIL (INDUCTION VIBRATOR). (See figure 24.)

(1) DESCRIPTION.

(a) The Triple-Unit, Single-Spark Starting Coil consists of three identical induction coil and relay assemblies mounted in a single radio-shielded case. Figure 25 is a view of the case with cover removed, showing the position of the three coil and relay assemblies. This unit provides starting impulses for three magnetos (No. 1, No. 2, and No. 7) during cranking of the engine, at which time the magnetos are not being turned fast enough to produce sparking voltage. This is accomplished by utilizing the electrical energy obtained from the 24-volt storage battery in the airplane. This coil differs from the conventional induction vibrator type in that it delivers only one

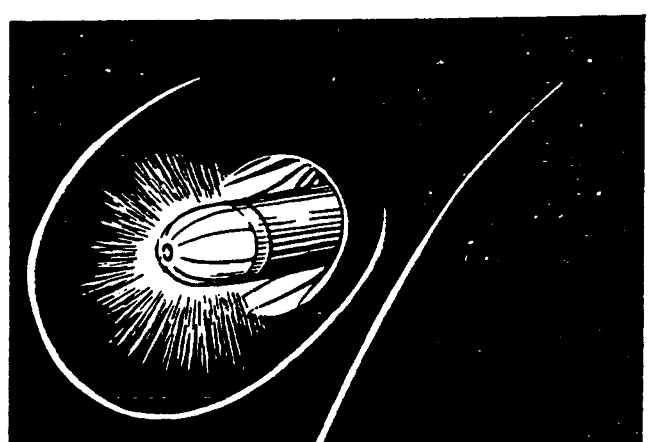


Figure 17. Top Center Indicator

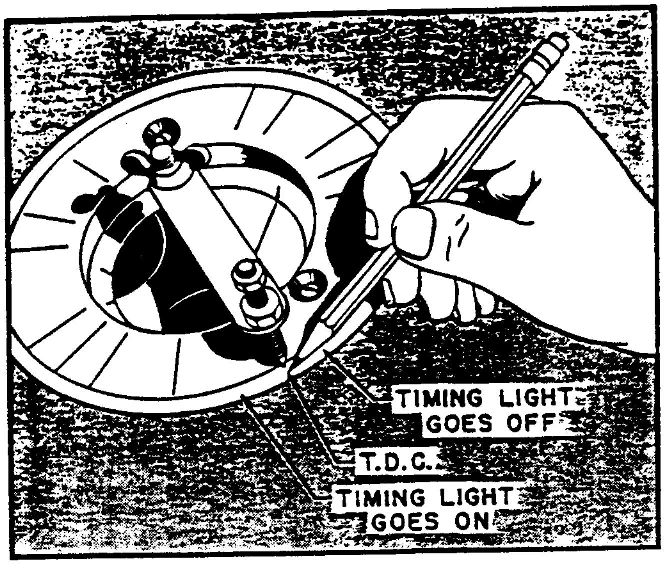


Figure 18. Locating T.D.C. on Timing Plate

spark at each opening of the magneto contact points.

(b) Figures 26 and 27 are simplified diagrams to show the operation of the starting coil assembly. At all times except during starting of the engine the starting coil contacts remain as in figure 26. The armature is up against the contact spring grounding it electrically, and holding it out of contact with the magneto terminal "T"

(c) During cranking of the engine the switch (or relay) "S" is closed, since it works with the starter switch on the engine. This allows battery current to flow through resistor "R" and coil "L" to the contact spring. Thence it goes through the closed contact between the spring and the armature and back to the ground. This flow of current "L" sets up a magnetic field around the coil core, attracting the armature to it.

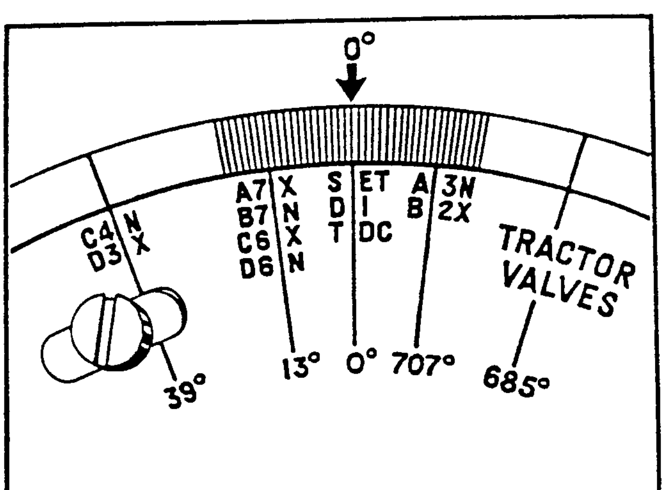


Figure 19. Zero Mark on Timing Plate

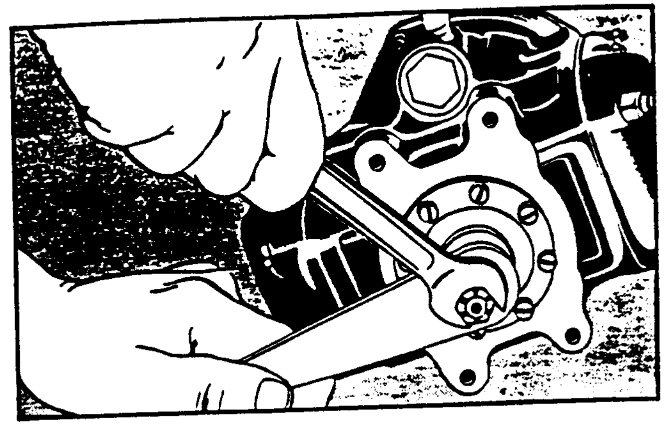


Figure 20. Loosening Rotor Shaft Nut

When the armature moves down, this position allows the contact spring to contact the magneto terminal "T". Then the armature moves still further down and in this position opens the contact between the armature and the contact spring. The position of the contacts when thus energized is shown in figure 27. Current now flows to ground through the closed contacts of the magneto or if the magneto contacts happen to open, through the primary of the magneto coil.

(d) The contacts in the starting coil assembly remain in the relation shown in figure 27 throughout the starting of the engine. These contacts do not vibrate or open as long as the starter is cranking the engine. They serve merely as a relay to connect the starting coil to magneto primary during starting of the engine, and to disconnect it when the starter engaging switch is released.

(e) The coil produces a single, correctly timed spark only once at each opening of the magneto contact in the following manner:

1. With the starting coil energized as shown in figure 27 current flows through resistor "R", coil "L" and thence through the contact points of the magneto to ground. Since the magneto primary is short-circuited by the contact points, there is no current flow in the primary at this time. The resistor "R" limits the current to a safe value so that the coil "L" will not be damaged by heat.

2. When the engine reaches its firing position, the contacts of the magneto open in the normal manner. This opening interrupts the flow of current through the points and causes it to seek a new path through the magneto primary. The voltage of the battery plus the self-induction voltage of the current-carrying coil "L" is sufficient to force a sudden current surge through the magneto primary. This sudden surge of current in the primary is transformed into a high-voltage impulse in the secondary which produces the desired spark for starting the engine.

NUMBER OF DEGREES EARLY		1	2	3	4	5	6	7	8	9	10	11
CORRECT TIMING BY NOTCHING	COUNTER-CLOCKWISE	1	2	2	3	4	5	5	6	7	8	8
	CLOCKWISE	1	2	2	3	4	5	5	6	7	8	8

NUMBER OF DEGREES LATE		1	2	3	4	5	6	7	8	9	10	11
CORRECT TIMING BY NOTCHING	COUNTER-CLOCKWISE	8	7	6	5	5	4	3	2	2	1	0
	CLOCKWISE	9	8	7	6	6	5	4	3	3	2	1

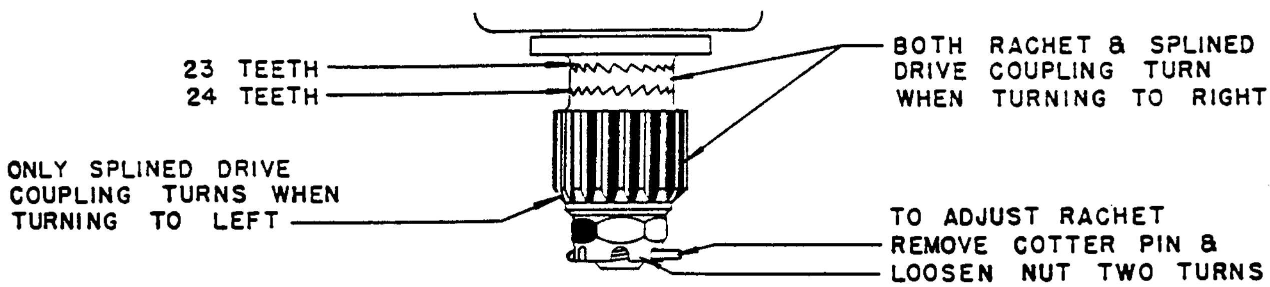


Figure 21. Magneto Timing Correction Chart

(f) The starting coil is completely automatic in operation. It requires no manipulation of extra controls of any kind since it functions in conjunction with the electric starter.

(2) REMOVAL.- Disconnect cables connecting the starter coil with the motor block unit and the engine disconnect box. Remove starter coil from attaching bracket.

(3) OPERATING TEST OF THE COILS.

(a) Disconnect the airplane system electrical wiring which connects to the terminal marked "BAT" on the starting coil.

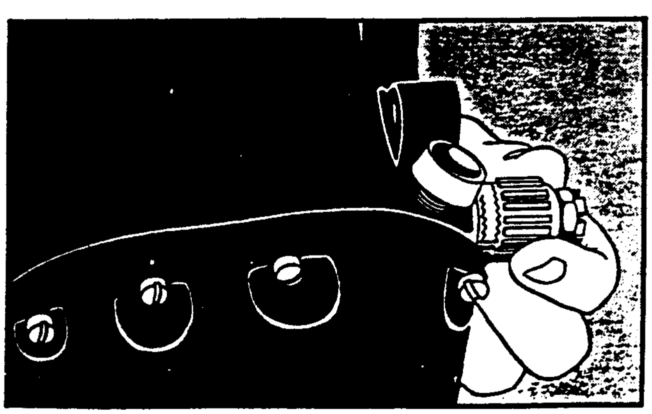


Figure 22. Turning Drive Coupling Ratchet

Connect a length of No. 12 wire to this same terminal. Place all ignition controls in the OFF position. Touch the end of the wire to an auxiliary source of power. Observe the operation of the starting coils. All three armatures should snap down against their own coil assemblies as shown in figure 27. If the coils do not operate in this manner, or if any coil has a tendency to buzz or to vibrate, shut off the power and check for possible causes of trouble.

(b) Do not operate the coils if any of them buzz or vibrate. Buzzing or vibrating means that the starting coil is operating into an open circuit, and that the high voltage developed across the coil under this condition will destroy very quickly the armature and main-spring contacts, ruining the coil.

NOTE

Due to the moderately high current drain of this unit, heat will be developed during its operation. Heat is normal and should not be a cause for alarm. In fact, newly installed units may smoke slightly when first energized. This smoke is due to vaporization of insulation impregnants and thin films of oil on the parts. It will not be harmful ordinarily.

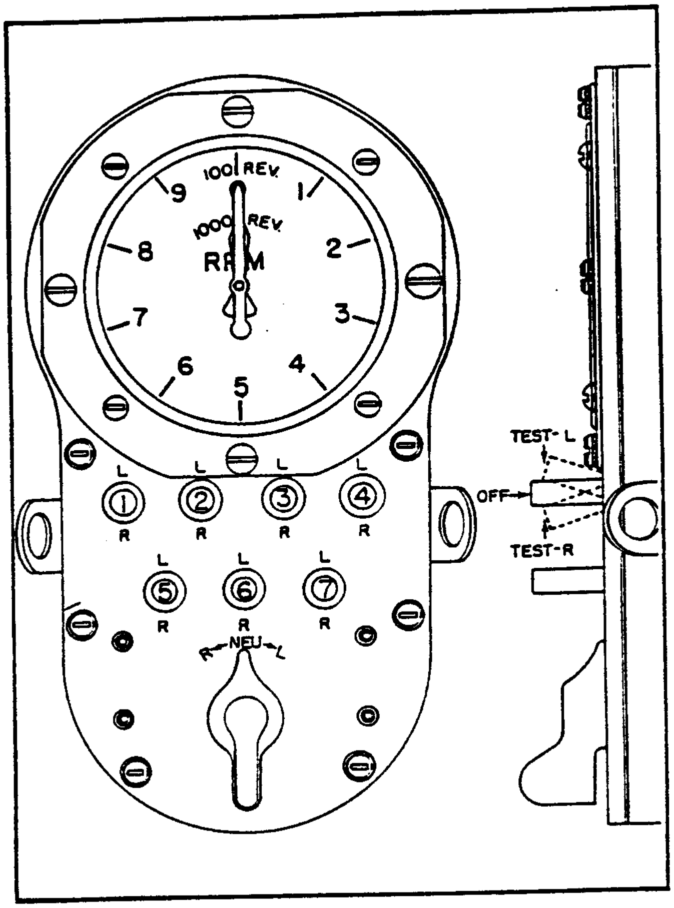


Figure 23. Magneto Test Diagram

(4) MAINTENANCE.

(a) The starting coil does not require lubrication at any time. In fact maintenance procedures in general should be directed toward keeping oil, grease, washdown solvents, or mineral spirit sprays away from the unit as they might interfere with proper functioning of the contacts.

(b) The starting coil should give very little trouble under normal operating conditions. It represents only a small part of the complete starting ignition circuit and is dependent upon several other components for aid in transmitting its output to the engine spark plug. Figure 28 illustrates a continuity diagram of the circuit in which the starting coil operates. Obviously, the starting coil will not function unless all of the other parts are performing properly. For this reason it is suggested that service personnel avoid tampering with the unit until other possible causes of trouble have been checked.

(5) INSTALLATION.- Reverse the REMOVAL procedure, described in paragraph 8 d (2).

e. STARTING COIL AND GROUND WIRE HARNESS. (See figure 29.)

(1) DESCRIPTION.- The ground wire harness is the only common connection between the seven magneto units. The ground wires run from the magneto ground wire connectors to a circular conduit attached to the front end of the crankcase. A trunk line conduit, which extends longitudinally to the rear of the engine between the No. 2 and No. 3 cylinder banks, carries the 14 ground wires from the circular conduit to a cannon plug leading to the engine disconnect box.

(2) REMOVAL.- Loosen the sleeve nut which secures the manifold to the circular harness. Loosen the nut which secures the magneto pressurizing pump pipe at the rear of the manifold and remove the two screws from the manifold clamp. The manifold can now be raised so that the cylinder hold-down nuts near it are accessible.

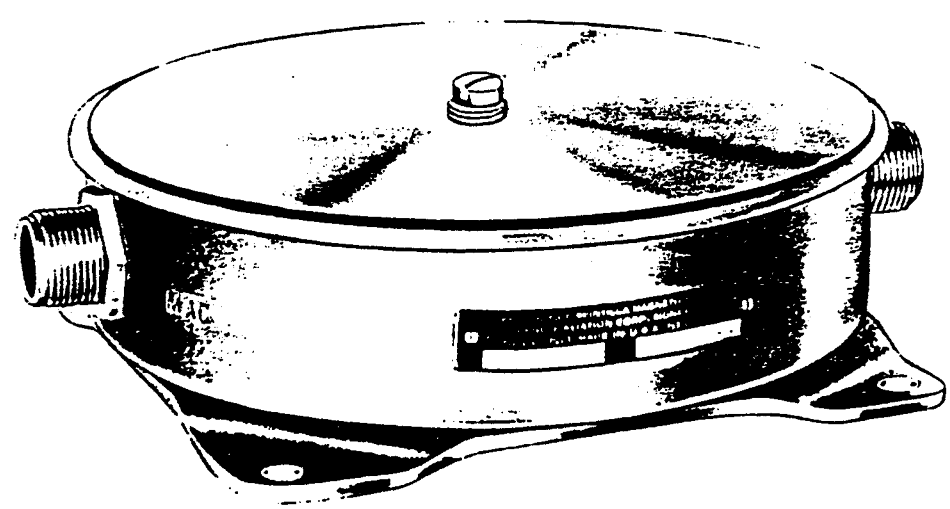


Figure 24. Triple Unit Single Spark Starting Coil

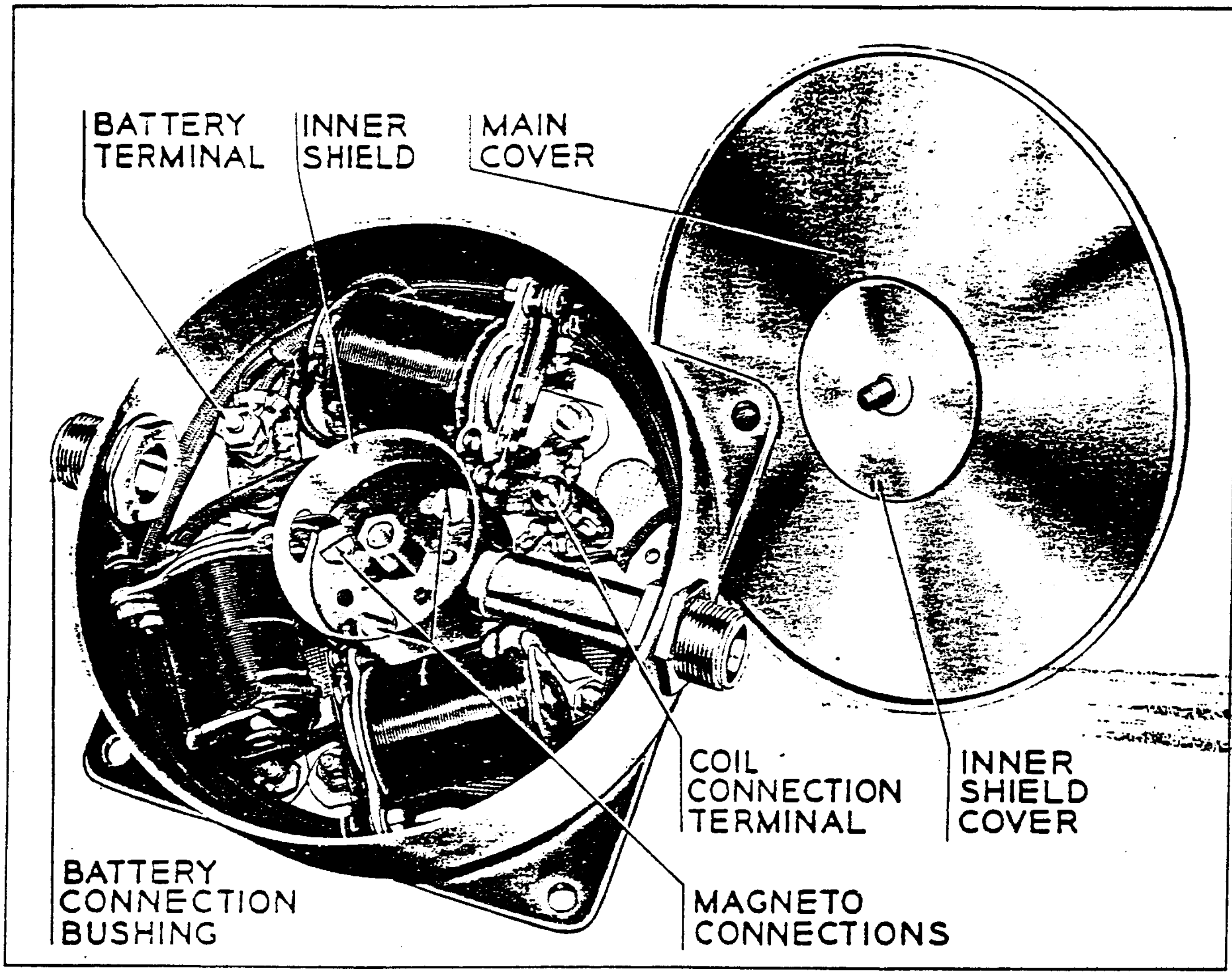


Figure 25. Triple Unit Single Spark Starting Coil-Cover Removed

(3) MAINTENANCE.- Replace damaged harness, or harness proved faulty by a continuity check.

(4) INSTALLATION.- Secure the rear of the harness with the screws and clamp. Tighten the magneto pressurizing pump connection and the nut which secures the manifold to the circular harness.

f. MAGNETO PRESSURIZING EQUIPMENT. (See figure 30.)

(1) DESCRIPTION.- The magnetos are pressurized to prevent the flashover which tends to occur in unpressurized ignition systems operating in the rarefied atmosphere of high altitudes. The rotary type pump that pressurizes the magnetos is mounted on the upper left side of the accessory drive case and is driven by the magneto pump drive shaft. Air is drawn into the pump through a screened intake, pressurized by the rotor vanes, and forced into a tubing assembly which joins the pump outlet to a connection at the rear end of the ground wire harness. The air tight conduits of the ground wire harness carry the pressurized air into the magneto through holes in the ground wire connectors. By permitting a predetermined amount of air leakage, the altitude valve in each magneto housing maintains a delicate balance between the air pressure for flashover prevention and the airflow necessary for magneto ventilation.

(2) REMOVAL.- Disconnect tubing assembly. Remove four nuts which secure pump to accessory case.

(3) INSTALLATION.- Reverse REMOVAL procedure, paragraph 8 f (2), immediately above.

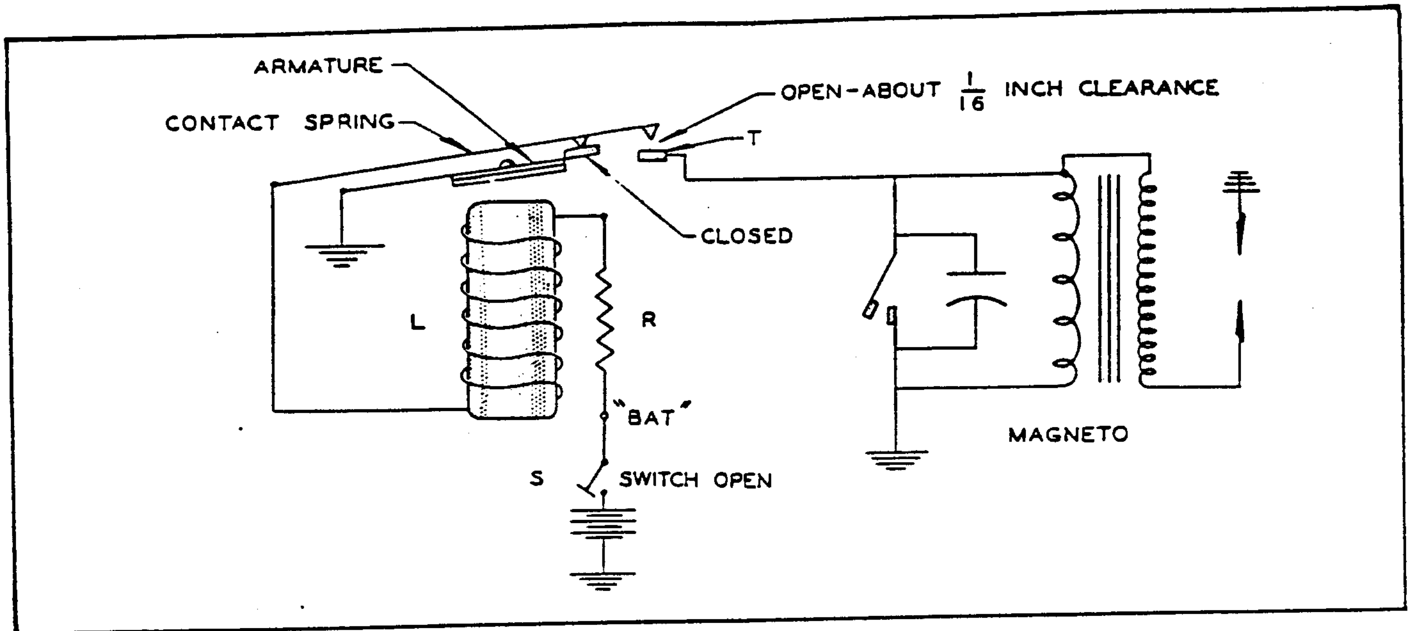


Figure 26 Starting Coil At Rest

g. IGNITION HARNESS. (See figure 29.)

(1) DESCRIPTION.- The distributor block end of each of the seven high tension cable assemblies is attached to the side of the magneto which opens into the distributor rotor compartment. Each distributor block carries eight electrodes, a pair of electrodes for the two spark plugs in each of the four cylinders fired by the magneto to which the spark plug cable assembly is attached. The cables from the electrodes to the spark plugs are housed in a metallic conduit filled with an insulating moisture proof sealing compound.

(2) REMOVAL.- Disconnect the leads from the spark plugs, remove the manifold positioning screws; then lift on the cable assemblies, being careful not to damage the magnetos or the distributor block.

(3) MAINTENANCE.- Replace damaged ignition harness or harness in which excessive leakage, as revealed by a continuity or high voltage test, occurs. Refer to paragraph 10, Service Inspection, Ignition System.

(4) INSTALLATION OF IGNITION CABLE ASSEMBLIES.- The seven ignition cable assemblies are identical and interchangeable. Place the assemblies in position, and attach each distributor cover with the screws and lock washers. Install and safety the manifold positioning screws.

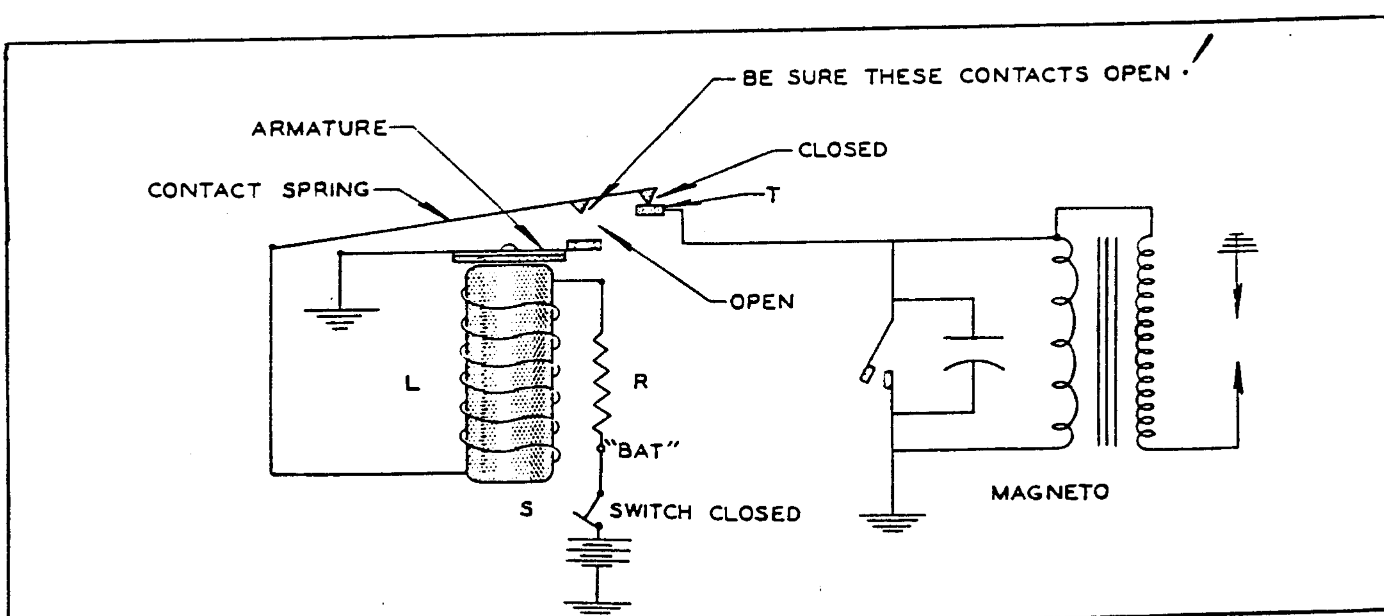


Figure 27. Starting Coil Energized

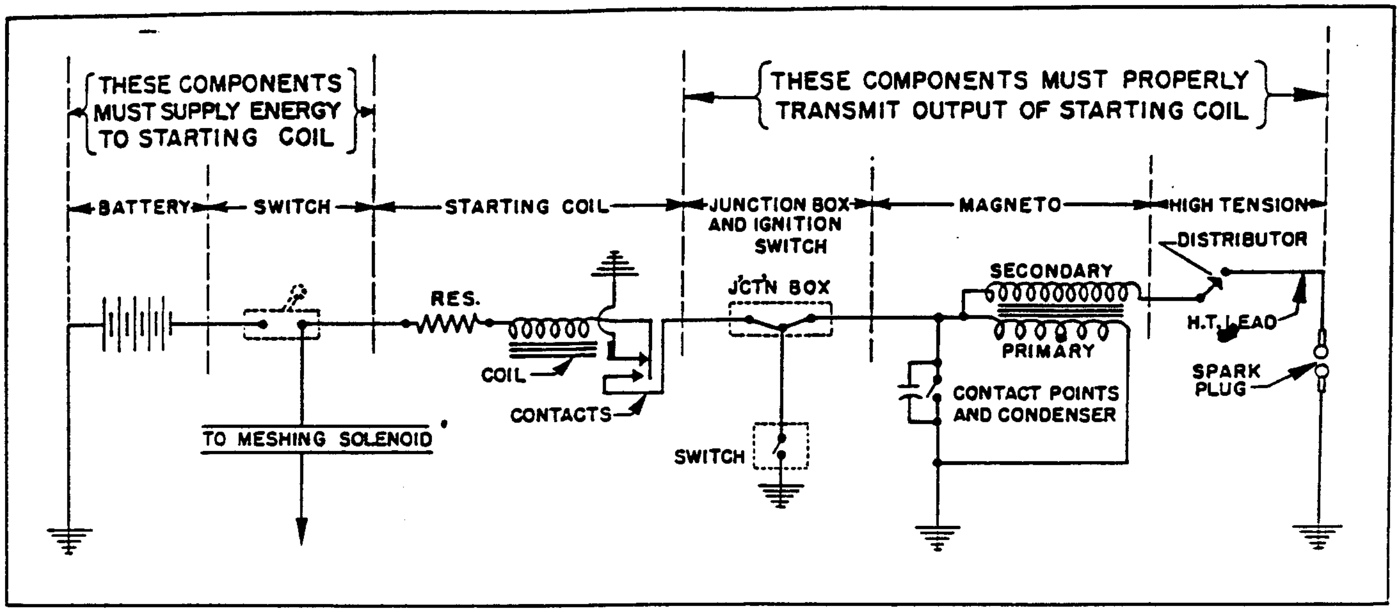


Figure 28. Continuity Diagram of Starting Ignition Circuit

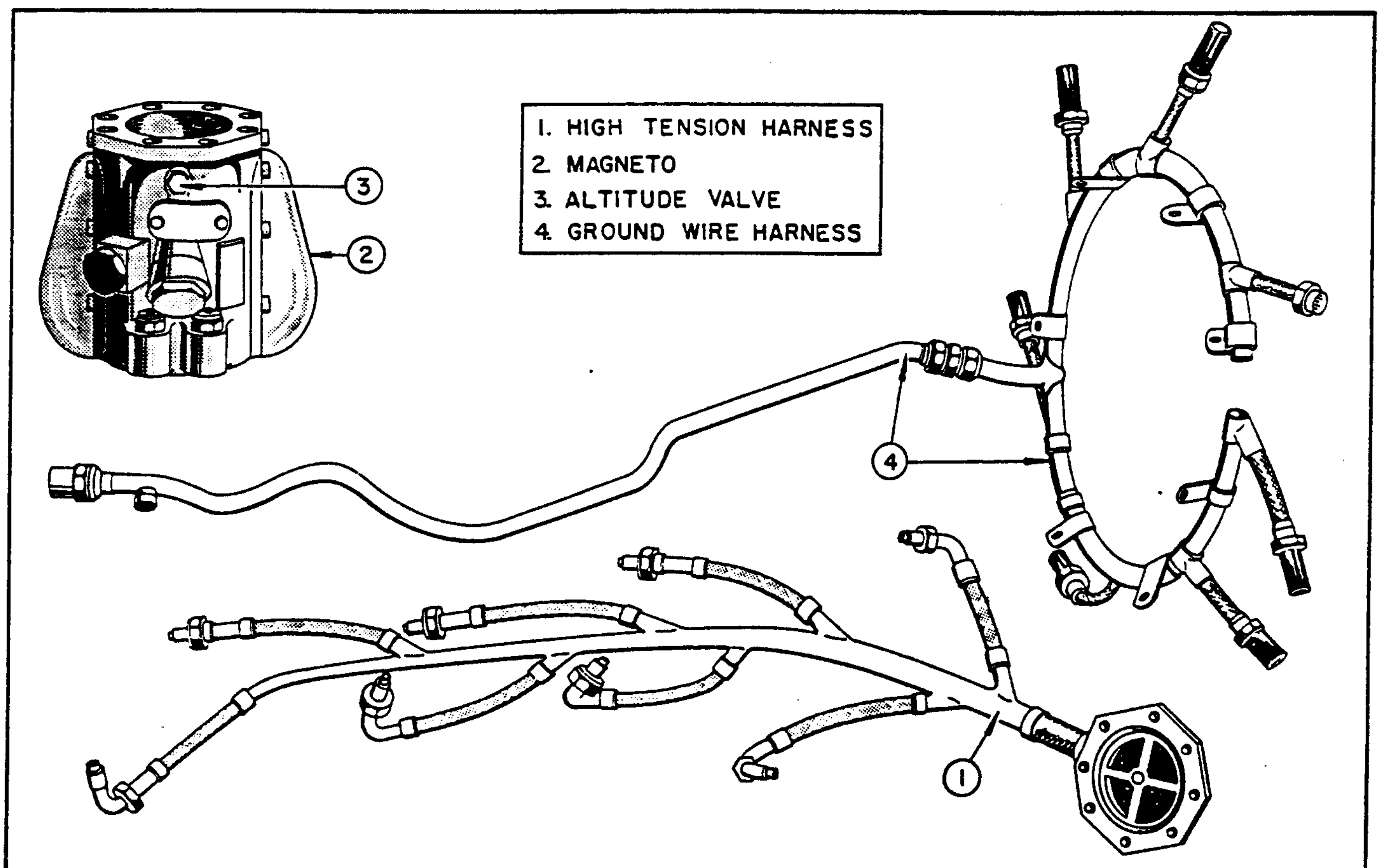


Figure 29. Magneto, Ignition Harness, and Starter Coil

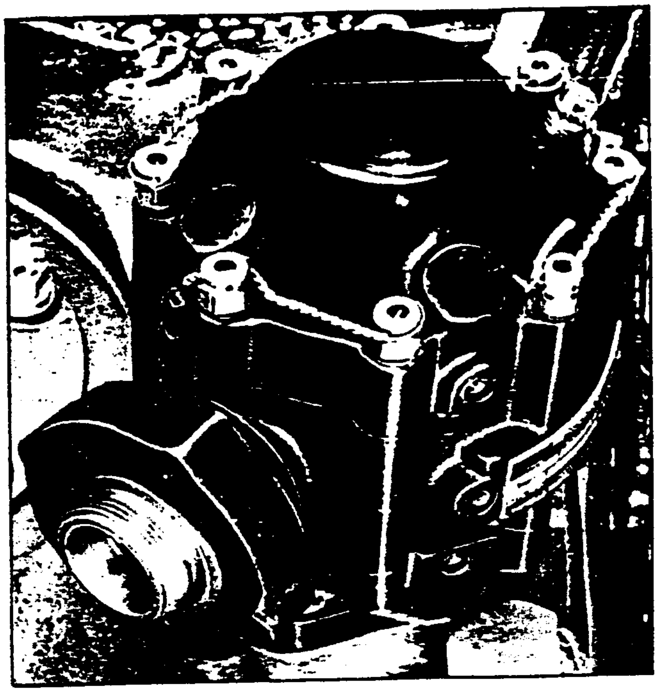


Figure 30. Magneto Pressurizing Pump

h. SPARK PLUGS, AND SPARK PLUG CONNECTORS.

(1) DESCRIPTION.- Two type BG, model RB-19-R, ceramic spark plugs are installed in each of the 28 cylinders of the R-4360 engines. They are connected to the appropriate magneto and distributor assembly by means of individual high tension cables.

(2) REMOVAL.- Unscrew the spark plug lead nuts with PWA-3315 Wrench, holding the lead firmly so that damage to the wires or leads will not occur. Withdraw the connector from each plug. Unscrew the spring and remove the spring and ceramic connector. Install a protector cap over each lead connector. Remove the spark plugs with PWA-3254 Wrench and place them in racks to avoid possible damage.

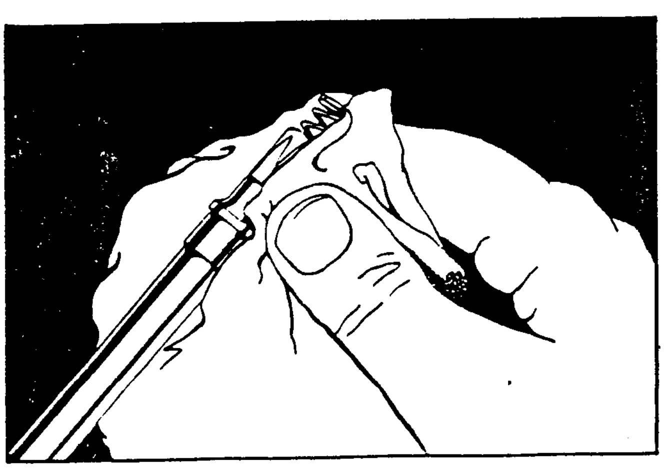


Figure 31. Cleaning Lead Connector

Figure 32. Tightening Lead Nut

(3) MAINTENANCE AND ADJUSTMENT.

CAUTION

Great care should be taken when cleaning ceramic spark plugs because rough handling or dropping may crack the ceramic, rendering them useless.

Wash the spark plugs in unleaded gasoline then dry them thoroughly. Inspect the threads of the plug for nicks, burrs, or other imperfections. To remove defects, run an 18-1.5 mm die by hand over imperfect threads. If this does not remove defects, reject the plug. Do not attempt disassembly. Clean the spark plug insert with a small, stiff fiber brush.

NOTE

The spark plug electrode gap should measure .014 (.355 mm) of an inch.

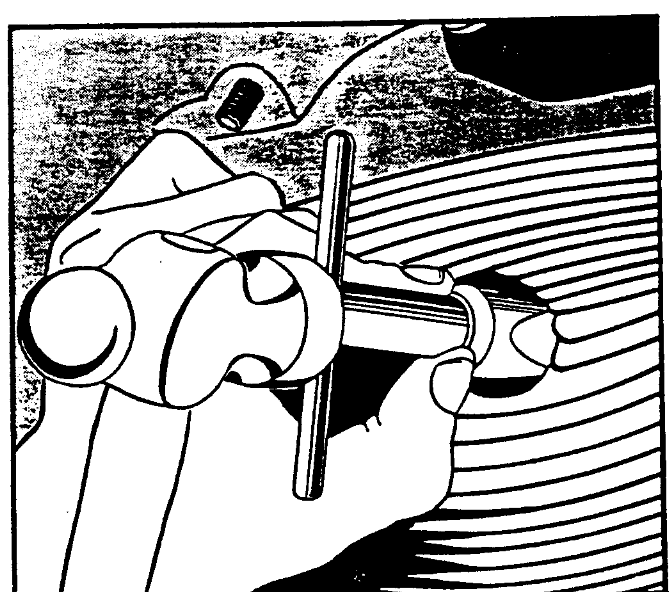


Figure 33. Installing Extractor

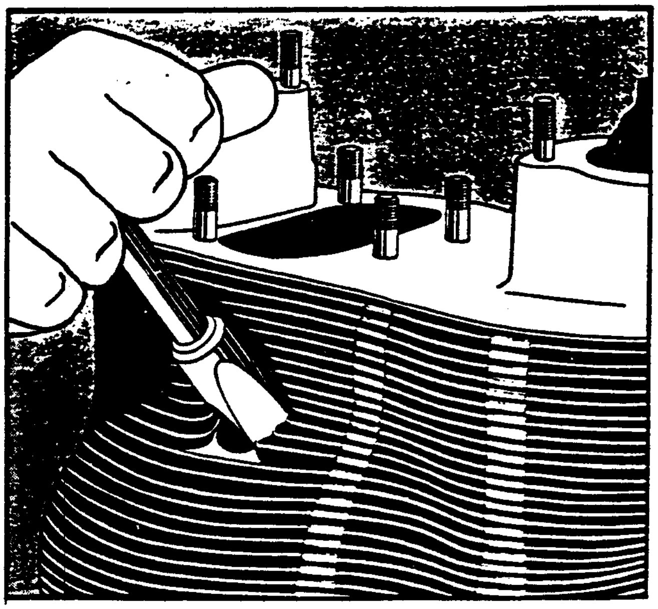


Figure 34. Removing Insert

(4) INSTALLATION.

(a) Wash the spark plug in unleaded gasoline; then dry it thoroughly. Place a serviceable solid copper gasket on the spark plug and apply Champion No. 119 Graphite base anti-seize compound to the first two threads of the plug.

CAUTION

It is of the utmost importance that graphite compounds be handled carefully. Allow none to get on the connectors or the spark plug electrodes.

(b) Screw the plug into the cylinder with finger pressure only until it seats on its gasket. Tighten the plug to a torque of 300 to 360 pounds, using PWA-3254 Wrench.

(c) Make certain that the inside of each spark plug barrel is dry. Clean the spark plug connector (see figure 31) and apply a light coating of Dow Corning No. 4

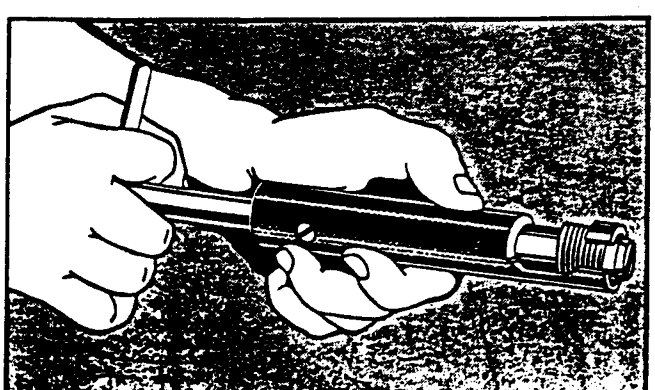


Figure 35. Engaging Coil in Sleeve

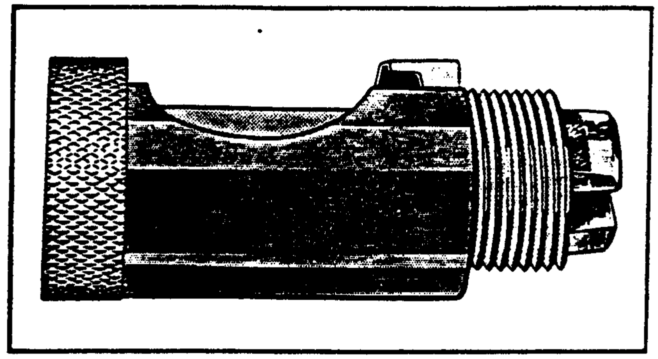


Figure 36. Coil Wound Tightly

compound with a brush to the connectors. Do not apply the compound with the fingers because the moisture from the hands tends to make the compound ineffective. Place the ceramic connector and spring over the lead wire threaded extension and screw the connector spring onto the threads of the extension, thereby securing the ceramic connector to the lead.

(d) Install lead connector and wipe off any compound which may have been deposited. on the threads of the plug barrel. The spark plug connectors must be perfectly clean and dry when they are installed. Tighten the lead nut finger tight; then tighten it one-half turn more with PWA-3315 Wrench. (See figure 31.)

i. SPARK PLUG HELI-COIL INSERT.

(1) DESCRIPTION.- The heli-coil insert resembles a compact coil spring. It is placed between the threads of the spark plug and the threads of the cylinder in place of the bronze bushing often used. It functions to prevent damage to the aluminum cylinder in instances where excessive torque or improper installation occurs.

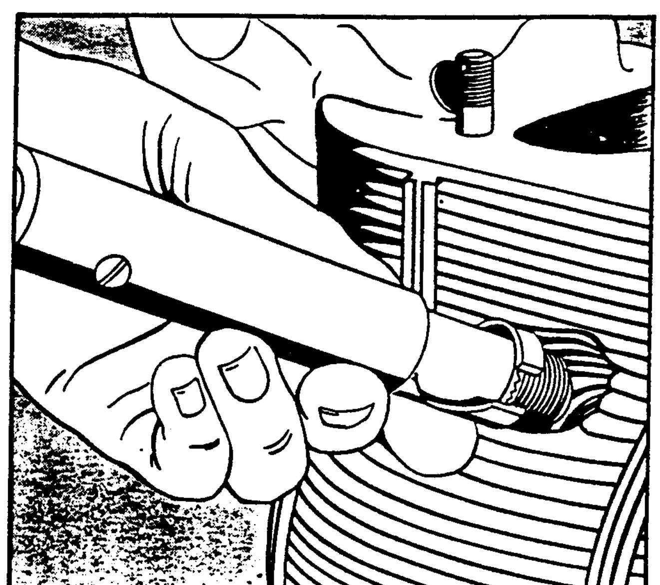


Figure 37. Installing Coil in Cylinder

(2) REMOVAL.- Insert PWA-4102 Extractor in the spark plug hole and apply a light blow to the end of it to imbed the knife edges in the insert. (See figure 33.) Turn the extractor in a counterclockwise direction to back the insert out of the head. (See figure 34.)

(3) CLEANING HELI-COIL SPARK PLUG INSERTS.- A wire brush may be used in conjunction with a power tool to facilitate the cleaning of Heli-coil spark plug inserts. However, the following precautions should be taken: The cleaning brush should be of a type which does not disintegrate with use, so that no bristles will fall into the combustion chambers. The diameter of the brush and the technique applied in the cleaning operation should be such as to preclude the removal of material from the coil proper or from the cylinder head surrounding the insert. Extreme care should be taken to prevent damaging of the spark plug gasket seating surface, since removing material from this location could cause combustion leakage with subsequent damage to the cylinder head. Ordinarily only a light application of a revolving brush will be required to clean an insert completely.

(4) INSTALLATION.

(a) Before installing a new Heli-coil insert, make certain that: 1. The face of the spark plug hole is free from burrs. 2. The threads of the spark plug hole are completely clean and dry. 3. The new insert is perfectly clean and dry.

NOTE

Use no oil on the insert or the tapered threads when installing the insert.

(b) Using PWA-3001 Driver, withdraw the mandrel beyond the recessed section of the sleeve; then slip the insert into the recess, tang forward, and advance the mandrel until the slot engages the tang of the coil. Press forward slightly on the handle of the mandrel and turn it clockwise to engage the coil in the threaded end of the sleeve. (See figure 35.) While holding the sleeve, continue turning the handle of the mandrel until the serrated portion of the coil disappears into the first thread of the sleeve. The coil should be wound tightly around the mandrel, with each coil touching the adjacent one. (See figure 36.)

(c) Start the insert into the spark plug hole by turning the entire inserting tool over the hole until the first coil picks up the first thread. (See figure 37.) Turn the coil into the hole until the face of the sleeve is approximately one-sixteenth of an inch from the face of the hole. Then holding the sleeve stationary, continue turning the coil in with the mandrel until the coil is free of the threaded portion of the sleeve. Continue turning the coil in a clockwise direction until the serrated end of the coil has entered from 1/2 to 3/4 of a turn into

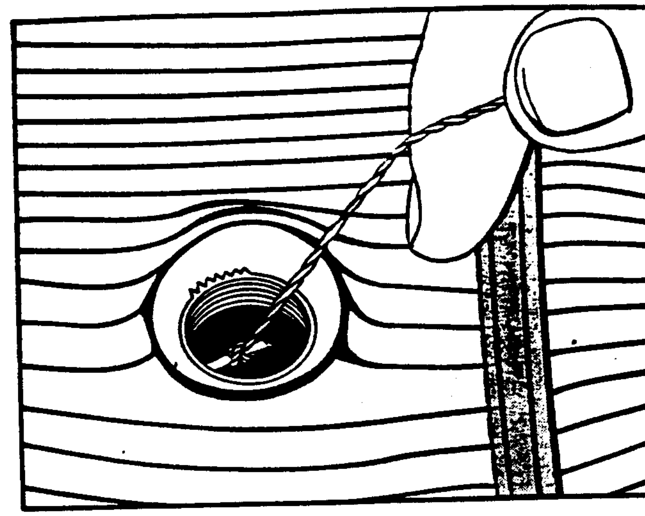


Figure 38. Removing Tang

the top thread of the hole. Remove the inserting tool and check the coil position at the top. In order to effect satisfactory staking, the serrated end of the coil must be held closely to the above specified 1/2 to 3/4 of a turn into the top thread of the hole. If, upon inspection, the end of the coil is not at least 1/2 of one turn into the top thread of the hole, the tool can be reinserted and the coil driven further.

CAUTION

Do not put excessive pressure on the inserting operation, as this may prematurely break off the tang of the coil. In reinserting the tool to drive the coil in farther, be careful when engaging the tang in the slot of the tool in order to avoid pushing the bottom coil of the insert out of its thread. Do not try to back a coil out by using the inserting tool; this will probably break off the tang.

(d) Slip a noose of string over the tang and draw the noose taut. (See figure 38.) Using a pair of longnose pliers, grasp the tang near the notch and break off the tang, being careful not to lift the coil from the thread.

(e) Screw PWA-3367 Primary Expander into the insert as far as it will go. Set the adjustable nut and tap the head of the plunger until the insert coil is firmly seated in the tapered threads of the spark hole. Draw out the plunger by turning down the adjustable nut; then back out the expanding tool.

(f) Insert PWA-3944 Gage into the insert for a check of the inside diameter. If the inside diameter is too small, use PWA-3367 Primary Expander again. If necessary, the expander may be reset for additional expansion by moving the position of the fixed nut slightly toward the heads of the plunger. If the inside diameter is too large (this is likely to occur), the insert must be removed and a new insert installed.

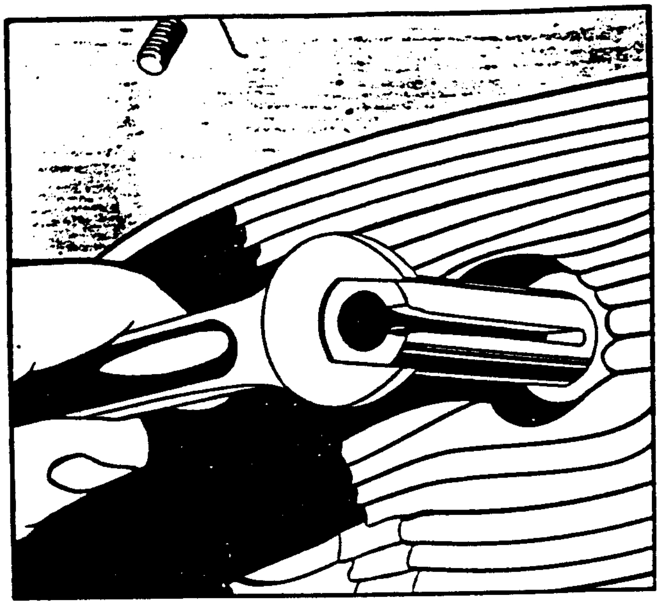


Figure 39. Installing Expander

(g) Remove the plunger from the offset expander and insert the offset expander into the coil insert.

NOTE

> FWA-3420 Expander is a combination of an offset expanding and a staking tool. The offset expanding part is used to offset and embed the points on the outside of the top coil of the insert into the side of the bushing. The staking part is used to stake each serration and to stake the end of the top coil.

Engage the top coil of the insert in the short, threaded portion of the tool and turn clockwise until the end of the coil hits the stop on the tool. Make certain that the end of the coil is up firmly against the stop on the tool. (See figure 39.) Insert the plunger

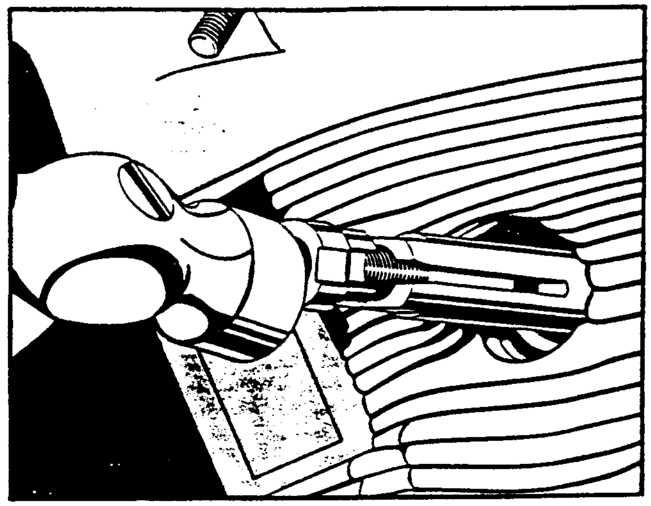


Figure 41. Expanding Insert

and set the adjustable nut on the plunger's spindle. The slot in the adjustable nut should line up with the slot in the fixed nut. (See figure 40.) Tap the head of the plunger (see figure 41) until the adjustable nut contacts the top of the offset expander. This operation embeds the points of the last coil into the side of the hole. Leave the tool in this position until the next operation is completed.

(h) Slide the staking sleeve over the offset expander (see figure 42) and tap it with a hammer sufficiently hard to bottom the sleeve on the edge of the spark plug hole. (See figure 43.) This operation stakes the serrations on the top coil, and stakes the end of the top coil. Make certain that the coil is fully staked, because once the offset expander is removed, it is not possible to index the staking sleeve for restaking. Remove the staking sleeve and draw out the plunger by turning down the adjustable nut (see figure 44); then remove the offset expander from the spark plug hole. Never try to remove the expander without first withdrawing the plunger.

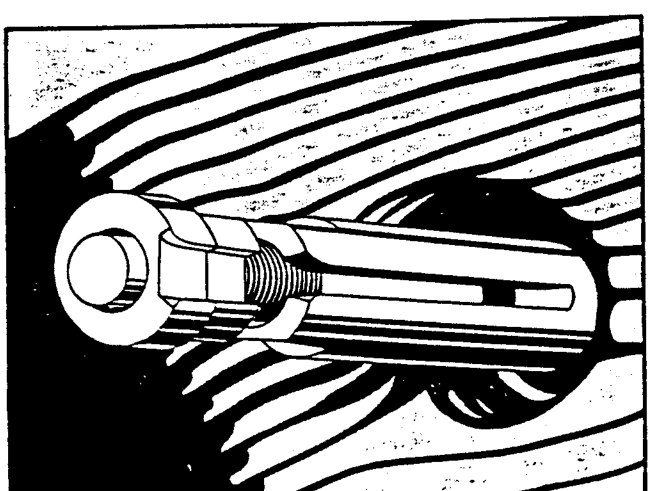


Figure 40. Slots in Nuts Lined Up

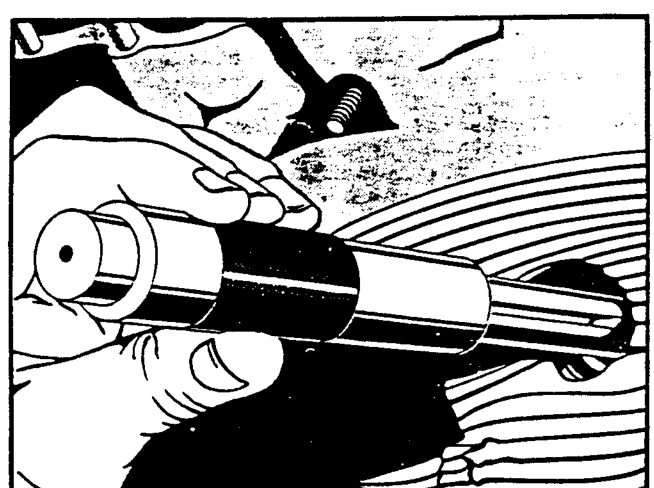


Figure 42. Installing Staking Sleeve

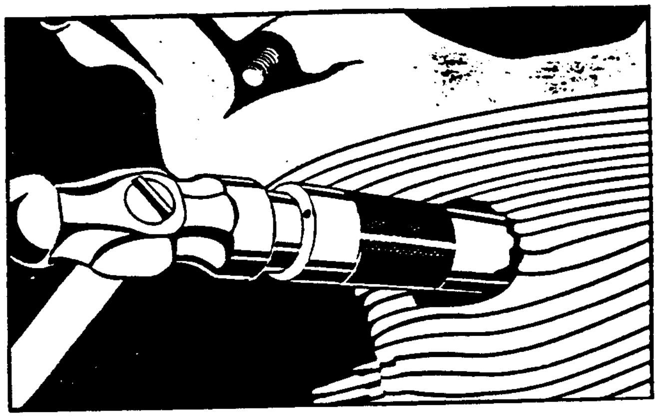


Figure 43. Staking Insert in Place

(l) Again check the inside diameter of the spark plug hole with PWA-3944 Gage.

j. IGNITION CONTROLS.- The ignition is normally controlled by switches on the engineer's upper electrical panel, but may be switched off in an emergency with an emergency crash switch on the pilot's pedestal, which is normally left in the "ON" position. The ignition switches for all engines are contained in a switch unit on the engineer's panel and permit a selective check of either the right or left plugs on an engine in addition to their function as an "ON" and "OFF" switch. The engine starters are controlled by switches mounted on the engineer's upper electrical panel. A starter coil is wired in parallel with the starter control circuit for each engine and operates during the engagement of the starter, furnishing a booster spark to magnetos #1, #2, and #7. The ignition control circuit operates on 28V. d.c. which is picked up from the d.c. bus on the pilot's pedestal panel and wired through a push type circuit breaker to the emergency crash switch located on the same panel. The switch positions are "ON" when the pull handle is in, and "OFF" when the handle is pulled out. From the "ON" position of the emergency crash switch the circuit is wired thru the engineer's junction panel to the common terminal of each magneto control switch of the ignition switch unit which is mounted on the

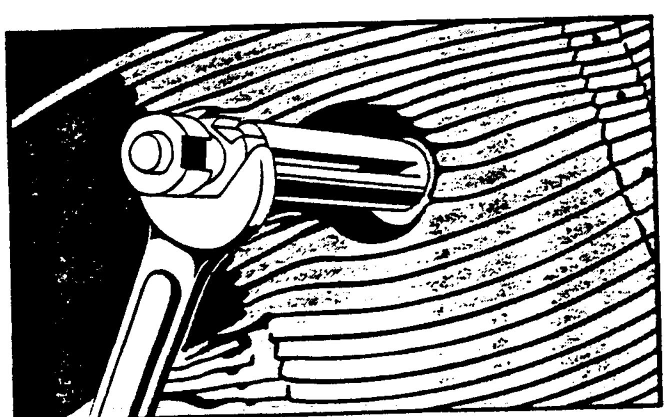


Figure 44. Removing Plunger

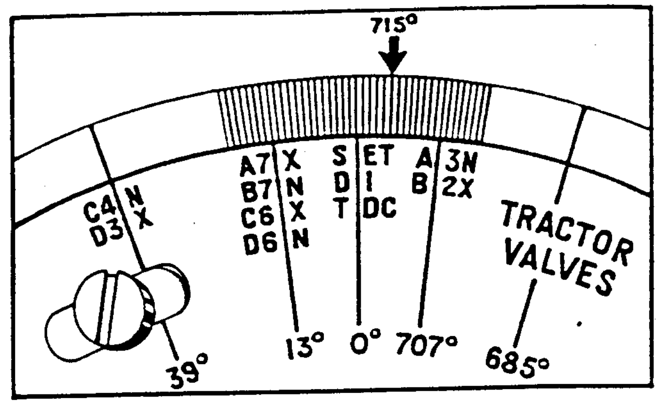


Figure 45. 715 Degree Mark on Plate

engineer's upper electrical panel. The four positions of these switches are marked "OFF," "L," "R," and "BOTH." The circuits from the "BOTH," "L," and "R" positions of a magneto control switch pass through the engineer's junction panel and the engine disconnect box to the motor block unit. The motor block unit, depending on the circuit selected by the magneto control switch, grounds one or the other of the two circuits to all the magnetos; when in the "BOTH" position neither circuit is grounded.

k. SPARK ADVANCE.

(1) DESCRIPTION.- A fixed spark advance o. 20 degrees is provided for the R-4360-17 and R-4360-21 engines.

(a) The four spark advance cylinders, each of which houses a spring loaded piston, a numbered right to left from 1 through 4. Spec oil transfer studs secure the pairs of cylinde to the rear face of the magneto drive case web The spark advance gear, which regulates the ti ing of the magneto drive system, has two arms, each of which is attached to a pair of pistons by two piston links.

(b) When the engine is not running, the is no pressure oil in the cylinder and the spa advance gear will be in the starting (5 degree spark advance position. After the engine star high pressure oil from the magneto drive case diverted to the No. 1 and No. 4 cylinders thru their special studs. The pressure oil, counte

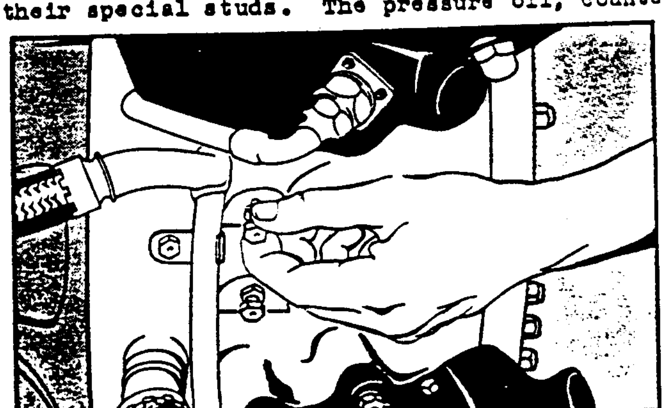


Figure 46. Loosening Stop (Adjust No. 2 Magneto)

acting the spring pressure, forces the pistons to turn the spark advance gear to the normal (20 degrees) spark advance position. When the oil drains from the cylinders after the engine stops, the No. 1 and No. 4 spring loaded pistons return the spark advance gear to the 5 degree spark advance position.

(c) The travel of each piston outward from its cylinder is limited by the inner end of an adjustable stop which is supported by a boss integral with the web of the case. The stops for No. 1 and No. 4 pistons are so adjusted that they prevent any movement of these pistons beyond the 20 degree spark advance position.

(2) SPARK ADVANCE ADJUSTMENT.

(a) Remove the distributor cover of No. 1 magneto and install the timing plate of PWA-3414 Fixture on the magneto housing. Unscrew the distributor finger retaining screw and install the pointer support stud detail of the fixture. Place the pointer on the stud and secure the assembly with the wing nut. Set the pointer at zero when the piston of D1 cylinder is at top center of its compression stroke, after the engine has been backed off 1/4 turn and advanced to this point in the normal direction of rotation. (Refer to paragraph 8 c (7).)

(b) Remove the ground connection from No. 1 magneto and install PWA-3827 Adapter. Clip the red wires of PWA-2417 Indicator to the adapter wires and ground the black wire to the magneto housing. Turn the indicator switch on. Rotate the engine opposite its normal direction of rotation about a quarter turn, then bring it up in the normal direction until the pointer is on the 715 degree mark on the timing plate (see figure 45). The indicator lights should just flash on when the pointer reaches this position. If they do not, No. 1 magneto is not correctly timed to the engine and it is recommended that the timing of all magnetos to the engine be checked and adjusted, if necessary. (Refer to paragraph 8 c (7).)

(c) Remove the plug from the magneto drive case between No. 1 and No. 7 magnetos, install PWA-2907 Adapter, and attach an air pressure hose to the adapter.

(d) Back off the engine at least a quarter turn; then bring it up in the normal direction of rotation until the fixture pointer is at the 700 degree mark on the timing plate. Under operating conditions, it will be at this point (20 degrees in advance of TDC) that the No. 1 magneto will fire the D1 cylinder. Loosen the lock nuts and back off the spark advance stop adjacent to No. 2 magneto (see figure 46) and the stop adjacent to No. 5 magneto (see figure 47). Apply air pressure of 60 to 100 pounds per square inch and open the adapter valve. Observe that the pointer on No. 1 magneto advances from the 700 degree mark on the timing plate toward TDC and passes the 715 degree mark (5 degrees BTC) by a few degrees. This will insure that sufficient air pressure is being applied and that the adapter has been correctly inserted, in the downward position, to direct the air pressure into the spark advance pressure passages. Turn off the air pressure. Turn in the 20 degree spark advance stops adjacent to No. 2 and No. 5 magnetos as far as they will go, and then back them out two turns each. Turn on the air pressure, and check the new position of the timing pointer. Turn off the air pressure. Make a further equal outward adjustment on each of the stops; then continue the process to approach the 715 pointer indication with the air pressure on and a simultaneous indication by the timing lights that the breaker points are opening. Lock these stops in place. (See figure 48.)

NOTE

If the stops are turned out too far, it will be necessary to turn them in beyond the desired setting point in readjusting them correctly. The air pressure must be turned off, and the engine must be backed off and then brought up in the normal direction of rotation once more to the original 700 degree mark on the timing plate. This will eliminate the possibility that backlash or internal linkage movements will upset the adjustment.

(e) Check the 20 degree spark advance by turning off the air pressure and backing off the engine about a quarter turn. Bring the engine up in the normal direction until the pointer is on the 700 degree mark on the plate. Turn on the air pressure, and if the 20 degree setting is correct, both indicator lights will flash on at the instant the pointer stops at the 715 degree mark. Turn off the air pressure and remove the hose and adapter.

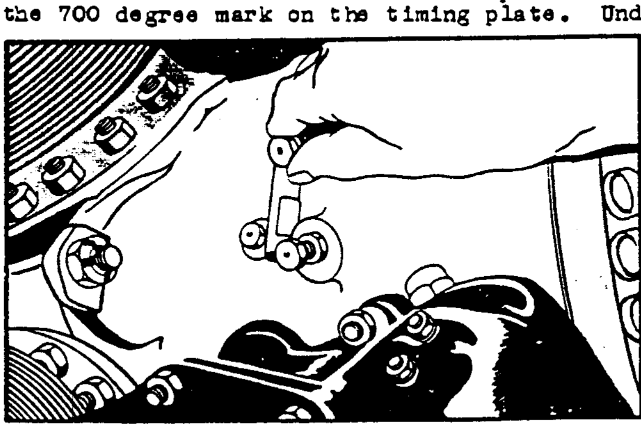


Figure 47. Loosening Stop (Adjust No. 5 Magneto)

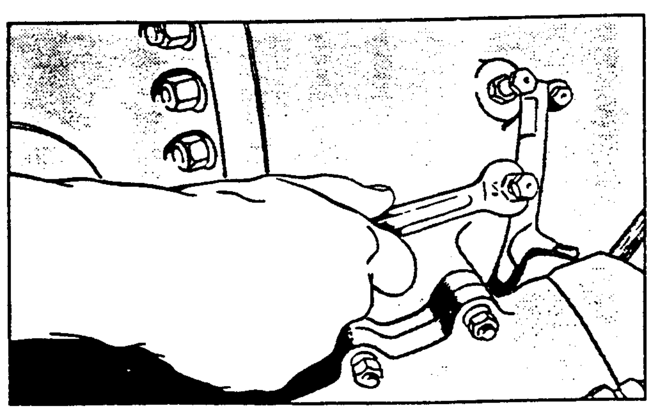


Figure 48. Locking Stop Nut

9. ENGINE CONTROLS

9. ENGINE CONTROLS. (See figures 1 thru 3 inclusive.)

a. GENERAL.- The engine controls, proper, for the XB-35 airplane, consist of the throttle, mixture, and priming systems. Other allied controls which affect engine operation in a secondary manner are discussed in paragraphs 8, 10, 13, and 14 b. The throttle and mixture control systems are linked mechanically to the carburetor; the primer, however, is electrically actuated.

b. TROUBLE SHOOTING.- Refer to Section IV, paragraph 7 b (2).

c. THROTTLE. (See figures 1, 4, and 6.)

(1) DESCRIPTION.- Two sets of throttle levers are linked to the carburetor as illustrated in figures 1 and 4. One set is located at the flight engineer's station and the other set between the pilot and copilot. Since the systems are mutually inter-connected any movement of one lever will produce a similar movement in the corresponding lever. Micro switches (further described in paragraph 5) attached to the throttle quadrant, cause a horn to blow whenever the throttles are retarded below cruising rpm and all three gears are not down and locked.

(2) REMOVAL.

(a) Place the throttle control levers in the open position.

(b) Install rigging pins so that the control area to be removed lies between the two nearest pin installation points.

(c) Disconnect cable at most convenient turnbuckle. If the cable pattern is complicated it is recommended that a follow-up cord or wire be attached to the cable being removed. This will facilitate reinstallation since the original pattern around pulleys and through fairleads will be preserved.

NOTE

Access to the majority of engine cables may be attained through the engine bays. In other instances cable access may be attained through access holes. Refer to Section III, figure 1.

(d) Decrease length of push rod assemblies in areas where cable removal will be facilitated.

(e) Disengage applicable quick disconnect couplings as insturcted in figure 7.

(3) INSTALLATION. (See figure 1.)

(a) Reverse the removal procedure described in paragraph 9 c (2).

(b) Rig the cables, as applicable, according to the following procedure:

1. Install rigging pins in flight engineer's control unit through the bracket and quadrants at crew nacelle station 190, crew nacelle station 98; wing station 188.5, left-hand side; wing station 125.5, right-hand side; at the outboard engines, and through the pilots' control unit. Make certain that all units are in the open position. Use .188 inch diameter or .250 inch diameter rigging pins in accordance with size of hole provided.

2. Fix bellcrank mechanisms on inboard engines in open position with push rods removed.

3. Rig all cables to 35 ± 3 pounds tension at 70°F (21°C). All rigging pins must be free after rigging.

4. Remove fix on bellcrank mechanisms on inboard engines and remove rigging pins from brackets and quadrants at outboard engines.

5. Fix throttle arms on carburetors on all engines in open position, and install end fittings in throttle arms.

6. Adjust length of push rod assemblies so that bolts can be inserted without forcing control system. Make certain that all four pilot's knobs are in line within ± .06 inch.

7. Remove fix on throttle arms of carburetors.

8. Remove rigging pins from all units.

9. Fix all throttle control levers at flight engineer's station against stop in open position.

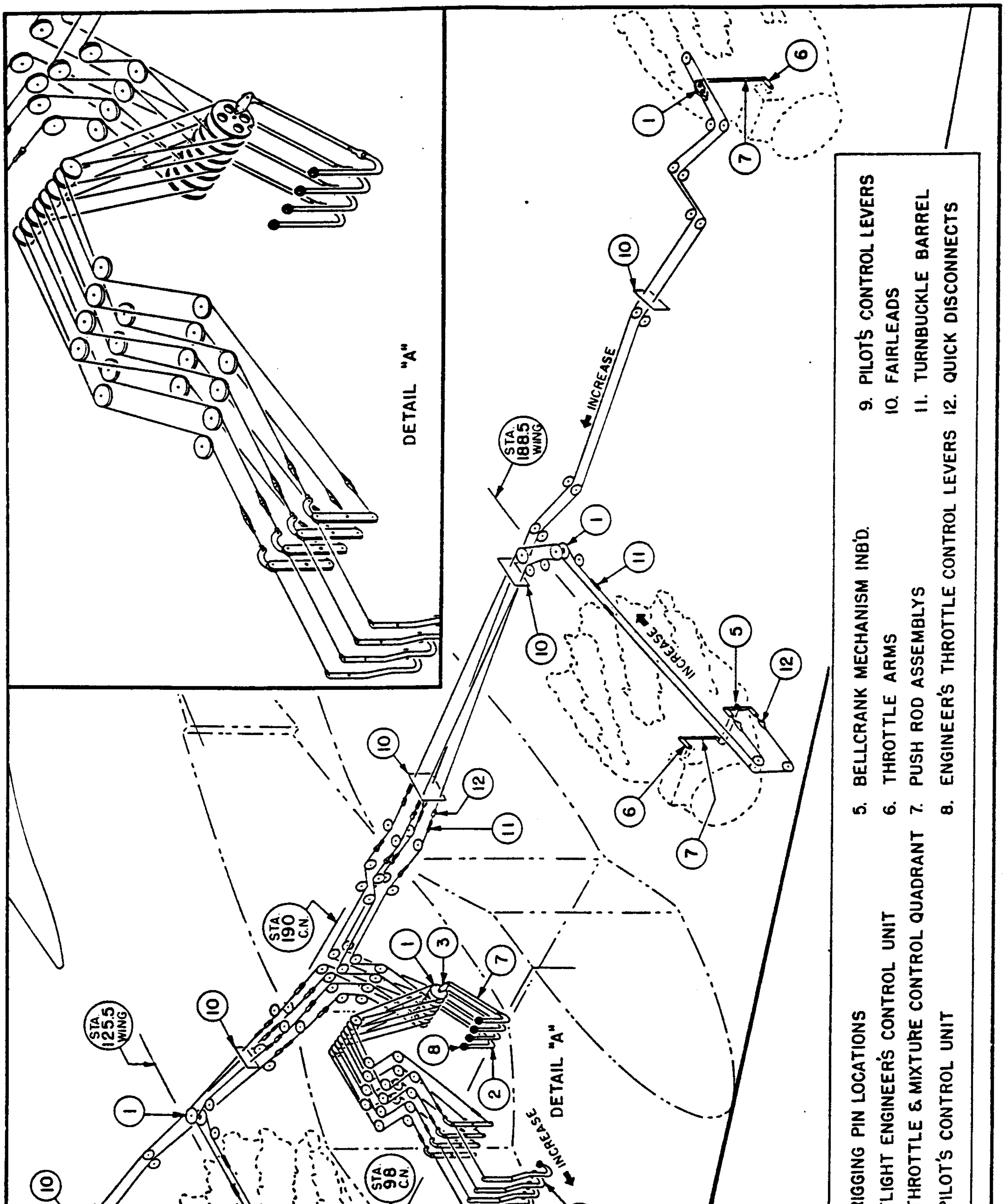


Figure 1. Throttle Control System

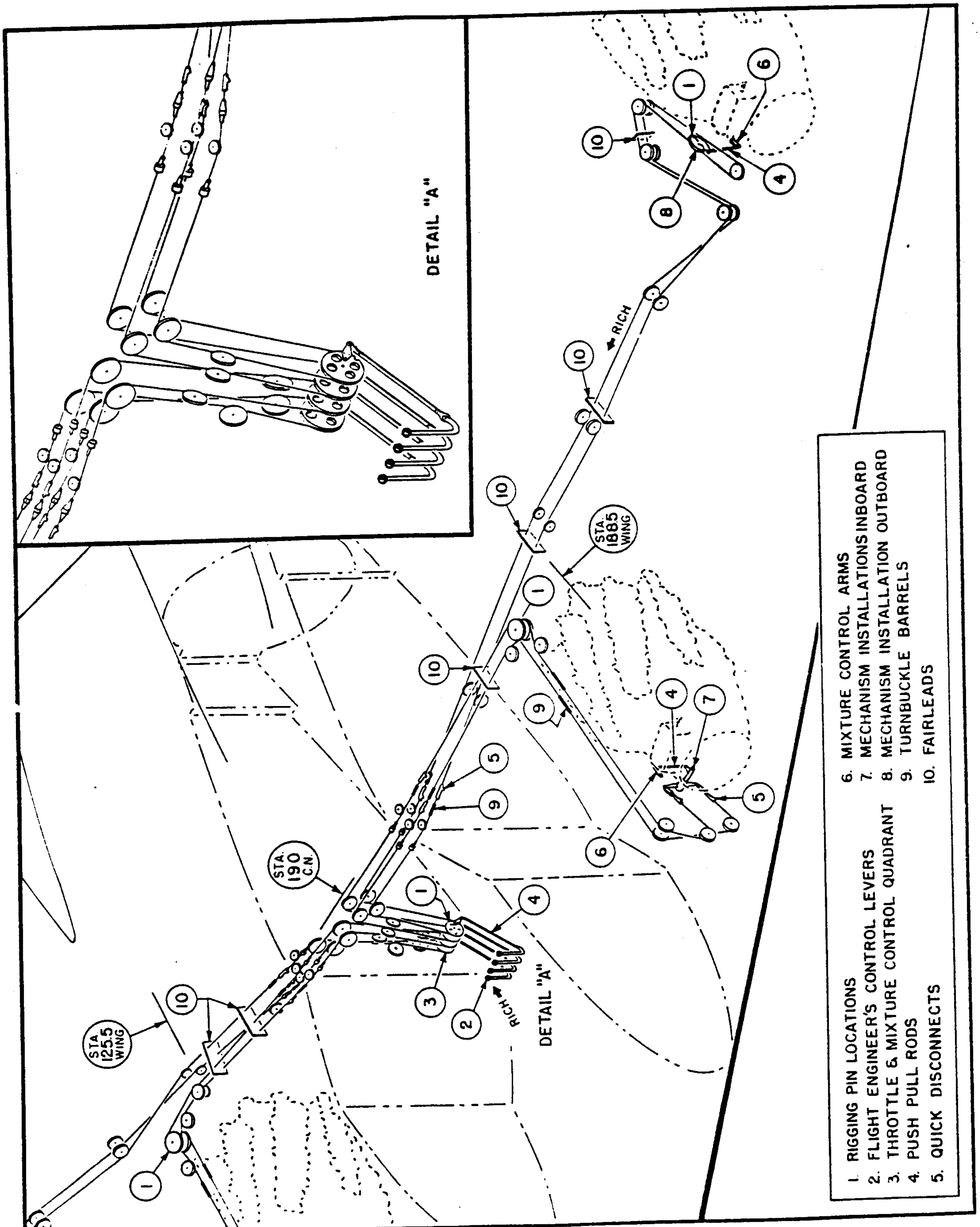
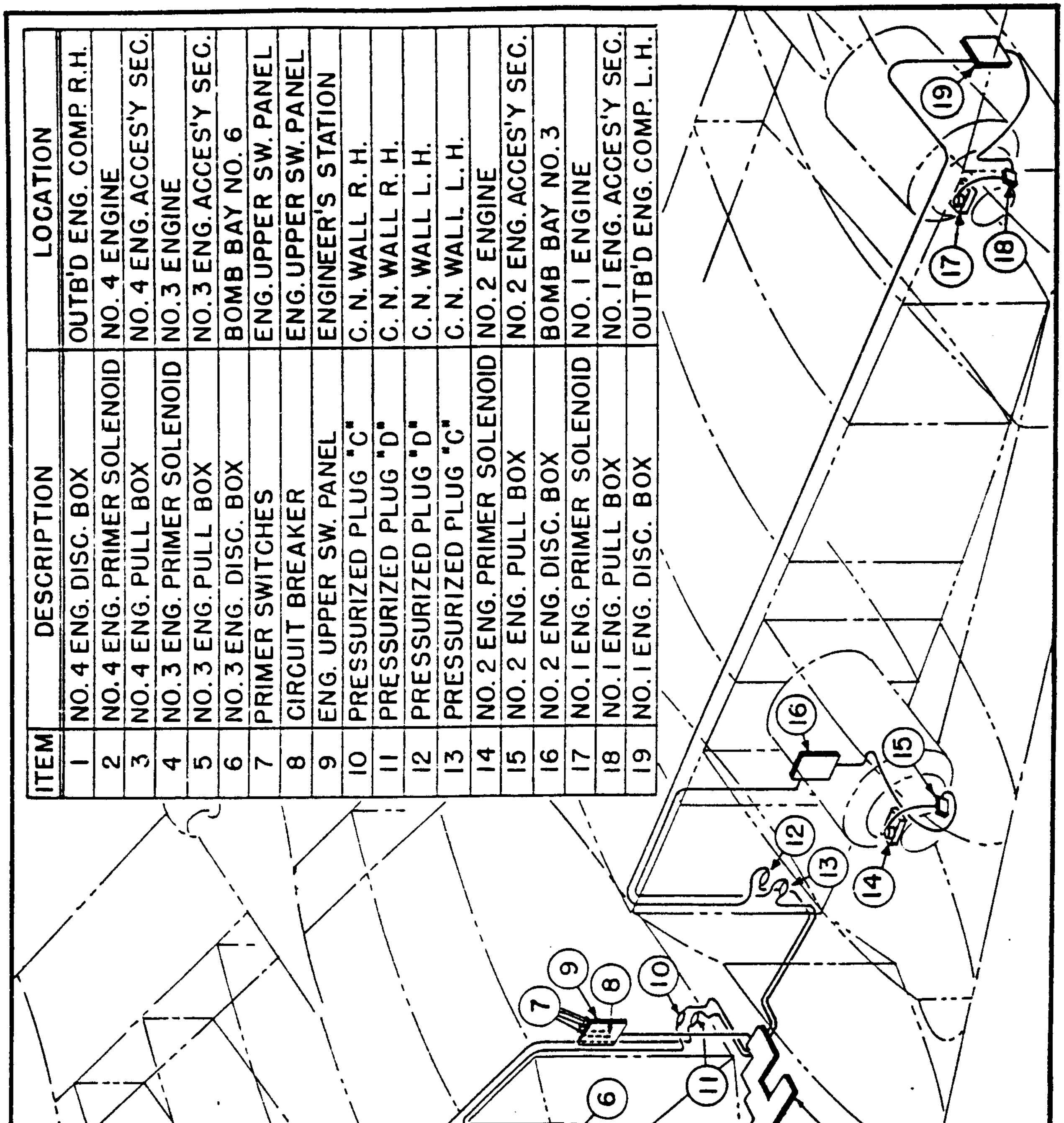


Figure 2. Mixture Control System



ITEM	DESCRIPTION	LOCATION
1	NO. 4 ENG. DISC. BOX	OUTB'D ENG. COMP. R.H.
2	NO. 4 ENG. PRIMER SOLENOID	NO. 4 ENGINE
3	NO. 4 ENG. PULL BOX	NO. 4 ENG. ACCES'Y SEC.
4	NO. 3 ENG. PRIMER SOLENOID	NO. 3 ENGINE
5	NO. 3 ENG. PULL BOX	NO. 3 ENG. ACCES'Y SEC.
6	NO. 3 ENG. DISC. BOX	BOMB BAY NO. 6
7	PRIMER SWITCHES	ENG. UPPER SW. PANEL
8	CIRCUIT BREAKER	ENG. UPPER SW. PANEL
9	ENG. UPPER SW. PANEL	ENGINEER'S STATION
10	PRESSURIZED PLUG "C"	C. N. WALL R. H.
11	PRESSURIZED PLUG "D"	C. N. WALL R. H.
12	PRESSURIZED PLUG "D"	C. N. WALL L. H.
13	PRESSURIZED PLUG "C"	C. N. WALL L. H.
14	NO. 2 ENG. PRIMER SOLENOID	NO. 2 ENGINE
15	NO. 2 ENG. PULL BOX	NO. 2 ENG. ACCES'Y SEC.
16	NO. 2 ENG. DISC. BOX	BOMB BAY NO. 3
17	NO. 1 ENG. PRIMER SOLENOID	NO. 1 ENGINE
18	NO. 1 ENG. PULL BOX	NO. 1 ENG. ACCES'Y SEC.
19	NO. 1 ENG. DISC. BOX	OUTB'D ENG. COMP. L. H.

Figure 3. Fuel Primer Solenoid System

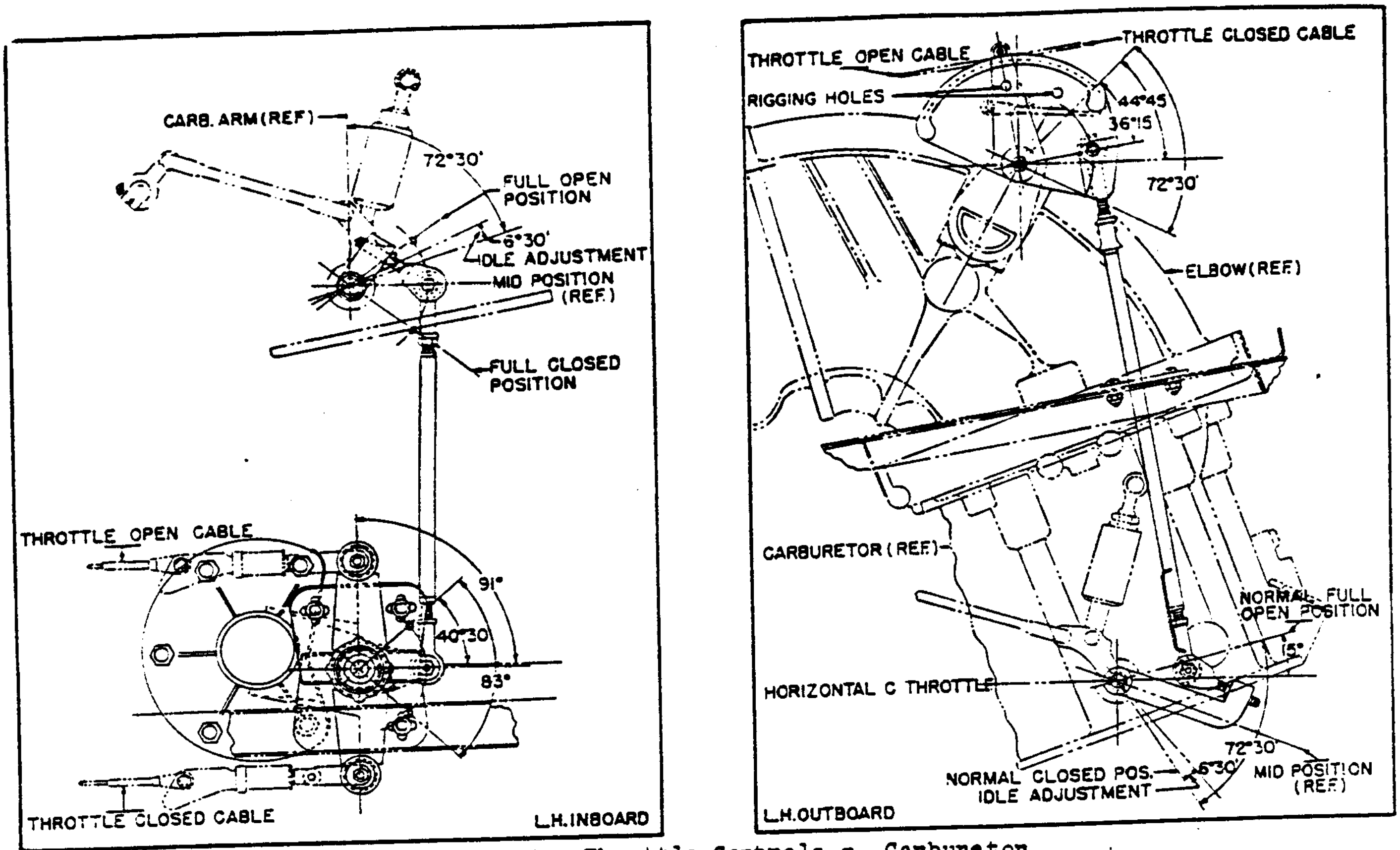


Figure 4. Throttle Controls - Carburetor

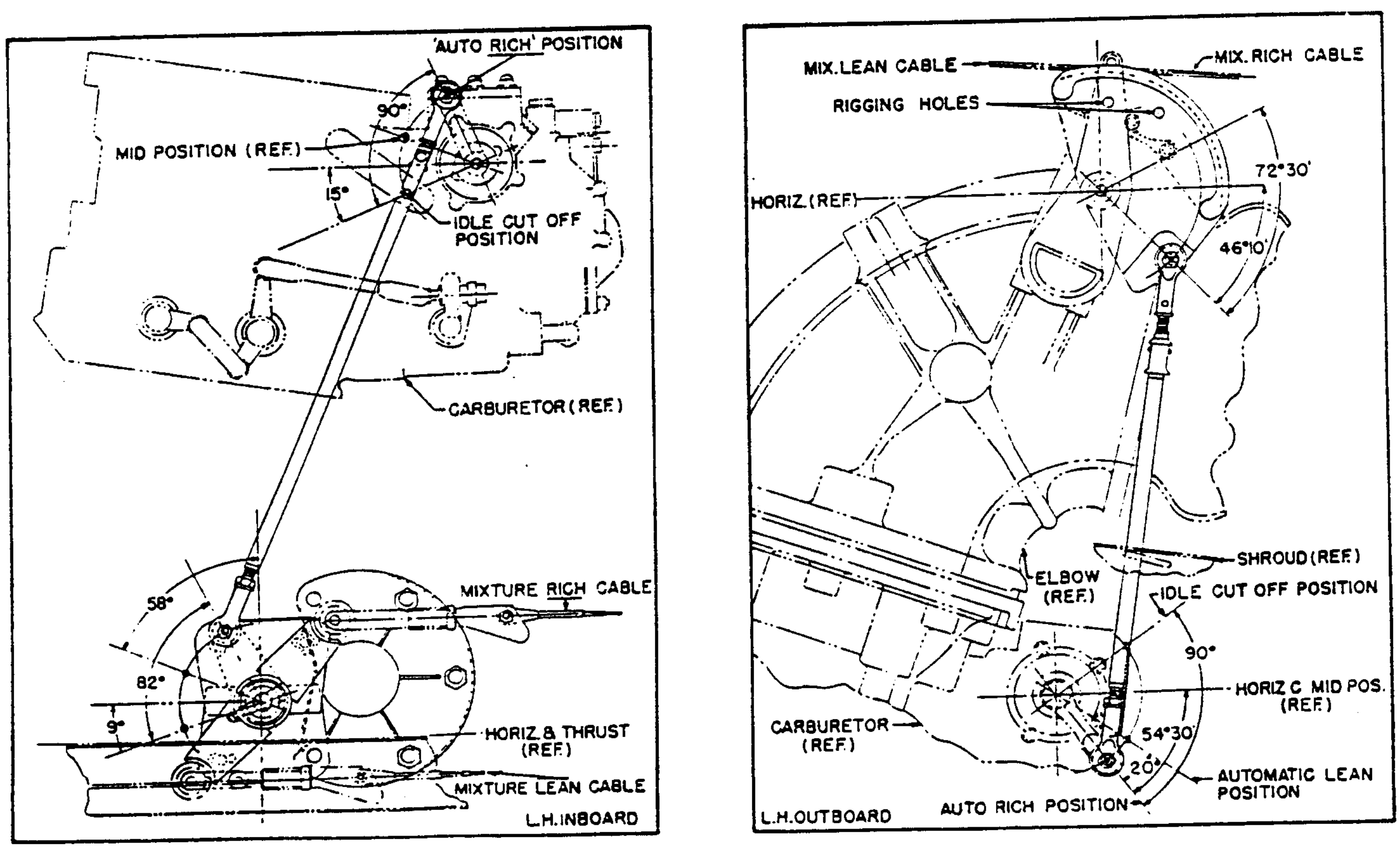


Figure 5. Mixture Controls - Carburetor

1. UPPER CARBURETOR FLANGE PRESSURE
2. STRAINER BOLT
3. ACCELERATING PUMP LINK
4. LOWER CARBURETOR FLANGE PRESSURE
5. THROTTLE BALANCE (ANTI-CREEP)

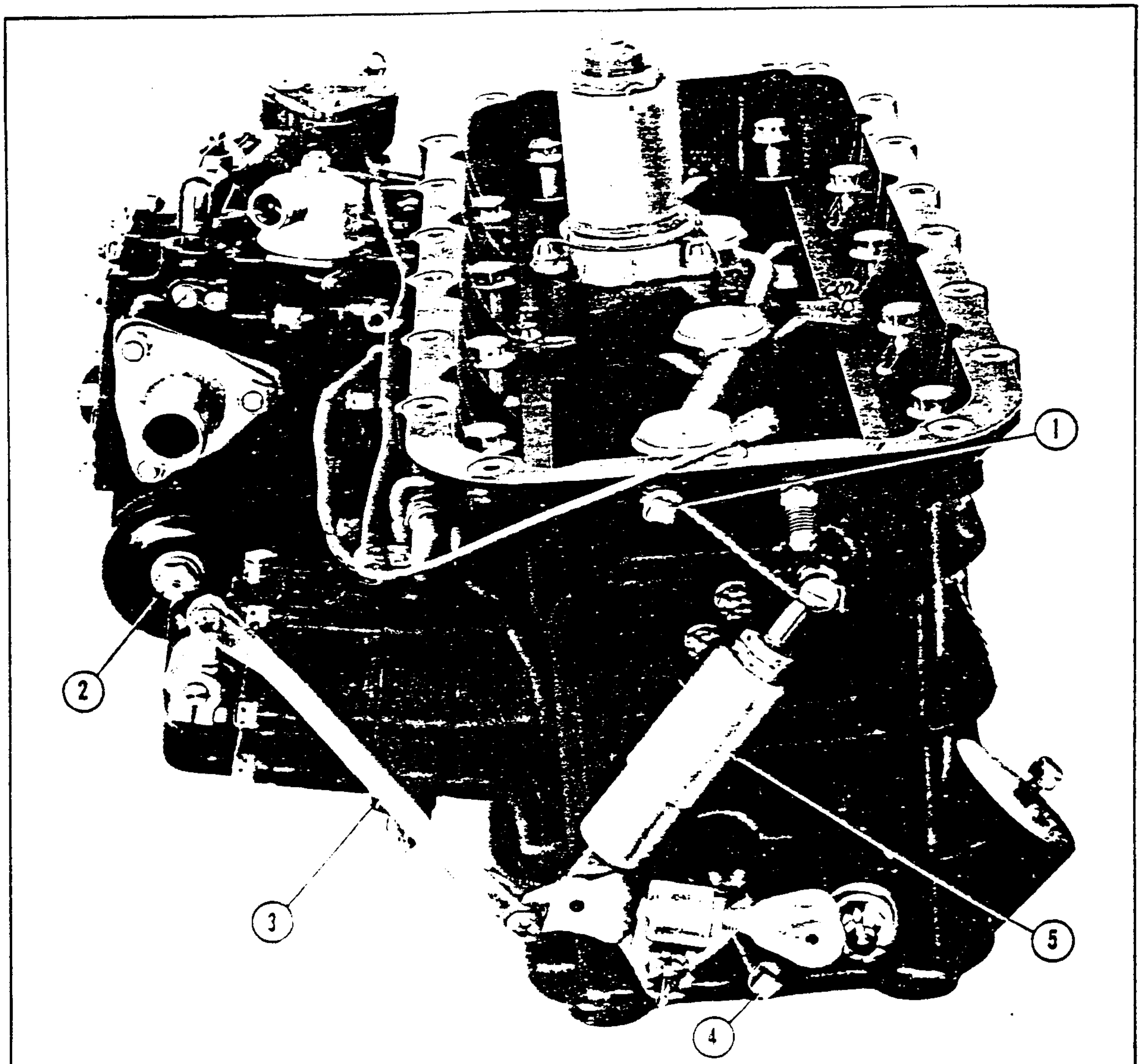


Figure 6. Carburetor Assembly - Lefthand View

10. Adjust stops at pilots' control unit so that with throttle levers held in closed position against stops, the cable tension in each throttle "closed" cable will be 80 ± 5 pounds at 70°F (21°C).

11. Fix all throttle control levers at flight engineer's unit against stops in closed position.

12. Adjust stops at pilots' control unit so that with throttle levers held in open position against stops, the cable in each throttle "open" position will be 80 ± 5 pounds at 70°F (21°C).

13. After adjusting idle speed of engine, install rigging pin in flight engineer's unit in closed position.

14. All adjustment necessary to bring throttle arms on all carburetors to closed position as determined by idle adjustment, must be made by changing length of throttle arm assemblies. Adjust end fittings in throttle arms with bolts through end fittings at right angles to push rods within ± 2 degrees.

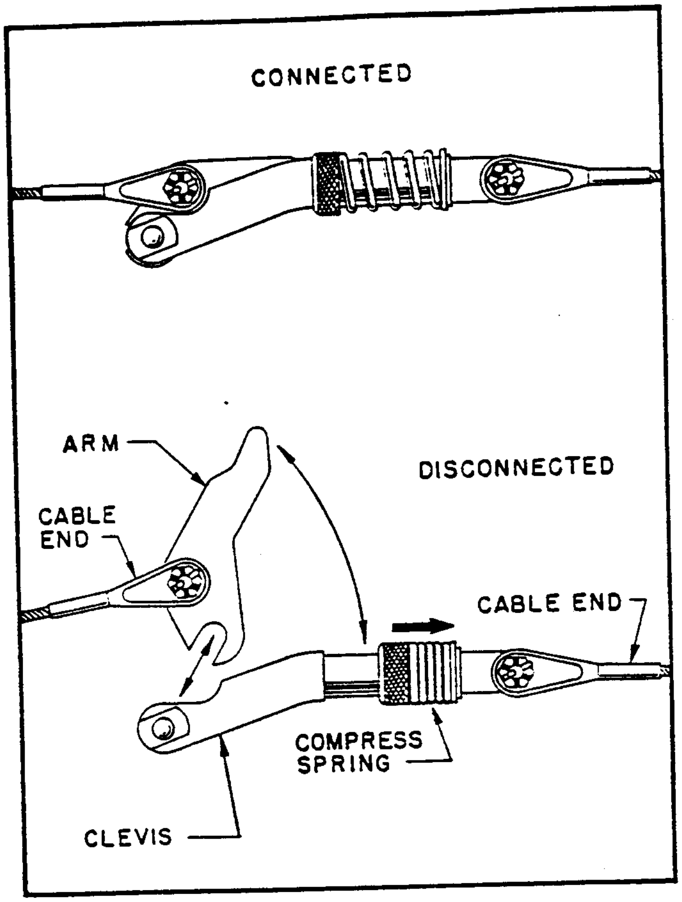


Figure 7. Quick Disconnect Coupling

15. Adjust cams on push rods at crew nacelle station 92 so that when all four knobs on pilots' control unit are 1.60 ± .10 inches from closed position, the warning horn switches will actuate.

NOTE

After the control cables have been rigged, the housing reservoir for Douglas type pressure seals is to be filled with AN-VV-O-366 hydraulic fluid.

d. MIXTURE. (See figures 2 and 5.)

(1) DESCRIPTION.- One throttle lever, located in the flight engineer's compartment, is linked to the carburetor as illustrated in figure 2.

(2) REMOVAL.- The mixture control cables are removed in essentially the same manner as the throttle cables. Refer to paragraph 9 c (2) and to figures 2 and 5.

(3) INSTALLATION. (See figures 2, 5, 7, 8, and 9.)

(a) Reverse the removal procedure, paragraph 9 d (2).

(b) Rig the cables, as applicable, according to the following procedure:

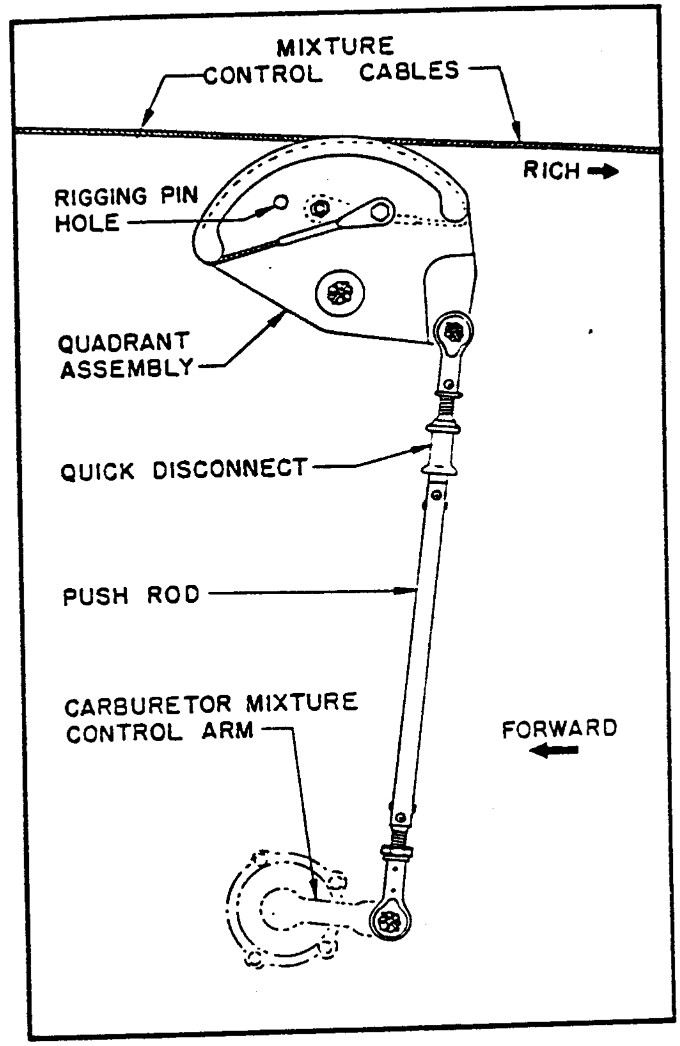


Figure 8. Mixture Mechanism Rigging

1. Install rigging pins in flight engineer's unit and quadrants at crew nacelle station 190; through brackets and quadrants at wing station 125.5, left-hand side; wing station 188.5, right-hand side; and at the outboard engines. The mixture control levers should be in line approximately 3.25 degrees from the stops at the "Auto Rich" position.

2. Install four inboard push-pull rods between the flight engineer's unit and the quadrant at crew nacelle station 190. The push-pull rod assemblies must be so adjusted that the bolts through the rod end bearings can be inserted without extreme pressure, or without changing relative positions of mixture control levers and quadrants as determined by the rigging pins.

3. Fix the bellcrank mechanisms on the inboard engines in "Auto Rich" position. This is done with the push-pull rods removed.

4. Install all cable assemblies, turnbuckle barrels and disconnect-assemblies between engines and quadrants at crew nacelle

1. AUTOMATIC MIXTURE CONTROL
2. AUTOMATIC MIXTURE CONTROL UNIT
3. ELECTRIC PRIMER
4. MANUAL MIXTURE CONTROL
5. THROTTLE ARM
6. IDLE SPEED ADJUSTMENT
7. IDLE MIXTURE ADJUSTMENT SREW

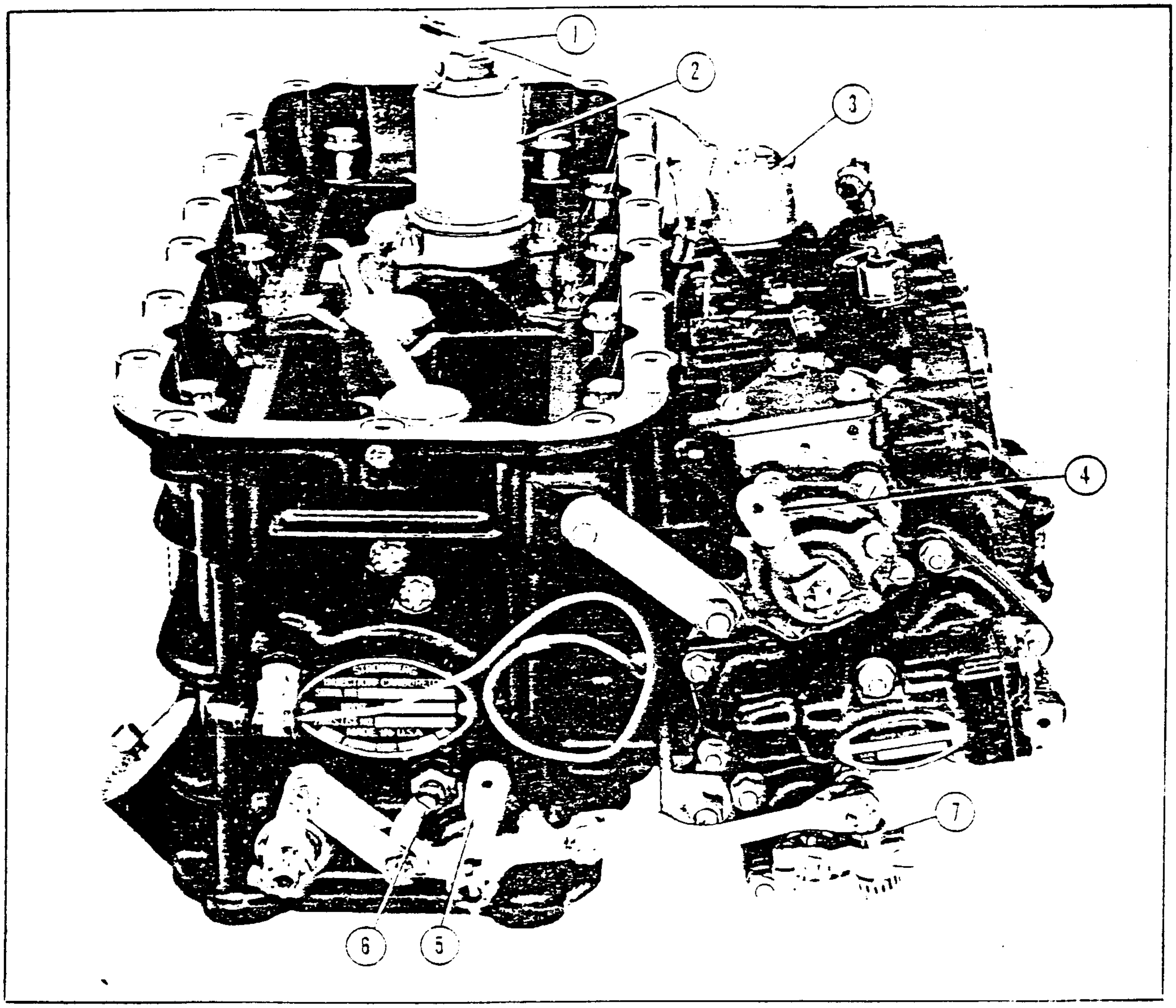


Figure 9. Carburetor Assembly - Righthand View

station 190. Rig cables to 35 ± 5 pounds tension at 70°F (21°C).

5. Remove fix on bellcrank mechanisms on inboard engines, and remove rigging pins from brackets and quadrants at outboard engines.

6. Fix mixture control arms on all carburetors at all engines in "Auto Rich" position.

7. Install push-pull rods between mechanisms and mixture control arms on carburetors. The length of the rod assemblies should be so adjusted that the bolts through rod ends can be installed without changing the relative positions of mechanisms.

8. Remove fix on mixture control arms on carburetors.

9. Remove all rigging pins.

(4) IDLE ADJUSTMENT. (See figures 8, 9, and 10.)

1. IDLE MIXTURE ADJUSTMENT SCREW
2. METERED FUEL CHAMBER DRAIN PLUG
3. UNMETERED FUEL CHAMBER DRAIN PLUG
4. FUEL PRESSURE GAGE CONNECTIONS
5. SUCTION CHAMBER DRAIN PLUG
6. STRAINER CHAMBER
7. ACCELERATING PUMP LINES
8. ACCELERATING PUMP
9. ACCELERATING PUMP LINK
10. THROTTLE ARM
11. THROTTLE PLATES
12. IMPACT TUBES (TYPICAL 8 PLACES)
13. BOOST VENTURI (TYPICAL 4 PLACES)
14. NOZZLE VENT HOLE
15. THROTTLE SHAFTS

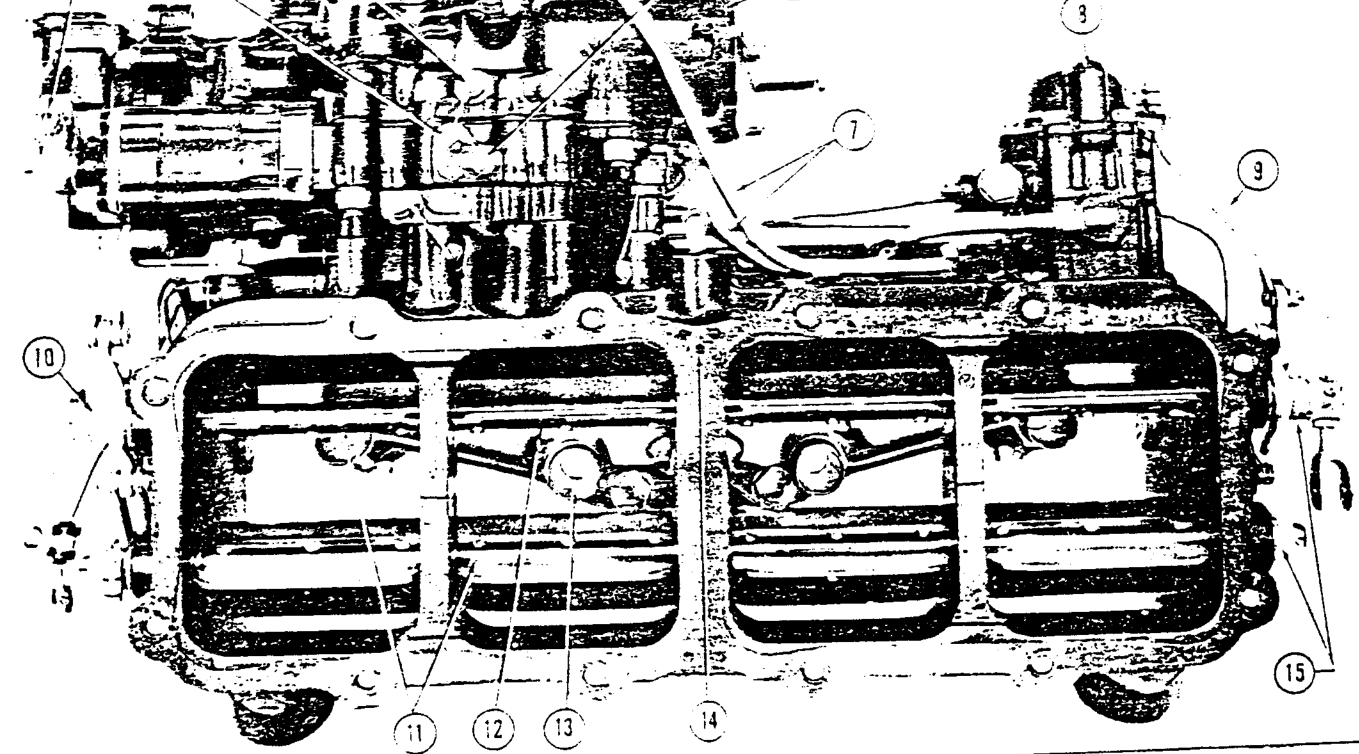


Figure 10. Carburetor Assembly - Bottom View

NOTE

When a carburetor has once been adjusted to idle satisfactorily it should not vary from this adjustment unless subject to extreme changes in weather and atmospheric conditions. It is, therefore, inadvisable to change the carburetor idle mixture adjustment until all other possible causes of unsatisfactory idling have been investigated.

(a) If it has been decided that the idle mixture should be adjusted, run the engine at 1000 rpm until the oil temperature is 140°F to 158°F (60°C to 70°C) and the cylinder head temperatures are normal. Run the engine at 2000 rpm and make a magneto drop-off check, clearing the plugs afterwards. If the drop-off has been normal, proceed with the adjustment of the idling mixture.

(b) Slow down to closed throttle, 400 to 500 rpm. Adjust the throttle stop if the engine does not idle at approximately this rpm.

(c) Move the mixture control momentarily into idle cut-off and observe the rise or fall in rpm. If the idling adjustment is properly set at 400 to 500 rpm, there will be a pickup of 5 to 10 rpm. Move the control back to auto rich before the engine stops.

(d) If the engine rpm decreases immediately when the mixture control is moved to idle cut-off, turn the knurled adjusting screw one or two notches in a clockwise direction to richen the mixture and again check the rpm when the control is moved to idle cut-off.

(e) If the engine rpm increases momentarily by more than 5 to 10 rpm when the mixture control is moved to idle cut-off, lean the mixture slightly by turning the knurled adjusting screw one or two notches in a counterclockwise direction; then move the control to idle cut-off and check the rpm.

(f) Each time the adjustment is changed, run the engine up to 2000 rpm to clear the spark plugs before proceeding with the rpm check.

(g) Repeat the adjustment procedure until a momentary increase of between 5 and 10 rpm is noted when the mixture control is moved to idle cut-off. When this condition exists, the idling adjustment is satisfactory.

e. CARBURETOR FUEL PRIMER. (See figures 3, 6, and 9.)- The carburetor fuel primers are electrically operated solenoids controlled by momentary switches (one for each engine) on the engineer's upper electrical panel. The primer is installed in the carburetor.

10. PROPELLERS. CONTROLS, AND PROPELLER GEAR BOXES

10. PROPELLERS, CONTROLS, AND PROPELLER GEAR BOXES.

NOTE

Throughout this paragraph when the words "forward" or "aft" are used in reference to the propellers, gear boxes, or drive shafts, they shall be taken to mean "forward" as the propeller end, and "aft" as the engine end of the units.

a. GENERAL.- Each engine drives a dual-rotating, eight-bladed Super-Hydromatic Hamilton Standard Propeller through propeller extension shafts and a gear box (see figure 1). The propellers are controlled from the pilots' and engineer's stations for operation of all or any appropriate combination of the following functions: constant speed, feathering, reversing, fixed pitch, manual pitch changing, and pitch indication.

b. TROUBLE SHOOTING.- The following information lists the troubles, the probable causes, and the remedies most frequently encountered in Super-Hydromatic propeller servicing work. It should be understood that some of these troubles might also be the result of malfunctioning of the engine or other accessories in the aircraft.

CAUTION

Many of the following remedies must be performed by partial disassembly of the propeller. This shall be accomplished only in an overhaul shop and shall never be attempted during line maintenance.

TROUBLE	PROBABLE CAUSE	REMEDY
Sluggish blade movement toward high pitch.	Excessive internal or external leakage of vane motor.	See "VANE MOTOR LEAKAGE."
	One or more pump-high-pressure check valves sticky.	Test for open high-pressure check valves. Remove faulty cylinder assembly from pump and examine valve for impurities lodged on the seat or burrs on valve seat.
	Improper relationship between compensating piston and pilot valve.	Turn compensating piston fork out in increments of 1/4 turns until proper action is obtained.
Sluggish blade movement toward low pitch.	Faulty servo piston seal.	Replace seal.
	Leaky auxiliary pump check valve.	Clean valve and valve seat.
	One or more pump-high-pressure check valves sticky.	Test for open high-pressure check valves. Remove faulty cylinder assembly from pump, examine valve for impurities lodged on the seat, or burrs on the valve seat.
	Improper relationship between compensating piston and pilot valve.	Turn compensating fork into piston in increments of 1/4 turns until proper action is obtained.

TROUBLE	PROBABLE CAUSE	REMEDY
Sluggish blade movement toward low pitch.	Sticky distributor valve.	Disassemble and clean.
Blades stuck in high pitch.	Distributor valve stuck in high pitch position.	Remove distributor valve and examine for burrs. Remove burrs with crocus cloth. Check for freedom of movement in distributor valve extension assembly. Inspect ID of cam for scoring.
	Translating control assembly bound in high pitch position.	Disassemble assembly and clean up any burrs that may be present. Remove any foreign material from rollers.
	Check valve of auxiliary pump stuck open.	Remove auxiliary pump and clean thoroughly.
	Governor pump drive shaft broken at gear pump.	Replace drive shaft and check for binding of gears.
	Increase pitch solenoid valve stuck open.	Replace or repair solenoid.
	Compensating piston stuck in drain position.	Remove governor head and free piston. If burrs are present on piston liner or compensating piston, remove with crocus cloth.
	Servo piston stuck in high pitch position.	Remove piston and examine. Remove any burrs or foreign material. Check liner for galling.
	Accumulator relief valve piston stuck open.	Remove piston and clean.
Blades stuck in low pitch.	Three or more pump-high-pressure check valves sticky.	Test for open high-pressure check valves. Remove faulty cylinder assembly from pump and examine valve for impurities lodged on seat or burrs on valve seat.
	High-pressure relief valve stuck open.	Disassemble and clean valve of any foreign matter. Remove any burrs on valve seat or stem.
	Excessive leakage in vane motors.	See "VANE MOTOR LEAKAGE."
	Distributor valve stuck in low pitch.	Remove valve and examine for burrs. Remove burrs and check clearance.
	Broken return ring.	Examine pump for any seized piston in the cylinders. Remove and correct. Replace return ring.
	Ratchet wheel lock stuck in up position.	Remove lock assembly and examine for burrs.
	Decrease-pitch solenoid stuck open.	Replace or repair solenoid.
	Servo piston stuck in low pitch position.	Remove piston and examine. Remove any burrs or foreign material.

TROUBLE	PROBABLE CAUSE	REMEDY
Inability to obtain low rpm setting.	Hydraulic stop not set at a sufficiently high blade angle.	Remove pitch limit solenoid and reset high pitch hydraulic stop. One full turn of stop is equivalent to approximately two degrees of blade angle.
	Low rpm stop on governor improperly set.	Adjust stop correctly.
	Erroneous reading tachometers or manifold pressure gages.	Calibrate instruments.
Inability to obtain high rpm setting.	Hydraulic stop not set at a sufficiently low blade angle.	Remove pitch limit solenoid and reset low pitch hydraulic stop. Mechanical low pitch stop ring must also be reset.
	High rpm stop on governor improperly set.	Adjust stop correctly.
	Low engine power.	See Section IV, paragraph 7.
	Erroneous reading tachometers or manifold pressure gages.	Calibrate instruments.
Overspeeding.	Compensating needle valve closed too far.	Back off needle valve in increments of 1/12 turns until proper adjustment has been obtained.
	Improper relationship of compensating piston and pilot valve.	Back compensating piston fork out in increments of 1/4 turns until proper action is obtained.
	Sticky servo rack.	Check for correct meshing of servo rack and pitch transmitter and of rack with translating control. Remove any burrs.
	Dirt or foreign matter under needle valve seat.	Remove needle valve and clean seat.
	Hub not full of oil.	Fill hub with oil.
Underspeeding.	Improper relationship of compensating piston and pilot valve.	Turn compensating piston fork <u>in</u> in increments of 1/4 turns.
	Leaky servo piston seal.	Replace seal.
	Governor sump not full.	Repair scavenging pump.
Sudden decrease in rpm, but governing at new speed.	Compensating piston stuck in up position allowing oil to drain.	Remove governor head and free plunger. Clean plunger of any burrs that may be present.
Hunting.	Hub not full of oil.	Fill hub with oil.
	Governor sump not full.	Repair scavenging pump.
	Compensating needle valve open too far.	Close valve in increments of 1/12 turns until hunting ceases.
	Too much play in translating control assembly. Guide pins in the support race assembly and the guide slots in the distributor valve thrust plate worn.	Replace units or assembly.

TROUBLE	PROBABLE CAUSE	REMEDY
Hunting.	Sticky compensating piston.	Remove piston and clean.
	Sticky distributor valve.	Remove distributor valve assembly and clean.
Inability to feather.	Inoperative pitch limit solenoid.	Check wiring for broken leads. Clean solenoid plunger.
	Hydraulic stop improperly set.	Set stop to correct angle. Reset high pitch mechanical stop ring if necessary.
	Insufficient electrical current.	Check electrical system.
	Faulty wiring system.	Check wiring system pertaining to control.
	Excessive vane motor leakage.	See "VANE MOTOR LEAKAGE."
	Insufficient pump pressure.	Disassemble pump assembly and check for inoperative high and low pressure check valves.
Inability to unfeather.	Inoperative auxiliary motor.	Check motor for broken leads.
	Auxiliary pump check valve stuck in open position.	Remove auxiliary pump and clean out valve and seat.
	Faulty servo piston seal.	Replace seal.
	Faulty wiring system.	Check and repair wiring system.
	Insufficient electrical current.	Check electrical system.
	Decrease-pitch solenoid inoperative.	Repair or replace solenoid.
	Excessive vane motor leakage.	See "VANE MOTOR LEAKAGE."
	Distributor valve stuck in high pitch.	Remove and clean.
Inability to reverse.	Inoperative pitch limit solenoid.	Check wiring for broken leads. Clean solenoid plunger.
	Hydraulic stop improperly set.	Set stop to correct angle. Reset mechanical stop ring if necessary.
	Governor pump drive shaft broken at gear pump.	Replace drive gear shaft and check for binding of gears.
	Faulty servo piston seal.	Replace seal.
	Auxiliary pump check valve stuck in open position.	Remove auxiliary pump and clean.
	Inoperative decrease pitch solenoid.	Repair or replace solenoid.
	Accumulator relief valve piston stuck open.	Remove piston and clean.
	Broken electrical connection.	Trace continuity of wiring used in reversing.

TROUBLE	PROBABLE CAUSE	REMEDY
Inability to reverse.	Sticky distributor valve.	Disassemble and clean.
Inability to unreverse.	Inoperative increase pitch solenoid.	Repair or replace solenoid.
	Excessive vane motor leakage.	See "VANE MOTOR LEAKAGE."
Inability to hold lock pitch.	Lock pitch solenoid stuck open.	Trace continuity of lock pitch wiring. Repair or replace solenoid.
	Leaky auxiliary pump check valve.	Remove and repair pump.
	Faulty servo piston seal.	Replace seal.
	Excessive leakage of vane motors.	See "VANE MOTOR LEAKAGE."
Propeller roughness.	Leaky blade plug.	Return blade to contractor for repair.
	Blades not set at same angle.	Readjust blades within .2 degree of each other.
	Propeller unbalanced.	Correct balance.
	Spark plugs or ignition faulty.	Refer to Section IV, paragraph 8.
	Engine failure.	Feather propeller.
External leakage.	Damaged gaskets, seals, or mating surfaces.	Replace gaskets or repair as required.
Pitch indicator not recording correct blade angle.	Broken electrical connection.	Trace through the wiring system and repair any broken connection.
	Pitch transmitter not synchronized with the blade angle.	Readjust pitch transmitter.
	Magnetic unit or inverter inoperative.	Replace faulty unit.
	Faulty pitch indicator.	Repair or replace instrument.
Vane motor leakage.	One or more of several seals leaking.	Test to determine faulty seal and replace.
Leakage past dowel seals.	Damaged seals.	Replace seals.
Leakage around pipe plugs.	Plugs not staked, and are backing out.	Tighten plugs and stake in position.
	Oil control pin preventing pipe plug from being screwed all the way in.	Remove pipe plug and drive in pin all the way. Replace pipe plug.
Leakage past end plate gaskets.	Damaged gasket.	Replace gasket.
Leakage around the cover nut seal.	Damaged seal.	Replace seal.
Leakage past top and bottom plates.	Damaged plates.	Lap plates on flat surface until damage is removed.
	Plates not seating properly.	Check all related dimensions and correct.
Leakage past strip seals.	Damaged seals.	Replace seals.
Leakage past center post seals.	Damaged seals.	Check for sharp corners on barrel vane. Remove corners and carefully replace seals.

c. MAINTENANCE.

(1) HUB ASSEMBLY.

(a) Minor leakage can usually be remedied by tightening the securing bolts or by the installation of the correct new gaskets. If the source of leakage is unknown, the following test is recommended: Wash the hub assembly thoroughly and wipe as dry as possible. Apply a light pasty mixture of Bon Ami (or its equivalent) and water over all points of suspected leakage or over all external surfaces if desired. Allow the mixture to dry until most of the water has evaporated. Then operate the engine for several minutes, changing blade pitch through two cycles. Shut down the engine and examine the hub for oil leaks which will be readily noticeable against the white mixture. Clean off the remaining mixture and repair the source of leakage.

(b) If leakage is due to a damaged rotating seal thrust ring, the surface of the ring must be lapped on a circular surface plate of the proper diameter. Local repair should not be attempted. Be certain that a perfect surface is produced. Breaks in the solder joint holding the thrust ring to its retainer should be carefully repaired.

(c) The distributor valve and valve sleeve are paired by serial number and must be kept together. The shape of the lands is precisely ground and should not be altered during cleaning. For this reason, only crocus cloth should be used on the lands. Do not use a coarser abrasive.

(d) Metal pick-up from galling on the rear cone and cone seat should be removed with fine emery cloth.

(e) The hub and blades assembly should be full of oil when the sump filler hole is at 45° from vertical. Fill with Pennsylvania Crude SAE No. 10 oil.

1. It is recommended that three filling runs of ten minutes each be made on each engine installation. One or two minutes during each of these runs should be at 2000 rpm providing all operating temperatures and pressures are maintained within safe limits. The propeller control should be in the constant speed position and just off the low pitch stop. Operate the increase-decrease rpm switch through two or three cycles during each run. Prior to each run the propeller low pressure sumps are to be filled with the filler cap in the top vertical position. After the third filling run has been made, the sumps are again to be filled with the cap in the top vertical position. If not more than 12 oz of propeller oil is required to fill the low pressure sump of either component following the third run, filling may be considered satisfactory. If more than 12 oz is required to fill either component after completion of the third filling, the filling run procedure is to be repeated until this requirement is met.

2. The governor housing reservoir is also to be filled prior to each run and after the final run. If the governor oil reservoir sight level gage does not show that the governor reservoir is full, following the final filling run, governor control housing should be checked for improper assembly or defective gaskets.

(2) BLADE ASSEMBLY.

(a) Due to the construction of this blade, all nicks and abrasions shall not be considered unsatisfactory unless the sponged synthetic rubber filler is exposed. Ordinary wear on the leading edge will expose the copper fillet; this is acceptable. Excessive abrasion shall be cause for replating of the blade.

(b) There shall be no buffing, filing, or mechanical working of the blade for any reason, except as noted in paragraph (c) following.

(c) Raised edges of nicks and scratches may be removed by the use of a coarse stone and fine emery only.

(d) Blades shall be magnetically inspected periodically.

(e) The blade shall be rejected if a dent has a depth greater than 1/7 the distance from the lowest point of the dent to the nearest point of tangency with the undamaged surface.

(f) If the blade is thought to be bent or twisted, check face alignment.

(g) Each blade should be marked with 1/2-inch letters and numbers between the 8- and 24-inch stations on the camber side to include the following: serial number, part or drawing number, and maximum and minimum blade angle settings. The foregoing data should be painted, stenciled, or rubber stamped on the blades, and in no instance should these markings be indented or cut into metal. The markings should be protected with a coat of spar varnish or clear lacquer.

(3) SPINNER ASSEMBLY.

(a) Nicks should be eliminated with fine emery cloth, being certain that each nick is completely removed. Cracks through the surface are cause for rejection of the damaged part. Dents can be hammered out by the use of a rubber mallet and a properly shaped supporting block.

(b) Enlarged screw holes are generally cause for replacement of the part. Loose rivets should be carefully removed and new rivets put in.

(4) CONTROL ASSEMBLY.

(a) Minor leakage can usually be remedied by tightening the securing nuts or screws, or by installing new gaskets. If the source of leakage is unknown, the following test is recommended: Wash the control assembly thoroughly and wipe as dry as possible. Apply a light pasty mixture of Bon Ami (or its equivalent) and water over all points of suspected leakage or over all external surfaces, if desired. Allow the mixture to dry until most of the water is evaporated. Then operate the engine for several minutes, changing blade pitch through two cycles. Shut down the engine and examine the control for all leaks which will be readily noticeable against the white mixture. Clean off the remaining mixture and repair the source of leakage.

(b) If leakage is apparent at the rotating seal, there may be several causes: A scratch or nick in the surface, a cracked ring, or a damaged toroid seal. The surface should be lapped on a surface plate until it is perfectly flat. If the ring is cracked, the assembly must be replaced. Likewise, a new toroid seal should be used if this is the cause.

(c) The electrical connections must be securely mounted and free from signs of chafing.

(d) If the oil level of the control assembly is not visible through the sight glass after a few minutes of operation, stop and inspect the propeller.

d. PROPELLERS.

(1) DESCRIPTION. (See figure 1.)- Each of the four counter-rotating propeller units consists of two components: the 80 component, which is the aft propeller and has the same rotation direction as the engine, and the 60 component. The pitch changes of the two components are synchronized by an interconnecting bearing and eccentric assembly; one control assembly is used for both components.

BLADE DIAMETER:	80 COMPONENT....15 ft. 3 in.
	60 COMPONENT....15 ft. 1 in.
PITCH SETTINGS:	LOW (fine)......13°
	HIGH (coarse)...60°
GEAR RATIO:	.381:1

(2) OPERATION. (See figure 2.)

(a) Propeller pitch changes are controlled by switches from the pilots' pedestal and engineer's instrument panel. All of the electrical control circuits are operated on 28 volts d.c.

(b) The control switches on the pilots' pedestal consist of individual feathering switches, two reverse switches (one for the inboard propellers, the other for the outboard propellers), and one governor switch which regulates the rpm (changes the pitch) of all of the propellers simultaneously. A system circuit breaker is installed on the pilots' pedestal, also a master disconnect switch which removes the engineer's set of propeller controls from the control circuit.

(c) The flow of hydraulic fluid to vanes in the propeller hub determines the pitch of the propeller. Pitch change is controlled either by a governor, which automatically meters the fluid to the vanes to maintain a constant rpm, or by several solenoid valves which, when energized in various combinations, direct the fluid to change the position of the vanes.

(d) These solenoid valves are integral with the hub assembly and are identified as the lock pitch solenoid, the decrease pitch solenoid, and the increase pitch solenoid. An additional solenoid in a separate housing known as the pitch limit solenoid operates stop links which limit the constant speed operating range of the servo rack. If operation beyond this range is desired, the solenoid is energized to pull the stop links down and allow the required movement. The stops hold the plunger down until the rack again returns to the constant speed range.

(e) The propeller can be controlled to function under any of the following conditions: constant speed, feather or unfeather, reverse or unreverse pitch, or lock pitch.

1. CONSTANT SPEED.- In the constant speed or automatic pitch position, propeller pitch is regulated by the mechanical governor.

2. FEATHERING.- This control circuit operates on 28 volts d.c. to energize the lock pitch solenoid, increase pitch solenoid, pitch limit solenoid, and auxiliary feathering motor. Current for the circuit is picked up from a bus in the pilots' pedestal and routed through a circuit breaker to the feathering switch. When the feathering switch is engaged to the "FEATHER" position, current is directed through a thermal timer and then back to a coil winding around the switch control handle. The thermal timer automatically disengages the switch after a set length of time (approximately four seconds). In the "UNFEATHER" position, current is fed to the auxiliary feathering motor and lock pitch solenoid. Current for the feathering motor is picked up from a bus in the wheel well d.c. panel, routed through a circuit breaker to a relay in the bomb bay aft relay panel. The relay is actuated when the feathering switch is engaged.

3. REVERSING.

a. This circuit picks up 28 volts d.c. from a bus in the pilots' pedestal and passes through a circuit breaker to the control switches. The switches, one for the inboard propellers and the other for the outboard propellers, direct current to the pilots' pedestal relay panel. When the switches are thrown, the relays (one four-pole and one two-pole for each propeller) are actuated, sending current through the engineer's junction panel to energize the lock pitch solenoid, the decrease pitch solenoid, and the pitch limit solenoid. When the pitch limit solenoid is

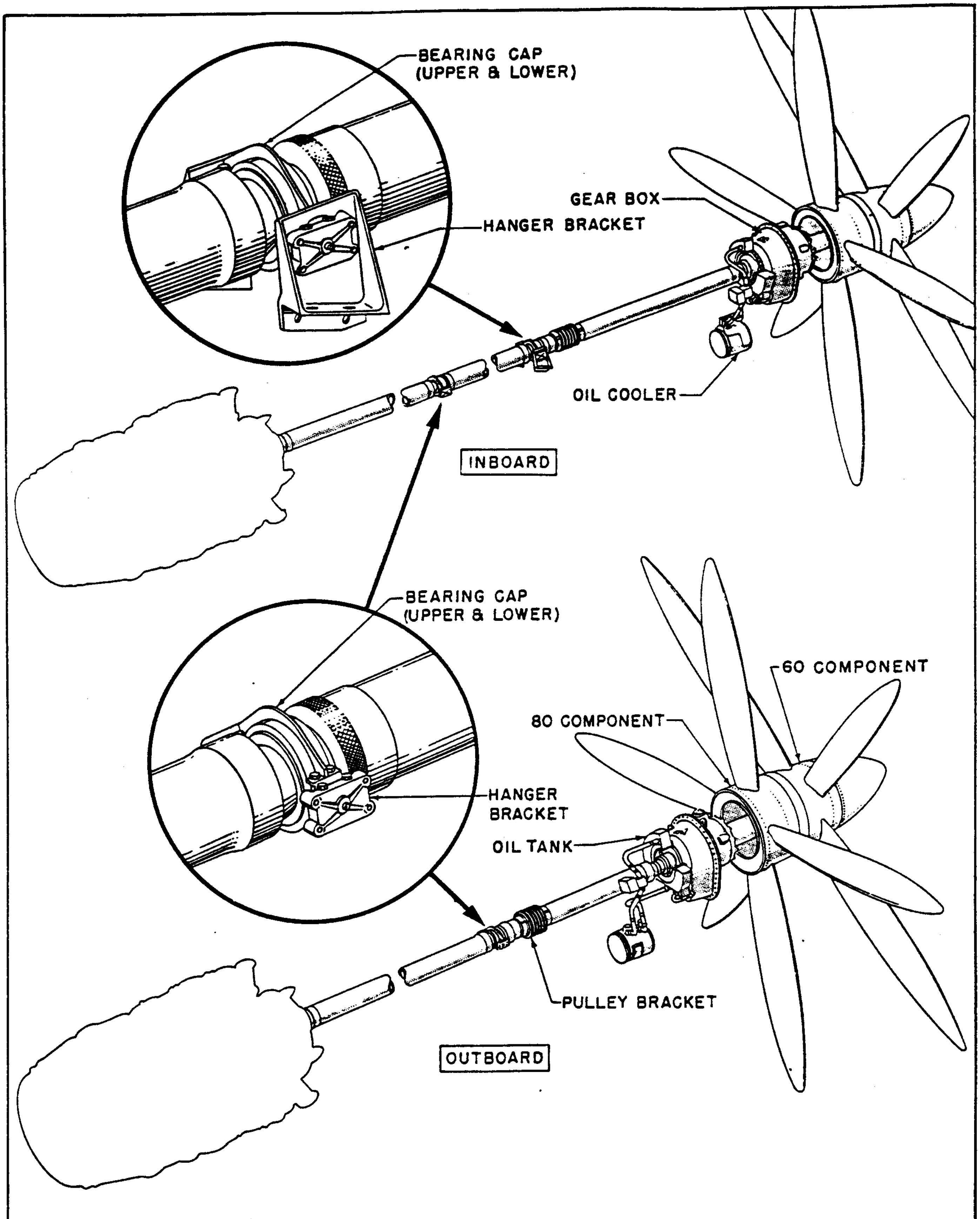


Figure 1. Propeller, Gear Box, and Extension Shaft Assembly

ITEM	DESCRIPTION	LOCATION
1	ENG. NO.4 PROPELLER UNIT	PROPELLER SHAFT HOUSING
2	PROPELLER NO.4 RELAY BOX	BOMB BAY NO.8 - AFT
3	RELAY PANEL	BOMB BAY NO.8 - AFT
4	ENGINE NO.3 PROPELLER UNIT	PROPELLER SHAFT HOUSING
5	D.C. PANEL	R.H. WHEEL WELL
6	PROPELLER NO.3 RELAY BOX	BOMB BAY NO.6 - AFT
7	RELAY PANEL	BOMB BAY NO.6 - AFT
8	CIRCUIT BREAKER	ENGINEER'S LOWER SW. PANEL

ITEM	DESCRIPTION	LOCATION
9	ENGINEER'S LOWER SW. PANEL	ENGINEER'S STATION
10	ENGINEER'S INSTRUMENT PANEL	ENGINEER'S STATION
11	PROPELLER PITCH INDICATORS	ENGINEER'S INSTRUMENT PANEL
12	PITCH LIMIT INDICATORS	ENGINEER'S INSTRUMENT PANEL
13	PROPELLER PITCH SWITCHES	ENGINEER'S INSTRUMENT PANEL
14	TRANSFORMER PANEL	CREW NACELLE BULKHEAD
15	PRESSURIZED PLUGS	R.H. CREW NACELLE BULKHEAD
16	ENGINEER'S JUNCTION PANEL	BENEATH ENGINEER'S FLOOR
17	PILOT MASTER DISCONNECT SW.	PILOT'S PEDESTAL PANEL
18	CIRCUIT BREAKER	PILOT'S PEDESTAL PANEL
19	FEATHERING PUSH BUTTONS	PILOT'S PEDESTAL PANEL
20	PILOT'S PEDESTAL PANEL	PILOT'S PEDESTAL
21	REVERSE & UNREVERSE SW'S	PILOT'S PEDESTAL PANEL
22	GOVERNOR SWITCH	PILOT'S PEDESTAL PANEL
23	PILOT'S PEDESTAL RELAY PANEL	BENEATH PILOT'S PEDESTAL
24	PRESSURIZED PLUGS	L.H. CREW NACELLE BULKHEAD
25	ENGINE NO.2 PROPELLER UNIT	PROPELLER SHAFT HOUSING
26	RELAY PANEL	BOMB BAY NO.3-AFT
27	PROPELLER NO.2 RELAY BOX	BOMB BAY NO. 3-AFT
28	D.C. PANEL	L.H. WHEEL WELL
29	RELAY PANEL	BOMB BAY NO.1 - AFT
30	PROPELLER NO.1 RELAY BOX	BOMB BAY NO.1 - AFT
31	ENGINE NO.1 PROPELLER UNIT	PROPELLER SHAFT HOUSING

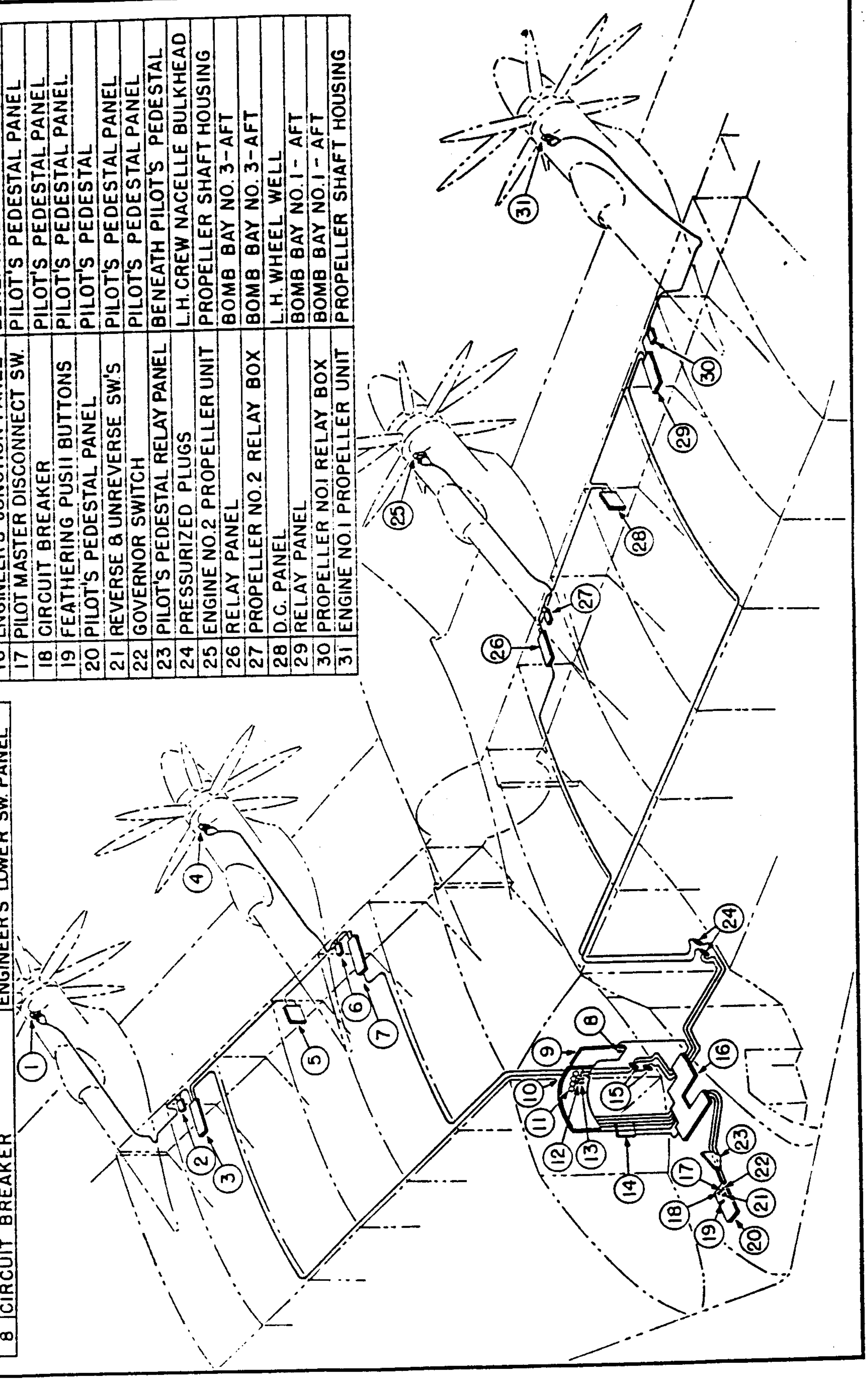


Figure 2. Automatic Propeller Control Electrical Installation

actuated, another circuit is closed and current is fed back through the engineer's junction panel to the coil of the four-pole relay.

b. When the reversing switches are opened (unreversing position), current to the relays is cut, but the four pole relay remains energized by the current from the switch actuated by the pitch limit stop. This set of conditions allows the decrease pitch solenoid to become de-energized and the increase pitch solenoid to become energized. When the blade angle is moved past the pitch limit stop, the switch energizing the four-pole relay is opened and the operating circuit is again functioning under normal conditions.

4. INCREASING AND DECREASING PITCH (Manual Governor Control).

a. Current for the governor control switch on the pilots' pedestal is picked up from the same bus as was used for the feathering circuit. The pilots' governor switch controls pitch changes for all the propellers at the same time; the switches on the engineer's instrument panel provide individual propeller pitch adjustment plus an additional position of the switch which locks the propellers in whatever fixed pitch position is chosen.

b. The pilots' governor-control-switch circuit, in the normal or constant speed position, directs current to a terminal in the engineer's junction panel. From there current is sent to the individual governor-control switches on the engineer's instrument panel; and also sent to actuate a relay in the transformer panel which supplies a.c. for the propeller indicators.

c. When either the pilots' governor switch is moved to "INCREASE RPM," or the engineer's switch(es) is held in "DECREASE PITCH," current is sent through the engineer's junction panel and the bomb bay aft relay panel to the propeller relay box. The relay box contains a reversing relay and a small reversing d.c. motor. This motor actuates switches which deliver d.c. in interrupted sequence to a stator motor in the electric head of the propeller assembly. The stator motor is linked to the governor spring. A variation in spring tension brings about a corresponding change in propeller pitch.

d. When either the pilots' governor switch is moved to "DECREASE RPM," or the engineer's switch(es) is held in "INCREASE PITCH," current to the motor in the relay box is reversed and the stator motor turns in the opposite direction to increase the pitch and decrease the rpm.

5. LOCK PITCH.- The engineer's pitch control switches also incorporate a "LOCK PITCH" position which allows the blades to be held at any desired angle. When the switch is moved to this position, current is sent through the engineer's junction panel and the bomb bay aft relay panel to energize the lock pitch solenoid in the propeller hub assembly; thus preventing governor action from affecting the control system.

6. INDICATOR CIRCUIT.

a. Indicators are provided on the engineer's instrument panel for each propeller unit. An indicator light (amber) illuminates whenever the pitch of the propeller has reached either of its normal range limits. There are also calibrated indicators for the degree of propeller pitch.

b. Both indicators operate on a.c. picked up from a bus in the engineer's junction panel. The current passes through a relay in the transformer panel which is actuated by current picked up in the pilots' pedestal and routed through the pilots' master disconnect switch, and then through the engineer's junction panel to the relay. The readings on pitch indicator instruments are controlled by the pitch transmitter in the propeller hub assembly. The current is routed from the pitch transmitter through the bomb bay aft relay panel, and the engineer's junction panel to the indicator instruments.

(3) REMOVAL AND DISASSEMBLY.- The following removal instructions are, in general, the reverse of installation procedure. However, a puller is needed to remove the inter-propeller bearing assembly. To remove the roller bearing assembly, first screw the puller into the threaded part of the outer race of the inter-propeller bearing. <u>These are left-hand threads.</u> Put on the inboard component retaining nut wrench and turn it counterclockwise to pull the bearing from the cover plate of the inboard component.

(a) 60 COMPONENT.

1. Cut safety wire and remove the attaching screws for the spinner.

2. Remove the retaining nut lock wire.

3. Raise the hub and blades assembly until the sling is just about supporting its weight, but is not lifting the shaft.

4. Install the retaining nut wrench into the nut, and insert a bar through the wrench holes. Turn the wrench in an anticlockwise direction, backing the hub and blades assembly off the engine shaft.

5. After the threads have disengaged, carefully pull the hub and blades assembly off the shaft. Replace the retaining nut lock wire and remove the rear cone.

(b) 80 COMPONENT.

1. Remove the inter-propeller bearing assembly.

2. Remove the retaining nut lock wire.

3. Raise the hub and blades assembly until the sling is just about supporting its weight, but is not lifting the shaft.

4. Install the retaining nut wrench into the nut, and insert a bar through the

wrench holes. Turn the wrench in an anti-clockwise direction, backing the hub and blades assembly off the engine shaft.

5. After the threads have disengaged, carefully pull the hub and blades assembly off the shaft. Replace the retaining nut lock wire and remove the rear cone.

(c) CONTROL ASSEMBLY.

1. Unsafety and unscrew the large AN connector which is attached to the wiring harness.

2. Cut the safety wire and unscrew the 12 cap screws which secure the control support to the gear box. Carefully pull off the complete control assembly.

3. Remove the gasket and keep it with the control assembly.

(4) ASSEMBLY AND INSTALLATION.

(a) PREINSTALLATION CHECKS.

1. The propeller is installed as three units: the control assembly and the two hub and blades assemblies. However, it is necessary to partially disassemble the control assembly in order that the eccentric assembly gears on the rear component hub may be meshed with the auxiliary gears in the control support. The entire hydraulic unit (the governor, governor head, servo motor, and solenoid pack assemblies) and the wiring harness, including auxiliary motor, must be removed.

2. Check all visible parts for nicks, burrs, and other damage. Carefully remove such damage with a fine stone or crocus cloth.

3. Clean the propeller thoroughly to minimize the chance of foreign matter entering the system. The use of leaded or aromatic fuels for cleaning should be avoided.

NOTE

Preservative compound should be thoroughly cleaned from the rear portion of the hub, including the eccentric assembly, pump rollers, thrust ring, etc., to minimize its absorption into the propeller oil system. The compound should also be removed from the control translating mechanism, especially the carbon rotating seal.

4. Test all parts for freedom of movement. The auxiliary gears in the support, the governor drive shaft, the auxiliary pump plunger, the eccentric, and the pump piston rollers should be rotated by hand. The servo rack and translating mechanism are checked for centering by depressing the calibrating pin and pushing the index stop against the pin with the spring compression bolt. (See

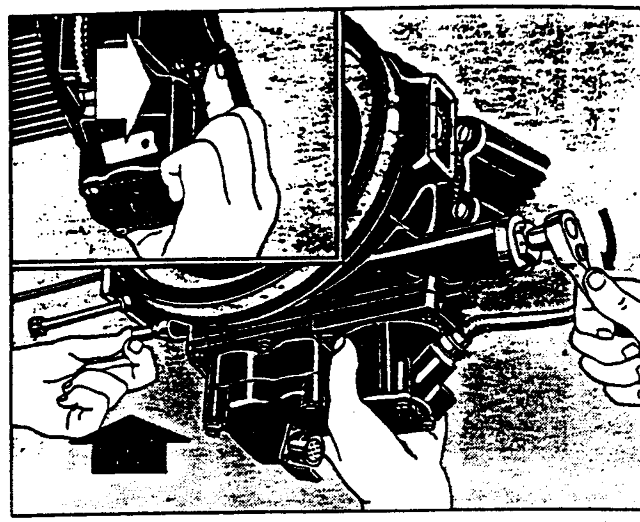


Figure 3. Tightening Spring Compression Bolt and Depressing Calibration Pin

figure 3.) If there is any doubt as to centering, or for a sure check, remove the solenoid pack and move the index stop against the calibrating pin by hand. Abnormal binding due to improper fits or foreign particles will usuall be revealed by the preliminary test.

(b) INSTALLATION TOOLS REQUIRED:

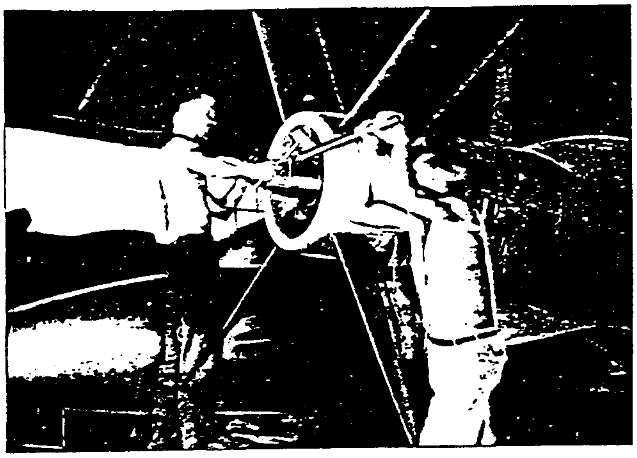
NOMENCLATURE	APPLICATION
Hub Retaining Nut Wrench for No. 60 Component.	To tighten and loos the propeller retaining nut.
Propeller Retaining Nut Wrench for No. 80 Component.	To tighten and loos the propeller retaining nut.
Valve Cap Wrench.	To install and remove the distributc valve cap.
Distributor Valve Gauge.	To check and adjust the distributor va setting.
Spring Compression Bolt. A steel 1/4 x 28 bolt, 2 in. in length and threaded full length.	To compress the se springs during the angle adjustment pr cedure.

(c) INSTALLATION PROCEDURE. (See figure

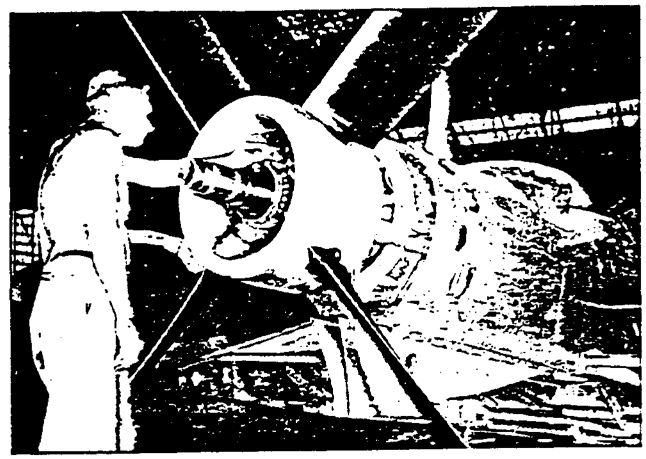
1. INSTALLATION OF CONTROL ASSEMBLY.

a. Place the composition gasket against the thoroughly cleaned mounting surfac of the gear box nose, then the control assemb minus the hydraulic and auxiliary motor-wirin harness units. It may sometimes be easier to place the gasket over the control screws, and then install both. The retaining screws whic hold the control onto the gear box should be tightened evenly, and safetied in pairs with wire. Care must be observed not to cock the control on the nose plate while tightening the screws.

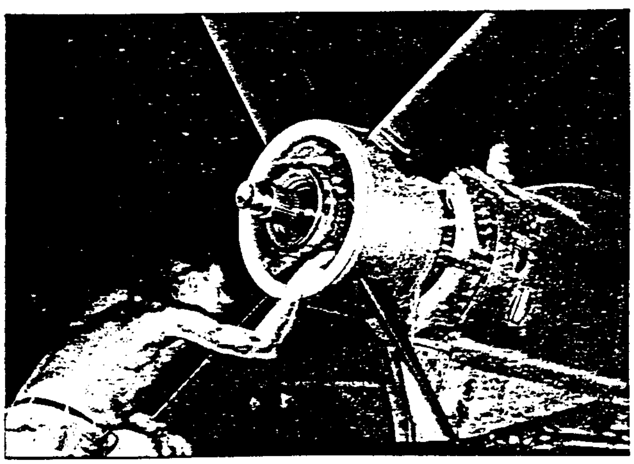
b. The servo rack should be in mid-position. If there is any doubt, recheck as outlined in paragraph 10 d (4) (a) 4 precedin



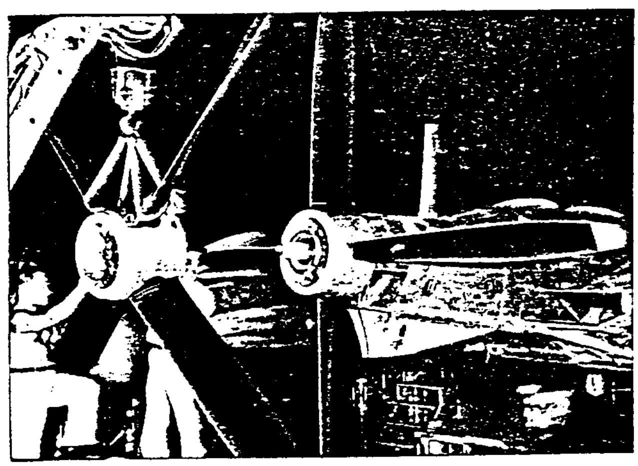
Tightening No. 80 Component Retaining Nut



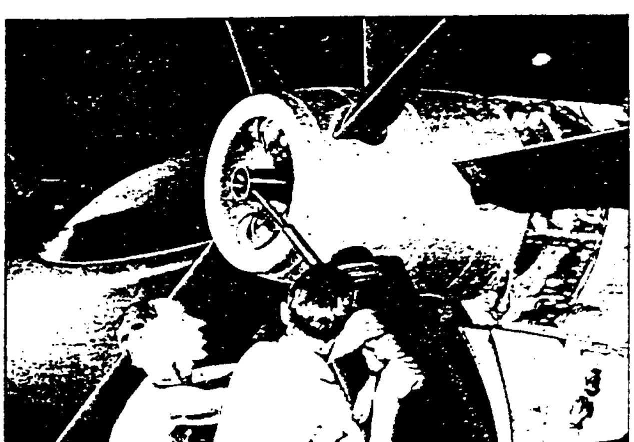
Checking Distributor Valve Setting



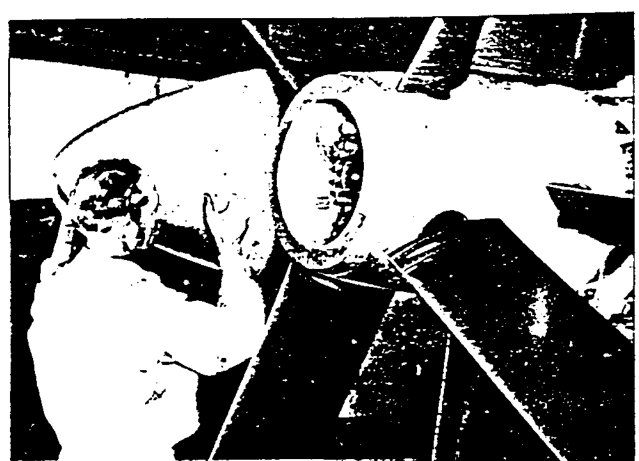
Translating Control Installed



Installing No. 60 Component



Tightening No. 60 Component Retaining Nut



Installing Spinner

Figure 4. Propeller Installation

c. If it is necessary to change the initial setting of the hydraulic stops, the rack must be in the midposition as determined by the calibrating pin; i.e, the rack guide surface contacting the calibrating pin must be in line with the "index" mark on the index plate. With the rack in this position, the stop setting can be changed to any angle indicated on the index plate. The flat sides of the constant speed stops indicate the angles at which they are set. The flat side of the reverse and feather stops in the housing indicate the angle set. To prevent the stops from rotating, a stop lock plate fitting into slots in the stops is attached to the housing.

2. INSTALLATION OF THE 80 HUB AND BLADES ASSEMBLY.

a. On initial installation only, the propeller bearing inner race must be shrunk on the outboard shaft. To install the inner race, first heat it in an oil bath to approximately 200°F. Slide the heated race against the shoulder of the outboard shaft and let it cool.

CAUTION

Make sure the race is put on in its proper position.

b. Install the rear cone on the propeller shaft, moving it back until it contacts the propeller shaft thrust bearing nut. To prevent seizure of the propeller retaining nut on the propeller shaft, apply a thin film of thread lubricant (Specification No. AN-C-53) or clean engine oil to the shaft threads and splines.

c. Lift the 80 component into position, making sure the hub is held so the blank spline in the hub is in line with the wide spline on the engine shaft, and that blade clearance is provided for the installation work stand. A woven strap lifting sling having straps at least two inches wide is recommended.

NOTE

The straps should be placed around the blade about one foot out on the airfoil section. Solid hook slings should never be used as they tend to damage the relatively thin blade-airfoil section.

d. Install the 80 component and move it carefully onto the splined shaft until the retaining nut threads contact the gear box shaft threads. Fit the 80 retaining nut wrench into the retaining nut and a short bar into the wrench. Then turn the nut, moving the hub and blades assembly onto the shaft. As this is done, rotate the auxiliary-pump-drive gear (small gear) and the governor drive (large gear) and idler gear with the fingers until the gears mesh with the hub gears.

CAUTION

The idler gear must ratchet (turn) clockwise.

When these have meshed, the auxiliary motor idler gear should be rotated as the retaining nut is turned farther onto the shaft until it is meshed with the hub eccentric gear.

NOTE

<u>Extreme care</u> must be exercised while turning the retaining nut, to mesh correctly the governor drive gear and the eccentric gear with the idler gears in the control support in order to prevent gear breakage.

At the time of mesh, all idler gears in the control support should be checked for a slight backlash. The hub retaining nut should advance on the threads without binding or catching. If it does not, recheck both the retaining nut and the propeller shaft threads for burrs, nicks, cross-threading, etc.

e. After these three sets of gears have meshed, the retaining nut should be secured with a torque of 1500 pound-feet. While this torque is maintained, rap the bar sharply with a four-pound hammer about one foot from the wrench. Lock the retaining nut by inserting the retaining nut lock ring. It can be held in place by applying a thin coating of grease on the ring. Should the slots not be lined up, the nut must be <u>tighten</u> until they do coincide. Never loosen the nut to align the locking slots.

f. Install the roller bearing assembly on the inner race. Use a non-metallic hammer to tap the outer race into the front cover plate of the 80 component. Make sure the bearing assembly is fully seated.

g. Remove the distributor valve cap from the 80 component. The cap slides off over the extension that operates the distributor valve of the 60 component. Lift the extension out of the slotted plug in the end of the distributor valve.

NOTE

The extension plug does not interfere with the use of the distributor valve gauge. The gauge fits over the plug.

h. In order to set the distributor valve, the blades should be at an angle between 20 and 50 degrees. Check the setting of the distributor valve. (See figure 5.) Place the distributor valve "GO, NO-GO" gauge over the distributor valve bushing in such a way that the outer ring of the gauge fits flatly against the end of the cam. The inner ring rests on top of the distributor valve. Then check the setting by twisting the "GO, NO-GO" gauge with the fingers. The square lug should pass over the surface marked "GO." Should the valve not be set correctly, it should be screwed in or out as required. (See figure 6.) If the lug is under the "GO"

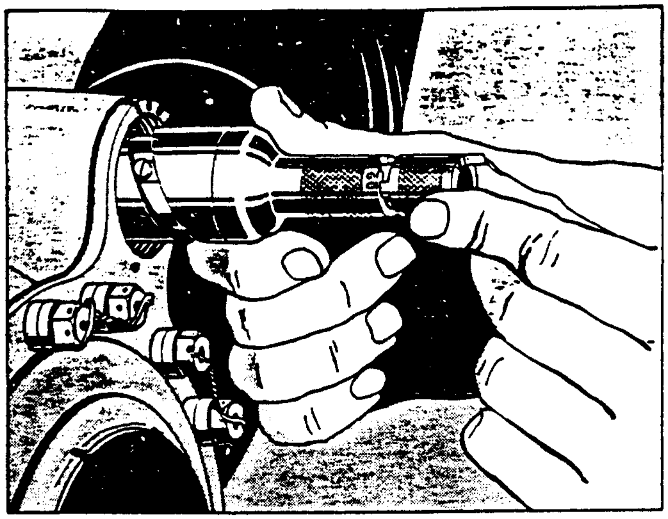


Figure 5. Checking Distributor Valve Setting

limit, turn the valve counterclockwise; if the lug is above the "NO-GO" limit, turn it clockwise. Reverse the gauge and push it into the valve opening so that the front, on the end of the gauge, fits into a groove on the adjustable stop. To unlock the adjustable stop which is normally locked by a pin, the gauge must be pushed in approximately 3/16-inch against distributor-valve-spring force while the valve is turned. One full turn of the distributor valve equals an approximate .025-inch adjustment and the locking grooves occur at .003-inch intervals. After correct adjustment has been made, care must be taken to insure that the spring-loaded stop snaps into a locked position. Then check the distributor valve setting as before with the "GO, NO-GO" gauge. This is repeated until the proper setting is obtained.

i. Replace the distributor valve extension and valve cap with its toroid seal using the distributor valve cap wrench, and tighten to a torque of 50 pound-feet. Safety the cap to the cover plate with a cotter pin.

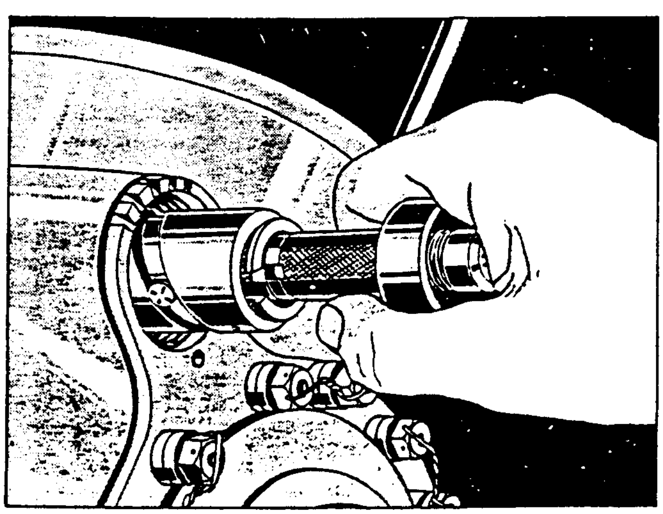


Figure 6. Adjusting Distributor Valve Position

j. Put on the oil guard gasket and the inter-propeller oil guard. Make sure there is an oil seal on the end of the distributor valve cap and another in the oil guard. Tighten the oil guard retaining screws evenly to prevent oil leakage. Safety the screws in pairs.

CAUTION

When installing the 60 component, make sure that the driven lug on the inter-propeller assembly is not in line with the driving lug on the oil guard.

3. INSTALLATION OF THE 60 HUB AND BLADES ASSEMBLY.

a. The 60 component is installed in the same manner as was the 80 component except in this case, there is no need of meshing any gears. The distributor valve is set in the same manner as above using the same gauge. The same propeller retaining nut torque applies to this component as on the 80 component. The blades of the two components should cross at 22.5 degrees.

b. Lock the retaining nut by inserting the retaining nut lock wire through one of the small holes in the retaining nut and into a mating slot of the cover plate. Should two of these not be lined up, the nut must be tightened until one end and one slot coincide. Never loosen the nut to align the locking holes.

4. COMPLETION OF THE INSTALLATION.

a. Install the hydraulic unit into the control support by mounting the governor over the four studs provided on the side of the control support, taking care that the proper gaskets are in place and that the idler gear in the bracket meshes correctly with the drive shaft. There should be a gasket between the governor and the control support and between the servo motor and the support. Draw up the self-locking nuts evenly and snugly onto the studs.

b. Attach and safety the auxiliary motor-wiring harness unit with its gasket to the control support. Then tighten and safety all electrical connections including the one to the crew nacelle.

c. To adjust the pitch transmitter, the alternating current must be on. The pitch indicator should now read 35 degrees; that is, the course hand should be midway between the 30 and 40-degree graduations and the fine hand at the 5-degree position. If necessary, turn the external adjusting screws on the rear of the transmitter case until the pitch indicator indicates the indexing angle of 35 degrees. (See figure 7.) Lock the adjusting screws in this position by tightening the self-locking nuts. If greater adjustment is necessary, the transmitter must be lowered from the control and the gear pinion rotated by hand. After installation of the transmitter, further external adjustment may be necessary.

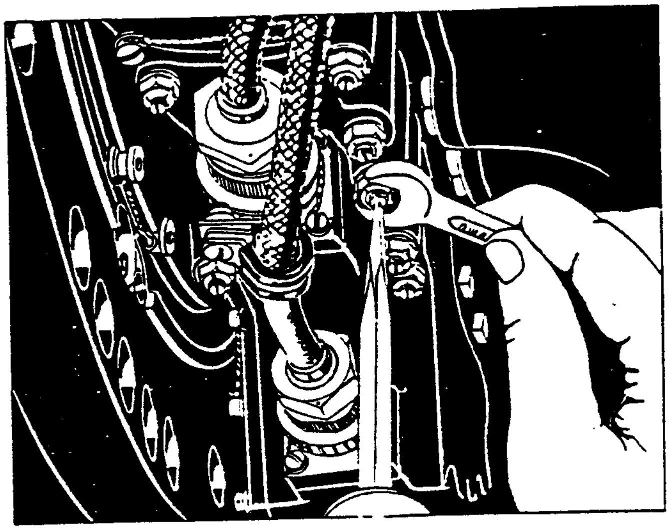


Figure 7. Adjusting the Pitch Transmitter

d. Tighten the spring compression bolt enough to relieve the load on the calibrating pin, allowing the pin to snap out into its original position. Then remove the bolt, and reinstall the pipe plug into the servo outer lock nut and safety it with wire. Then replace and safety the calibrating pin cap. Note that the calibrating pin cap should be tightened finger tight only.

e. Remove the hub sump filler plug and fill the sump with paraffin base SAE No. 10 oil. Under extreme low temperature conditions where congealing is a factor, the use of Univis No. 60 oil is recommended. Replace and safety the plug or release the plunger. Assuming that the control has been oil tested or that it has not been disassembled after the removal, no oil need be added to the control when installed, as the scavenge pump fills the unit.

f. In order to completely fill the hub and control hydraulic systems, run the engine for five minutes and exercise the propeller through its constant speed range. Stop the engine and check both sumps. If necessary, add oil to the hub sump, and replace the filler plug. This check should be repeated until the hub sump will accept no more than five ounces of oil.

5. CONTROL ADJUSTMENTS.

a. GENERAL.- The control system should permit the pilot to set the desired rpm accurately and conveniently.

b. GROUND TEST.- The low pitch limit should never be adjusted so low that it will be impossible to maintain flight in case the propeller goes to full low pitch. The high pitch setting should permit level flight without excessive manifold pressure, since the blades will assume the high pitch position if the control oil force fails to act upon the servo piston.

1. If, with the low pitch hydraulic stop correctly set and the crew nacelle control in the high rpm position, the engine speed increases as the throttle is opened until it approaches the rated take-off rpm, the propeller blades are in full low pitch, and the governor may be adjusted to govern at a higher rpm than required. This shows that the governor unit is operating correctly and can be set to govern at the indicated rpm. Move the switch to the "INCREASE RPM" position until the tachometer reads the rated take-off rpm, and then without further adjustment of the propeller controls, shut down the engine.

NOTE

> If engine speed exceeds the proper high rpm setting when the crew nacelle control is moved into the high rpm position, it is possible that the governor setting is too high, and the blade angle setting too low. To check, reduce the throttle, move the governor control into the high rpm position, and then shut down the engine. Check the low blade angle by using a protractor at the 72-inch blade-reference station. If the low pitch stop is incorrectly set, remove the pitch limit solenoid assembly and the stop lock plate, reset the low pitch stop, then reinstall the plate and the pitch limit solenoid. To adjust the take-off setting, follow the instructions described in this paragraph.

2. If, with the crew nacelle control at the high rpm position, the engine does not turn rated take-off rpm on the blocks but does respond to a slight reduction in control setting, it is an indication that the unit is governing but the setting of the governor high rpm adjustment screw is too low. It should be noted that loss in engine power brought about by poor carburetion, fouled plugs, etc. may also be evidenced by the inability to obtain take-off rpm, and these factors should be taken into consideration.

e. GEAR BOX. (See figures 8, 9, and 10.)

(1) GENERAL.- A gear box, for the purpose of translating power is located between each engine extension shaft and its respective propeller assembly. (See figure 1.) Each gear box consists of a propeller-shaft-case section and a reduction-gear-case section.

(2) PROPELLER-SHAFT-CASE SECTION.

(a) PROPELLER SHAFT CASE.- The propeller-shaft case supports the outer propeller shaft, and houses the propeller governor, and the outer-propeller-shaft reverser-drive gearing.

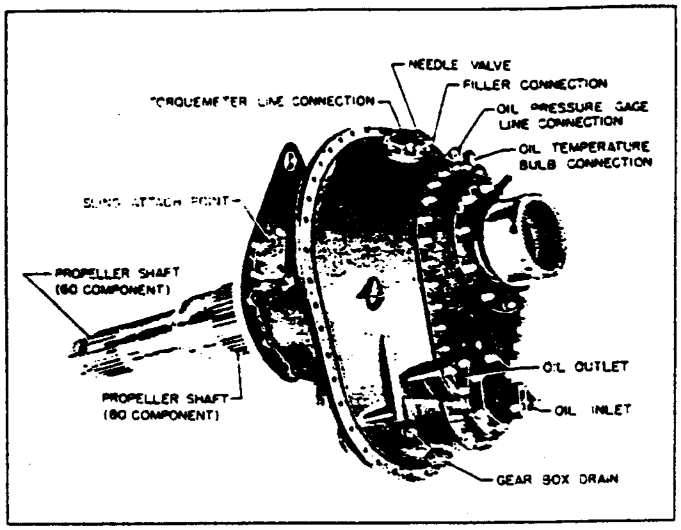


Figure 8. Gear Box - Front

(b) OUTER-PROPELLER SHAFT.- The outer-propeller shaft incorporates a No. 80 spline at its front end for mounting the rear propeller. The main body of the shaft is supported in the propeller shaft case by the outer propeller shaft thrust bearing. The rear end of the shaft is supported by the inner propeller shaft thrust bearing. A liner, shrunk and pinned inside the outer propeller shaft, provides a seat for two oil seal rings mounted in a carrier on the inner propeller shaft.

(c) OUTER-PROPELLER-SHAFT-REVERSER DRIVE.- The outer-propeller-shaft reverser-drive gear is bolted to the forward side of the reduction drive pinion shaft front support. The reverser pinion cage is splined to the rear inside diameter of the propeller shaft case. The pinions rotate on shafts which are secured in the pinion cage by special lock screws.

(d) The reverser pinions drive the outer-propeller-shaft drive gear which rests on its

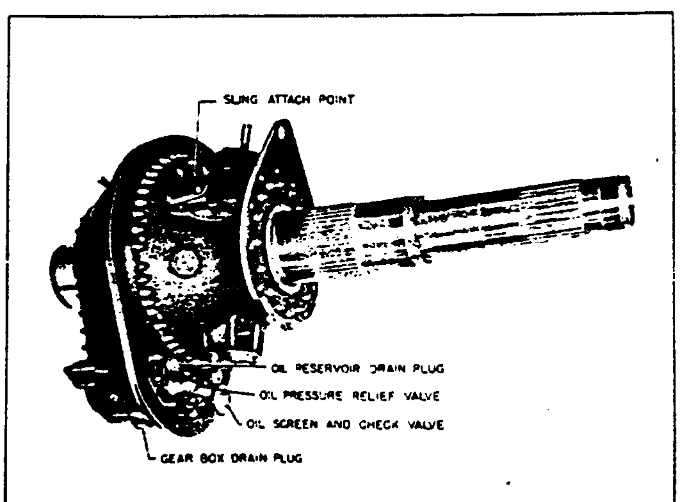


Figure 9. Gear Box - Rear

support. The outer-propeller-shaft drive gear support is, in turn, supported by a ball bearing. The drive gear is splined to the outer propeller shaft coupling which is bolted to the propeller shaft flange. The front accessory drive gear, which is attached to the front of the outer-propeller-shaft flange, [illegible] the governor intermediate-drive bevel gear.

(e) GOVERNOR DRIVE.- The governor intermediate-drive spur gear is supported by a flanged bushing in each end of a boss projecting internally from the upper part of the propeller shaft case. The governor intermediate-drive bevel gear is splined to the inner end of the spur gear shaft and is driven by the front accessory drive gear. The governor intermediate-drive spur gear meshes with the governor drive gear, which is mounted in an adapter at the top of the case.

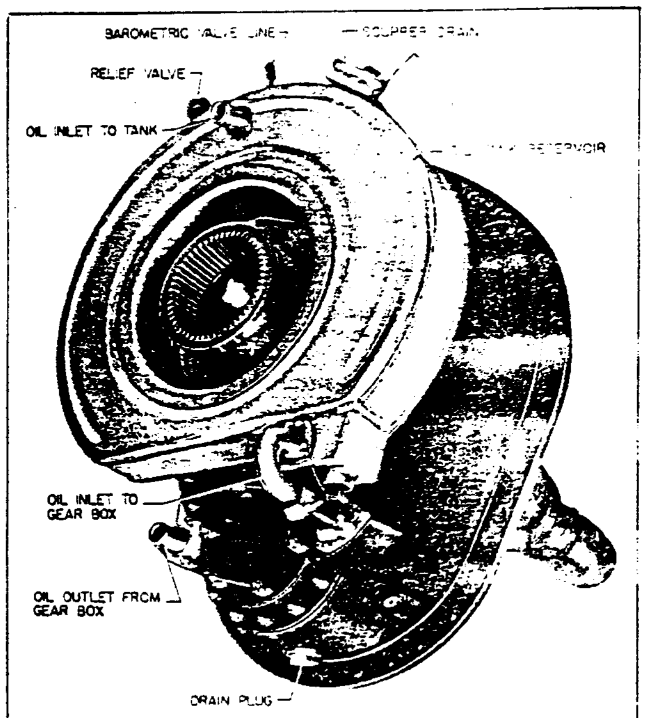


Figure 10. Gear Box and Oil Reservoir Assembly

(f) PROPELLER SHAFT THRUST BEARINGS.

1. Both the inner-propeller shaft and the outer-propeller shaft thrust bearings are of the ball type with split [illegible]. The outer race of the outer-propeller shaft bearing seats in the propeller shaft case liner. The thrust bearing cover retains the outer race of the bearing against the rear flange of the liner, and the thrust bearing nut retains the inner race against a shoulder on the propeller shaft. The [illegible] bearing nut carries two oil seal rings which contact the liner in the thrust bearing cover. The thrust bearing cover spacer [illegible] between the thrust bearing cover [illegible] outer race of the bearing. An oil slinger is held between the thrust bearing nut and the bearing

inner race. The bearing supports the main body of the outer propeller shaft and transmits propeller thrust from the outer propeller shaft to the case.

2. The inner-propeller-shaft thrust bearing is the smaller of the two thrust bearings. The outer propeller shaft coupling retains the outer race of the bearing against a shoulder in the rear end of the outer propeller shaft. The inner race of the bearing is retained on the inner-propeller shaft between the inner-propeller-shaft oil seal ring carrier and the outer-propeller shaft drive gear support bearing. An oil slinger is held between the oil seal ring carrier and the thrust bearing inner race.

(3) REDUCTION-GEAR-CASE SECTION

(a) REDUCTION-GEAR CASE.- The reduction-gear case incorporates a torquemeter operating mechanism and a three chamber oil pump, and houses the propeller reduction drive gearing and a power take-off. The power take-off drive gear, supported at each end by a ball bearing, mounts a spur gear at its forward end from which the oil pump is driven. Oil is fed to and from the oil pump through external pipes.

(b) INNER-PROPELLER SHAFT.- The inner-propeller shaft incorporates a No. 60 spline at its front end for mounting the front propeller and supports the reduction-drive pinion cage. The pilot end of the shaft is supported by two bronze steel backed bearings in the bore of the reduction-drive shaft. The main body of the inner-propeller shaft is supported by the inner-propeller shaft thrust bearing and by a propeller shaft intermediate bearing which is located on the inside diameter of the outer-propeller shaft. The bore of the inner-propeller shaft is separated into two compartments by a propeller-shaft plug. Various oil holes and pipes transfer oil from the rear compartment to lubricate the reduction gearing. No oil is admitted to the front compartment of the inner propeller shaft.

(c) REDUCTION-GEAR-DRIVE SHAFT.- The reduction-gear-drive shaft is supported by a ball type thrust bearing seating in a liner in the bore of the reduction gear case rear cover. The bearing outer race is retained against the liner inner flange by a thrust bearing cover and spacer. The rear face of the bearing inner race bears against an oil slinger held between the inner race and an oil seal ring carrier which, in turn, seats against a shoulder on the reduction-gear-drive shaft. The power take-off intermediate drive gear is splined onto the reduction gear drive shaft, with its rear hub seating against the front face of the thrust bearing inner race, thus retaining the race in place.

(d) REDUCTION-DRIVE PINIONS.- The 11 reduction drive pinions are of the spur planetary type. Each pinion rotates around a steel race which is slotted to engage the pinion shaft dowel pin, thereby preventing the race from spinning. The ends of each pinion shaft are supported by the pinion shaft front and rear supports.

(e) REDUCTION-DRIVE-PINION-SHAFT SUPPORTS.- The pinion cage consists of the pinion shaft front and rear supports. The hub end of the front support is pressed onto the splines on the rear of the inner-propeller shaft and locked in place by a spanner nut. The rear support is secured to the rear ends of the pinion shafts.

(f) REDUCTION-DRIVE GEAR.

1. The reduction-drive pinions are driven by the reduction-drive gear and, as they rotate within the reduction-drive fixed gear, they turn the pinion supports and hence the propeller shafts at .381 times crankshaft speed.

2. The reduction-drive gear is pressed onto the splines of the reduction-drive gear outer coupling which is splined onto the inner coupling. This unit is, in turn, splined onto the reduction gear drive shaft, seating against the front hub of the power take-off intermediate-drive gear and locked in place by a spanner nut. The reduction-drive gear, the outer coupling, and the inner coupling are locked together by four snap rings.

(g) REDUCTION-DRIVE-SHAFT OIL TRANSFER BEARING.- The reduction-drive-shaft oil transfer bearing floats on the reduction drive gear coupling just behind the reduction drive gear. Oil from the front oil pump flows through a passage around the power take-off drive gear, around the power take-off intermediate drive pinion, through a telescoping pipe into the oil transfer bearing. The oil then flows through holes in the coupling, drive shaft, and propeller shaft into the bore of the propeller shaft where it maintains oil pressure for lubricating the reduction-drive pinions. Oil flows from the oil transfer bearing through a spring-loaded telescoping pipe and through cored passages in the reduction-gear case to lubricate the outer-propeller-shaft drive gear reverser pinions.

(h) REDUCTION-GEAR-CASE OIL PUMP.- The reduction gear case oil pump housing consists of four sections bolted together to form one booster pressure chamber for torquemeter mechanism operation, a pressure chamber for reduction gearing lubrication, and an oil scavenge chamber. The pump housing incorporates an oil screen chamber and a high pressure compensating relief valve. The torquemeter section boosts oil from the reduction gear case oil pump pressure chamber sufficiently to operate the torquemeter under the greatest engine driving torque. A spring loaded relief valve by-passe the surplus oil to the oil passage at the inlet pressure.

(i) TORQUEMETER OPERATING MECHANISM.

1. The splines in the reduction-gear case engage similar splines on the reduc-

tion-drive fixed gear, and are cut at an angle so that engine driving torque produces a component thrust toward the rear on the fixed gear. To counteract this thrust there are 40 small pistons placed in holes in the rear face of the fixed gear. The piston heads rest on a torquemeter steel thrust ring attached to the reduction gear case.

2. Engine oil under high pressure from the booster section of the front oil pump enters the fixed gear through the torquemeter gear oil feed hose and is admitted to the pistons through the drilled passages in the fixed gear. One of the pistons, the master piston, controls the oil flow in such a way that, as the fixed gear moves toward the front, the oil flow is decreased; and as the fixed gear moves toward the rear, the oil flow is increased. Thus the fixed gear is balanced between the thrust component of the engine torque and the thrust caused by the oil pressure on the pistons. The piston oil pressure is directly proportional to the engine driving torque and is transmitted from the gear to the inner side of the transmitter diaphragm, by the torquemeter oil feed hose. The torquemeter gage in the crew nacelle provides a direct indication of the propeller driving torque.

3. TORQUEMETER TRANSMITTER.- The torquemeter transmitter, which consists of a diaphragm and housing assembly, is attached to the reduction-gear case. It prevents engine oil from mixing with the low viscosity oil used in the torquemeter pressure gage line, thus preventing congealing in the line with resultant sluggish operation of the pressure gage.

(4) REMOVAL.

(a) Disconnect engine from adjoining extension shaft by proceeding as instructed in Section IV, paragraph 7 b (3).

(b) Remove gear box fairing and cowling. Further access to the gear box may be attained through hand-holes.

(c) Loosen three wood screws in knurled nut which secures extension shaft to gear box.

(d) Secure strap wrench to knurled nut.

(e) Disconnect extension shaft from gear box by turning the propeller assembly opposite the normal direction of rotation. This may be done by hand. If propeller has previously been removed, turn spline shaft by means of special wrench.

(f) If propeller assembly has not been removed, remove as instructed in paragraph 10 d (3) preceding.

(g) Secure sling to mount (gun synchronizer) pads.

(h) Drain oil from oil reservoir by removing plug immediately above oil pressure relief valve.

(i) Disconnect AN-3 bolt which secures gear box drain to gear box.

(j) Disconnect plumbing and electrical lines to gear box and oil reservoir. These include an oil-in and an oil-out line, a scupper drain, a barometric control line, torquemeter and oil pressure transmitter lines, an oil reservoir drain line, and a thermometer bulb connection.

(k) Remove nut plate bolts which secure gear box to airplane.

(l) Maneuver entire assembly (gear box and oil reservoir) aft, until it is free of obstruction.

(5) INSTALLATION.- Reverse the removal procedure described in paragraph 10 e (4) preceding.

(6) TORQUEMETER TRANSMITTER CHECK.- Carefully examine the line to the torquemeter pressure transfer diaphragm for looseness and signs of leakage. If leakage has occurred, it may be necessary to add fluid to the system in order to insure elimination of all air between the diaphragm and the gage in the crew nacelle. To add fluid to the torquemeter gage line, remove the cap from the filler connection; then back off the needle valve in the torquemeter pressure transfer diaphragm cover and open the bleed at the crew nacelle end of the gage. Pump fluid into the system until it flows from the bleed at the crew nacelle end of the gage line and the desired preload pressure is indicated on the gage. Close the bleed at the gage end of the line; then close the needle valve in the diaphragm cover and disconnect the pump line. Install the cap on the filler connection. An increase in the reading on the gage occasioned by turning in the needle valve may now be removed by opening the bleed at the gage end of the line and bleeding fluid until the desired pressure is indicated.

f. EXTENSION-DRIVE SHAFTS.

(1) DESCRIPTION. (See figure 1.)

(a) Engine thrust is transmitted from the crankshaft to the remote reduction-gear-drive shaft through a multiple-section extension-drive shaft which is secured to the crankshaft by a compound coupling and crankshaft extension assembly supported at the magneto case by the extension bearing support. The outboard engines have a two-section extension-drive shaft which provides a length of 213.847 inches from engine centerline to face of propeller thrust bearing nut. The inboard engines have a three-section extension-drive shaft which provides a length of 326.404 inches from engine centerline to face of propeller thrust bearing nut.

(b) The crankshaft extension is supported by a ball type thrust bearing in the extension bearing support. (See figure 11.) The bearing inner race is retained against a shoulder on the crankshaft extension by the crankshaft extension coupling which is splined onto the

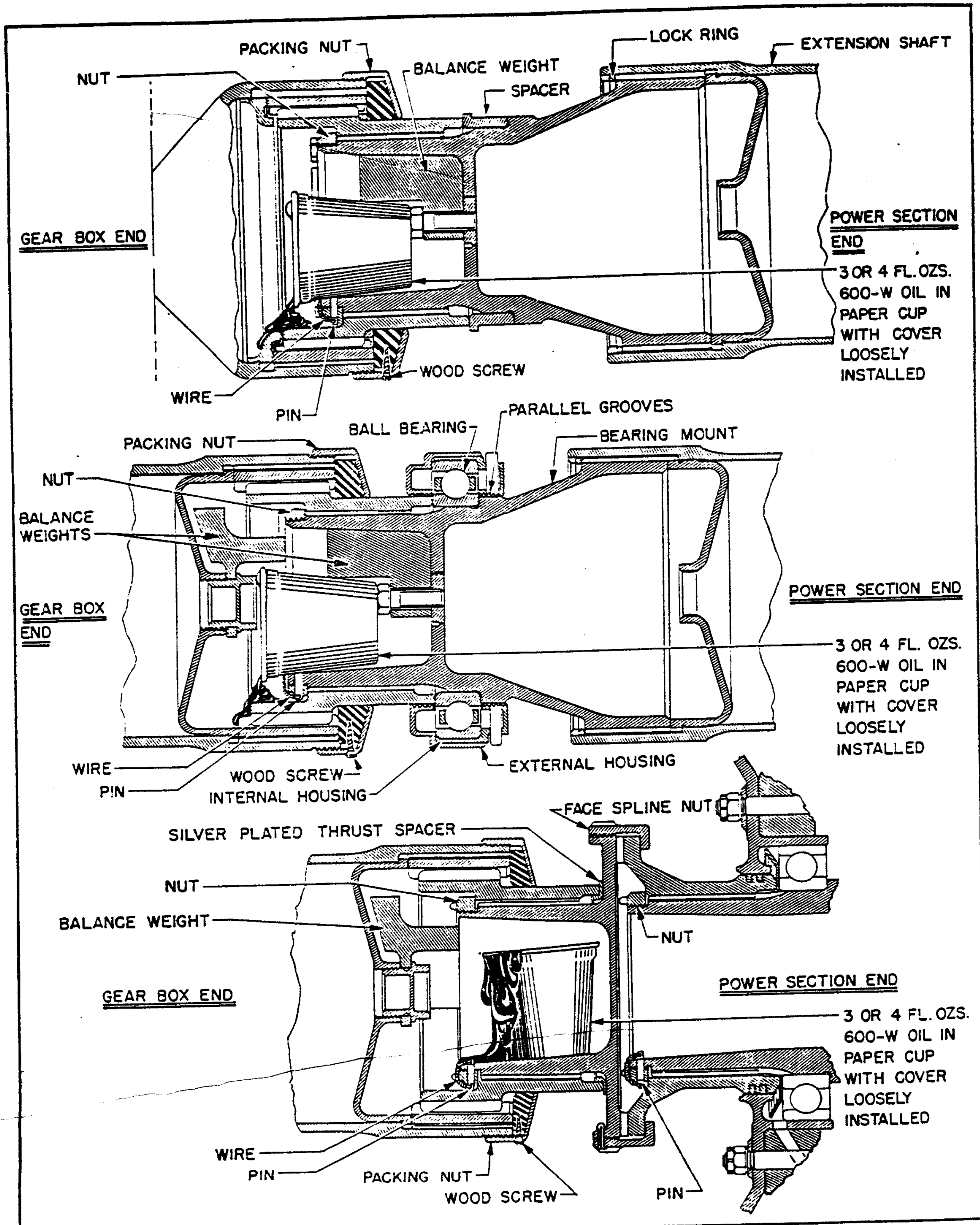


Figure 11. Extension Shaft Joint Assembly

crankshaft extension and secured with a spanner nut. An oil slinger is held between the thrust bearing inner race and the crankshaft extension coupling. A vertical plane engine mounting ring bracket is bolted to the front of the bearing support and incorporates two lips, the larger of which serves to locate the bracket in the bore of the bearing support and acts as a liner in which the thrust bearing outer race is supported. The smaller lip provides a seat for the two oil seal rings incorporated on the crankshaft extension coupling. The extension-drive shaft intermediate coupling is splined onto the extension-drive shaft coupling, butting against a thrust spacer which seats on the flange of the extension-drive-shaft coupling, and is secured with a spanner nut. This compound coupling is face splined to the crankshaft extension coupling and locked in place with a spanner nut incorporating a lip, and mounted on the crankshaft extension coupling. The extension-drive shaft is splined onto the extension-drive-shaft intermediate coupling and secured with a spanner nut. The extension-drive shaft is similarly coupled to the reduction-gear-drive shaft at the reduction-gear case.

(c) The crankshaft extension is bolted to the crankshaft adapter, which is splined onto the front splines of the crankshaft and locked in place with a spanner cap nut. The bolts which retain the crankshaft extension also secure a ring gear to the crankshaft adapter.

(2) REMOVAL AND DISASSEMBLY. (See figures 1 and 11.)- To facilitate work, it is recommended that the engine and the propellers and gear boxes for the extension shaft to be removed, be disconnected and removed from the airplane first. To disconnect and remove the engine refer to Section IV, paragraph 7 b (3). To remove propellers and gear box refer to paragraphs 10 d (3) and 10 e (4) preceding.

NOTE

After removing the engine, and before removing the propellers and gear boxes, disconnect the drive shaft at the gear box by gripping the locking nut with a strap wrench and pulling the propellers through by hand in the opposite direction. See paragraph 10 e (4) preceding.

CAUTION

The loose fitting splines will accommodate, without binding, a maximum angular (axial) misalignment of 41 minutes. Likewise, the ball bearing will accommodate, without serious damage, a maximum angular misalignment of 41 minutes. The shafts must be supported within these limits during assembly and disassembly. 41 minutes is equal to approximately 1 inch deflection per 100 inches along a shaft axis.

(a) INBOARD EXTENSION SHAFT.- The inboard extension shaft consists of three segments. Access to the shafts and shaft joints is gained through the bomb bays. The aft shaft joint has two lightening holes in the shaft housing at the joint on the inboard side, which are covered with tape; the outboard side of the shaft housing has two large hand holes. The forward shaft joint has two hand holes on the inboard side, and one hand hole on the outboard side.

1. Remove the three wood screws locking the packing nut, and with a strap wrench holding one shaft, back off the packing nut with another strap wrench.

2. Remove the two lock pins and with a PWA-3087 Wrench, back off the nut joining the shafts.

3. Remove the upper and lower bearing cap and one bracket.

4. Remove the aft shaft.

5. Remove the three wood locking screws on the nut at the second shaft joint and back off the packing nut with a strap wrench.

6. Remove the two lock pins, and with a PWA-3087 Wrench back off the nut joining the shafts.

7. Remove only the upper bearing cap and remove the second section of the shaft.

8. Remove the lower half of the leather bulkhead seal around the forward drive shaft.

9. Release the tension on the hydraulic pump belts at the pump brackets.

10. Remove the wedges holding the pulley sheaves in place.

11. Remove the center and then the aft sections of the extension shaft through the engine compartment.

(b) OUTBOARD EXTENSION SHAFT.- The outboard extension shaft consists of two segments. Access to the shaft is through the engine compartment and the access holes in the propeller shaft housing.

1. Remove the three wood screws locking the packing nut and, with a strap wrench holding one shaft, back off the packing nut with another strap wrench.

2. Remove the two lock pins, and with a PWA-3087 wrench back off the nut joining the two shafts.

3. Release the tension on the hydraulic pump belts at the pump brackets.

4. Remove the wedges holding the pulley sheaves in place.

5. Remove the upper and lower bearing caps.

6. Remove the aft and then forward shaft segment.

(3) ASSEMBLY AND INSTALLATION. (Refer to figures 1 and 11.)

(a) The extension shafts are in lengths of approximately five and seven feet. Each outboard engine has a five foot length next to the engine power section and a seven foot length next to the remote gear box. One ball bearing is used where the two lengths are splined together. Each inboard engine has three seven foot lengths supported by ball bearings at the shaft joints. A face spline is used between the power section and the adjacent shaft to provide a connection requiring little axial movement for disengagement. The shafts can be assembled in the airplane by working from the power section toward the gear box.

CAUTION

Do not use hand-holes in the propeller shaft housing structure as fulcrums for levers when installing shafts.

(b) Figure 11 shows the make-up of the joints and all connections. Each shaft length should be completely assembled as a subassembly up to the loose fitting spline in order to reduce to a minimum the work required around the airplane structure.

CAUTION

The loose fitting splines will accommodate, without binding, a maximum angular (axial) misalignment of 41 minutes. Likewise, the ball bearing will accommodate, without serious damage a maximum angular misalignment of 41 minutes. The shafts must be supported within these limits during assembly and disassembly. 41 minutes is equal to approximately one inch deflection per 100 inches along a shaft axis.

(c) The assembly and installation procedure is the reverse of the disassembly and removal procedure outlined in paragraph 10 f (2) preceding.

(d) In order to insure proper lubrication, each ball bearing should be cleaned, inspected, and lubricated just prior to installation of the shafts in the airplane. To lubricate and assemble a ball bearing, place the bearing in its two housings and use enough 600-W oil to cover half the lowest ball (see figure 12). Assemble the bearing and housings onto the bearing mount, drifting against the bearing inner race only. Assemble the splined adapter, rubber packing, and packing nut onto the bearing mount. Tighten the lock nut with PWA-3087 Wrench.

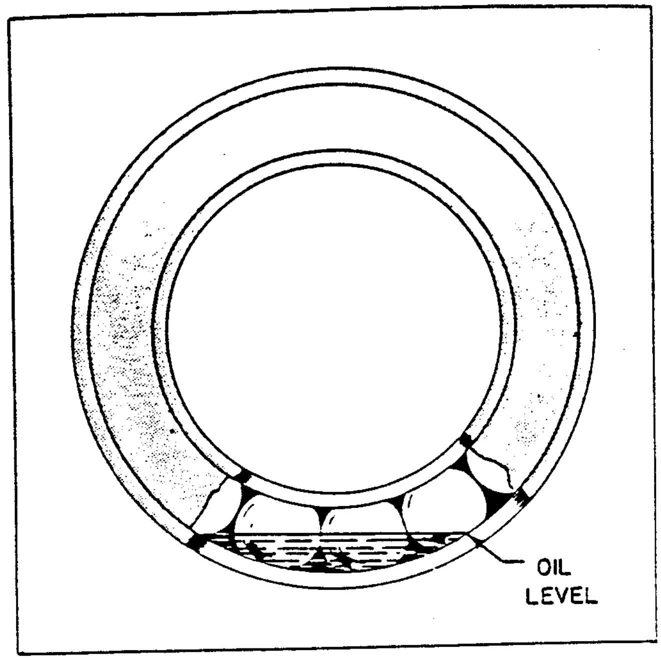


Figure 12. Bearing Lubrication Level

Secure the nut with the special lock pin and safety wire. Do not secure the nut with a cotter pin.

NOTE

After lubrication, the bearing races should be retained in a vertical plane to prevent the loss of oil.

(e) The loose fitting spline, likewise, is lubricated with 600-W oil. This is done when the shafts are assembled in the airplane by placing 3 or 4 fluid ounces of the oil in a small paper cup, such as a Dixie cup, and placing the cup in the bearing mount. As soon as the engine is started, the oil will spill onto the splines. No damage results from leaving the cup inside. (See figure 11.)

(f) The balance weights shown in the sketches (figure 11) are tack welded when the shafts are balanced at the factory, and the welds should not be broken at any time. If the bearing mount is ever removed from the shaft, be sure to align the marked splines upon reassembly.

(g) The large nut at the face spline was originally designed with slots on the OD for a spanner wrench. A later design incorporates scallops for a chain wrench. It is recommended that PWA-3243 Chain Wrench be used on both types of nut. Secure the nut with a cotter pin.

(h) Be careful not to damage the nut used adjacent to the rubber packing. To obtain a satisfactory seal, the nut must be drawn up very tightly with a strap wrench. Make sure the packing is in its proper position. Lock each nut with three wood screws placed through the OD of the nut and screwed into the rubber packing.

11. FUEL SYSTEM

11. FUEL SYSTEM.

a. MAIN FUEL SYSTEM DESCRIPTION. (See figure 1.)

(1) Each engine is provided with an independent fuel supply system comprised of the following units: two interconnected self-sealing fuel cells (one of which contains a submerged fuel booster pump and a fuel level transmitter), a fuel strainer, emergency fuel shut-off valve, fuel control valves, fuel flow transmitter, and an engine-driven fuel pump. Manual emergency fuel shut-off valve controls are located in the forward cabin above the entrance doorway. The fuel valve controls, pressure gages, rate of flow indicators, and the fuel level gages are located on the engineer's control panel.

(2) The two left-hand fuel systems are connected to a common manifold, the left-hand and right-hand manifolds being connected through the cross-feed line. Two-position, on and off, fuel valves are incorporated in the manifold and cross-feed lines. These valves are electrically-controlled, motor operated units (see figure 2). The emergency fuel shut-off valves are manually-operated through cable control systems. (See figure 3.)

(3) Electrically-operated priming and oil dilution systems are provided for each engine. Information pertinent to these two systems is contained in Section IV, paragraphs 7 and 12 respectively.

b. AUXILIARY POWER PLANT FUEL SYSTEM DESCRIPTION.

(1) The airplane is provided with two auxiliary power plants, each of which is supplied with 86 octane fuel from a separate fuel system. Each system has an individual fuel tank having a capacity of 42.5 U.S. gallons. (See figure 14.) Both of these fuel tanks are mounted side by side in the number five bomb bay, the left-hand fuel tank supplying fuel to the auxiliary power plant in the number three bomb bay, and the right-hand fuel tank supplying fuel to the auxiliary power plant in the number six bomb bay. A dip stick is located in the top of each tank for measuring the quantity of fuel. A solenoid-operated shut-off valve is installed in each fuel system. This solenoid valve is opened when the starting circuit is energized, and remains open until the ignition switches are turned "OFF." Fuel is gravity fed to the engine-driven fuel pumps.

c. MAIN FUEL SYSTEM OPERATION.- Fuel may be supplied to an engine from any tank desired through the use of the cross-feed and fuel-control valves.

WARNING

Any fuel tank selections other than those listed should be ground checked first to determine if proper fuel pressure is being maintained. This precaution should be taken until future flight tests are made to confirm booster pump pressures.

The "TANK ONLY" position of the engine valve allows fuel from each main tank to flow to its respective engine. The "TANK AND MANIFOLD" position allows fuel from a main tank to feed its respective engine and also directs fuel into the manifold line. The "MANIFOLD ONLY" position connects an engine with the manifold line and cuts off its main tank supply. Therefore, if an engine valve is turned to "TANK AND MANIFOLD" and another engine valve is turned to "MANIFOLD ONLY," two engines will operate from one fuel tank. If an engine is operated on fuel from a tank on the opposite side of the airplane, the cross-feed valves must be "OPEN" to connect the two manifolds. The fuel booster pumps must be "ON" during all engine operations.

d. TROUBLE SHOOTING.

TROUBLE	PROBABLE CAUSE	REMEDY
Loss of fuel pressure	Engine pump spline shaft sheared.	Replace the pump.
	Booster pump not operating.	Check electrical wiring. Replace booster pump.

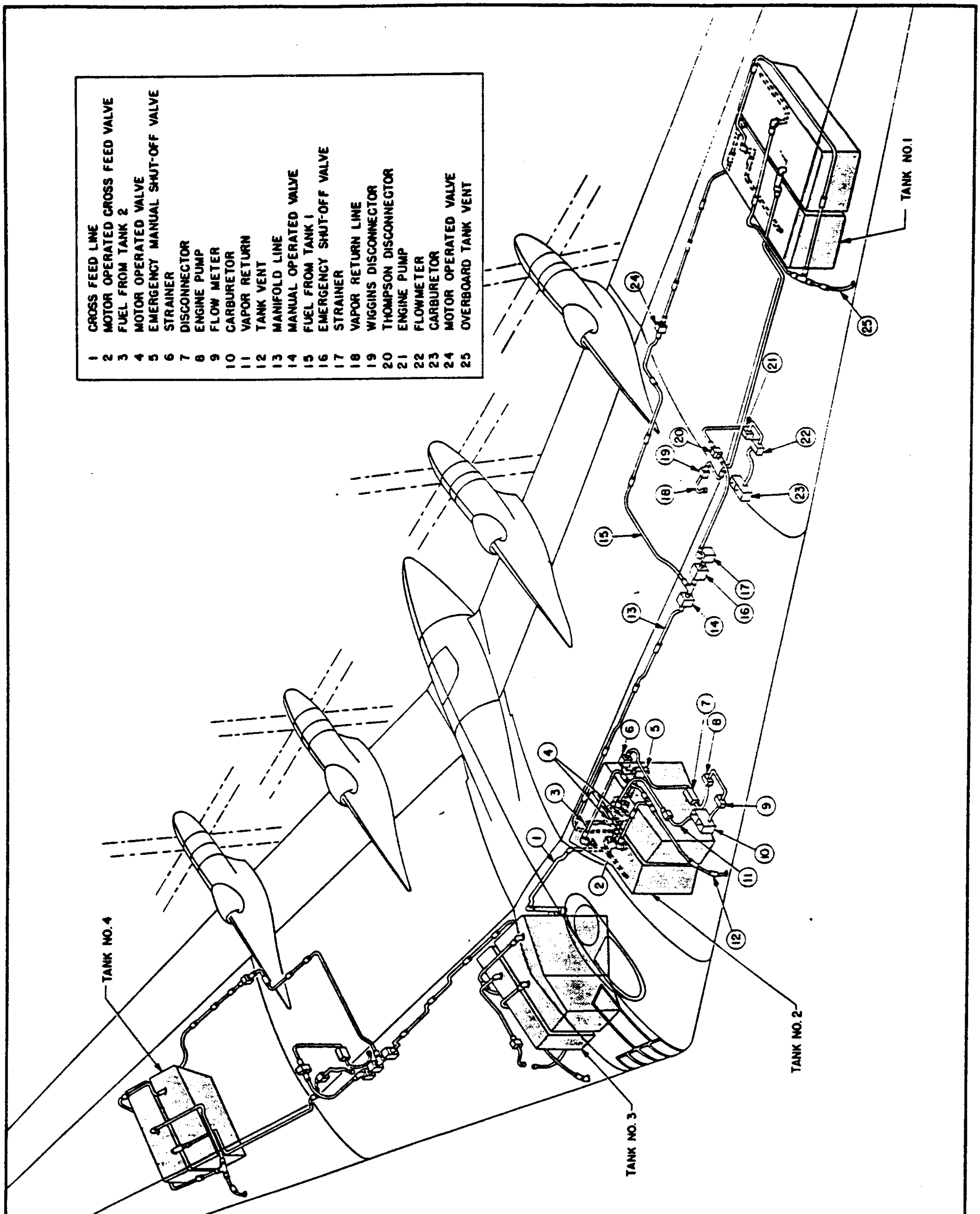


Figure 1. Fuel System

TROUBLE	PROBABLE CAUSE	REMEDY
Loss of fuel pressure.	Air leak in fuel intake line.	Check and tighten or replace connection.
	By-pass valve in engine pump held open.	Remove the valve. Check valve and seat. Clean and reinstall or replace.
Fuel leaking from the engine pump drain.	Worn pump seals.	Remove pump and replace seals or install new pump.
Engine loses power or sputters.	Water in fuel system.	Drain 1/2-pint of fuel from each tank drain and clean the fuel stainers.
Jelly-like substance on fuel strainer screen.	Defective fuel cell.	Drain and inspect the fuel cells; repair or replace as necessary. Clean the fuel strainers.
Metal particles in the fuel strainer.	Booster pump impeller rubbing the pump casting.	Remove booster pumps and inspect. Replace the faulty booster pump.

e. FUEL SYSTEM PRESSURE TEST.- The following tests are designed to provide a complete check for each individual fuel tank. Any fuel tank or combination of fuel tanks may be checked by use of the cross-feed and fuel selectors. A spot check of a replaced hose or line may be made by turning the fuel booster pumps "ON" and observing the connections for leaks.

WARNING

Fuel tank cells are not to be pressurized in excess of 5 inches Hg (2½ psi).

(1) Secure all fuel tank filler caps.

(2) Turn off all tank sump drains and engine strainer drain valves.

(3) Seal each of the main tank vent lines at the outlet end.

(4) Disconnect and seal each carburetor fuel vapor return line as close to the carburetor as conveniently possible.

(5) Turn each fuel quick disconnect off at each engine bay.

(6) "OPEN" the "EMERGENCY FUEL SHUT-OFF VALVES."

(7) "CLOSE" the cross-feed valves.

(8) Turn the main engine valves to engines number two, three, and four to "TANK ONLY."

(9) Turn the main engine valve for engine number one, to "TANK AND MANIFOLD."

(10) Using a manometer to indicate pressure, apply 5 inches Hg air pressure to the line connected to the outboard side of the left-hand cross-feed fuel valve.

(11) This pressurizes number one main fuel tank and all lines leading from it.

(a) The tank and lines now under pressure are to hold this pressure for a period of fifteen minutes without leaking. If leakage is indicated, using soap and water, locate and repair the leak. Re-test for fifteen minutes.

(12) Open and close engine number one strainer drain, and one at a time remove each line seal to check for line obstructions.

(13) Turn number one main engine valve to "TANK ONLY," and turn number two main engine valve to "TANK AND MANIFOLD." This pressurizes the number two main fuel tank and all lines leading from it.

(14) Test all lines leading from engine number two main fuel tank as outlined in paragraph (12) above.

(15) Turn number two main engine valve to "TANK ONLY" and "OPEN" the cross-feed valves. This pressurizes the cross-feed fuel line and the right-hand fuel manifold line up to the manifold fuel control valves for engines number three and four.

(16) Turn the number three main engine valve to "TANK AND MANIFOLD" and test the number three main fuel tank and lines as outlined in paragraph (12) above.

(17) Turn number three main engine valve to "TANK ONLY" and turn number four main engine valve to "TANK AND MANIFOLD."

(18) Test number four main fuel tank and lines as outlined in paragraph (12) above.

(19) Release the pressure from the system and turn all main engine valves to "TANK AND MANIFOLD."

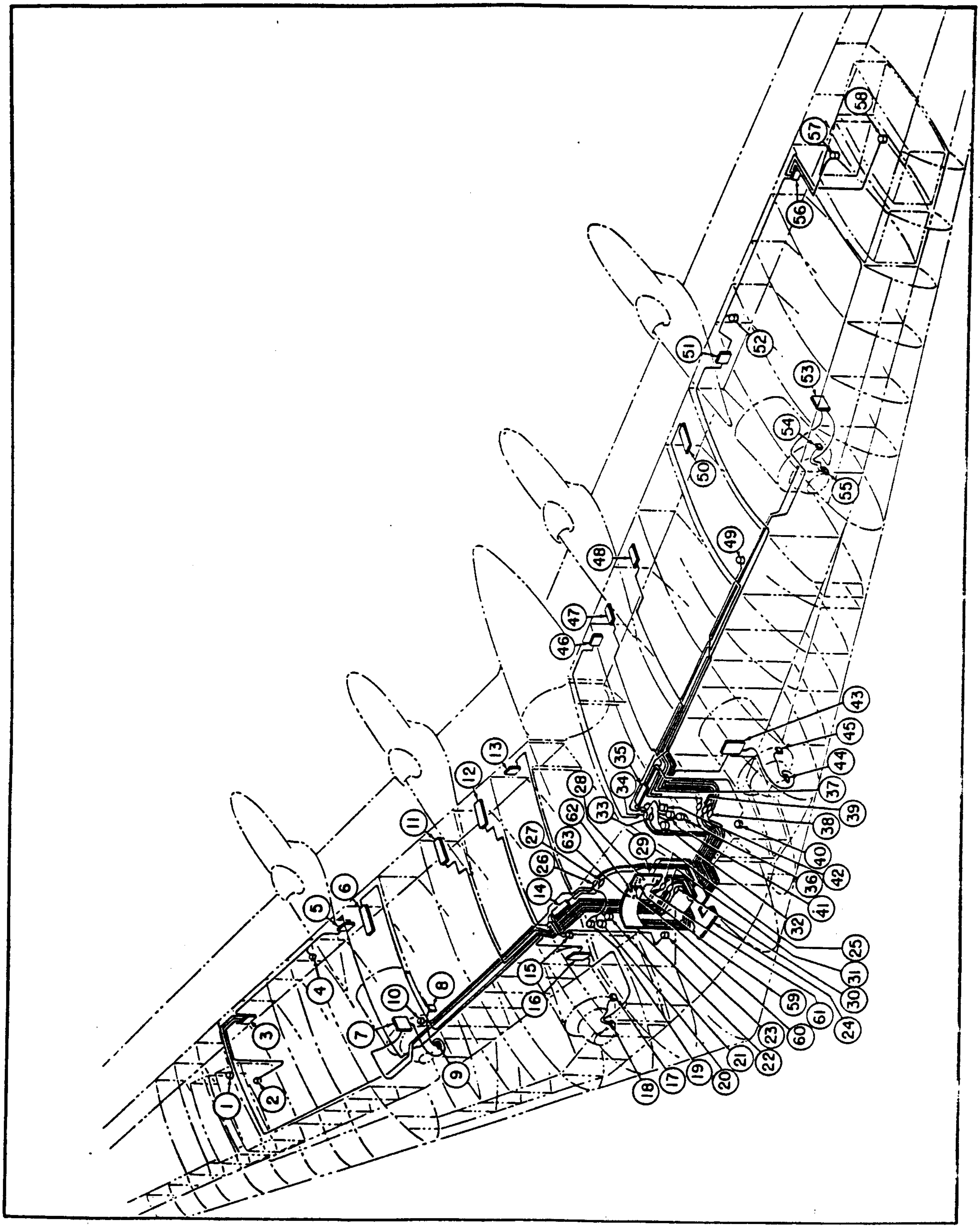


Figure 2. Fuel System Electrical Diagram (Sheet 1 of 3 Sheets)

ITEM	DESCRIPTION	LOCATION	DWG. NO.
1	Fuel Level Transmitter	Outboard Main Tank RH	593002
2	Fuel Pump	Outboard Main Tank RH	593002
3	AC Sectionalizing Panel	RH Outer Wing	553472-1
4	Engine No. 4 Tank Valve	RH Outer Wing	588850
5	Aft Relay Panel	No. 4 Engine Compartment RH	584574
6	Aft Relay Panel	Bomb Bay No. 8	584630
7	Disconnect Box	No. 4 Engine Compartment	584572
8	Fuel Flow Transmitter	No. 4 Engine Compartment	588850
9	Pull Box	No. 4 Engine	584578
10	No. 4 Engine Manifold Valve	Bomb Bay No. 8	588850
11	Aft Relay Panel	Bomb Bay No. 7	584632
12	Aft Relay Panel	Bomb Bay No. 6	584634
13	Relay Panel	Bomb Bay No. 5	557738-1
14	Fwd. Relay Panel	Bomb Bay No. 5	584598
15	Fuel Level Transmitter	Inboard Main Tank RH	593006
16	Disconnect Box	Engine No. 3 Compartment	584569-1
17	Fuel Flow Transmitter	Engine No. 3 Compartment	588850
18	Pull Box	Engine No. 3	584576
19	Engine No. 3 Tank Valve	Center Wing RH	588850
20	Engine No. 3 Manifold Valve	Center Wing RH	588850
21	Cross Feed Valve RH	Center Wing	588850
22	Engineer's Instrument Panel	Crew Nacelle Nose Section	551057
23	Fuel Pump	Inboard Main Tank RH	593006
24	Engineer's Junction Panel	Crew Nacelle Nose Section	551144
25	Pressurized Plug "E" RH	Center Wing	584544
26	Pressurized Plug "A" RH	Center Wing	584544
27	Pressurized Plug "B" RH	Center Wing	584544
28	Cross Feed Switch	Engineer's Lower Switch Panel	552672
29	Engineer's Lower Switch Panel	Crew Nacelle Nose Section	552672
30	Pressurized Plug "C" RH	Center Wing	584544
31	Pressurized Plug "D" RH	Center Wing	584544
32	Cross Feed Valve LH	Center Wing	588850
33	Pressurized Plug "B" LH	Center Wing	584543
34	Pressurized Plug "A" LH	Center Wing	584543
35	Fwd. Relay Panel	Bomb Bay No. 4	584597
36	No. 2 Engine Manifold Valve	Center Wing LH	588850

Figure 2. Fuel System Electrical Diagram (Sheet 2 of 3 Sheets)

ITEM	DESCRIPTION	LOCATION	DWG. NO.
37	Pressurized Plug "E" LH	Center Wing LH	584543
38	Pressurized Plug "C" LH	Center Wing	548543
39	Pressurized Plug "D" LH	Center Wing	584543
40	Fuel Pump	Inboard Main Tank LH	593005
41	Engine No. 2 Tank Valve LH	Center Wing	588850
42	Fuel Level Transmitter	Inboard Main Tank LH	593005
43	Disconnect Box	Engine No. 2 Compartment	584569
44	Pull Box	No. 2 Engine	584575
45	Fuel Flow Transmitter	Engine No. 2 Compartment	588850
46	Relay Panel	Bomb Bay No. 4	587738
47	Relay Panel	Bomb Bay No. 3	584633
48	Relay Panel	Bomb Bay No. 2	584631
49	Engine No. 1 Manifold Valve	Bomb Bay No. 1	588850
50	Relay Panel	Bomb Bay No. 1	584629
51	Relay	Engine No. 1 Compartment	584573
52	Engine No. 1 Tank Valve	Outer Wing	588850
53	Disconnect Box	Engine No. 1 Compartment	584571
54	Fuel Flow Transmitter	Engine No. 1 Compartment	588850
55	Pull Box	Engine No. 1	584577
56	AC Sectionalizing Panel	Outer Wing LH	553472
57	Fuel Level Transmitter	Outboard Main Tank LH	593001
58	Fuel Pump	Outboard Main Tank LH	593001
59	Tank Pump Switches	Engineer's Lower Switch Panel	552672
60	Fuel Flow Switches	Engineer's Lower Switch Panel	552672
61	Circuit Breakers	Engineer's Lower Switch Panel	552672
62	Fuel Level Indicators	Engineer's Instrument Panel	551057
63	Fuel Flow Indicators	Engineer's Instrument Panel	551057

Figure 2. Fuel System Electrical Diagram (Sheet 3 of 3 Sheets)

(20) Disconnect and seal each main fuel line at each of the four main fuel tanks.

(21) Using an air pressure gage, to indicate pressure, apply 25 psi air pressure to the fuel lines. The lines are to hold this pressure for a period of five minutes without leaking. If leakage is indicated, locate and repair the leak, and re-test for another five minute period.

(22) If leakage occurs through the quick-disconnect fittings, release the system air pressure and lubricate the fittings with fuel or engine oil, operate several times, then turn to "OFF," and re-apply the test pressure for another five minute period.

f. MAIN FUEL TANKS.

(1) DESCRIPTION. (See figure 1.)- Two interconnected self-sealing fuel cells are provided for each engine. Each set of cells is considered as one main tank, and incorporates a submerged fuel booster pump, fuel level transmitter, and a fuel drain. The fuel tank capacities are as follows:

Left outboard main tank (2 cells)
1239 U.S. (1031.68 Imperial) gallons

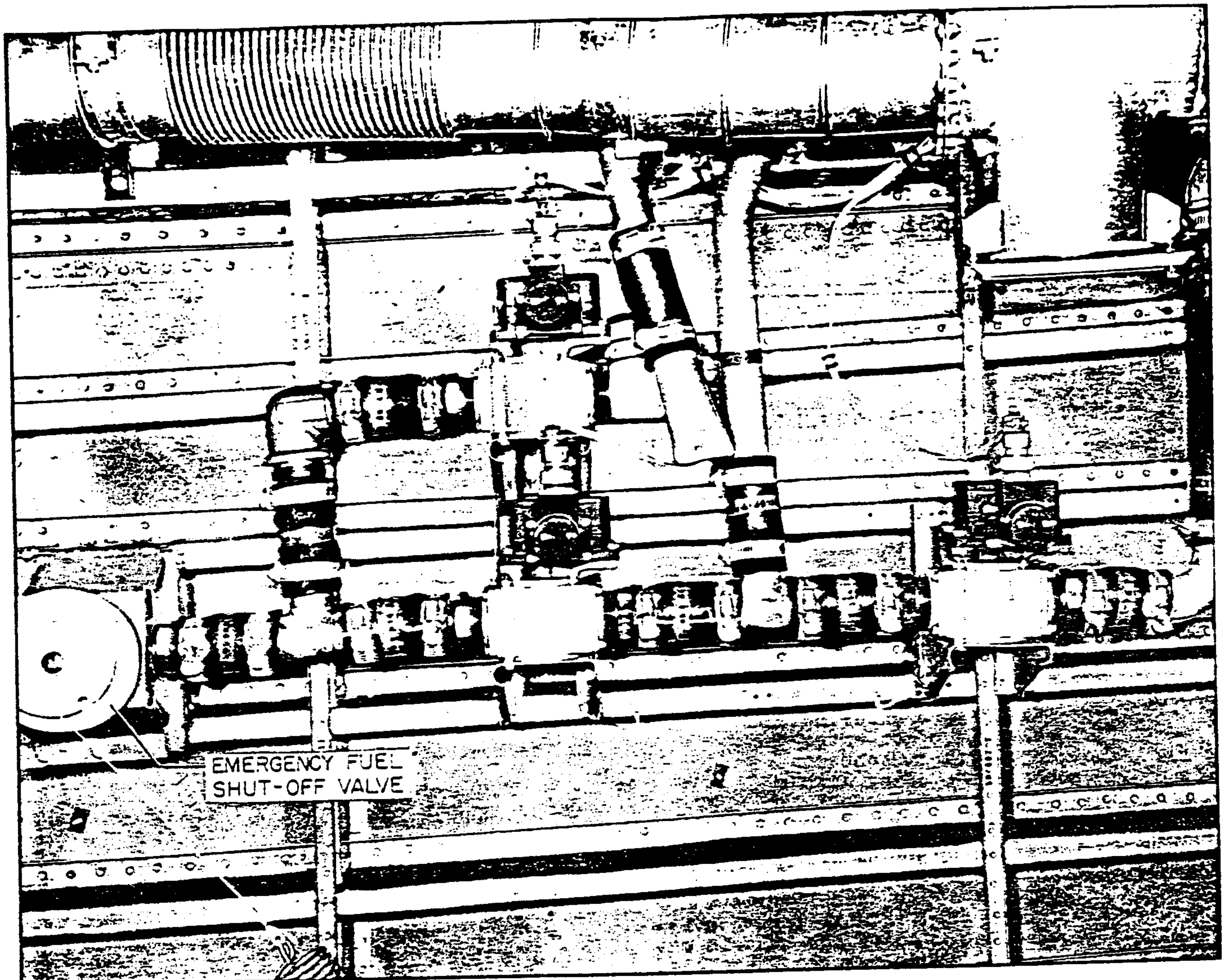


Figure 3. Motor Control Valves and Emergency Shut-off Valve

Left inboard main tank (2 cells)
1201 U.S. (1000.04 Imperial) gallons

Right inboard main tank (2 cells)
1321 U.S. (1099.96 Imperial) gallons

Right outboard main tank (2 cells)
1239 U.S. (1031.68 Imperial) gallons

TOTAL: 5000 U.S. (4163.36 Imperial) gallons

(2) REMOVING MAIN FUEL TANKS.- Each of the four main fuel tanks is comprised of two self-sealing fuel cells which are installed in separate compartments. The fuel cells are bolted to hangers installed on the compartment walls. The two fuel cells comprising a main tank are connected together by means of fuel and vent interconnectors (see figures 4 and 5.) The interconnectors, hanger bolts, and fuel line connections are accessible from within the fuel cells. The outboard main tank fuel cells are removed through access doors in the upper surface of the outer wing, and the inboard main tank cells are removed through doors bolted to the front spar in the forward end of the numbers three, four, five, and six bomb bays.

(a) Open the two access cover plates on the under side of the wing and drain the fuel from the cells to be removed. If the cell to be removed contains the fuel booster pump, disconnect the electrical wiring and remove the studs securing the cell to the structure around the booster pump.

(b) Remove the filler cap access cover from the top of the wing, then remove the 12 studs securing the filler cap neck to the structure (see figure 6).

(c) Remove the rectangular-shaped access cover over the inboard cells or the access door over the outboard cells.

(d) Mark the position in which the inspection covers are installed on the two cells, then remove them.

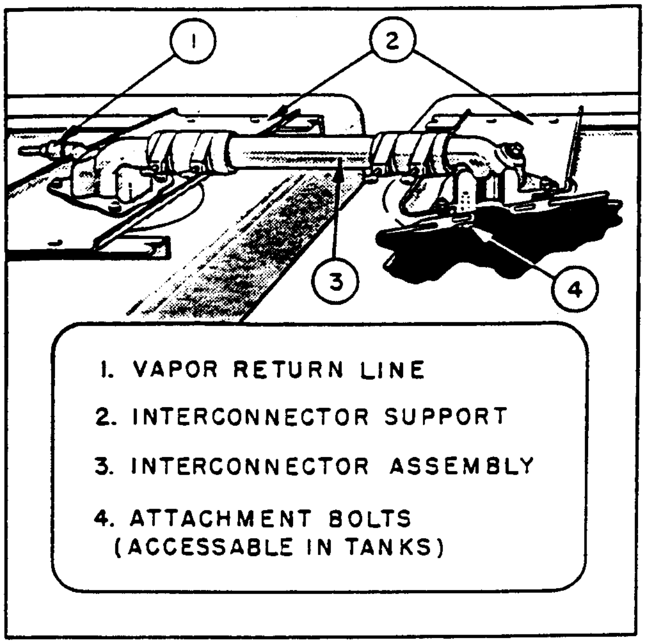


Figure 4. Fuel Cell Vent Interconnectors

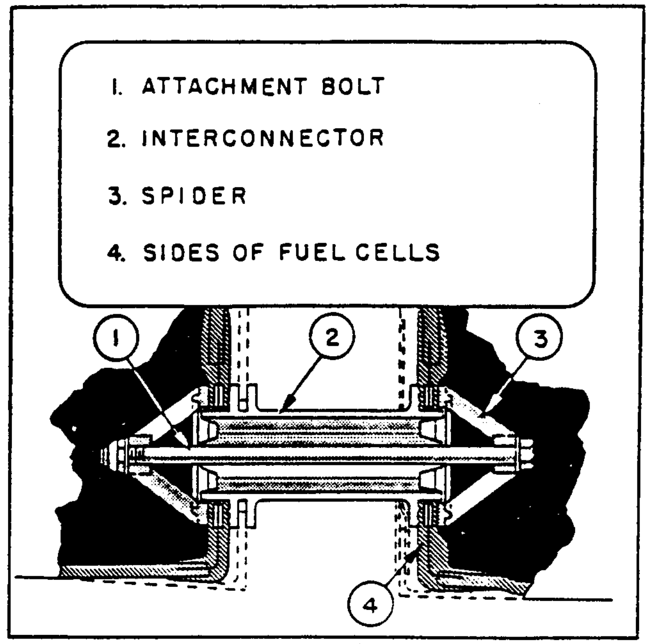


Figure 5. Fuel Cell Supply Interconnectors

WARNING

Fuel fumes are toxic; allow sufficient time for them to evaporate before entering the fuel cells. Do not enter the fuel cells with matches on your person or using lights that are not vapor-proof.

(e) The fuel interconnectors are secured to the cells by means of a bolt which extends through the center of the connectors from one cell to the other (see figures 4 and 5). Two men are required to remove this bolt; one to hold the head of the bolt in one fuel cell, while the other removes the nut and washer in the other fuel cell. Remove the bolt and connector fittings from each of the two connectors.

(f) Disconnect the vent interconnectors by removing the studs securing them to the top of the cells.

(g) Remove the hanger bolts from within the cell that is to be removed.

(h) Disconnect the vent line connections at the top of the cell.

(i) If the cell to be removed contains the fuel booster pump, make the following additional disconnections and removals:

1. Disconnect the scupper drain line at the filler neck.

2. Disconnect the fuel level gage electrical connections.

3. Disconnect the fuel supply line connection within the cell.

4. Remove the fuel booster pump and fuel drain line assemblies from the bottom of the cell. See paragraph g (2).

(j) If an inboard tank cell is to be removed, remove the door from the front spar in the bomb bay.

CAUTION

Handle fuel cells carefully to prevent damage to the magnesium ring inserts.

(k) Remove the cells from the wing as follows:

1. Inboard fuel cells: Draw cell aft into the bomb bay and lower it to the ground.

2. Outboard fuel cells: Lift up the forward end of the cell and insert wooden paddles between the cell and tank wall. Collapse the lower forward edge of the cell and at the same time hoist the cell upward and pull forward.

NOTE

Weights of the fuel cells are as follows:

Inboard forward set of leakproof cells:

Left-hand inboard cell	344.6 pounds
Right-hand inboard cell	375.4 pounds
Left-hand outboard cell	268.3 pounds
Right-hand outboard cell	276.7 pounds

Outboard aft set of leakproof cells:

Left-hand inboard cell	294.4 pounds
Right-hand inboard cell	285.6 pounds
Left-hand outboard cell	259.3 pounds
Right-hand outboard cell	272.6 pounds

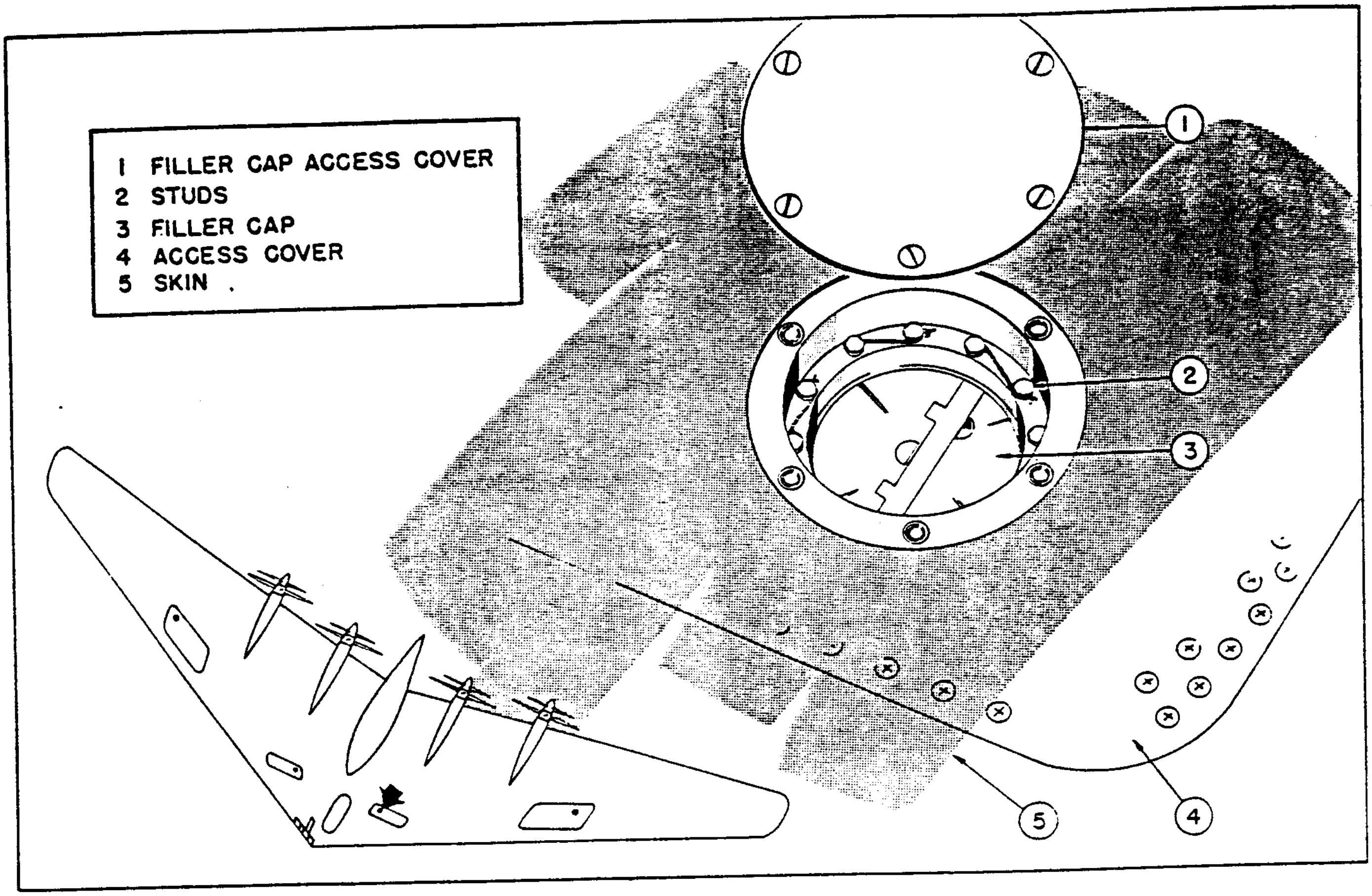


Figure 6. Fuel Tank Filler Cap Access

(3) INSTALLATION MAIN FUEL TANKS. (See figures 7 and 8.)

(a) All bolts must be tightened to the following torques:

3/16 - 1/4 inch	35-40	inch-pounds
5/16 - inch	40-50	inch-pounds
3/8 - inch	120	inch-pounds

(b) See that the fuel cell has been properly inspected.

(c) Hoist an inboard fuel cell up into the bomb bay, then work it forward into its compartment. Lower the aft end of an outboard fuel cell into its compartment, then work the fuel cell aft and collapse the lower forward edge of the fuel cell with wooden paddles so that it will drop down into the compartment.

(d) On inboard fuel cells, connect the vent interconnector on top of the fuel cell, then install the access door on the front spar.

(e) On outboard fuel cells, install the two vent interconnectors on the top of the fuel cell.

(f) Install the two fuel interconnectors from within the fuel cells. Tighten the bolts to the required torque and safety them.

(g) Install the hanger bolts from within the cell. Be sure that two washers are installed under the head of each bolt. Tighten the bolts to the required torque and safety them to the washers.

(h) Install the booster pump and connec the wiring. Tighten the bolts to the required torque and safety them.

(i) Install the fuel drain assembly. Tighten the bolts to the required torque and safety them.

(j) Connect the fuel level gage.

(k) Connect the fuel and vent lines within the fuel cell.

(l) Inspect the interior of the cell thoroughly for foreign objects. Replace the inspection covers on the top of the cell. Tighten the bolts to the required torque and safety them.

(m) Install the access door over the top of the cell.

(n) Connect the scupper drain line at the filler neck.

(o) Install the studs securing the filler cap to the access door.

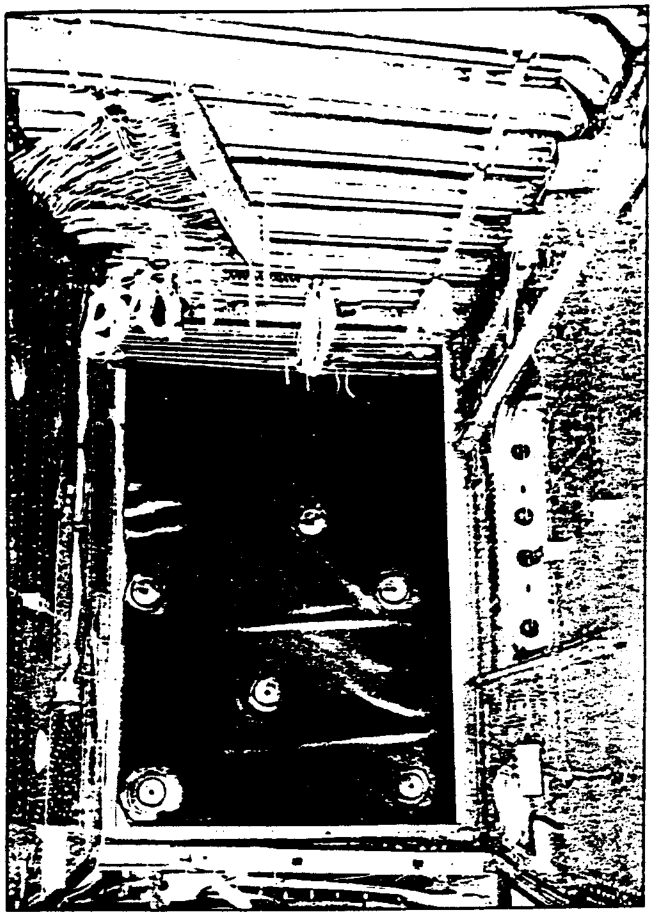


Figure 7. Inboard Fuel Tank Installation

(p) Test the fuel cell installation for leakage as outlined under paragraph 13 e.

(q) Fill the fuel tank and check the gage reading.

(r) Install the filler access door.

g. FUEL BOOSTER PUMPS. (See figure 9.)

(1) DESCRIPTION.- A Type B-15, 200 volts, 400 cycles, three phase, alternating current electric motor-driven fuel booster pump is installed in each main fuel tank. The fuel booster pumps are submerged, and operate flooded with fuel to provide lubrication of the bearings and cooling of the motor windings. The pump is bolted to fittings in the bottom of the fuel tank, and access is gained by removing the access cover from the lower side of the wing, under each main fuel tank.

(2) REMOVAL.

(a) Remove the access cover from the lower side of the wing.

(b) Drain the fuel from the tank.

(c) Disconnect the electrical wiring from the pump.

(d) Disconnect the drain line connection at the bottom of the pump.

(e) Cut the safety wire securing the bolts and hold the pump, then remove the bolts.

(f) Lower the pump through the bottom of the tank until the hose connection can be reached, then disconnect the hose connection and remove the pump.

(3) INSTALLATION.

(a) See that the fuel booster pump has been properly inspected.

(b) Hold the pump up into the tank and connect the fuel supply line to the pump connection.

(c) Position the pump into the bottom of the tank and install the bolts. Tighten the bolts to the required torque and safety them.

(d) Connect the electrical wiring. Turn the respective booster pump switch "ON" for a momentary operational check.

(e) Connect the drain line to the bottom of the pump.

(f) Safety the booster pump and tank drains.

(g) Install the access covers on the lower side of the wing.

h. FUEL CONTROL VALVES. (See figure 3.)

(1) DESCRIPTION.- Two electrically-operated, 24 volts, direct current, motor-controlled fuel control valves are incorporated in each engine fuel system. One fuel control valve, normally open, is installed in the main fuel tank supply line and the other, normally closed, is installed in the manifold line. Both fuel control valves operated from a single engine valve switch on the engineer's control panel (see figure 10).

(2) OPERATION.- The "TANK ONLY" position of the main engine valve switch allows both fuel control valves to assume their normal positions; manifold line fuel valve closed and main tank line fuel valve open. The "TANK AND MANIFOLD" position opens both fuel valves, thereby allowing fuel to flow to the engine and also into the manifold line. "MANIFOLD ONLY" position opens the fuel valve in the manifold line and closes the fuel valve in the fuel supply line from the tank.

i. CROSS-FEED VALVES.

(1) DESCRIPTION.- Two electrically-operated, 24 volts, direct current, motor-controlled fuel valves are installed in the cross-feed line which extends across the crew nacelle connecting the left and right manifold lines. An "ON-OFF" switch on the engineer's control panel operates these valves.

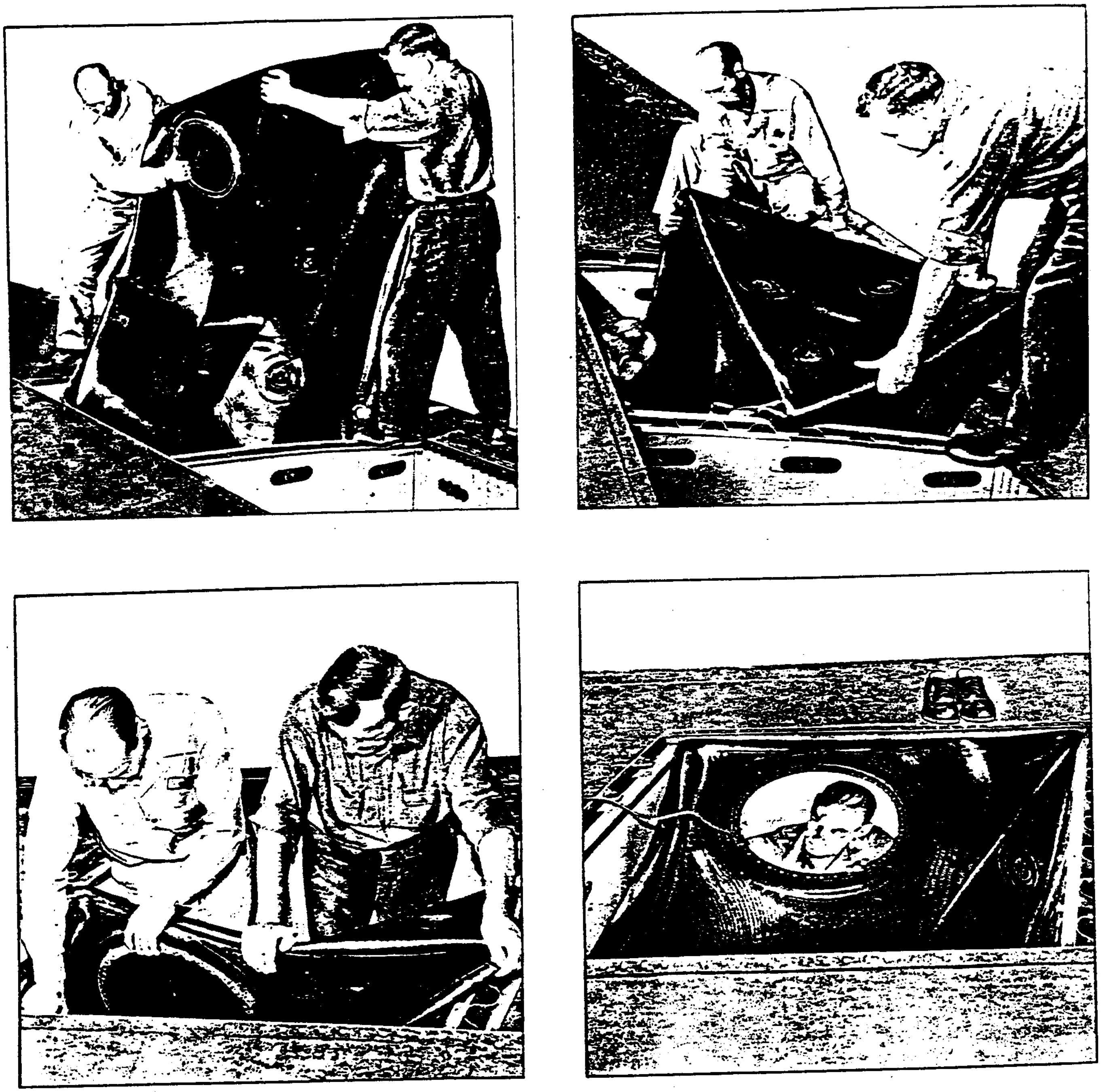


Figure 8. Outboard Fuel Tank Installation

(2) FUEL VALVE REMOVAL.- The engine fuel and cross-feed fuel valves are of the same type and removal procedure is the same for either.

(a) Remove the electrical connection to the valve motor.

(b) Loosen the hose clamps and remove the hose connections.

(c) Remove the two nuts and bolts which secure the valve to the support bracket and lift the motor and valve from the bracket.

CAUTION

Moving valves manually while they are assembled to the electric motor will damage the mechanism.

(3) FUEL CONTROL VALVE INSTALLATION.

(a) Bolt the valve to the supporting bracket in the correct position.

(b) Replace the hose connections and securely tighten the hose clamps.

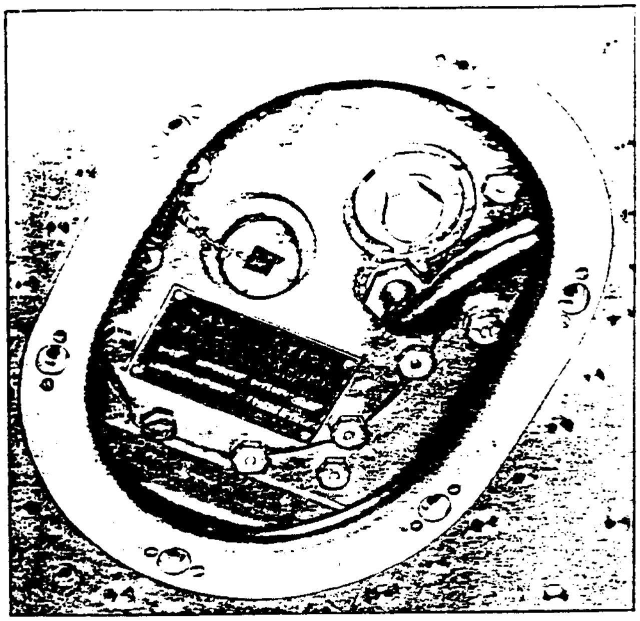


Figure 9. Fuel Booster Pump Installation

(c) Replace the electrical connections to the valve motor.

(4) FUEL CONTROL VALVE OPERATIONAL CHECK.- When a fuel valve has been removed and replaced, or any of the electrical wiring to the fuel valve has been altered or repaired, it must be given an operational check. Following is a complete check for the left-hand side of the airplane, including the fuel valves in the cross-feed line. The fuel valves on the right-hand side of the airplane may be given an operational check in the same manner by simply substituting engine numbers 4 and 3, and 1 and 2, respectively.

NOTE

If the airplane's auxiliary power plant is not running, an outside 208 volts, 400 cycles, alternating current source of power must be used to operate the fuel booster pumps, and the motor generators turned "ON" to operate the fuel valves.

WARNING

Before turning "ON" the fuel booster pumps check to be sure

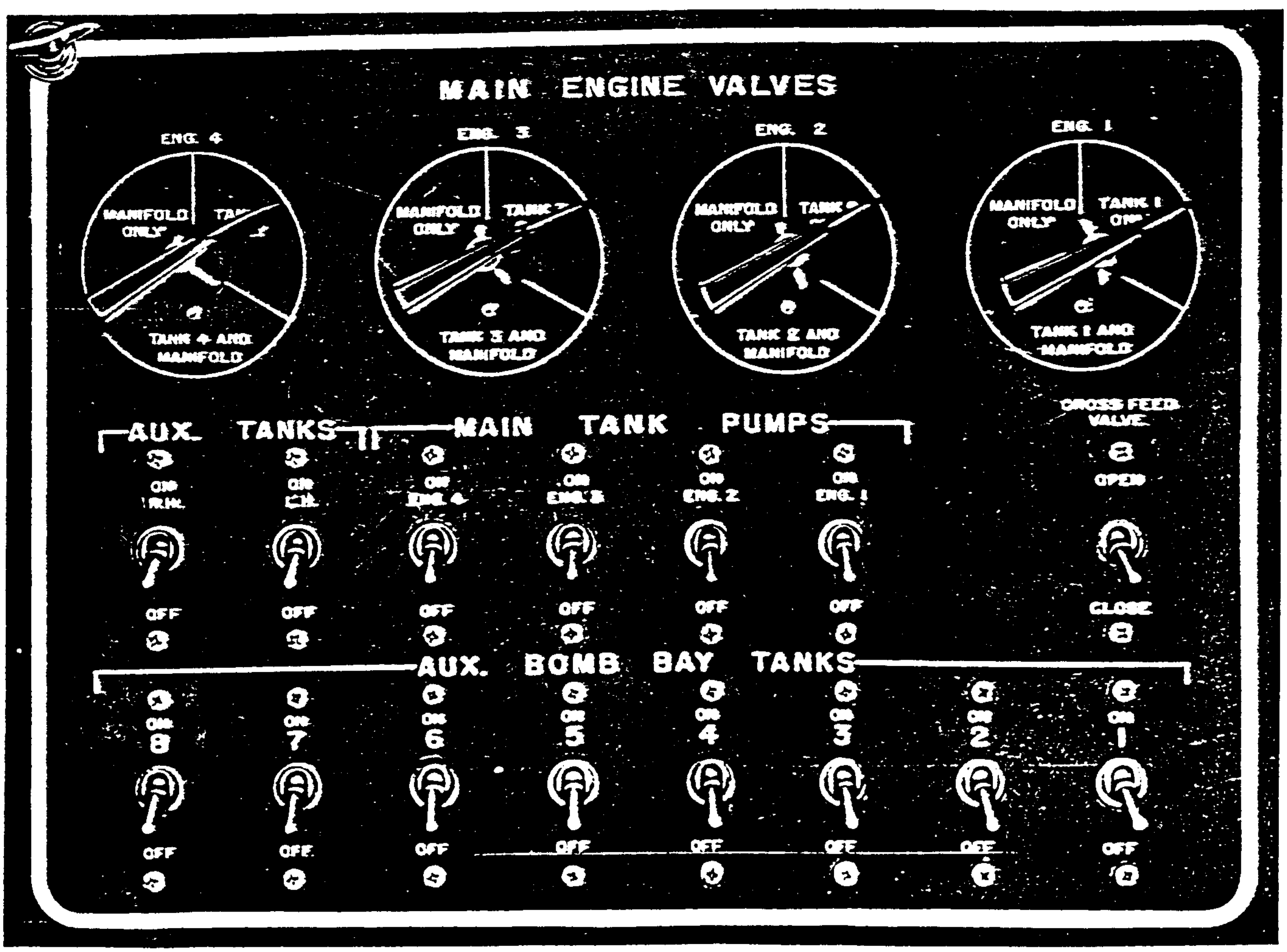


Figure 10. Fuel Controls

the mixture controls for each engine are in the "IDLE CUT-OFF" position, otherwise fuel will be forced through the carburetor and into the engine and blower, which may result in a dangerous fire when the engine is started.

(a) Turn the engine valve for engine number one, to "MANIFOLD ONLY."

(b) Turn the engine valve for engine number two, to "TANK ONLY."

(c) "OPEN" the "EMERGENCY FUEL SHUT-OFF VALVES" for engines number one and two.

(d) "CLOSE" the "CROSS-FEED" valve.

(e). Place a suitable container under the fuel strainer drain for engine number one, and drain the fuel manifold line. Leave the fuel strainer drain valve open.

(f) Turn "ON" the switches for the main tank fuel booster pumps in tanks for number one and number two engines. No fuel should flow from the strainer drain. Leave the fuel booster pumps "ON."

(g) Turn the engine valve for engine number two, to "TANK AND MANIFOLD." Fuel should flow from the fuel strainer drain, showing that "TANK AND MANIFOLD" fuel valves to engine number two are operating correctly.

(h) Turn the engine valve for engine number two, to "MANIFOLD ONLY." No fuel should flow from the fuel strainer drain.

(i) Turn the engine valve for engine number one, to "TANK ONLY." Fuel should flow from the fuel strainer drain, showing that "TANK ONLY" fuel valve to engine number one is operating correctly.

(j) Turn "OFF" the main fuel tank booster pumps.

(k) Close and safety the fuel strainer drain valve.

(l) Place a suitable container under the fuel strainer drain for engine number two, and drain the fuel manifold line. Leave the fuel strainer open.

(m) Turn the engine valve for engine number one to "TANK ONLY."

(n) Turn the engine valve for engine number two to "MANIFOLD ONLY."

(o) Turn "ON" the switches for the main tank fuel booster pumps in tanks for engines number one and number two. No fuel should flow from the fuel strainer drain. Leave the fuel booster pumps "ON."

(p) Turn the engine valve for engine number one, to "TANK AND MANIFOLD." Fuel should flow from the fuel strainer drain, showing that the "TANK AND MANIFOLD" fuel valves for engine number two are operating correctly.

(q) Turn the engine valve for engine number one to "MANIFOLD ONLY." No fuel should flow from the fuel strainer drain valve.

(r) Turn the fuel selector for engine number two, to "TANK ONLY."

(s) "CLOSE" the "EMERGENCY FUEL SHUT-OFF VALVE" for engine number one, and turn "OFF" the fuel booster pump. Fuel should flow from the fuel strainer drain, showing that the "TANK ONLY" fuel control valve for engine number two is operating correctly.

(t) Turn "OFF" the main tank fuel booster pump for engine number two.

(u) Close and safety the fuel strainer drain.

(5) CROSS-FEED FUEL CONTROL VALVE OPERATIONAL CHECK.

NOTE

If the airplane's auxiliary power plant is not running, an outside 208 volts, 400 cycles, alternating current source of power must be used to operate the fuel booster pumps, and the motor generators turned "ON" to operate the fuel valves.

(a) Open the cross-feed valves.

(b) Open the emergency fuel shut-off valves.

(c) Turn the engine valves for engine number one to "TANK ONLY."

(d) Turn the engine valve for engine number two to "MANIFOLD ONLY."

(e) Turn the engine valve for engine number three to "TANK AND MANIFOLD."

(f) Turn the engine valve for engine number four to "TANK ONLY."

(g) Place a suitable container under the fuel strainer for engine number two, and open the drain valve.

(h) Turn "ON" the main tank fuel booster pump for engine number three. Fuel should flow under pressure from the fuel strainer for engine number two, showing that the "CROSS-FEED" valves are "OPEN."

(i) "CLOSE" the "CROSS-FEED" valves. Fuel should cease to flow, when the manifold line has drained, showing that the "CROSS-FEED" valves are "CLOSED."

j. FUEL STRAINERS.

(1) DESCRIPTION. (See figure 11.) A type C-6 fuel strainer is installed in each fuel supply line, between the "EMERGENCY FUEL SHUT-OFF VALVE" and the engine. These strainers are located on the aft side of the front spar in the forward section of bomb bays numbers one, three, six and eight.

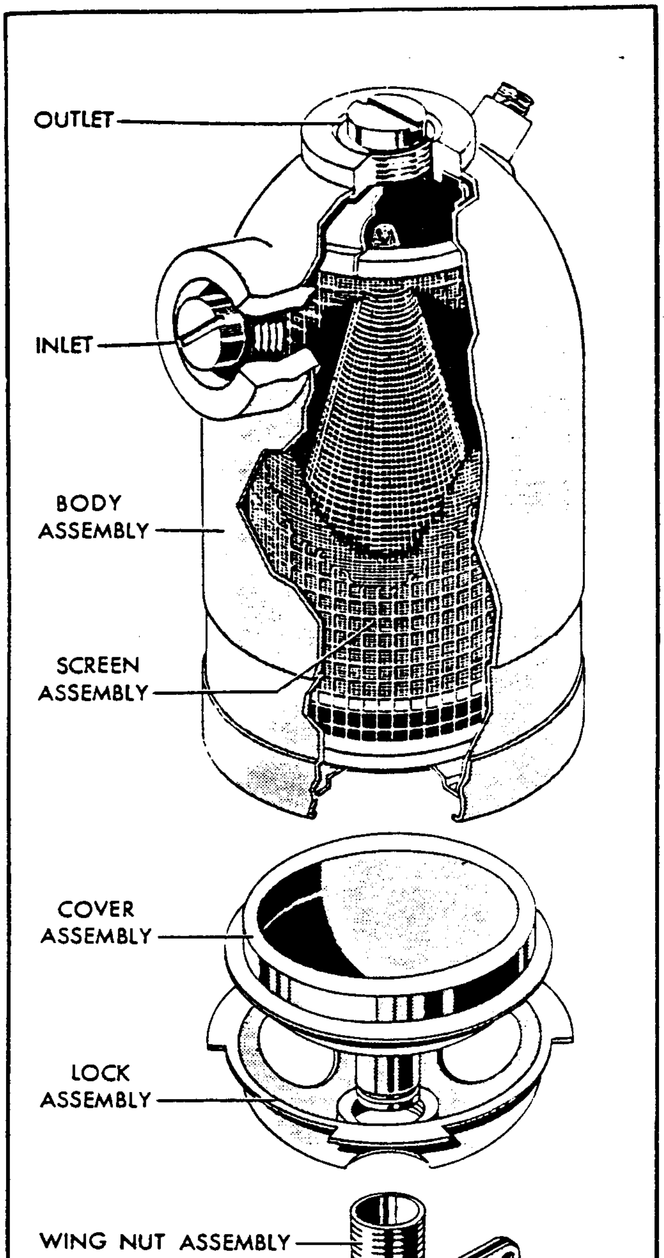


Figure 11. Fuel Strainer

(2) FUEL STRAINER REMOVAL.

(a) Turn "OFF" the respective "EMERGENCY FUEL SHUT-OFF VALVE."

(b) Place a suitable receptacle under the fuel strainer to catch the fuel which drains from the lines, and drain the fuel strainer.

(c) Loosen the hose clamps and remove the fuel inlet, outlet, and drain hoses.

(d) Remove the mounting bracket bolts and remove the fuel strainer.

(3) CLEANING.

(a) Cut the safety wire securing the cover handle on the strainer.

(b) Turn the cover handle and the cover counterclockwise until loose, then pull to remove the screen.

(c) Remove the screen from the strainer. Clean the strainer thoroughly in kerosene, Federal Specification No. VV-K-211, or solvent, Federal Specification No. P-S-661, and blow the screen dry with compressed air.

(d) Hold the screen in its normal position and press the strainer cover onto the screen with about one-quarter turn.

(e) Insert the screen and cover into the strainer body.

(f) Engage the cover with the slots in the strainer and turn the cover clockwise about one-third turn, until the cover is fully engaged with the body.

(g) Tighten the wing nut securely, using the fingers only, and re-safety.

(4) INSTALLATION.

(a) Secure the strainer in position on the mounting bracket.

(b) Connect the fuel inlet, outlet and drain lines. Tighten the hose clamps securely.

(c) See that the fuel strainer wing nut is properly safetied.

k. EMERGENCY FUEL SHUT-OFF VALVES AND CONTROLS.

(1) DESCRIPTION. (See figure 12)- A manually-controlled fuel shut-off valve is installed in each engine fuel supply line. The fuel shut-off valves are cable-controlled and operated by levers located in the forward cabin, above the entrance doorway. The valve controls are labeled "EMERGENCY FUEL AND OIL SHUT-OFF VALVES," however, they may be used at any time it is desired to shut off the fuel supply to an engine.

(2) REMOVAL.- The manually-controlled "EMERGENCY FUEL SHUT-OFF VALVES" are of the same type as the electrically-operated engine valves.

(a) Turn both engine valves on the side of the airplane from which the emergency fuel shut-off valve is to be removed, to "MANIFOLD ONLY."

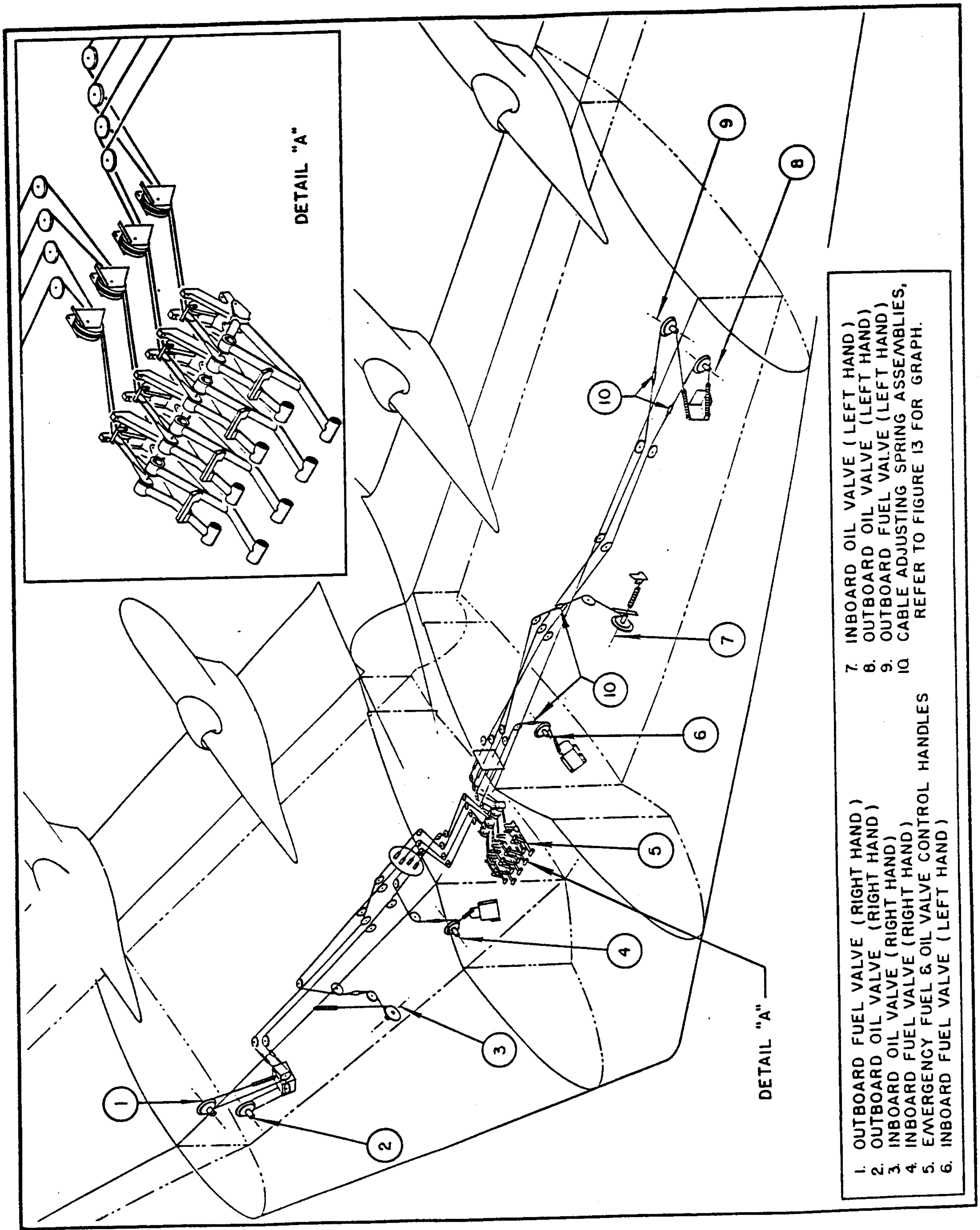


Figure 12. Manual Emergency Shut-off Valve Control System

NOTE

If the airplane's auxiliary power plant is not running, an outside 208 volts, 400 cycles, alternating current source of power should be used and the motor generators turned "ON" to operate the engine valves.

(b) Place a suitable container under the fuel strainer and drain the fuel strainer and drain the fuel from the lines.

(c) Loosen the hose clamps and remove the hose connections.

(d) Relieve the tension on the valve pulley cables.

(e) Remove the nut and taper pin which secures the pulley-control quadrant assembly to the valve stem, and remove the pulley control quadrant assembly.

(f) Remove the two nuts and bolts which secure the valve to the support bracket, and lift the valve from the bracket.

(3) INSTALLATION.

(a) Secure the valve to the mounting bracket with two bolts, nuts and washers.

(b) Connect the fuel lines to the valve and securely tighten the hose clamps.

(c) Install the pulley-control quadrant assembly to the valve stem with the taper pin and nut.

(d) Adjust the quadrant control cables.

(e) Check the emergency fuel shut-off valve for leaks and operation. (See EMERGENCY FUEL SHUT-OFF VALVE TEST following.)

(4) EMERGENCY FUEL SHUT-OFF VALVE TEST.

(a) Move the "EMERGENCY FUEL SHUT-OFF VALVE" lever to the "OFF" position.

(b) Drain the fuel from the fuel strainer and the fuel lines into a suitable container.

NOTE

If the airplane's auxiliary power plant is not running, an outside 208 volts, 400 cycles, alternating current source of power must be used to operate the fuel booster pumps, and the motor generator turned "ON" to operate the fuel valves.

(c) Turn the engine valve to "TANK ONLY" and turn the fuel booster pump "ON." No fuel should flow from the fuel strainer.

(d) Move the "EMERGENCY FUEL SHUT-OFF VALVE" lever to the "ON" position. Fuel should flow from the fuel strainer.

l. MANUAL EMERGENCY FUEL SHUT-OFF VALVES CABLE CONTROL SYSTEM.

(1) DESCRIPTION.- The control cables for operation of the "EMERGENCY FUEL SHUT-OFF VALVES" are enclosed in rigid conduit. Each of the four systems controls a fuel shut-off valve for one engine. The valve is closed by the cable and opened by a spring which is connected to the valve quadrant arm. A temperature compensator is connected to the cable, near the fuel shut-off valve.

(2) ADJUSTMENT.

(a) See that the control handles for the emergency shut-off valves are in the up position.

(b) With the valve opening spring assembly attached to the quadrant, and the valve against the open stops, adjust the turnbuckle so that the dimension "A" in figure 13 is .73 inches at 70°F.

m. ENGINE PRIMER. (See Section IV, paragraph 7.)

n. FUEL LEVEL INDICATORS.- Two dual fuel level indicators of the D-C Selsyn 3-wire type are installed in the engineer's instrument panel, and register the fuel level of each main fuel tank. A fuel level transmitter is installed in each fuel tank. One dual indicator registers the fuel levels of the two outboard fuel tanks and the other registers the fuel levels of the two inboard fuel tanks. The systems operate on 28 volts, d.c., picked up from a bus in the engineer's switch panel and routed through a switch-type circuit breaker to the engineer's instrument panel. (See figure 2.)

o. AUXILIARY POWER UNIT FUEL TANKS. (See figure 14.)- The two fuel tanks for the A.P. Units are installed in No. 5 bomb bay.

(1) REMOVAL.- It is advisable to remove both tanks at the same time in the following manner:

(a) Drain the fuel from the tanks.

(b) Disconnect the fuel supply and vent lines.

(c) Unfasten the turnbuckles on one side of the tanks.

(d) Lift the tanks out of the cradles together.

(2) INSTALLATION.- Reverse the removal procedure.

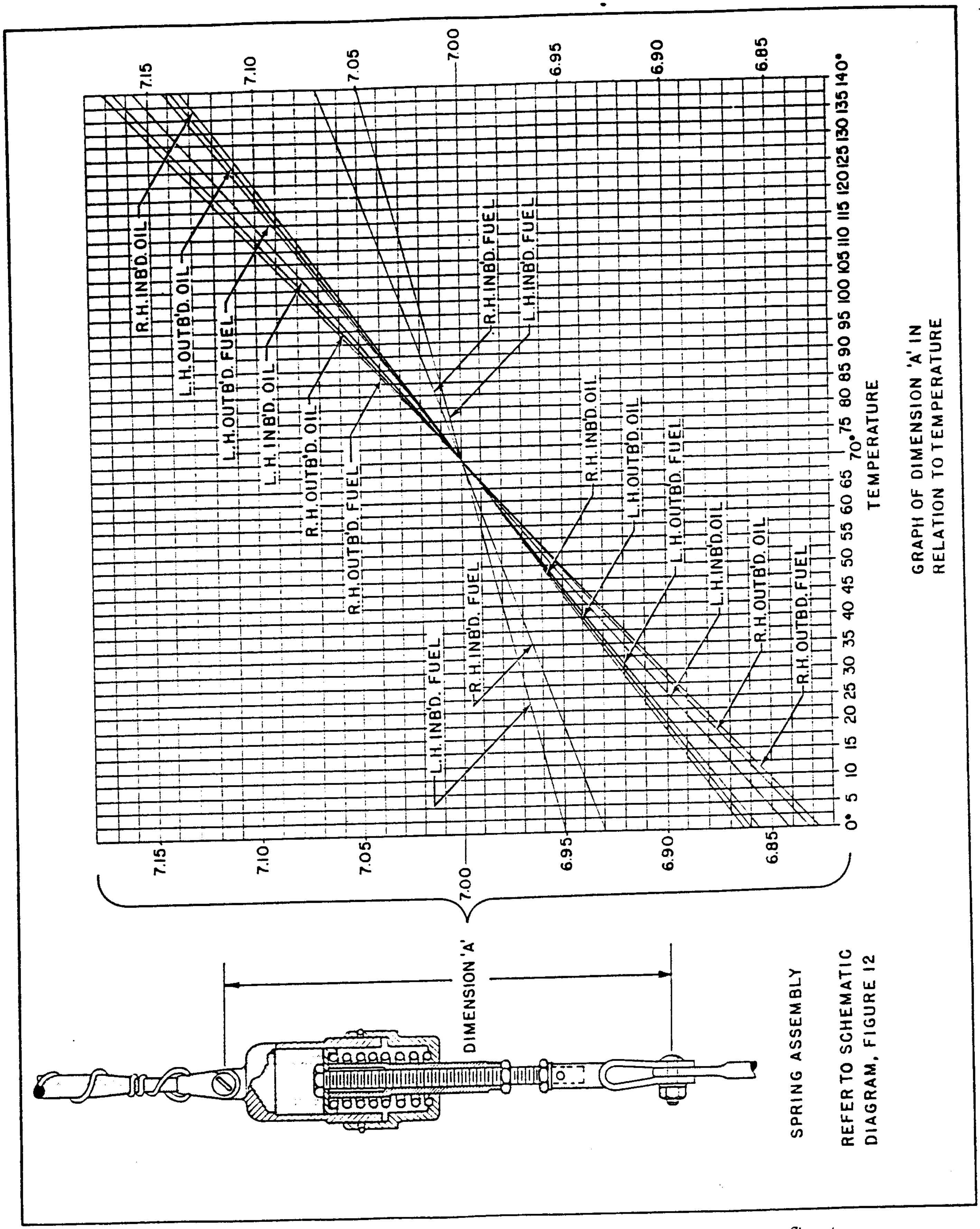


Figure 13. Emergency Fuel and Oil Shut-off Cable Adjustment Chart

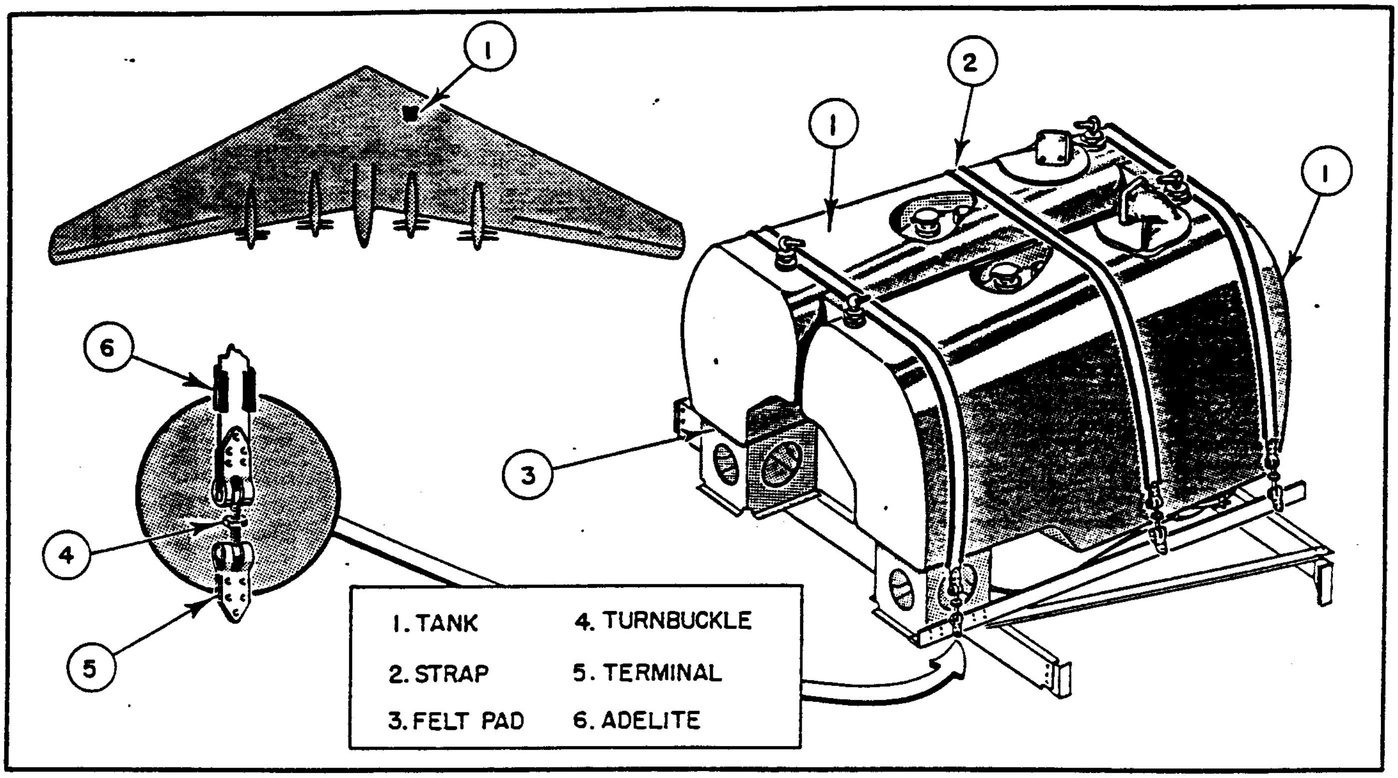


Figure 14. A.P.U. Fuel Tank Installation

12. OIL SYSTEM

12. OIL SYSTEM.

a. GENERAL.

(1) DESCRIPTION. (See figure 1.)- An individual oil system is provided for each engine. Each system consists of the following parts: an 85-gallon, hopper-type, oil supply tank, a transfer line incorporating an oil transfer pump for each pair of oil tanks, three drain valves, an oil cooler, a temperature control valve, an emergency oil shut-off valve, and an oil dilution valve. The temperature control valve controls the flow of engine oil to the oil cooler shutter operating mechanism. The emergency oil shut-off valve in the tank-to-engine main oil supply line is manually operated from controls located in the forward cabin, above the entrance doorway. The oil transfer pump is electrically-controlled by manually-operated switches located on the engineer's switch panel, and is used to transfer oil from an inboard tank to an outboard tank, or an outboard tank to an inboard tank on the same side of the airplane. See figure 2 for the engine oil system electrical diagram. The turbosuperchargers receive their oil from the main engine oil tanks, two turbosuperchargers receiving oil from the same oil tank. The propeller gear boxes are supplied with oil for lubrication by an individual oil system for each propeller gear box (see figure 3). Each of the auxiliary power units has an integral sump type oil system. There are no external tanks or connections to other systems. The aluminum alloy oil pan has a capacity of 9 quarts of Specification AN-VV-O-446, grade 1065 lubricating oil. Maximum safe oil temperature is 220° F. Pressure is 35 to 45 pounds.

(2) ENGINE OIL SYSTEM OPERATION.- Oil is gravity fed from the oil supply tank to the engine-oil pressure pump. After being distributed through the engine the oil is returned by the scavenge pump through the oil cooler to the supply tank. If an obstruction or congealed oil restricts the flow of oil through the oil cooler, the spring-loaded relief valve will by-pass the oil directly to the oil tank. Oil may be transferred from one oil tank to the other on the same side of the airplane. A manually-operated emergency oil shut off valve is incorporated between the oil tank and the engine. Closing the emergency oil shut-off valve does not stop the flow of oil from the oil tanks to the turbosuperchargers. Airflow through the oil cooler is thermostatically controlled.

(3) MAINTENANCE.- At each engine oil change, drain and flush the system with kerosene, Federal Specification No. VV-K-211, or solvent, Federal Specification No. P-S-661. Clean the oil tanks, oil strainers, and oil coolers at this time. See paragraph b (3), in this section.

(4) TURBOSUPERCHARGER OIL SYSTEM OPERATION.- Oil is gravity-fed from the main engine oil tanks to pumps in the superchargers. The oil pump feeds through a type G159J purolator oil filter to the bearings in the turbosupercharger. A scavenge pump, also built into the turbosupercharger, returns the oil directly to the main engine oil tanks. (See figure 1.)

(5) MAINTENANCE OF TURBOSUPERCHARGER OIL SYSTEM.- On each daily inspection, the Purolator oil filter handle must be turned one complete revolution.

(6) TROUBLE SHOOTING.

TROUBLE	PROBABLE CAUSE	REMEDY
Low oil pressure.	Restriction in oil supply line.	Clean line with compressed air.
	Pressure relief valve setting incorrect.	Adjust as necessary. See Section IV, paragraph 7.
	Congealed oil in pressure gage line.	Clean and refill line with new oil.
	Clogged oil strainer screen.	Remove screen and clean.

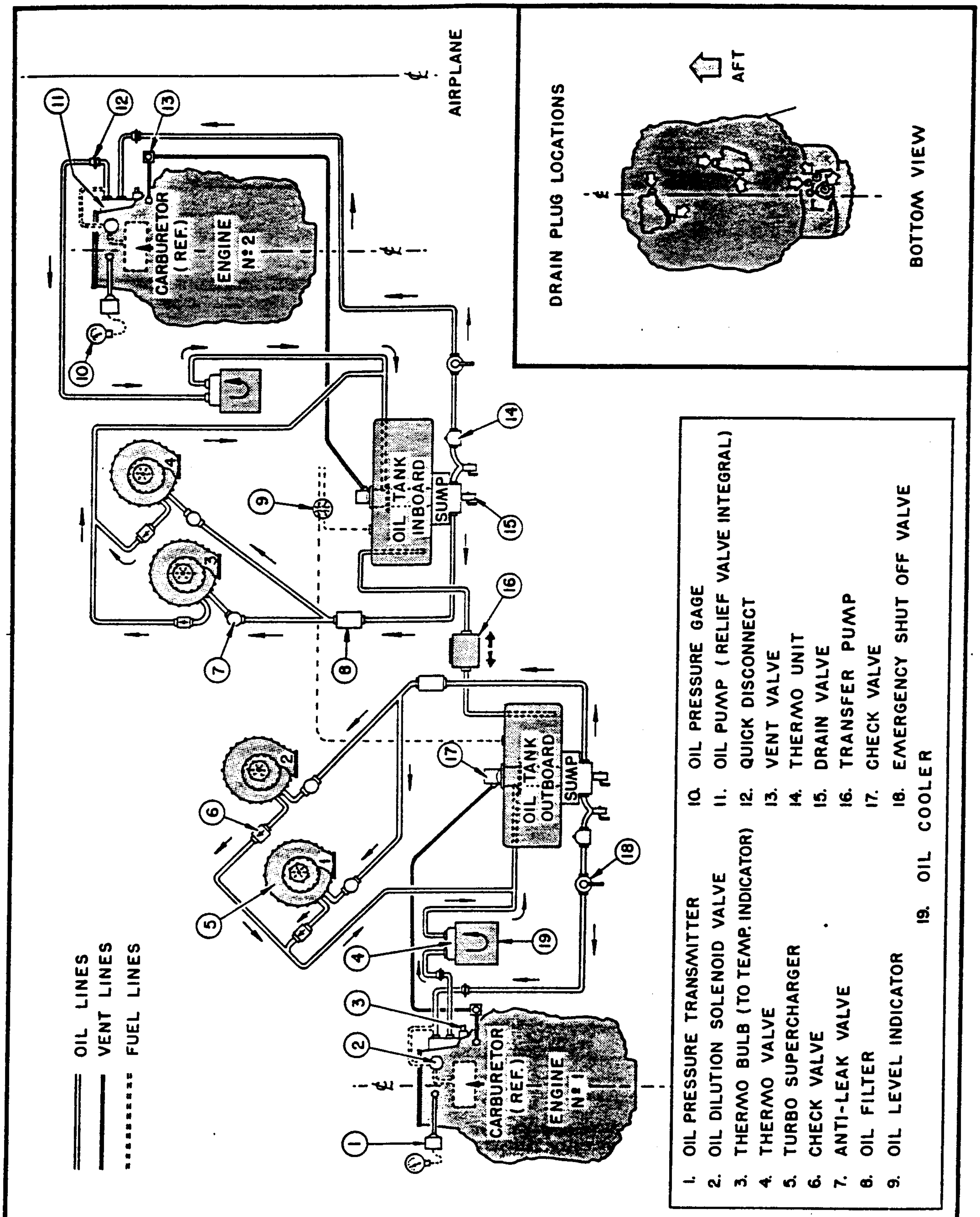


Figure 1. Engine and Turbo Oil System

TROUBLE	PROBABLE CAUSE	REMEDY
Low oil pressure.	Improper setting of oil-pressure relief valve.	Check valve and seat for foreign particles.
	Excessive oil inlet temperature.	See "High oil temperature," following.
	Loose oil inlet line.	Tighten connections.
	Defective gage.	Replace.
High oil pressure	Restriction in oil return line.	Inspect and clean with compressed air.
	Incorrect grade of oil.	Drain and refill system.
	Improper setting of pressure relief valve.	Adjust oil pressure relief valve. See Section IV, paragraph 7.
Loss of oil pressure.	Flexible oil hose kinked.	Replace oil hose.
	Broken oil line.	Replace oil line and refill system.
	Damaged oil pump.	Replace oil pump.
High oil temperature.	Restriction in cooling system.	Investigate and clean system.
	Improper magneto setting.	Reset timing. See Section IV, paragraph 8.
	Defective by-pass valve in oil cooler.	Check valve. Replace if necessary.
	Improper operation of oil cooler shutters.	Check operation of shutters and make necessary repairs.
	Air passages in cooler core plugged.	Blow out with compressed air.
	Improper grade of oil.	Drain the system and refill with the correct grade of oil.

(7) PROPELLER GEAR BOX OIL SYSTEM DESCRIPTION. (See figure 2.)- The propeller gear boxes are supplied with oil for lubrication by an individual oil system for each propeller gear box. Oil, Specification No. AN-VV-O-446, is stored in a 3-gallon doughnut-shaped oil tank which is attached to the gear box and encircles the propeller driveshaft. The propeller gear box oil system is composed of the following parts: an oil tank, oil filter, oil pressure and scavenge pumps, and an oil cooler. Airflow through the oil cooler is thermostatically controlled.

(8) MAINTENANCE OF PROPELLER GEAR BOX OIL SYSTEM.- When the engine is run up for the first time following an overhaul, with the three-gallon oil tank full and the system dry, the gear box, oil cooler and lines are filled by circulation, leaving the tank again empty. The gear box oil tank must be checked and refilled following a brief run of the engine and gear box on initial installations, after overhauls, or if the system has been previously drained. The gear box oil tank must be checked, and refilled if necessary, after every engine run.

b. OIL TANKS, MAIN ENGINE. (See figure 4.)

(1) DESCRIPTION.- Four hopper-type oil supply tanks, having a capacity of 85 U.S. gallons each, are located as follows: one each in the forward, upper inboard end of each main landing gear wheel well, and one each in the forward, upper outboard end of the numbers three and six bomb bays. The oil tanks are secured in the tank compartments by hanger bolts which are accessible from within the oil tank. Each engine oil tank is provided with a liquidometer gage, electrically connected to an oil quantity indicator on the engineer's instrument panel.

(2) REMOVAL.

(a) Drain the oil from the tank to be removed, by opening the petcock in the bottom of the hopper.

(b) Disconnect the electrical connection to the liquidometer.

(c) Remove the liquidometer as follows:

ITEM	LOCATION	DESCRIPTION
1	DISCONNECT BOX- ENG. NO. 4	ENG. NO. 4 COMPARTMENT
2	RELAY PANEL	BOMB BAY NO. 8- FORWARD
3	RELAY PANEL	MAIN GEAR WELL-FORWARD R.H.
4	RELAY PANEL	BOMB BAY NO.7- FORWARD
5	OIL DILUTION SOLENOID	ENGINE NO. 4
6	NO.4 ENGINE PULL BOX	ENGINE ACCESSORY SECTION
7	OUTB'D OIL DIVERSION VALVE	PLENUM CHAMBER- AFT R.H.
8	OIL TRANSFER PUMP	AFT OUTBOARD OIL TANK-R.H
9	THERMOSTAT- OIL DIVERTER	BENEATH OUTBOARD OIL TANK
10	OIL LEVEL TRANSMITTER	OUTBOARD OIL TANK-R.H.
11	A.C. SECTIONALIZING PANEL	MAIN GEAR WELL- FORWARD R.H.
12	INB'D OIL DIVERSION VALVE	PLENUM CHAMBER-AFT OIL COOLER
13	OIL LEVEL TRANSMITTER	INBOARD OIL TANK R.H.
14	THERMOSTAT-OIL DIVERTER	BENEATH INBOARD OIL TANK
15	OIL DILUTION SOLENOID	ENGINE NO. 3
16	NO.3 ENGINE PULL BOX	ENGINE ACCESSORY SECTION
17	DISCONNECT BOX-ENGINE NO.3	BOMB BAY NO.6 FORWARD
18	INSTRUMENT PANEL	ENGINEER'S STATION
19	OIL LEVEL INDICATOR	ENGINEER'S INSTRUMENT PANEL
20	SWITCHES-OIL DILUTION	ENGINEER'S SWITCH PANEL
21	SWITCH PANEL-ENGR'S UPPER	ENGINEER'S STATION
22	CIRCUIT BREAKER-OIL DIL.	ENGINEER'S SWITCH PANEL
23	SWITCHES-OIL TRANSFER	ENGINEER'S LOWER SWITCH PANEL
24	CIRCUIT BREAKER- OIL TRANS.	ENGINEER'S LOWER SWITCH PANEL
25	CIRCUIT BREAKER-OIL LEVEL	ENGINEER'S LOWER SWITCH PANEL
26	SWITCH PANEL- ENG'R'S LOWER	ENGINEER'S STATION
27	JUNCTION PANEL-ENGINEER'S	BENEATH ENGINEER'S FLOOR
28	DISCONNECT BOX-ENGINE NO.2	BOMB BAY NO.3 FORWARD
29	OIL DILUTION SOLENOID	ENGINE NO.2
30	NO.2 ENGINE PULL BOX	ENGINE ACCESSORY SECTION
31	OIL LEVEL TRANSMITTER	INBOARD OIL TANK- L.H.
32	INB'D OIL DIVERSION VALVE	PLENUM CHAMBER-AFT OIL COOLER
33	THERMOSTAT-OIL DIVERTER	BENEATH INBOARD OIL TANK-L.H.
34	OIL LEVEL TRANSMITTER	OUTBOARD OIL TANK- L.H.
35	THERMOSTAT-OIL DIVERTER	BENEATH OUTBOARD OIL TANK-L.H.
36	OIL TRANSFER PUMP	AFT OUTBOARD OIL TANK - L.H.
37	A.C. SECTIONALIZING PANEL	MAIN GEAR WELL-FORWARD L.H.
38	OUTBD OIL DIVERSION VALVE	PLENUM CHAMBER- AFT L.H.
39	OIL DILUTION SOLENOID	ENGINE NO.1
40	NO.1 ENGINE PULL BOX	ENGINE ACCESSORY SECTION
41	DISCONNECT BOX- ENGINE NO.1	ENGINE NO.1 COMPARTMENT
42	RELAY PANEL	BOMB BAY NO.1-FORWARD
43	RELAY PANEL	MAIN GEAR WELL-FORWARD L.H.
44	RELAY PANEL	BOMB BAY NO.2-FORWARD

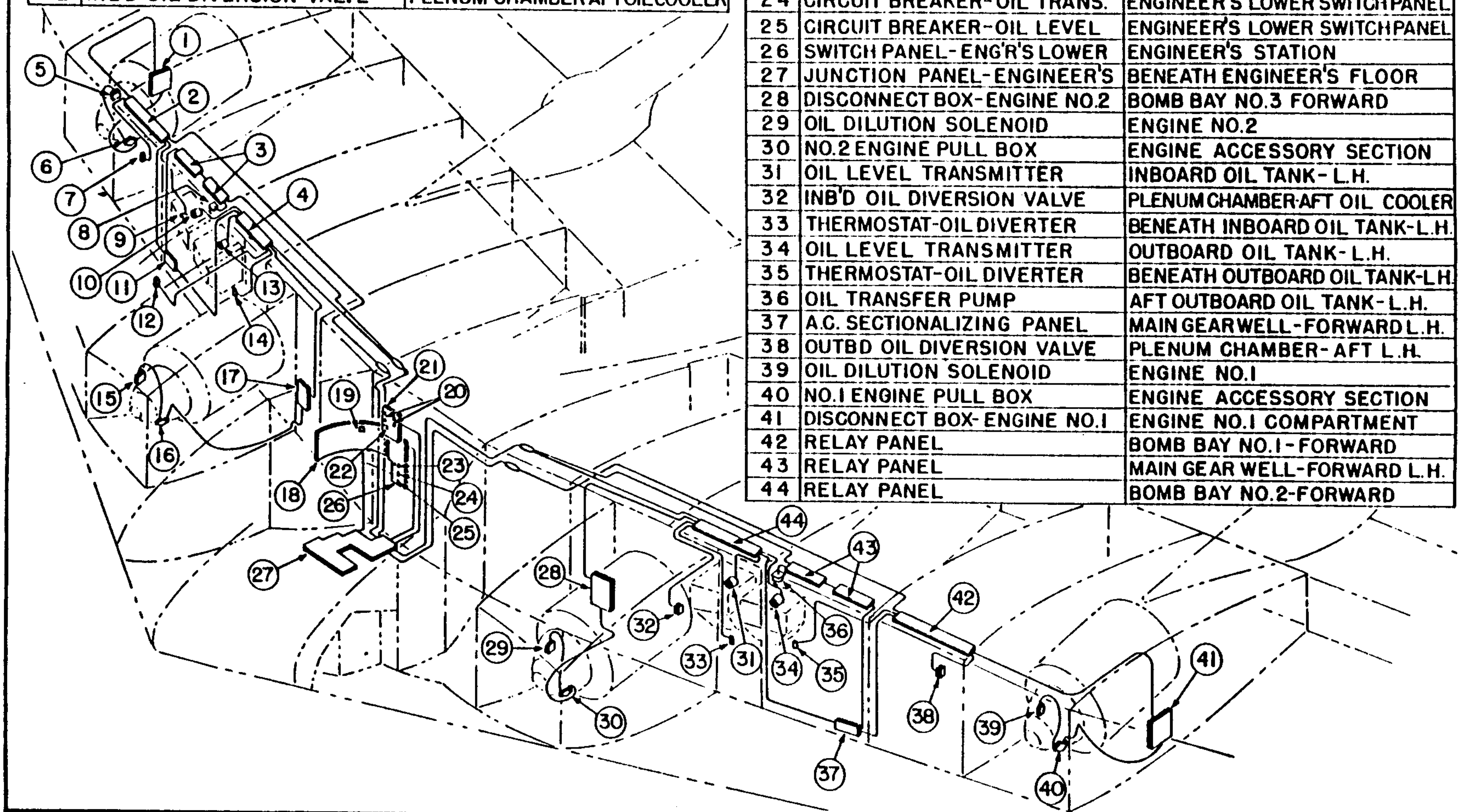


Figure 2. Oil System Electrical Diagram

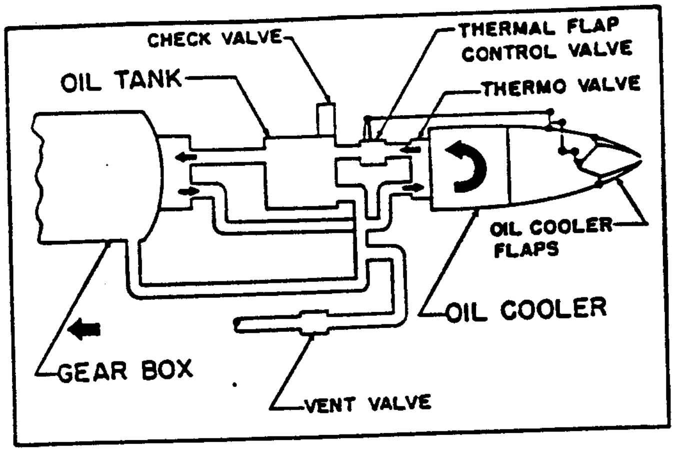


Figure 3. Propeller Gear Box Oil System

1. Remove the five Phillips head screws which secure the liquidometer assembly to the support casting.

NOTE

Do not remove the six hexagon-shaped slotted head screws which secure the liquidometer cover.

2. Remove the 10 nuts and washers from the stud bolts which secure the liquidometer support casting to the tank.

NOTE

Liquidometer, although appearing similar, are not interchangeable because of the difference in the length of the float arm and calibration.

3. Carefully remove and tag the liquidometers.

(d) Remove the access structure door, which is held in place by Phillips head screws.

(e) Remove the tank cover door.

(f) Remove the bottom hopper bolts.

(g) Remove the hopper as follows:

1. Remove the bolts and nuts which secure both halves of the hopper together at the flange joint.

2. Separate hopper at the flange joint, and lift the upper half of hopper clear of the lower section.

3. Remove the bolts which secure the lower half of the hopper to the sump.

4. Remove the lower half of the hopper.

5. Remove the upper half of the hopper by pulling down and working loose at the same time.

(h) Remove all but the top hopper section.

(i) Remove the oil transfer line on inside of the same wall as the access door. This transfer line is inside the cover door and may be felt by running the hand around just inside the door. The oil transfer line fitting is attached with four stud bolts which run through the structure and the tank, the heads of which are on the outside of the tank, above the access door.

(j) Disconnect the hopper oil line.

NOTE

No other vent or oil lines need be disconnected.

(k) Remove the upper section of the hopper, which is bolted to the structure.

(l) Disconnect scupper drain line.

(m) Remove scupper through access hole in top of wing.

(n) Remove scupper drain fitting stop nut.

(o) Remove by-pass cover which is attached with six 1/4" bolts and nuts through tank and structure. This by-pass cover is located on the outboard wall on outboard tanks, and on the forward wall, adjacent to oil inlet fitting in inboard tanks.

(p) Remove the scupper drain fitting.

(q) Remove bolts from the oil inlet fittings, which are located outside the tanks.

NOTE

These inlet fittings for the inboard oil tanks are located on the forward bulkhead directly behind left-hand and right-hand inboard oil coolers. On the outboard tanks, they are located on the outboard bulkhead.

(r) Remove all hanger bolts from inside the oil tank.

(s) Collapse the oil tank and start the large tank opening through the structure access hole in a horizontal plane. Fold the edges of the tank under the access frame for compactness and ease of removal, and carefully work tank out through access hole.

(3) CLEANING.- The oil tanks must be cleaned at each normal engine change, or in the event of internal engine failure. It is not necessary to remove oil tanks for cleaning.

(a) Drain the oil from the tank to be cleaned, by opening the petcock in the bottom of the hopper.

(b) Disconnect the electrical connection to the liquidometer.

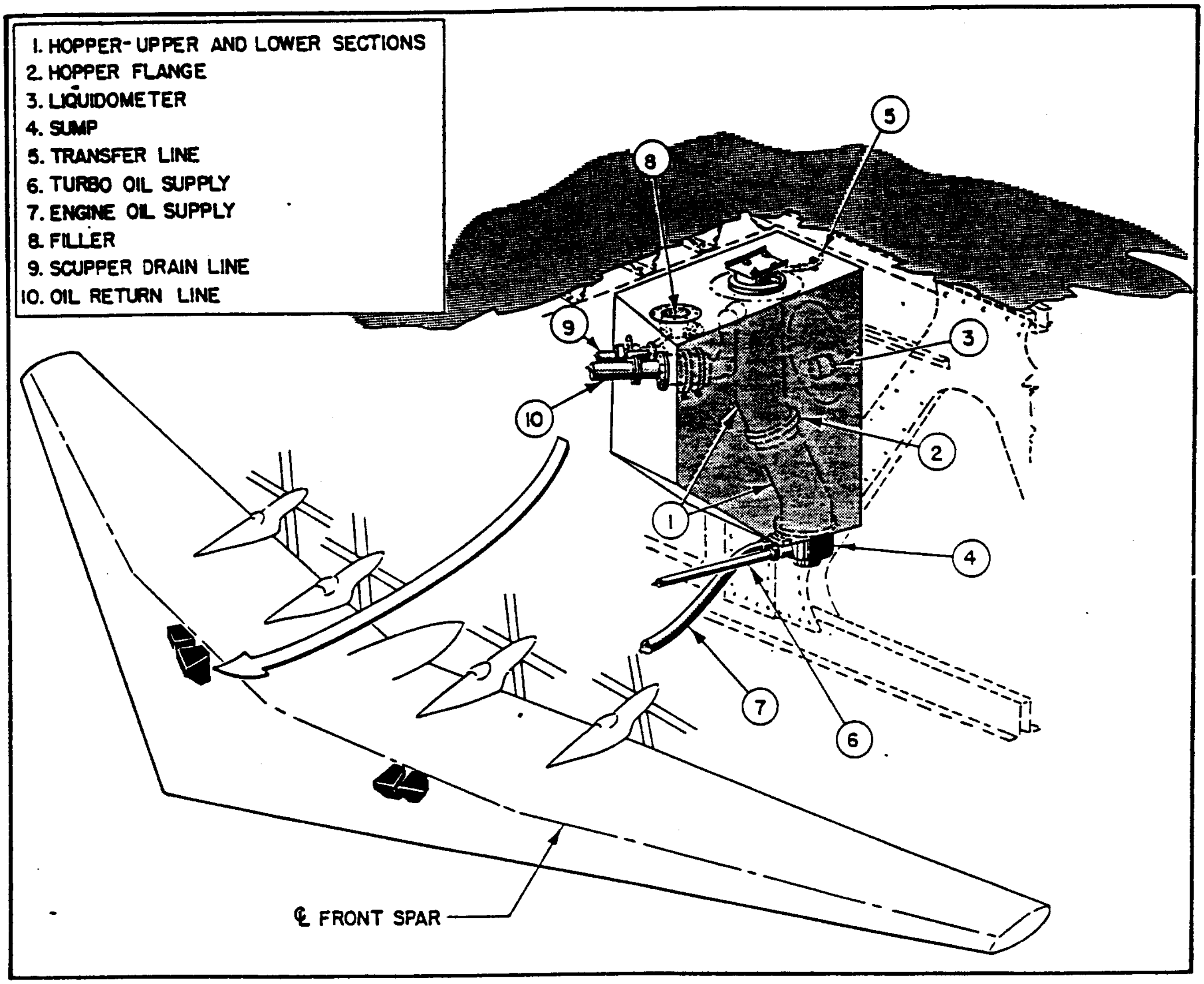


Figure 4. Engine Oil Tanks

(c) Remove the liquidometer. See paragraph b (2) (c) 1 to 3 inclusive, this section.

(d) Remove the access door, which is held in position by screws.

(e) Remove the tank cover door.

(f) Using a spray gun, thoroughly clean the inside of the oil tank with kerosene, Federal Specification No. VV-K-211, or solvent, Federal Specification No. P-S-661. Use kerosene or solvent at room temperature. Use rags and a stiff brush to dislodge hard or gummy particles.

CAUTION
When using kerosene or solvent, observe fire-hazard precautions.

(4) INSTALLATION.- Reverse the removal procedure to install the main oil tanks.

(a) See that the tank is clean, and that it has been properly inspected.

(5) TEST.- After completing the oil tank installation, or cleaning the oil tank or system, it must be pressure tested. Use a manometer to determine air-pressure maintenance, and a solution of soapy water or equivalent on all connections to detect leaks.

(a) Disconnect and seal the oil tank vent line at the engine, or within the engine bay.

(b) Turn the "quick disconnect valves" in the main oil lines in the engine bays to the off position.

(c) Disconnect and seal each turbosupercharger oil-in and oil-out line at each turbo supercharger (two per engine).

(d) Seal the oil tank filler opening.

(e) Disconnect and seal the oil transfer line at the oil transfer pump.

(f) Move the "EMERGENCY OIL SHUT-OFF VALVE" lever to the "OPEN" position.

(g) Apply 7 inches Hg. air pressure to any convenient point in the oil system. If after a five-minute period, a pressure loss is indicated, locate and repair the leak. After repairing the leak, re-test for another five-minute period.

c. ENGINE OIL LEVEL INDICATORS.- Each of the four main engine oil tanks is equipped with an oil level transmitter. One multiple gage dial oil level indicator, located on the engineer's instrument panel is connected to all four oil level transmitters. The indicator operates on a two-wire, 28 volt d.c. system, the third wire from the protective resistors in the instrument being grounded. The electrical power for operation of the system is picked up on the engineer's lower electrical panel, and routed through a switch-type circuit breaker on the same panel, to the indicator. (See figure 2.)

d. OIL TRANSFER PUMPS. (See figure 5.)

(1) DESCRIPTION.- Two type S-1145A (Pesco) oil transfer pumps are installed in the oil transfer lines; one between the inboard and outboard oil tanks on each side of the airplane. Each pump is electrically controlled by manually-operated momentary switches, located on the engineer's switch panel, making it possible to transfer oil from either an inboard to an outboard oil tank, or from an outboard to an inboard oil tank on the same side of the airplane. The reversible electric motors which drive the pumps operate on 208 volts, 400 cycles, 3 phase, a.c. A 28 volt d.c. control circuit operates a reversing relay which is mounted on the wheel well relay panel. The relay closes the 208 volt, 400 cycle, 3 phase, a.c. circuit to operate the electric motor and transfer the oil

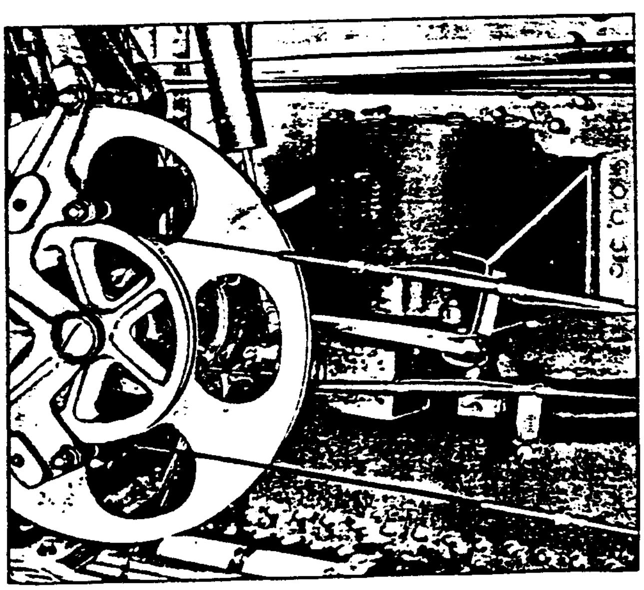


Figure 5. Oil Transfer Pump

(2) REMOVAL.

(a) Remove the electrical connection to the electric motor.

(b) Disconnect and plug the open ends of the oil lines at the pump.

(c) Remove the four bolts, nuts and washers which secure the pump to the supporting bracket, and lift the pump from the bracket.

(3) INSTALLATION.

(a) Reverse the removal procedure to install the oil transfer pump.

NOTE

Before the pump is installed, check to be sure that the oil flow coincides with the direction indicated on the switch. This may be accomplished by connecting the electrical connection, placing the fingers loosely over the oil line connections at the pump, and having someone operate the "OIL PUMPS" switch on the engineer's lower switch panel.

e. ENGINE OIL COOLERS. (See figure 6.)

(1) DESCRIPTION.- Each engine oil system is provided with an (Airesearch No. 16345) oil cooler which is installed in the leading edge of the wing. The coolers are of the honeycomb-core type, incorporating the use of spring-loaded oil-temperature control valves The control valves are designed to by-pass oil directly to the oil tank in the event the oil has become congealed or that flow through the oil cooler has become obstructed. No adjustment is provided for the control valve. Airflow through the oil cooler is thermostatically controlled.

(2) REMOVAL.

(a) Remove the turbosupercharger access door.

(b) Remove the turbosupercharger. See Section IV, paragraph 14 b.

(c) Remove the engine exhaust head exchanger. See Section IV, paragraph 14 a.

(d) Disconnect the oil-in and oil-out lines at the oil cooler. Seal the open ends of the lines.

(e) Disconnect the oil cooler hold-down straps, and carefully work the oil cooler out and lower it to the ground.

(3) CLEANING.- Oil cooler assemblies must be cleaned at each normal engine change. In the event of internal engine failure the oil coolers must be removed and rebuilt before using them for future engine operation. Clean oil coolers as follows:

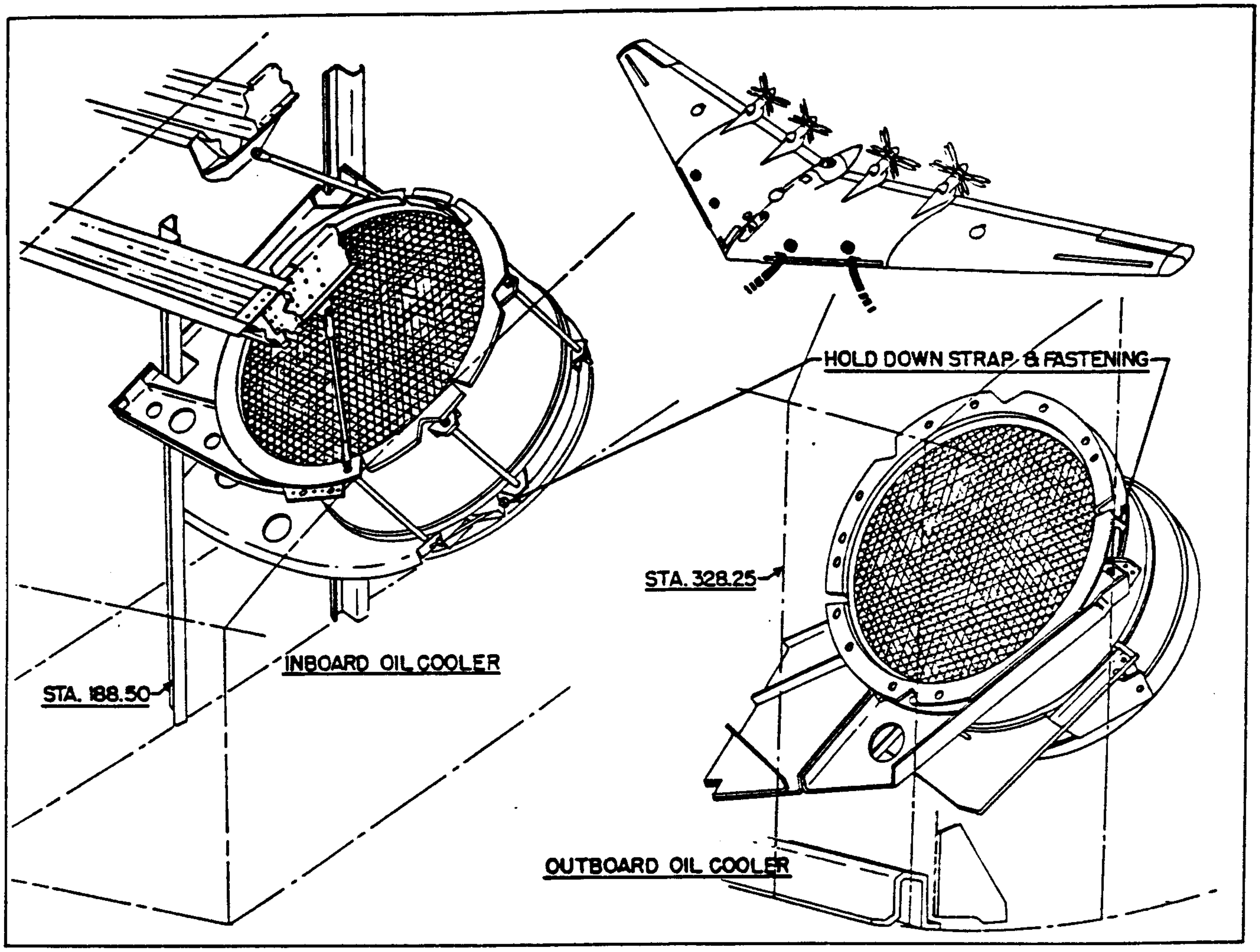


Figure 6. Engine Oil Cooler

(a) Remove the oil temperature control assembly from the oil cooler.

(b) Clean the oil cooler and oil temperature control assembly in separate tanks. Use kerosene, Federal Specification No. VV-K-211, or solvent, Federal Specification No. P-S-661, at room temperature.

CAUTION

Observe fire hazard precautions while using kerosene or solvent.

(c) Pump the kerosene or solvent through the oil cooler for approximately 15 minutes.

(d) Drain the oil cooler, then flush with water. Dry the cooler thoroughly with compressed air.

(e) Re-install the oil temperature control valve on the oil cooler. See paragraph f (4), this section.

(4) TEST.

(a) Plug all openings in the oil cooler. Fill with compressed air to 100 psi, then submerge the cooler in hot water, 76.7°C ± 3° (170°F ± 5°).

(b) After completing test (a), dehydrate the oil cooler in a light, clean oil, Specification No. AN-VV-O-446, at 121°C ± 6° (250°F ± 10°).

(5) INSTALLATION.

(a) Position the oil cooler in the wing, and attach to the support brackets.

(b) Connect the oil cooler hold-down straps.

(c) Unseal the ends of the oil-in and oil-out lines, and connect to the oil cooler.

(d) Re-install the engine exhaust heat exchanger. See section IV, paragraph 14 a.

(e) Replace the turbosupercharger. See section IV, paragraph 14 b.

(f) Replace the turbosupercharger access doors.

f. ENGINE OIL TEMPERATURE INDICATORS.- Two 28 volt d.c. dual oil temperature indicators, operating within a temperature range of -70°C to 150°C, are mounted on the engineer's instrument panel. An electrical resistance temperature bulb, located in the accessory case of each engine, transmits the oil-in temperature to its respective indicator. The 28 volts d.c. used to operate the indicator is routed from a switch-type circuit breaker located on the engineer's lower electrical panel. (See figure 2.)

g. OIL TEMPERATURE CONTROL. (See figure 7.)

(1) DESCRIPTION.- The oil temperature control consists of a pressure relief valve, surge protection, and a thermostatic oil cooler shutter control, which is mounted on the oil cooler as a single unit. Oil passing through the pressure relief valve operates the thermostatic oil cooler shutter control, which is connected by mechanical linkage to the oil cooler shutters, thereby regulating the flow of air through the oil cooler.

(2) REMOVAL.- The oil temperature regulator is attached to the oil cooler by means of eight screws.

(a) Disconnect the shutter mechanism by removing the clevis bolt which connects the rod end of the piston to the bellcrank.

(b) Cut the safety wire and remove the eight screws, then lift the assembly off the oil cooler.

(3) TEST.- The following test is designed to check the operation of the oil temperature control:

NOTE

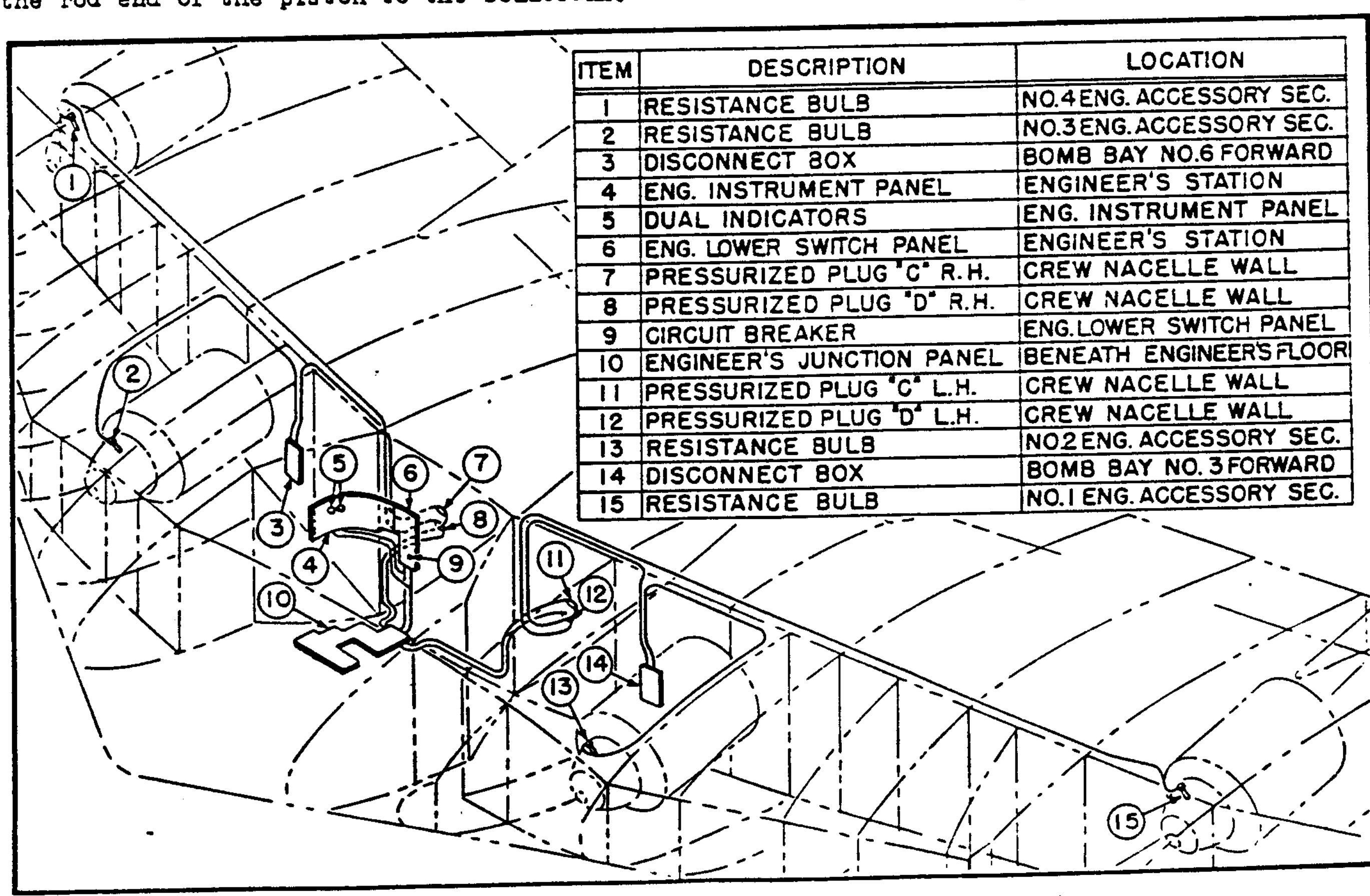
The oil cooler shutters may be open or closed at the start of the test.

(a) Apply clean oil, Specification No. AN-VV-O-446, Grade 1120, to the inlet port of the regulator, with the outlet port open, at a rate of flow of seven gallons per minute, at room temperature.

(b) Increase the oil temperature gradually to 93.3°C (200°F). At 79.4°C ± 3° (175°F ± 5°), measured at the inlet port, the shutters should start to open.

(c) After reaching 93.3°C (200°F) reduce the oil temperature gradually. At 73.9°C (165°F), measured at the inlet port, the shutters should start to close.

(d) Increase the rate of flow to approximately 41 gallons per minute, and restrict the outlet port until a pressure of 50-60 psi is reached at the inlet port, then check for leakage. None is permitted.



ITEM	DESCRIPTION	LOCATION
1	RESISTANCE BULB	NO.4 ENG. ACCESSORY SEC.
2	RESISTANCE BULB	NO.3 ENG. ACCESSORY SEC.
3	DISCONNECT BOX	BOMB BAY NO.6 FORWARD
4	ENG. INSTRUMENT PANEL	ENGINEER'S STATION
5	DUAL INDICATORS	ENG. INSTRUMENT PANEL
6	ENG. LOWER SWITCH PANEL	ENGINEER'S STATION
7	PRESSURIZED PLUG "C" R.H.	CREW NACELLE WALL
8	PRESSURIZED PLUG "D" R.H.	CREW NACELLE WALL
9	CIRCUIT BREAKER	ENG. LOWER SWITCH PANEL
10	ENGINEER'S JUNCTION PANEL	BENEATH ENGINEER'S FLOOR
11	PRESSURIZED PLUG "C" L.H.	CREW NACELLE WALL
12	PRESSURIZED PLUG "D" L.H.	CREW NACELLE WALL
13	RESISTANCE BULB	NO.2 ENG. ACCESSORY SEC.
14	DISCONNECT BOX	BOMB BAY NO. 3 FORWARD
15	RESISTANCE BULB	NO.1 ENG. ACCESSORY SEC.

Figure 7. Engine Oil Temperature Indicator Electrical Diagram

(4) INSTALLATION.- Be sure that the inlet connection is to the bottom of the oil cooler. Install the eight screws. Safety the two screws at the inlet end of the valve together, and safety the screws in groups of three at each side of the valve.

h. ENGINE DRIVEN OIL PRESSURE PUMP.- See section IV, paragraph 7.

i. OIL DILUTION AND DIVERSION.- Control switches for oil dilution and diversion are provided on the engineer's upper electrical control panel. The four individual switches, one for each engine oil system, have two positions; "OIL DILUTION" (momentary on), and the center position (on) which is an an automatic position. In the center position (automatic), a thermostat in the oil line controls the diversion valve which diverts the oil into the hopper as necessary for warm-up. In the "OIL DILUTION" position, the oil dilution solenoid is opened for oil dilution and the diversion valve is actuated to direct the diluted oil into the hopper. The control circuits for the thermostat, oil diverter, and oil dilution solenoid operate on 28 volts d.c., picked up from a bus in the engineer's upper electrical panel and routed through a switch-type circuit breaker to the control switches. (See figure 3.)

j. EMERGENCY OIL SHUT-OFF VALVES AND CONTROLS.

(1) DESCRIPTION. (See section IV, paragraph 11, figure 12.)- A manually-controlled oil shut-off valve is installed in each engine oil supply line (see figure 8). The oil shut-off valves are cable-controlled and operated by levers located at the top of the cabin between the radio operator's and the engineer's stations. The valve controls are labeled "EMERGENCY FUEL AND OIL SHUT-OFF VALVES," however, they may be used at any time it is desired to shut off the oil supply to an engine.

(2) REMOVAL.

(a) Drain the oil from the tank by opening the drain valve located in the oil line between the oil tank and the emergency oil shut-off valve. If sufficient space is available in the adjoining oil tank on the same side of the airplane, a quantity of the oil may be transferred.

(b) Relieve the tension on the pulley cables.

(c) Loosen the hose clamps and remove the hose connections.

(d) Remove the nut and taper pin which secure the pulley-control quadrant assembly to the valve stem, and remove the pulley control quadrant assembly.

(e) Remove the nuts and bolts which secure the valve to the support bracket, and lift the valve from the bracket.

(3) INSTALLATION.

(a) Secure the valve to the mounting bracket with the two bolts, nuts and washers.

(b) Connect the oil lines to the valve and securely tighten the hose clamps.

(c) Install the pulley-control quadrant assembly to the valve stem with the taper pin and nut.

(d) Adjust the quadrant control cables.

(e) Fill the oil tank with oil, Specification No. AN-VV-0-446, and check the valve for leaks and operation.

(4) ADJUSTMENT.

(a) Fix valve control handles in "UP" position (valve open position).

(b) With the valve-opening-spring assembly attached to the quadrant and the valve fully opened, adjust the turnbuckle so that dimension "A" is .730 in. at a temperature of 70°F (see Section IV, paragraph 11, figure 13).

k. OIL TANKS, PROPELLER GEAR BOX. (See figure 9.)

(1) DESCRIPTION.- Four metal oil tanks having a capacity of 3 U.S. gallons each, furnish oil for lubrication of the propeller gear boxes. The oil tanks encircle the propeller drive shaft, and are secured to the propeller gear box housing by ten studs, nuts and washers.

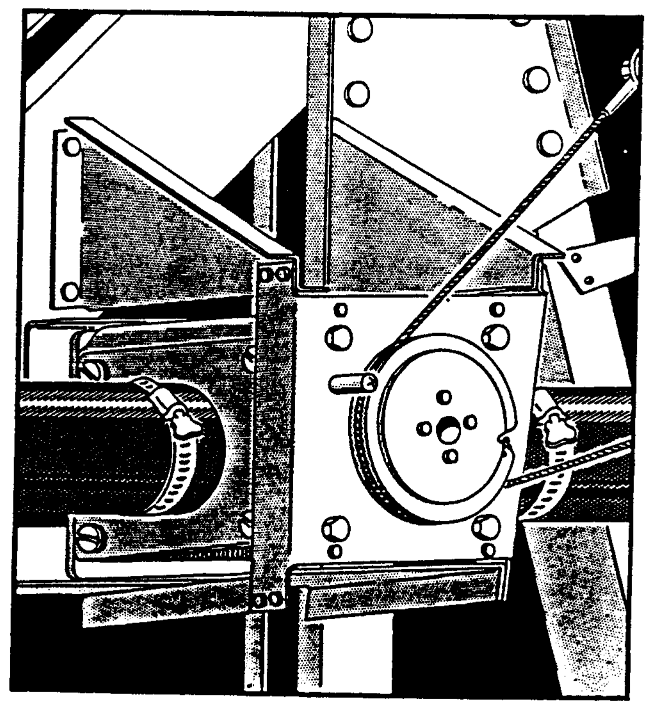


Figure 8. Emergency Oil Shut-off Valve

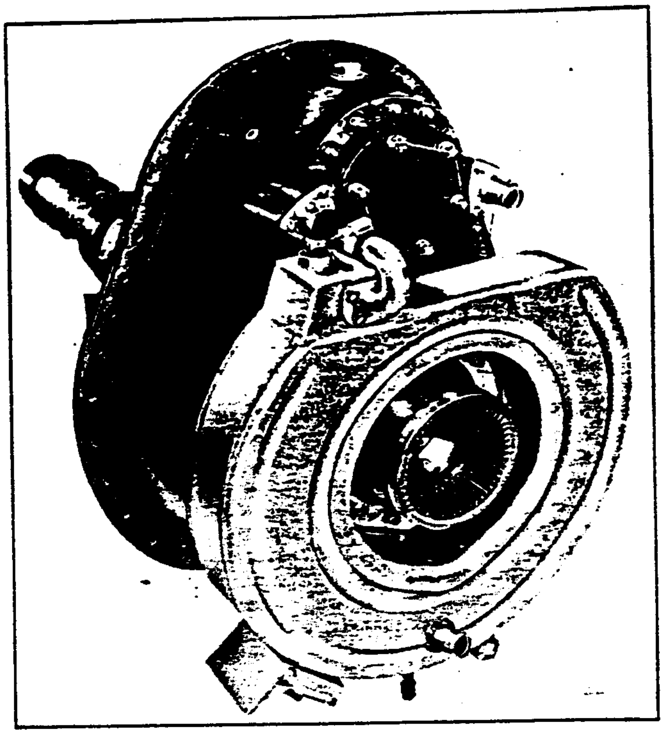


Figure 9. Propeller Gear Box Oil Tank

(2) REMOVAL.

(a) Remove the propeller. (See Section IV, paragraph 10.)

(b) Drain the oil from the tank to be removed.

(c) Disconnect and remove the oil return line at the top of the oil tank.

(d) Disconnect and remove the oil line at the bottom of the oil tank.

(e) Disconnect and remove the oil vent lines at the top of the oil tank.

(f) Remove the propeller gear box. (See Section IV, paragraph 10.)

(g) Remove the 10 elastic stop nuts and washers which secure the tank to the propeller gear box housing.

(3) CLEANING.- The oil tanks must be cleaned at each major overhaul, whenever signs of metallic wear appear in the oil, or when the propeller gear box is removed.

(a) Submerge the oil tank in kerosene, Federal Specification No. VV-K-211, or solvent, Federal Specification No. P-S-661. Use kerosene or solvent at room temperature.

CAUTION

When using kerosene or solvent, observe fire hazard percautions.

(b) Agitate the tank vigorously in the kerosene or solvent and remove the gum and sediment with a cloth or brush.

(c) Flush the tank with clean kerosene or solvent and dry thoroughly.

(4) PROPELLER GEAR BOX OIL TANK TEST.- Due to the difficulty in removal and installation of the propeller gear box oil tank, it is recommended that after cleaning, a pressure test be made before installation. The tanks may be tested by sealing all openings and applying 5 psi air pressure to the tank. Paint all seals and connections with soapy water, or submerge the tank in water to detect leaks.

(5) INSTALLATION.- Reverse the removal procedure to install the propeller gear box oil tanks.

(6) PROPELLER GEAR BOX OIL SYSTEM TEST.- After completing the oil tank installation, or after cleaning the oil tank or system, it should be pressure tested. Use a manometer to determine air pressure maintenance, and a solution of soapy water on all connections to detect leaks.

(a) Disconnect and seal the oil-in and oil-out lines at the propeller gear box.

(b) Disconnect and seal the vent line at the propeller gear box.

(c) Seal the outlet end of the oil vent overboard line.

(d) Apply 7 inches Hg. to any convenient point in the oil system. If after five minutes, a pressure loss is indicated, locate and repair the leak, then re-test for another five-minute period.

l. OIL COOLERS, PROPELLER GEAR BOX.- Each propeller gear box oil system is provided with an oil cooler (Airesearch No. 19096 outboard and No. 16930 inboard) which is located below and forward of the propeller gear box, in the propeller shaft housing. (See figure 10.) The oil coolers are of the honeycomb-core type, incorporating the use of a spring-loaded oil pressure relief valve, temperature control, and surge protection. The control valve is designed to by-pass oil in the event the oil has become congealed or that flow through the oil cooler has become obstructed. No adjustment is provided for the control valve. Airflow through the oil cooler is automatically controlled by thermo-electrically operated shutters. The shutters may be controlled by manually operated switches located on the electrical panel. These switches may be thrown from the off position to any one of three positions, "AUTO," "WARMER," and "COOLER;" "WARMER" and "COOLER" are momentary and "AUTO" is maintained closed.

m. PROPELLER GEAR BOX OIL TEMPERATURE INDICATORS.- Two dual oil temperature indicators are mounted on the engineer's instrument panel. An electrical resistance temperature bulb, located in the forward section of each

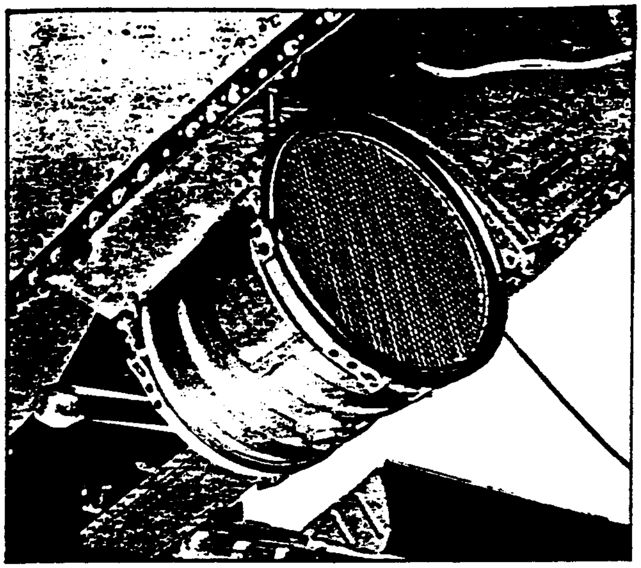


Figure 10. Propeller Gear Box Oil Cooler

propeller gear box transmits the oil-in temperature to its respective indicator. The 28 volt, direct current used to operate the indicator is routed from a switch-type circuit breaker located on the engineer's lower electrical panel. (See figure 11.)

n. PROPELLER GEAR BOX OIL TEMPERATURE CONTROL.- The propeller gear box oil is cooled by circulating it through an oil cooler which is located below and forward of the propeller gear box, in the propeller shaft housing. Rammed air passing through the oil cooler is controlled by cooling flaps installed in the housing fairing aft of the oil cooler. The oil temperature may be controlled automatically by means of a thermo switch, installed in the oil cooler outlet line, and an electrically operated actuator which is mechanically linked to the cooling flaps. The cooling flaps may also be maintained in an open or closed position by causing the control circuit for the actuator to by-pass the thermo switch. The actuator is driven by an induction motor which operates on 208 volts, 3 phase, 400 cycles, alternating current, which is controlled by a reversing power relay operated by 28 volt, d.c. control circuits. The control circuits pass through a manually operated switch (one for each gear box) on the engineer's lower switch panel, which may be thrown from the off position to any one of three positions, "AUTO," "WARMER," and "COOLER;" "COOLER" and "WARMER" are momentary and "AUTO" is maintained closed. The control current is picked up through a circuit breaker on the engineer's lower switch panel and wired to the control switches which are mounted on the same panel. Three control circuits are wired from the three positions of each switch, through the engineer's junction panel and through pressurized plugs in the crew nacelle to the propeller housing junction panel. The circuit for automatic control passes from the propeller housing junction panel to the thermo switch where it is switched to one of two circuits that are connected to the reversing power relay which is mounted on the propeller housing junction panel. The temperature of the oil determines which circuit shall control the relay; if the oil is too warm the relay cuts in the proper polarity of the power circuit to rotate the motor in a direction that will increase the cooling flap opening; if the oil is too cool, the direction of motor rotation will be reversed, and cause the flap opening to be reduced. When the control switch is placed in either the "WARMER" or "COOLER" position, the control circuit passes directly to the relay and causes the doors to respectively close or open. The power for the motor is wired to the relay from a rear spar a.c. sectionalizing panel in the left-hand outboard engine compartment for engine number one; in bomb bay number three, for engine number two; in bomb bay number six for engine number three; and in the right-hand outboard engine compartment for engine number four. The control circuits energize the coils of the relay and pass through limit switches in the actuator unit to the ground.

o. OIL SYSTEM DRAINS.- Each engine oil system is provided with the following drains: one in the bottom of each oil tank, one in each oil line near the oil tank, one in the bottom of each oil cooler, and one for each turbosupercharger.

p. PROPELLER GEAR BOX OIL DRAINS.- Each propeller gear box oil system is provided with the following oil drains: one drain is located in the bottom of each oil cooler, one drain in the bottom of the propeller gear box oil tank, and one drain plug in the bottom of the propeller gear box housing.

q. LOCATION OF OIL FILLER CAPS.- The oil filler neck is reached by removing the small covers located on the top of the wing directly over the main oil tank.

r. LOCATION OF PROPELLER GEAR BOX OIL FILLER CAPS.- The oil filler neck is reached by removing the oil filler caps located under the small covers on the propeller drive shaft housing.

s. OIL LINES.- Oil supply and return lines are of aluminum alloy, 52SO, 2-inch diameter. Oil-vent lines are of aluminum alloy, 52SO, .375-inch diameter. The lines are marked for identification with 1/2-inch bands of yellow tape near each end. When installing new lines, make certain that they are not kinked or dented.

ITEM	DESCRIPTION	LOCATION
1	PANEL, FORWARD RELAY	BOMB BAY NO.8
2	THERMO SWITCH	NO.4 ENG. PROP. SHAFT HOUSING
3	PROP. SHAFT HOUSING JUNC. PANEL	NO.4 ENG. PROP. SHAFT HOUSING
4	ACTUATOR-OIL COOLER AIR FLAP	NO.4 ENG. PROP. SHAFT HOUSING
5	PANEL-FORWARD RELAY	BOMB BAY NO.6
6	THERMO SWITCH	NO.3 ENG. PROP. SHAFT HOUSING
7	PROP. SHAFT HOUSING JUNC. PANEL	NO.3 ENG. PROP. SHAFT HOUSING

ITEM	DESCRIPTION	LOCATION
8	ACTUATOR-OIL COOLER AIR FLAP	NO.3 ENG. PROP. SHAFT HOUSING
9	ENGINEER'S LOWER SW. PANEL	ENGINEER'S STATION
10	CONTROL SWITCHES	ENGINEER'S LOWER SW. PANEL
11	CIRCUIT BREAKER	ENGINEER'S LOWER SW. PANEL
12	PRESSURIZED PLUG "C"	CREW NACELLE WALL R.H.
13	PRESSURIZED PLUG "E"	CREW NACELLE WALL R.H.
14	ENGINEER'S JUNCTION PANEL	BENEATH ENGINEER'S FLOOR
15	PRESSURIZED PLUG "E"	CREW NACELLE WALL L.H.
16	PRESSURIZED PLUG "C"	CREW NACELLE WALL L.H.
17	PANEL-FORWARD RELAY	BOMB BAY NO.3
18	THERMO SWITCH	NO.2 ENG. PROP. SHAFT HOUSING
19	PROP. SHAFT HOUSING JUNC. PANEL	NO.2 ENG. PROP. SHAFT HOUSING
20	ACTUATOR-OIL COOLE AIR FLAP	NO.2 ENG. PROP. SHAFT HOUSING
21	PANEL-FORWARD RELAY	BOMB BAY NO.1
22	THERMO SWITCH	NO.1 ENG. PROP. SHAFT HOUSING
23	PROP. SHAFT HOUSING JUNC. PANEL	NO.1 ENG. PROP. SHAFT HOUSING
24	ACTUATOR-OIL COOLER AIR FLAP	NO.1 ENG. PROP. SHAFT HOUSING
25	RESISTANCE BULB	NO.1 ENG. PROP. GEAR BOX
26	RESISTANCE BULB	NO.2 ENG. PROP. GEAR BOX
27	RESISTANCE BULB	NO.3 ENG. PROP. GEAR BOX
28	RESISTANCE BULB	NO.4 ENG. PROP. GEAR BOX
29	INDICATORS-TEMPERATURE	ENGINEER'S INST. PANEL
30	ENGINEER'S INST. PANEL	ENGINEER'S STATION

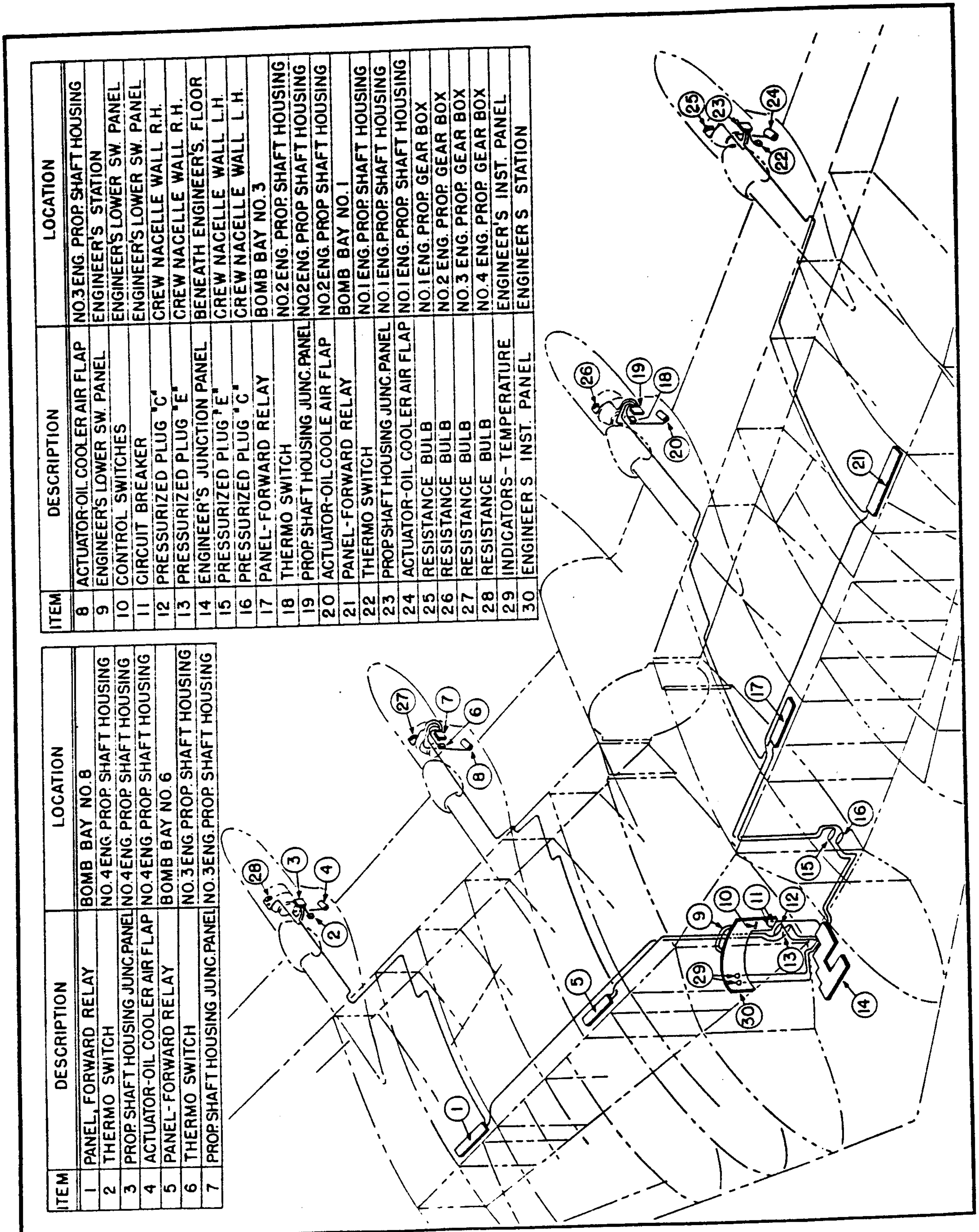


Figure 11. Propeller Gear Box Oil Temperature Electrical Diagram

13. ENGINE SECTION COOLING

13. ENGINE SECTION COOLING. (See figures 1 and 2, paragraph 14 a.)

a. GENERAL.- Engine section cooling for each Pratt and Whitney wasp major, air cooled, pusher type engine and allied turbosupercharger system is accomplished by an engine fan intake duct, engine fan, appropriate fan diffusers and diffuser adapters, a ram air intake duct, shrouding, a heat exchanger, overboard valves or wastegates, an engine air exit flap, and necessary control mechanisms.

(1) FLIGHT OPERATION.

(a) Cylinder cooling is accomplished principally by the engine fan which distributes and accelerates an airflow introduced through a duct in the leading edge of the wing. After flowing past the cylinder baffles, the air is emitted into the slipstream through an air exit flap.

(b) Component parts encircled by cooling shrouds (exhaust pipes and headers, exhaust collector rings, tailpipes, and exhaust ducts leading to the turbosuperchargers) receive an air supply both from the engine fan and the ram air duct. The relative influence of these two sources varies in accordance with the air pressure at the entrance of the ram air inlet duct. Refer to paragraph 13 e. Air ejection occurs through the overboard wastegates or valves as illustrated in figure 1, Section IV, paragraph 14 a.

NOTE
Cooling of the compressed and heated air received into the carburetor from the compressor side of the turbosuperchargers is described in Section IV, paragraph 14 b.

(2) GROUND OPERATION.- The engine fan is the only source of air supply for engine section cooling while the airplane is on the ground. Refer to figures 1 and 3, and paragraph 13 e.

b. TROUBLE SHOOTING.- Trouble within the engine cooling system must be suspected whenever the engine overheats or a too frequent adjustment of controls is required. After determining that the engine proper is not at fault, check the following points until the difficulty has been isolated.

(1) Check the fan tachometer indicator reading against the control setting of the fan speed control. If the trouble appears to be in this area check the wiring connections or, if necessary, replace faulty components.

(2) Check fan air inlet duct and ram air inlet duct to see that foreign material is not obstructing the free flow of air.

(3) Check fan blades to see that setting has not changed or that there are no large dents or nicks on the surface.

(4) Check the action of the air exit flaps by manually operating the switch controls. If pressure override switches appear to be at fault, replace them, then repeat the check.

(5) Check the action of the wastegate valves to see that they open and close properly.

(6) Inspect the cooling shrouds for possible evidence of air leakage.

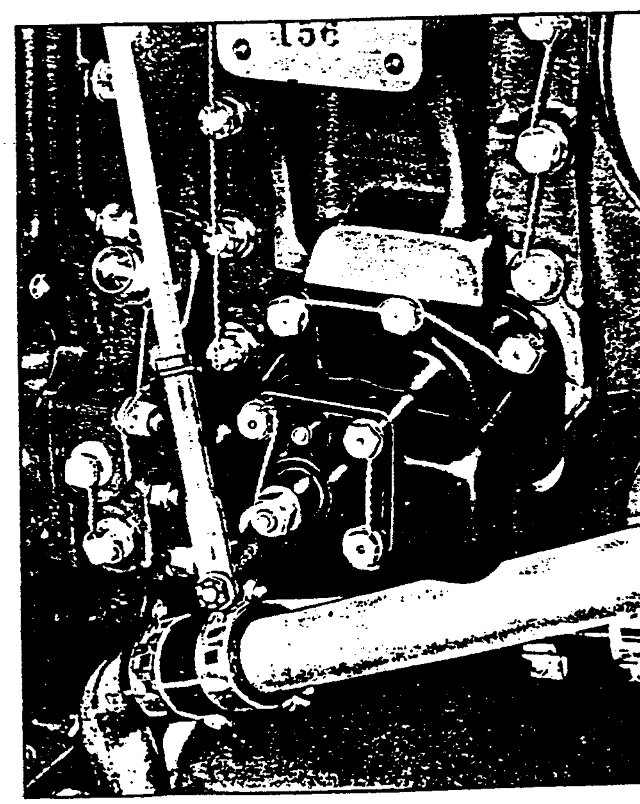
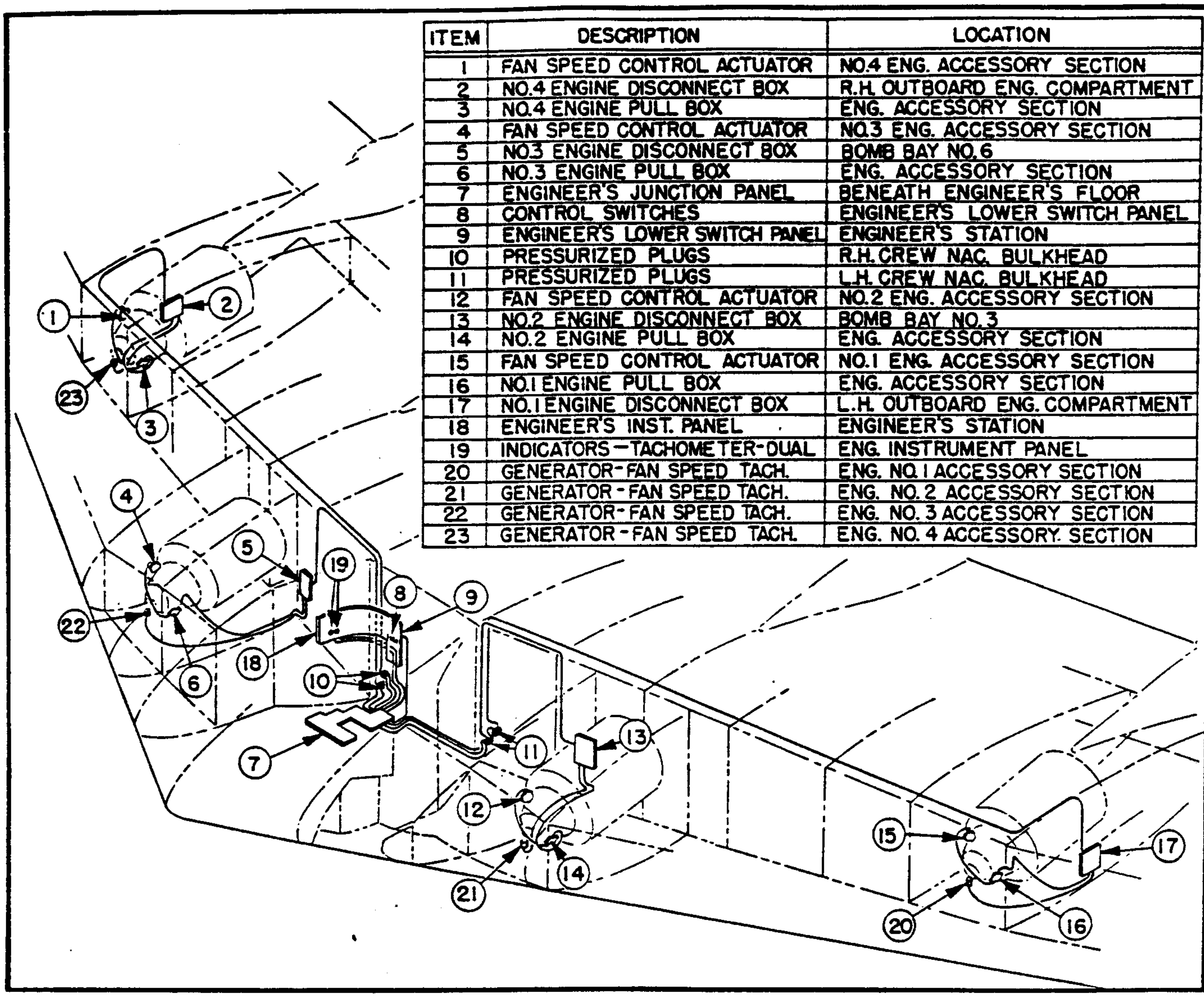


Figure 1. Engine Fan Speed Control



ITEM	DESCRIPTION	LOCATION
1	FAN SPEED CONTROL ACTUATOR	NO.4 ENG. ACCESSORY SECTION
2	NO.4 ENGINE DISCONNECT BOX	R.H. OUTBOARD ENG. COMPARTMENT
3	NO.4 ENGINE PULL BOX	ENG. ACCESSORY SECTION
4	FAN SPEED CONTROL ACTUATOR	NO.3 ENG. ACCESSORY SECTION
5	NO.3 ENGINE DISCONNECT BOX	BOMB BAY NO.6
6	NO.3 ENGINE PULL BOX	ENG. ACCESSORY SECTION
7	ENGINEER'S JUNCTION PANEL	BENEATH ENGINEER'S FLOOR
8	CONTROL SWITCHES	ENGINEER'S LOWER SWITCH PANEL
9	ENGINEER'S LOWER SWITCH PANEL	ENGINEER'S STATION
10	PRESSURIZED PLUGS	R.H. CREW NAC. BULKHEAD
11	PRESSURIZED PLUGS	L.H. CREW NAC. BULKHEAD
12	FAN SPEED CONTROL ACTUATOR	NO.2 ENG. ACCESSORY SECTION
13	NO.2 ENGINE DISCONNECT BOX	BOMB BAY NO.3
14	NO.2 ENGINE PULL BOX	ENG. ACCESSORY SECTION
15	FAN SPEED CONTROL ACTUATOR	NO.1 ENG. ACCESSORY SECTION
16	NO.1 ENGINE PULL BOX	ENG. ACCESSORY SECTION
17	NO.1 ENGINE DISCONNECT BOX	L.H. OUTBOARD ENG. COMPARTMENT
18	ENGINEER'S INST. PANEL	ENGINEER'S STATION
19	INDICATORS—TACHOMETER-DUAL	ENG. INSTRUMENT PANEL
20	GENERATOR-FAN SPEED TACH.	ENG. NO.1 ACCESSORY SECTION
21	GENERATOR-FAN SPEED TACH.	ENG. NO.2 ACCESSORY SECTION
22	GENERATOR-FAN SPEED TACH.	ENG. NO.3 ACCESSORY SECTION
23	GENERATOR-FAN SPEED TACH.	ENG. NO.4 ACCESSORY SECTION

Figure 2. Engine Fan Speed Control and Tachometer Generator - Electrical

c. ENGINE FAN.

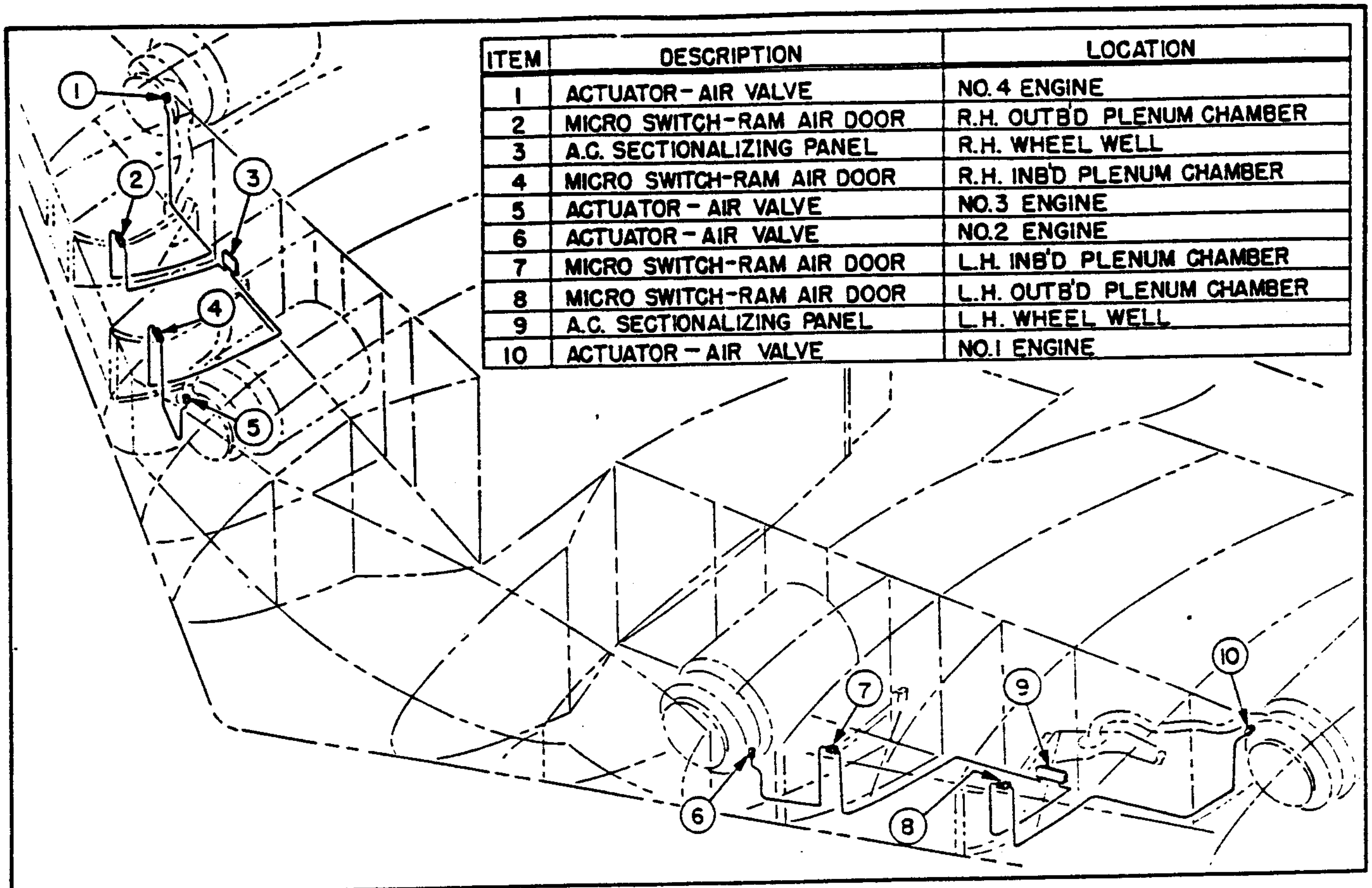
(1) DESCRIPTION.- The hydraulically driven engine fan is secured to the accessory drive case at the anti-propeller (rear) end of the engine. It is controlled manually by an adjacent selector valve (fan speed control) in accordance with cooling demands. The fan drive low ratio gear is bolted to the rear face of the fan drive high ratio gear and this assembly is splined onto the fan drive shaft. The hub of the high ratio gear seats against the thrust bearing inner race and is retained in place with a spanner nut. The low ratio gear meshes with the low ratio hydraulic coupling fan intermediate drive pinion and the high ratio gear meshes with the two high ratio coupling fan intermediate drive pinions. The cooling fan is bolted to the face of the flanged fan drive shaft.

(2) REMOVAL.- Refer to paragraph 13 i (5).

(3) INSTALLATION.- Refer to paragraph 13 j (1).

d. ENGINE FAN SPEED CONTROL. (See figures 1 and 2.)

(1) DESCRIPTION.- The speed of the engine fan is controlled by a hydraulic valve which is actuated by a 28 volt d.c. reversible motor. The actuating motor is mounted on the right side of the accessory section of the engine, and is wired through the engine disconnect box to the flight engineer's junction panel which is located under the engineer's floor. The circuit from the junction panel picks up the current from the 28 volt d.c. supply. Control is effected by a double throw momentary toggle switch that is normally in an OFF position. It is located on the engineer's upper electrical control panel. The two ON positions are designated "WARMER" and "COOLER", and when the switch is placed in either of these positions, the circuit to the motor is closed causing the motor to rotate in the appropriate direction to respectively reduce or increase the fan speed.



ITEM	DESCRIPTION	LOCATION
1	ACTUATOR - AIR VALVE	NO. 4 ENGINE
2	MICRO SWITCH-RAM AIR DOOR	R.H. OUTB'D PLENUM CHAMBER
3	A.C. SECTIONALIZING PANEL	R.H. WHEEL WELL
4	MICRO SWITCH-RAM AIR DOOR	R.H. INB'D PLENUM CHAMBER
5	ACTUATOR - AIR VALVE	NO. 3 ENGINE
6	ACTUATOR - AIR VALVE	NO. 2 ENGINE
7	MICRO SWITCH-RAM AIR DOOR	L.H. INB'D PLENUM CHAMBER
8	MICRO SWITCH-RAM AIR DOOR	L.H. OUTB'D PLENUM CHAMBER
9	A.C. SECTIONALIZING PANEL	L.H. WHEEL WELL
10	ACTUATOR - AIR VALVE	NO. 1 ENGINE

Figure 3. Ground Cooling Air Valve - Electrical

(2) REMOVAL.- Refer to paragraph 13 i (8).

(3) INSTALLATION.- Refer to paragraph 13 j.

e. GROUND COOLING AIR VALVE. (See figure 3.)

(1) DESCRIPTION.- The ground cooling air valve assembly is located on the right hand side of the engine fan cooling shroud of engines 1 and 3, and on the left hand side of the shroud of engines 2 and 4. Though it is installed primarily to provide a channel for engine fan cooling air (to the exhaust ducting system) when the airplane is on the ground, it is utilized also when the airplane is in flight. When the airplane reaches a sufficient speed, the increased air pressure in the ram air duct actuates a valve which energizes a motor driven actuator incorporated in the ground cooling valve. This valve then returns to the closed position where it remains until the ram air pressure again falls. The rammed air valve in closing operates a single pole, double throw micro switch, which completes the power circuit to one of the windings of the reversible, single phase a.c. actuator motor, thereby causing the valve to open. When the air pressure becomes great enough to open the rammed air valve, the micro switch completes the power circuit to the other motor winding, causing the motor to revolve in the opposite direction, and the ground cooling valve to close. Built-in limit switches cut off the operating current when the valve is in the open or closed position. 115 volt, single phase 400 cycles a.c. is picked up from a terminal on the main wheel well a.c. sectionalizing panel, and wired in separate circuits to the inboard and outboard rammed air valve switches. Two circuits, one for the open and one for the closed valve position, are wired from each switch to its respective motor.

(2) REMOVAL.- Refer to paragraph 13 i (6).

(3) INSTALLATION.- Refer to paragraph 13 j.

f. AIR EXIT FLAPS. (See figures 4,5,6 and 7.)

NOTE

Automatic air exit flap controls, except for the pressure override switches, are not operative in the XB-35 airplane. However, necessary provisions for the purpose of possible future modification are included. (See figure 8.)

(1) DESCRIPTION.- Each engine section is provided with an adjustable cooling flap assembly which, in conjunction with the engine fan, acts to control the temperature of the engine compartments, the pressure

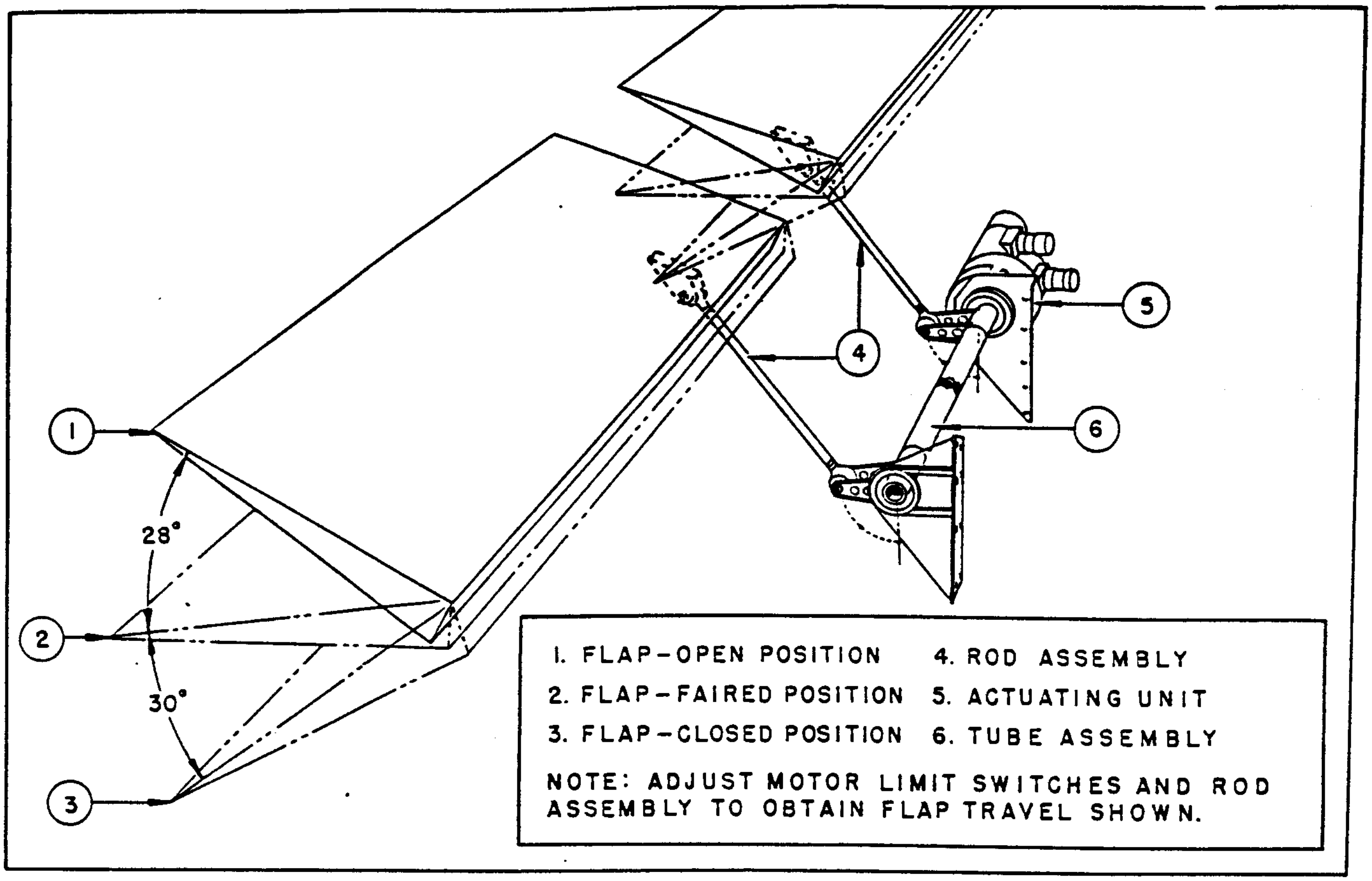


Figure 4. Cooling Flap Mechanism - Inboard Engine

within the engine compartments, and also (for the inboard engines only) the pressure within the designated bomb bays. In outboard engine compartments, the air, originally accelerated by the engine fan, is emitted through a single flap in the trailing edge of the wing.

Figure 5. Engine Air Exit Flap Motor - Inboard

This flap moves downward toward the open position. In inboard engine compartments, the air originally accelerated by the engine fan is carried through two bomb bays (No. 2 and 3 for engine 2, and No. 6 and 7 for engine 3) and is emitted through a split type flap which moves upward toward the open position. These flaps are controlled manually by switches on the flight engineer's lower electrical panel. They are automatically controlled when the pressure override switches in the outboard engine compartments or in the designated bomb bay (inboard) react to excessive pressure. In addition, the bomb release switches in the bombardier's compartment which are operated manually, override all other switches and cause the engine cooling flaps to move to the full open position. Each flap assembly is actuated by a motor which operates on 208 volt, three phase, 400 cycles a.c. A transmitter, one for each flap assembly, supplies a position reading to appropriate instruments at the flight engineer's station.

g. CYLINDER HEAD THERMOCOUPLES.- A gasket type thermocouple for transmitting temperature readings to a corresponding indicator is installed at C1 cylinder on each engine. Refer to Section IV, paragraph 7, figure 36.

h. FAN SPEED TACHOMETER.- A generator tachometer installed adjacent to each engine fan supplies a reading to a corresponding

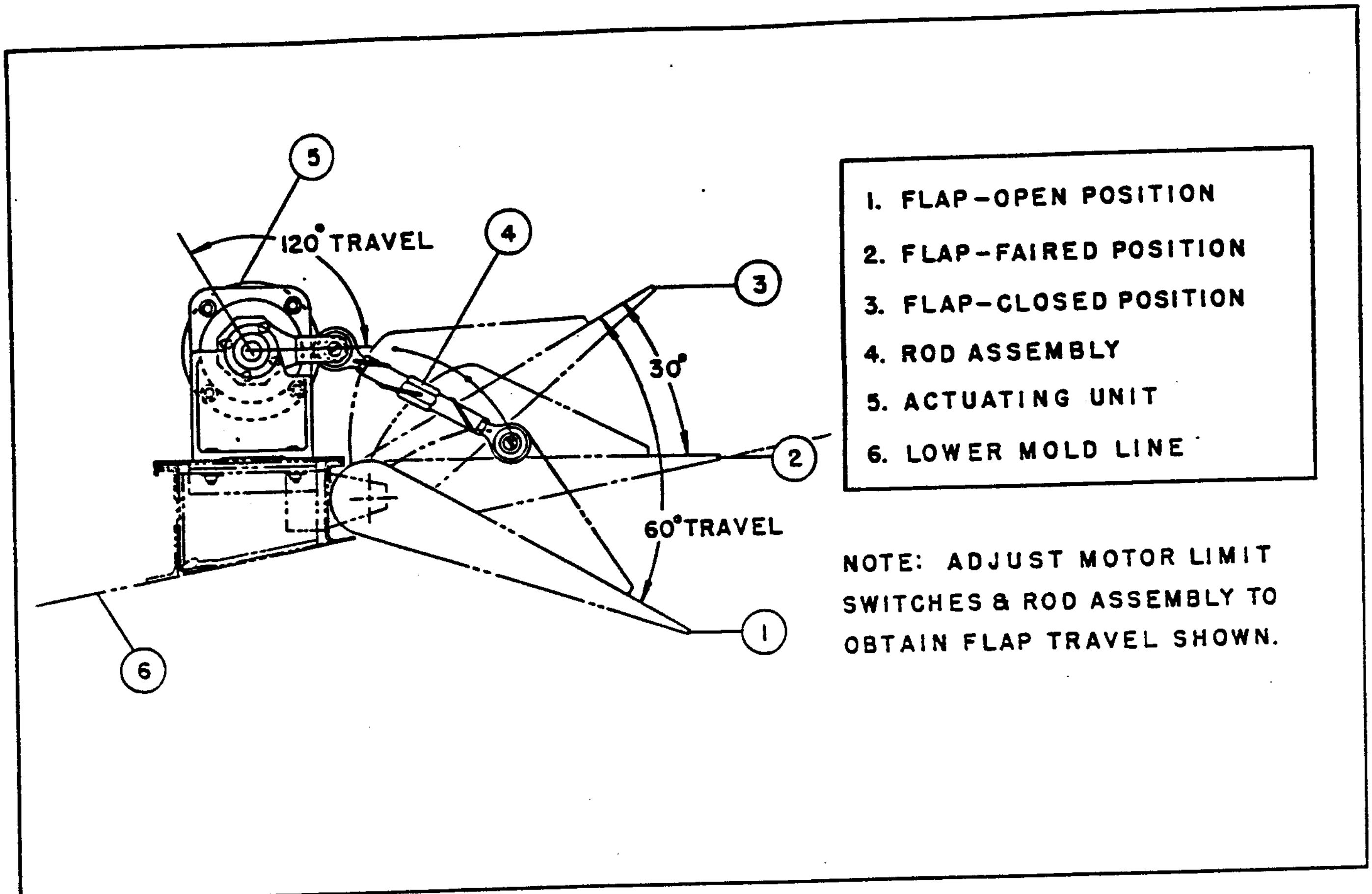


Figure 6. Cooling Flap Mechanism - Outboard

indicator located at the flight engineer's station. Refer to figure 9.

i. ENGINE SECTION COOLING COMPONENTS REMOVAL.

NOTE

The removal procedures for the various engine section cooling components are included under a single heading inasmuch as the removal of one part will often necessitate the removal of others.

(1) EXHAUST HEADER SHROUDS, TAILPIPE SHROUDS, COLLECTOR RING SHROUDS, EXHAUST DUCT SHROUDS.- The removal of these parts is described in Section IV, paragraph 14 a (b).

(2) FAN DIFFUSER.- The engine assembly including the fan and the fan diffuser adapter may be removed without removing the diffuser. Any major repair of this component should be made at a repair depot.

(3) FAN SPEED TACHOMETER.- Although the tachometer generators are located in different locations in respect to the engine fan, the removal procedure is essentially the same. Disconnect the shaft leading to the hub of the engine fan. Disconnect the electrical cable. Remove from the bracket.

(4) DIFFUSER ADAPTER.- Remove bolts attaching the diffuser adapter to the fan cooling shroud.

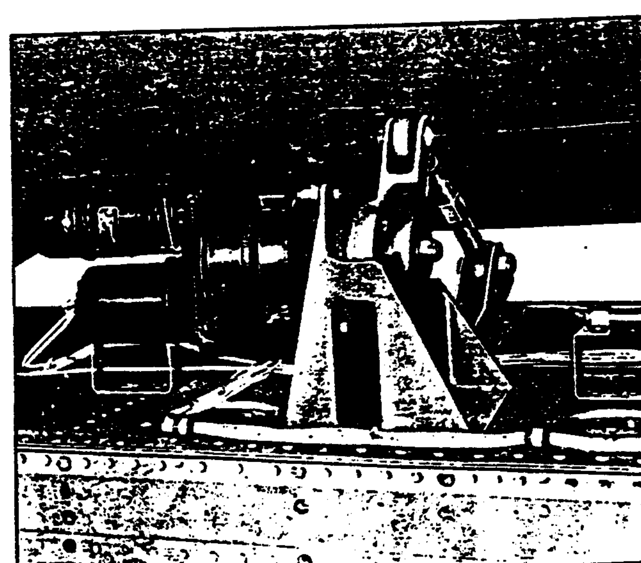
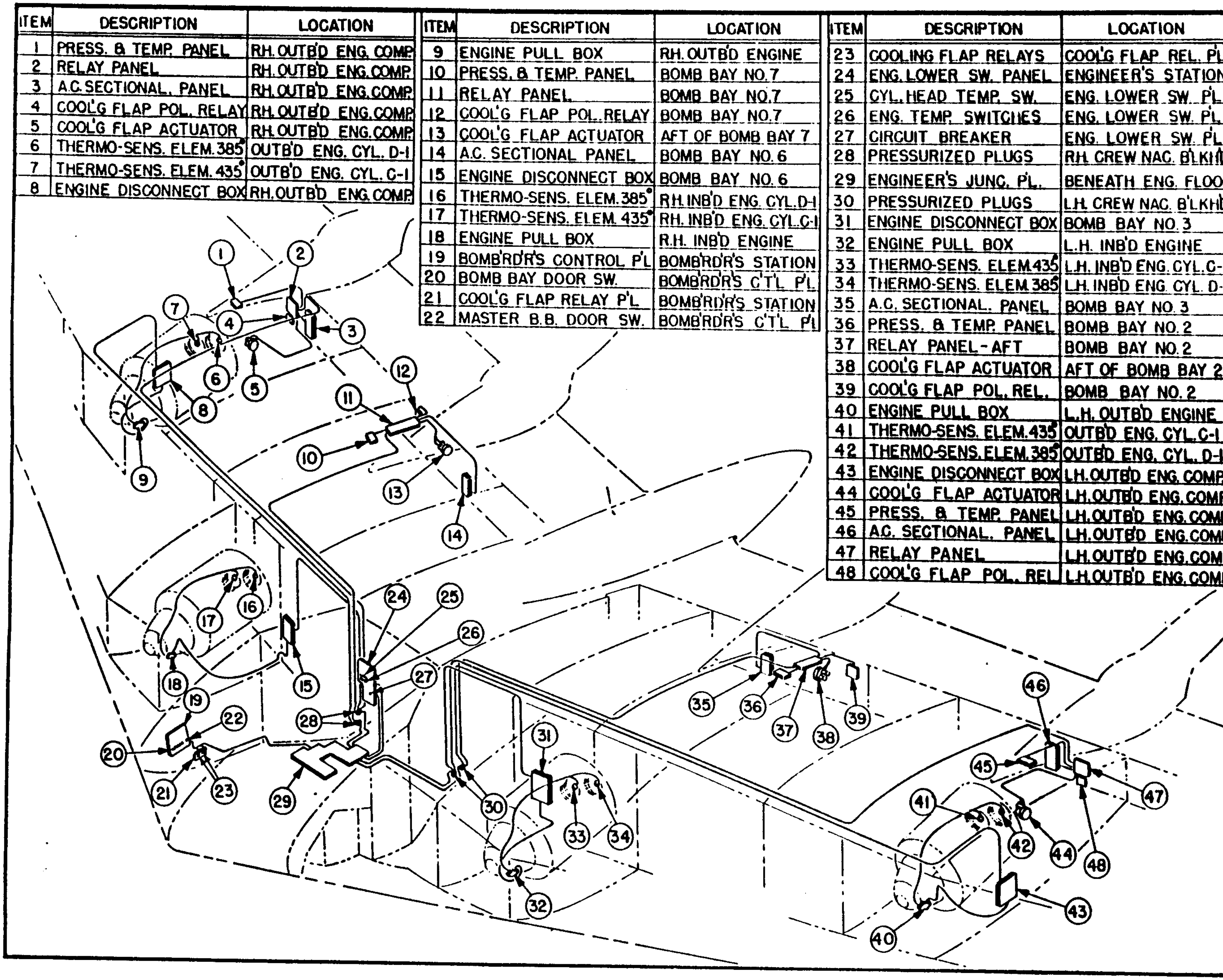


Figure 7. Engine Air Exit Flap Motor - Outboard



ITEM	DESCRIPTION	LOCATION
1	PRESS. & TEMP. PANEL	RH. OUTB'D ENG. COMP.
2	RELAY PANEL	RH. OUTB'D ENG. COMP.
3	A.C. SECTIONAL. PANEL	RH. OUTB'D ENG. COMP.
4	COOL'G FLAP POL. RELAY	RH. OUTB'D ENG. COMP.
5	COOL'G FLAP ACTUATOR	RH. OUTB'D ENG. COMP.
6	THERMO-SENS. ELEM. 385°	OUTB'D ENG. CYL. D-1
7	THERMO-SENS. ELEM. 435°	OUTB'D ENG. CYL. C-1
8	ENGINE DISCONNECT BOX	RH. OUTB'D ENG. COMP.
9	ENGINE PULL BOX	RH. OUTB'D ENGINE
10	PRESS. & TEMP. PANEL	BOMB BAY NO. 7
11	RELAY PANEL	BOMB BAY NO. 7
12	COOL'G FLAP POL. RELAY	BOMB BAY NO. 7
13	COOL'G FLAP ACTUATOR	AFT OF BOMB BAY 7
14	A.C. SECTIONAL PANEL	BOMB BAY NO. 6
15	ENGINE DISCONNECT BOX	BOMB BAY NO. 6
16	THERMO-SENS. ELEM. 385°	RH. INB'D ENG. CYL. D-1
17	THERMO-SENS. ELEM. 435°	RH. INB'D ENG. CYL. C-1
18	ENGINE PULL BOX	R.H. INB'D ENGINE
19	BOMB'RDR'S CONTROL P'L	BOMB'RDR'S STATION
20	BOMB BAY DOOR SW.	BOMB'RDR'S C'T'L P'L
21	COOL'G FLAP RELAY P'L	BOMB'RDR'S STATION
22	MASTER B.B. DOOR SW.	BOMB'RDR'S C'T'L P'L
23	COOLING FLAP RELAYS	COOL'G FLAP REL. P'L
24	ENG. LOWER SW. PANEL	ENGINEER'S STATION
25	CYL. HEAD TEMP. SW.	ENG. LOWER SW. P'L
26	ENG. TEMP. SWITCHES	ENG. LOWER SW. P'L
27	CIRCUIT BREAKER	ENG. LOWER SW. P'L
28	PRESSURIZED PLUGS	RH. CREW NAC. B'LKHD
29	ENGINEER'S JUNC. P'L	BENEATH ENG. FLOOR
30	PRESSURIZED PLUGS	L.H. CREW NAC. B'LKHD
31	ENGINE DISCONNECT BOX	BOMB BAY NO. 3
32	ENGINE PULL BOX	L.H. INB'D ENGINE
33	THERMO-SENS. ELEM. 435°	L.H. INB'D ENG. CYL. C-1
34	THERMO-SENS. ELEM. 385°	L.H. INB'D ENG. CYL. D-1
35	A.C. SECTIONAL. PANEL	BOMB BAY NO. 3
36	PRESS. & TEMP. PANEL	BOMB BAY NO. 2
37	RELAY PANEL - AFT	BOMB BAY NO. 2
38	COOL'G FLAP ACTUATOR	AFT OF BOMB BAY 2
39	COOL'G FLAP POL. REL.	BOMB BAY NO. 2
40	ENGINE PULL BOX	L.H. OUTB'D ENGINE
41	THERMO-SENS. ELEM. 435°	OUTB'D ENG. CYL. C-1
42	THERMO-SENS. ELEM. 385°	OUTB'D ENG. CYL. D-1
43	ENGINE DISCONNECT BOX	LH. OUTB'D ENG. COMP.
44	COOL'G FLAP ACTUATOR	LH. OUTB'D ENG. COMP.
45	PRESS. & TEMP. PANEL	LH. OUTB'D ENG. COMP.
46	A.C. SECTIONAL. PANEL	LH. OUTB'D ENG. COMP.
47	RELAY PANEL	LH. OUTB'D ENG. COMP.
48	COOL'G FLAP POL. REL.	LH. OUTB'D ENG. COMP.

Figure 8. Engine Cylinder Head Temperature Control

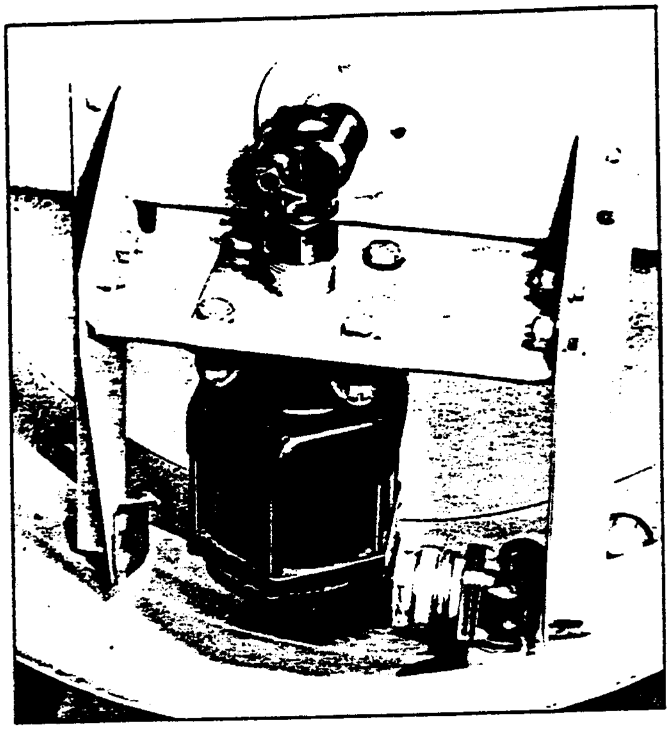


Figure 9. Engine Fan Tachometer - Typical

NOTE

A segment of the outboard engine fan adapter is removed at the time the engine assembly is removed.

(5) ENGINE FAN.- Remove 12 bolts which secure fan to fan drive shaft.

(6) GROUND COOLING VALVE.- Disconnect the electrical cable. Remove complete assembly by means of Dzus fasteners.

(7) ENGINE FAN COOLING SHROUD.- Remove panels by means of Dzus fasteners. This will allow access to the various engine accessories.

(8) FAN SPEED CONTROL. (See figures 1 and 2.)- Remove four bolts which secure engine fan speed control to bracket. Disconnect electrical plug. Remove nut which secures actuating arm to engine case.

(9) AIR EXIT FLAPS.- Flap removal is described in Section IV, paragraph 1.

(10) AIR EXIT FLAP ACTUATOR MECHANISMS. (See figures 5 and 7.)- Although the actuator mechanisms are located differently in respect to the flap assemblies which they control, the removal procedure is essentially the same. Remove entire motor assembly from bracket, tube assembly or bellcrank, by means of bolts. Disconnect electrical cable. If it is necessary to remove push rods leading to flap assembly, make certain that the adjustment is not changed.

(11) FLAP POSITION TRANSMITTERS.- Although the inboard and outboard transmitters are located differently in respect to their corresponding flap assembly, they are removed in essentially the same manner. Remove bolts which secure transmitter to bracket. Disconnect transmitter arm, then remove complete transmitter assembly.

j. ENGINE SECTION COOLING COMPONENTS INSTALLATION.- The installation procedure for all engine cooling components is essentially the reverse of the removal procedure, paragraph 13 i (1) through (10), except for the following precautions:

(1) The 12 bolts which secure the engine fan to the fan drive shaft must be tightened to 400-450 inch pounds.

(2) Actuator mechanisms relating to the flap assemblies must be reinstalled or replaced in such a manner as to retain the original adjustment.

NOTE

All maintenance on engine section cooling components is to be accomplished by replacement except in instances where repair may be effected by removing small abrasions or dents from the damaged part.

14. PLENUM CHAMBER

14. PLENUM CHAMBER. The plenum chamber is that part of the wing containing the exhaust system (exclusive of the engine section), induction system, heat, vent and cabin supercharging system, and the wing anti-icer system.

a. ENGINE EXHAUST SYSTEM. (See figures 1 and 2.)

(1) GENERAL.- The engine exhaust system, in addition to conveying exhaust gas from the engine, is utilized to provide motive power for the turbosuperchargers, heat for outer wing anti-icing (outboard engines), and cabin warmth (inboard engines). Refer to paragraph 14 c and d. The exhaust gas from the 28 cylinders of each engine is routed through a heat exchanger and then is diverted into two turbosuperchargers, eventually escaping through the applicable normal exhaust outlet (flight hood), or wastepipe. (See figures 1 and 2.) However, under certain conditions determined by the flight engineer, the exhaust gas may be directed through only one of the two turbosuperchargers. Refer to paragraph 14 b, and also to figures 1 and 2. The heat exchangers function primarily to decrease the temperature of the exhaust gas flowing into the turbosupercharger. Cool ram air, after passing through and collecting heat from a heat exchanger, normally discharges into the slipstream through an overboard wastegate assembly; but, if desired, may be diverted for use in outer wing anti-icing or cabin heating. Refer to paragraphs 14 c and d.

(2) TROUBLE SHOOTING.- Refer to paragraph 14. b.

(3) HEADERS, COLLECTOR RINGS, PIPES, AND DUCTS. (See figure 2.)

(a) DESCRIPTION.- The exhaust pipe coupling in the exhaust port of each cylinder is equipped with a steel liner and four studs for securing to an appropriate exhaust pipe header. These headers are constructed of stainless steel and are encased within removable, individually formed, cooling shrouds. They are installed somewhat differently on the inboard and outboard engines and, because of the close fitting tolerence necessary, are not ordinarily interchangeable even from one cylinder configuration to another. From the headers the exhaust gas is routed into a collector ring which is similarly encased within cooling shrouds. On inboard engines this exhaust gas then passes through a transition chamber directly into the heat exchanger but on outboard engines the gas is first routed through a tailpipe. The exhaust pipes aft of the heat exchangers and leading to the turbosuperchargers are also encased in cooling shrouds.

(b) REMOVAL.- Removal and installation procedure should follow a numbered sequence to insure that all parts removed are reinstalled in their original positions.

NOTE

It is advisable to remove an exhaust duct without removing its encasing cooling shroud in instances where this is possible.

1. EXHAUST HEADERS AND COOLING SHROUD ASSEMBLIES.

a. Remove studs which secure exhaust pipe to cylinder.

b. Remove hose clamp which secures cooling duct (adjacent to engine fan) to exhaust header and cooling shroud assembly.

c. Disconnect exhaust header and cooling shroud assembly from exhaust collector ring and cooling shroud assembly by means of external and internal clamps.

d. Break inboard collector ring and cooling shroud assembly into two sections by means of external and internal clamps located immediately above area leading into heat exchanger, and at the point adjacent to the exhaust cooling shroud assembly vent. The outboard collector ring and cooling shroud assembly may be removed in one piece, or it may be broken into two sections if desired.

e. Remove studs which secure collector ring supports to engine.

f. Disconnect inboard collector ring and exhaust cooling shroud assembly from duct leading toward heat exchanger by removing clamps. Disconnect outboard collector ring and cooling shroud assembly from tailpipe by removing clamps.

g. Remove outboard engine aspirator and section of exhaust tailpipe and cooling shroud assembly by proceeding as directed in paragraph 7 b (2).

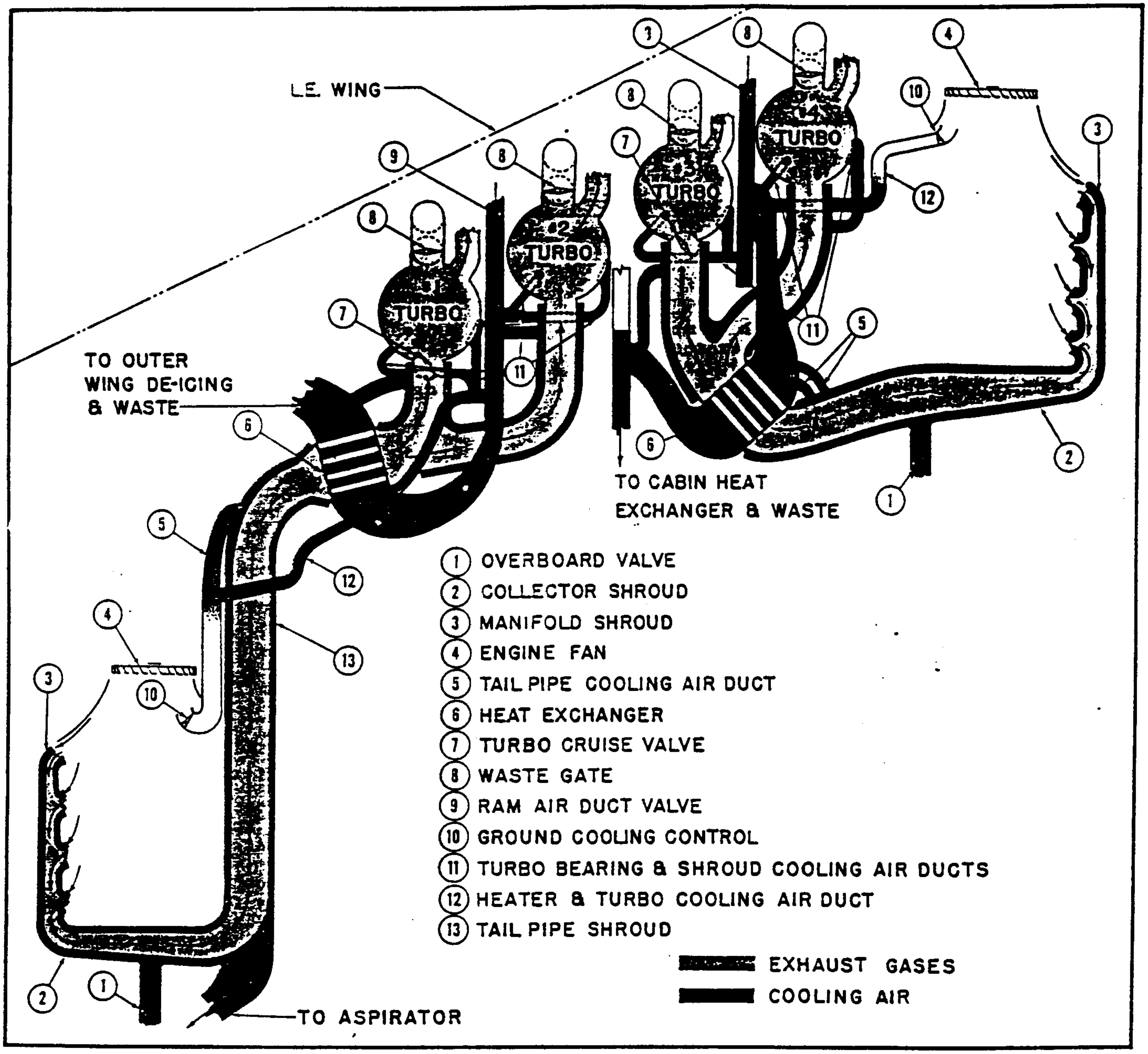


Figure 1. Exhaust and Cooling System

NOTE

It is not practicable to give detailed instructions pertaining to exhaust system removal adjacent to and aft of the heat exchangers. Except in case of emergency this work should be accomplished at a repair depot.

h. Remove turbosuperchargers (inboard and outboard) as directed in paragraph 14 b.

i. Remove insulating blankets (inboard and outboard) from exhaust pipe and cooling shroud assemblies. Refer to figure 2.

j. Remove cooling air shrouds (inboard and outboard) by means of external clamps.

2. INBOARD ENGINE EXHAUST SYSTEM. (TURBOS TO HEAT EXCHANGERS.)

a. Remove flex cooling ducts. Refer to figure 2, reference 5.

b. Remove flex ground cooling duct. Refer to figure 2, reference 15.

c. Remove (universal) ball joint aft of turbosupercharger nozzlebox. Refer to figure 2, reference 7 and 10.

d. Remove cooling air duct adjoining ram air duct and heat exchanger. Refer to figure 2, reference 4.

e. Remove turbosupercharger branch exhaust chamber which interconnects the exhaust piping from both turbosuperchangers to the heat exchanger. This chamber is fitted to the heat exchanger by a flange. Refer to figure 2, reference 8.

f. Remove remaining exhaust piping between collector ring and heat exchanger.

g. Remove anti-icing warm air duct from between heat exchanger and cabin heat plenum chamber. Refer to figure 2, reference 9.

h. Remove heat exchanger by removing bolts on all four sides. It is attached to bracket hangers. Refer to figure 2, reference 6.

3. OUTBOARD ENGINE EXHAUST SYSTEM.

a. Remove diffuser sections forward of engine bay. This is necessary in order to attain access to the remaining tailpipe section immediately forward of transition chamber adjacent to heat exchanger. Proceed as follows:

1. Remove diffuser cap by removing six bolts. See figure 2, reference 22.

2. Remove both halves of diffuser. See figure 2, reference 23.

3. Remove frame and aft skin. See figure 2, reference 19.

4. Remove duct (access) doors. See figure 2, reference 24.

5. Remove stringer assemblies by removing bolts. See figure 2, reference 17.

b. Remove ground cooling ducts. Refer to figure 2, reference 15.

c. Remove remaining section of tailpipe.

d. Remove transition chamber between tailpipe and heat exchanger. See figure 2, reference 25.

e. Remove (universal) ball joint aft of turbosupercharger nozzlebox.

f. Remove exhaust piping between turbosupercharger ball joints and heat exchanger. Refer to figure 2, reference 12 and 13.

g. Remove anti-icing cool air chamber adjacent to heat exchanger. Refer to figure 2, reference 14.

h. Remove anti-icing warm air duct adjacent to heat exchanger. Refer to figure 2, reference 26.

i. Remove heat exchanger by removing bolts on all four sides. The heat exchanger is attached to structure beneath it on two sides.

(c) MAINTENANCE.- Replace any exhaust piping proved faulty by visual inspection or test. Various tests are described in paragraph 14 b. Cooling ducts necessary to the exhaust system, but treated more fully in paragraph 13, may be reshaped or welded if the damage is slight.

(d) INSTALLATION.- Installation is essentially the reverse of the REMOVAL procedure. Refer to paragraph 14 a (3) (b). If desired, make use of figure 2 then proceed with the installation, working from the engines to the turbosuperchargers. Make certain that the pipes or ducts are secured tightly in their correct positions and that all possibility of leakage is forestalled.

CAUTION

When installing the duct to the turbo, the attaching bolts should be only snug tight (0 torque). This is extremely important to eliminate bolt failure due to expansion.

(4) HEAT EXCHANGERS.

(a) DESCRIPTION.- A heat exchanger is provided for each pair of turbosuperchargers. Each exchanger is located adjacent to the engine which it serves and is constructed of stainless steel. The exhaust gas flow from the engine is channeled through tubes, within the exchanger, to an adjoining duct system which leads to the turbosuperchargers. A transverse cooling air flow initiated as described in paragraph 13 causes a reduction in temperature of the exhaust gas entering the nozzleboxes of the turbosuperchargers.

(b) MAINTENANCE INSPECTION.- Replace all heat exchangers which by visual inspection or test prove faulty. A test for this unit is described in paragraph 14 a.

(c) REMOVAL AND INSTALLATION.- The removal and installation procedures for these units are described in paragraphs 14 a (3) (b) and (d).

(5) TURBOSUPERCHARGER CRUISE VALVE. (See figure 2.)

(a) DESCRIPTION.- An electrically actuated exhaust diverter (cruise) valve is installed in the exhaust duct immediately aft of turbosuperchargers No. 1, No. 3, No. 6, and No. 8. By use of the applicable corresponding control (engine turbo selector switch) any one of these turbosuperchargers may be rendered inoperative, thereby permitting its allied turbosupercharger to return to normal operation in instances

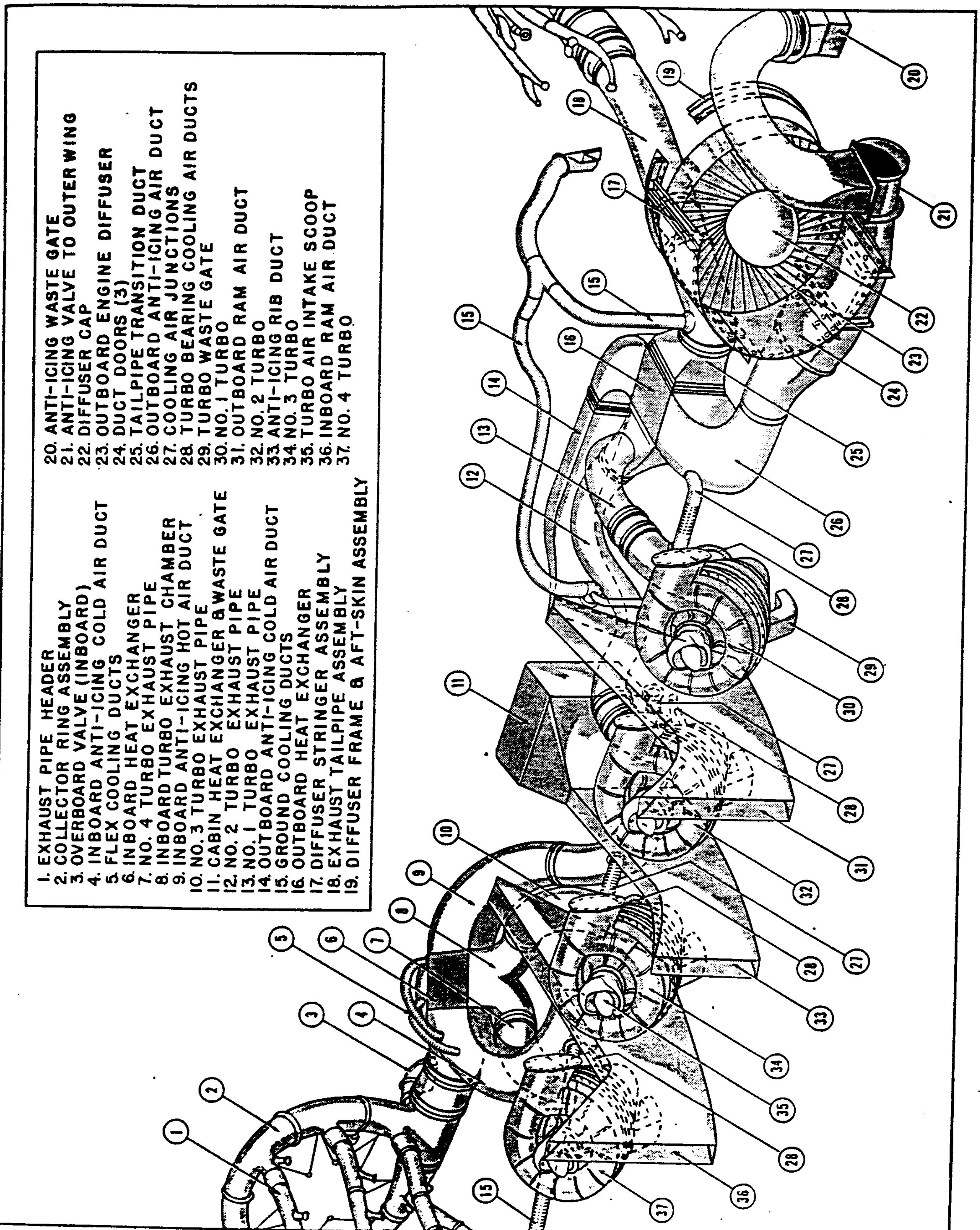


Figure 2. Exhaust System

where pulsation occurs or collapse is imminent. The controls are located on the flight engineer's upper switch panel and have two positions, SINGLE and PARALLEL. The actuator is driven by a reversible motor and contains built-in limit switches. Action is transmitted to the valve by means of a push rod.

(b) REMOVAL.

1. Disconnect electrical cables to electric motor.

2. Remove nuts which secure ends of push rod to actuator arm and valve arm. Lift off push rod.

3. Remove nuts which secure electric motor to bracket.

4. Remove duct containing valve as described in paragraph 14 a (3) (b).

(c) INSTALLATION AND ADJUSTMENT.- The installation procedure is essentially the reverse of the REMOVAL procedure. Make certain when installing the duct containing the cruise valve that the push rod is adjusted to such a length as to allow the limit switch on the electric motor to operate slightly before the valve reaches the fully closed position.

(6) TURBOSUPERCHARGER WASTEGATE. (See figures 1 and 2.)- The wastepipe functions as an alternate or additional outlet for the release of engine exhaust gas into the slipstream, as is necessary to regulate turbosupercharger operation. Refer to paragraph 14 b. The position of an electrically controlled butterfly valve or gate within this pipe determines the route of the exhaust gas. When the gate is completely closed, most of the gas will escape through the normal exhaust (flight hood); and when the valve is completely open the opposite condition will exist. Refer to paragraph 14 b and to figures 3 and 15. Since both the normal exhaust (flight hood) and the wastepipe are integral parts of the turbosupercharger, maintenance information pertaining to these components is also contained in paragraph 14 b.

b. INDUCTION SYSTEM. (See figure 3.)

(1) GENERAL.- The carburetor fuel-air induction system includes turbosuperchargers, two for each engine; eight filter assemblies, one for each turbosupercharger; four intercoolers, each serving one pair of turbosuperchargers; necessary interconnecting ducts and controls. The carburetor and the internal engine supercharger (blower) are discussed in paragraph 7. Essentially the induction system operates as follows:

(a) Ram air enters the turbosupercharger centrifugal air compressor through the ram air intake scoop as directed by the position (ram air, filtered air, pre-heat air) of the internal butterfly valve. (See figures 5 and 24.)

(b) The air compressor impeller, which is driven by the exhaust gas turbine (paragraph 14 a) compresses the air.

(c) The compressed air is discharged from the compressor casing into the intercooler where heat (gained during compression) is removed. (See figure 26.) This cooling of the supercharged air is necessary in preventing detonation, with its consequent limitation of the power rating of the engine.

(d) From the intercooler the compressed and cooled air passes into the carburetor, where it is mixed with the fuel.

(e) The fuel-air mixture then goes to the inlet of the gear-driven internal engine supercharger (blower) which further compresses the mixture and distributes it to the intake manifold of the engine.

(f) Exhaust gases are channeled into the turbine of the turbosupercharger, thereby furnishing motive power for continued air compression.

NOTE

Although a trouble may apparently have its origin within the induction system it is advisable to eliminate other possible sources first. An engine malfunction or a malfunction in certain engine accessories may affect manifold pressure in the same manner as trouble within the turbo control system proper. Also mechanical difficulties affecting the free flow of air or exhaust gas may have a similar effect.

(2) TROUBLE SHOOTING.

TROUBLE	PROBABLE CAUSE	REMEDY
Unable to get take-off manifold pressure.	Reduced nozzlebox clear ance.	If nozzlebox clearance is less than 0.080 inch or greate r than 0.160 inch at any point around the circumference of bucket wheel, reshim or replace the turbo-supercharger.

TROUBLE	PROBABLE CAUSE	REMEDY
Unable to get take-off manifold pressure.	Turbosupercharge wastegate bound.	Remove foreign material or replace wastepipe assembly. Clean bearings and work out carbon.
	Ram air intake scoop filter clogged.	Check and clean if necessary. refer to paragraph 14 b (5) (c) 3.
	Ram air intake scoop clogged.	Check for obstruction in air-intake scoop and ducting. Remove any foreign material present.
	Faulty turbosupercharger regulator system.	Refer to electronic controls system test, paragraph 14 b (3).
	Leaks in exhaust system.	Thoroughly examine exhaust manifold system for leaks. Adjust or replace any parts which cause leakage.
	Leaks in air-induction system.	Check induction system from intake to internal blower for leaks. Adjust or replace any parts which cause leakage.
	Improper functioning of manifold-pressure gage	Check reading of manifold-pressure with barometric reading to see if gage is recording correctly. For further information consult Section IV, paragraph 23.
	Improper functioning of internal supercharger.	Warm up engine and adjust propeller controls to obtain take-off engine rpm. Advance throttle to full-open position and check if manifold pressure, normal under these conditions, is attained. If not, check throttle-control system as instructed in paragraph 9.
	Improper operation of propeller governor.	Check to see if take-off rpm is obtained, If not, check governor as instructed in Section IV, paragraph 10.
	Faulty turbosupercharger wastegate motor.	Replace with serviceable unit.
	Faulty calibration of turbo boost selector.	Recalibrate according to instructions given in paragraph 14 b (4).
	Turbosupercharger rotor bound.	Revolve rotor by hand. If rotation is sticky or rough, replace turbosupercharger.
Excessive manifold pressure.	Turbosupercharger wastegate bound.	Repair wastegate by removing foreign material or replace wastepipe assembly. Clean bearings and work out carbon.
	Faulty turbosupercharger regulator system.	Consult paragraph 14 b (6).

TROUBLE	PROBABLE CAUSE	REMEDY
Excessive manifold pressure.	Clogged air line.	Clean air-line running between pressuretrol and carburetor intake.
Erratic manifold pressure in flight.	Faulty calibration of turbo boost selector.	Recalibrate according to paragraph 14 b (4).
	Leaks in exhaust and induction systems.	Check exhaust and induction system for leaks. Refer to paragraph 14 b (5).
	Faulty turbosupercharger regulator system.	Consult paragraph 14 b (3).
High carburetor air temperature.	Intercooler ducting restricted.	Check ducting for foreign material and remove any obstructions.
	Intercooler flaps jammed shut.	Repair or replace defective mechanical or electric equipment.
Manifold pressure falls off abnormally as airplane climbs.	Leaks in induction system.	Repair or replace defective part of induction system.
	Obstructions in air scoop or air filter.	Remove obstructions.
	Leaks in exhaust system.	Repair or replace part causing trouble.
	Failure of tube in the amplifier.	Replace tube.
Manifold pressure increases as airplane climbs, or it is abnormally high on one or more engines.	Leaky connection in pressuretrol tubing.	Tighten or replace tubing and connections as needed.
	Faulty pressuretrol operation.	Replace pressuretrol.
	Low voltage or faulty 7C5 tubes.	Locate by using continuity check, and repair or replace part affected.
	Electrical troubles in bridge system.	Locate by using continuity check, and repair or replace part affected.
	Fuse blown - wastegate stopped at partly closed position.	Check turbo control system for shorts and grounds, faulty condensers, or mechanical failures, and make repairs or replacements as needed.
	Electrical troubles in bridge system.	Check bridge system for opens, grounds, or shorts by continuity check.
	AN connector loose on some unit.	Insert properly and tighten.
	Pressuretrol AN connector inserted in wrong position.	Check alignment with guide key.
Manifold pressure "Hunts" at low altitude.	Faulty pressuretrol operation.	Replace pressuretrol.

TROUBLE	PROBABLE CAUSE	REMEDY
Manifold pressure "Hunts" at low altitude.	Faulty propeller-governor operation.	Run prop through full rpm range. If this doesn't remedy the condition, refer to Section IV, paragraph 10 for further information.
	Engine ignition system troubles.	Refer to Section IV, paragraph 8.
	Break in balance or pressuretrol potentiometer winding.	Replace defective unit.
	Intermittent open or ground in bridge system.	Make continuity test. Correct wiring difficulty.
	Loose wastegate linkage.	Tighten or replace part affected.
	Ram air intake scoop valve unstable.	Repair valve actuating mechanism.
Manifold pressure "Hunt" more pronounced at high altitude.	Turbo governor not smooth in overspeed range.	Replace governor.
	Ignition-system troubles.	Refer to Section IV, paragraph 8.
	Propeller-governor troubles.	Refer to Section IV, paragraph 10.
	Carburetor troubles.	Refer to Section IV, paragraph 7.
	Faulty pressuretrol.	Replace pressuretrol.
Manifold pressure overshoots when throttles are advanced rapidly.	Pressuretrol not operating properly.	Replace pressuretrol.
	Propeller governors not operating properly, allowing rpm to overshoot.	Refer to Section IV, paragraph 10.
Manifold pressure falls off at high altitude and then stays below normal during remainder of descent, or until throttle range is reached.	Overspeed potentiometer wiper stuck part way up on winding.	Replace governor.
	Governor out of calibration.	Replace governor.
	Leak in induction system.	Repair or replace faulty part.
	Ice in carburetor.	Close intercooler flaps, increase turbo boost.
Excessive oil running down through turbine wheel and flight hood.	Malfunction of either anti-leak valve or check valve.	Flush or clean valve to remove foreign particles that may have lodged underneath the valve seat. If the trouble still remains, replace the valve.

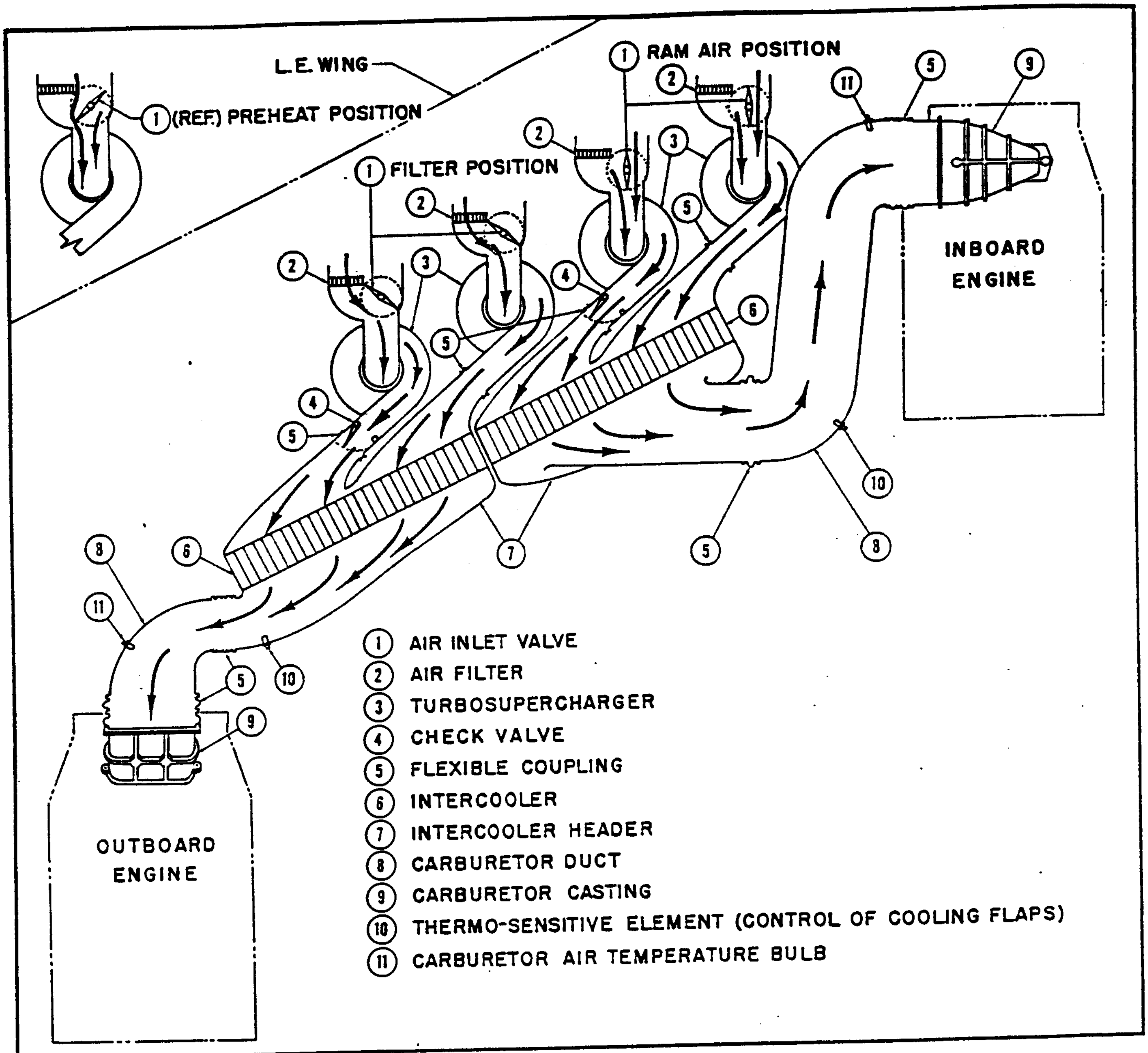


Figure 3. Induction System

(3) ELECTRONIC CONTROLS SYSTEM TEST. (See figure 4.)

(a) FUNCTIONAL VOLTAGE CHECK.

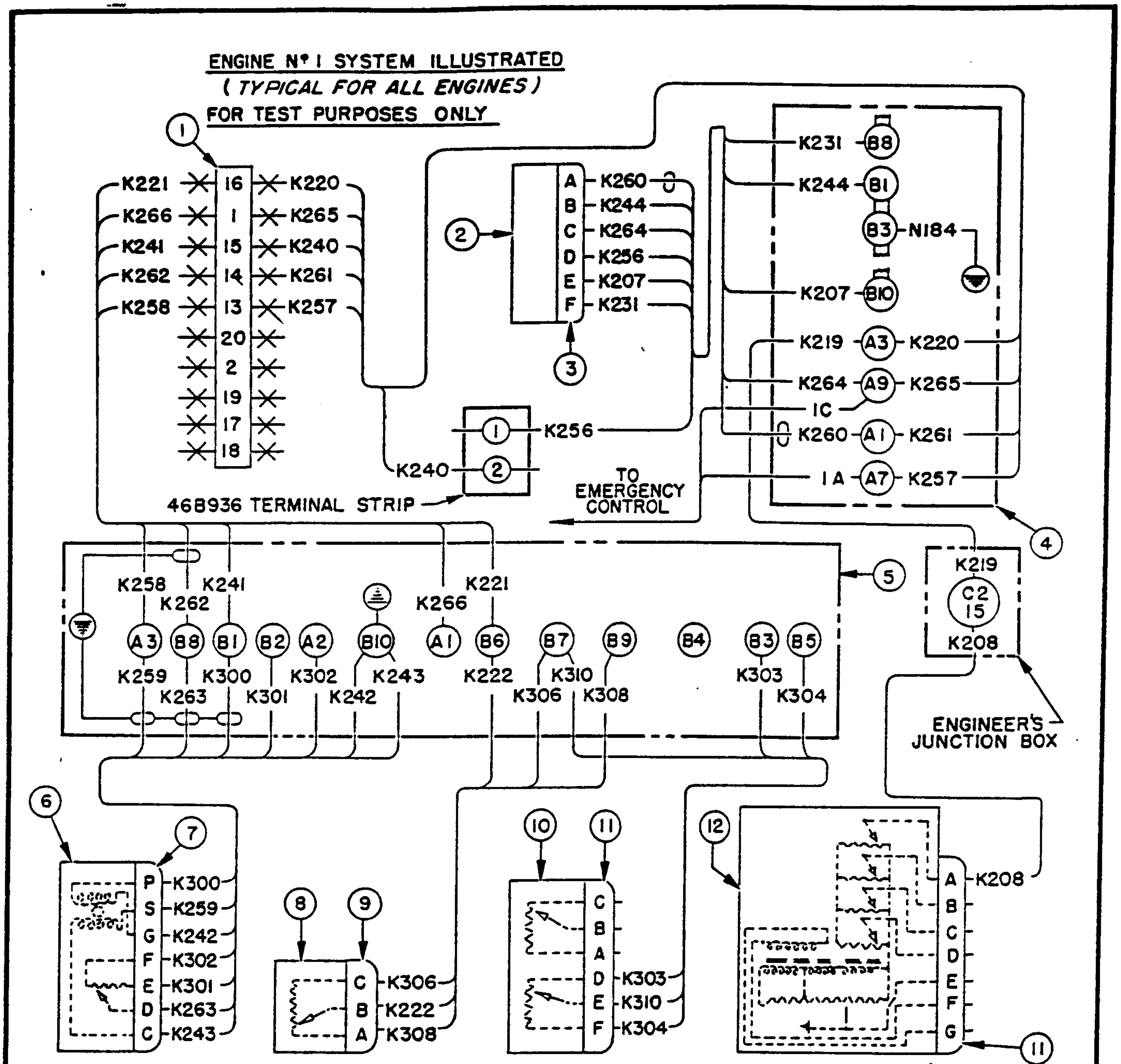
1. MOTOR AND AMPLIFIER SIGNAL CHECK.

a. Turn turbo boost selector (figure 15) until a 2V signal is obtained from pin A on amplifier to ground. From pin D to ground should read 200V ± 20%. Engine "J" box terminal B1 to ground should read 325V, + 75% or - 25%. A widely varying voltage from pin D to ground indicates amplifier trouble. If unsatisfactory voltage from B1 is obtained make a check from engine "J" box A1 to ground. The reading should be 115V ± 10%. If A1 is satisfactory but B1 is not, the trouble lies either in the condenser or in the motor winding.

2. PRESSURETROL. (See figure 22.)

a. With the turbo boost selector set at 7, the voltage check from B7 to B6 should be 8½V at sea level.

b. Disconnect hose leading to carburetor and reattach a short hose. Turn turbo boost selector until wastegate is approximately half closed. Blow through this hose and check to see that wastegate moves. Increased pressure should cause wastegate to open; suction to close. Also observe action of potentiometer wiper and resulting voltage.



ART.	NAME	REQ.	MAKE	TYPE	SPEC. OR PART NO.
1	PLUG-PRESSURIZED	1	THOMAS & BETTS		BDS-1354-B
2	AMPLIFIER-TURBO SUPERCHARGER	1	MINNEAPOLIS-HONEYWELL		G403A1
3	PLUG-ELECT. CONN. STRAIGHT	1			AN3108-22-24S
4	BOX- MAIN TURBO JUNCTION	1	MINNEAPOLIS-HONEYWELL		G1066A1
5	BOX-TURBO NACELLE JUNCTION	1	NORTHROP		584549
6	MOTOR-WASTE GATE	1	MINNEAPOLIS-HONEYWELL		G303A2
7	PLUG-ELECT. CONN. STRAIGHT	1			AN3106-28-4S
8	PRESSURETROL	1	MINNEAPOLIS-HONEYWELL		G16A2
9	PLUG-ELECT. CONN. STRAIGHT	1			AN3106-14S-1S
10	GOVERNOR-TURBO	1	MINNEAPOLIS-HONEYWELL		G1057A3CA4
11	PLUG-ELECT. CONN. STRAIGHT	1			AN3106-16S-1S
12	SELECTOR-TURBO BOOST	1	MINNEAPOLIS-HONEYWELL		GX305881

Figure 4. Turbosupercharger Voltage Test

3. TURBO BOOST SELECTOR. (See figure 17.)

a. Turn calibration adjustment (figure 16) fully clockwise.

b. Set turbo boost selector dial at 0.

1. The main "J" box terminal A3 should have a voltage reading of 18V.

2. The movement of the turbo boost selector should cause the voltage to decrease uniformly to 0 and then raise to 12.

3. Turn calibration knob full counterclockwise.

4. Set turbo boost selector at 0. There should be a reading of 30 volts at A3 to ground. Movement of the turbo boost selector dial toward 10 should cause the voltage to decrease uniformly to 0.

WARNING

Do not apply force to calibration knobs.

4. OVERSPEED GOVERNOR. (See figure 22.)

a. Voltage between nacelle "J" box terminals B3 and B4 should be zero. A reading indicates that one of the following conditions exists:

1. The wiper has been driven part way out on the winding and has not returned.

2. The wiper is not making contact with the potentiometer winding.

(4) GROUND CALIBRATION ADJUSTMENTS.- The turbo control system should be calibrated to take-off pressure during ground run-up following any change of calibrator settings, or when necessary following replacement of any unit in the system. It should not be necessary to recalibrate when changing grade of gasoline. The calibration should be made so that take-off pressures for 100 octane gasoline will be obtained with a turbo boost selector dial setting of "8;" the lower manifold pressures used for 91 octane gasoline will then be obtained by stopping the dial at a point below "8." It should not be necessary to change the calibrator settings during regular engine run-up procedure or preflight checks. If initial calibration is made carefully, variations in manifold pressure in regular run-up tests will then indicate malfunctions in the engine or turbo control system. To permit a more accurate check during engine run-up, avoid changing calibration settings in flight.

(a) Turn on "ON-OFF" switch.

(b) Proceed with regular engine run-up with dial of turbo-boost selector at "0."

(c) Set propeller governors for maximum rpm.

(d) Set turbo boost selector at "8" (when using 100 octane gasoline).

(e) Calibrate each engine individually for take-off manifold pressure at full throttle and take-off rpm.

(d) To calibrate, slowly turn calibrator clockwise, increasing manifold pressure until it reaches full take-off value if engine comes to take-off rpm. If the engine does not come to take-off rpm, the manifold pressure should be calibrated accordingly, approximately 1½ inches lower for each 100 rpm below take-off speed. However, if the engine fails to come within 100 rpm of take-off rpm, locate and remedy the cause of this engine malfunction before further calibration is attempted.

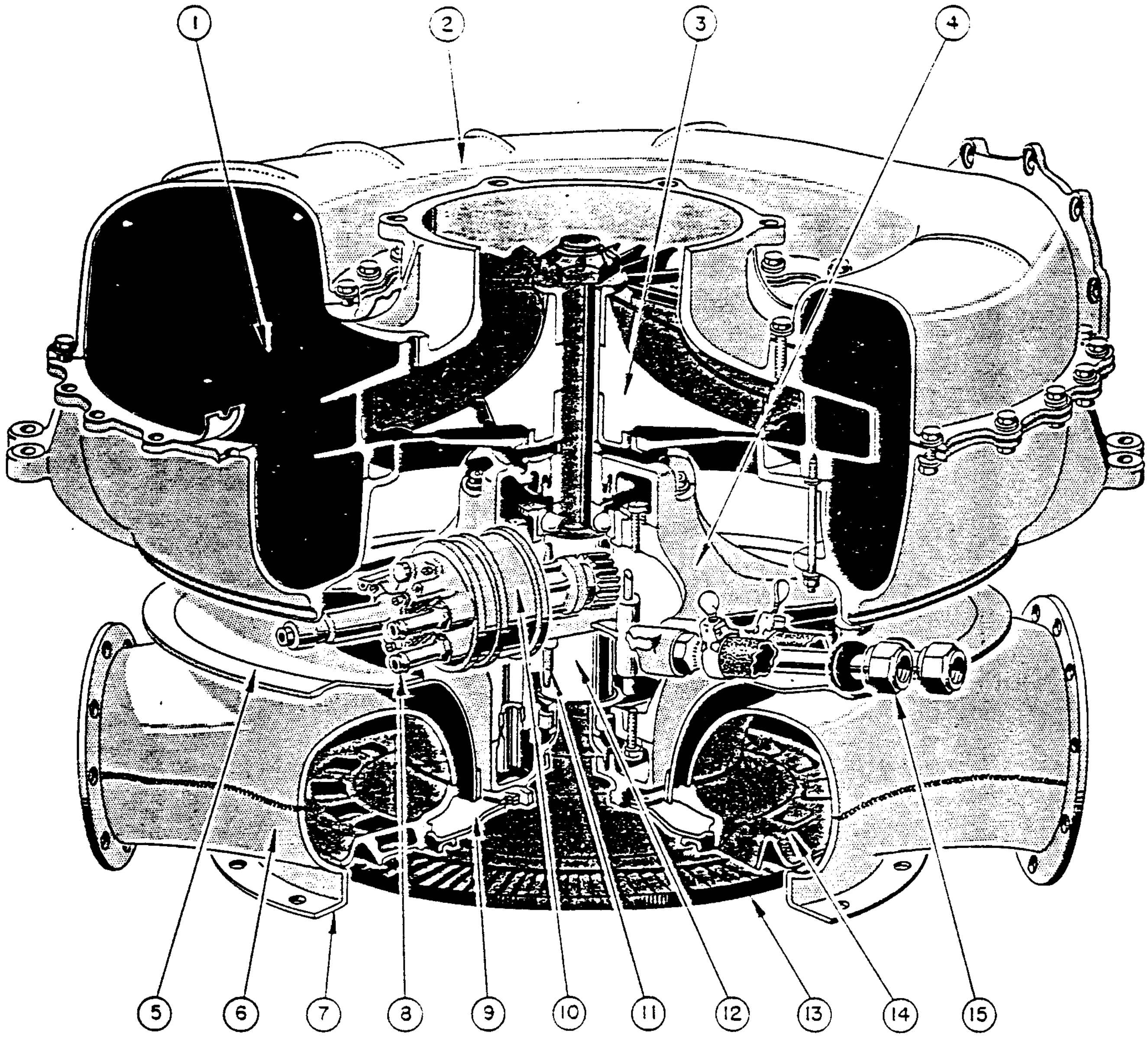
NOTE

Take-off dial setting for 100 octane gasoline -- 8.

Take-off pressure for 100 octane gasoline -- 51 in. Hg.

(5) TURBOSUPERCHARGERS. (See figure 5.)

(a) DESCRIPTION.- The type BH-1 and BH-2 airplane engine turbosuperchargers are variable speed, centrifugal type air compressors, directly driven by an exhaust gas turbine. Each consists of three main assemblies: compressor casing, bearing and pump casing, and nozzle box. These three main parts are so assembled that their various openings will line up with the corresponding ducts and piping of the airplane. The compressor casing contains an impeller and a diffuser. Air enters the impeller through a circular opening in the center of the compressor casing assembly, is picked up by the impeller blades, and is given a high velocity as it travels outward toward the diffuser vanes. The diffuser vanes "straighten out" the air flow and also serve to convert the velocity of the air into pressure. This air then is discharged into the duct leading to the intercooler. The bearing and pump casing is located between the compressor casing and the nozzlebox. This casing contains a high speed, double-gear type lubricating pump that supplies oil to the drive gears and rotor bearings. The two sets of pump gears, one for delivery of the oil and one for scavenging, are located side by side on the same shaft, and obtain their power from the turbosupercharger by means of a drive gear on the pump shaft and a worm sleeve on the rotor shaft. Oil, obtained from the applicable engine oil tank, is piped through a Cuno type filter and a barometric anti-leak valve before being drawn into the casing. The scavenge oil then passes through a check valve prior to its return to the tank. The barometric anti-leak valve acts primarily to hold back the static head of oil from the turbosupercharger (when the turbosupercharger is not in operation) thereby preventing oil



EXHAUST GASES | OIL | COMPRESSED AIR | ATMOSPHERIC AIR | ROTOR

1. DIFFUSER	6. NOZZLEBOX	11. OIL JET
2. COMPRESSOR CASING	7. NOZZLEBOX "L" RING	12. PUMP DRIVE SLEEVE
3. IMPELLER	8. FILTER LINES	13. BUCKET WHEEL
4. BEARING AND PUMP CASING	9. SEALING PLATE ASSEMBLY	14. NOZZLE BOX DIAPHRAGM
5. BAFFLE RING	10. OIL PUMP	15. OIL LINES

Figure 5. Turbosupercharger

from running down over the turbine wheel. The check valve acts to hold back the static head of oil from the return side of the turbosupercharger to the oil tank. It performs the same function as the barometric anti-leak valve.

NOTE

For satisfactory operation of the anti-leak valve, it is essential that the position of the bellows remain as set at the factory. Under no circumstances should the lock wire seal be broken or the adjusting screw tampered with.

Refer to Section IV, paragraph 12 a (4) and figure 1, reference 5. Information pertaining to the nozzlebox (which transmits motive power to the compressor impeller) is contained in paragraph 14 a.

(b) REMOVAL.

NOTE

Whether the turbosupercharger is to be removed or not will be governed by its condition as determined by inspection. See paragraph 14 b (5) (c). Operating time between overhaul is not to exceed 1300 hours. Likewise a serious mechanical failure of the engine to which the turbosupercharger is connected is also cause for removal and inspection. A repair of any type, except for minor adjustments, must be performed with the unit removed from the airplane. If disassembly is involved; the unit must be sent to a repair depot.

1. Remove flight hood fairing (figure 6) enclosing turbosupercharger, as described in paragraph 14 a.

2. Remove flight hood shroud.

3. Provide a suitable container, then disconnect oil lines and drain. Install protective plugs.

4. Disconnect the wastegate valve control linkage.

5. Disconnect flexible drive connection to turbo-governor.

6. Remove seals.

7. Disconnect the flex ducts.

8. Disconnect transition duct.

9. Disconnect the air discharge duct from the compressor casing discharge flange.

10. Remove air intake scoop.

11. Install lift plate to turbosupercharger by air intake scoop bolts.

12. Remove the mounting bolts which support the turbosupercharger.

13. Lower turbosupercharger slowly by crane and cable attachment.

NOTE

It will be necessary for a minimum of three men to be engaged during the removal operation. Make certain that the turbosupercharger is handled by the compressor casing, as the nozzlebox is not designed to carry the full weight of the unit.

14. Place suitable covers over the ducting within the airplane.

15. Place protective covers over the compressor casing openings to prevent damage to the flange faces.

(c) INSPECTION AND MAINTENANCE.

1. DUCTING SYSTEM.- Examine the ducts, joints, and gaskets of the airplane induction system for evidence of chafing, collapse, cracks, or other signs of deterioration. Tighten or replace any loose or faulty parts of the system.

2. RAM AIR INLET SCOOP.- Beam a flashlight into the air-induction scoop to see if any foreign objects are obstructing the flow of air through the ducts. Remove any foreign material that may be present. Objects such as newspapers, rags, nameplates, bolts, etc., may cause serious damage to the turbosupercharger impeller or intercooler during operation. Bulky material, such as rags or newspapers, may restrict the flow of air to the turbosupercharger, thereby lowering the critical altitude of the airplane.

3. IMPELLER.- The turbosupercharger impeller should be inspected in conjunction with the inspection of the air scoop. Minor nicks or dents may be smoothed off with a No. 2 or 3 file. (See figure 7.) Replace any impeller that has large nicks, dents, or gouges in it.

CAUTION

Dust covers or plugs should be installed in the ram air inlet scoop whenever the airplane is to remain upon the ground for a considerable length of time or immediately after flight if practical. Also observe this precaution whenever repair or removal of any type, other than simple adjustment, is performed within the vicinity of the plenum chambers. Immediately after flight the turbosupercharger (carburetor air) ram air intake valve control should be placed in the FILTER position.

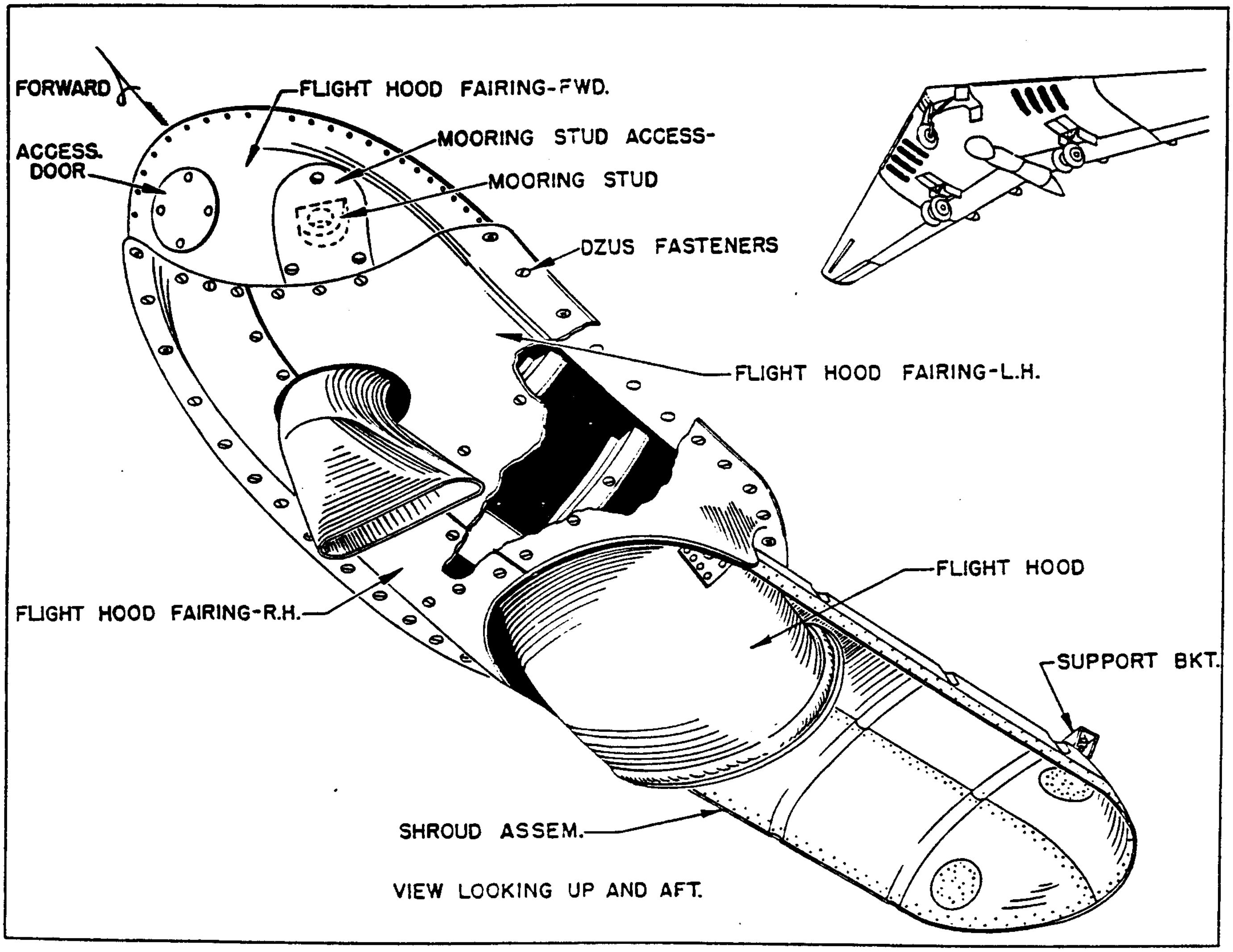


Figure 6. Flight Hood, Flight Hood Shroud, and Flight Hood Fairing

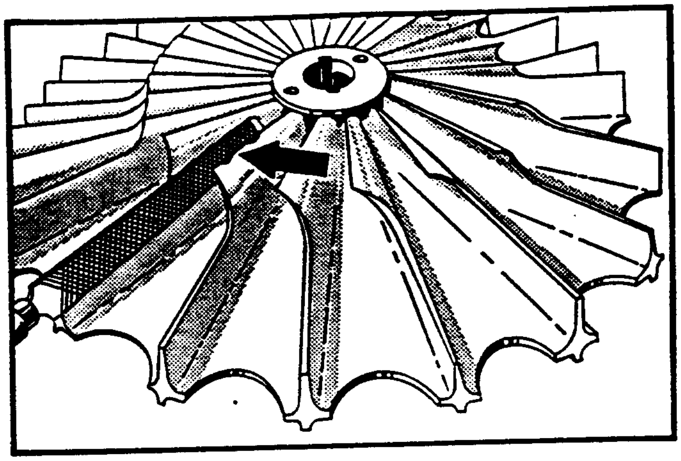


Figure 7. Filing Nicks in Impeller

4. CLEANING AIR FILTER.- Remove the air filter element from the filter duct and inspect it for contamination. If necessary, clean the filter element as follows:

a. After the filter element is removed, tap it lightly to dislodge any loose dirt. Submerge the filter element in cleaning solvent, Specification P-S-661, and agitate it until all dirt is removed.

b. Allow the filter element to dry completely, or induce drying by passing a stream of clean compressed air over the cell in the opposite direction of normal air flow. Thorough drying is necessary or oil will not adhere to the element.

c. Submerge the filter element in mixture of three parts oil, Specification AN-VV-O-446, Grade 1120, and one part corrosion preventive compound, Specification AN-VV-C-576, for two to five minutes.

d. Remove the filter element from the oil bath and let it stand on end to drain for two to five hours before replacing in the filter frames. Do not wipe surplus oil from the cell, as such oil is necessary for proper filtering of the intake air.

NOTE

In emergencies, engine oil, Specification No. AN-VV-O-366B, may be substituted for the oil listed above. If engine oil is used, the filter elements must be allowed to drain for at least four hours (or preferably overnight) before replacing in the filter frames.

e. Prior to installing the filter element, inspect the intake duct below the filter to see if oil is dripping from the element. If necessary, clean the duct with gasoline.

f. Under extremely dusty conditions, inspect the air filter after each flight, and clean it if necessary.

5. INDUCTION SYSTEM PRESSURE TEST.- Leaks in the induction system force the turbosupercharger to operate at a higher speed to supply the excessive quantity of air required as a result of the leakage. This may result in the exhaust back pressure becoming so high that normal engine power output can no longer be attained, or the speed of the turbosupercharger rotor may become so excessive that the overspeed turbo-governor will come into action and force the wastegate open. This latter condition prevents overspeeding of the wheel, and thus lowers the critical altitude of the airplane. Pressure test the induction system as illustrated in figure 8. Repair or replace parts as necessary to eliminate any leaks discovered in the induction system.

6. EXHAUST MANIFOLD SYSTEM.- At sea level, where the pressure difference between the gases in the exhaust system and the atmosphere is slight, leaks do not seriously affect the performance of the power plant. However, this condition changes radically as the airplane gains altitude and the atmospheric pressure decreases. With the pressure of the hot gases in the exhaust system several times that of the atmosphere, the resulting blow torch effect of the hot gases will quickly change a small leak into a gaping hole. The blast of escaping gases not only decreases the amount of available energy to the turbine wheel, but it also constitutes a definite fire hazard.

a. Make a visual check of the entire exhaust system for cracks in the welding and for signs of leakage as evidenced by deposits on the pipes. Check the flange connections for stretched or broken bolts, and see that the entire system is properly supported.

b. If any leaks are discovered, repair or replace the faulty parts, taking care to avoid over-tightening the bolts and clamps, as allowance must be made for expansion of the parts when the system is hot. Correct any insecurity of the mounting. Replace any stretched bolts, as retightening will only lead to additional stretching and eventual failure. There is no cause for alarm if the clamps or flange bolts are loose when cold, provided that the system is tight when hot.

7. WASTEGATE.- Visually and manually inspect the turbosupercharger wastegate to see that it operates freely. It should be closed at 3/32 of an inch from the stop. The axial play should be about 1/8 inch. Inspect both the spindle and gate to see that they are not distorted or warped, as any binding will cause unsatisfactory operation. If the wastegate or spindle are not serviceable, the wastegate assembly must be repaired or replaced. If the spindle is bound with carbon, saturate the bearings with solvent, AAF Specification No. 20025 and work out the carbon by moving the spindle from side to side.

8. WASTEGATE LINKAGE. (See figure 15.)- Grasp the wastegate and shake it back and forth to check for excessive lost motion

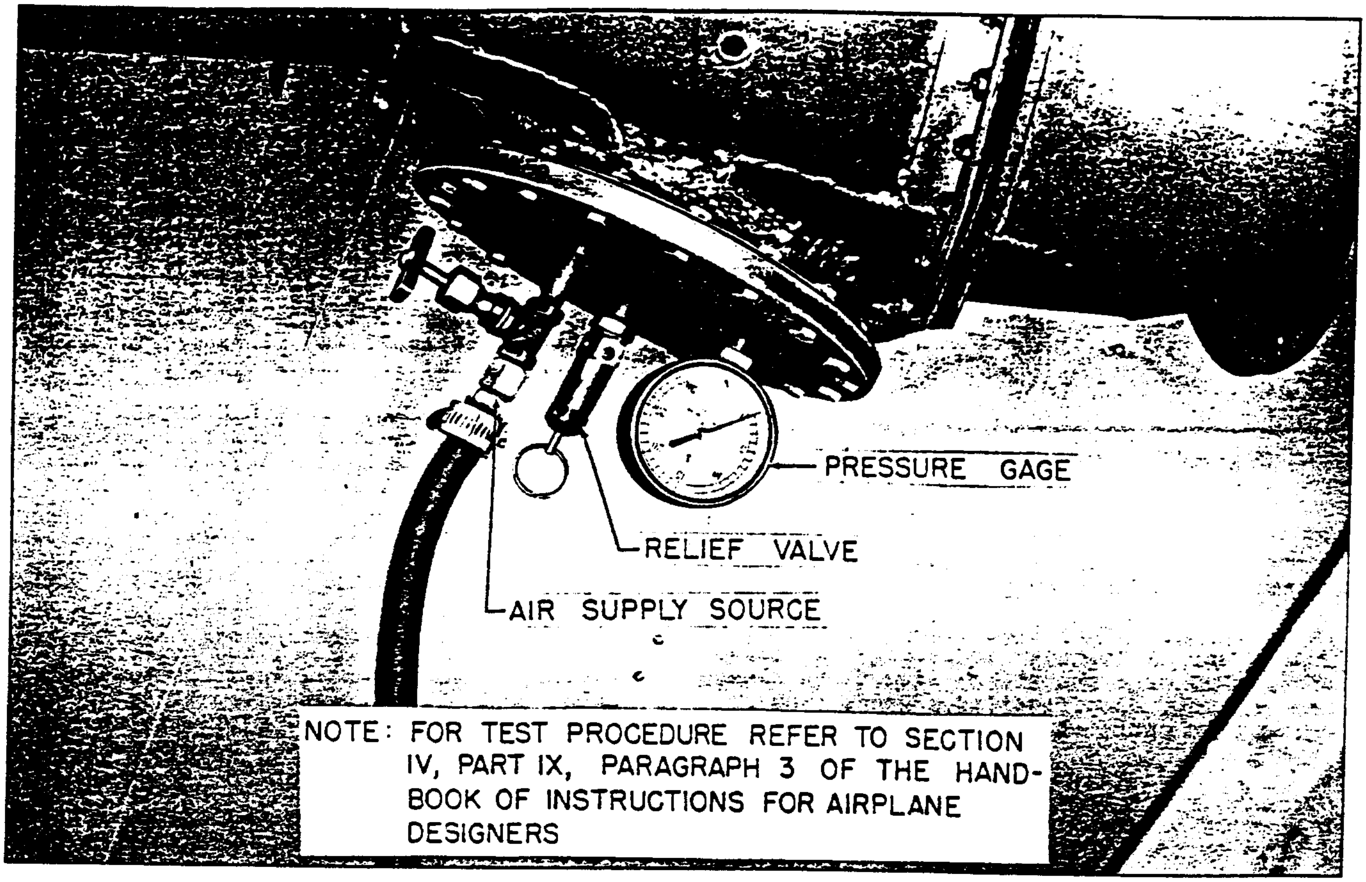


Figure 8. Induction System Pressure Test

in the linkage. There should be a certain amount of play in the linkage, but if it is beyond reasonable limits, locate and eliminate the source.

CAUTION

Do not force the wastegate closed. As the wastegate motor transmits motion to the wastegate through a gear train, any undue forcing may cause damage to the linkage or gears.

9. LUBRICATION SYSTEM.- With a flashlight check the turbosuperchargers for oil leakage and security of mounting. Replace any faulty part which does not necessitate disassembly of a turbosupercharger, or replace complete turbosupercharger if necessary.

NOTE

Oil seepage from the turbosupercharger oil seal onto the bucket wheel and onto the exhaust hood is permissible when the turbosupercharger is idle.

10. DIAPHRAGM.- Check the nozzle diaphragm for cracks or evidence of deterioration. The inside of the diaphragm can be inspected by spinning the bucket wheel, projecting a flashlight beam into the clearance between the diaphragm and the bucket wheel, and looking through the space between the buckets.

11. FREEDOM OF ROTOR.- Internal rubbing or indication of bearing failure can be detected by spinning the turbine bucket wheel counterclockwise by hand. Replace the turbosupercharger if any defects are noted.

12. TOTAL SIDE (RADIAL) PLAY OR ROTOR.- Remove the exhaust hood and cooling cap assembly and rigidly attach a dial indicator on the mounting ring so that the point rests against the outside of the rim of the bucket wheel. (See figure 9.) Move the bucket wheel from side to side to check the total side play of the rotor for bearing wear. If the total side play is greater than 0.005 inch, the turbosupercharger must be replaced.

13. TOTAL END (AXIAL) PLAY OF ROTOR.- With the exhaust hood still removed, relocate the indicator so that the pointer of the indicator rests on the flat rim of the wheel disc. (See figure 10.) Move the bucket wheel up to check the total end play of the rotor for bearing wear. If the total end play is greater than 0.011 inch, replace the turbosupercharger.

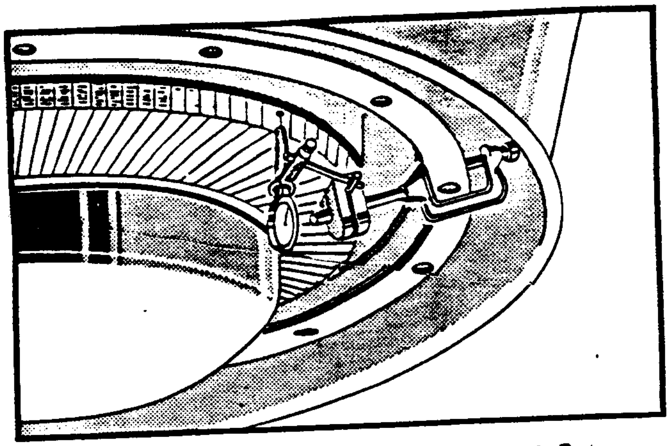


Figure 9. Checking Radial Play of Rotor

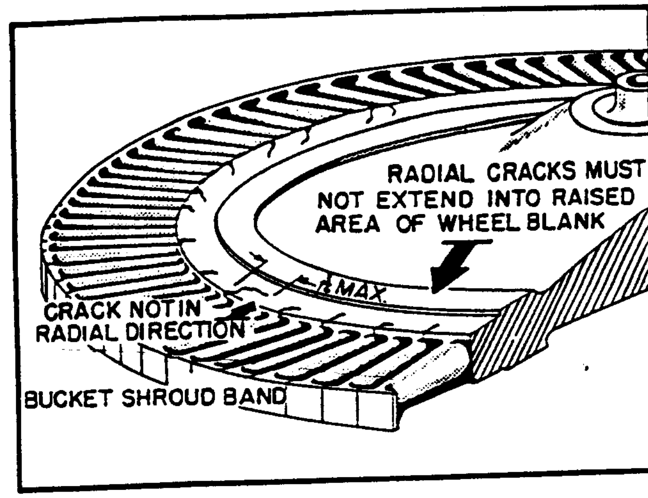


Figure 11. Radial Cracks in Bucket Wheel

14. COOLING CAP CLEARANCE.- Gain access to the bucket wheel and measure the maximum and minimum clearance between the bucket wheel and cooling cap ~~at four~~ or more places. Use the L-shaped cooling cap clearance gage for this procedure. If the clearance is outside the allowable limits (.125 to .185) reshim the cooling cap until the clearance is within the proper limits around the entire circumference of the cooling cap rim.

15. NOZZLEBOX AND EXHAUST HOOD BOX.- Remove the exhaust hood and cooling cap assembly and replace any broken bolts or safety wires. If any of the bolts have stretched, it is advisable to replace them with new bolts because retightening will lead to additional stretching and probable failure during operation.

16. NOZZLEBOX.- Thoroughly inspect the entire nozzlebox for cracks, especially in the weld, and for evidence of deterioration.

17. NOZZLEBOX CLEARANCE.- Gain access to the bucket wheel and measure the maximum and minimum clearance between the bucket wheel and nozzlebox at four or more places. This is done by inserting the special L-shaped nozzlebox clearance gage radially into the clearance far enough so that the clearance of both the inner and outer ring of the nozzlebox diaphragm is measured. Replace the turbosupercharger if the clearance is outside of the allowable limit (.080 to .160).

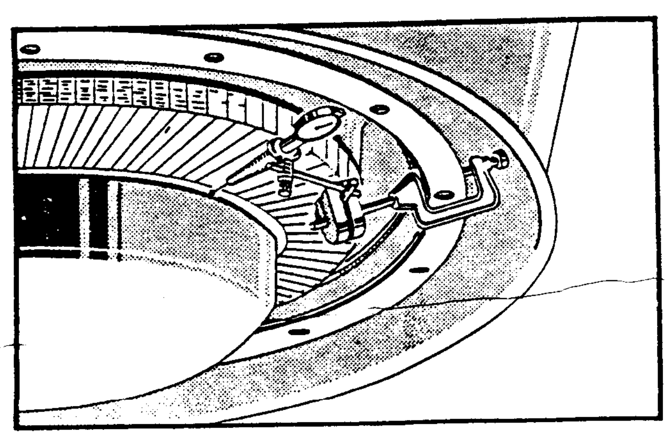


Figure 10. Checking Axial Play of Rotor

18. CRACKS IN WHEELS.- Radial cracks in the wheel which extend into the raised area or step of the wheel blank (figure 11) are cause for removal of the turbosupercharger. Cracks which extend in other than a radial direction must not progress more than three sixteenth inch circumferentially, even though they are outside of the raised area.

19. BUCKET WHEEL RUN-OUT.- Mount the indicator so that the contact point rests on the flat rim of the wheel disc. This is the same position as for checking axial play. (See figure 10.) The wheel rim must be thoroughly scraped and cleaned, as carbon deposits on the rim will affect the indicator readings. Cleaning by a wire brush is not sufficient. Revolve the bucket wheel slowly by hand and locate the high and low points on the wheel rim. Also look for evidence of cracks or distortion. If the difference between the high and low points is greater than 0.005 inch, or if any crack is observed in the wheel disc, replace the turbosupercharger.

20. BUCKET WHEEL DEFECTS. (See figure 12.)

a. MECHANICAL DAMAGE.- Nicks, dents or gouges on the underside (rear of the bucket) are caused by foreign material coming in contact with the rotating bucket wheel. This usually signifies that loose nuts, bolts, or other stray objects have entered the exhaust system and have been discharged through the diaphragm onto the bucket wheel. This type of damage is cause for replacement of the turbosupercharger.

b. CRACKS.- Buckets showing any cracks are cause for replacement of the turbosupercharger.

c. MUSHROOMING OR UPSETTING.- If the total gap between the ends of the bucket shrouds is less than that required to absorb

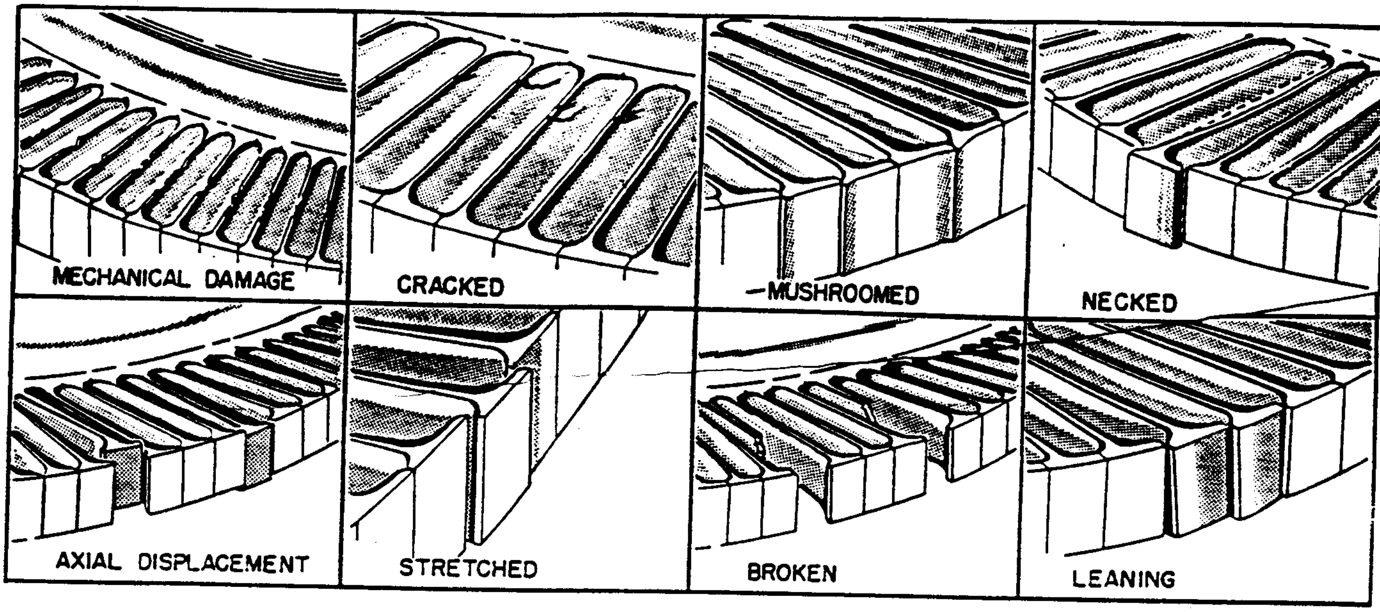


Figure 12. Bucket Wheel Defects

the expansion of the wheel periphery at operating temperature, the buckets will press together, thus causing an upturning or mushrooming of the ends of the bucket shrouds. Mushrooming is not a cause for replacement of the turbosupercharger unless it has progressed to the point where the end of the shroud is cracked or broken.

d. NECKING.- Necking of the bucket occurs only in the blade. This condition is distinguished by a contraction in the cross-section of the blade and is cause for replacement of the turbosupercharger.

e. AXIAL DISPLACEMENT.- Buckets may become displaced axially under high speed and temperature conditions. This will give the edge of the shroud band a jagged or sawtooth effect. Axial displacement must not exceed a maximum of 0.015 inch from normal in either direction. If this limit is exceeded, replace the turbosupercharger.

f. STRETCHING.- Centrifugal force and high operating temperatures cause elongation or stretching of the buckets. When this has progressed to the point where the shrouding of one bucket extends beyond the shroud of adjacent buckets, the turbosupercharger must be replaced.

g. BREAKS.- Broken buckets affect the balance of the rotor beyond safe operating limits and are cause for replacement of the turbosupercharger.

h. BACK LEAN OR TIPPING.- The high speed and temperature under which turbine wheels operate may cause a slight leaning or tipping of the buckets. This gives the circumference of the wheel a jagged appearance, but it is not cause for replacement of the turbosupercharger unless it is so pronounced that the shroud of one bucket overlaps the shroud of the following bucket.

i. GAP BETWEEN ADJACENT BUCKETS.- Buckets are assembled in the wheel disc with an accumulative nominal clearance between the ends of the bucket shrouds to allow for expansion. This clearance on factory assembly is equally spaced around the wheel, but due to leaning and mushrooming a series of buckets may be found with their shrouds touching and a large gap between this series and the next. This condition is normal and is to be disregarded unless other defects necessitate removal of the turbosupercharger.

(d) INSTALLATION AND TEST. (See figures 13 and 14.)

NOTE

Check the AAF setting number on the nameplate of the turbosupercharger. Make certain that the setting number for the left hand turbosupercharger is 2, and the right hand turbosupercharger is 1; otherwise, installation cannot be accomplished.

1. Place air intake scoop on shelf created by forward fairing and fasten with small wire.

2. Make certain that electrical wiring is not in path of installation.

3. Install ball mount fittings on sides of turbosupercharger with AN5-12 bolts.

4. Fasten lift plate on top of turbosupercharger. Use scoop bolts.

5. Raise turbosupercharger and maneuver until in place in compartment.

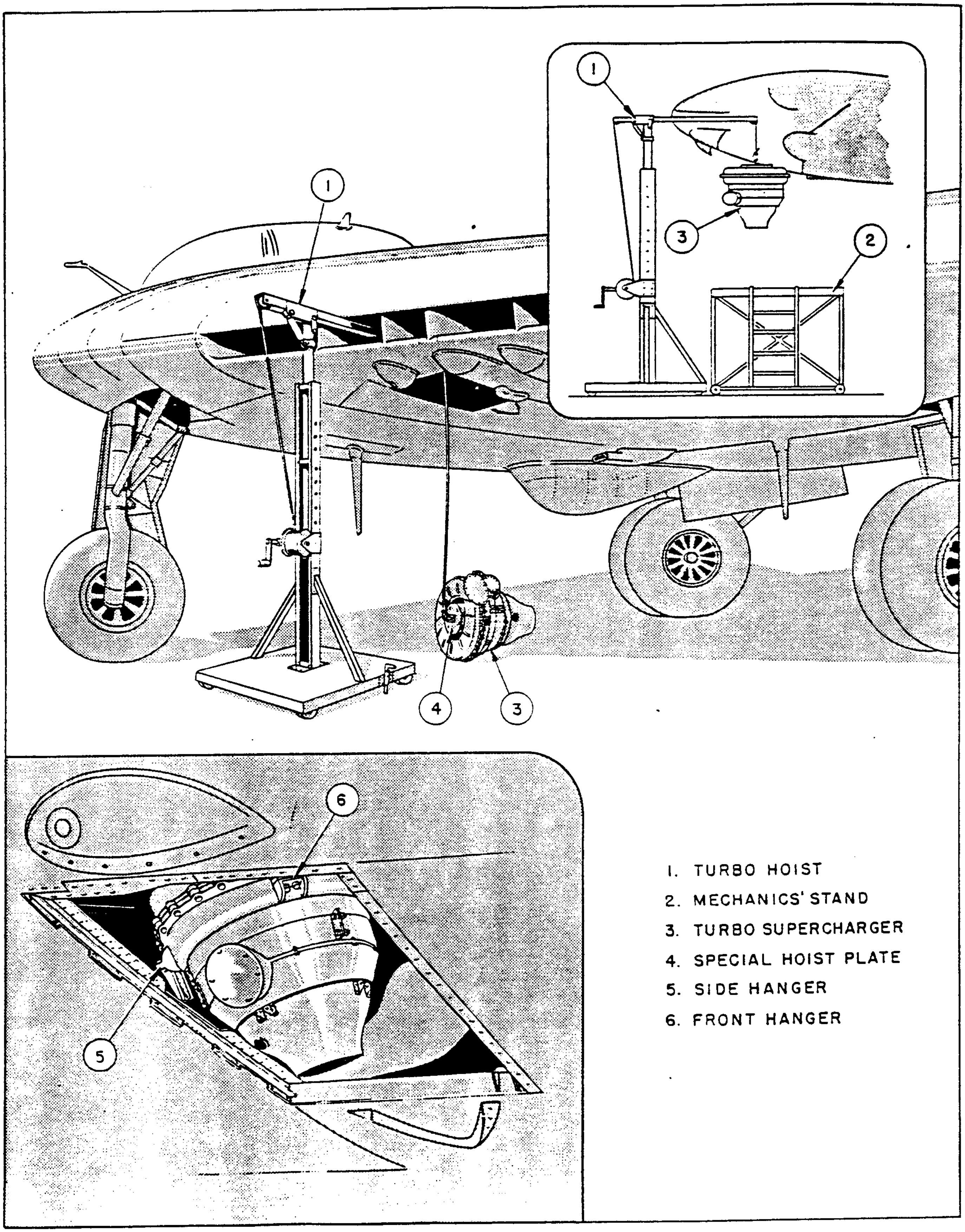


Figure 13. Installation of Turbosuperchargers

ITEM	DESCRIPTION	LOCATION
1	PRESSURETROL - ENGINE NO. 4	BOMB BAY NO. 8 AT FRONT SPAR
2	JUNCTION BOX - ENGINE NO. 4 TURBO	TURBO NACELLE R.H.
3	PANEL - FORWARD RELAY	BOMB BAY NO. 7
4	PRESSURETROL - ENG. NO. 3 TURBO.	INB'D ENGINE COMP. AFT
5	JUNCTION BOX - ENG. NO. 3 TURBO.	BOMB BAY NO. 7 - FORWARD
6	GOVERNOR - OUTBOARD TURBOS	OUTB'D PLENUM CHAMBER R.H.
7	TACH. GENERATOR OUTB'D TURBOS	OUTB'D PLENUM CHAMBER R.H.
8	WASTE GATE MOTOR - OUTB'D TURBO	OUTB'D PLENUM CHAMBER R.H.
9	WASTE GATE MOTOR - INB'D TURBO	INB'D PLENUM CHAMBER R.H.
10	GOVERNOR - INBOARD TURBOS	INB'D PLENUM CHAMBER R.H.
11	TACH. GENERATOR INB'D TURBOS	INB'D PLENUM CHAMBER R.H.
12	TRANSFORMER PANEL	ENGINEER'S STATION
13	SUPERCHARGER SWITCH	ENGINEER'S LOWER SW. PANEL

ITEM	DESCRIPTION	LOCATION
14	ENG. INSTRUMENT PANEL	ENGINEER'S STATION
15	INDICATORS - TACHOMETER DUAL	ENG. INSTRUMENT PANEL
16	PRESSURIZED PLUG "B"	CREW NACELLE WALL - R.H.
17	ENG. LOWER SWITCH PANEL	ENGINEER'S STATION
18	PRESSURIZED PLUG "B"	CREW NACELLE WALL - R.H.
19	TURBO BOOST SELECTOR	ENGINEER'S STATION
20	TURBO EMERGENCY CONTROL SW.	EMERGENCY CONTROL PANEL
21	EMERGENCY CONTROL PANEL	ENGINEER'S STATION
22	ENGINEER'S JUNCTION PANEL	BENEATH ENGINEER'S FLOOR
23	TERMINAL STRIP	CREW NACELLE - CENTER SEC.
24	TURBO AMPLIFIER - NO. 1 ENGINE	CREW NACELLE - CENTER SEC.
25	TURBO AMPLIFIER - NO. 2 ENGINE	CREW NACELLE - CENTER SEC.
26	TURBO AMPLIFIER - NO. 3 ENGINE	CREW NACELLE - CENTER SEC.
27	TURBO AMPLIFIER - NO. 4 ENGINE	CREW NACELLE - CENTER SEC.
28	PRESSURIZED PLUG "B"	CREW NACELLE WALL L.H.
29	JUNCTION BOX - MAIN TURBO	CREW NACELLE - CENTER SEC.
30	PRESSURIZED PLUG "E"	CREW NACELLE WALL L.H.
31	PANEL - FORWARD RELAY	BOMB BAY NO. 2
32	PRESSURETROL - ENGINE NO. 2	INB'D. ENGINE COMP. AFT
33	GOVERNOR - INBOARD TURBOS	INB'D PLENUM CHAMBER L.H.
34	TACH. GENERATOR - INB'D TURBOS	INB'D PLENUM CHAMBER L.H.
35	WASTE GATE MOTOR - INB'D TURBO.	INB'D PLENUM CHAMBER L.H.
36	JUNCTION BOX - ENG. NO. 2 TURBO.	BOMB BAY NO. 2 FORWARD
37	TACH. GENERATOR - OUTB'D TURBO.	OUTB'D PLENUM CHAMBER L.H.
38	GOVERNOR - OUTB'D TURBOS	OUTB'D PLENUM CHAMBER L.H.
39	WASTE GATE MOTOR OUTB'D TURBO	OUTB'D PLENUM CHAMBER L.H.
40	JUNCTION BOX - ENG. NO. 1 TURBOS	TURBO NACELLE L.H.
41	PRESSURETROL - ENGINE NO. 1	BOMB BAY NO. 1 AT FRONT SPAR

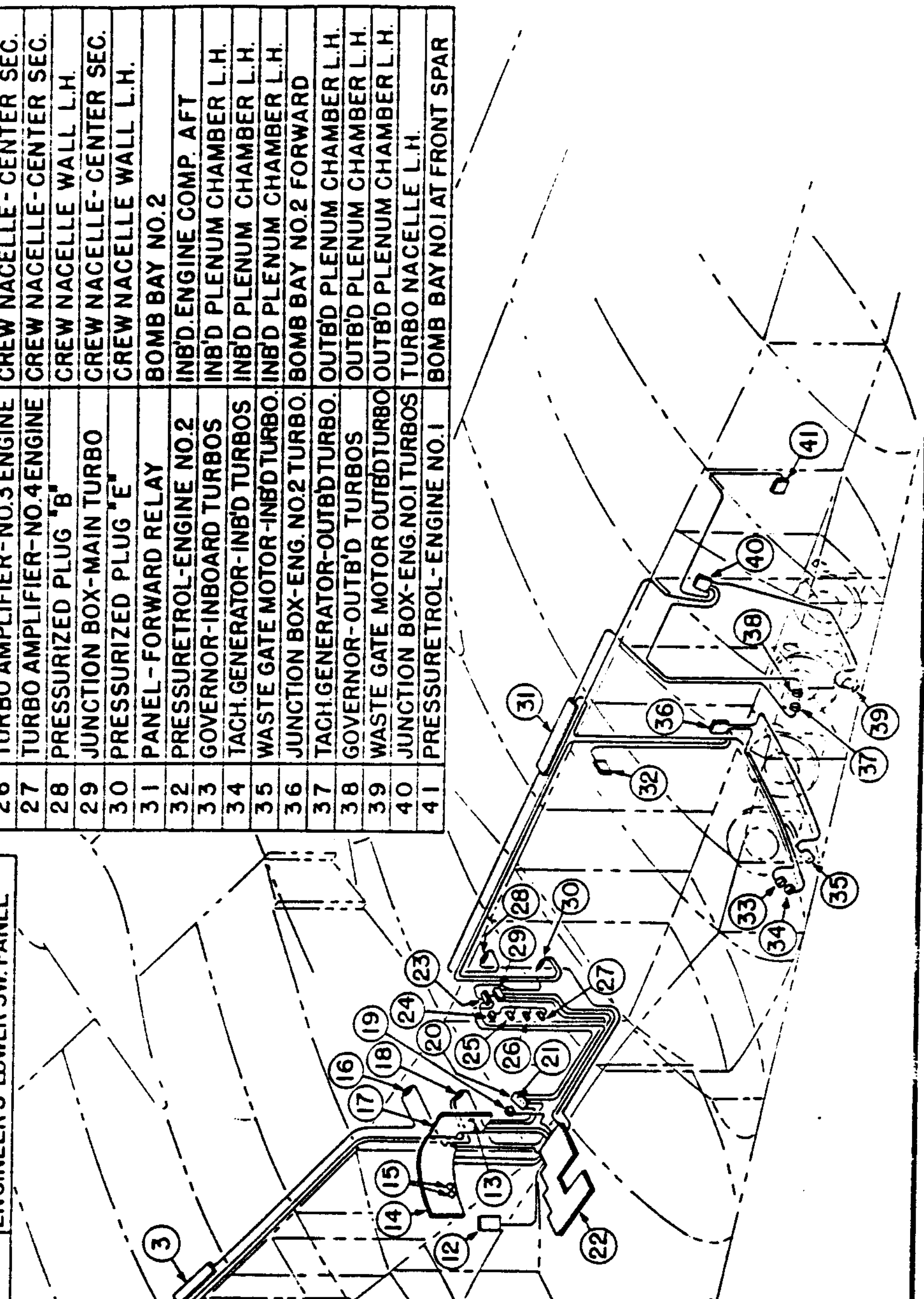


Figure 14. Turbosupercharger Installation - Electrical

6. Secure side fittings to angles on sides with AN4-7 bolts and tighten to a torque to 100 inch-pounds.

7. Secure front fastenings.

8. Install air intake scoop on top of turbosupercharger. Work through front openings.

9. Install flex duct on top of turbosupercharger.

10. Install wastepipe on bottom of turbosupercharger.

11. Install exhaust hood and cooling shroud assembly on bottom of turbosupercharger.

12. Assemble the ducting of the induction system to the corresponding compressor casing openings, taking care to obtain an airtight connection. Safety wire the six bolts on the flange of the compressor casing inlet joint.

CAUTION

Be absolutely sure that the protective covers are removed from over the compressor casing flanges before the ducts are assembled to the compressor casing.

13. Assemble the exhaust system to the nozzlebox inlet. Be sure that the flanges line up and that there is no strain on the nozzlebox.

CAUTION

Tighten the flange nuts only until the faces of the flanges bear firmly against each other. failure of the flange bolts will result if the bolts are overtightened. Be sure the protective cover is removed from the nozzlebox inlet.

14. Install remaining flex ducts.

15. Connect wastegate linkage.

16. Connect turbo governor and tachometer flexible shaft.

NOTE

Extreme care should be exercised in installing this shaft since any undue stress or bend will impose an excessive load on the brass gear that drives the turbosupercharger oil pump.

17. Connect the turbosupercharger oil "IN" and oil "OUT" lines.

CAUTION

Be sure that all connections are tight. This is especially important for the filter lines which operate at a maximum pressure of 60 pounds per square inch. Failure of oil line connections when the turbosupercharger is operating at high speeds may cause immediate failure of the bearings.

18. Spin the bucket wheel in a counterclockwise direction (by use of a high pressure air jet) until oil is discharged through the main "OUT" line. A rotor speed of 600 to 700 rpm is usually sufficient, but if the turbosupercharger is almost dry, it may take four or five minutes before scavening flow is established.

NOTE

If difficulty is encountered in pre-oiling or priming a turbosupercharger, proceed as follows: Disconnect the turbosupercharger oil-out line and force the bucket wheel to revolve in the conventional manner by a compressed air jet. Once oil has started to flow through the oil-out line, it is considered that the turbosupercharger has been pre-oiled or primed. If further priming difficulty is experienced, it may be necessary to disconnect the oil-in line to the turbosupercharger at a point below the antileak valve and fill the line with lubricant oil.

During priming, check for freedom of rotor and listen for any indication of rubbing. A slight clicking noise should be disregarded, as it is caused by the alternate opening and closing of the check valve in the oil "OUT" section of the pump.

CAUTION

Take care that the compressed air nozzle does not damage the bucket wheel blades during the priming.

19. Install flight hood, flight hood shroud, and fairing.

(6) TURBOSUPERCHARGER WASTEGATE CONTROLS.

NOTE

The REMOVAL and INSTALLATION procedures for the electronic control units (Turbo Boost Selector, Turbo Boost Selector Calibrating adjustments, Manual Emergency Control) and attendant linkage adjacent to the flight engineer's or pilot's position, is not given inasmuch as the equipment is easily accessible and is conventionally installed. Likewise, all defective electronic units are to be replaced rather than repaired. Refer to ELECTRONIC CONTROL SYSTEM TEST, paragraph 14 b (3).

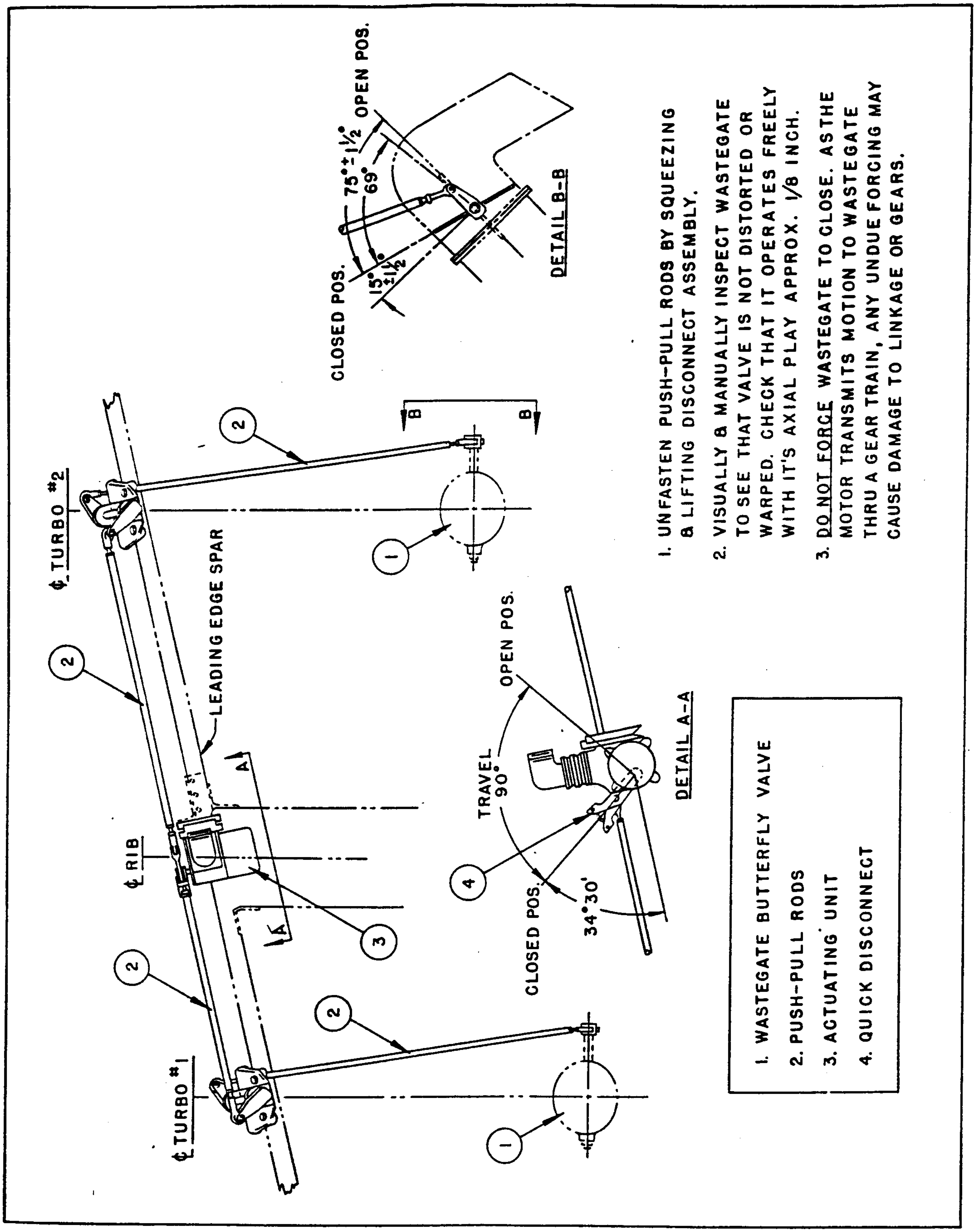


Figure 15. Turbosupercharger Wastegate Control Mechanism

(a) GENERAL.- The speed of the two turbosupercharger turbines, the consequent and corresponding speed of the compressor impellers, and the resultant inlet pressure furnished to the carburetor are determined by the position of the two wastegates. (See figures 15 and 16.) When the wastegates are closed, all of the exhaust gas (except for leakage) will be forced through the turbines to the normal exhaust outlets (flight hoods) and the turbines will revolve at high speed. When the opposite condition exists, most of the exhaust gas will escape through the wastegates and the turbines will idle. The position of the wastegates is determined by the direction and degree of motion of the two-phase, reversible, motor driven actuator, which may be controlled either manually or automatically. A mechanical linkage consisting of push rods and arms extends from the actuator to the two wastegates causing them to operate simultaneously and in unison. One phase of the a.c. is supplied to the motor by the normal 115 volts, single phase a.c., from the airplane's alternators; the other phase is picked up from the same source and is caused to lead or follow the normal phase by 90° through the operation of a turbosupercharger amplifier in conjunction with various control units and condensers, thereby enabling the motor to revolve in either direction. In addition to the drive motor the actuator also contains an automatic brake and clutch, a gear train to the output shaft, and a potentiometer which has its wiper arm connected to the output shaft. The control system operates primarily on 115 volts, single phase, 400 cycles a.c. Various other a.c. voltages required for the operation of the system are obtained from the secondaries of transformer windings.

(b) ON-OFF SWITCH.- The current for the system is controlled by this switch. It is installed on the flight engineer's lower electrical panel.

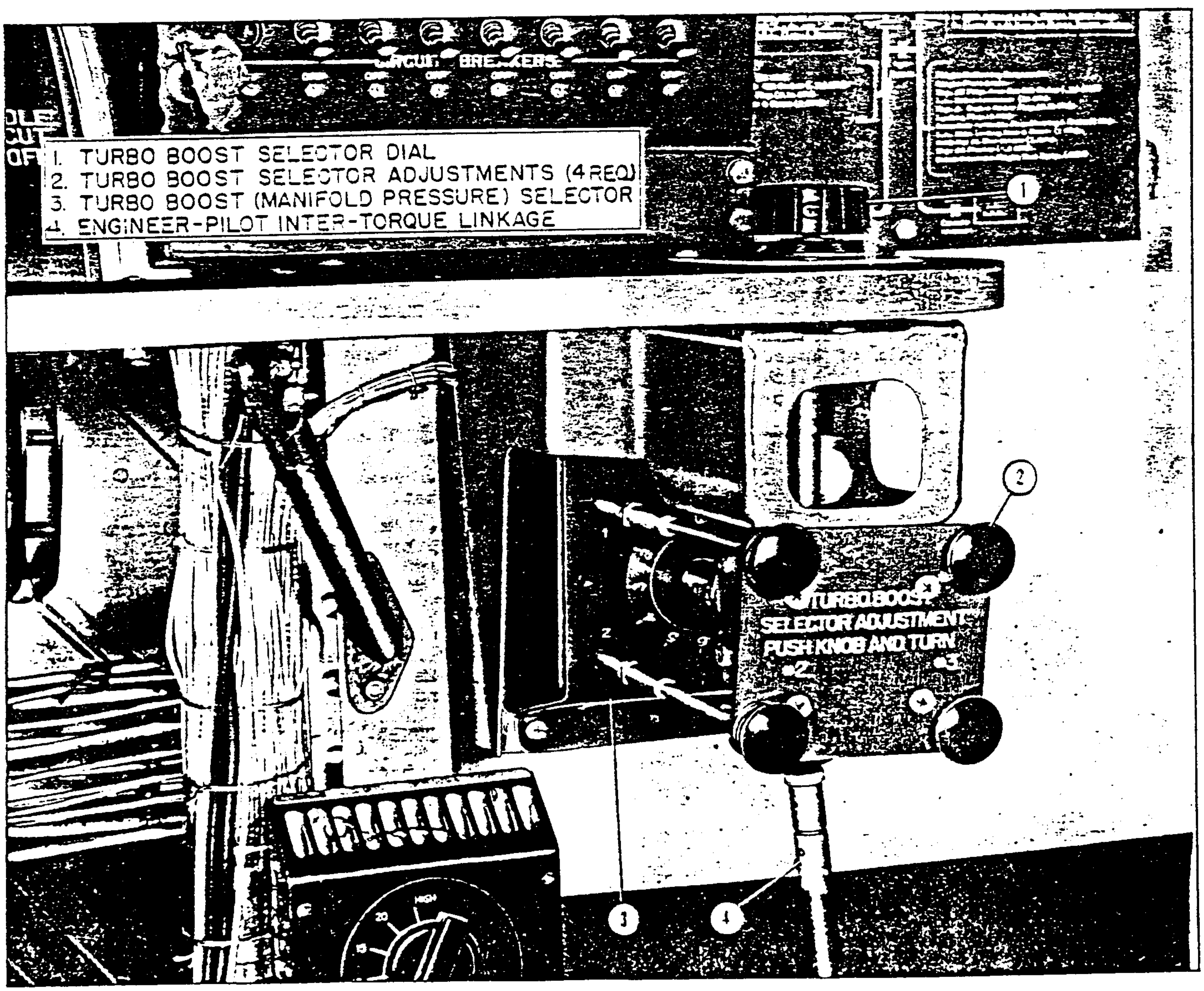


Figure 16. Turbosupercharger Manual Controls

(c) TURBOSUPERCHARGER BOOST SELECTOR DIALS. (See figures 16, 17, and 18.)- Manual control setting of the turbosuperchargers is effected through applicable dials on the pilot's pedestal and on the flight engineer's table. These dials are linked to each other by means of a tube arrangement (figure 19) and consequently when the setting on one is changed the setting on the other is moved to an identical position. Each dial is mutually linked to the turbosupercharger boost selector (manifold pressure selector), which is the control unit for the system.

(d) TURBO BOOST SELECTOR CALIBRATING ADJUSTMENTS.- Each turbo boost selector contains four potentiometers to coordinate the operation of the four pairs of turbosuperchargers. Control knobs are located immediately below the flight engineer's turbo-selector dial.

(e) CRUISE VALVE. (See figure 20.)- Refer to paragraph 14 a (5).

(f) EMERGENCY MANUAL CONTROLS. (See figure 21.)- Emergency manual controls, one for each pair of turbosuperchargers, are incorporated in a control box located in the flight engineer's compartment. In the event the manifold pressure reading for an engine fluctuates more than is allowable while the allied turbosuperchargers are under automatic control, control may be shifted to manual and the wastegate position determined by means of a momentary switch.

NOTE

The direction and duration of motor rotation, and the resultant position of the wastegates of each pair of turbosuperchargers is automatically controlled by means of a pressuretrol, a turbo-governor, a turbo-amplifier, and a potentiometer that is incorporated in the wastegate actuator.

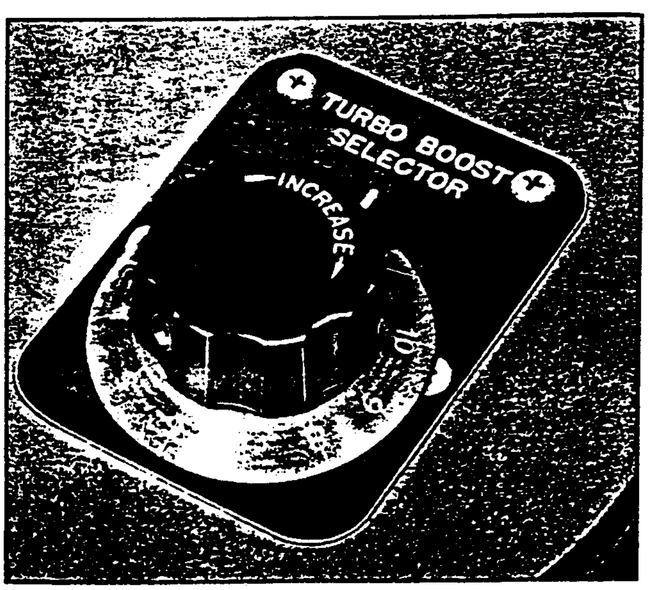


Figure 17. Turbosupercharger Boost Selector Dial

(g) PRESSURETROL. (See figure 22.)

1. DESCRIPTION.- The pressuretrol is essentially a pressure controlled potentiometer which has its wiper arm moved through the effect of the carburetor inlet pressure on a bellows and its attached linkage. The movement of the potentiometer wiper transmits the actual pressure, relative to the required pressure, to the turbo-amplifier as electrical signals. The pressuretrols for the inboard engines are located at wing station 128.5, just forward of the front spar, in the engine compartments, and those for the outboard engines are installed at the front spar inboard from wing station 338. The carburetor inlet pressure is transmitted through a tube from a fitting in the carburetor air duct elbow to the pressuretrol bellows. The leads from the pressuretrol potentiometer are wired to the turbo-nacelle junction box, where two of them pick up current from the secondary winding of a transformer in the junction box, and the third is connected to a terminal to which the circuit from the turbo-boost selector calibrator is wired. The transformer is energized by a 115 volt A.C. circuit which is routed from a terminal in the main turbo-supercharger junction box.

2. TEST.- A test for the pressuretrol is included in the system test for the electronic control units, paragraph 14 b (3).

3. REMOVAL.

a. Remove fire detector wiring.

b. Disconnect electrical plug.

c. Disconnect pneumatic line.

d. Remove Lord mounts from bracket. Remove bracket.

e. Remove pressuretrol from bracket by means of three screws.

4. MAINTENANCE.- Replace defective units.

5. INSTALLATION.- Installation is essentially the reverse of the REMOVAL procedure. Make absolutely certain that all mountings and connections are secure.

(h) TURBO-GOVERNOR.

1. DESCRIPTION.- The turbo-governor contains two potentiometers which also transmit signals to the turbo-amplifier; one to limit the turbosuperchargers to a safe maximum speed, and the other to prevent excessive movement of the wastegates when sudden changes occur in the carburetor inlet pressure.

NOTE
The latter potentiometer is not used in the XB-35 airplanes.

ITEM	DESCRIPTION	LOCATION
1	OUTBOARD CRUISE VALVE MOTOR R.H.	AFT LEADING EDGE
2	FORWARD RELAY PANEL	R.H. WHEEL WELL
3	INBOARD CRUISE VALVE MOTOR R.H.	AFT LEADING EDGE
4	PRESSURIZED PLUG "B" R.H.	CREW NACELLE CENTER SECTION
5	ENGINEER'S UPPER SWITCH PANEL	ENGINEER'S STATION
6	ENGINEER'S JUNCTION PANEL	ENGINEER'S STATION
7	PRESSURIZED PLUG "B" L.H.	CREW NACELLE CENTER SECTION
8	FORWARD RELAY PANEL	L.H. WHEEL WELL
9	INBOARD CRUISE VALVE MOTOR L.H.	AFT LEADING EDGE
10	OUTBOARD CRUISE VALVE MOTOR L.H.	AFT LEADING EDGE
11	CIRCUIT BREAKER	ENGINEER'S UPPER SWITCH PANEL
12	CONTROL SWITCHES	ENGINEER'S UPPER SWITCH PANEL

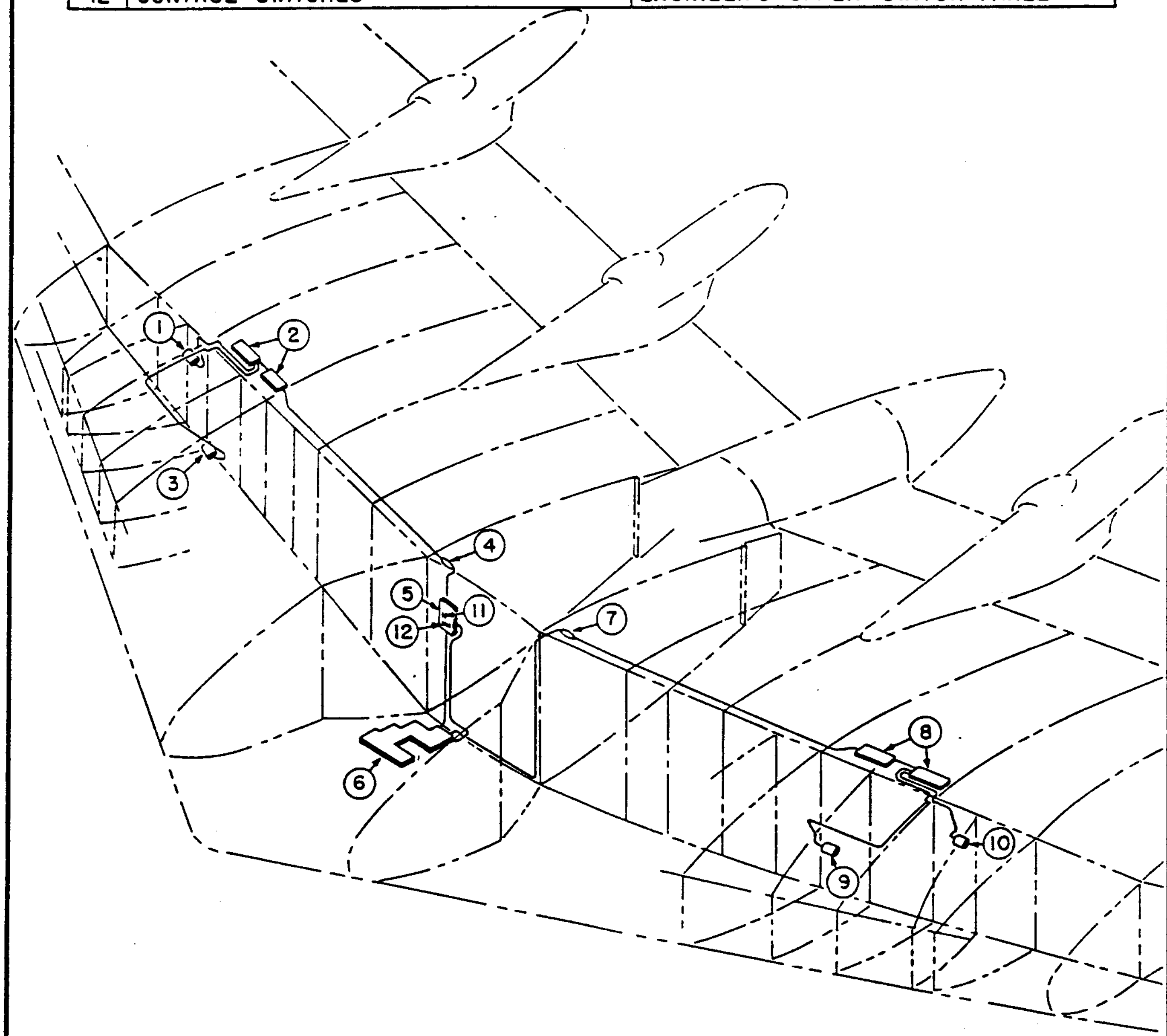


Figure 18. Engine Turbosupercharger Selector - Electrical

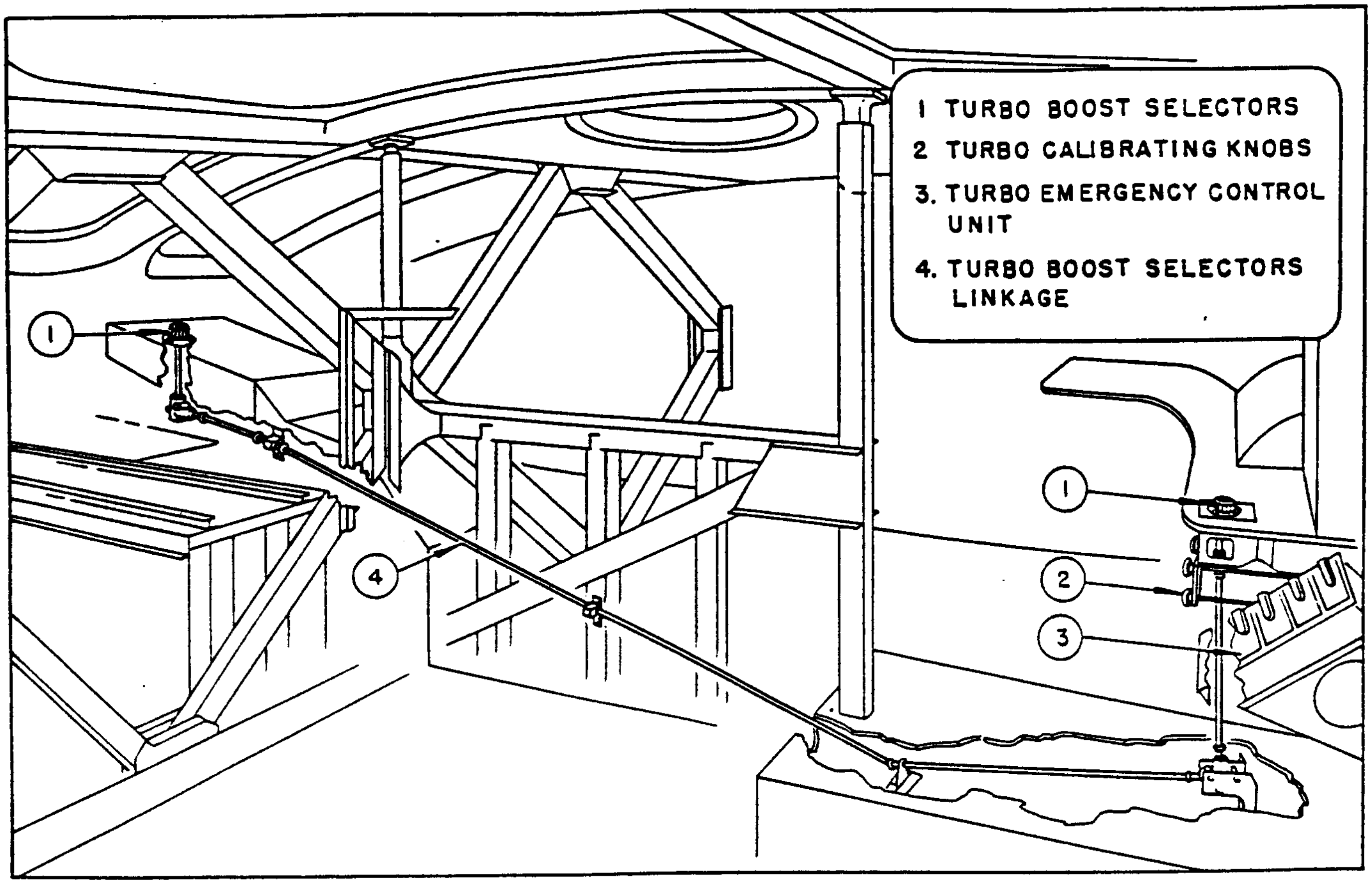


Figure 19. Turbosupercharger Control Interconnecting Mechanism

From these signals the turbo-amplifier modifies the motor action to suit the conditions imposed by the positions of the potentiometer wipers. The wastegate actuator potentiometer prevents excessive movement of the wastegates by sending signals to the amplifier to balance the signals from the carburetor inlet pressure before their travel has overrun the amount required to maintain constant pressure. One turbo-governor unit is installed for each pair of turbos, and is operated by a flexible shaft (figure 23) which is geared to the inboard turbosupercharger of each pair. A flyweight governor controls the travel of the wiper on the over-speed potentiometer, and the action of a spring driven rotating weight in connection with a cam determines the position of the accelerometer wiper.

2. TEST.- A test for the turbo-governor is included in the system test for the electronic control units, paragraph 14 b (3).

3. REMOVAL.

a. Remove necessary fairings, shrouds, and stressed doors over turbo-supercharger area. Refer to paragraph 14 a.

b. Disconnect electrical plug.

c. Remove turbo-governor from bracket.

4. MAINTENANCE.- Replace defective units.

5. INSTALLATION.- The installation procedure is essentially the reverse of the REMOVAL procedure. Make certain that all mountings and connections are secure.

(i) TURBO-AMPLIFIER.

1. DESCRIPTION.- The turbo-amplifier analyses the signals received from the pressuretrol electronically, and then by electronic means transmits one phase of the A.C. power to the wastegate actuator motor. The turbo-amplifier determines from the pressuretrol signals which polarity of this phase shall be supplied to the motor so that the direction of its rotation will properly position the wastegates to effect the required pressure at the carburetor. The four turbo-amplifiers are mounted in a frame on the crew nacelle wall near the main turbosupercharger junction box. They each contain a power transformer, four tubes (one rectifier, one voltage amplifier, and two beam power amplifiers which are used as discriminators), condensers, and resistors. The rectifier tube supplies a D.C. plate voltage for the voltage amplifier tube. The voltage amplifier tube amplifiers the signals from the electrical control units. The discriminating tubes discriminate between a signal calling for an open wastegate and one calling for a closed wastegate, while their plate current

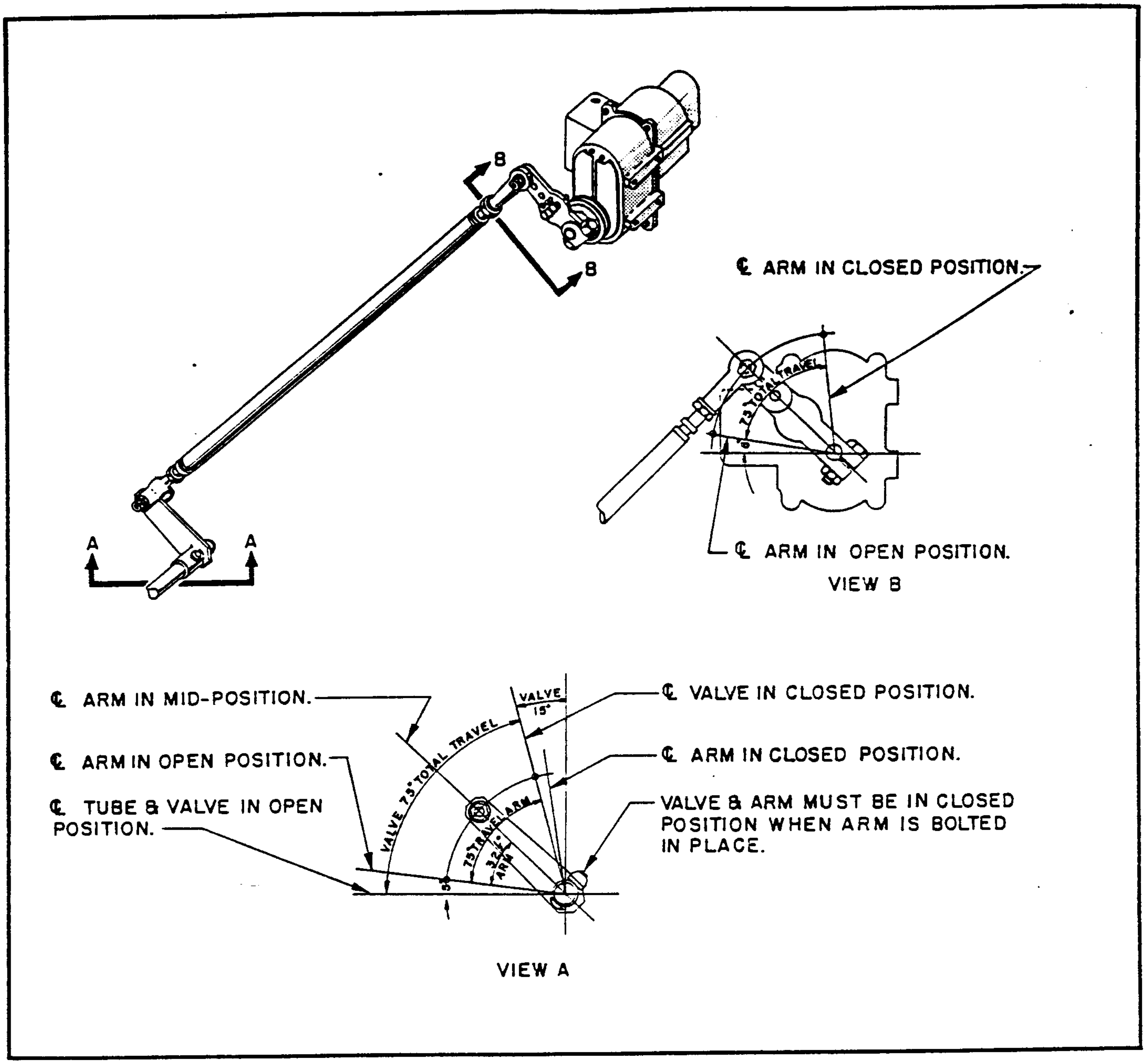


Figure 20. Turbo Selector Valve Mechanism

supplies the variable phase of the power for the wastegate actuator motor. The transformer has three secondary windings that supply plate current for the two discriminating tubes and the rectifier tube, and the heater current for all tubes. The power for the turbo-amplifiers is picked up from the 115 volts A.C. bus in the main turbosupercharger junction box. The control and power circuits from the turbo-amplifiers all pass through the main turbo junction box, through pressurized plugs in the crew nacelle, and to the turbo nacelle junction boxes. From the turbo nacelle junction boxes the circuits are distributed to the control units which are located in the turbo nacelles.

NOTE

A spare turbo amplifier for emergency replacement is secured in the crew nacelle, at station 190.

2. TEST.- A test for the turbo-amplifier is included in the system test for the electronic control units, paragraph 14 b (3).

3. REMOVAL.

a. Disconnect electrical plug.

b. Remove from bracket by means of airloc fastener.

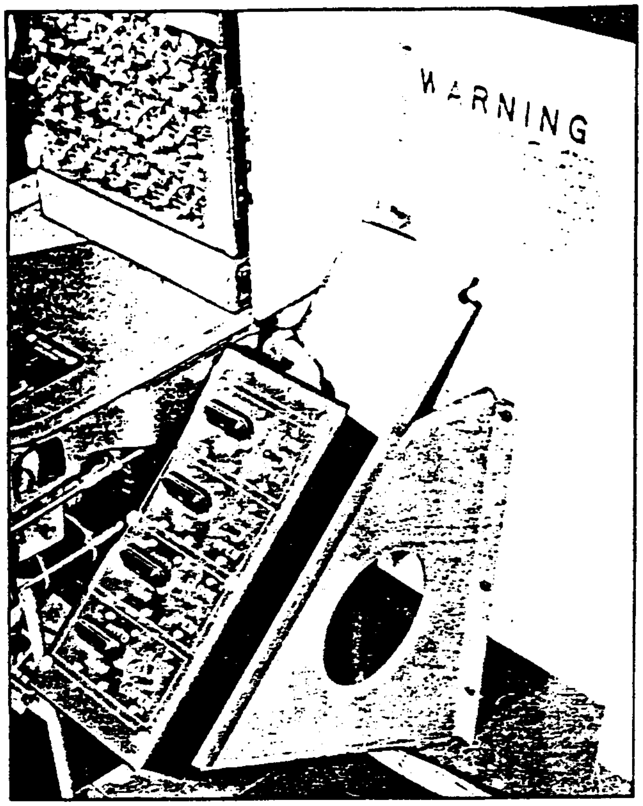


Figure 21. Turbosupercharger Emergency Controls

4. INSTALLATION.- The installation procedure is essentially the reverse of the REMOVAL procedure. Make absolutely certain that all mountings and connections are secure.

(7) TURBOSUPERCHARGER (CARBURETOR AIR) RAM AIR INLET SCOOP VALVE. (See figures 24 and 25.)- Each turbosupercharger incorporates a scoop containing a butterfly type air valve which may be adjusted to admit rammed air in a "Normal" or maximum open position, a "Pre-heat" or restricted position, or through a filter ("Filter" position). Valve position is affected by means of four 208 volt, 3 phase, 400 cycles A.C., reversible, motor actuators; one for each pair of turbosuperchargers. The motors, all of which operate in unison, are normally controlled by a single pole, triple throw, manually operated switch on the flight engineer's upper switch panel. However, if the rammed air pressure becomes excessive (with the flight engineer's switch in "Pre-heat" or "Filter" position) an override switch causes the butterfly valve to return to the maximum open position where it will remain until the pressure has again diminished to normal. The valve will again return to the position previously determined by the setting of the flight engineer's switch.

(8) INTERCOOLERS. (See figures 26 and 27.)- Since air, heated by the turbosupercharger compressors, would result in engine detonation if received directly into the carburetors, it is necessary that the flow first be ducted through intercoolers. For this purpose four intercoolers, one for each pair of turbosuperchargers, are installed in the leading edge of the wing. Each intercooler is capped with a header which channels the cooled and compressed air for release into the carburetor and also, if desired, for cabin supercharging. Refer to paragraph 14 c. The ram air flow and the consequent cooling range of each intercooler is determined by the position of the flaps in the trailing edge of the wing. Other information in regard to the intercoolers is not presented inasmuch as MAINTENANCE, REMOVAL, and INSTALLATION are repair depot functions. The intercoolers are pressure tested at the factory and in the induction system pressure test as described in figure 6.

(9) INTERCOOLER TEMPERATURE CONTROL. (See figure 28.)

(a) DESCRIPTION.- The temperature of the supercharged air is regulated by controlling the volume of rammed cooling air that passes through the intercoolers. This is accomplished by motor actuated adjustable intercooler flaps built into the trailing edge of the wings aft of bomb bays #1 and #8, and aft of the wheel wells. The cooling air, after passing through the intercoolers, discharges into the bomb bay and wheel well, passes through them, and is emitted through the flap opening. The reversible actuating motor, which is installed just aft of the rear spar aft of bomb bay, operates on 208V, 3 phase, 400 cycles a.c. which is controlled by a three pole, double throw, reversing a.c. power relay. The relay is mounted on the bomb bay aft relay panel which is installed in the top of the bomb bay. The relay is operated by 28V direct current and may be controlled either automatically or manually by a switch on the engineer's lower switch panel. The automatic control occurs through the action of three thermal sensitive elements, one in the duct between the inboard intercooler header and the inboard engine carburetor, one in the outboard intercooler header, and one under the top surface of the wing on the pressure override panel in bomb bay #1 L.H., and in bomb bay #8 R.H. A thermostat switch installed in the aft leading edge section of the wing, aft of the intercoolers and aft of #2 supercharger, normally closes the circuit to the thermal sensitive element in the inboard cooler duct, but if the temperature in the plenum chamber becomes excessive the thermostat switch cuts out that thermal sensitive element and puts the outboard intercooler thermal sensitive element in the circuit. The circuit from either of the intercooler thermal sensitive elements normally passes through a second thermostatic switch in the bomb bay #1 pressure and temperature panel, located in the top of the bomb bay (bomb bay #8 in right wing). The circuit then passes through one coil of a polarized relay located on the forward side of the rear spar in bomb bay #1 (bomb bay #8 in right wing), then to the "Automatic" position of the control switch located on the engineer's lower switch panel. From the switch the current passes through two pressure override switches installed in the bomb bay #1 pressure and temperature

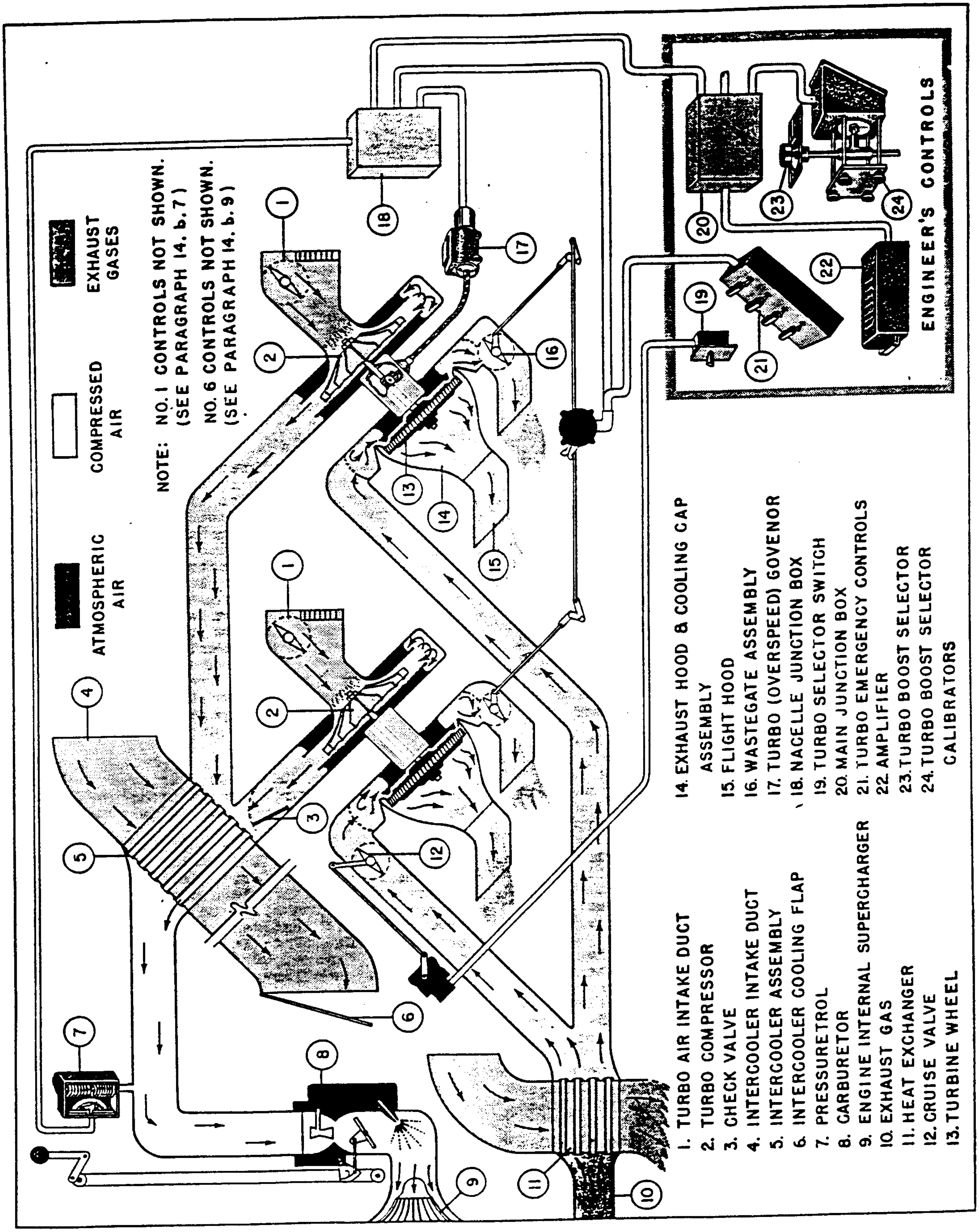


Figure 22. Turbosupercharger Electronic System Controls

Figure 23. Turbosupercharger Governor and Tachometer Generator - Inboard

panel (bomb bay #8 in right wing), then through one side of mechanical locking, electrically reset relay switch which is operated by the movement of the bomb bay door switches on the bombardier's control panel, and then to the 28V direct current supply in the engineer's lower switch panel. The 28V direct current supplied to the polarized relay also passes through the other coil of the relay and then through a follow-up resistance, which is operated by the flap movement, and to the ground. The circuits through the two relay coils are normally balanced, but if the resistance in the thermal sensitive element is changed, due to a change in temperature, it causes the relay to close one of its control circuits to the a.c. power relay, thus starting the actuating motor and causing the position of the flap to change enough for the temperature to return to normal. The motion of the flap changes the resistance of the follow-up to the extent that it balances the resistance of the thermo-sensitive element and causes the polarized relay to break the control circuit and stop the motor. The thermo-sensitive element and thermostat switch in the bomb bay control the polarized relay to break the control circuit and stop the motor. The thermo-sensitive element and thermostat switch in the bomb bay control the polarized circuits, after cutting out the intercooler thermo-sensitive elements, in the event that the temperature in the bomb bay becomes excessive. The pressure override switches by-pass the temperature controls and close the control circuit directly to the A.C. power relay causing the flap to open if the pressure in the bomb bay becomes too great. The flap will remain open until the pressure is again normal. The switch on the engineer's lower switch panel has, in addition to the "AUTOMATIC" position, an "OPEN" and a "CLOSE" position which furnish manual control of the flap. When operated manually the control circuit by-passes the thermostatic control, and, subject to the pressure control, operates the power relay switch directly, causing the flap to assume an open or closed position depending on the position of the engineer's switch. The flap remains in such position until the position of the engineer's switch is changed, or if closed, until opened by action of the pressure override switches if the bomb bay pressure becomes excessive.

NOTE

> When the bombardier's switches are thrown to open the bomb bay doors, they also operate the two mechanical locking, electrically reset relay switches, that are installed below the bombardier's electrical terminal blocks. These relay switches cause the control circuits to by-pass the thermostatic controls and operate the power relay switches, causing the flap to open on the same side on which the doors are opening. The control circuit is held locked in this position as long as the bomb bay doors remain open.

(10) HEAT EXCHANGERS.- Information pertaining to the various heat exchangers will be found in paragraph 14 a (4) and paragraph 14 c (4).

(11) HEAT EXCHANGER WASTEGATES. (See figures 29, 30, and 31.)- Each pair of turbosuperchargers is provided with a heat exchanger which functions to lower the temperature of the exhaust gas directed against the bucket wheels. This is necessary in order to prevent damage. Cool air enters through a ram duct then flows transversely through a heat exchanger thereby extracting heat from the exhaust gases. Normally this heated air is expelled through a wastegate but if desired may be diverted for use in wing anti-icing.

NOTE

> On airplane 42-13603 (N-1484) only outer wing anti-icing is operative.

The wastegate for each pair of outboard turbosuperchargers is located on the forward section of the engine access door and the wastegate for

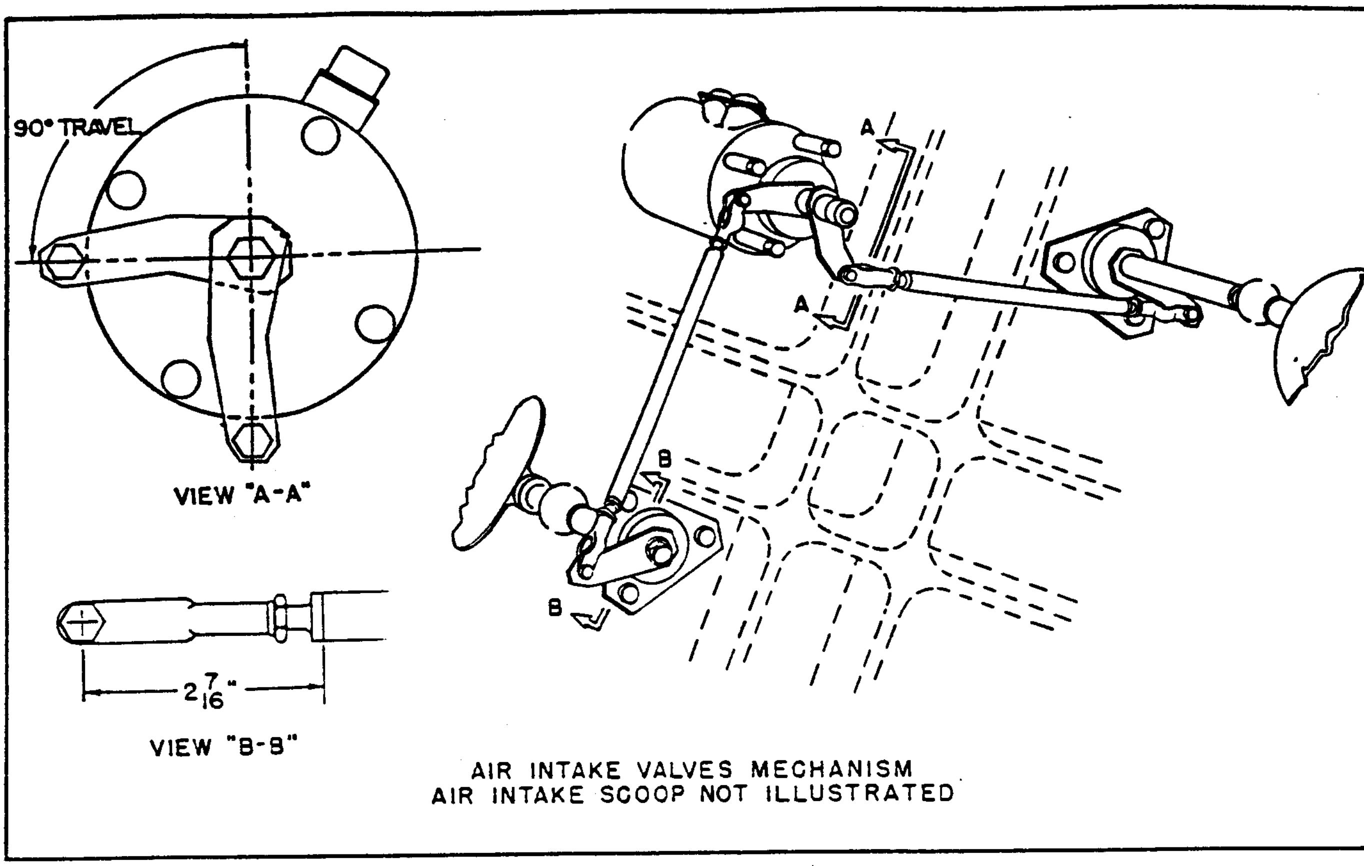
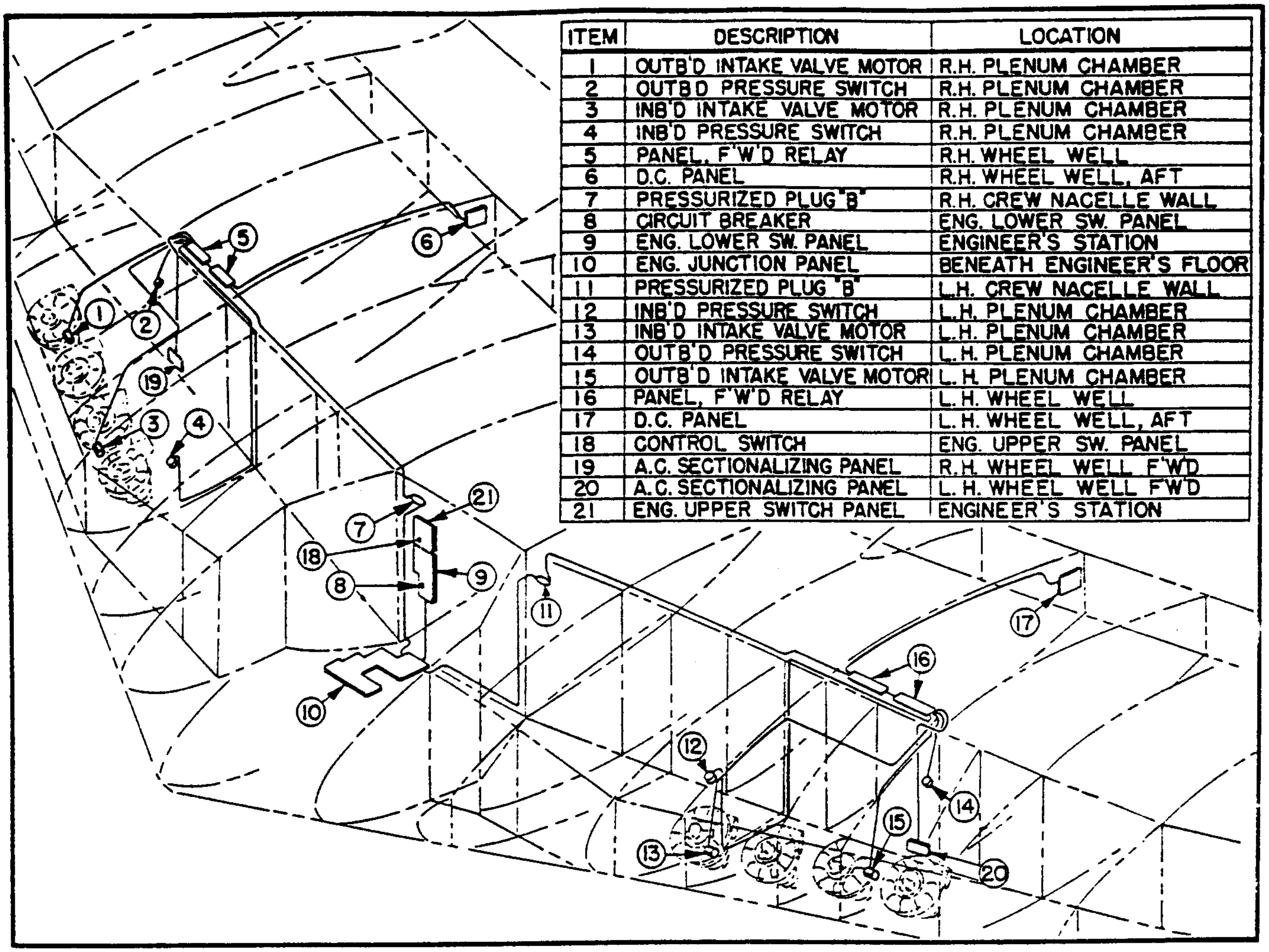


Figure 24. Turbosupercharger (Carburetor Air) Ram Air Intake Valve Mechanism

each pair of inboard turbosuperchargers is located at the bottom of the cabin heat exchanger. All wastegate actuator motors are reversible and operate on 208V, 3 phase, 400 cycles a.c. Each actuator incorporates built-in limit switches, a follow-up resistance which acts to balance the current passing through the coils of a polarized relay, and a thermal overload protector. Control is accomplished by means of four-position switches ("OFF," "AUTOMATIC," "OPEN," "CLOSE"), one for each wastegate, located on the flight engineer's upper switch panel. The "OPEN" and "CLOSE" positions of the wastegate control switches are of the momentary type. During normal flight with the control switches in the "AUTOMATIC" position, a heat exchanger duct thermo-sensitive element controls its applicable wastegate actuator. When, however, the anti-icer system is placed in operation (with the wastegate control still in "AUTOMATIC") the thermo-sensitive element for the outboard system becomes inoperative and control is shifted to a thermo-sensitive element in the edge of the outer wing. A pressur override switch removes all temperature controls, and causes the wastegates to open, when the rammed air intake falls below that require for normal cooling of the exhaust gas.

(12) CHECK VALVES.- Check valves are installed in the ram air ducts and in the air ducts adjacent to the turbosuperchargers provided with cruise valves. They cause the air to continue in the correct direction of flow when only one of a pair of turbosuperchargers is in operation or when air from the engine fan is being used for ground cooling purposes. Turbosupercharger lubrication system anti-leak and check valves are discussed in paragraph 14 b (5).

(13). DUCTS.- Information pertaining to ducts serving the INDUCTION SYSTEM will be found in paragraph 14 a, EXHAUST SYSTEM.



ITEM	DESCRIPTION	LOCATION
1	OUTB'D INTAKE VALVE MOTOR	R.H. PLENUM CHAMBER
2	OUTB'D PRESSURE SWITCH	R.H. PLENUM CHAMBER
3	INB'D INTAKE VALVE MOTOR	R.H. PLENUM CHAMBER
4	INB'D PRESSURE SWITCH	R.H. PLENUM CHAMBER
5	PANEL, F'W'D RELAY	R.H. WHEEL WELL
6	D.C. PANEL	R.H. WHEEL WELL, AFT
7	PRESSURIZED PLUG "B"	R.H. CREW NACELLE WALL
8	CIRCUIT BREAKER	ENG. LOWER SW. PANEL
9	ENG. LOWER SW. PANEL	ENGINEER'S STATION
10	ENG. JUNCTION PANEL	BENEATH ENGINEER'S FLOOR
11	PRESSURIZED PLUG "B"	L.H. CREW NACELLE WALL
12	INB'D PRESSURE SWITCH	L.H. PLENUM CHAMBER
13	INB'D INTAKE VALVE MOTOR	L.H. PLENUM CHAMBER
14	OUTB'D PRESSURE SWITCH	L.H. PLENUM CHAMBER
15	OUTB'D INTAKE VALVE MOTOR	L.H. PLENUM CHAMBER
16	PANEL, F'W'D RELAY	L.H. WHEEL WELL
17	D.C. PANEL	L.H. WHEEL WELL, AFT
18	CONTROL SWITCH	ENG. UPPER SW. PANEL
19	A.C. SECTIONALIZING PANEL	R.H. WHEEL WELL F'W'D
20	A.C. SECTIONALIZING PANEL	L.H. WHEEL WELL F'W'D
21	ENG. UPPER SWITCH PANEL	ENGINEER'S STATION

Figure 25. Turbosupercharger (Carburetor Air) Ram Air Intake Valve Control

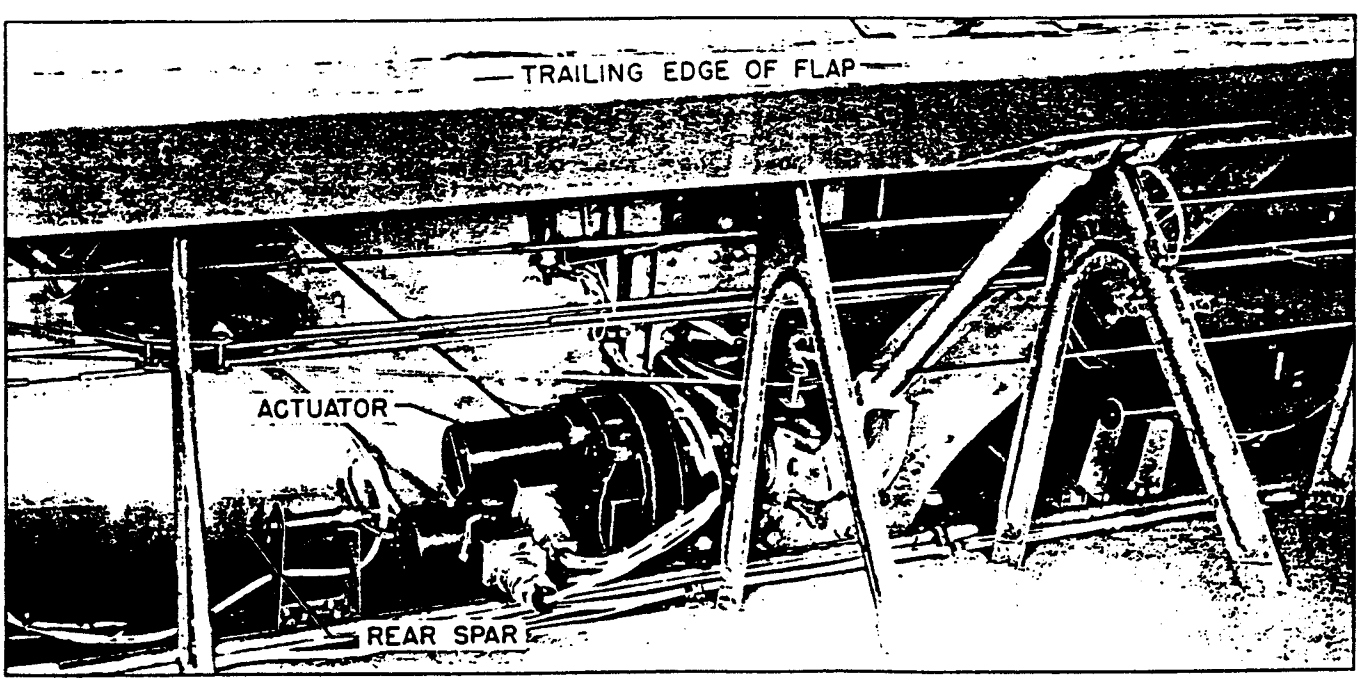


Figure 26. Intercooler Flap Actuator Mechanism (Typical)

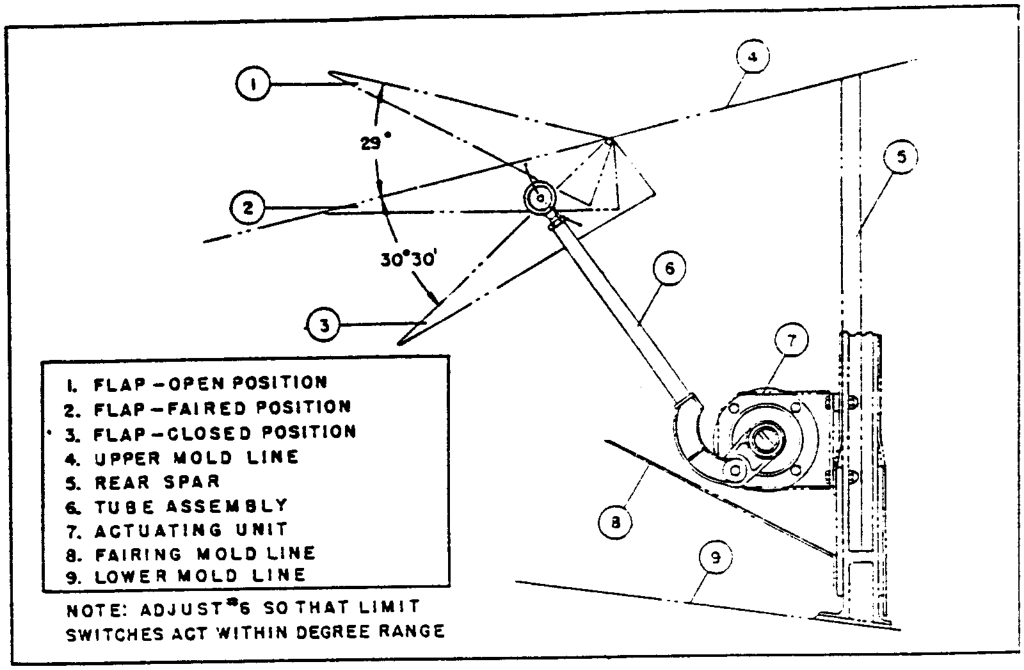
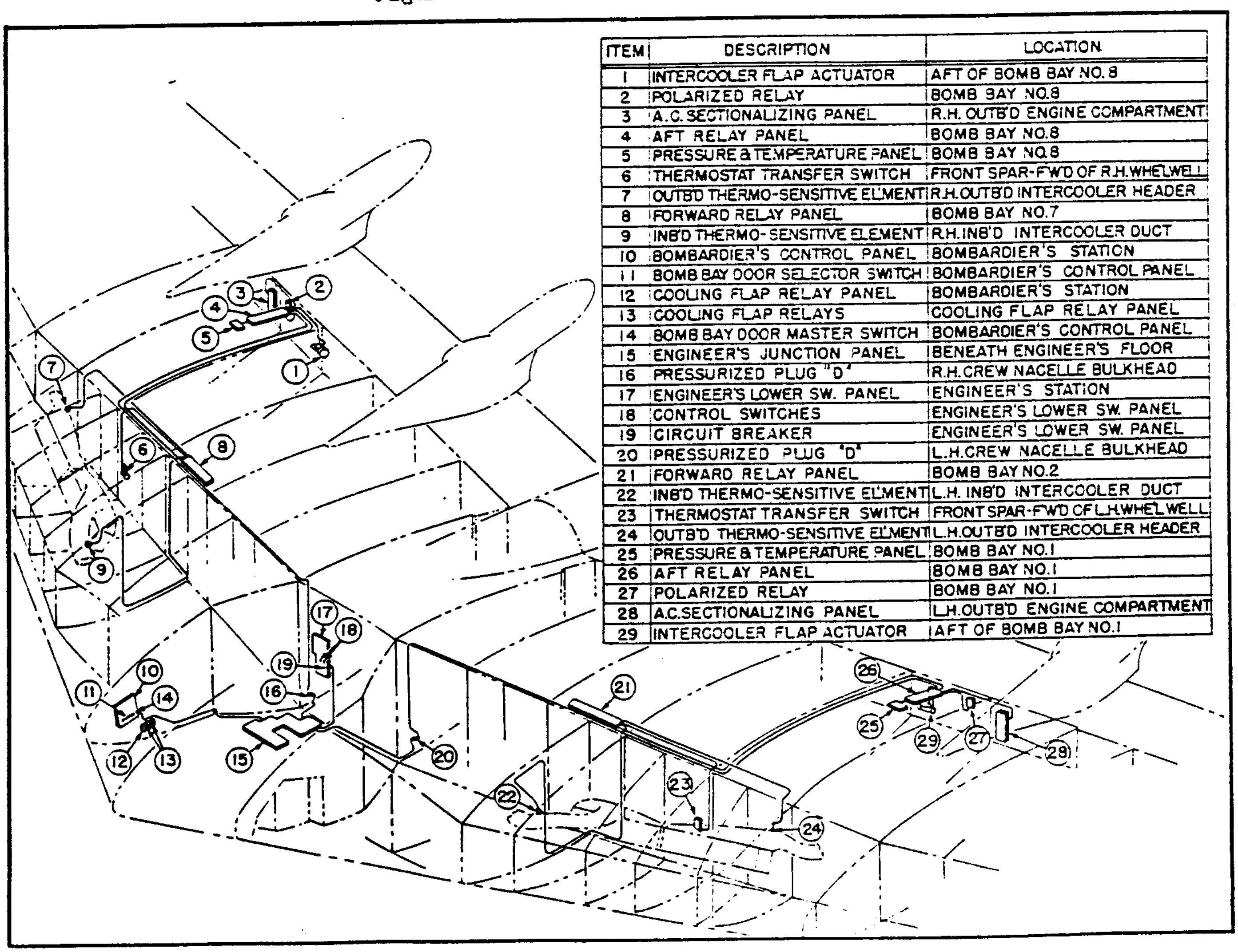


Figure 27. Intercooler Flap Mechanism



ITEM	DESCRIPTION	LOCATION
1	INTERCOOLER FLAP ACTUATOR	AFT OF BOMB BAY NO. 8
2	POLARIZED RELAY	BOMB BAY NO.8
3	A.C. SECTIONALIZING PANEL	R.H. OUTB'D ENGINE COMPARTMENT
4	AFT RELAY PANEL	BOMB BAY NO.8
5	PRESSURE & TEMPERATURE PANEL	BOMB BAY NO.8
6	THERMOSTAT TRANSFER SWITCH	FRONT SPAR-FWD OF R.H.WHEELWELL
7	OUTB'D THERMO-SENSITIVE ELEMENT	R.H.OUTB'D INTERCOOLER HEADER
8	FORWARD RELAY PANEL	BOMB BAY NO.7
9	INB'D THERMO-SENSITIVE ELEMENT	R.H.INB'D INTERCOOLER DUCT
10	BOMBARDIER'S CONTROL PANEL	BOMBARDIER'S STATION
11	BOMB BAY DOOR SELECTOR SWITCH	BOMBARDIER'S CONTROL PANEL
12	COOLING FLAP RELAY PANEL	BOMBARDIER'S STATION
13	COOLING FLAP RELAYS	COOLING FLAP RELAY PANEL
14	BOMB BAY DOOR MASTER SWITCH	BOMBARDIER'S CONTROL PANEL
15	ENGINEER'S JUNCTION PANEL	BENEATH ENGINEER'S FLOOR
16	PRESSURIZED PLUG "D"	R.H.CREW NACELLE BULKHEAD
17	ENGINEER'S LOWER SW. PANEL	ENGINEER'S STATION
18	CONTROL SWITCHES	ENGINEER'S LOWER SW. PANEL
19	CIRCUIT BREAKER	ENGINEER'S LOWER SW. PANEL
20	PRESSURIZED PLUG "D"	L.H.CREW NACELLE BULKHEAD
21	FORWARD RELAY PANEL	BOMB BAY NO.2
22	INB'D THERMO-SENSITIVE ELEMENT	L.H. INB'D INTERCOOLER DUCT
23	THERMOSTAT TRANSFER SWITCH	FRONT SPAR-FWD OF L.H.WHEELWELL
24	OUTB'D THERMO-SENSITIVE ELEMENT	L.H.OUTB'D INTERCOOLER HEADER
25	PRESSURE & TEMPERATURE PANEL	BOMB BAY NO.1
26	AFT RELAY PANEL	BOMB BAY NO.1
27	POLARIZED RELAY	BOMB BAY NO.1
28	A.C.SECTIONALIZING PANEL	L.H.OUTB'D ENGINE COMPARTMENT
29	INTERCOOLER FLAP ACTUATOR	AFT OF BOMB BAY NO.1

Figure 28. Intercooler Flap Temperature Control

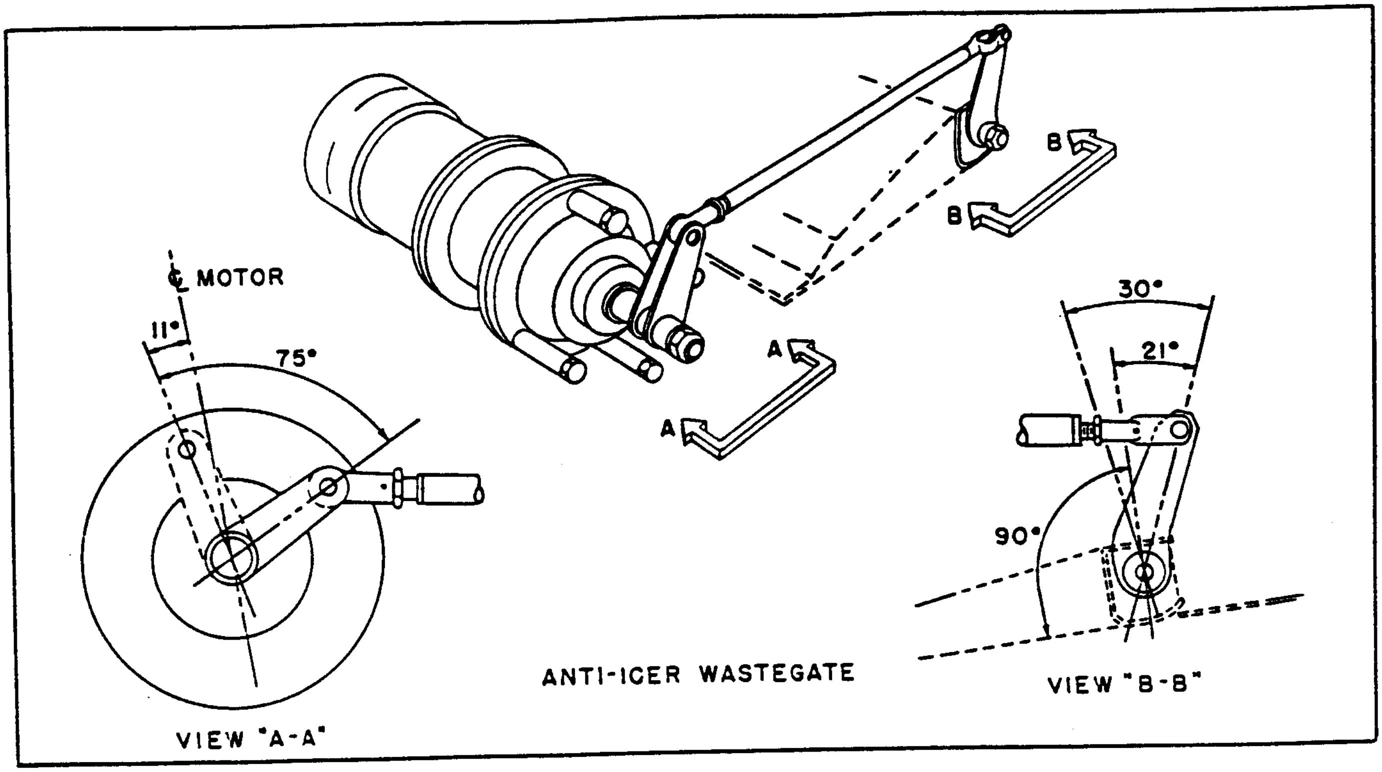


Figure 29. Exhaust Heat Exchanger Wastegate (Anti-icer Wastegate) Mechanism

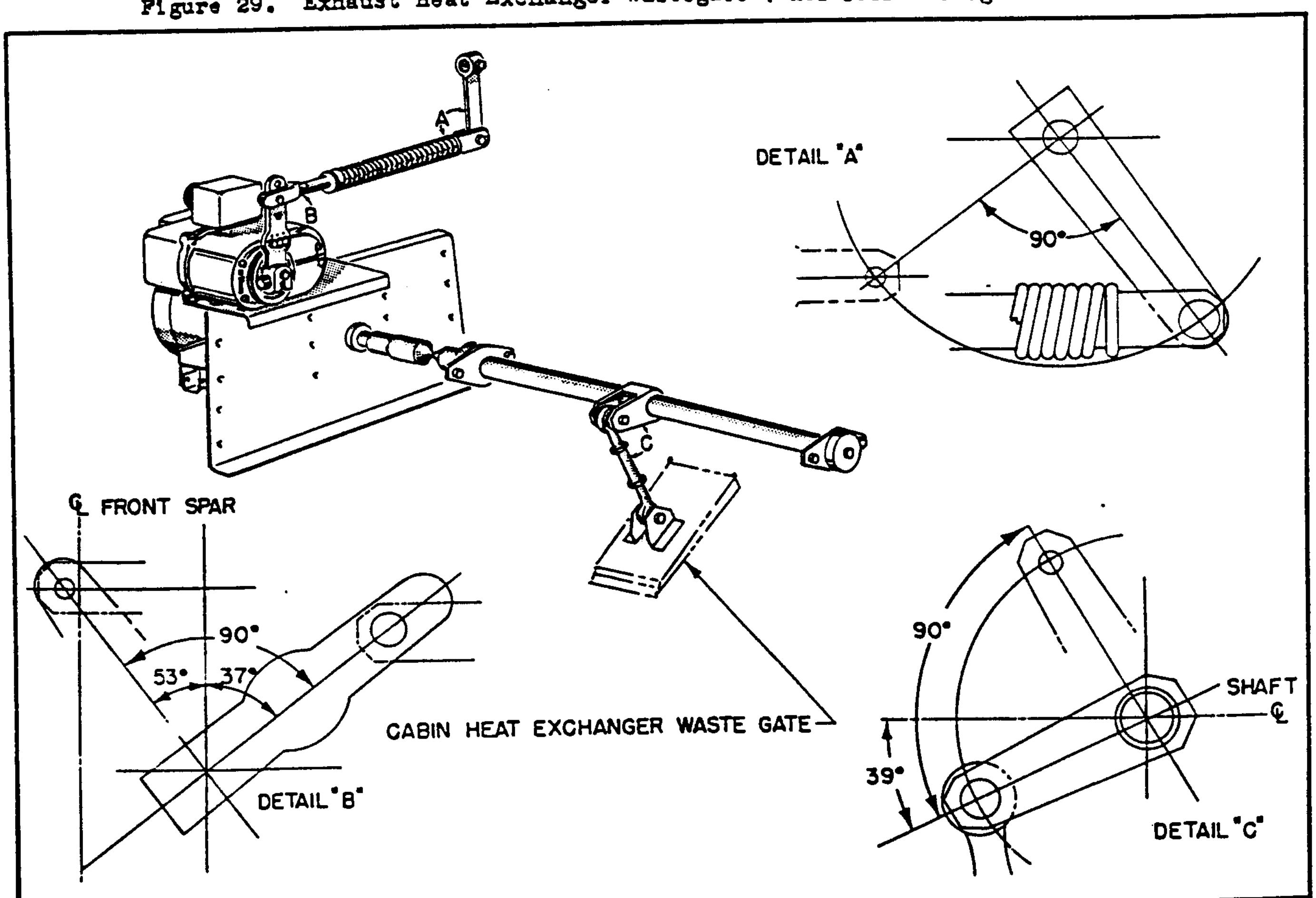
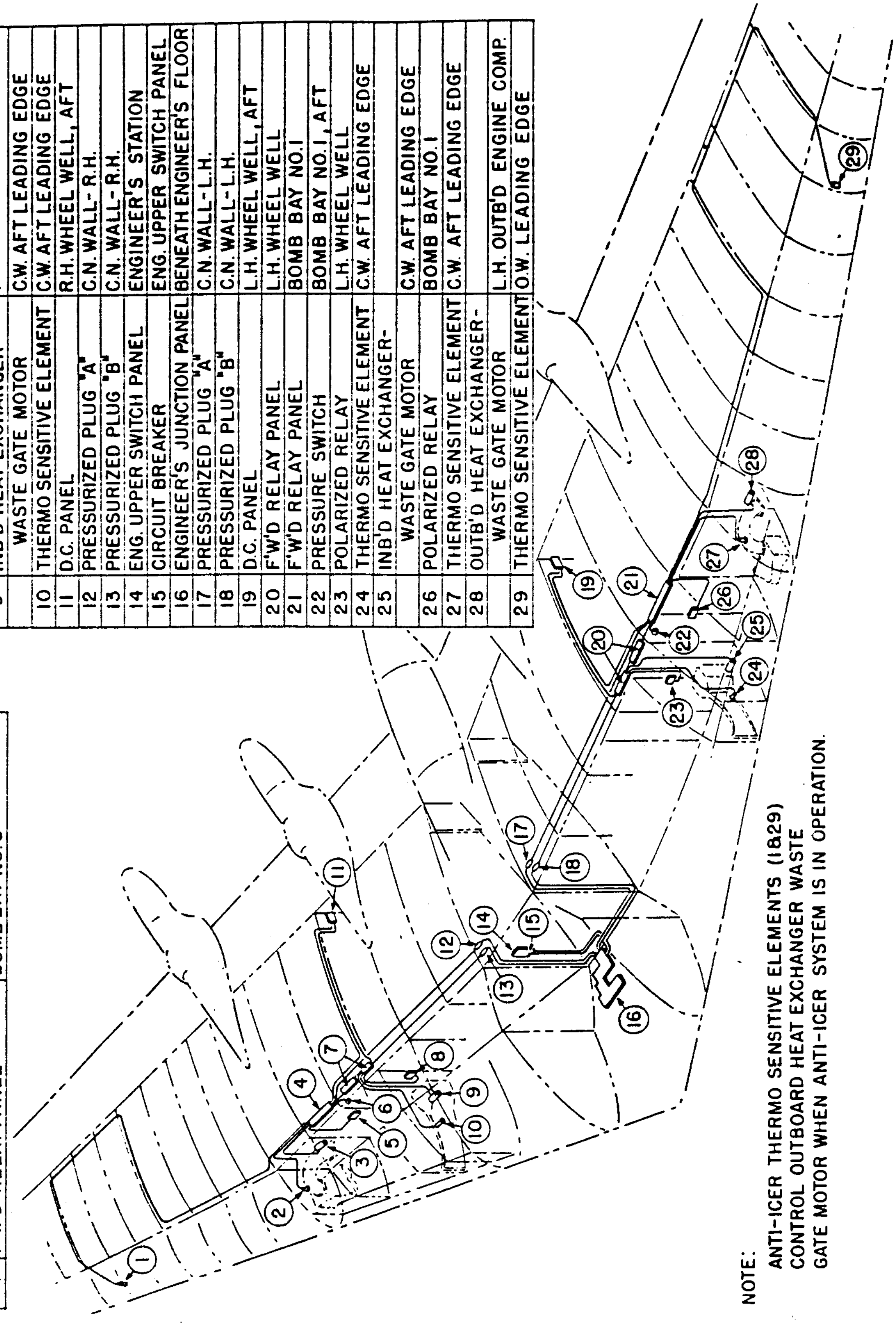


Figure 30. Exhaust Heat Exchanger and Cabin Heat Exchanger Wastegate Control Mechanism



ITEM	DESCRIPTION	LOCATION
1	THERMO SENSITIVE ELEMENT	O.W. LEADING EDGE
2	THERMO SENSITIVE ELEMENT	C.W. AFT LEADING EDGE
3	OUTB'D HEAT EXCHANGER-WASTE GATE MOTOR	R.H. OUTB'D ENG. COMP.
4	F'W'D RELAY PANEL	BOMB BAY NO.8

ITEM	DESCRIPTION	LOCATION
5	POLARIZED RELAY	R.H. WHEEL WELL
6	PRESSURE SWITCH	BOMB BAY NO.8
7	F'W'D RELAY PANEL	R.H. WHEEL WELL
8	POLARIZED RELAY	R.H. WHEEL WELL
9	INB'D HEAT EXCHANGER-WASTE GATE MOTOR	C.W. AFT LEADING EDGE
10	THERMO SENSITIVE ELEMENT	C.W. AFT LEADING EDGE
11	D.C. PANEL	R.H. WHEEL WELL, AFT
12	PRESSURIZED PLUG "A"	C.N. WALL - R.H.
13	PRESSURIZED PLUG "B"	C.N. WALL - R.H.
14	ENG. UPPER SWITCH PANEL	ENGINEER'S STATION
15	CIRCUIT BREAKER	ENG. UPPER SWITCH PANEL
16	ENGINEER'S JUNCTION PANEL	BENEATH ENGINEER'S FLOOR
17	PRESSURIZED PLUG "A"	C.N. WALL - L.H.
18	PRESSURIZED PLUG "B"	C.N. WALL - L.H.
19	D.C. PANEL	L.H. WHEEL WELL, AFT
20	F'W'D RELAY PANEL	L.H. WHEEL WELL
21	F'W'D RELAY PANEL	BOMB BAY NO.1
22	PRESSURE SWITCH	BOMB BAY NO.1, AFT
23	POLARIZED RELAY	L.H. WHEEL WELL
24	THERMO SENSITIVE ELEMENT	C.W. AFT LEADING EDGE
25	INB'D HEAT EXCHANGER-WASTE GATE MOTOR	C.W. AFT LEADING EDGE
26	POLARIZED RELAY	BOMB BAY NO.1
27	THERMO SENSITIVE ELEMENT	C.W. AFT LEADING EDGE
28	OUTB'D HEAT EXCHANGER-WASTE GATE MOTOR	L.H. OUTB'D ENGINE COMP.
29	THERMO SENSITIVE ELEMENT	O.W. LEADING EDGE

NOTE:
ANTI-ICER THERMO SENSITIVE ELEMENTS (1&29) CONTROL OUTBOARD HEAT EXCHANGER WASTE GATE MOTOR WHEN ANTI-ICER SYSTEM IS IN OPERATION.

Figure 31. Exhaust System Heat Exchanger Wastegates

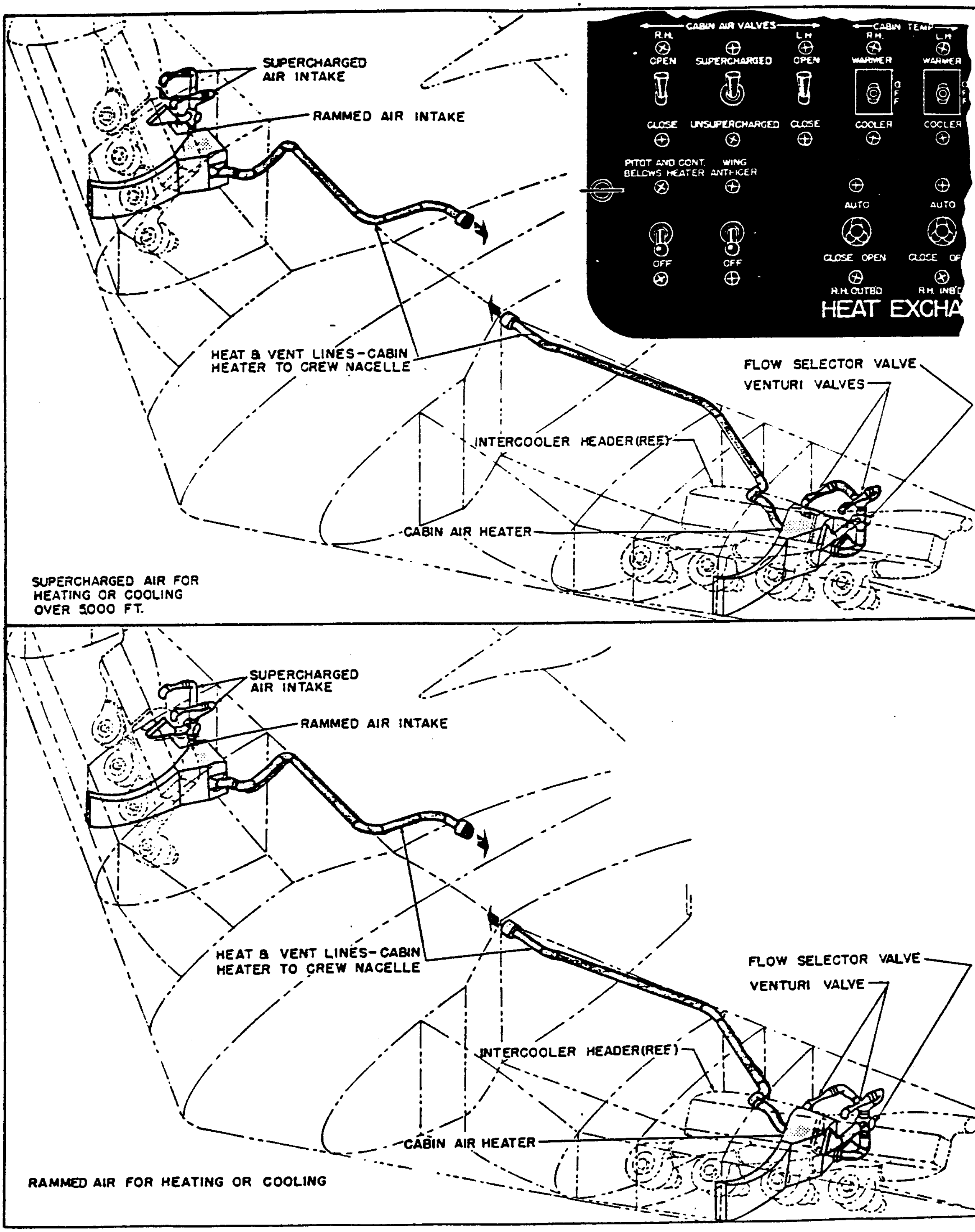


Figure 32. Cabin Heat and Vent System

(c) CABIN HEATER VALVE ASSEMBLY.

TROUBLE	PROBABLE CAUSE	REMEDY
Valve fails to operate when electrical contact is made.	Valve flapper binding or sticking.	Clean flapper mounting shaft. If parts are bent or damaged, replace valve unit.
Valve fails to open or close to full position.	Improper adjustment on adjustment arm.	Adjust arm so valve will travel to full open or closed position.
	Faulty adjustment on limit switches.	Check limit switches.
Valve will open but will not close or vice versa.	Broken or damaged limit switches in actuator sub-assembly.	Replace limit switches.
	Loose connection to motor terminals.	Check wiring.
Motor fails to operate.	Burned or fouled brushes.	Replace brushes.
	Loose connection or open circuit in electrical system.	Check all wiring.
	Burned out motor.	Replace motor.

(3) CABIN AIR SELECTOR VALVES. (See figure 34.)

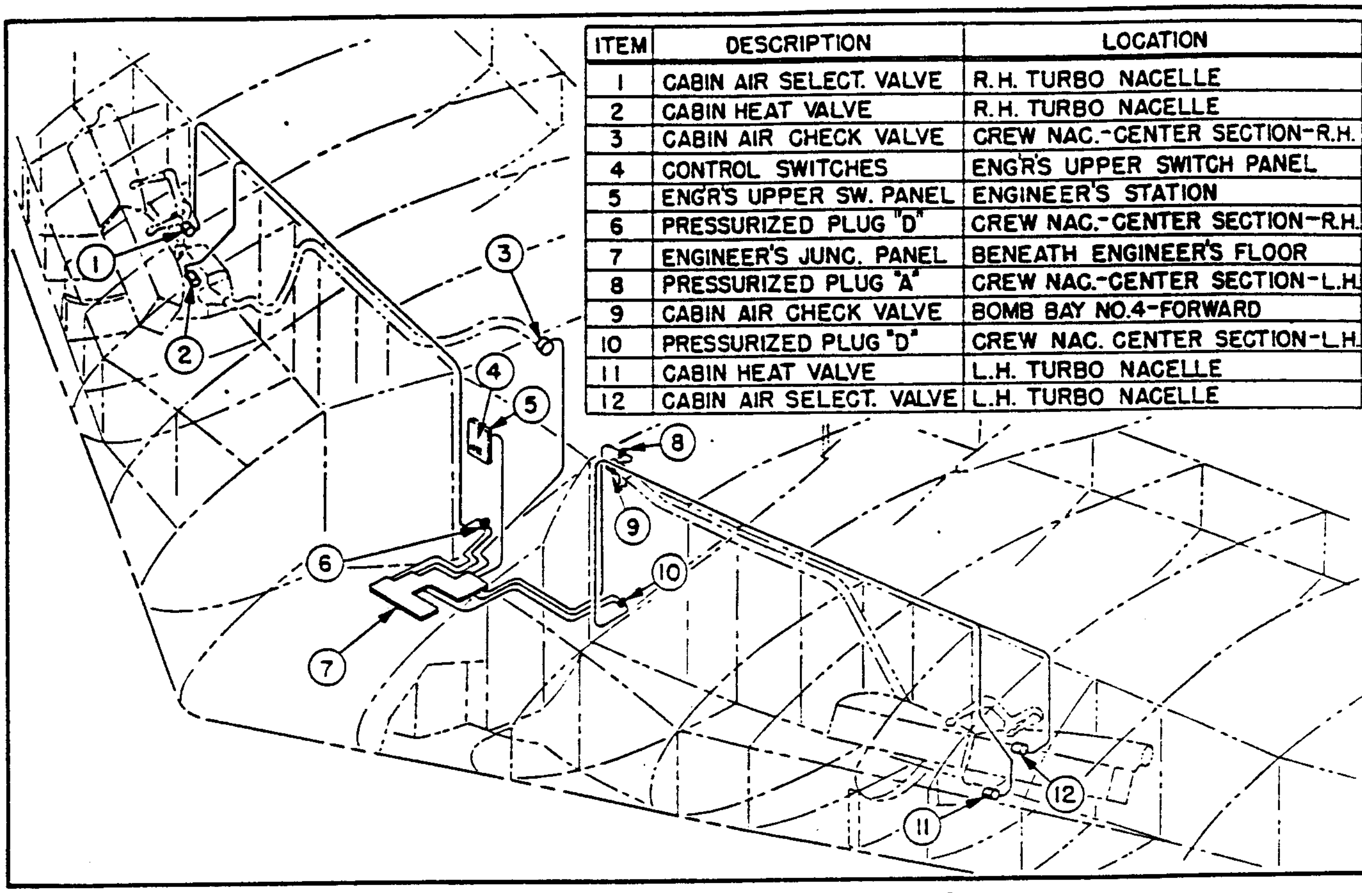
(a) DESCRIPTION.- The cabin air pressure may be varied from the normal rammed air pressure to the full pressure developed by the superchargers by means of a flow selector valve installed in each cabin air heating and ventilating duct. The rammed air is directed to the valve by a duct that passes through a slot in the intercooler. The supercharged air is taken from the header of each intercooler by a duct that leads to a venturi which discharges into a "Y" that is connected to the valve. Another duct from the valve directs the air to the cabin heat exchanger. The valve is located aft of the point where the two intercoolers meet.

(b) OPERATION.- Each valve is actuated by a reversible motor which operates on 115v., single phase, 400 cycles a.c. The operating current is picked up at the engineer's junction panel beneath the engineer's floor and wired to a two-position switch on the engineer's upper electrical panel. The switch positions are labeled "SUPERCHARGE" and "UNSUPERCHARGE" and control both left and right valves simultaneously through circuits which pass from the switch to the engineer's junction panel and then in parallel to the actuating motors.

1. MANUAL.- Two valve flappers are installed within this assembly on a single shaft, one flapper acting to open and close the supercharged air inlet passage and the other to open and close the rammed air inlet. One outlet passage to the cabin air heat exchanger continues the flow of air (rammed air or supercharged air) through the valve. A spring mounted on the flapper shaft acts to hold both flappers closed in static condition. When unpressurized flight is desired, the engineer operates the switch to close the pressurized air inlet. The flapper arm moves the pressurized air inlet flapper to its closed position, allowing rammed air to move the rammed air inlet flapper from its seat. When pressurized flight is desired, the reverse action takes place. The torque type actuator is connected to a flapper adjustment arm through the flapper shaft. This flapper adjustment arm is mounted on the flapper shaft and rotates through a 90° travel when the actuator sub-assembly turns the shaft. Movement of the valve flappers is independent of the shaft movement. Two limit switches are connected in the actuator motor circuit which stop the drive motor when the actuator has moved the flapper adjustment arm through its 90° travel in either direction. Two adjustment screws are provided on the actuator control box for adjustment of the limit switches. The drive motor is equipped with a magnetic brake which stops the flapper adjustment arm as soon as the power is shut off.

2. AUTOMATIC.- In the event of failure of the supercharger when pressurized air is being supplied to the cabin area, the pressure holding the pressurized air inlet flapper is cut off. The flapper spring acts to close the flapper. Backflow of pressurized air forces the flapper against its seat, thus preventing leakage through the air duct to the supercharger.

(c) MAINTENANCE.- This unit requires no maintenance other than check to assure that bolts and screws are secure, and possible replacement of the flapper holding spring. No lubrication is required on this assembly. The actuator sub-assembly is lubricated by the manufacturer and needs no further lubrication during its service life.



ITEM	DESCRIPTION	LOCATION
1	CABIN AIR SELECT. VALVE	R.H. TURBO NACELLE
2	CABIN HEAT VALVE	R.H. TURBO NACELLE
3	CABIN AIR CHECK VALVE	CREW NAC.-CENTER SECTION-R.H.
4	CONTROL SWITCHES	ENG'R'S UPPER SWITCH PANEL
5	ENG'R'S UPPER SW. PANEL	ENGINEER'S STATION
6	PRESSURIZED PLUG "D"	CREW NAC.-CENTER SECTION-R.H.
7	ENGINEER'S JUNC. PANEL	BENEATH ENGINEER'S FLOOR
8	PRESSURIZED PLUG "A"	CREW NAC.-CENTER SECTION-L.H.
9	CABIN AIR CHECK VALVE	BOMB BAY NO.4-FORWARD
10	PRESSURIZED PLUG "D"	CREW NAC. CENTER SECTION-L.H.
11	CABIN HEAT VALVE	L.H. TURBO NACELLE
12	CABIN AIR SELECT. VALVE	L.H. TURBO NACELLE

Figure 33. Cabin Air Electrical Control System

(d) REMOVAL.

1. Disconnect electrical terminals.

2. Remove the screws, washers and lock nuts that attach the valve to the assembly.

3. Remove valve from the assembly.

(e) INSTALLATION.- Reverse the removal procedure.

(4) CABIN HEATER ASSEMBLY. (See figure 35.)

(a) DESCRIPTION.- The cabin air heat exchangers are installed within each inner wing, aft of the intercoolers, and are accessible through the wheel wells. The rammed or supercharged air that is directed through the exchanger can be heated or allowed to remain at its initial temperature. Cabin air temperature is controlled by a reversible motor actuated valve which regulates the volume of exhaust heated air passing through the heat exchanger, and thus controls the temperature of the air passing to the cabin. Switches located on the engineer's electrical panel control the valve operations. The switch positions are designated "WARMER" and "COOLER" and permit the engineer to vary the valve opening by limiting the operating time of the motor when regulating the temperature.

(b) OPERATION.- Exhaust heated air is ducted into the housing containing the cabin air heat exchanger, where by valve control it is directed either through or around the exchanger and dumped overboard through the wastegate. To increase the cabin air temperature, the engineer moves the switch to the "WARMER" position. The motor then turns the valve to direct the exhaust heated air through the exchanger and out the wastegate. When the switch position is on "COOLER" the motor moves the valve to a position where the exhaust air is by-passed around the exchanger and expelled overboard through the wastegate. The motors are operated on 28 volt d.c. that is picked up from the d.c. bus on the engineer's upper electrical panel. Controlled by a double throw momentary switch located on the same panel, and wired through the engineer's junction panel directly to the motor. The cabin air filter holder assembly is attached to the cabin air heat exchanger. Air from the rammed and supercharger intake passes through the filter before entering the cabin air heat exchangers. The filter element can be removed for servicing or replacement by loosening the two wing nuts which hold the cover in place. (See figure 36.)

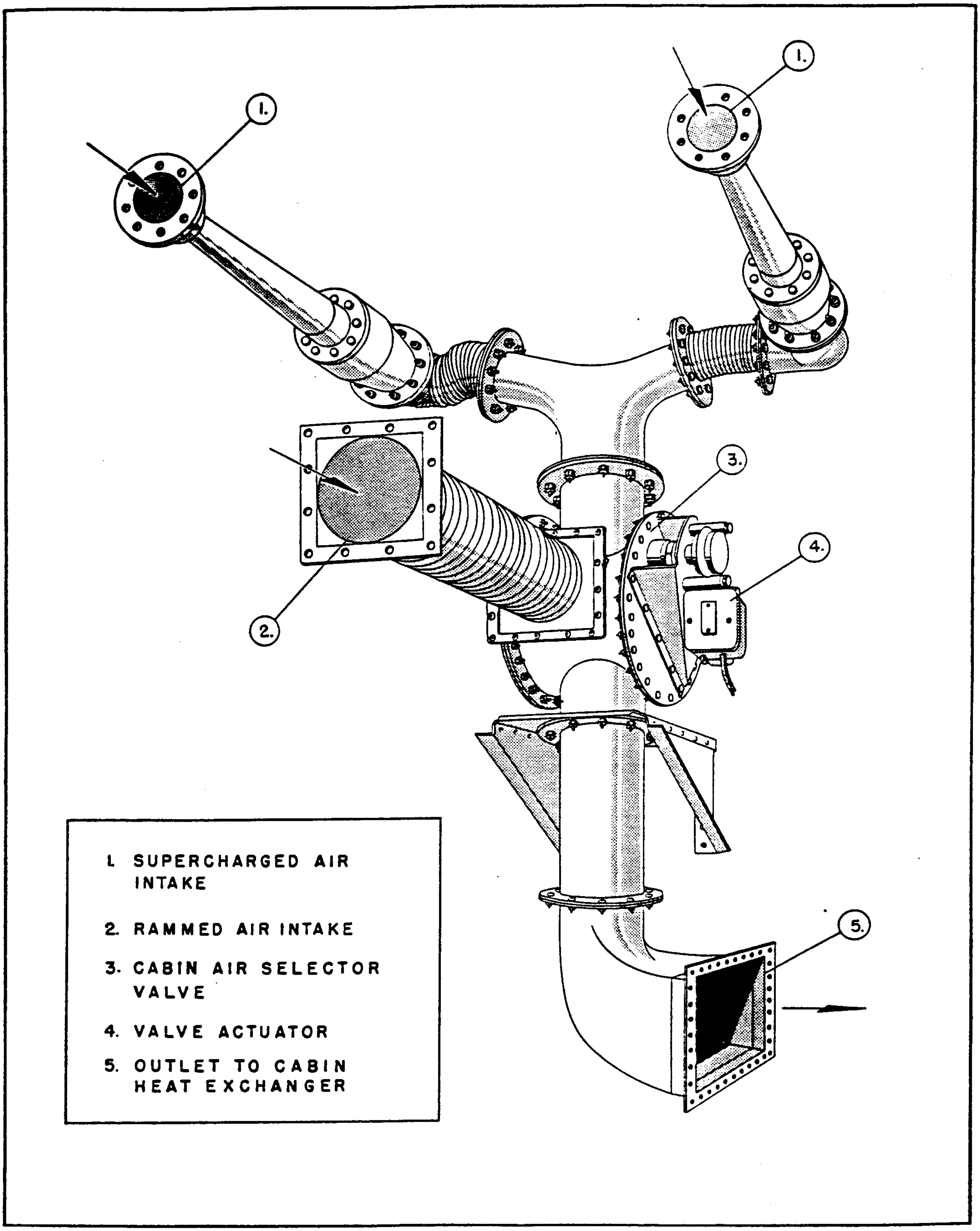


Figure 34. Cabin Air Selector Valve Assembly

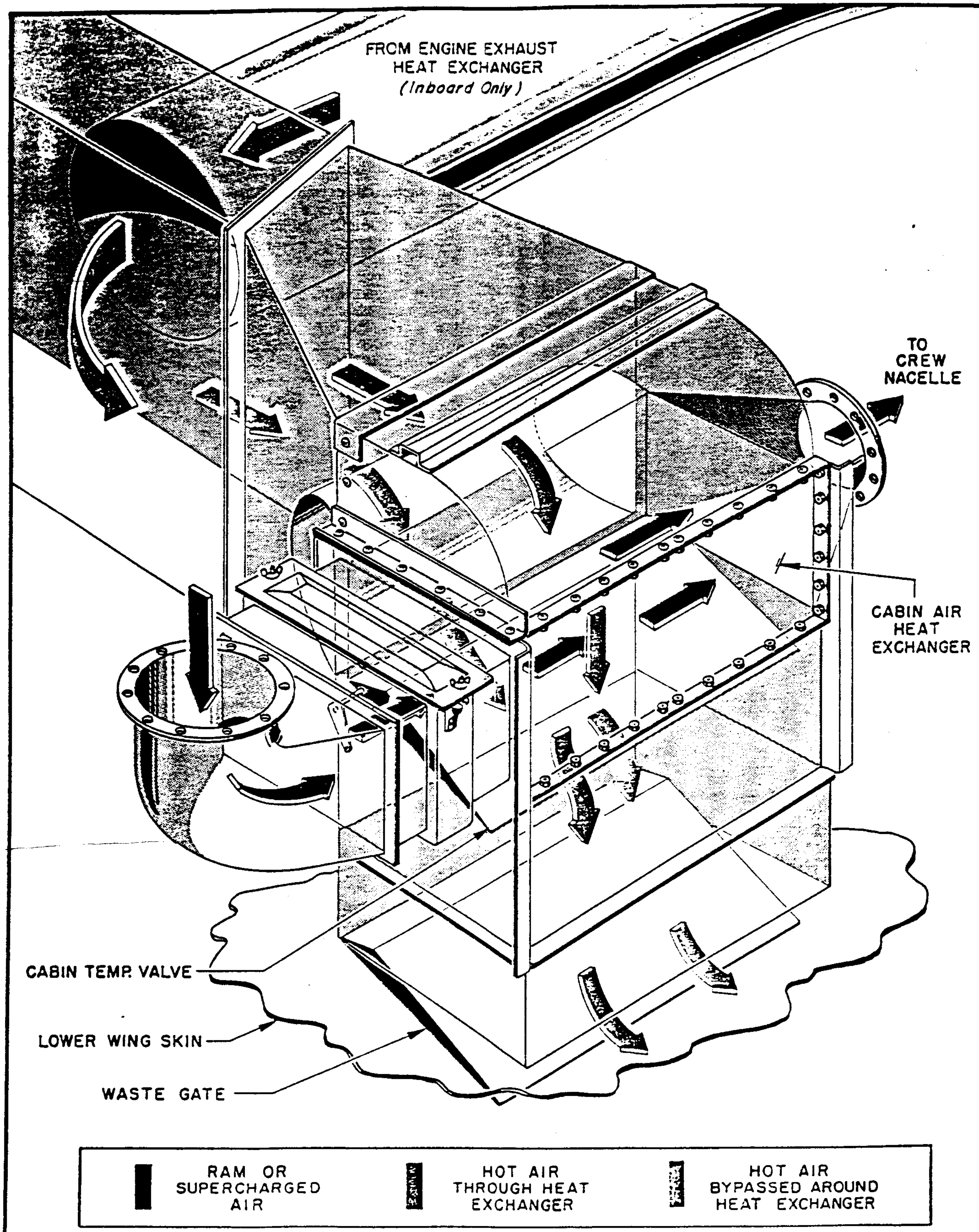


Figure 35. Cabin Heat Exchanger

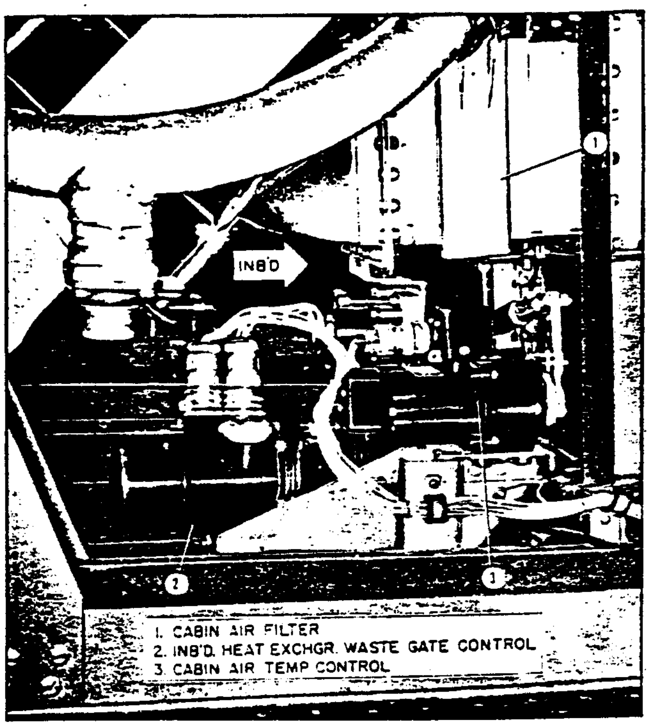


Figure 36. Cabin Air Temperature Control Actuator

(c) REMOVAL.

1. Remove the screws, nuts, and washers that attach the heater to the hood assembly.

2. Remove the screws, nuts, and washers, at each end of heater, which attach the filter holder assembly and the transition assembly.

3. Remove the screws, nuts, and washers, that attach heater to base assembly.

4. Remove the heater from the airplane.

(d) INSTALLATION.

1. Reverse removal procedure, making sure that all gaskets are located in proper places.

(e) ADJUSTMENT.- The cabin heat exchanger is not equipped with parts that require adjustment.

(5) GROUND HEAT. (See figure 37.)

(a) DESCRIPTION.- The ground heat connection is utilized to supply heated air to the crew nacelle while the airplane is parked on the ground. The connection is incorporated in the air duct leading into the cabin, and is located in the left hand inner wing bomb bay number four. Sealing the ground heat inlet is a cover or plate, which can be removed by loosening the two attaching wing nuts.

(6) CABIN AIR CHECK VALVES. (See figure 37.)

(a) DESCRIPTION.- Crew nacelle heating and ventilating ducts leading from the cabin heat exchanger enter the cabin near the top on the left and right sides; one on the left at crew nacelle station 203.5 and the other on the right at crew nacelle station 243.5. The air from each duct is controlled by a check valve installed in the duct. The valve on the left is attached to the ground heat connection and is located outboard of the crew nacelle. The one on the right is located inboard of the crew nacelle. Each valve is actuated by a motor operating on a 115 volt, 400 cycle, single phase power supply, and controlled by an individual two-position switch mounted on the engineer's upper electrical panel. The switch positions are designated "CLOSE" and "OPEN." The operating power is derived from a connection on the engineer's junction panel and wired to both switches, and from the switches the circuit passes through the engineer's junction panel to the respective motors.

(b) OPERATION.- The cabin air check and snut-off valve assembly is designed and installed as an emergency unit to prevent airflow into or out of the cabin depending on the operation. In normal position the valve flap is open permitting air to flow through the duct into the cabin. If the air selector valve or the supercharger becomes inoperative and airflow ceases, the pressure holding the flap open is cut off and the flow of air bleeding back into the duct from the cabin forces the valve flapper to "CLOSED" position thus preventing cabin air from escaping out through the duct. The switch mounted on the engineer's upper electrical control panel is connected to the actuator sub-assembly for manual control of the valve unit. This switch has two limit switches connected in the actuator motor circuit. The limit switches ~~shut the power~~ off from the drive motor when the actuator has moved the flapper to its open or closed position. The drive motor of the actuator is equipped with a magnetic brake which stops the flapper as soon as the power is shut off. Should the engineer desire to shut off the flow of air from the ducts to the cabin, he can close the valve flapper or gate manually. The time required to close the valve from full open position is 15 seconds.

(c) LUBRICATION.- There is no lubrication on this unit. The actuator subassembly is greased at the factory and needs no further lubrication during its service life.

(d) REMOVAL.

1. Disconnect electrical terminals from the assembly.

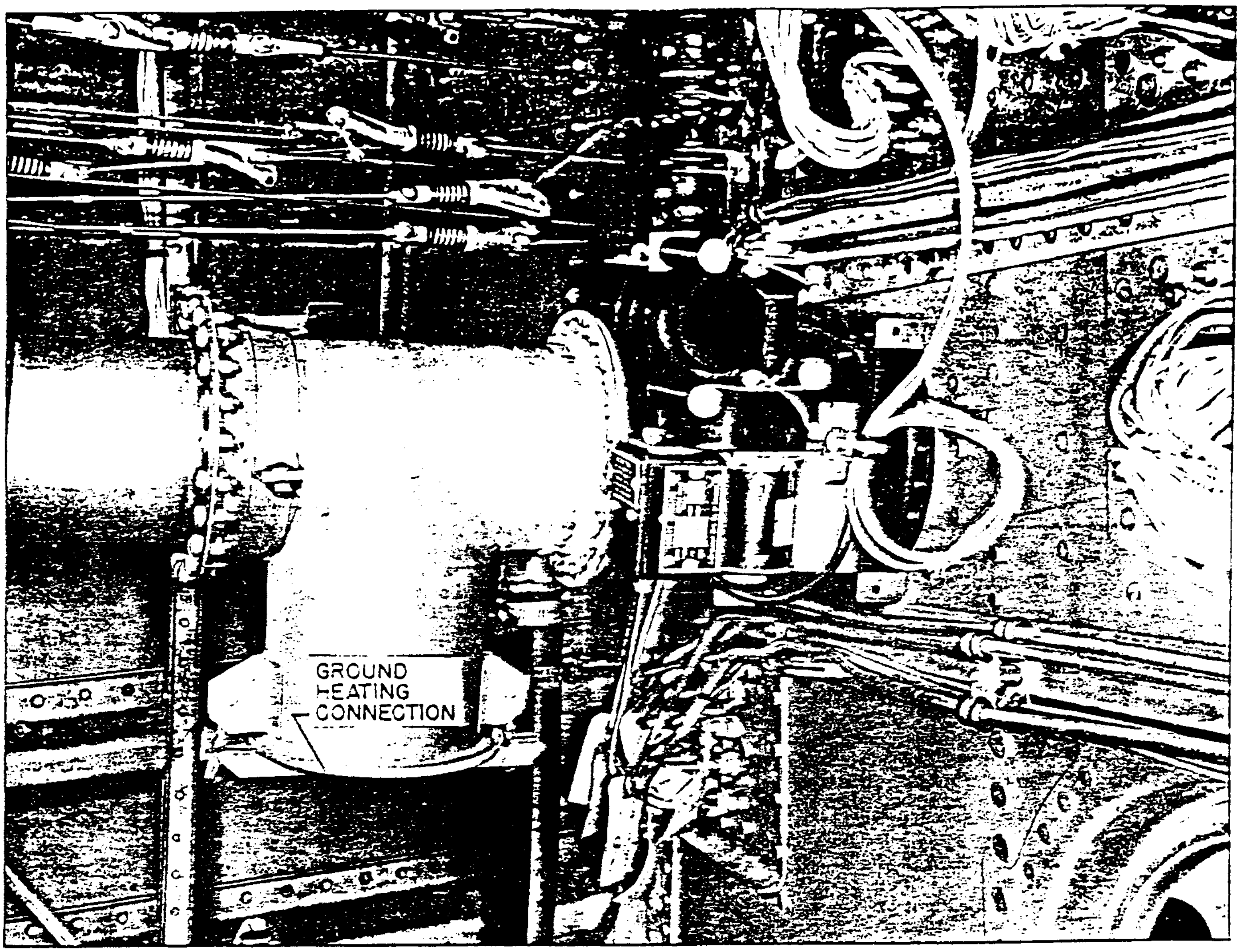


Figure 37. Cabin Air Check Valve and Ground Heat Connection

2. Remove locking wire from screw heads at both ends of valve.

3. Remove the attaching screws and washers.

4. (R.H. side only.) Remove screws, washers and nuts, attaching valve to bracket.

5. Remove valve and gaskets from the duct.

(e) INSTALLATION.

1. Place gaskets in position on each end of valve.

2. Place the valve in position and secure with attaching screws and washers.

3. Safety wire the attaching screws.

4. (R.H. side only.) Secure the valve to supporting bracket with attaching screws, washers and lock nuts.

5. Connect electrical terminals.

(7) HEATED FLYING SUIT CONTROLS. (See figure 38.)

(a) DESCRIPTION.- The pilot, co-pilot, bombardier, navigator, engineer, and radio operator are proved with individual receptacles for the current supply to their heated flying suits. Receptacles are located as follows: Pilot, mounted on brace, R.H. side of pilot's chair. Co-pilot, mounted on panel, left of wheel. Bombardier, mounted on R.H. wall beneath bomb bay switch panel. Navigator, located on R.H. wall, mounted on oxygen regulator panel. Engineer, mounted on wall, beneath table, R.H. side. Radio operator, located over table, L.H. wall, mounted on oxygen regulator panel.

(b) ELECTRICAL CIRCUIT.- Current for the receptacles is picked up from two transformer panel (#854003). Transformer input is 115V. a.c., 400 cycles, single phase; output 30V. a.c., 400 cycles, single phase. From the transformer panel, current is routed to two [illegible] in the [illegible]'s junction panel. The individual receptacles are wired to these [illegible].

ITEM	DESCRIPTION	LOCATION
1	BOMBARDIER'S RHEOSTAT	BOMBARDIER'S STATION
2	NAVIGATOR'S RHEOSTAT	NAVIGATOR'S STATION
3	TRANSFORMER PANEL	ENGINEER'S STATION
4	ENGINEER'S RHEOSTAT	ENGINEER'S STATION
5	RADIO OP. RHEOSTAT	RADIO OP.'S STATION
6	ENGINEER'S JUNC. PANEL	BENEATH ENGINEER'S FLOOR
7	PILOT'S RHEOSTAT	PILOT'S STATION
8	CO-PILOT'S RHEOSTAT	CO-PILOT'S STATION

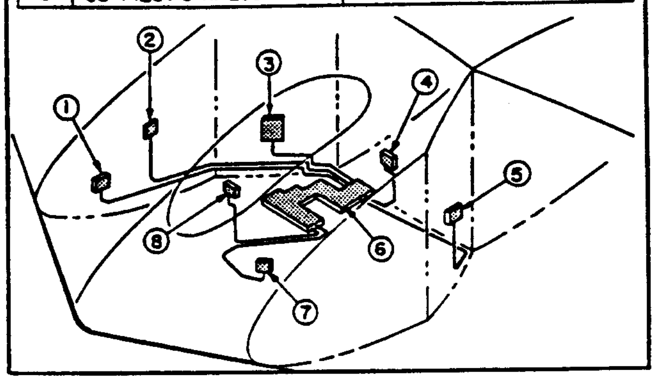


Figure 38. Heated Flying Suit Electrical Diagram

(8) ALTITUDE WARNING SIGNAL.

(a) DESCRIPTION.- Two altitude warning horns which are installed in the crew nacelle at the pilot's and engineer's station operate when air pressure drops below a predetermined pressure. When the cabin pressure drops, a pressure switch energizes the coil of a relay by grounding the circuit, and causes the relay to complete the horn circuits through ground.

(b) ELECTRICAL CIRCUIT.- The alarm system operates on 28 volts d.c. which is picked up in the engineer's upper switch panel (#552722), and routed through a switch type circuit breaker to a post in the engineer's junction panel. The relay coil and one side of both horn circuits are wired to this post. The return wire of the horn circuits is routed back through the engineer's junction panel to thre relay switch box.

d. ANTI-ICER SYSTEM

(1) DESCRIPTION.- Anti-icing systems are designed for the leading edges of both the inner and outer wings, but on this airplane only the systems in the outer wings are used. The anti-icing is accomplished by heating the leading edge of the outer wing through the utilization of heat extracted from the outboard engine exhaust as it passes through the exhaust heat exchanger. The rammed cooling air for the outboard heat exchanger, after picking up heat from the exhaust, is normally directed through respective ducts to wastegates in the lower skin of the wing. (See figure 39.) This duct to the outboard wastegate has a branch duct which connects to a slotted duct that is installed in the leading edge of the outer wing. An electrically operated valve, installed in the entrance to the outer wing duct, permits the heated air from the outboard heat exchanger to be admitted into the duct when icing conditions are encountered. Openings in the lower wing skin provide for the discharge of air after it has passed through the ducts. The anti-icer valve is controlled by a two-position switch, located on the engineer's upper switch panel. The switch positions are designated "OFF" and "ON."

(2) OPERATION.- The valve that permits the flow of heated air to the outer wing anti-icing system is installed within the outer wing anti-icing duct at wing station 400 (figure 39.) This valve is of flapper type and is mounted on a shaft which turns through a 76° angle. The opening and closing of the valve is controlled by an electrically driven valve actuator motor, which is connected to the valve shaft by an adjustable arm. The actuator motor is reversible and operates on 28 volts d.c. which is derived from the same source as the current for the wastegate control. Built-in limit switches control the travel of the actuator. Electrical control of the anti-icer system is picked up through a circuit breaker type switch from a bus in the engineer's upper switch panel. When the switch is in the "ON" position the current energizes the coil of a two-pole, double-throw relay which is installed on the bomb bay No. 1 forward relay panel in the left wing, and another relay of the same type located on the bomb bay No. 8 forward relay panel in the right wing. These relays change the temperature control from the outboard thermal sensitive elements in the heat exchanger ducts to those installed in the leading edges of the outer wings, and also close a 28 volt d.c. circuit to the anti-icer valve actuator motor, causing it to open the valve. When the switch is returned to the "OFF" position, the temperature control is shifted back for normal operation, and another 28 volt d.c. circuit to the anti-icer valve actuator motor is completed, which reverses the motor and closes the valve. (See figure 40.)

(3) TROUBLE SHOOTING.

TROUBLE	PROBABLE CAUSE	REMEDY
Valve fails to operate when electrical contact is made.	Valve flapper binding or sticking.	Clean flapper mounting shaft. If parts are bent or damaged replace valve unit.
	Broken or damaged limit switches in actuator.	Replace limit switches.

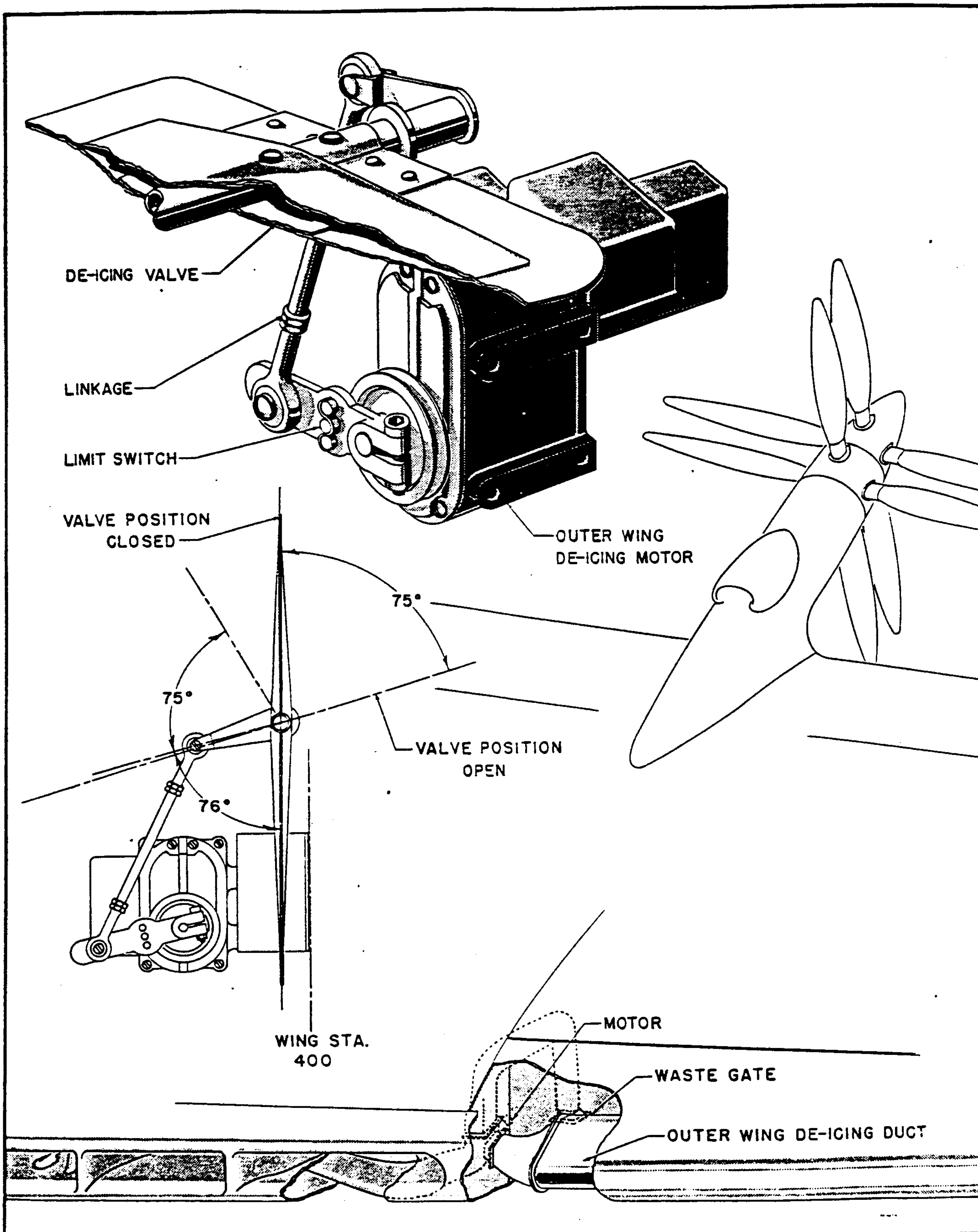


Figure 39. Outboard Wing De-icing Valve

TROUBLE	PROBABLE CAUSE	REMEDY
Valve fails to open or close to full position.	Improper adjustment on arm connecting motor to valve.	Adjust arm so valve will travel to full open or closed position.
	Faulty adjustment on limit switches.	Check limit switches.
Valve operates in one direction only.	Broken or damaged limit switches in actuator.	Replace limit switches.
	Loose connection to motor terminals.	Check wiring.
Valve fails to operate manually.	Burned-out motor on actuator.	Replace actuator.
	Loose connection or open circuit in electrical system.	Check wiring.

(4) REMOVAL OF MOTOR.

(a) The anti-icing valves and actuating motors are accessible through the outboard engine air intake lips. Remove the forward lower, outboard panels, which are held in place with Dzus fasteners.

(b) To remove the actuating motor, disconnect the adjustable connecting arm from the motor by removing the attaching cotter pin, nut, washers and clevis bolt.

(c) Remove attaching lockwire, bolts, and washers, which secure motor to bracket.

(d) Remove motor from airplane.

(5) INSTALLATION OF MOTOR.- Reverse the removal procedure.

(6) REMOVAL OF VALVE.

(a) Remove the screws, washers, and nuts, attaching the portion of duct assembly which is located just inboard of valve. Remove the assembly from duct.

(b) Remove the cotter pin and washers from end of valve shaft.

(c) Remove the six screws, nuts and washers, attaching valve assembly to shaft.

(d) Remove shaft and valve assembly from duct.

(7) INSTALLATION OF VALVE.

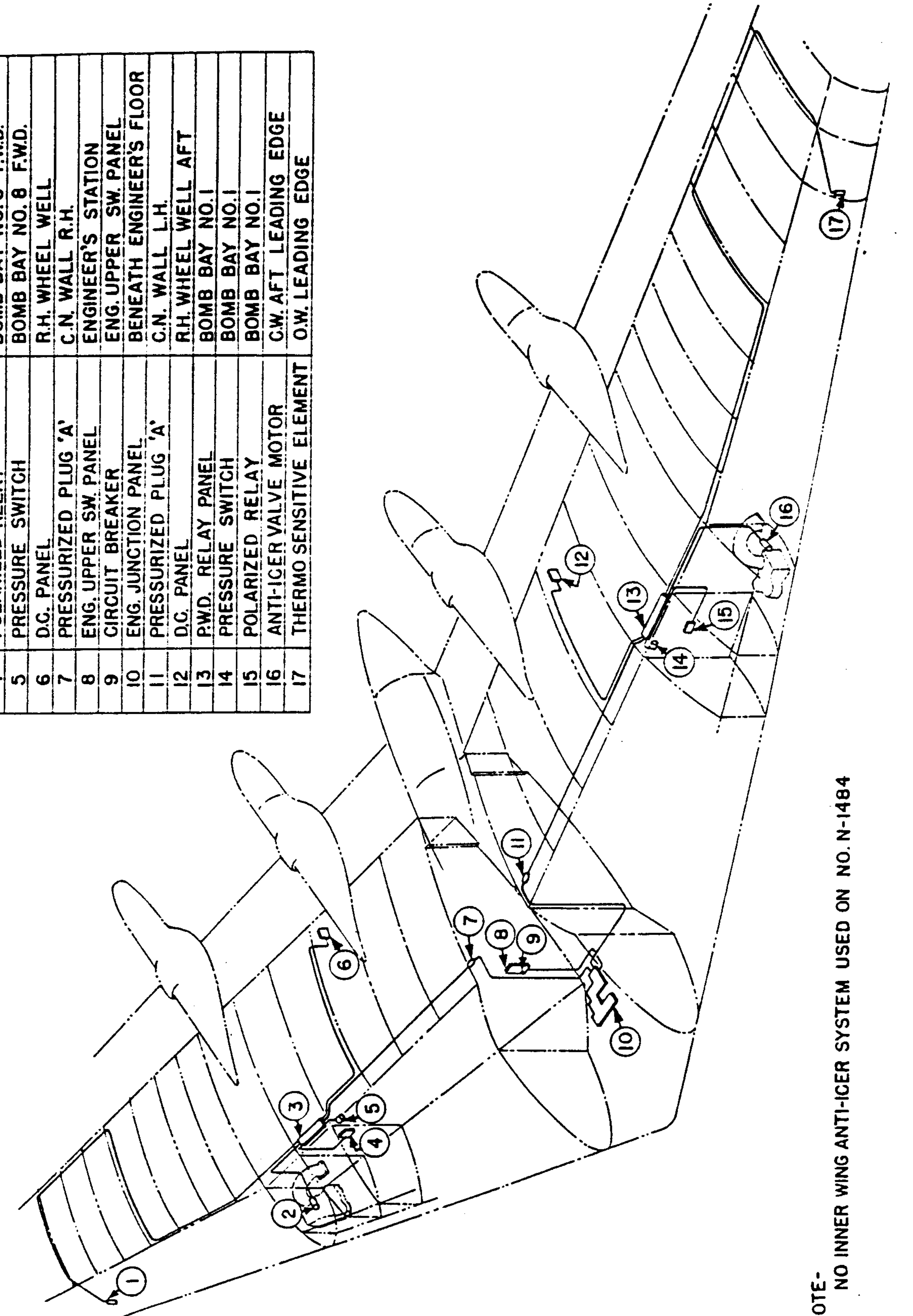
(a) Insert shaft end through opening in duct, slide valve assembly on shaft and attach with the six screws, washers and nuts.

(b) Insert shaft end through opening in opposite side of duct and secure with washer and cotter pin.

(c) Attach adjustable connecting arm to motor.

(d) Adjust arm to operate valve to proper 76° travel.

(e) Replace the portion of duct assembly and secure in place with the attaching screws, washers, and nuts.



ITEM	DESCRIPTION	LOCATION
1	THERMO SENSITIVE ELEMENT	O.W. LEADING EDGE
2	ANTI-ICER VALVE MOTOR	C.W. AFT LEADING EDGE
3	F.W.D. RELAY PANEL	BOMB BAY NO. 8
4	POLARIZED RELAY	BOMB BAY NO. 8 F.W.D.
5	PRESSURE SWITCH	BOMB BAY NO. 8 F.W.D.
6	D.C. PANEL	R.H. WHEEL WELL
7	PRESSURIZED PLUG 'A'	C.N. WALL R.H.
8	ENG. UPPER SW. PANEL	ENGINEER'S STATION
9	CIRCUIT BREAKER	ENG. UPPER SW. PANEL
10	ENG. JUNCTION PANEL	BENEATH ENGINEER'S FLOOR
11	PRESSURIZED PLUG 'A'	C.N. WALL L.H.
12	D.C. PANEL	R.H. WHEEL WELL AFT
13	FWD. RELAY PANEL	BOMB BAY NO. 1
14	PRESSURE SWITCH	BOMB BAY NO. 1
15	POLARIZED RELAY	BOMB BAY NO. 1
16	ANTI-ICER VALVE MOTOR	C.W. AFT LEADING EDGE
17	THERMO SENSITIVE ELEMENT	O.W. LEADING EDGE

NOTE-
NO INNER WING ANTI-ICER SYSTEM USED ON NO. N-1484

Figure 40. Anti-icer System - Electrical

15. FIRE EXTINGUISHER SYSTEMS

15. FIRE EXTINGUISHING SYSTEMS.

a. GENERAL.- There are three fire extinguishing systems in the XB-35 airplane. They are: the engine section fire extinguishing system, the auxiliary power unit fire extinguishing system, and the engine blower throat fire extinguishing system.

b. TROUBLE SHOOTING.

(1) ENGINE SECTION SYSTEM.

TROUBLE	PROBABLE CAUSE	REMEDY
Blown discharge indicator.	Ruptured safety disk on cylinder valve.	Replace cylinder with fully charged one.
Indicator light burning when there is no fire.	Defective wiring between detectors and control panel.	Check wiring for short circuits.
Discharge from safety outlet during charging.	Blown safety disk.	Replace safety disk.
Leakage at valve outlet.	Foreign matter or nick in main check seat.	Renew main check or polish out nicks with fine emery and crocus cloth.
Leakage at cylinder valve pilot check.	Foreign matter or nick in pilot check seat.	Renew pilot check or polish out nicks with fine emery and crocus cloth.
Leakage at safety discharge outlet.	Loose safety disk plug retainer.	Tighten securely.

NOTE

CO_2 cylinders should be further inspected in accordance with T.O. 06-20-3.

(2) BLOWER THROAT SYSTEM.

TROUBLE	PROBABLE CAUSE	REMEDY
Extinguisher cart adapter will not attach to cart hose.	Threads are dirty.	Clean threads.
	Threads are stripped.	Replace necessary parts.
Adapter will not attach to disconnect plug in airplane.	Disconnect plug is dirty.	Clean plug.
	Disconnect plug is damaged.	Replace necessary parts.

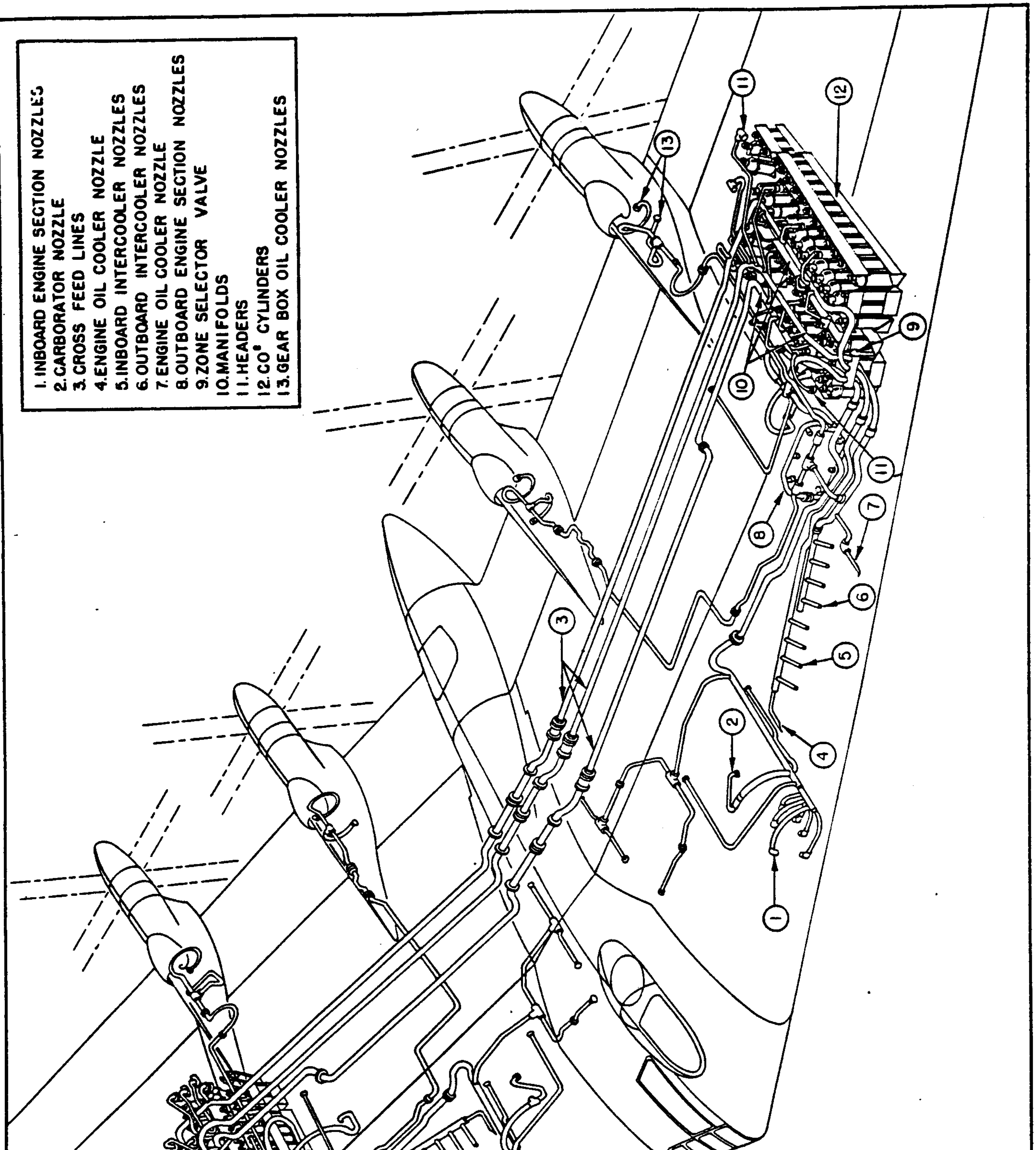


Figure 1. Main Fire Extinguisher System

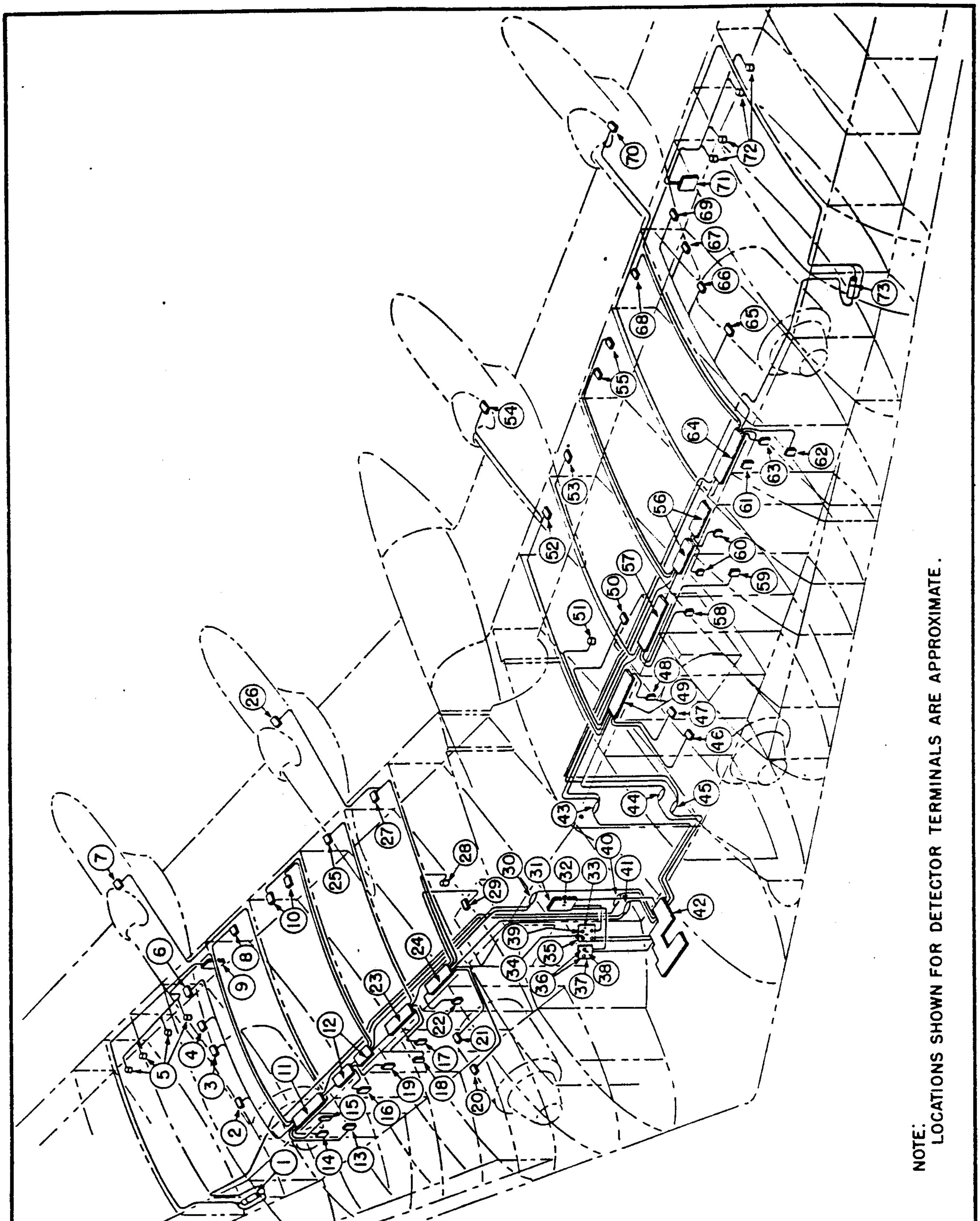


Figure 2. Fire Extinguisher Electrical Diagram (Sheet 1 of 4 Sheets)

ITEM	DESCRIPTION	LOCATION	DWG. NO.
1	Selector Valve	RH Outer Wing	551195-1
2	Terminal-Mount Ring Detectors	No. 4 Engine Compartment	
3	Terminal-Shroud Support Detectors	No. 4 Engine Compartment	
4	Terminal-Aft of Shroud Detectors	No. 4 Engine Compartment	
5	Solenoid Valves Bank "B"	RH Outer Wing	556141
6	Terminal-Air Cooler Exit Detectors	No. 4 Engine Compartment	
7	Terminal-Propeller Gear Box Oil Cooler Detectors	No. 4 Engine Propeller Shaft Housing	
8	Terminal-Rear Spar Detectors	Bomb Bay No. 8	
9	Panel-Aft Relay	No. 4 Engine Compartment	584574
10	Terminal-Rear Spar Detectors	RH Wheel Well	
11	Panel-Forward Relay	Bomb Bay No. 8	584600
12	Panel-Forward Relay	RH Wheel Well	584606
13	Terminal-Outboard Turbo Detectors	RH Plenum Chamber	
14	Terminal-No. 4 Engine Oil Cooler Detector	RH Plenum Chamber	
15	Terminal-Front Spar Detectors	Bomb Bay No. 8	
16	Terminals- Front Spar Detectors	RH Wheel Well	
17	Terminal-No. 3 Engine Oil Cooler Detectors	RH Plenum Chamber	
18	Terminal-Inboard Turbo Detectors	RH Plenum Chamber	
19	Terminal-Front Spar Detectors	RH Wheel Well	
20	Terminal-Mount Ring Detectors	No. 3 Engine Compartment	
21	Terminal-Shroud Support Detectors	No. 3 Engine Compartment	
22	Terminal-Front Spar Dectectors	Bomb Bay No. 6 Forward	
23	Panel-Forward Relay	Bomb Bay No. 7	584604
24	Panel-Forward Relay	Bomb Bay No. 6	584602
25	Terminal-Air Cooler Exit Detectors	Bomb Bay No. 7 Aft	
26	Terminal-Propeller Gear Box Oil Cooler Detectors	No. 3 Engine Propeller Shaft Housing	
27	Terminal-Air Cooler Exit Detectors	Bomb Bay No. 6 Aft	
28	Solenoid Valve-Auxiliary Power Unit	Bomb Bay No. 6	556733
29	Terminal-Auxiliary Power Unit Detectors	Bomb Bay No. 6	

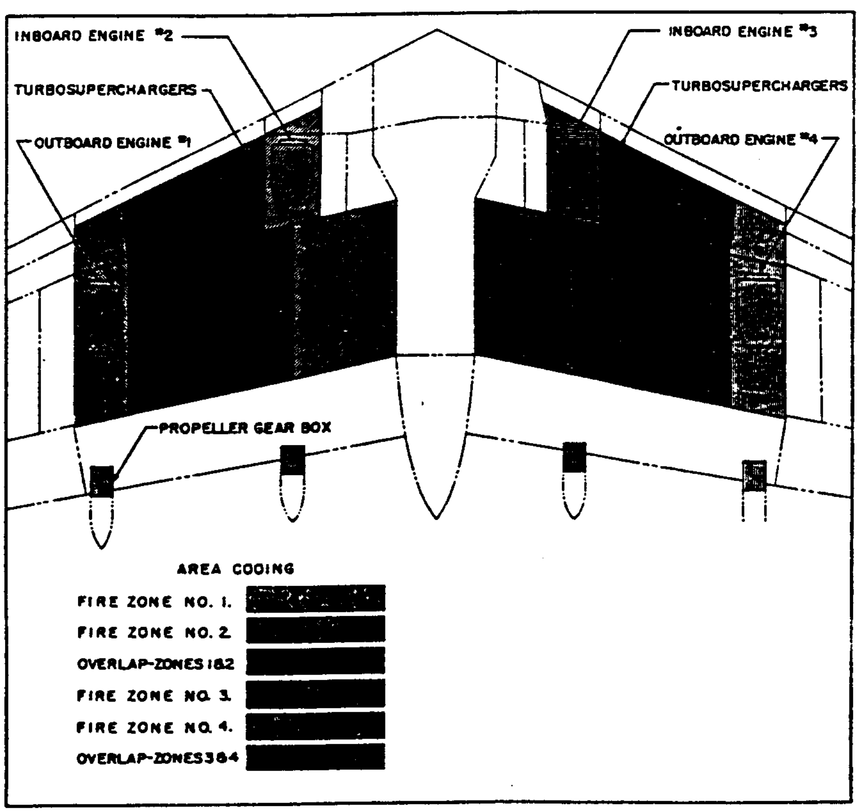
Figure 2. Fire Extinguisher Electrical Diagram (Sheet 2 of 4 Sheets)

ITEM	DESCRIPTION	LOCATION	DWG. NO.
30	Pressurized Plug "B"	RH Crew Nacelle Wall	
31	Engineer's Upper Switch Panel	Engineer's Station	552722
32	Circuit Breakers	Engineer's Upper Switch Panel	552722
33	Discharge Switch	Fire Extinguisher Control Panel	553068
34	Selector Switch	Fire Extinguisher Control Panel	553068
35	Fire Extinguisher Control Panel	Engineer's Station	553068
36	Indicator Lights	Auxiliary Power Unit Fire Control Panel	558244
37	Auxiliary Power Unit Fire Control Panel	Engineer's Station	558244
38	Control Switch	Auxiliary Power Unit Fire Control Panel	558244
39	Indicator Lights	Fire Extinguishing Control Panel	553068
40	Pressurized Plug "C"	RH Crew Nacelle Wall	
41	Pressurized Plug "E"	RH Crew Nacelle Wall	
42	Engineer's Junction Panel	Beneath Engineer's Floor	551144
43	Pressurized Plug "B"	LH Crew Nacelle Wall	
44	Pressurized Plug "E"	LH Crew Nacelle Wall	
45	Pressurized Plug "C"	LH Crew Nacelle Wall	
46	Terminal-Mount Ring Detectors	No. 2 Engine Compartment	
47	Terminal-Shroud Support Detectors	No. 2 Engine Compartment	
48	Terminal-Front Spar Detectors	Bomb Bay No. 3	
49	Panel-Forward Relay	Bomb Bay No. 3	584601
50	Terminal-Auxiliary Power Unit Detectors	Bomb Bay No. 3	
51	Solenoid Valve-Auxiliary Power Unit	Bomb Bay No. 3	556733
52	Terminal-Air Cooler Exit Detectors	Bomb Bay No. 3 Aft	
53	Terminal-Air Cooler Exit Detectors	Bomb Bay No. 2 Aft	
54	Terminal-Propeller Gear Box Oil Cooler Detectors	No. 2 Engine Propeller Shaft Housing	
55	Terminal-Rear Spar Detectors	LH Wheel Well	
56	Panel-Forward Relay	LH Wheel Well	584605
57	Panel-Forward Relay	Bomb Bay No. 2	584603
58	Terminal-No. 2 Engine Oil Cooler Detectors	LH Plenum Chamber	

Figure 2. Fire Extinguisher Electrical Diagram (Sheet 3 of 4 Sheets)

ITEM	DESCRIPTION	LOCATION	DWG. NO.
59	Terminal-Inboard Turbo Detectors	LH Plenum Chamber	
60	Terminal-Front Spar Detectors	LH Wheel Well	
61	Terminal-Front Spar Detectors	Bomb Bay No. 1	
62	Terminal-Outboard Turbo Detectors	LH Plenum Chamber	
63	Terminal-No. 1 Engine Oil Cooler Detectors	LH Plenum Chamber	
64	Panel-Forward Relay	Bomb Bay No. 1	584599
65	Terminal-Mount Ring Detectors	No. 1 Engine Compartment	
66	Terminal-Shroud Support Detectors	No. 1 Engine Compartment	
67	Terminal-Aft of Shroud Detectors	No. 1 Engine Compartment	
68	Terminal-Rear Spar Detectors	Bomb Bay No. 1	
69	Terminal-Air Cooling Exit Detectors	No. 1 Engine Compartment	
70	Terminal-Propeller Gear Box Oil Cooler Detectors	No. 1 Engine Propeller Shaft Housing	
71	Panel-Aft Relay	No. 1 Engine Compartment	584573
72	Solenoid Valves-Bank "A"	LH Outer Wing	556141
73	Selector Valve	LH Outer Wing	551195

Figure 2. Fire Extinguisher Electrical Diagram (Sheet 4 of 4 Sheets)



c. ENGINE SECTION FIRE EXTINGUSHING SYSTEM.

(1) DESCRIPTION. (See figure 1.)- This is a high pressure carbon dioxide system capable of fighting two independent fires before the storage cylinders are exhausted. The system consists of fire detection-indication circuits and an electrically operated discharge control system. For accurate location the airplane is divided into four zones. Each zone includes one of the engines and is numbered accordingly. That is, engine number one is in zone number one, engine two if in zone two, etc.

(2) OPERATION.- When a fire zone indicator light is illuminated, the following steps should be taken:.

(a) Shut off fuel and oil.

(b) Shut off ignition.

(c) Turn zone selector valve until the knob points toward the light.

(d) Hold discharge switch in "FIRST FIRE" position (for first fire) briefly.

(e) When fire is out, light will go out.

(f) Do not start engine again until trouble has been corrected.

(3) DETECTOR AND INDICATOR CIRCUITS.

(a) OPERATION.- Whenever one of the approximately seventy Fenwall #S2237 fire detectors in any zone is heated above 350°F, the circuit is grounded and the light corresponding to the zone in which the fire takes place is lighted on the flight engineer's fire extinguisher control panel. Thus the light is both an alarm and a locator of the fire.

(b) ELECTRICAL. (See figure 2.)

1. The fire detectors in zone one are wired to the bomb bay number one forward relay panel and the left hand wheel well forward relay panel.

2. The fire detectors in zone two are wired to the bomb bay number two forward relay panel, bomb bay number three forward relay panel, and the left hand wheel well forward relay panel.

3. The fire detectors in zone three are wired to the right hand wheel well forward relay panel, bomb bay number six forward relay panel, and bomb bay number seven forward relay panel.

4. The fire detectors in zone four are wired to the right hand wheel well forward relay panel and bomb bay number eight forward relay panel.

5. From the relay panels the fire detection circuits are wired to the zone indicator lights on the flight engineer's fire extinguisher control panel through the engineer's junction panel. Current to operate the circuits is picked up in the engineer's junction panel and wired to the indicators through a switch type circuit breaker in the flight engineer's upper switch panel

(c) NUMBER AND LOCATIONS OF FIRE DETECTORS. (See figure 3.)

ZONE	NO. REQ.	WHERE ATTACHED
	3	Engine Number One Oil Cooler
	8	" " " Exhaust Collector Supports
	7	" " " Cooling Air Exit
1	2	" " " Propeller Gear Box Oil Cooler
	4	Aft of Outboard Turbosuperchargers
	12	Aft of Engine Number One Exhaust Collector Shroud
	10	Rear Spar in Plenum Chamber Air Exit Area
	9	Front Spar in Plenum Chamber Area
	4	Aft of Inboard Turbosuperchargers
	8	Engine Number Two Mounting Ring
	3	" " " Oil Cooler
2	7	" " " Exhaust Collector Shroud Supports
	2	" " " Propeller Gear Box Oil Cooler
	4	Front Spar in Plenum Chamber Area
	26	Front Spar
	15	Rear Spar
	26	Front Spar
	12	Rear Spar
	4	Front Spar in Plenum Chamber Area
3	3	Rear Spar in Plenum Chamber Air Exit Area
	4	Inboard of Turbosuperchargers
	3	Engine Number Three Oil Cooler
	2	" " " Propeller Gear Box Oil Cooler
	8	" " " Mounting Ring
	7	" " " Exhaust Collector Shroud Support
	20	Front Spar at Plenum Chamber Area
	10	Rear Spar at Plenum Chamber Air Exit Area
	2	Engine Number Four Propeller Gear Box Oil Cooler
4	3	" " " Oil Cooler
	8	" " " Exhaust Collector Shroud Supports
	10	" " " Exhaust Collector Shroud
	8	" " " Mounting Ring
	7	" " " Cooling Air Exit

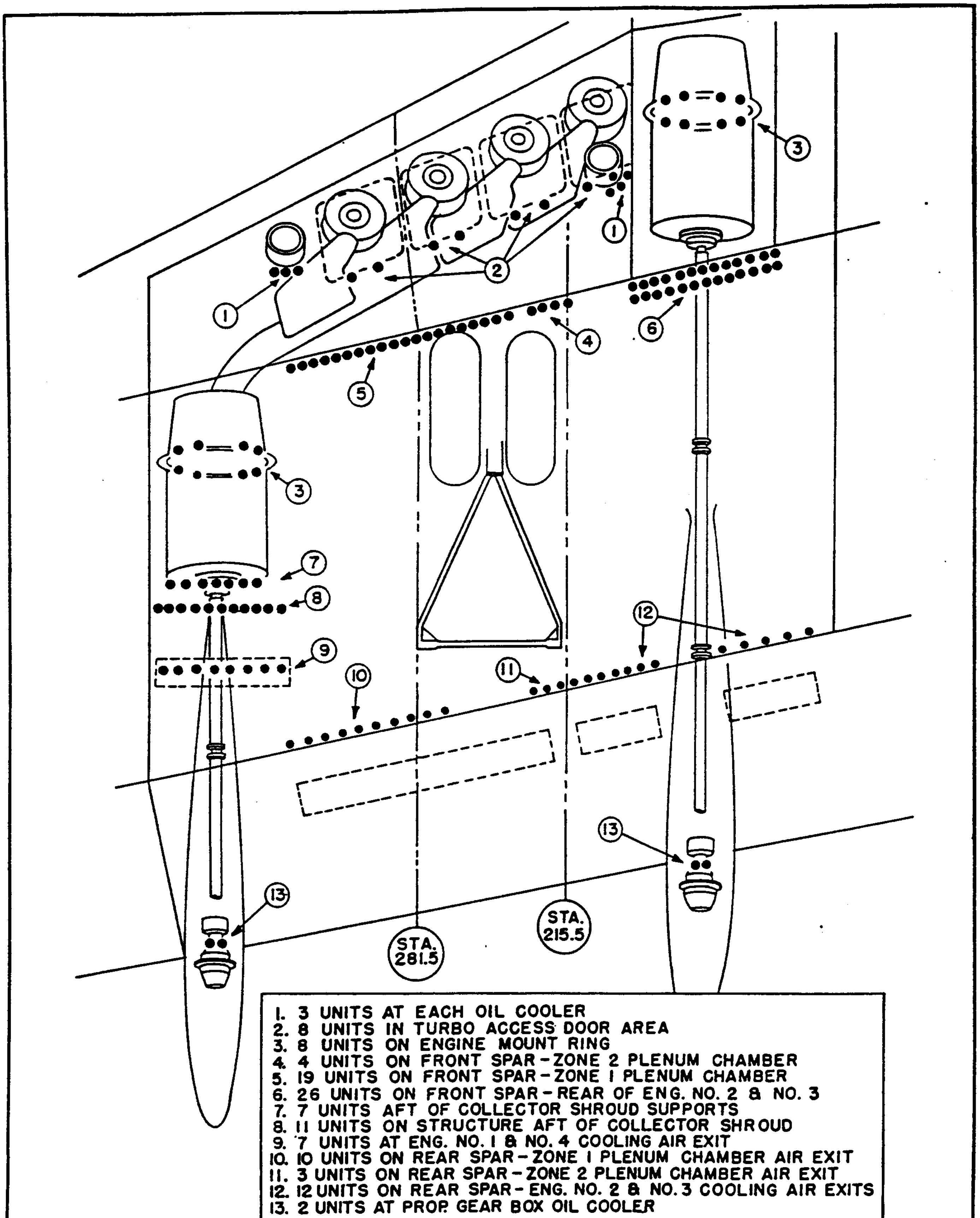


Figure 3. Engine Section Fire Detectors

(d) TEST.

1. Test the indicator light bulbs by pressing firmly with the finger on each light as per the instructions on the control panel.

2. Remove and test all fire detectors in any zone in which a fire has taken place. Those detectors that do not operate at 350°F ± 2° should be replaced by new ones.

CAUTION

Test indicator light bulbs before each flight. The shape of the airplane is such that visual detection of fire in the engine is impossible.

(4) DISCHARGE CONTROLS. (See figure 4.)

(a) ELECTRICAL.- The electrical controls consists of a five-position zone selector switch and a three position (normally off) discharge switch, both mounted in the fire extinguisher control panel; and zone selector valves, solenoid valves, and relays. When a fire zone indicator light is illuminated, the fire zone selector switch (which receives its operating current from the discharge switch) is rotated until the knob points toward that light. The discharge switch is then held in the "FIRST FIRE" position. 28 volt, direct current from a switch type circuit breaker in the engineer's upper switch panel passes successively through the discharge switch, the zone selector switch, the engineer's junction panel, the zone selector valve, and then goes to a reversing relay in the outboard engine compartment relay panel. The relay then closes the power circuit to operate the valve motor. When the motor has turned the valve into the correct position for discharging CO_2 into the zone selected, the control circuit to the relay is broken by a switch in the valve assembly. At the same time the relay circuit is broken, the valve assembly switch closes a circuit to the discharge solenoid valves by engaging two relays in the flight engineer's fire extinguisher control panel. This opens the solenoid valves on one bank of CO_2 cylinders. The function of the electrical circuits for a second fire is the same as the first fire, except that the discharge switch is held in the "SECOND FIRE" position and the discharge circuit is routed to the solenoid valves for the other bank of CO_2 cylinders.

(b) MOTOR OPERATED VALVES. (See figure 5.)

1. DESCRIPTION.- One motor operated multiple CO_2 valve is located in each wing. They consist of a 208 volt, 3 phase 400 cycle, alternating current motor with integral brake, cam operated switch assembly, and valve. When a zone is selected by the zone selector switch and the discharge switch is held on, 28 volt d.c. current is supplied through the proper switch in the valve assembly to the reversing relay. The relay applies 208v. a.c. current to the motor and brake. The brake (normally on) is held off and the motor turns the valve. When the valve has turned to the proper point for the zone selected, a cam opens the switch and the relay is opened. This shuts off the motor and applies the brake.

2. REMOVAL.

a. Disconnect all lines to the valve.

b. Disconnect all wiring at the AN753 disconnect points at the valve and the plug at the motor.

c. Remove the eight AN4 bolts holding the valve to the airplane. Remove the valve.

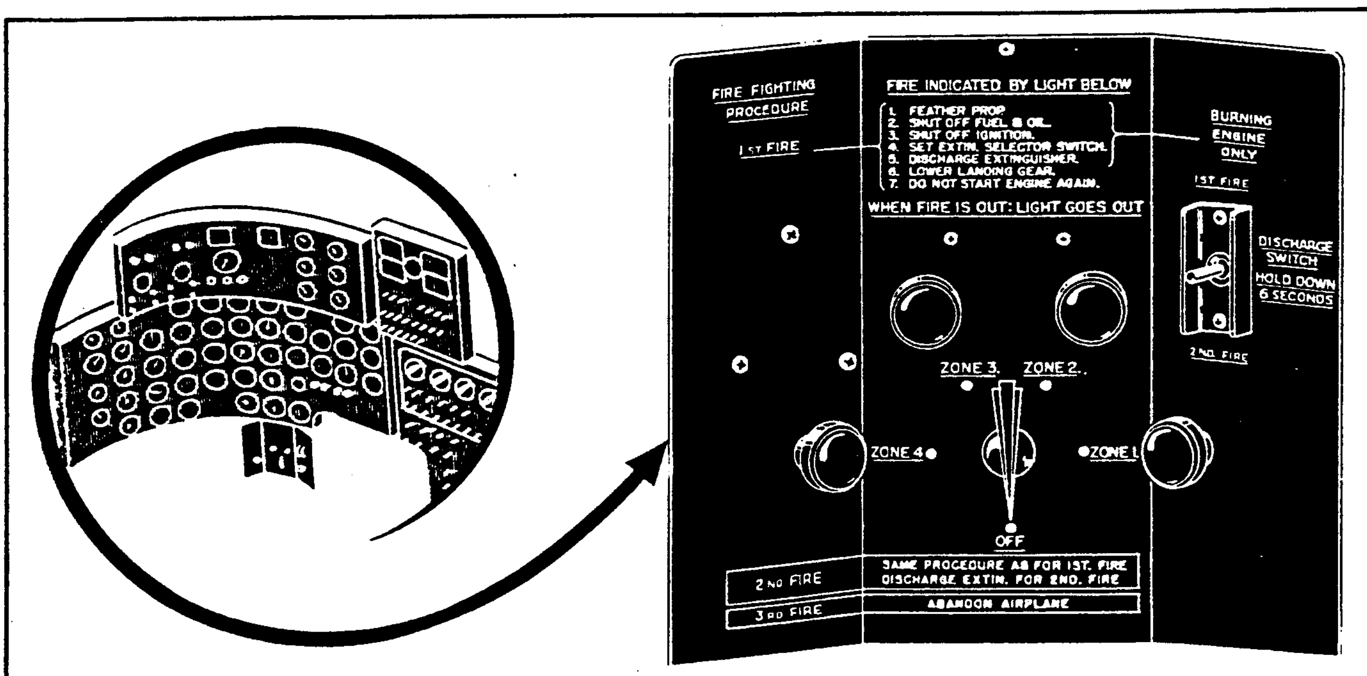


Figure 4. Engine Section Fire Control Panel

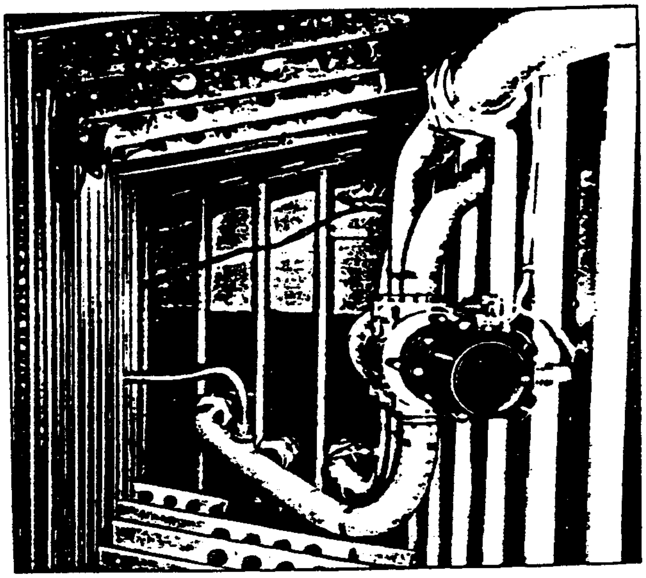


Figure 5. Multiple CO_2 Valve Installed

3. DISASSEMBLY. (See figure 6.)

a. Locate the position of the rotor in relation to the position of the cam to assure proper operation when the valve is re-assembled.

b. Remove the sixteen AN4 bolts holding the motor assembly to the valve. Remove the motor.

c. Remove the four AN515 screws holding the dust cover over the switches. Remove the dust cover.

d. Remove the nut and washer on the end of the cam drive shaft.

e. Loosen the set screw holding the cam in place.

f. Remove the sixteen AN4 bolts holding the end plate to the valve. Remove the end plate including switches. Remove the cam at the same time. No further disassembly of the switch section is normally necessary.

g. Work the rotor assembly out of the housing being careful not to damage the bearings.

h. Remove the bearings and packings.

4. ASSEMBLY. (See figure 6.)

a. Place the rotor in the housing.

b. Work the bearings into place.

c. Put new packing in place. Never re-use packing that has been removed.

d. Put the end plate and cam on simultaneously to avoid disrupting the position of the switches. Install the washer on the shaft between the cam and the outer switch bracket before tightening the sixteen AN4 bolts holding the end plate in position.

e. Adjust the cam to the proper position in relation to the position of the rotor. Tighten the set screw to hold the cam in position.

f. Check the location of the switches to see that they are in the correct position in relation to the cam. If necessary loosen the screws holding the switch brackets to the end plate and move the brackets slightly to align the switches. Tighten the bracket screws.

g. Install the washer and nut on the end of the cam drive shaft.

h. Put the motor assembly in place and fasten the sixteen AN4 bolts.

i. Bench test the valve.

j. Place the dust cover over the switches and fasten the four AN515 screws.

5. TEST.- Apply a power source of 208 volt, 400 cycle, 3 phase, alternating current to the motor through a 28 volt d.c. relay. Operate the relay by feeding current through each of the switches in turn. Check the alignment of the valve each time to make sure that it has stopped in the right position. If the valve is off, adjust the switches as per paragraph 15 c (4) (b) 4 f above.

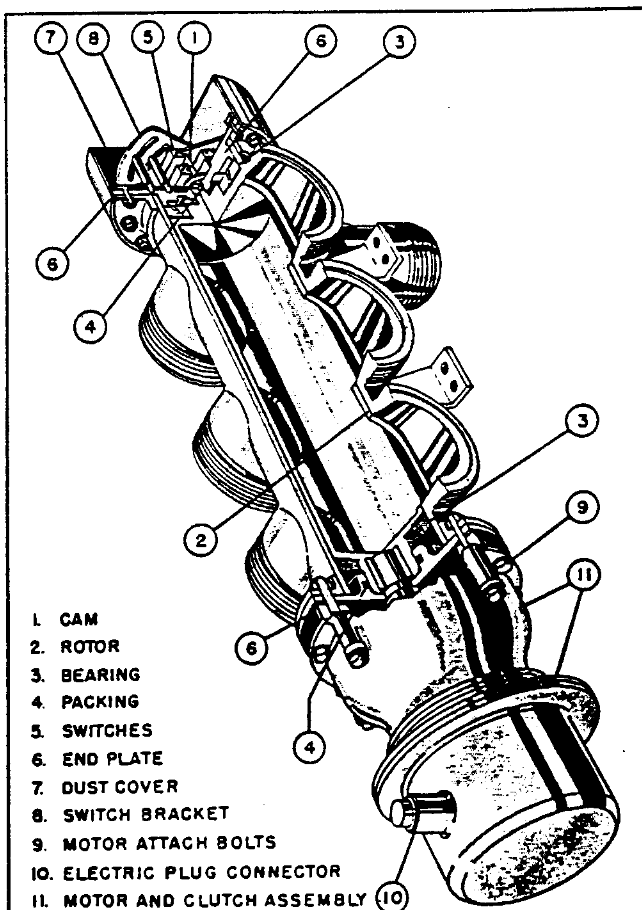


Figure 6. Multiple CO_2 Valve Cutaway

6. INSTALLATION. (See figure 5.)

a. Position the valve in the airplane and install the eight AN4 bolts holding it in place.

b. Connect the wiring at the disconnect points making sure that the wires are properly matched. Connect the power supply plug to the motor.

c. Connect all lines.

(c) SOLENOIDS.- The solenoids act through interconnectors to open the cylinder valves to which they are attached. The pressure thus released is used through the interconnectors and boosters to open the rest of the valves.

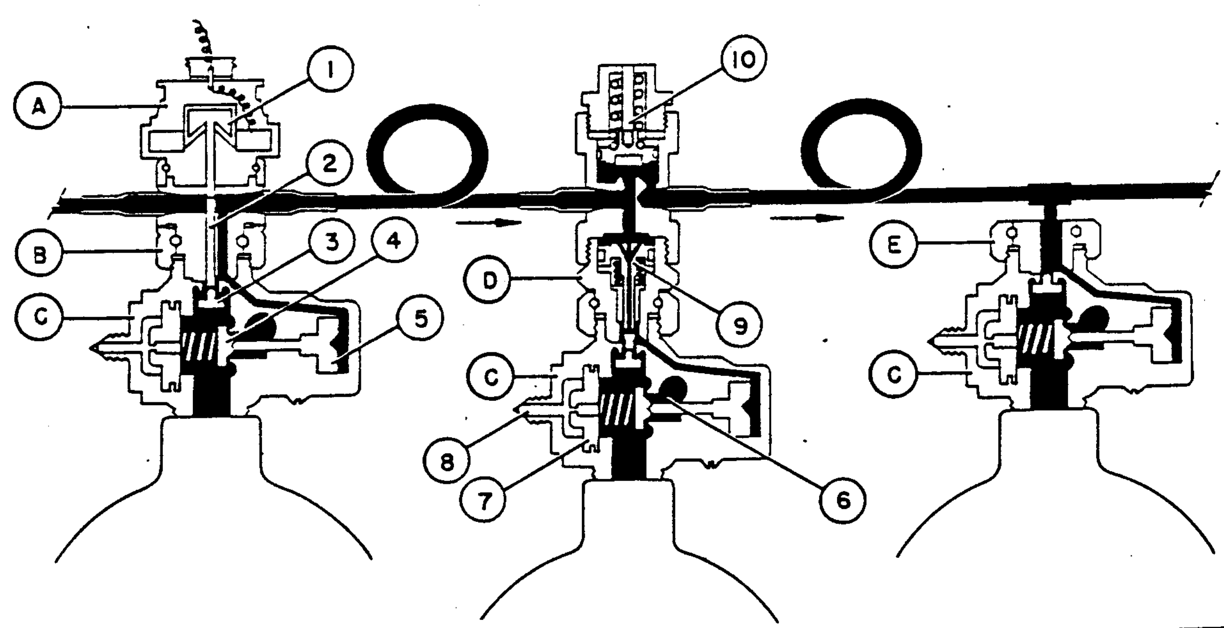
(d) DISCHARGE UNITS.

1. DESCRIPTION.- The discharge units are made up of cylinder assemblies, interconnectors, boosters, lines, headers, and miscellaneious fittings. There are four discharge units in each wing. They connect with manifolds leading to the zone selector valves. The four units in the left wing discharge for the first fire. The units in the right wing discharge for the second fire.

2. OPERATION. (See figure 7.)- Each discharge unit of approximately 15 cylinders is controlled by one solenoid head with interconnector, and two boosters. The plunger of the solenoid depresses the plunger of the interconnector, which in turn unseats the pilot check in the cylinder valve. Unseating the pilot check permits a small portion of CO_2 to be diverted against the piston of the main check, opening it and discharging the cylinder. Some of the gas passed by the pilot check is diverted to the interconnectors and out through the tubing to the boosters. The gas depresses a piston in the booster to unseat the pilot check of the cylinder valve to which it is attached. The combined pressures from the pilot checks of the two booster controlled cylinders and the solenoid controlled cylinder force open spring loaded valves to reach the pressure control heads on the rest of the cylinder. The pressure heads conduct the gases directly to the pistons of the main checks. The use of boosters permits almost simultaneous discharge of a majority of the cylinders.

3. CYLINDERS.

a. DESCRIPTION.- Each cylinder assembly consists of cylinder, syphon tube, and cylinder valve. Each steel, 45 pound (full) cylinder is charged with 15 pounds of carbon dioxide at 1800 psi and a temperature of 70°F (21.1°C). A safety disk in the cylinder valve ruptures and releases the gas to the outer air whenever the temperature of the cylinder increases the pressure to the danger point (see figure 8).



(A) SOLENOID CONTROL HEAD 1. SOLENOID PLUNGER (B) INTERCONNECTOR 2. INTERCONNECTOR PLUNGER	(C) CYLINDER VALVE 3. PILOT CHECK 6. DISCHARGE OUTLET 4. MAIN CHECK 7. SAFETY DISC 5. PISTON 8. BLOWOUT FITTING	(D) BOOSTER 9. BOOSTER PISTON 10. SPRING VALVE (E) PRESSURE CONTROL HEAD

Figure 7. Operation Of Discharge Units

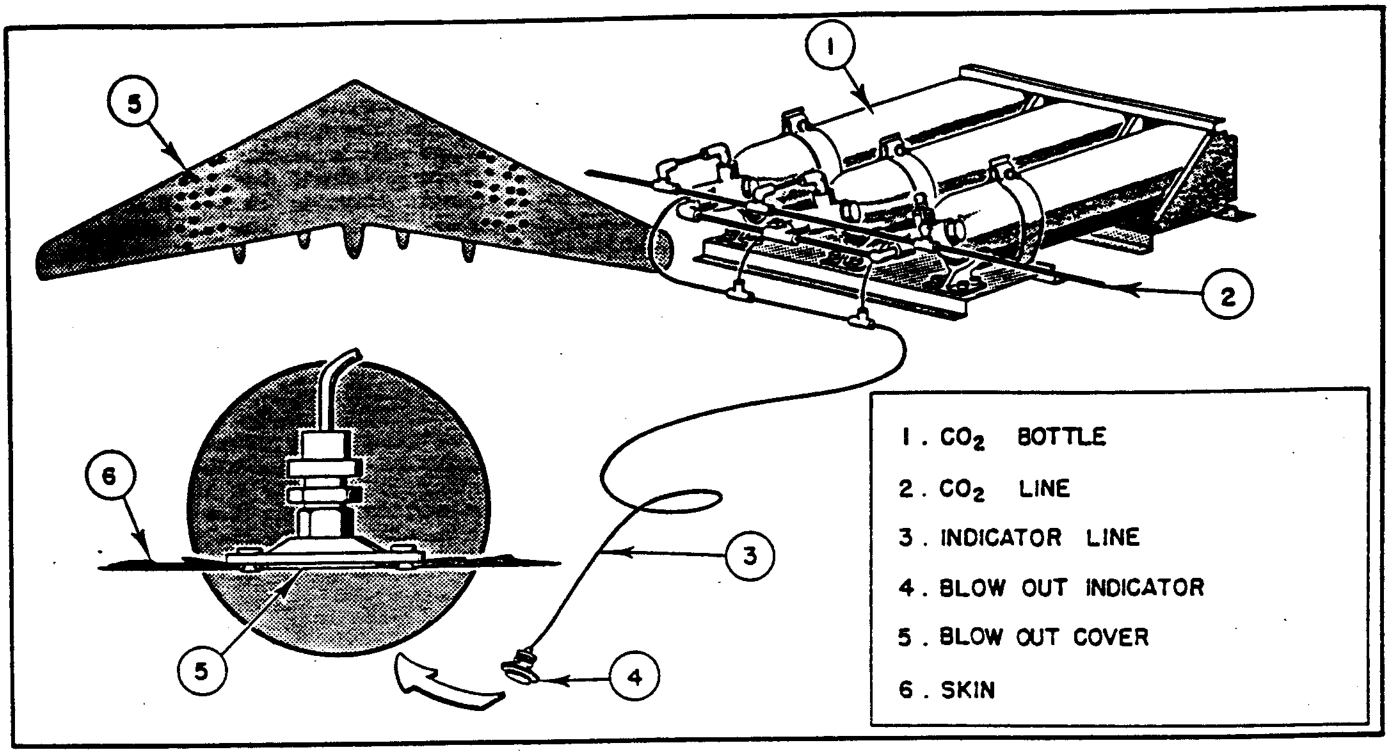


Figure 8. Location Of Blow Out Indicators

b. MAINTENANCE.

1. Keep the cylinders painted to prevent rusting. These cylinders are made of steel and depend entirely on the protective coating of paint for their preservation.

2. Handle carbon dioxide cylinders carefully during installation and dismantling. Do not drop them. For although they are made of steel, they may become dented and thereby lose some of their strength.

c. REMOVAL OF CYLINDERS.

CAUTION

Follow instructions carefully when removing cylinders for weighing or recharging. Loss of gas and injury to personnel may result from carelessness. Always remove control heads first and replace last.

1. Disconnect the pressure control heads, the interconnectors with attached solenoid control heads, and the boosters. Support each unit above its cylinder until all of the cylinders are free. Then, keeping the units and their connecting tubing in their normal relationship, lift them entirely free of the cylinders.

2. Remove the discharge hose from the cylinder valve main outlet. Disconnect the safety discharge tubing from the outboard coupling of each cylinder valve. Support all of this tubing in its normal position as much as possible

3. Each of the cylinders is held in place by two bolts which press it downward into a bracket and by a strap that prevents any side motion. To remove a cylinder, loosen the two bolts and unfasten the strap. Lift the cylinder out.

d. RECHARGING CYLINDERS.- Recharging should be done only by authorized personnel at a regular base with standard equipment. Charge with 15 pounds of CO_2 at 1800 psi to make a total weight of 45 pounds. Do not reuse any badly dented or deeply scratched cylinders.

CAUTION

Cylinders must be recharged with completely dry carbon dioxide only. Any moisture will freeze in the tubes and valves at the extreme cold of high altitudes, possibly rendering the extinguisher inoperative.

e. TEST.- Test the cylinder and valve for leakage before installing on airplane.

1. Place the valve outlet <u>only</u> into a small cup of water.

2. Tilt the cylinder so that the side hole in the control head outlet is above the center hole (pilot check stem hole).

WARNING

Place enough water in the control head to cover the center hole only. Do not allow any of the water to enter the side hole.

Water trapped in the control head will freeze at high altitudes and possible prevent the proper functioning of the extinguisher.

3. Remove all water, wiping dry with suitable absorbent material.

4. Check the weight of the cylinder against the weight printed on the cylinder.

f. LUBRICATION.- No lubrication of any sort is necessary.

g. INSTALLATION OF CYLINDERS.

1. Set the cylinder in the bracket and fasten the strap in place loosely to allow for adjustments when connecting the tubing.

2. Connect the safety discharge tubing to the overboard couplings. Connect the main hose to the cylinder valve main discharge outlet.

3. Check the solenoid control heads by selecting any zone with the zone selector switch and holding the discharge switch on. Make sure that the discharge switch is held in the "FIRST FIRE" position for the bank of cylinders in the left wing and in the "SECOND FIRE" position for the cylinders in the right wing. Do not fail to disconnect all of the solenoids in both banks of cylinders before making the test.

4. Put the pressure control heads, the interconnectors with attached solenoid control heads, and the boosters in place on the cylinder valve and tighten.

5. Seat the cylinder in its bracket. Tighten the strap and hold-down bolts.

WARNING

This is a high pressure system (1800 psi). Do not attempt to remove the cylinder valve from the cylinder or disassemble the valve while still on the cylinder without first making sure that no pressure remains. A freely moving pilot check indicates absence of pressure.

(5) TEST OF ENGINE FIRE EXTINGUISHING SYSTEM.- A test of the complete system will be made at the end of each 500 hours, six months, or whenever it is considered necessary. Both banks of cylinders should be discharged by to different zones. A record of the zones used will allow the other two to be selected the next time a test is made.

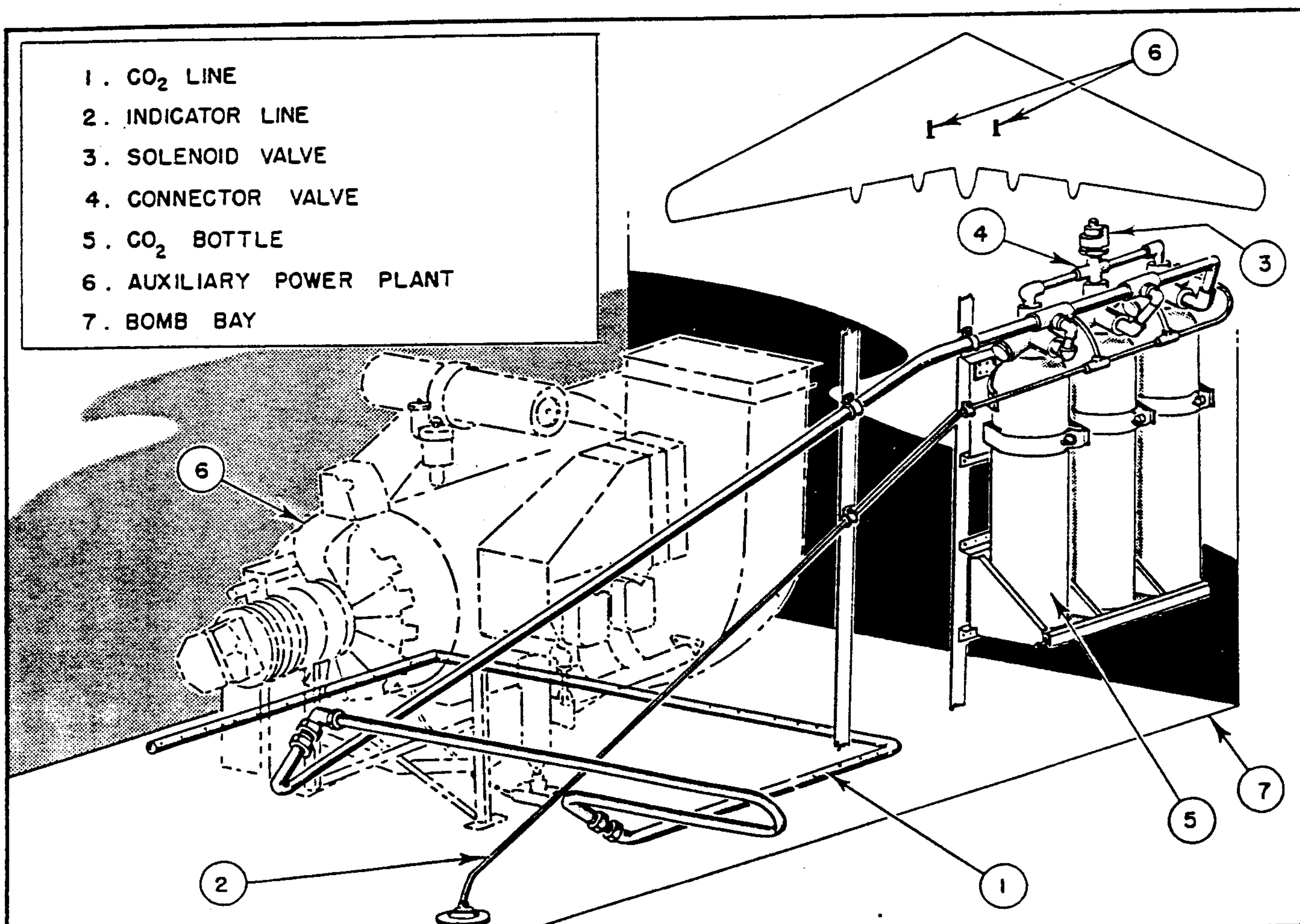


Figure 9. A.P.U. Fire Extinguisher System

Connect external power sources of 28 volts d.c. and 208 volts, 400 cycles, 3 phase a.c. when making the test. At the time of operation a man should watch the discharge to check for efficient distribution of the CO_2 gas about the engine selected. Due to the sudden, sharp cooling, frost will usually form on the discharge nozzles. Those without frost or with noticeably lighter coatings should be checked for stoppage. Upon completion of the test replace the empty CO_2 bottles with full ones and restore the system to its operating condition.

CAUTION

Air in large quantities should be supplied at all times to anyone working on the cylinders. Carbon dioxide is not toxic but will drive away the air and suffocate a person. Anyone checking discharge should wear an oxygen mask or take similar precautions if it is not practical to supply him with air.

d. AUXILIARY POWER UNIT FIRE EXTINGUISHING SYSTEM.

(1) DESCRIPTION. (See figure 9.)- The auxiliary power units are provided with a separate fire detection and fire control system. One fire may be taken care of in each A.P.U. complartment by the three 1800 psi carbon dioxide cylinders installed there.

(2) OPERATION.- When an indicator light shows a fire in either of the A.P.U. compartments, the following steps should be taken:

(a) Throw the paralleling switch of the A.P.U. at which the fire is indicated to "RELEASE." Throw the exciter field parallel switch to "NON PARALLEL."

(b) Turn off the A.P.U.

(c) Hold the discharge switch on briefly in the direction of whichever indicator light is illuminated.

(d) When the fire is out the light will go out.

(e) Do not start A.P.U. again until trouble has been corrected.

(3) TROUBLE SHOOTING.- Trouble shooting problems are the same as indicated in paragraphs 15b and 15 c (4) (d) 3 h.

(4) A.P.U. DETECTOR AND INDICATOR CIRCUITS.

(a) OPERATION.- The operation of these circuits is similar to that of the main fire detector circuits. When any of the four detectors in either of the A.P.U. compartments is over-heated, it grounds a circuit and illuminates a light on the flight engineer's A.P.U. fire extinguisher control panel.

(b) ELECTRICAL. (See figure 10.)- The fire detectors are wired to the control panel through bomb bay #3 or bomb bay #6 forward relay panel and the engineer's junction panel.

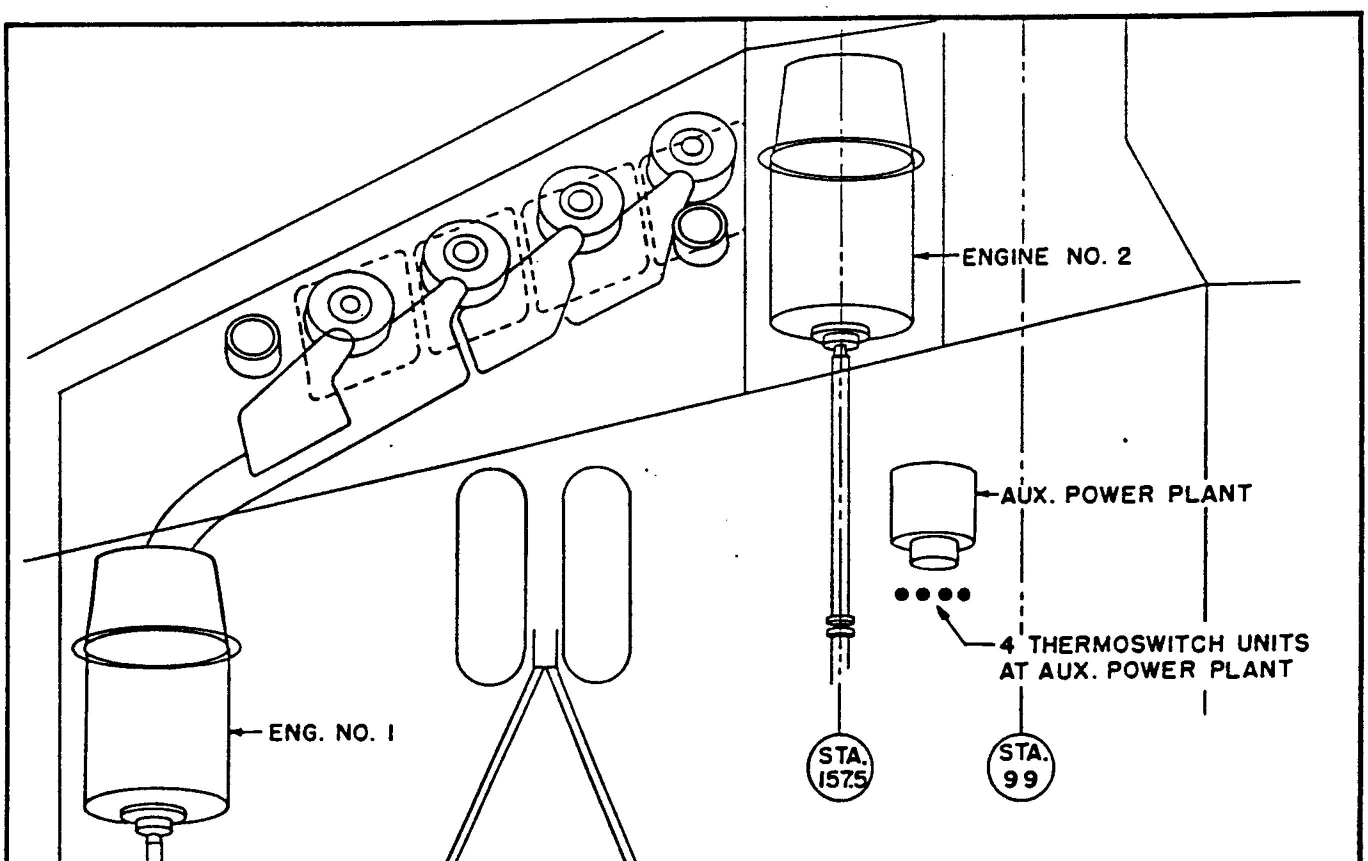


Figure 10. A.P.U. Fire Detectors

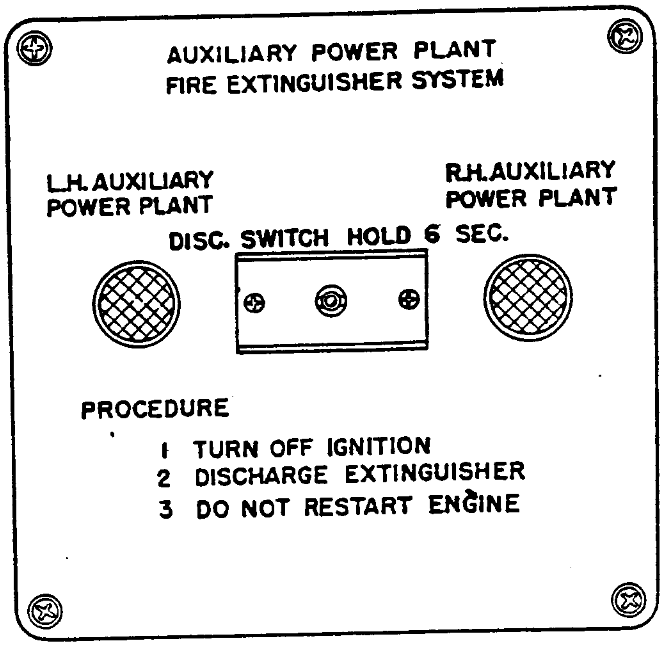


Figure 11. A.P.U. Fire Control Panel

(5) DISCHARGE CONTROLS. (See figure 11.)

(a) OPERATION.- A three position electrical switch (normally off) on the engineer's A.P.U. fire control panel controls the discharge of the cylinders through a solenoid valve. Holding the switch to the left turns on the extinguisher for the left hand A.P.U. The right hand position does the same for the right hand A.P.U. The same switch-type circuit breaker in the engineer's upper switch panel supplies both the indicators and the discharge controls. Current passes from the discharge switch through the engineer's junction panel and the #3 or #6 bomb bay forward relay panel to the solenoid. The solenoid operates through an interconnector to open the pilot check. CO_2 gas released by the pilot check operates a piston to open the main check. At the same time, some of the gas released by the pilot check is directed by the interconnector to the pressure control heads of the other cylinders and opens their main checks. From the cylinders the gas is directed into a common line leading directly to the A.P.U. There is one blowout indicator for each group. Each cylinder weights 18.8 pounds when filled with a charge of 7.25 pounds of CO_2.

(b) TROUBLE SHOOTING.- Trouble shooting problems are the same as indicated in paragraph 15 c (4) (d) 3 h.

(c) MAINTENANCE.- Maintenance, removal, installation, lubrication, etc., are the same as indicated in paragraphs 15 c (4) (d) 3 b, c, d, e, f, and g. All warnings, notes, cautions, etc., for the main extinguishing system should be observed for the A.P.U. fire extinguishing system also.

(d) TEST FOR AUXILIARY POWER UNIT FIRE EXTINGUISHER.- A discharge test of the system should be run in conjunction with the 500 hour or six month test of the main extinguishing system. The nozzles should be observed for stoppages, etc., at that time and all precautions taken as indicated in paragraph 15 c (5).

e. ENGINE BLOWER THROAT FIRE EXTINGUISHING SYSTEM.

(1) GENERAL. (See figure 12.)- For maximum protection when starting an engine this system adapts a cart type ground fire extinguisher to discharge directly into the engine blower throat.

(2) INSTALLATION OF ADAPTER.- Remove discharge horn from Kidde Model #50 wheeled type fire extinguisher (or equivalent) where the horn fastens to the hose. Screw on Northrop tube assembly #558668-2 in place of horn.

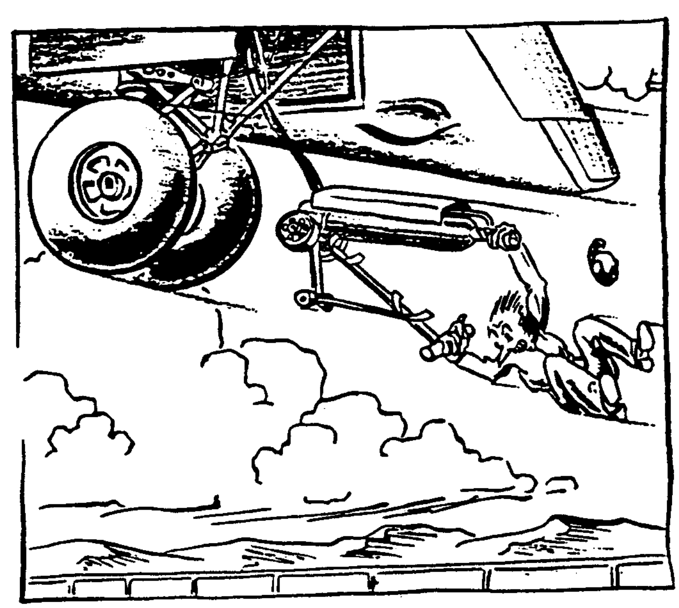
(3) OPERATION.

(a) Open hand valve slightly to check pressure and make sure that the valve can be turned without trouble. Close the valve again

(b) There are two snap-on type quick couplings in each main wheel well. The aft coupling feeds to the outboard engine and the forward coupling feeds to the inboard engine. Snap the quick coupling in the end of the adapter tube to the fitting in the wheel well and stand by.

NOTE

Carry adapter tube stowed in airplane when making cross country flights.



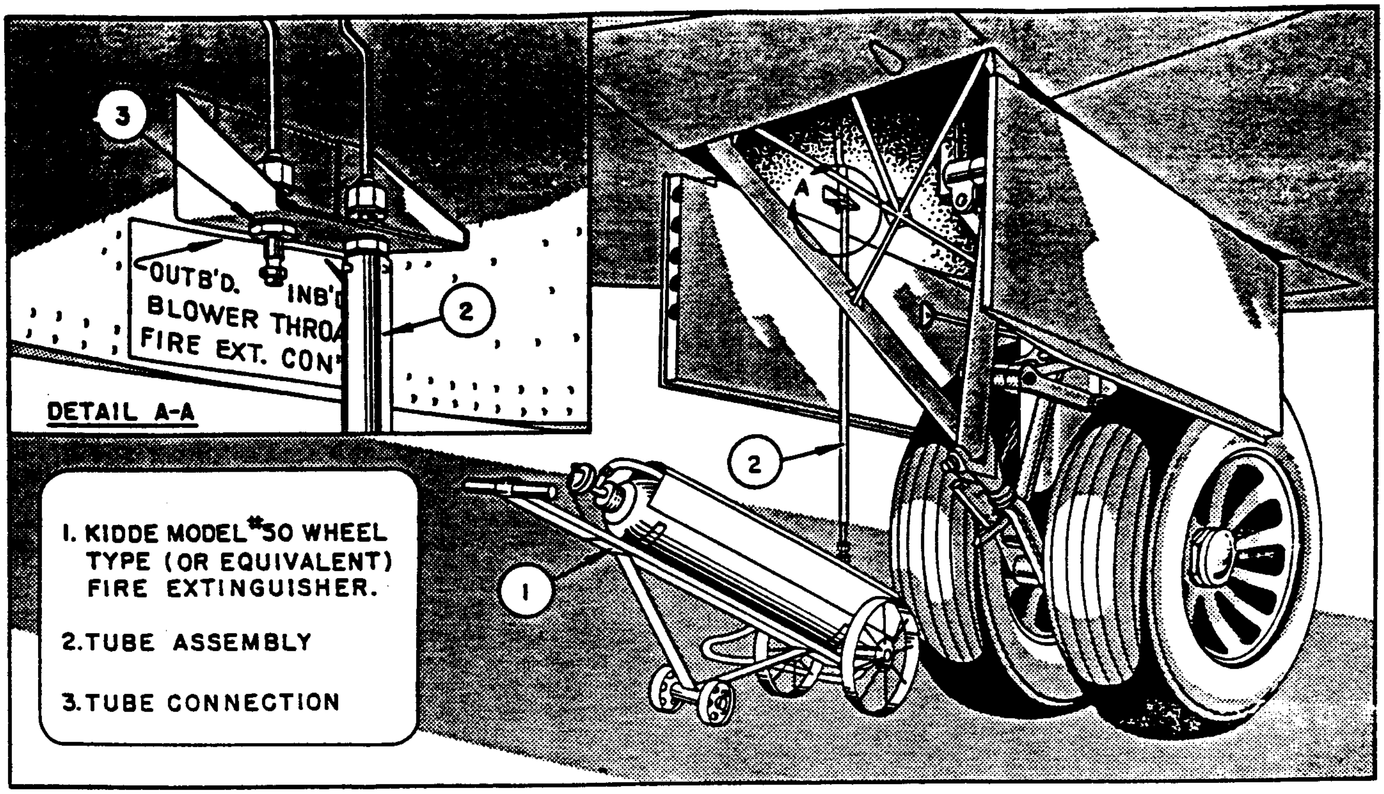


Figure 12. Blower Throat Fire Extinguisher System

16. HYDRAULIC SYSTEMS

16. HYDRAULIC SYSTEM.

a. GENERAL.- The airplane has two separate hydraulic systems, with no interconnection. These systems are known as the power boost system operating at 2000 psi and the nose steering and brake system operating at 3000 psi.

(1) POWER BOOST SYSTEM.

(a) DESCRIPTION. (See figures 1 and 2.)

1. The power boost system consists of four identical installations; one in each propeller shaft housing. The two inboard installations are known as the inboard system and the two outboard installations as the outboard system.

2. The inboard system has two sections; right-hand and left-hand. The right-hand section supplies power to the RH inboard elevon cylinder and the RH inboard rudder cylinder. The left-hand section supplies power to the LH inboard elevon cylinder and the LH inboard rudder cylinder.

3. The outboard system also has two sections; right-hand and left-hand. The right-hand section supplies power to the RH outboard elevon cylinder, the RH outboard rudder cylinder, and the RH slot door cylinder. The left-hand section supplies power to the LH outboard elevon cylinder, the LH outboard rudder cylinder, and the LH slot door cylinder.

(b) OPERATION. (See figure 2.)

1. GENERAL.

a. The propeller housing hydraulic installations are identical and are connected as follows: a common reservoir is used to feed two variable volume pumps with a flow of 9.5 gpm at 3750 rpm for each pump. The pumps are driven by belts from the propeller shaft. Oil from the pumps flows through check valves at the pumps, then through the system check valve and through the main system relief valve, set at 2150 psi. Pressure is taken off ahead of the system check valve to operate the aspirator used to pressurize the reservoir at 25 psi. Air to pressurize the reservoir is drawn in by the aspirator through an air filter. Fluid to the aspirator is filtered and reduced in pressure to 500 psi. Fluid at 2000 psi is supplied to a pressure switch which is used to operate the cross-transfer system. The pressure gages in the crew nacelle are operated from the pressure line ahead of the main system relief valve. A gage fuse is used to protect the system in event of gage line failure. Fluid returning to the reservoir passes through a normally open valve which is also part of the cross-transfer system. Quick-disconnect fittings are provided at each propeller housing for connection to the ground test stands. (See figures 1 and 3.)

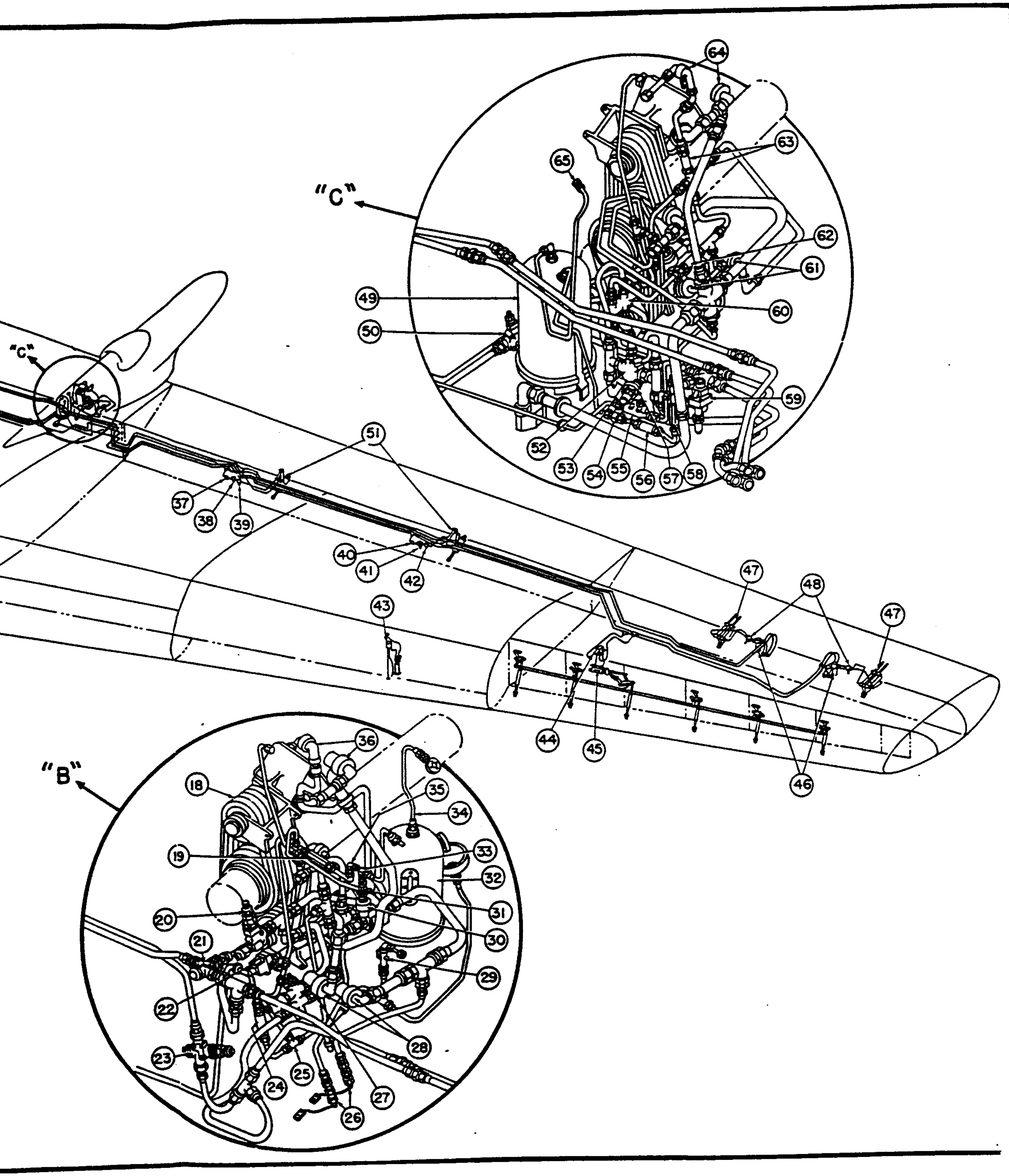
b. The slot doors are operated by one cylinder on each door. The rudders and elevons are each operated by two cylinders. The rudder and elevon servo valves and cylinders are protected by micronic type filters in the pressure line. The servo valves, operated by cables, direct the fluid to the proper end of the cylinder to correspond with control movement. Provision is also made within each elevon servo valve to permit normal operation should the servo valve become stuck for any reason. This is accomplished by incorporating an inner spool which allows the oil in the cylinder to flow to the return. This reduces the force necessary to move the surface with the remaining cylinder and permits normal operation. The slot door is operated by an electric solenoid valve energized by an aerodynamic switch. A manual override switch adjacent to the pilot is used to operate the doors in an emergency. When the controlling switches are in the "OPEN" position, the slot doors are held open by hydraulic pressure and springs; the valve is not energized.

2. CROSS-TRANSFER SYSTEM. (Refer to figures 1 and 2.)

a. The right- and left-hand sections of the inboard systems are interconnected by cross-transfer lines utilizing four normally closed valves; two in the cross-transfer pressure line and two in the cross-transfer return line. The same arrangement applies to the right- and left-hand sections of the outboard systems. Normally open valves are provided in the return line at each hydraulic reservoir. These valves are controlled electrically by a pressure switch.

1. Main Pump
2. Air Brake Valve
3. Air Tank and Gage
4. Pressure Gages
5. Pressure Switch
6. Pressure Regulator
7. Reservoir
8. Reservoir Vent Line
9. Foot Brake Valves
10. Steer Damp
11. Hand Brake Valves
12. Auxiliary Pump
13. Four-way Steering Solenoid
14. Relief Valve
15. Solenoid Brake-Valve Normally Closed
16. Accumulator
17. Pressure Gage
18. V-belts
19. Restrictor and Filter
20. Solenoid Valve-Normally Open
21. Solenoid Valve-Normally Closed
22. Pressure Switch
23. Solenoid Valve-Normally Closed
24. Gage Line Fuse
25. Relief Valve
26. Ground Test Couplings
27. Check Valve
28. Flexible Swivel Joints
29. Drain Cock
30. Filter
31. Check Valve
32. Reservoir
33. Aspirator
34. Reservoir Vent
35. Check Valve
36. Flexible Swivel Joints
37. Check Valve
38. Solenoid Valve-Normally Closed
39. Filter
40. Check Valve
41. Solenoid Valve-Normally Closed
42. Filter
43. Aerodynamic Pressure Switch
44. Four-way Slot Door Solenoid Valve and Filters
45. Slot Door Actuating Cylinder
46. Filters
47. Cylinder and Swivel
48. Rudder Servo Valves
49. Reservoir
50. Solenoid Valve-Normally Closed
51. Elevon Cylinders and Swivels
52. Solenoid Valve Normally Open
53. Check Valve
54. Aspirator
55. Gage Line Fuse
56. Check Valve
57. Air Filter
58. Restrictor and Filter
59. Pressure Switch
60. Relief Valve
61. Flexible Swivel Joints
62. Check Valve
63. Check Valves
64. Flexible Swivel Joints
65. Reservoir Vent

Figure 1. Hydraulic Systems (Sheet 1 of 2 Sheets)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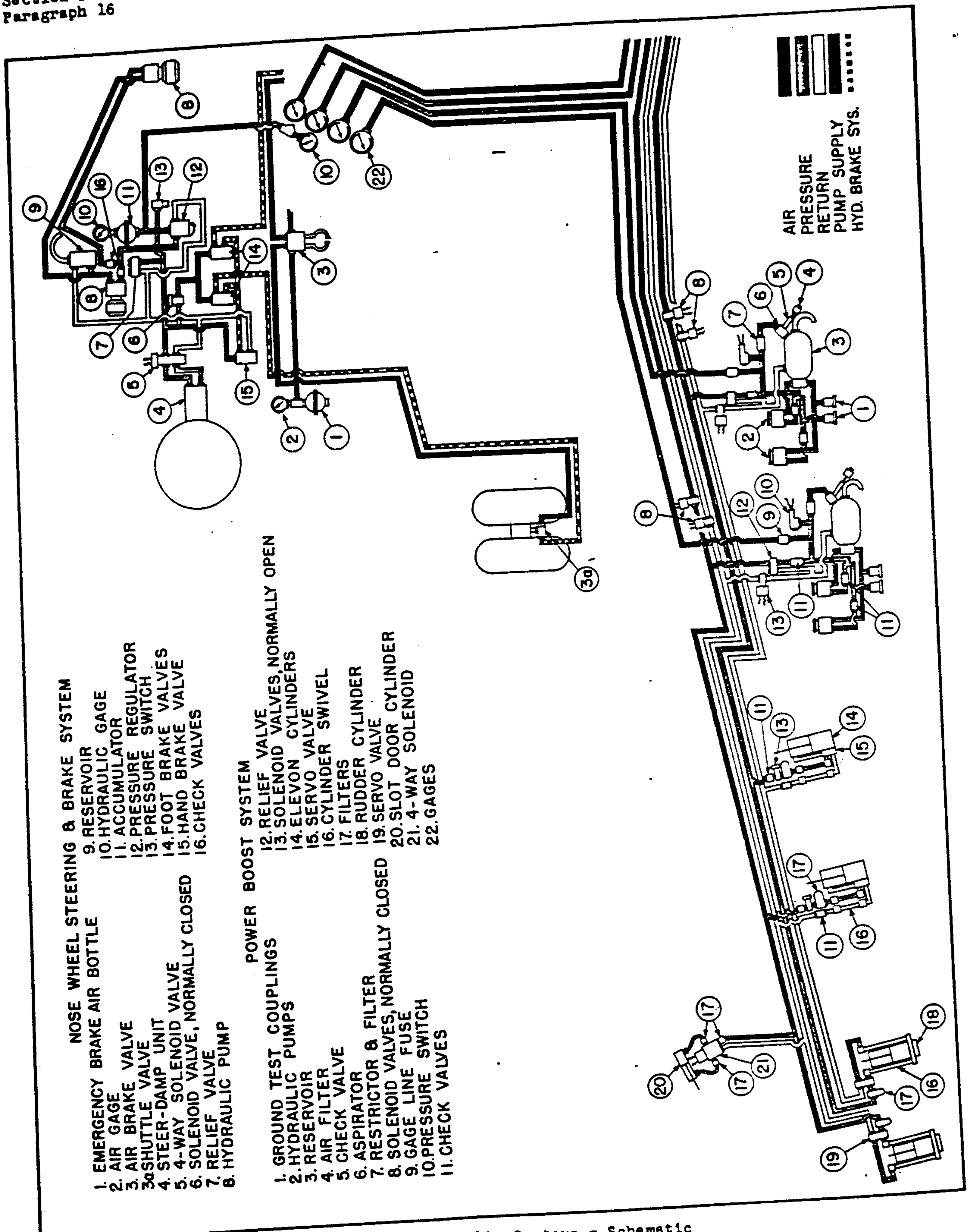
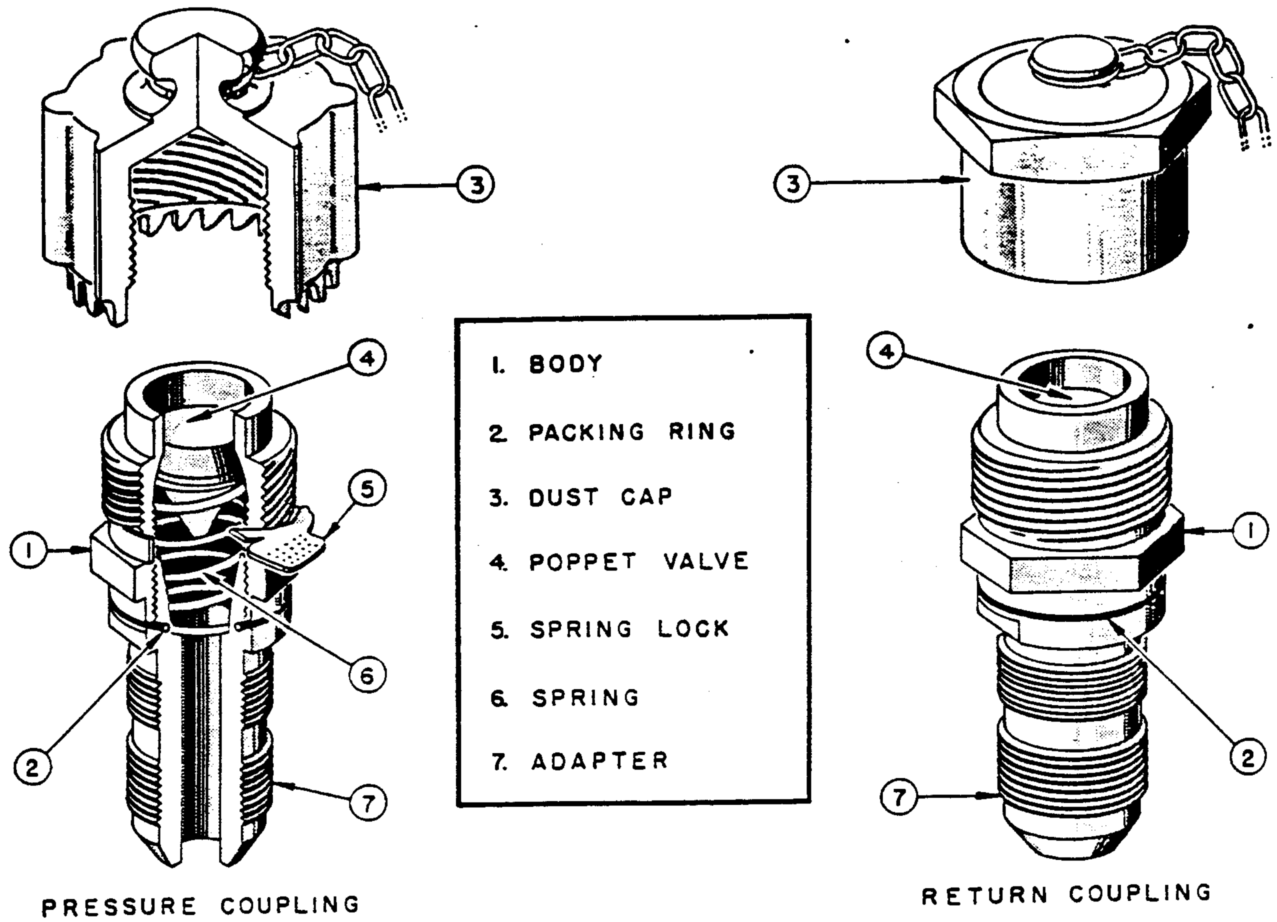


Figure 2. Hydraulic Systems - Schematic



1. BODY
2. PACKING RING
3. DUST CAP
4. POPPET VALVE
5. SPRING LOCK
6. SPRING
7. ADAPTER

Figure 3. Ground Test Coupling

b. Under normal operating conditions all four pump installations are supplying their respective controls. If one engine, either inboard or outboard, on either side of the airplane should fail, the cross-transfer system operates automatically. The pressure switch is actuated by loss of pressure, thereby closing the normally open valve and opening the normally closed valves. This allows the remaining pumps of the system to transfer pressure to the other side of the airplane and operate its respective controls. If both inboard or outboard engines should fail, the controls must be operated by the remaining pumps at reduced efficiency.

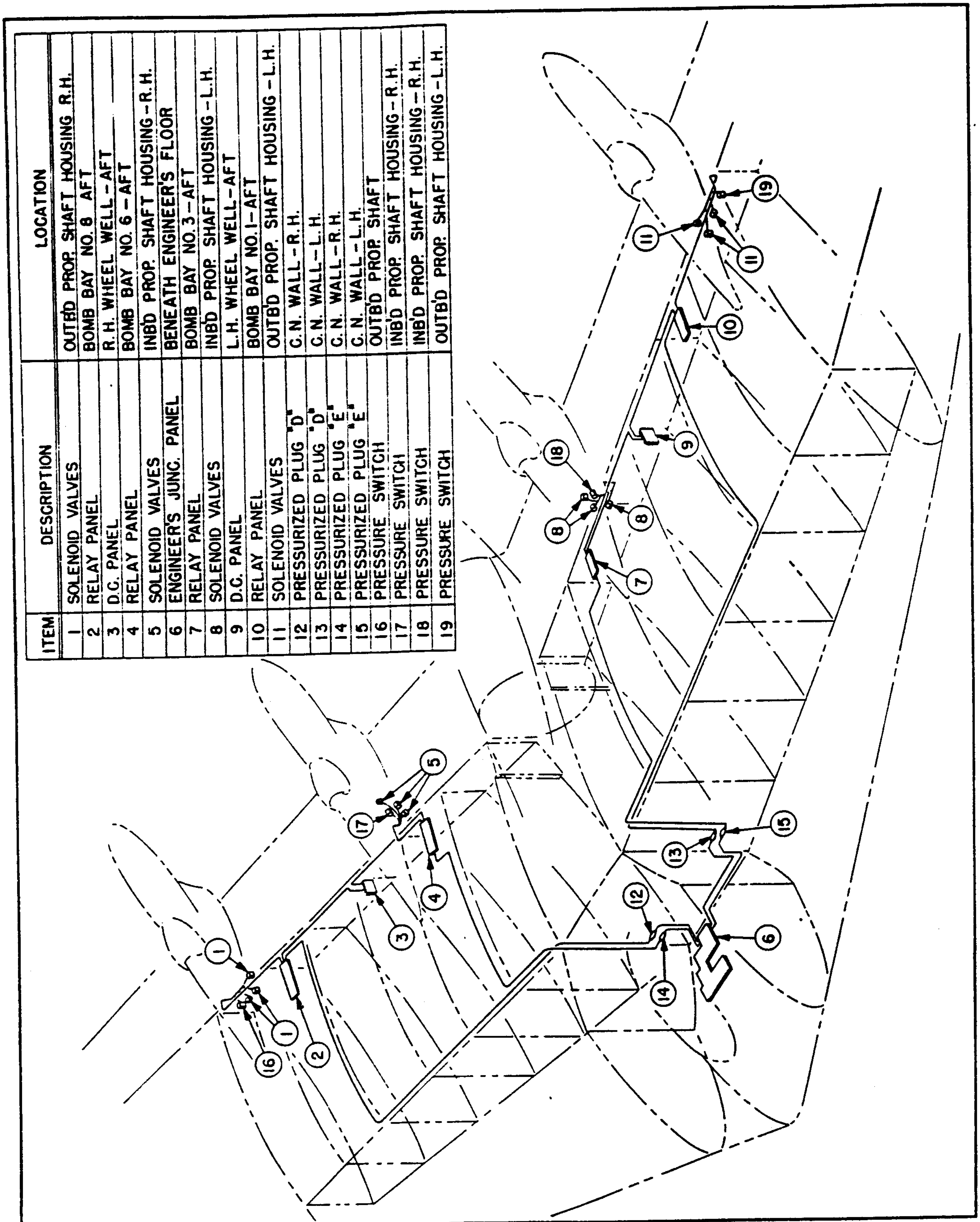
3. ELECTRICAL. (See figure 4.)

a. The electrical equipment operates automatically on 28 volt d.c. picked up from a bus on each main wheel well d.c. panel for the respective right-hand and left-hand systems. The circuits are routed thru bomb bay No. 1 relay panel, bomb bay No. 8 relay panel, to the pressure switches for the outboard systems, and thru bomb bay No. 6 relay panel, to the pressure switches for the inboard systems. The pressure switches for the outboard systems are interconnected in such a way that, should the pressure on one switch be reduced, it closes the circuits to all four normally closed solenoid valves on the interconnecting lines, causing them to open, and also closes the circuit to the normally open return line solenoid valve, causing it to close and thereby isolate the reservoir. In closing these circuits, it breaks the operating circuit that normally is wired to the switch, and operates on the power passing thru the switch on the opposite side of the airplane. If the pressure on both switches drops, the operating current is removed from them, and so breaks the current to all the solenoid valves and causes them to return to their normal positions. The two inboard systems are controlled in the same manner as the outboard systems.

b. When the pressure in a system is restored, the switch and valves return to their normal positions.

(2) NOSE STEERING AND BRAKE SYSTEM. (See figures 1 and 2.)

(a) DESCRIPTION.- The nose steering and brake system is supplied by two pump-and-motor units each capable of delivering 3



ITEM	DESCRIPTION	LOCATION
1	SOLENOID VALVES	OUTB'D PROP. SHAFT HOUSING R.H.
2	RELAY PANEL	BOMB BAY NO.8 AFT
3	D.C. PANEL	R.H. WHEEL WELL-AFT
4	RELAY PANEL	BOMB BAY NO. 6-AFT
5	SOLENOID VALVES	INB'D PROP. SHAFT HOUSING-R.H.
6	ENGINEER'S JUNC. PANEL	BENEATH ENGINEER'S FLOOR
7	RELAY PANEL	BOMB BAY NO.3-AFT
8	SOLENOID VALVES	INB'D PROP. SHAFT HOUSING-L.H.
9	D.C. PANEL	L.H. WHEEL WELL-AFT
10	RELAY PANEL	BOMB BAY NO.1-AFT
11	SOLENOID VALVES	OUTB'D PROP. SHAFT HOUSING-L.H.
12	PRESSURIZED PLUG "D"	C.N. WALL-R.H.
13	PRESSURIZED PLUG "D"	C.N. WALL-L.H.
14	PRESSURIZED PLUG "E"	C.N. WALL-R.H.
15	PRESSURIZED PLUG "E"	C.N. WALL-L.H.
16	PRESSURE SWITCH	OUTB'D PROP. SHAFT
17	PRESSURE SWITCH	INB'D PROP. SHAFT HOUSING-R.H.
18	PRESSURE SWITCH	INB'D PROP. SHAFT HOUSING-R.H.
19	PRESSURE SWITCH	OUTB'D PROP. SHAFT HOUSING-L.H.

Figure 4. Hydraulic Power Boost Electrical Installation

gpm at 2300 rpm. The nose steering and brake system is operative only when on the ground. Cut-off switches located on each main gear mechanism open the circuit when the gears retract. The circuit to operate the solenoid valves is energized by the master battery switch. The pump will not start until a.c. power is available. An anti-steering switch is located on the nose gear strut so that the strut must be compressed before the steering unit can be used. An emergency override switch is mounted on the engineer's lower instrument panel for emergency operation of the main hydraulic pump.

(b) OPERATION. (See figure 2.)

1. GENERAL.

a. The main hydraulic pump is located in the leading edge compartment, outboard of the right-hand cabin bulkhead. The auxiliary pump located in the nose gear wheel well is controlled by a pressure switch which turns the motor off at 2800 psi. This pump will start when the system pressure drops to approximately 2200 psi.

b. Oil from the pumps flows through check valves to a pressure regulator valve which controls the main pump within the range of 2600 (+100 -50) psi and 3000 (±50) psi. Pressure is teed off downstream of the unloading valve to operate the auxiliary pump pressure switch. Fluid flows from the unloading valve to the main system relief valve set at 3150 psi. Fluid from the relief valve is teed off to a 7½ inch accumulator and to the pressure gage in the crew nacelle. Fluid then flows to the four-way solenoid valve which supplies the nose steering and shimmy damper unit. Fluid is also teed off ahead of the four-way solenoid valve to a two-way solenoid valve which supplies the foot brake valves. This same line also furnishes the parking brake valve direct.

2. BRAKE SYSTEM.

a. The foot brake system is operated by either the pilot or copilot. Each has a switch on the control wheel which must be depressed to operate the solenoid valve, thus furnishing hydraulic pressure to the foot brake valves. Depressing the rudder pedals operates the brake valves to supply the brakes with hydraulic pressure up to 1300 psi.

b. The parking brake is operated by pulling on the steering handle. This operates the parking brake valve direct, supplying variable pressure up to 1300 psi. The handle is released by an integral trigger. In the event of hydraulic failure an emergency air brake system is used to operate the wheel brakes. This system is supplied by an air bottle with 1500 psi air charge. A duplex metering type air valve supplies air to the brakes up to 625 psi. A shuttle valve at each brake prevents air from escaping through the hydraulic lines.

3. STEERING SYSTEM.- Nose steering is accomplished by depressing a button on the steering handle which energizes the solenoid valve and supplies fluid to the steering unit. When in the "off" position, the valve maintains a preload pressure in the shimmy damper. Energizing the valve cuts out the damper and supplies pressure for steering. The steering unit has an internal valve which is operated manually by turning the steering handle. Depressing the button on the steering handle also energizes the solenoid valve which supplies oil to the foot brake valves. Thus the pilot can steer and energize the foot brakes at the same time.

4. ELECTRICAL. (See figure 5.)

a. The current to the main pump is controlled by micro switches which are operated by the complete extension and retraction sequence of the main landing gears. The complete cycle of extending either gear causes the control circuit of the pump motor to be completed, by closing two micro switches in series with the source of control current supply in the respective main wheel well d.c. panel and the power relay of the pump. One of the micro switches is actuated when the landing gear strut reaches its fully extended position, and the other when the main gear doors are closed.

b. The current to the auxiliary pump is controlled by a limit switch on the nose gear strut and a pressure switch installed in the hydraulic line. Both of these switches are in series with the power source of the control circuit and the power relay of the pump. The micro switch is closed when the weight of the airplane is on the strut, and the pressure switch is closed when the hydraulic pressure in the system has been reduced to a predetermined minimum (2200 psi). As both switches must be closed before the control circuit is completed, two conditions must be satisfied before the auxiliary pump will operate: the airplane must be on the ground and the pressure in the system must be below the minimum requirements. An emergency override switch for operating the main pump is installed on the engineer's instrument panel.

c. Both hydraulic pump motors operate on 208 volt, 3 phase, 400 cycle a.c. taken from a.c. sectionalizing panels and controlled by relays. A.c. for the main pump motor is taken from the crew nacelle nose a.c. sectionalizing panel; current for the auxiliary pump motor is taken from the nose wheel well a.c. sectionalizing panel.

d. Current for the main pump relay circuit is taken from either the d.c. panel in the left wheel well, or from the d.c. panel in the right wheel well or both, depending on which gear micro switch is actuated first. Current for the auxiliary pump relay circuit is picked up from a bus in the pilots' pedestal panel and routed through a push-type circuit breaker to the terminal panel where it is connected to the relay control circuit.

ITEM	DESCRIPTION	LOCATION
1	D.C. PANEL	R.H. MAIN GEAR WELL
2	HYDRAULIC PUMP SWITCH	R.H. MAIN GEAR WELL
3	WHEEL WELL RELAY PANEL	R.H. MAIN GEAR WELL
4	GEAR DOOR LIMIT SWITCH	R.H. MAIN GEAR WELL
5	PRESSURIZED PLUG	R.H. CREW NACELLE BULKHEAD
6	PRESSURIZED PLUG	L.H. CREW NACELLE BULKHEAD
7	ENGINEER'S JUNCTION PANEL	ENGINEER'S STATION
8	PILOT'S BRAKE SOLENOID SWITCH	PILOT'S WHEEL
9	PILOT'S PEDESTAL PANEL	PILOT'S PEDESTAL
10	CIRCUIT BREAKER	PILOT'S PEDESTAL PANEL

ITEM	DESCRIPTION	LOCATION
11	COPILOT'S BRAKE SOLENOID SW.	COPILOT'S WHEEL
12	HYDRAULIC PRESSURE SWITCH	CREW NACELLE NOSE SECTION
13	BRAKES SOLENOID VALVE	CREW NACELLE NOSE SECTION
14	STEERING SOLENOID VALVE	CREW NACELLE NOSE SECTION
15	A.C. SECTIONALIZING PANEL	CREW NACELLE NOSE SECTION
16	PRIMARY HYDRAULIC PUMP RELAY	CREW NACELLE NOSE SECTION
17	PRIMARY HYDRAULIC PUMP	CREW NACELLE NOSE SECTION
18	SECONDARY HYDRAULIC PUMP SW.	NOSE WHEEL STRUT
19	NOSE STEERING SAFETY SWITCH	NOSE WHEEL STRUT
20	NOSE STEERING & BRAKE RLAY PNL	CREW NACELLE NOSE SECTION
21	SECONDARY HYDRAULIC PUMP	NOSE WHEEL WELL
22	STEERING HANDLE SWITCH	NOSE STEERING HANDLE
23	NOSE STEERING HANDLE	CREW NACELLE NOSE SECTION
24	PRESSURIZED PLUG	CREW NACELLE NOSE SECTION
25	SECONDARY HYD. PUMP RELAY	NOSE WHEEL WELL
26	A.C. SECTIONALIZING PANEL	NOSE WHEEL WELL
27	GEAR DOOR LIMIT SWITCH	L.H. MAIN GEAR WELL
28	WHEEL WELL RELAY PANEL	L.H. MAIN GEAR WELL
29	HYDRAULIC PUMP SWITCH	L.H. MAIN GEAR WELL
30	D.C. PANEL	L.H. MAIN GEAR WELL
31	PRESSURIZED PLUG "P" R.H.	CREW NACELLE NOSE SECTION
32	ENG. LOWER INSTRUMENT PANEL	ENGINEER'S STATION
33	OVER-RIDE SWITCH	ENG. LOWER INSTRUMENT PANEL
34	ENG. LOWER SWITCH PANEL	ENGINEER'S STATION
35	CIRCUIT BREAKER	ENG. LOWER SWITCH PANEL

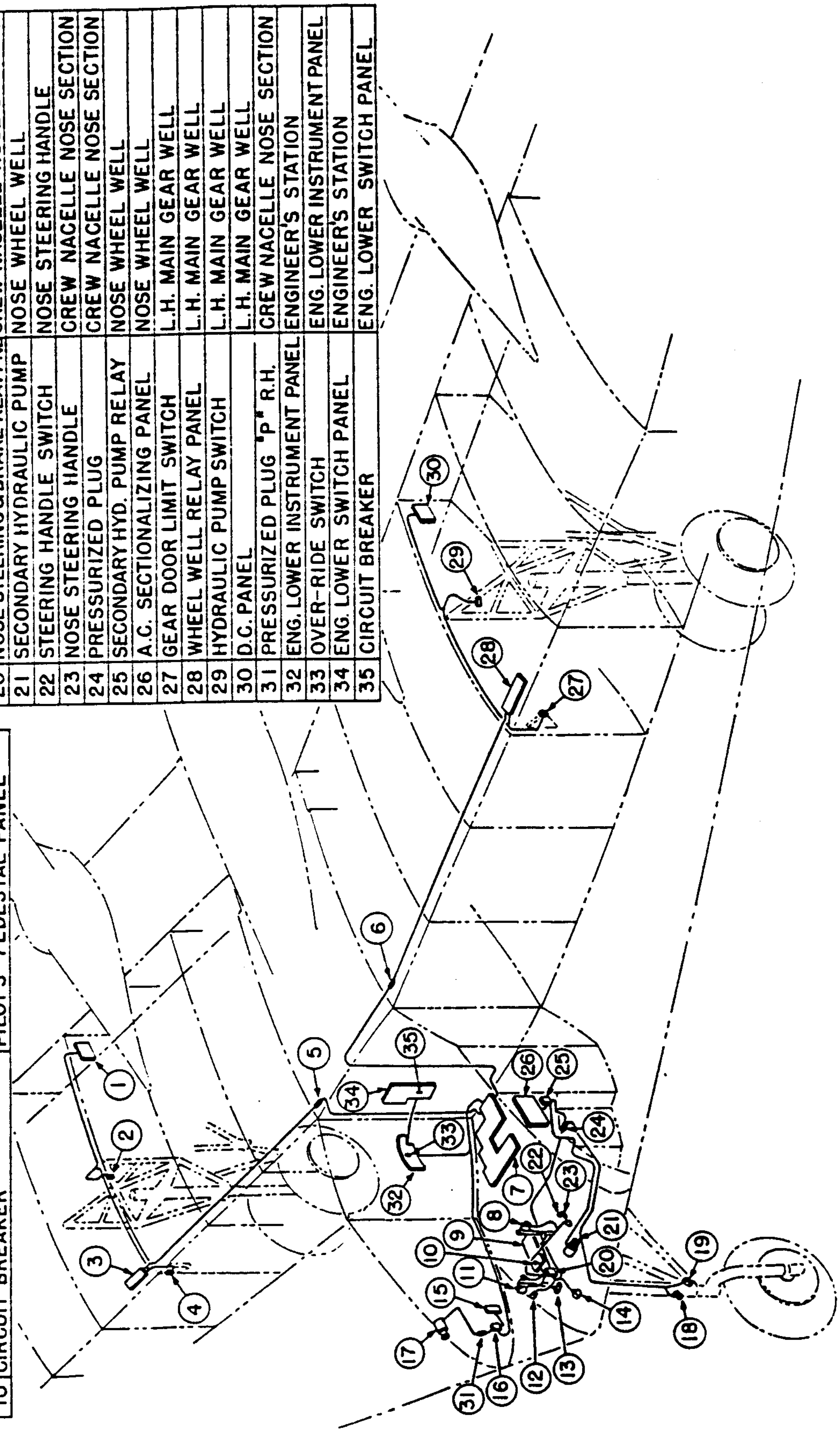


Figure 5. Landing Gear, Brakes, & Nose Wheel Steering Electrical Installation

b. TROUBLE SHOOTING.

NOTE

For adjustment or test of any hydraulic unit, remove the unit from the airplane.

(1) GENERAL.

TROUBLE	PROBABLE CAUSE	REMEDY
Lack of pressure in system, or failure of pressure to reach the unit.	Clogged reservoir.	Drain fluid from reservoir. Thoroughly clean reservoir and reservoir filter. Fill with clean fluid, Specification AN-VV-O-366.
	Insufficient fluid in system.	Add fluid to bring to normal level.
	Wrong fluid in system.	Drain fluid from system, flush if necessary, and fill with proper liquid.
	Suction line, reservoir to pump, clogged or broken.	Check to make certain line is not restricted or broken.
	Loose or faulty connections at the pump.	Tighten connections or, if necessary, install new connections.
	Small air leak at pump intake fitting.	Tighten or replace fitting.
	Sheared pump shaft.	Replace shaft.
	External leak in system.	Trace through various parts of system until leak is found. Make necessary repairs or replacements.
	Pressure regulator (unloading valve) stuck in unloading position.	Tap valve lightly. If this does not relieve the trouble, replace the valve.
	Relief valve setting not high enough.	Check setting and make necessary adjustment.
	Relief valve sticking open.	Tap valve lightly. If this does not relieve the trouble, disassemble, inspect, and replace the valve if necessary.
Extreme drop in pressure when units are in operation.	Loss of air from accumulator.	Check accumulator and fittings for leakage. Replace or tighten as necessary.
Pressure regulator (unloading valve) operating too frequently.	Low air pressure in accumulator at "O" psi hydraulic pressure.	Inflate to proper air pressure (650 psi).
	Leak in hydraulic control system lines, cylinders or valves.	Test system and make necessary repairs or replacements.
Actuating cylinder operates sluggishly.	Internal fluid leaks caused by worn piston-sealing rings.	Install new rings.
	External fluid leaks caused by worn or deteriorated packing rings.	Install new packing rings.

TROUBLE	PROBABLE CAUSE	REMEDY
Failure of any individual unit to function when other units are functioning.	Clogged line between non-functioning and functioning unit.	Remove obstructions from line.
	Stuck or otherwise inoperative valves supplying pressure.	Check functioning of valves for cause of failure.
Slot door and elevon inoperative.	Normally open solenoid valve in outboard system stuck closed.	Tap valve several times. If valve continues to remain stuck, remove and replace.

(2) POWER BOOST SYSTEM.

(a) HYDRAULIC PUMP.

TROUBLE	PROBABLE CAUSE	REMEDY
Pump not delivering fluid.	V-belts slipping, or broken.	Tighten adjusting bolt on pulley bracket. Replace belts if broken or badly frayed.
	Fluid level in reservoir too low. No fluid being drawn into pump.	Add hydraulic fluid to raise the level in reservoir to proper place.
	Leakage between reservoir and pump.	Replace broken lines or fittings. Be sure all connections are tight.
	Shear section in coupling shaft broken.	Install new coupling shaft.
Pump delivering insufficient fluid (indicated by sluggish operation).	Relief valve setting too low.	Raise relief valve setting to the proper cracking point. Refer to paragraph 16 j (1) (g).
	External leakage from system connections.	Tighten all fittings and connections.
	Excessive internal leakage due to neglect in reassembly; i.e. seals left out of yoke counter-bores; valve block improperly installed, allowing seals to blow out.	Check pump assembly. Be sure that seals are installed correctly and that valve block is securely attached to yoke.
	Reservoir pressure too low.	Check all parts of the reservoir pressurizing system for dirt, leaks, and malfunctioning. Check reservoir, including filler cap, for air leaks.
	Excessive internal leakage caused by valving surfaces and/or metallic seals having been scored by foreign matter in the hydraulic fluid or by carelessness in handling.	Rework parts to correct damage.
	Pressure control setting too low.	Adjust pressure control setting to proper point. See paragraph 16 j (1) (g).

TROUBLE	PROBABLE CAUSE	REMEDY
Pressure control not functioning properly (indicated by excessive pressure, causing over-heating).	Pressure control installed for opposite direction of rotation.	Reverse position of pressure control body.
	Foreign matter between pilot valve and bushing, causing valve to stick.	Disassemble pressure control body and clean parts thoroughly. Check to be sure parts are not damaged. Flush and refill system.
Noise and low rate of delivery.	Slight air leakage at pump inlet line.	Be sure all connections are air-tight.
	Air in hydraulic system.	Bleed system.
External leakage.	Defective pump shaft oil seal, line connections, gaskets, leaking plugs.	Rework or replace shaft oil seal, tighten connections, replace gasket, and tighten plugs.

(b) RELIEF VALVE.

TROUBLE	PROBABLE CAUSE	REMEDY
System pressure too high or too low.	Foreign matter in the system.	Drain, flush, refill and bleed the system.
	Valve improperly adjusted.	Adjust valve to proper setting (2150 psi). Refer to paragraph 16 j (6) (g).
	Ball not seating properly.	Back off on adjusting screw several turns while running pump to be certain no foreign matter is caught on seat, preventing ball from seating. Check condition of ball and seat if malfunctioning still persists.
	Relief valve spool remaining inoperative.	Remove sleeve and spool subassembly and check for freedom of movement. Also check movement of large end of spool inside body bore. Check condition of seating surface of spool against seat of sleeve. Check condition of large spring at base of spool.

(c) SOLENOID VALVE - NORMALLY CLOSED.

TROUBLE	PROBABLE CAUSE	REMEDY
Valve does not open.	Low voltage.	Check d.c. power output voltage.
	Open or shorted circuit in electro-magnet.	Check resistance of magnet coil. Refer to paragraph 16 j (7) (g).
	Improper electrical connection.	Check electrical connection and repair.

TROUBLE	PROBABLE CAUSE	REMEDY
Valve does not open.	Pilot valve piston binding in cylinder.	Disassemble, clean and inspect. Refer to paragraph 16 j (7) (e).
Valve will not close.	Dirt or foreign matter in pilot valve causing it to hold open.	Disassemble, clean and inspect. Refer to paragraph 16 j (7) (e).
	Pilot piston orifice plugged.	Disassemble and clean. Refer to paragraph 16 j (7) (e).
	Damaged main valve seat or ball.	Disassemble, inspect and replace damaged parts. Refer to paragraph 16 j (7) (e).
	Binding of ball guide.	Disassemble, inspect and replace damaged parts. Refer to paragraph 16 j (7) (e).

(d) PRESSURE SWITCH.

TROUBLE	PROBABLE CAUSE	REMEDY
Leakage from cap.	Upper cup leaking.	Open and inspect. If worn or scored, replace.
Leakage through to micro switch.	Lower cup leaking.	Open and inspect. If worn, or scored, replace.
Failure of circuit to open or close at specified pressure.	Cap and spring not properly adjusted.	Adjust cap and lock with nut.
	Piston stuck.	Remove and clean valve; reset.

(e) FOUR-WAY SOLENOID VALVE.

TROUBLE	PROBABLE CAUSE	REMEDY
Valve fails to operate.	Electrical failure.	Continuity test the circuit.
	Leakage.	Check pilot valve for leakage. Replace if necessary.
	Pilot valve ball not seating.	Check pin on solenoid core; make certain that the pin will push pilot valve ball against its saat. If pin is bent or slightly peened on the end where it comes in contact with the ball, it may not have sufficient travel. Replace if necessary.
	Shuttle sticking.	Check to see that shuttle does not stick in sleeve. Replace if necessary.

(3) NOSE WHEEL STEERING AND BRAKE SYSTEM.

(a) HYDRAULIC PUMPS.

TROUBLE	PROBABLE CAUSE	REMEDY
Complete loss of capacity.	Reservoir supply low.	Replenish reservoir.

TROUBLE	PROBABLE CAUSE	REMEDY
Complete loss of capacity.	Air leak to suction line.	Check suction line and fittings at pump intake port for air leaks. Test suspected areas by applying heavy grease or oil to surface and restart pump. Make air-tight if leaks are present.
Complete loss of capacity.	System suction line plugged.	Disconnect suction line at pump intake port. Ascertain that line is open to reservoir. Remove obstruction, or replace crushed tubing if present.
	Broken drive coupling.	Replace.
	Broken pump shaft.	If drive coupling is intact but can be turned by hand, a broken shaft is indicated. Replace shaft.
	Air leak to vacuum through shaft seal.	Test for air leak.
	Air leak to vacuum through damaged or improperly assembled "O" rings.	Test for air leak.
	Broken control valve spring.	Replace.
Pump does not prime.	May be caused by one or more of the probable causes under "Complete loss of capacity."	Investigate and correct as directed under "Complete loss of capacity."
Partial loss of capacity.	Reservoir supply low.	Correct as under "Complete loss of capacity."
	Air leak to system suction line.	Correct as under "Complete loss of capacity."
	System suction line plugged.	Correct as under "Complete loss of capacity."
	Air leak to vacuum through seal or through damaged "O" rings.	Correct as under "Complete loss of capacity."
	Fouled or improperly seating check valve at pump pistons.	Test for air leak to vacuum.
	Fluid leakage at by-pass port.	Perform volumetric test.
	Fouled piston.	Replace.
	Broken piston return spring.	Replace broken spring.
	Worn pistons and worn cylinder block.	Replace.
	Worn bearings and worn creep plates.	Test and replace worn parts.
Excessive pulsation.	Reservoir supply low.	Low reservoir level permits intermittent exposure of suction line. Add hydraulic fluid to reservoir.

TROUBLE	PROBABLE CAUSE	REMEDY
Excessive pulsation.	Air leak to system suction line.	Indicated by total or partial loss of capacity. See corrective measures under "Complete loss of capacity."
	Air leak to system through seal.	Indicated by total or partial loss of capacity. See corrective measures under "Complete loss of capacity."
	Fouled check and/or damaged cylinder block face.	Indicated by slight loss of capacity at no pressure operation and with increased capacity loss as pressure is increased. Apply corrective measures as described under "Partial loss of capacity."
	Fouled piston.	See remedy under "Partial loss of capacity."
	Broken piston return spring.	See remedy under "Partial loss of capacity."
Excessive heating.	Failure of oil supply.	Determine if loss of capacity is complete or partial. Investigate probable causes outlined and apply remedy indicated.
	Scored bearings.	Replace bearings.
	Pressure regulator not functioning.	Check for too high pressure setting. Also check for dirt or otherwise malfunctioning of valve.
	Pressure switch stuck.	Check pressure switch for operation at proper setting.
Failure to maintain correct pressure.	Improper control valve adjustment.	Properly adjust control valve as described in paragraph 16 k (1) (d).
	Broken control valve spring.	Remove broken spring and replace.
	Malfunctioning of control valve.	May result from scored or seized pilot piston, pilot piston liner assembly, valve piston or control valve liner. Perform tests for control valve adjustment.

(b) PRESSURE REGULATOR.- Refer to "Excessive heating (of pump)" preceding.

(c) RELIEF VALVE.- Refer to relief valve under power boost system (paragraph 16 b (2) (b)).

NOTE

This valve is set at 3150 psi; a different relief pressure than the valve used in the power boost system.

(d) PRESSURE SWITCH.- Refer to "Excessive heating (of pump)" preceding.

c. LINE MAINTENANCE.

(1) PRESSURE RELIEF.- Pressure in the brake and steering system is most quickly relieved by operating the hand brake. The power boost system pressure drops of its own accord after the pumps have stopped.

(a) Relieve pressure from the emergency brake air tank before removing the units or lines connected to the tank. Relieve pressure by loosening bleeder plug at the bottom of the tank.

(b) Relieve pressure from the accumulator in the steering and brake system by loosening the valve body. Depressing the valve stem may damage the core.

(2) BLEEDING THE SYSTEMS.

(a) POWER BOOST SYSTEM.- Before proceeding with the following operations a thorough check must be made to determine the correct rigging of all controls. It is necessary that the rudder and elevon controls be rigged in accordance with instructions given in Section IV, paragraph 3 in order to insure proper operation and to prevent damage to the surfaces.

1. The electrical system in the airplane is used to operate the cross-transfer valves and the slot door valves.

2. Connect one ground test stand to the left-hand outboard ground test connections and one ground test stand to the left-hand inboard ground test connections (see figure 1). Connect Purolator (31550) filters in the pressure hoses at the airplane. Fill the reservoirs. Shut off the reservoirs in the ground test stands. Set test stands to operate at 1000 psi.

3. Neutralize all controls and start the test stands. Check the fluid level in the reservoirs; the levels should remain constant and should not show any signs of fluid being transferred from the right-hand to the left-hand side of the airplane, or vice versa.

4. Bleed the left-hand gage lines by disconnecting the lines at the gages and depressing the bleed valves on the gage fuses until all air has escaped from the gage lines. Connect the gage lines to the gages and, when pressure is indicated on the gages, release the bleed valves. Bleed gages at 500 psi.

5. Bleed the rudder, elevon and slot door cylinders on the right and left sides of the airplane. This bleeding must be accomplished by removing the bleed plugs at each cylinder in turn and moving the controls until enough oil has been expelled to run free of air.

6. Stop both test stands.

(b) NOSE WHEEL STEERING AND BRAKE SYSTEM.- The electrical system in the airplane must be used to energize the solenoid valves and to run the pump to supply hydraulic pressure. Connect outside a.c. and d.c. power to the external power receptacle.

1. Charge the hydraulic accumulator with 600 psi air pressure.

2. Attach bleeder hoses to the wheel brake bleeder plugs.

3. Fill the reservoir as directed on the instruction plate.

4. Parking and foot brakes "off," and all brake and steering buttons "off."

5. Start the hydraulic pump. Operate intermittently until approximately 1000 psi shows on gage.

6. Bleed the foot brakes. Maintain approximately 100 psi on the system.

7. Bleed the parking brakes and refill the reservoir as required.

8. Start the hydraulic pump. When system pressure shows 3000 psi, operate the steering handle several times.

9. Operate foot and parking brakes.

10. Repeat steps 6 through 10 as required, to remove air from the system.

11. Stop the hydraulic pump.

(3) FLUSHING THE SYSTEM.

(a) GENERAL.

1. All personnel engaged in the installation, handling, and testing of hydraulic units, lines etc., should use extreme care in preventing dirt or foreign matter from entering the units at the time of assembly.

2. All units must be kept capped until the time they are connected into the system. Particular care must be used during installation operations to prevent foreign matter from entering open ports. Replacement lines must be given a final cleaning by using solvent or some suitable liquid directed in a pressure stream to remove all dirt from the inside.

3. The following flushing operations must be performed carefully in order to insure a clean system. Due to the long runs of tubing it is necessary to use a high velocity oil flow in order to remove the particles which may remain in the lines.

CAUTION

The failure of either the power boost control system or the nose steering system could result in great damage to the airplane and personnel. Each person should maintain a high degree of cleanliness as regards the hydraulic systems.

(b) FLUSHING THE OUTBOARD BOOST SYSTEM.

1. Cap the pressure and return tees leading to the right and left outboard elevon cylinders.

2. Cap the pressure and return tees leading to the right and left slot door cylinders.

3. Connect the pressure and return lines together at the right and left outboard rudder cylinders to make a continuous circuit.

4. Connect a 24 volt d.c. electrical source to the four cross-transfer valves (see figure 1) in this system. A switch is necessary so that these valves may be turned on or off as required.

5. Connect two ground test stands in parallel, using only one test-stand reservoir, to give a combined flow of approximately 14 gpm.

6. Connect the ground test stands directly into the pressure and return lines in the left-hand outboard housing. This will require capping the normally open valve (40R698) in the right-hand outboard housing. Connect Purolator (31550) filters in the pressure and return hoses at the airplane.

7. Energize the cross-transfer valves. Operate the test stands to fill all lines and hoses. Refill the test stand reservoir as required.

8. Operate the test stands at high speed for 15 minutes. The cross-transfer valves must remain open during this time.

9. Stop the test stands and switch off the cross-transfer valves.

10. Reverse the test stand hoses to obtain a reverse flow through the system.

11. Energize the cross-transfer valves and operate the test stands for 15 minutes. Shut off the stands and valves.

12. Remove all test items and return the system to normal.

(c) FLUSHING THE INBOARD BOOST SYSTEM.

1. Cap the pressure and return tees leading to the right and left inboard rudder cylinders to make a continuous circuit.

2. Connect the pressure and return lines together at the right and left inboard rudder cylinders to make a continuous circuit.

3. Connect a 24 volt d.c. electrical source to the four cross-transfer valves (see figure 1) in this system. A switch is necessary so that these valves may be turned on or off as required.

4. Connect two ground test stands in parallel, using only one test-stand reservoir, to give a combined flow of approximately 14 gpm.

5. Connect the ground test stands directly into the pressure and return lines in the left-hand inboard housing. This will require capping the normally open valve (40R698) in the right-hand inboard housing. Connect Purolator (31550) filters in the pressure and return hoses at the airplane.

6. Energize the cross-transfer valves. Operate the test stands to fill all lines and hoses. Refill the test-stand reservoir as required.

7. Operate the test stands at high speed for 15 minutes. The cross-transfer valves must remain open during this time.

8. Stop the test stands and turn off the cross-transfer valves.

9. Reverse the test stand hoses to obtain a reverse flow through the system.

10. Energize the cross-transfer valves and operate the test stands for 15 minutes. Shut off the stands and valves.

11. Remove all test items and return system to normal.

12. Remove the elements from the 31550 filters and inspect for dirt. Particular attention should be given to the filter in the return line. This will show the dirt removed from the airplane.

(d) FLUSHING THE NOSE STEERING AND BRAKE SYSTEM.- Because of the cramped quarters surrounding the units which make up the nose steering system, it is recommended that the procedure outlined below be followed.

1. Remove all lines and units.

2. Bench test and flush all units.

3. Clean and bench test all lines.

4. Install units and lines.

d. REMOVAL AND DISASSEMBLY.- When removing a line or unit from the hydraulic system, first relieve the pressure in the entire system. (See paragraph 16 c (1).) Upon removal, plug all open ports and the ends of lines to prevent the loss of oil or entrance of foreign matter. Although hydraulic units will withstand some abuse, it is desirable to exercise great care when working on them. Minor damage such as a slight scratch or burr on the inside of a valve or cylinder may cause the unit to function improperly and thus endanger the operation of the entire system. Immediately after disassembly, the component parts of a hydraulic unit should be thoroughly cleaned. Carefully remove the packings and rub them dry with a clean, lint-free cloth.

CAUTION

Never clean packings with naptha or kerosene. Remove the packings, then clean the metal parts of the unit with naptha or kerosene. If a brush is used to clean the unit, extreme care must be exercised to avoid scratching the plated or polished surfaces. Wipe the parts thoroughly dry with a clean, lint-free cloth, or blow them dry with compressed air. When units are disassembled, they should be protected from dust, preferably by keeping them wrapped in wax paper.

e REPAIRS AND REPLACEMENTS.

(1) When repairing or replacing a part, disturb as little of the unit as possible. Refer to the illustration of the unit in order to become familiar with its construction before attempting disassembly. When the design of the unit will permit, the packing should be removed without disturbing any other portion of the assembly. Care must be taken not to damage the threads. If looseness in the threads is observed, the part should be replaced immediately.

(2) Remove the ring-seal packing as carefully as possible to prevent distortion, which might cause cracking. Observe the same precaution when installing ring seals. Do not try to install the wrong size. Before installing a ring seal, examine it carefully for cracks or faults, and be certain that it is thoroughly clean. Immerse it in hydraulic fluid Specification No. AN-VV-O-366, so that it will be completely coated before installation. When the seal is in place, check to see that it lies flat in the groove and is not twisted in any way.

f. ASSEMBLY.

(1) When assembling hydraulic units, carefully inspect all cylinders and barrels for scratches, burrs, or other imperfections. Make sure that washers, retainers, and packings are the correct size, are facing the correct surface, and are assembled in the proper order. Use only those parts specified.

(2) All parts within the unit must be absolutely clean. Moisten all parts with hydraulic fluid, Specification No. AN-VV-O-366, before assembly.

(3) Do not apply too much pressure to retainers, and heads of bolts which are seated on gaskets and washers. A firm seating rather than a tight one is all that is desired.

g. TEST BEFORE INSTALLATION.- All testing must be done with hydraulic fluid, Specification No. AN-VV-O-366. Be sure that the fluid is clean. Do not place any unit in service until test results have shown that it is correctly assembled and that it functions properly.

NOTE

Minor replacements which do not require removal of the unit from the airplane may be accomplished without subsequent test. Whether or not such a procedure is satisfactory must be determined in advance with reference to the replacements to be made and the unit concerned.

h. INSTALLATION.

(1) Before installing hydraulic units, examine fittings carefully for satisfactory condition of threads. The lines and units must be clean.

(2) Apply a thin coating of thread lubricant, Specification No. AN-C-53, to tapered-thread male-pipe threaded-fittings. Do not permit lubricant to get inside of lines. Do not apply in excessive quantities. Lubricate all straight-threaded connections with hydraulic fluid, Specification No. AN-VV-O-366.

(3) It is important that the lines and fittings fit perfectly; otherwise, leaking will occur at the connections. Turn the line-attaching nuts with the fingers as far as possible. Never start a line-attaching nut with a wrench. After the nut is finger-tight, the turning moment applied to nuts at the connections must not exceed the following values:

WRENCH TORQUE (INCH-POUNDS)				
TUBING OD INCHES	ALUMINUM TUBING		STEEL TUBING	
	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
3/16	15	35	30	70
1/4	40	65	50	90
5/16	60	80	70	120
3/8	75	125	90	150
7/16	120	180	..	...
1/2	150	250	155	250
5/8	200	350	300	400
3/4	300	500	430	575
1	500	700	550	750

i. OPERATIONAL TEST.

(1) POWER BOOST SYSTEM.

(a) PART I.

1. Connect one ground-test stand to the LH outboard ground-test connections and one ground-test stand to the LH inboard ground-test connections. Connect Purolator (31550) filters in the pressure hoses at the airplane. Fill the airplane reservoirs. Shut off the reservoirs in the ground-test stands and set the test stands to operate at 2000 psi.

2. Check all airplane reservoirs and fill as required.

3. Connect a 50 psi pressure gage into each reservoir to determine reservoir pressure. This pressure must be within the limits of 23-27 psi with the test stands running. During the following tests, pressure will show only at the left-hand reservoirs.

4. Neutralize all controls and start the test stands. Check reservoir oil levels for evidence of oil transferring from the right to left side of the airplane, or vice versa.

5. Apply full right rudder. The right rudder must open fully. Release the pedal. The rudder must close completely.

6. Repeat item 5 with the left rudder.

7. Repeat item 5 and 6 with both pedals.

8. With the control column centered, apply full right aileron. The right elevon must raise and the left elevon must lower. Return to neutral.

9. Repeat item 8 with full left aileron. Reverse action should result. Return to neutral.

10. With the control wheel centered, apply full down elevator. Both elevons must move down. Return to neutral.

11. Repeat item 10 with full up elevator. Reverse action should result. Return to neutral.

12. Repeat items 8, 9, 10 and 11 only with both controls applied at the same time. Return to neutral.

13. Move the manual override switch for the slot doors to the "CLOSED" position. Both doors must close. Move the switch to the "OPEN" position. Both doors must open.

14. Shut off the inboard test stand and repeat the above tests with one test stand connected to the LH outboard ground-test connections.

15. Repeat above tests with one test stand connected to the LH inboard ground-test connections. Slot doors will not operate during this test.

NOTE

During the preceding operational test the movements of the surfaces must be observed for any signs of sticking, chattering, or malfunctioning. All surfaces must respond immediately to any movement of the controls, and must function smoothly at all times.

(b) PART II.

1. Connect one ground-test stand to the RH outboard ground test connections and one ground-test stand to the RH inboard ground test connections. Connect Purolator (31550) filters in the pressure hoses at the airplane. Shut off the reservoirs in the ground-test stands. Fill the airplane's reservoirs and set the test stands to operate at 500 psi.

2. Neutralize all controls and start the test stands. Check the fluid level in the reservoirs; the level should remain constant and should not show any signs of fluid being transferred from the right to the left side of the airplane, or vice versa.

3. Bleed the right-hand gage lines in accordance with paragraph 16 c (2) (a) 4.

4. Set ground-test stands at 2000 psi.

5. Apply full right rudder. The right rudder must open fully. Release the pedal. The rudder must close completely.

6. Repeat item 5 with the left rudder.

7. Repeat items 5 and 6 with both pedals.

8. With the control column centered, apply full right aileron. The right elevon must raise and the left elevon must lower. Return to neutral.

9. Repeat item 8 with full left aileron. Reverse action should result. Return to neutral.

10. With the control wheel centered apply full down elevator. Both elevons must move down. Return to neutral.

11. Repeat item 10 with full up elevator. Reverse action should result. Return to neutral.

12. Repeat items 8, 9, 10 and 11 only with both controls applied at the same time. Check for proper movement.

13. Move the manual override switch for the slot doors to the "CLOSED" position. Both doors must close. Move the switch to the "OPEN" position. Both doors must open.

14. Shut off the inboard test stand and repeat the above tests with one test stand connected to the RH outboard ground test connections.

15. Repeat preceding tests with one test stand connected to the RH inboard ground-test connections. Slot doors will not operate during this test.

NOTE

During the preceding operational test the movements of the surfaces must be observed for any signs of sticking, chattering, or malfunctioning. All surfaces must respond immediately to any movement of the controls, and must function smoothly at all times.

(c) RESERVOIR PRESSURIZING TEST.- This may be made during the course of making the boost system operation test, Parts I and II.

1. With system pressure at zero fill the reservoir to the proper level.

2. Connect a 50 psi gage into each reservoir to register reservoir pressure.

3. Start the test stands and as soon as system pressure is at 2000 psi, start timing the rise in reservoir pressure. Do not operate any controls during this period.

4. The pressure gage should read 23 to 27 psi within a maximum of 10 minutes.

5. Repeat this test with each reservoir in turn.

(d) PREFLIGHT.- The following tests are required to prove correct operation of the boost system with the engines running. This test should be made prior to each flight.

1. Remove cover plates at each elevon cylinder.

2. Lock one LH outboard and one RH inboard elevon servo valve in neutral by means of "U" shaped wedges around the valve outer spool.

3. Start all engines. If possible, the engine speed should be held constant at 1500 rpm during the following tests.

4. Operate the elevons slowly in a normal manner, using both elevator and aileron controls. During this test the surfaces should be closely watched to determine that the elevon servo valve by-pass is functioning properly. There should not be any signs of excessive warping in the elevon surfaces, although there will be a slight lag in the action of the valve which is locked in neutral.

5. Repeat test "4" with the opposite elevon valves.

6. Remove wedges from the elevon valves.

7. Make normal check for operation of all controls including the slot doors. Refer to paragraph 16 i (1) (a) and (b).

8. Stop No. 1 engine. All controls should operate normally except at slightly reduced speed.

9. Stop No. 4 engine. All controls should operate normally except at slightly reduced speed. Slot doors will not operate with only inboard engines running.

10. Stop No. 2 engine. All controls should operate normally except at reduced speed. Slot doors will not operate.

(2) NOSE STEERING TEST.

(a) Kill system pressure by operating the foot brakes. Accumulator gage must show 600 psi air charge. Re-charge as needed.

(b) Refill the hydraulic reservoir as needed.

(c) If the airplane is on jacks, the nose gear must be compressed approximately four inches before the test can be made. The main gear should be down and locked.

(d) The master battery switch must be closed before the solenoid will operate.

(e) Connect a.c. power to the airplane. Both pumps should start. As pressure builds up, the auxiliary pump should stop at 2750-2800 psi. The main pump should unload at 3000 +100 -50 psi. The pump will probably cycle several times until the air and oil temperature stabilizes in the accumulator.

(f) Depress the steering button on the steering and parking brake handle. This will energize the nose steering unit.

(g) Turn the handle slowly to full right travel. Return to neutral.

(h) Turn the handle slowly to full left travel. Return to neutral.

(i) Repeat items (g) and (h) several times to remove all air from the steering unit. Refill reservoir as required.

(j) The steering handle position should indicate the position of the nose wheel. The nose wheel should follow the handle regardless of direction of travel.

(k) Return the handle to neutral and shut off the pump and master battery switch.

(3) BRAKE SYSTEM TEST.

(a) Kill system pressure by operating the foot brakes. The accumulator gage must show 600 psi air charge. Re-charge as needed.

(b) Check the emergency brake air bottle for air charge. The gage must show 1500 psi air charge. Re-charge as needed.

(c) Re-fill the hydraulic reservoir as required.

(d) If the airplane is on jacks, micro-switches on the main gear must be closed before the test can be made.

(e) The master battery switch must be closed before the solenoid valves will operate

(f) Connect an a.c. power source to the airplane. Both pumps should start as the pressure builds up, the auxiliary pump should stop at 2750-2800 psi. The main pump should unload at 3000 +100 -50 psi. The pump will probably cycle several times until the air and oil temperature stabilizes in the accumulator,

(g) Bleed each brake assembly by loosening the bleed screws at each spot cylinder and applying the foot brakes until clear oil runs from the loosened screws. Tighten the screws.

(h) Connect a 2000 psi hydraulic gage to the bleed port on the forward side of one brake assembly on each main gear.

(i) Depress the brake switch on the pilot's wheel.

(j) Depress the rudder pedals to give full brake pressure. The gages at the brakes must read 1300 ± 50 psi. Release switch on pilot's wheel.

(k) Repeat step (j) at copilot's position.

(l) Pull the parking brake handle to full on position. The gages at the brakes must read 1300 ± 50 psi. Release the parking brake.

(m) Pull the right-hand emergency brake handle. The gage on the right strut must read 600 ± 50 psi. Release the handle.

(n) Pull the left-hand emergency brake handle. The gage on the left strut must read 600 ± 50 psi. Release the handle.

(o) Pull both emergency brake handles to full on. Both gages must read 600 ± 50 psi. Release the handles.

(p) Repeat step (g) to remove all air from brakes.

(q) Recharge the emergency brake air bottle to 1500 psi.

(r) Set the parking brake and shut off pump and master battery switch. The pressure at the brakes must not drop below 1000 psi in 30 minutes. Release brakes.

(s) Remove brake gages and wire bleed plugs.

NOTE

During the above tests the auxiliary pump may cut in depending on the speed at which the brakes are applied. The pump should cut in at approximately 2200 psi. Applying full parking brake will result in the pressure dropping to approximately 1800 psi momentarily. Normal single and double foot-brake applications will result in pressure dropping to approximately 2200 psi. After the system has been thoroughly operated, and the pumps have run approximately 15 minutes, the system should not load oftener than once every 5 minutes. This time will increase depending on length of operation until a maximum time of 15-20 minutes is obtained. However, once every 5 minutes, is considered satisfactory.

j. INDIVIDUAL UNITS OF THE POWER BOOST SYSTEM.

(1) HYDRAULIC PUMP. (Vickers AA-2038)

(a) DESCRIPTION. (See figures 6 and 7.)

1. The pumps deliver a non-pulsating flow of hydraulic fluid under continuous working pressure in varying volume as required for operation of the equipment in the hydraulic system. The pumps are powered by the propeller shafts through V-belts. Each unit weighs about 16 pounds.

2. The unit is a nine-cylinder, piston type pump with pressure and volume automatically regulated by a pressure control incorporated on the unit.

3. The housing encloses all of the component parts of the pumping unit except the pressure control body, which is accessible for adjustment.

a. The pumping unit -- consisting of the valve block, the valve plate, the cylinder block, and the drive shaft and pistons subassembly -- is placed in the main bore of the housing. The drive shaft is sealed by the use of an oil seal assembly which is secured by a retainer. The cylinder block is enclosed and supported by a yoke, on which the valve block is also mounted. The yoke swivels on the two pintle subassemblies and is linked directly to the pressure control.

b. The pressure control consists of two main parts: the pressure control body and the pressure control cylinder. The pressure control body houses the pilot valve which regulates the flow of fluid to the pressure control cylinder. The cylinder is spring loaded, and mechanically linked to the yoke.

(b) OPERATION.- Operation is fully automatic since the pumps are designed to build up and maintain pressure without manual control. The pressure is maintained within a preadjusted range, and ready for use in the amount required within this range. The pumps operate at maximum volume up to the predetermined pressure setting, at which time the pressure control cuts in.

(c) MAINTENANCE.- The most important maintenance is to keep the system free from air, water, and foreign matter. During the overhaul or repair of the pump, which should be done at a repair depot, all gaskets and seals that have been removed must be replaced with new ones. The use of an air hose for cleaning or drying is not recommended either on or near hydraulic equipment because of the presence of moisture and foreign matter in the air stream.

(d) REMOVAL.- (See figure 8.) Access is gained through the panel at the bottom of the propeller shaft housing at the trailing edge of the wing flap. The pump itself, not including the pulley bracket, can be removed by removing the four bolts on the mounting flange. Disconnect and cap the pressure and suction lines.

(e) DISASSEMBLY AND ASSEMBLY.- This should be done at a repair depot.

(f) INSTALLATION. (See figure 8.)- If installing both pumps, install the upper one first. If the pulley bracket is to be installed at the same time, the pump and pulley bracket may be assembled before installation providing the propeller shaft has been removed.

CAUTION

Fill case of pump with hydraulic fluid before starting it.

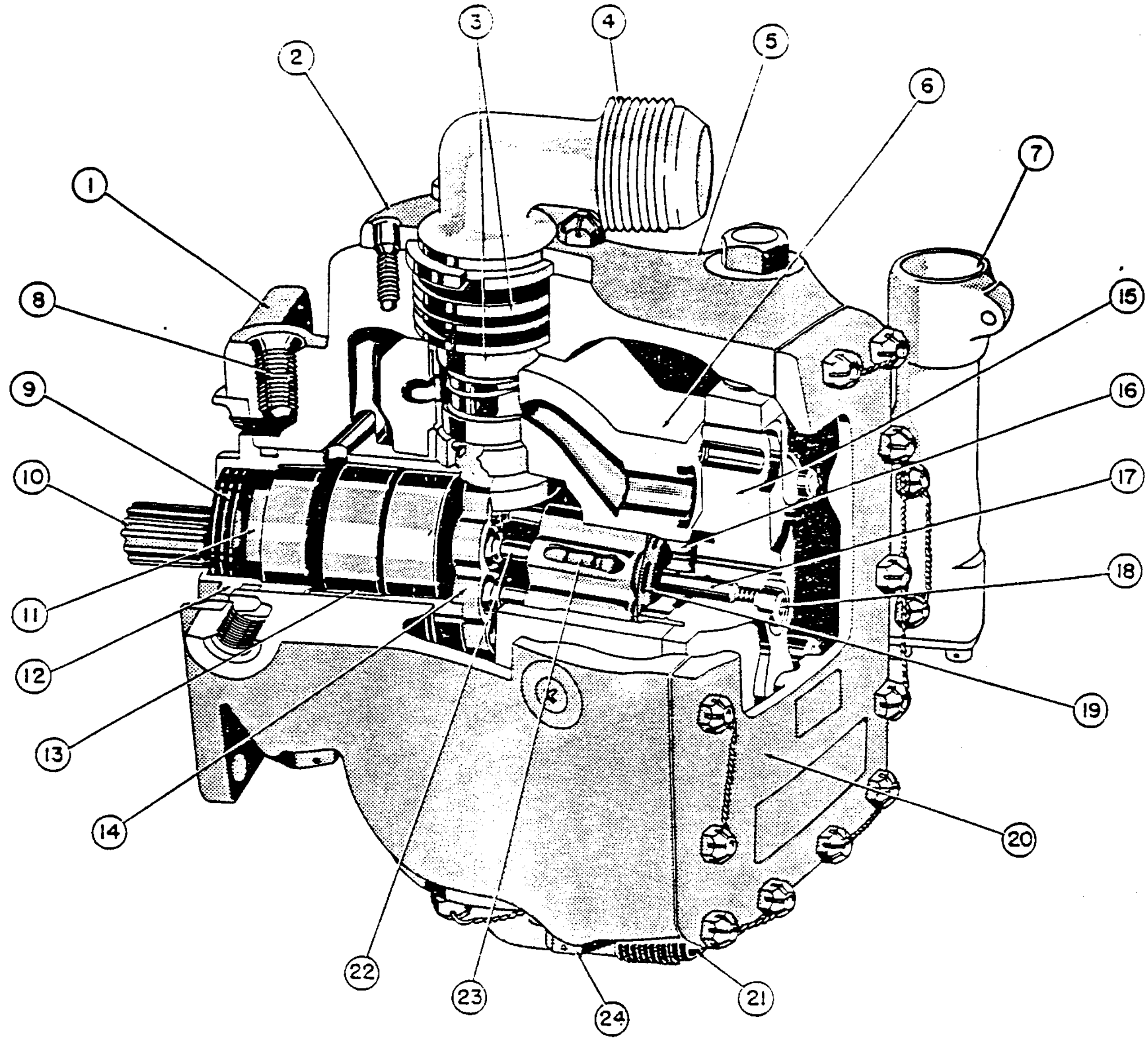
1. Coat the drive spline with lubricant Specification No. AN-G-3. Apply a thin coat of the same lubricant or hydraulic fluid to all nipple male threads using care to keep lubricant from the leading threads.

2. Make certain that the mounting surfaces are smooth and clean; set the pump in place.

3. Install and tighten the mounting bolts evenly and firmly.

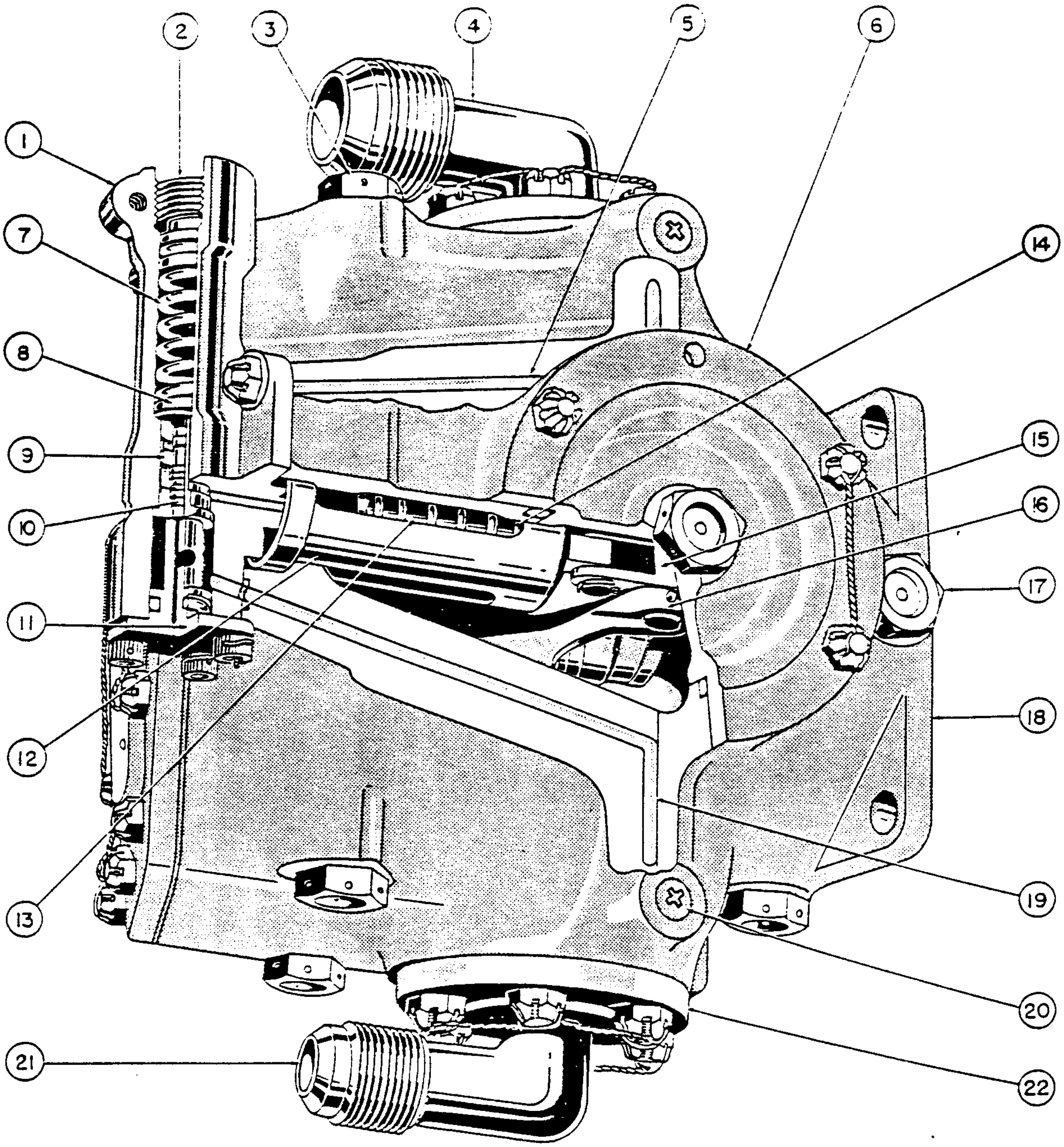
4. Install and tighten the V-belts. See paragraph 16 j (3).

5. Connect hydraulic lines and bleed the system.



1 MOUNTING FLANGE	13 DRIVE SHAFT BEARINGS
2 ELBOW FLANGE	14 DRIVE SHAFT & PISTONS SUBASSEMBLY
3 PINTLE	15 VALVE BLOCK
4 INLET ELBOW	16 VALVE PLATE
5 PUMP HOUSING	17 CYLINDER BEARING PIN
6 YOKE	18 CYLINDER BEARING PIN RETAINING SCREW
7 PRESSURE CONTROL BODY	19 CYLINDER BLOCK
8 COUPLING CHAMBER SEEPAGE CONNECTION	20 REAR COVER
9 OIL SEAL ASSEMBLY	21 OUTLET ELBOW
10 COUPLING SHAFT	22 CONNECTING ROD
11 SEALING RING RETAINER	23 PISTON
12 OIL SEAL RETAINER	24 DRAIN CONNECTION

Figure 6. Hydraulic Pump - Pumping Unit View



1. PRESSURE CONTROL BODY
2. PRESSURE CONTROL ADJUSTING SCREW
3. DRAIN CONNECTION
4. INLET ELBOW
5. INTERNAL PRESSURE PASSAGES
6. SIDE COVER
7. SPRING
8. PILOT VALVE SEAT
9. PRESSURE CONTROL BUSHING
10. PRESSURE CONTROL PILOT VALVE
11. PRESSURE CONTROL BODY FLANGE
12. PRESSURE CONTROL RETAINER
13. PRESSURE CONTROL CYLINDER
14. PRESSURE CONTROL SPRING
15. PRESSURE CONTROL LINK
16. YOKE BRACKETS
17. COUPLING CHAMBER SEEPAGE CONNECTION
18. MOUNTING FLANGE
19. INTERNAL PRESSURE PASSAGES
20. SEALING SCREW
21. OUTLET ELBOW
22. ELBOW FLANGE

Figure 7. Hydraulic Pump - Pressure Control View

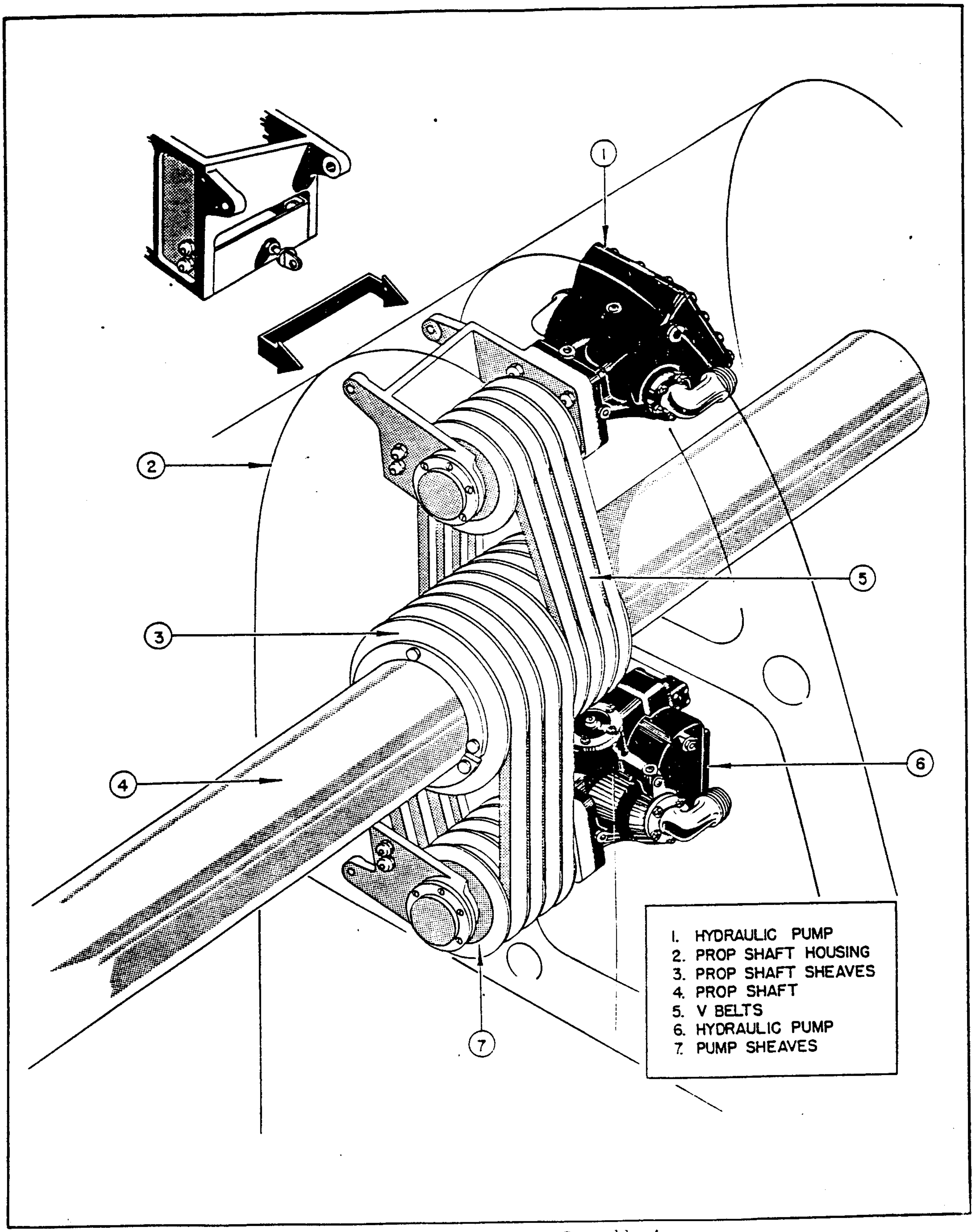


Figure 8. Hydraulic Pump Installation

CAUTION

When attaching lines to flexible joints, make certain tubing is the right length. Do not throw joint out of line to make a fit. When tightening nuts, hold flexible joint securely to prevent tightening torque from twisting or misaligning flexible joint.

(g) ADJUSTMENT.

1. Two adjustments may be made on these pumps. Adjustment of the pump should not be made while the pump is installed on the airplane. Adjustment of the pressure control should not be necessary except for pump overhaul. The pressure control is closely adjusted within limits at the factory, and pressures of all pumps are closely synchronized with each other.

2. To adjust the pressure control, turn the pressure control adjusting screw (See figure 7.) in to raise, or out to lower, until it cuts out at 2000 psi and in at 1850 psi.

(h) LUBRICATION.- Lubrication of the internal parts of the pump is provided by the hydraulic fluid. The splined coupling shaft should be lubricated with graphite grease, Specification AN-G-6.

(i) TEST.- Test should be conducted with a modified closed circuit supercharged from an external source to not less than 15 psi nor more than 25 psi.

1. DESCRIPTION.

a. A simple test set-up that meets these requirements (see figure 9) includes a motor, a 10-inch accumulator fitted with an "X" fitting and a capped filler pipe, a volume control valve, a flowmeter (or a Vickers MF-713 hydraulic motor), two hydraulic pressure gages, and an air vent.

NOTE

In making the tests that are described in the following paragraphs, use only AN-VV-O-366 (red) fluid. The temperature of the fluid should be approximately 50°C (120°F).

b. The pumps must always be driven through a coupling shaft incorporating a shear section that will shear at a torque load of approximately 1800 inch-pounds.

2. PREPARATORY STEPS.- Since these tests are to be made in a closed, supercharged circuit, it is important that the following preparatory steps be observed carefully:

a. Bolt the pump to the electric driving motor so that the inlet and outlet elbows lie in a vertical plane.

b. Attach the line leading from the accumulator to the inlet elbow of the pump, and attach the pressure line to the outlet elbow.

c. Open the air chamber of the accumulator to atmospheric pressure and fill the accumulator with hydraulic fluid, using a stand pipe that is high enough to assure an adequate displacement of the accumulator diaphragm. Replace the cap in the filler opening and tighten it securely.

d. Remove one of the hexagonal plugs from the top of the housing (not at the flange), and completely fill the housing with fluid.

e. Attach the drain line of the set-up to the hole through which the housing was filled. The drain line and the return line must be placed higher than the highest part of the housing.

f. Open the petcock at the vent and turn the motor and pump by hand in order to draw fluid into -- and expel air out of -- the pumping unit. Continue until fluid begins to flow from the vent line.

g. Close the vent and charge the accumulator with 25 psi air pressure. This pressure will be shown in gage "A." (See figure 9.) Continue to rotate the motor and pump by hand a few times, cracking the vent line once in a while until a solid flow of fluid is ejected from the vent line. Then close the vent.

h. Recharge the accumulator to 25 psi pressure. Start the pump in operation. Open the vent line a few times to be sure all air is eliminated from the system. The air pressure in the accumulator should be maintained at 20 psi. If it is too low after the system is completely bled, add more air; if the pressure is too high, open the vent line until the pressure drops to 20 psi.

3. RUN-IN.- Run the pump for approximately 15 minutes at about 3600 rpm at not more than 200 psi outlet pressure, as regulated by the volume control valve installed in the outlet line and shown by gage "B" (see figure 9).

NOTE

All pressures stated hereafter are "net;" that is, not including supercharge pressure shown on the return line gage, and must be corrected for the prevailing supercharge. In other words, the amount of supercharge pressure must be subtracted from the pressure shown on the high-pressure gage while making the tests.

4. REGULATION OF THE PRESSURE CONTROL.- This test must be conducted at approximately 3600 rpm, with the temperature of the fluid at about 50°C (120°F).

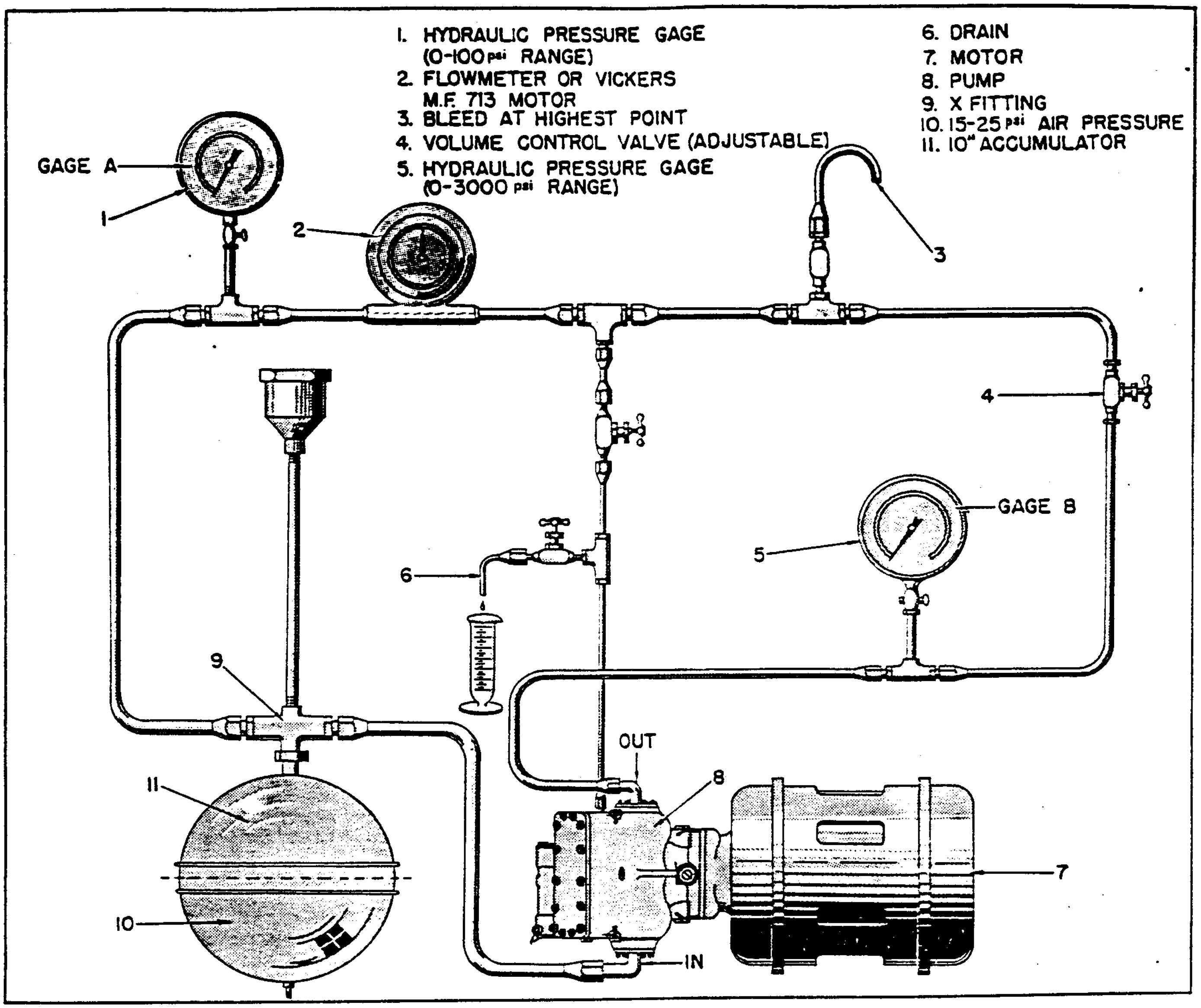


Figure 9. Hydraulic Pump Test Set-Up

a. Close the volume control valve in the outlet line. Loosen the lock screw at the pressure control adjusting screw. Then turn the pressure control adjusting screw (figure 9) in to raise or out to lower until gage "B" indicates the correct cut-out pressure. Tighten the locking screw at the adjusting screw.

b. Open the volume control valve slowly while watching the pressure gage. The pressure gage hand will flutter slightly when the pressure drops to the cut-in point of the pressure control, 1850 psi.

c. Double check the preceding operation by first opening the volume control valve fully. Then close it gradually while watching the pressure gage. The cut-in point will be indicated by a slight flutter of the gage hand which will continue to rise as the volume control valve is being closed. When the valve is completely closed, the pressure reading on the gage should be the same as that for which it was first adjusted at the cut-out point.

5. DELIVERY.- The delivery rate for this pump is .600 cu. in. per revolution at 1800 psi.

a. Sudden changes in output, including complete shut-off of the valve should not be accompanied by continued fluttering of the pressure gage hand in the pressure outlet line.

b. When the valve in the pressure line is completely closed for any continued length of time (not more than five minutes), the pressure must not rise more than 25 psi above, nor fall more than 25 psi below, the original cut-out pressure.

6. INTERNAL LEAKAGE.- Open the shut-off valve "C" and close valve "D." (See figure 9.) Operate the pump at approximately 3600 rpm, against maximum pressure. The total leakage flowing out of the open drain connection must not exceed 800 cc's per minute.

7. EXTERNAL LEAKAGE.- Check again while conducting these tests to be sure that no external leakage occurs. There is, however, an allowable leakage at the drive-shaft oil seal. This leakage shall not be more than five drops in 15 minutes.

(2) FLEXIBLE SWIVEL JOINT (Barco SK2219 and SK2220) (See figure 10).

(a) DESCRIPTION.- Flexible swivel joints are used at each pump installation in the power boost system. The joints are designed to swivel and to take a 20° flex.

(b) REMOVAL AND DISASSEMBLY.- The units are easily removed by disconnecting the hydraulic lines. Refer to figure 10 for disassembly.

(c) TEST.

1. Attach a hydraulic line to the stationary part of the joint. Flow sufficient fluid through the joint to bleed all air. Cap rotating port. Apply 3000 psi for three

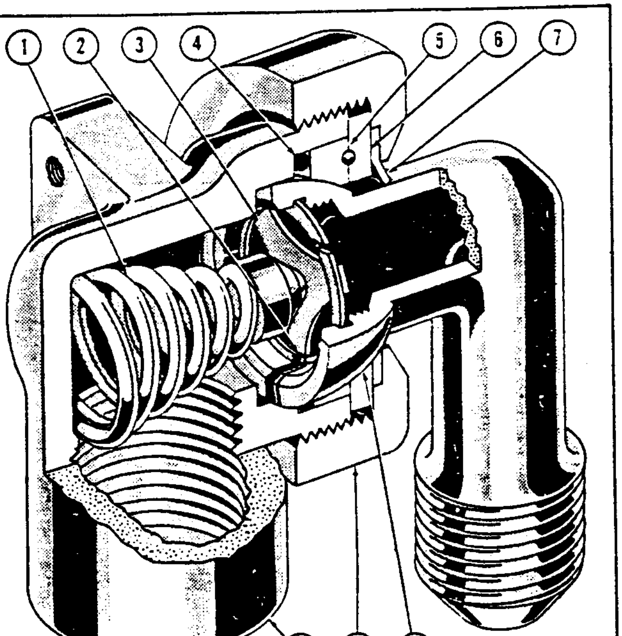


Figure 10. Flexible Swivel Joint

minutes. There should be no leakage while the unit is intermittently rotated 360°.

2. Reduce pressure to 10 psi for three minutes. There should be no leakage.

(d) ASSEMBLY AND INSTALLATION.- Refer to figure 10 for assembly. When installing the unit, make certain that tubing is the correct length and that the flexible joint is not thrown out of alignment just to make a fit. Also, when tightening the hydraulic fittings, hold the joint securely to prevent twisting the unit out of alignment. After the unit is installed, bleed the system.

(3) V-BELTS.

(a) DESCRIPTION.- Eight V-belts are driven by a pulley on each of the propeller drive shafts, and drive the two hydraulic pumps in each propeller-shaft-housing hydraulic unit. The belts are made of rubber base, pre-stretched cords and are two-ply fabric covered. An adjustable pulley bracket, mounting a four grooved pulley, provides the means for keeping the belts taut. Each pump is assembled to a pulley bracket; the lower pump is installed directly below the propeller drive shaft, the upper pump, directly above the shaft.

(b) MAINTENANCE.- No maintenance of the belts is required other than that they be kept very taut and centered. The belts are tightened by adjusting the bolt on the pump pulley bracket.

(c) REMOVAL AND INSTALLATION.- The V-belts can only be removed or installed after the propeller shaft has been removed. See removal of propeller shafts, Section IV, paragraph 10 d (3).

CAUTION

The belts have a part number and a matching number which is stamped in white. Belts driving any one pump should have the same matching number.

(4) HYDRAULIC RESERVOIR.

(a) DESCRIPTION. (See figures 11, 12, and 13)- Each hydraulic reservoir in the power boost system holds 3.8 U.S. gallons and incorporates a filter with a relief valve. Air pressure is admitted to the reservoir through the aspirator port and remains at about 25 psi. The reservoir has a visual type gage with two indicated levels marked "A" and "B." The "A" mark is for maximum hydraulic fluid level and "B" for minimum.

(b) OPERATION.- The reservoir is pressurized automatically with air to approximately 25 psi by an aspirator. The filter for the system is contained within the reservoir.

(c) REMOVAL. (See figure 12.)

1. INBOARD RESERVOIRS. (The two reservoirs are located in the two inboard propeller-shaft nacelle housings.)

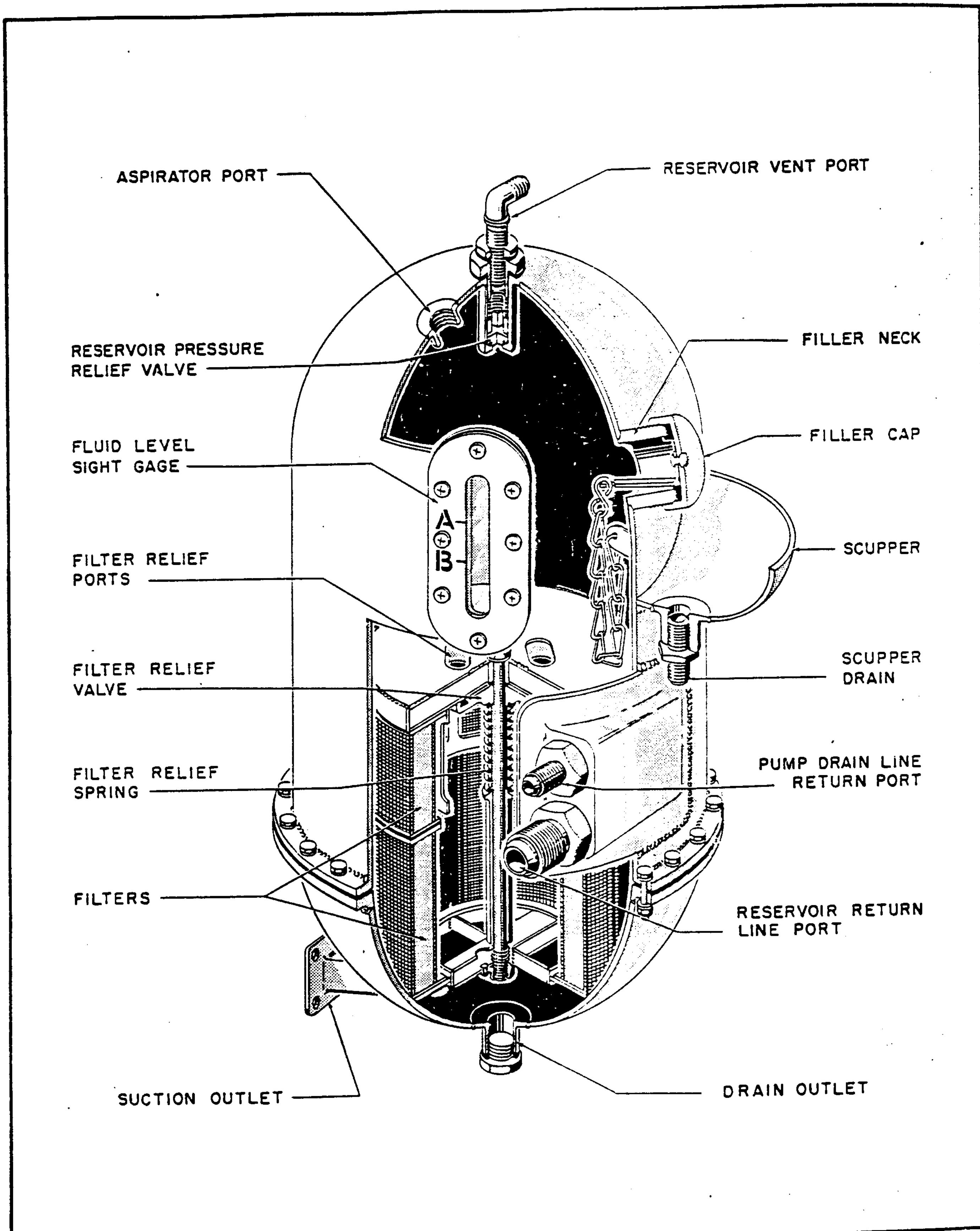


Figure 11. Hydraulic Reservoir

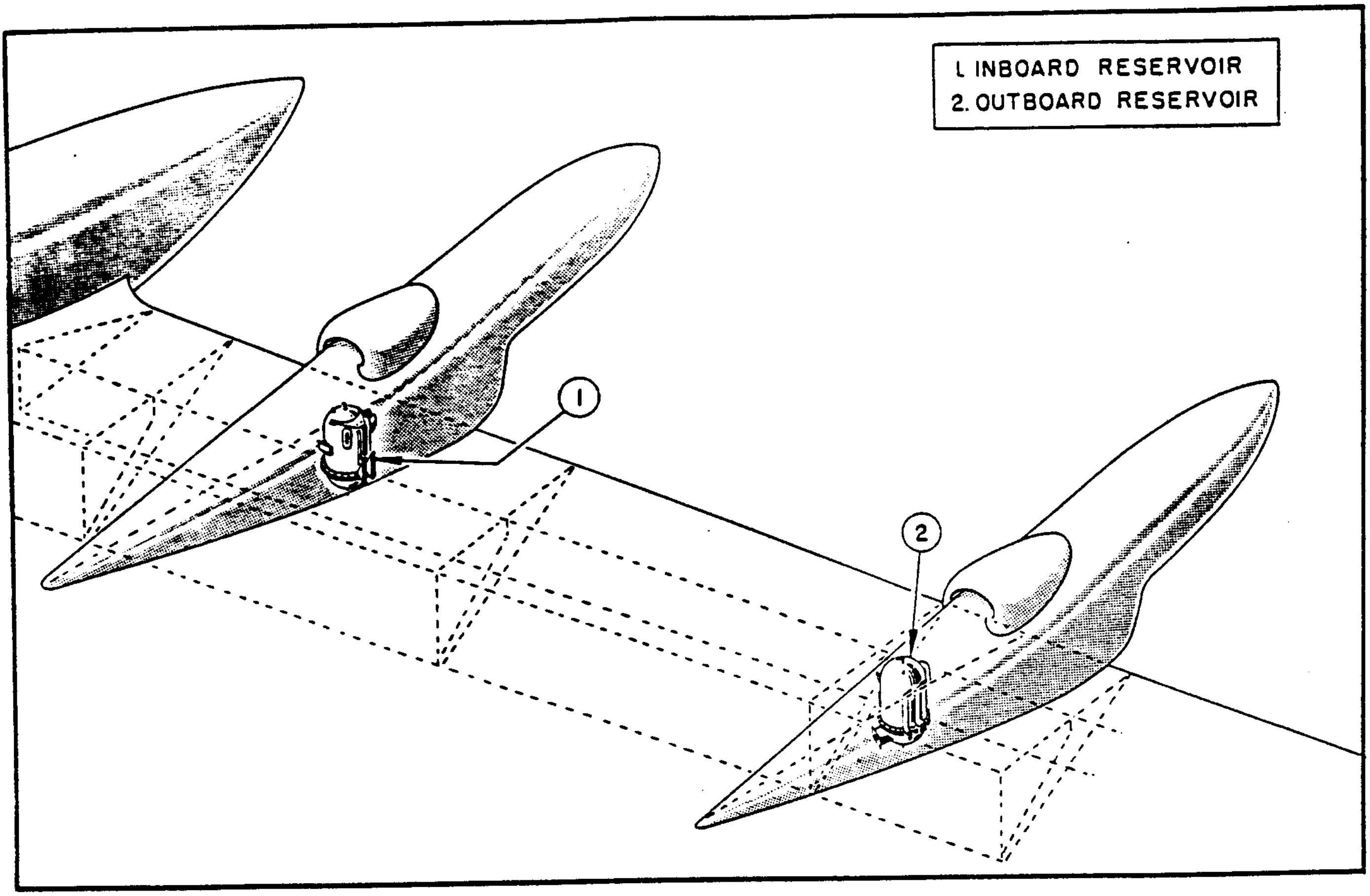


Figure 12. Hydraulic Reservoirs Installed

a. Remove access plate cover from the wing structure directly below the reservoir.

b. Disconnect the necessary hydraulic lines (pressure lines, suction lines, return lines), and disconnect the bracket attaching the scupper line to the wing structure. Cap all the disconnected lines immediately.

c. Remove the six screws, washers and nuts that attach the reservoir bracket to the propeller-shaft nacelle housing.

d. Remove the reservoir from the airplane with the bracket on the reservoir.

2. OUTBOARD RESERVOIRS.

a. Each outboard reservoir is installed adjacent to and just inboard of the propeller-shaft housing, and is accessible at the trailing edge of the wing with flaps lowered.

(d) DISASSEMBLY.- Refer to figure 11.

(e) ASSEMBLY.- Refer to figure 11.

NOTE

When assembling the filter unit, do not tighten bolt more than 25 inch-pounds.

(f) SERVICING.- Fill reservoirs only with AN-VV-O-336 fluid. Fill outboard reservoirs through the top of the skin just inboard of the propeller shaft. Each inboard reservoir is filled from the outboard side of the propeller shaft housing.

(g) PRESSURIZING TEST.

1. This test may be made during the course of making the boost system operation test - Part I and Part II. See paragraphs 16 i (1) (a) and (b).

2. With system pressure at zero, fill the reservoir to the proper level.

3. Connect a 50 psi gage into each reservoir to register reservoir pressure.

4. Start the test stands and as soon as system pressure is at 2000 psi, start timing the rise in reservoir pressure. Do not operate any controls during this period.

5. The pressure gage should read 23 to 27 psi within a minimum of 10 minutes, if not, test the individual units of the reservoir pressurizing system.

(5) RESERVOIR ASPIRATOR. (See figure 13.)

(a) DESCRIPTION.- An aspirator is used to pressurize the reservoir with air to

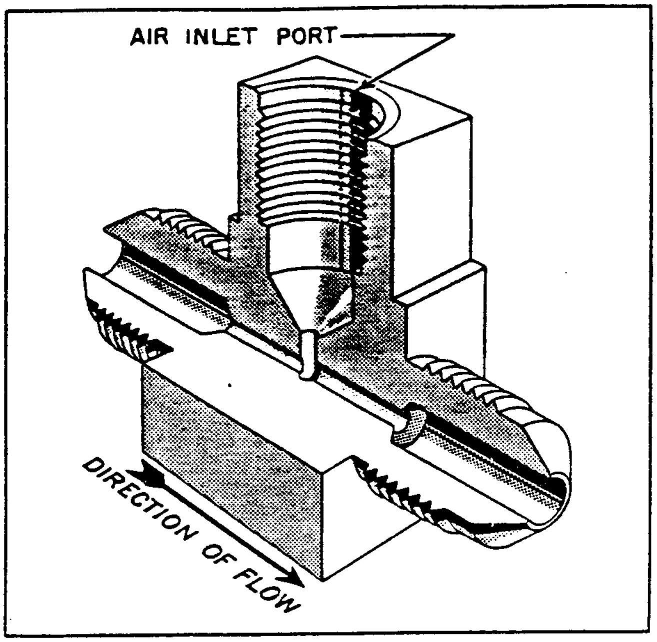


Figure 13. Reservoir Aspirator

approximately 25 psi. It is installed in the reservoir pressurizing line near the reservoir. The aspirator draws in air from the atmosphere through an air filter and a check valve. See figures 1 and 2.

(b) REMOVAL.- The unit is easily removed by disconnecting and capping the hydraulic lines.

(c) TEST.- Make the test set-up as follows: connect a pressure line having a 2000 psi hydraulic gage to the aspirator at the in port. To the air port of the aspirator connect a 30 in. Hg vacuum gage. Allow the remaining port to be open.

1. Increase pressure to 500 psi.

2. The vacuum gage must read 22 in. Hg minimum.

3. The gage reading should increase steadily and remain constant at 500 psi. Any tendency toward unstable readings should be checked by a complete inspection of the part.

4. Apply 500 psi and measure the flow rate through the aspirator. The flow rate shall be within the limits of .60 to .70 gpm.

(d) INSTALLATION.- Be certain when installing the aspirator that the arrow on the unit is pointing in the direction of hydraulic flow.

(e) RELIEF VALVE. (Vickers AA-11348) See figure 14.

(a) DESCRIPTION.- The relief valve for each pumping unit in the system is mounted below the propeller shaft, aft of the hydraulic pumps. The valve consists of a housing having two pressure ports and two return ports.

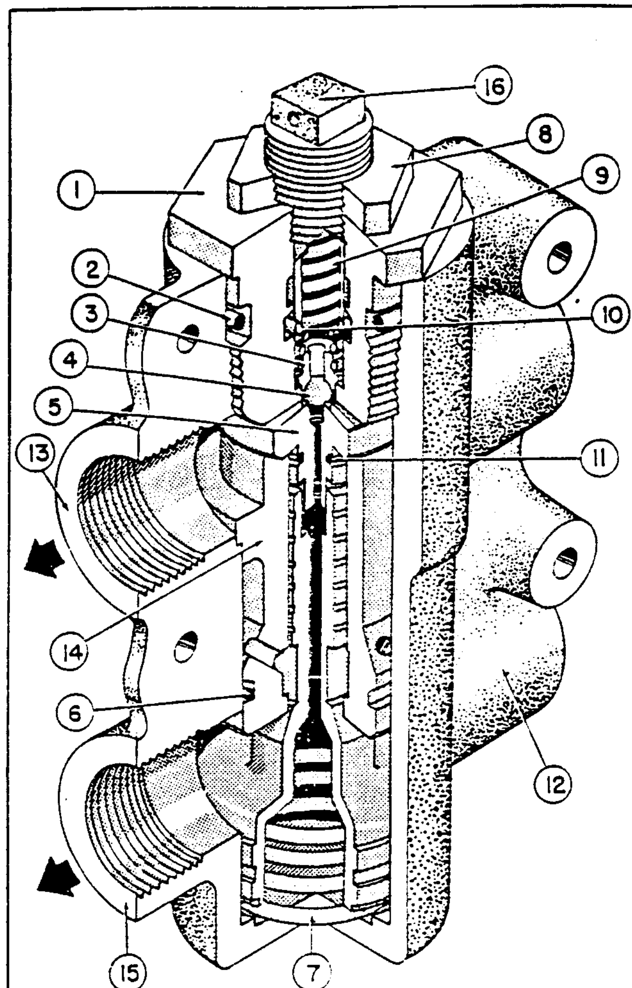


Figure 14. Relief Valve

A central bore in the housing contains all of the working parts of the valve. These parts are held in place in the housing by a large retainer through which protrudes an adjusting screw used to regulate the pressure range. One of the return ports is not used and is plugged. The operation of the relief valve is automatic. The valve remains closed until pressure in the system reaches 2150 psi, then the valve opens allowing the pressure to return to the reservoir while pressure control is maintained.

(b) REMOVAL.- Disconnect and cap the hydraulic lines to the unit, and remove the four mounting screws.

(c) DISASSEMBLY.- Refer to figure 14. To replace spring or packings, remove the jam nut near the relief port and unscrew the adjusting screw.

NOTE

To remove the spool and sleeve subassembly insert a wood dowel in each of the pressure ports and press upward on the bottom of the sleeve. This will also release the spring. (Reference 7, figure 14.)

(d) ASSEMBLY.- Refer to figure 14. When threading retainer into its housing, screw down securely.

CAUTION

Do not attempt to tighten the retainer down excessively; to do so will damage the sleeve.

Since the retainer holds the sleeve and spool subassembly in place, be certain subassembly is firmly seated in place and that the spool will operate freely when it is pressed down against the spring and allowed to spring up against the seat.

NOTE

Make certain that the seal (reference 10, figure 14) is in its proper recess and not being retained at the base of internal threads.

(e) TEST.

1. Make test set-up as shown in figure 15.

2. Open the manual shut-off valve. Gradually open the pressure valve until 2150 psi cracking pressure is reached. Oil must break from the fitting and flow over the sides to determine cracking pressure. The valve must not show signs of seepage below 1940 psi. However, a leakage of four to five drops per minute above 1500 psi is normal.

3. Close the manual shut-off valve and increase the pressure until six gpm is flowing through Rotometer. Pressure must not exceed 2365 psi at six gpm.

4. Gradually reduce pressure to 2000 psi. Open the manual shut-off valve and allow the valve one minute to seat. Leakage must not exceed five drops per minute. The valve must reseat above 1940 psi.

5. Remove the unit from test set-up and cap both return ports and one pressure port. Apply 3000 psi for three minutes to the pressure port. There should be no external leakage. Release pressure.

(f) INSTALLATION.- Remount the unit on the bracket with the four screws. Reconnect the lines and bleed the system.

(g) ADJUSTMENT.- Adjustment of pressure is accomplished by loosening the jam nut and turning the adjusting screw; turn the screw clockwise to increase pressure.

NOTE

Remove the unit from the airplane for adjustment.

(7) SOLENOID CONTROL VALVE (Normally closed) (General Controls 40R629) See figure 16.

(a) DESCRIPTION.- These valves are operated by a pilot piston which is controlled by an integral electro-magnet pilot valve. The valves are packless in construction, having metal-to-metal seats throughout. These valves are used in the cross-transfer system. See figures 1 and 2. The valve is normally closed but is opened magnetically and automatically when energized by the hydraulic pressure switch in the hydraulic system.

(b) OPERATION. (See figure 16.)

1. VALVE CLOSED.- With the pilot-valve magnet de-energized, the pilot-valve armature is on its seat allowing no pressure to be applied to the pilot piston. Valve inlet pressure is in the main valve ball chamber and also in the pilot-valve chamber through the inlet passage. Thus the pressure and ball spring hold the valve ball firmly in place on the valve seat preventing fluid flow through the valve.

2. TO OPEN VALVE.- When the pilot-valve magnet is energized, the pilot-valve armature is magnetically lifted from its seat. This allows inlet pressure to flow into the pilot-piston cylinder. This pressure forces the pilot piston downward over-

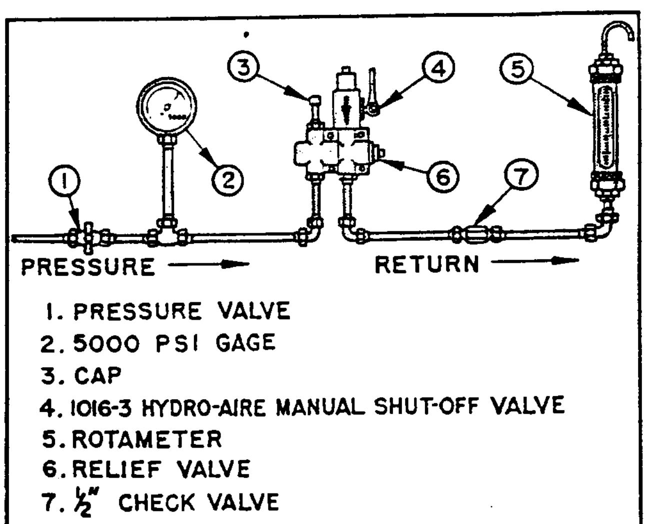
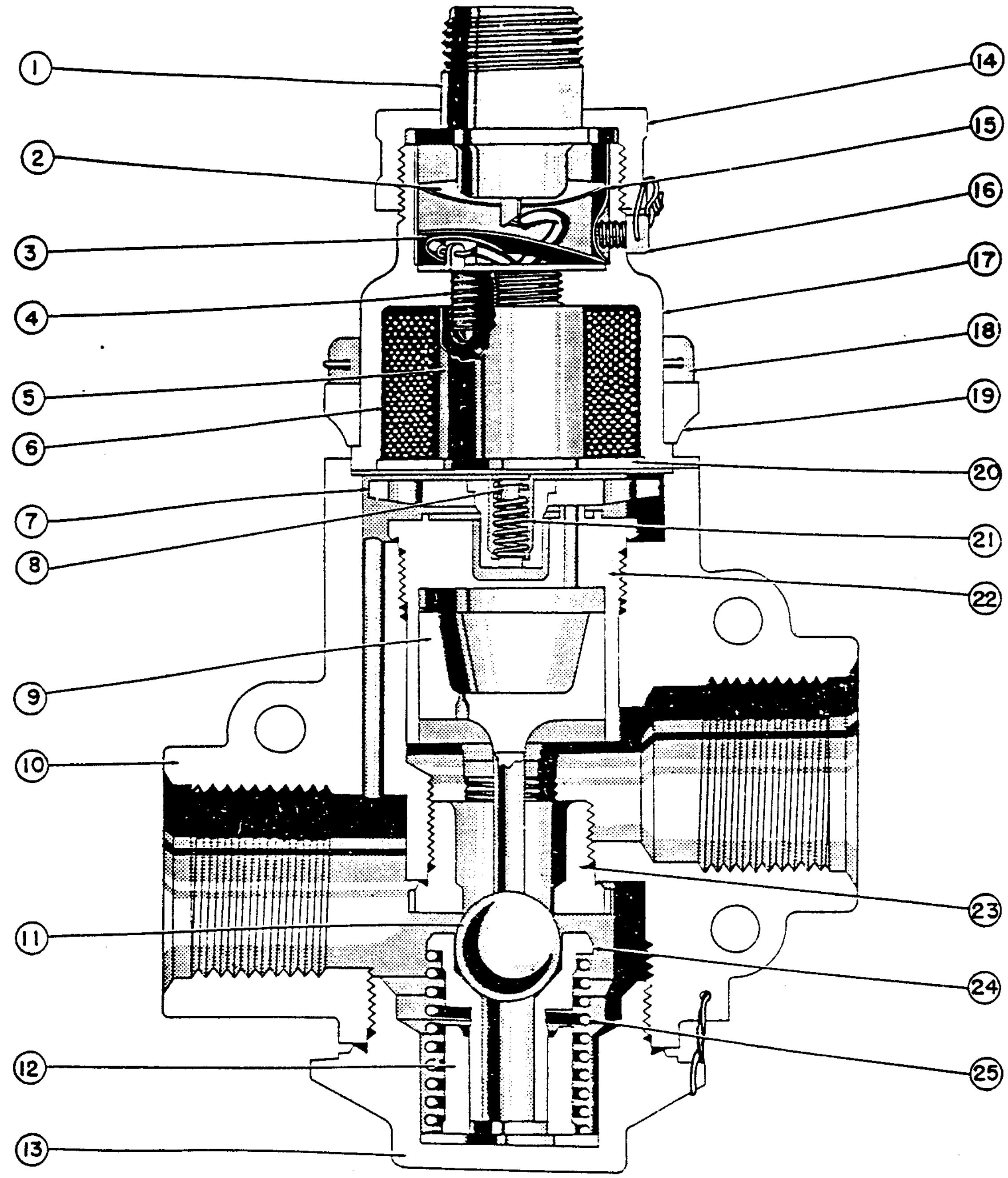


Figure 15. Relief Valve Test Set-Up



1. ELECTRICAL CONNECTOR
2. INSULATING DISC
3. INSULATING DISC
4. CORE LOCK SCREW
5. COIL
6. COIL CORE
7. ARMATURE
8. SPRING GUIDE
9. PISTON
10. BODY
11. VALVE BALL
12. BALL GUIDE
13. BOTTOM CAP
14. UNION NUT
15. WALL INSULATOR
16. SAFETY WIRE SCREW
17. COIL HOUSING
18. FLANGE SCREW
19. FLANGE
20. BACKER PLATE
21. SPRING
22. PILOT VALVE SEAT
23. MAIN VALVE SEAT
24. BALL RETAINER
25. SPRING

Figure 16. Solenoid Valve - Normally Closed

coming the inlet pressure force and the spring force on the valve ball, opening the valve port and allowing fluid flow through the valve.

3. TO CLOSE VALVE.- The pilot-valve magnet is de-energized allowing armature spring to return pilot-valve armature to its seat, shutting off pressure flow to the pilot-piston cylinder. The fluid pressure above the piston is relieved through an orifice in the piston, releasing the main-valve ball. This allows the main-valve spring to return the valve ball to its seat closing the valve port. Thus fluid flow through the valve is shut off.

(c) MAINTENANCE.- No maintenance is required between major overhauls.

(d) REMOVAL.- Location of valve is shown in figure 1. Disconnect and cap the hydraulic lines. Disconnect the electrical plug. Remove the three mounting bolts.

(e) DISASSEMBLY.- Refer to figure 16.

CAUTION

Do not remove pilot-valve seat from valve body. This seat is installed in the body prior to final machining of the magnet mounting shoulder in order to obtain the proper armature lift.

(f) ASSEMBLY.- Refer to figure 16.

NOTE

It is important that all flange screws be tightened evenly to prevent external leakage. Bring all screws to contact, then tighten by turning each screw one-quarter revolution at a time.

(g) TEST.

1. Connect a hydraulic pressure line to the inlet port (in direction of arrow); also connect a 24 volt d.c. electrical source through an on-off switch to the electrical connection.

2. Operate the valve several times at low flow and pressure settings to check for correct operation.

3. With the valve in the off position, apply 3000 psi for three minutes; leakage of two drops in three minutes is allowable.

4. Repeat step three at 2000 psi for three minutes; leakage of two drops in three minutes is allowable.

5. Cap outlet port and energize valve. Apply 3000 psi for three minutes. There should be no external leakage.

6. Apply 2000 psi and operate the valve several times to check for correct operation.

(h) INSTALLATION.- Mount the unit and connect the hydraulic lines. Make the electrical connection and bleed the system.

(8) SOLENOID CONTROL VALVE. (Normally open) (General Controls 40R698) See figure 17.

(a) DESCRIPTION.- These valves are operated by a ball-type valve which is controlled by an integral electro-magnet pilot valve. The valves are packless in construction having metal-to-metal seats throughout. The valve is normally open, but is closed magnetically and automatically when energized by a pressure switch in the system. The valve is installed in each shaft-housing hydraulic system and in the pressure line to each elevon actuating cylinder.

(b) OPERATION. (See figure 17.)

1. VALVE OPEN.- With the pilot valve demagnetized, the pilot-valve ball is off its seat allowing pressure to be applied on the main-valve piston. Valve inlet pressure is in both ball chambers through the inlet passage. Thus the pressure on the main-valve piston overcoming the spring pressure on the main-ball valve allows fluid flow through the valve.

2. TO CLOSE VALVE.- When the pilot-valve magnet is energized, the pilot-valve armature is lifted and the pilot ball seats by spring pressure, shutting off inlet pressure to the main valve chamber. As the main-valve ball is seated by spring pressure, fluid is bled from the main-valve chamber through the small orifice. Thus the valve, closed by spring pressure, shuts off fluid flow.

3. TO OPEN VALVE.- The pilot-valve magnet is de-energized allowing the pilot valve to open by spring pressure and permitting fluid pressure to flow into the main-valve piston. Thus, the fluid pressure overcomes the main-valve spring pressure and the main ball is unseated, allowing fluid to flow through the valve.

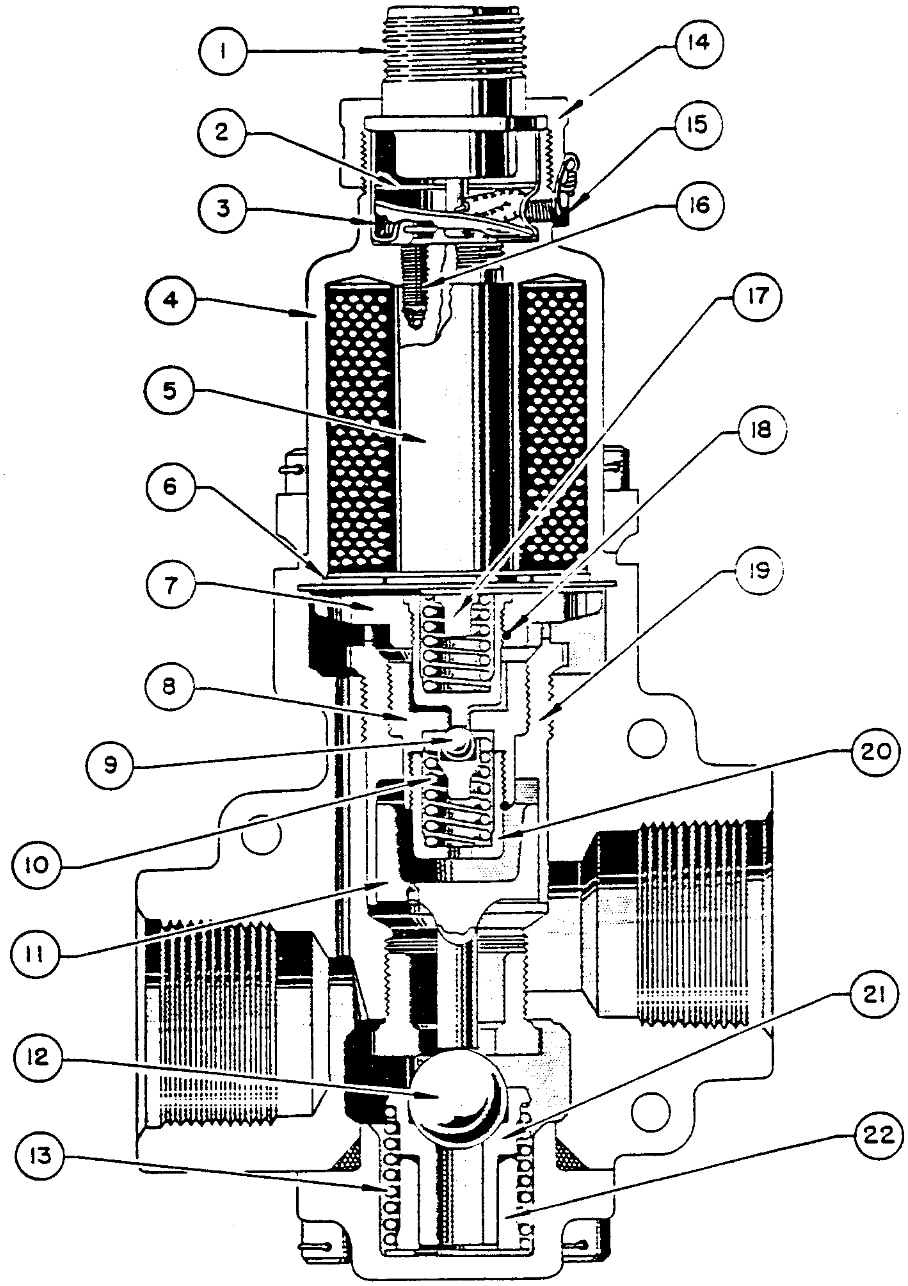
(c) MAINTENANCE.- No maintenance is required between major overhauls. The trouble shooting instructions given in paragraph 16 b (2) (c) can be used as a guide for this valve.

(d) REMOVAL.- Access to the valves for the elevon unit is through the access door in the underside of the outer wing. See figure 1. Disconnect and cap the hydraulic lines. Remove the electrical connection and remove the three mounting bolts.

(e) DISASSEMBLY AND ASSEMBLY.- Refer to figure 17. Refer to precautions in paragraphs 16 j (7) (e) and (f) preceding.

(f) TEST.- Test the unit before installation as follows:

1. Connect a hydraulic pressure line to the inlet port (in direction of arrow); also connect a 24 volt d.c. electrical source



1.	ELECTRICAL CONNECTOR	12.	BALL
2.	INSULATING DISC	13.	SPRING
3.	WALL INSULATOR	14.	CONNECTOR UNION NUT
4.	COIL HOUSING	15.	SAFETY WIRE RETAINING SCREW
5.	COIL CORE	16.	CORE LOCKING SCREW
6.	DIAPHRAGM	17.	VALVE SPRING GUIDE
7.	ARMATURE	18.	LOCKING PIN
8.	PILOT PORT SEAT	19.	VALVE CYLINDER
9	PILOT VALVE BALL	20.	PILOT SPRING RETAINING NUT
10.	PILOT VALVE SPRING	21.	BALL RETAINER
11.	VALVE PISTON	22.	BALL RETAINER GUIDE

Figure 17. Solenoid Valve - Normally Open

through an on-off switch to the electrical connection.

2. Operate the valve several times at low flow and pressure settings to check for correct operation.

3. With the valve in the "on" position apply 2000 psi for three minutes; leakage of four drops in three minutes is allowable.

4. Cap outlet port and place valve in "off" position. Apply 3000 psi for three minutes; there should be no external leakage.

5. Apply 2000 psi and operate the valve several times to check for correct operation.

(g) INSTALLATION.- Mount the unit and connect the hydraulic lines. Make the electrical connection and bleed the system.

(9) PRESSURE SWITCH. (Bendix 405050) See figure 18.

(a) DESCRIPTION.- The pressure switch is used to actuate the normally closed valves and the normally open valves at the reservoirs in the event of system pressure drop due to line or pump failure. The switch assembly is a combination electric and hydraulic device incorporating a very sensitive electric switch operated by a spring-loaded pin. The assembly consists of a cast aluminum body containing an adjustable spring, pin, and micro switch.

(b) OPERATION.

1. The micro switch is a normally closed type switch. Pressure applied at the port enters the packing chamber and causes the pin to compress the spring in the cap, thereby breaking contact with the micro switch. When this pressure drops, the compressed spring pushes the pin back to its original position making contact with the micro switch, closing the switch. The switch is actuated at 150 psi (max) and resets at 100 psi (min).

(c) MAINTENANCE.

1. In order that the unit operate correctly, it is imperative that the micro switch (reference 7, figure 18) be kept dry.

2. The adjustment of the springs (reference 16, figure 18) should be checked at the regular 25-hour inspection.

3. No lubrication is necessary.

(d) REMOVAL.- The switch is installed in the pressure line in each propeller-shaft-housing hydraulic system. See figure 1. Disconnect the electrical plug and the hydraulic lines. Cap the lines and remove the mounting bolt.

(e) DISASSEMBLY.- Refer to figure 18.

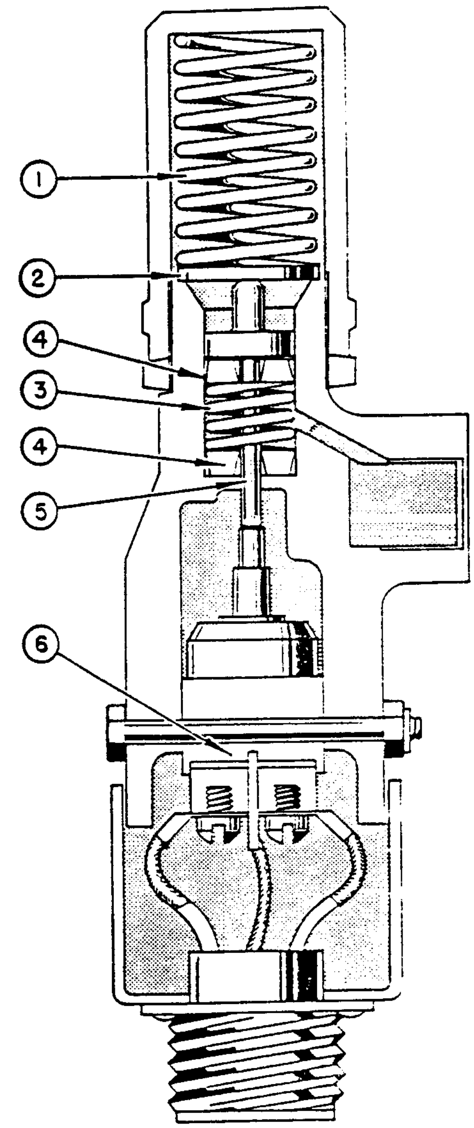


Figure 18. Pressure Switch

NOTE

It is not necessary to remove the hydraulic parts when removing the micro switch (reference 7, figure 18).

(f) ASSEMBLY.- See figure 18.

NOTE

The cups may be packed in petroleum jelly to facilitate assembly.

(g) TEST.

1. Connect the hydraulic pressure line to the inlet port. Connect a battery and light to the switch to check "open" and "close" pressure.

2. Apply hydraulic pressure until the microswitch opens. This pressure should not be less than 100 psi.

3. Apply 3000 psi for three minutes. There should be no leakage. Release the pressure.

(h) INSTALLATION.- Mount the unit and connect the hydraulic lines. Make the electrical connection and bleed the system.

(10) GAGE LINE FUSE. (Aireon 30004) See figure 19.

(a) DESCRIPTION.- A hydraulic fuse is installed in each of the gage lines to protect the system in the event of gage line failure. The fuse will close on a flow of 1 to 6 cu in. per minute.

(b) OPERATION.- The fuse is automatic in operation. A break in the gage line, and subsequent increase in flow, causes the shuttle to move to the gage line port side, seating on the "O" packing ring. In order to bleed the gage line, or when installing the fuse, the by-pass valve is pushed open to allow fluid to bypass the shuttle.

NOTE

If the airplane has not been operated for some time, and the gages do not show full hydraulic pressure after the engines have started, it may be necessary to bleed any gage line not showing full system pressure.

(c) REMOVAL.- Access is gained through the door panel on the underside of the propeller shaft housing.

1. Remove the two hydraulic lines from the unit.

2. Cap both lines.

(d) DISASSEMBLY.- Refer to figure 19.

(e) ASSEMBLY.- Refer to figure 19.

(f) TEST.

1. Make test set-up as shown in figure 20.

2. Open the line bleed valve and depress the bleed valve on the fuse. Open the pressure valve sufficiently to bleed the fuse. Close the pressure valve. Release the bleed valve. Close the line bleed valve.

3. Apply 3000 psi by opening the pressure valve. Place a beaker graduated in

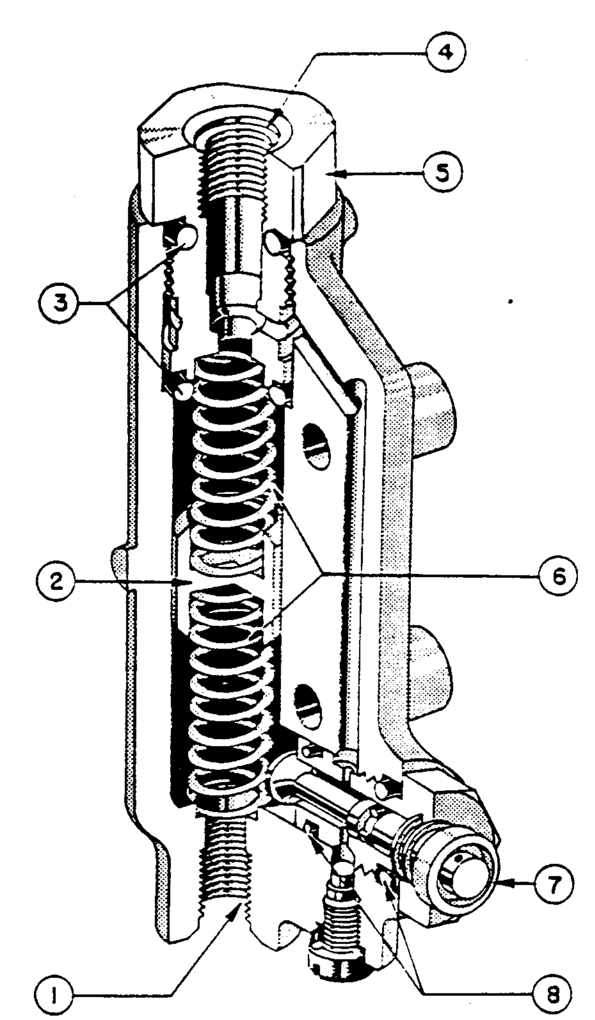


Figure 19. Gage Line Fuse

cubic inches under the bleed line. Graduall[y] open the line bleed valve until the fluid is flowing at the rate of 1 cu in. per minute. The fuse must not shut off this amount, or less than this amount. Close the pressure valve and bleed off pressure. Close the lin[e] bleed valve when pressure is zero.

4. Open the pressure valve and app[ly] 3000 psi. Gradually open the line bleed val[ve] until flow is shut off by the fuse. This sh[ut] off should occur completely before the rate [of] flow exceeds 6 cu. in. per minute. After th[e] flow has stopped, open the line bleed valve completely and allow one minute for drainage. Leakage should not exceed two drops in three minutes at 3000 psi.

5. Increase pressure to 4500 psi fo[r] two minutes. Allowable leakage is two drops per minute. Release pressure.

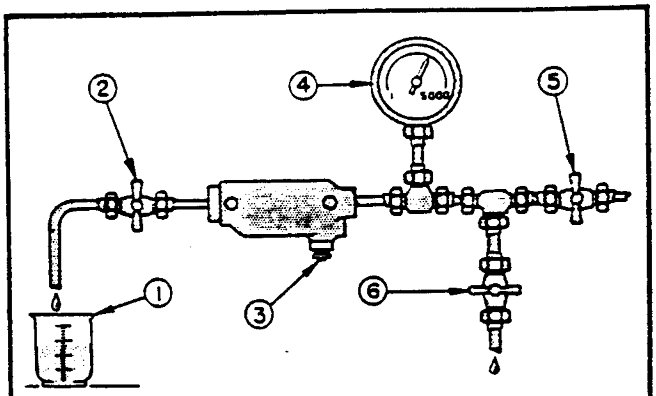


Figure 20. Gage Line Fuse Test Set-Up

(g) INSTALLATION.- Install the unit and connect the hydraulic lines. Bleed the fuse unit and gage line by disconnecting the gage line at the gage and depressing the by-pass button on the fuse unit. At the same time, hydraulic fluid at 500 psi (from ground test stand unit) is sent through the gage line to bleed the system.

(11) FOUR-WAY SOLENOID VALVE. (Slot door valve) (Aireon 62086 and -1) See figure 21.

(a) DESCRIPTION.- A four-way solenoid valve is used to operate each slot door cylinder. The valve directs hydraulic fluid under pressure to the slot door cylinders to actuate the slot doors. Power to move the valve shuttle is electrically controlled by an aerodynamic switch.

(b) REMOVAL. (See figure 27.)- Disconnect the electrical plug. Disconnect the hydraulic lines and cap the ends. Remove the unit from the bracket.

(c) DISASSEMBLY AND REPAIR. (See figure 21.)- The solenoid valve is of a complicated internal design, and no disassembly or repairs should be attempted. If the valve operates in a faulty manner, replace it.

(d) TEST.

1. Connect the valve through an "on-off" electrical switch to a 24 volt d.c. power source. Connect a hydraulic pressure line to the pressure port.

2. Connect a two-way cylinder, capable of operating at 3000 psi, to the cylinder ports.

3. Apply 250 psi pressure and cycle the cylinder approximately five times.

4. With the switch "off," increase the pressure to 3000 psi. Operate the valve to cycle the cylinder. There must be no tendency to chatter, delay in transferring, or tendency to restrict flow in either direction.

5. With the switch "off" and the return port open, apply 3000 psi for three minutes. The maximum allowable leakage is 2½ cc per minute, after the first minute.

6. Repeat test five with the switch "on." The maximum allowable leakage after the first minute is 5 cc per minute.

(e) INSTALLATION. (See figure 27.)- Bolt the unit to its bracket and replace the electrical connection. Connect the hydraulic lines and bleed the system.

(12) RUDDER, ELEVON, AND WING SLOT ACTUATING CYLINDERS.

(a) DESCRIPTION.- Hydraulic actuating cylinders are used to operate the wing slot doors, rudders and elevons. See figures 22, 23, and 24. They are of the conventional cylinder and piston type. The elevon and rudder cylinders function through a servo unit. See paragraph 16 j (13).

1. The rudder actuating cylinders are located aft of the main spar of the trim flaps. One cylinder is mounted at each end of each rudder. Each cylinder is mounted in brackets, one bracket attached to the trim flap spar, the other to the rudder. See figure 25.

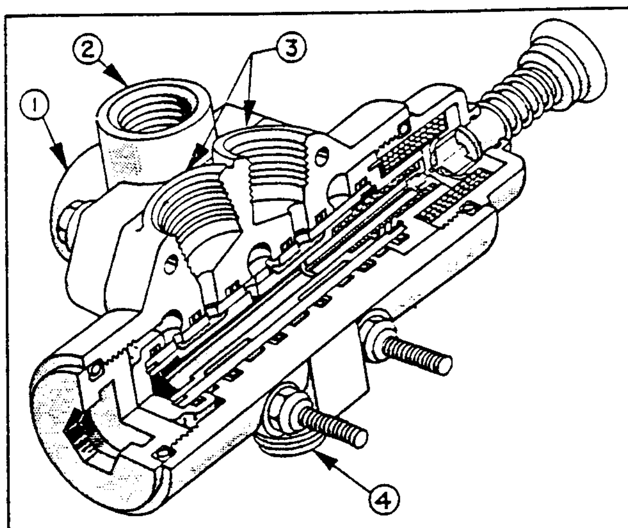


Figure 21. Four-Way Solenoid Valve

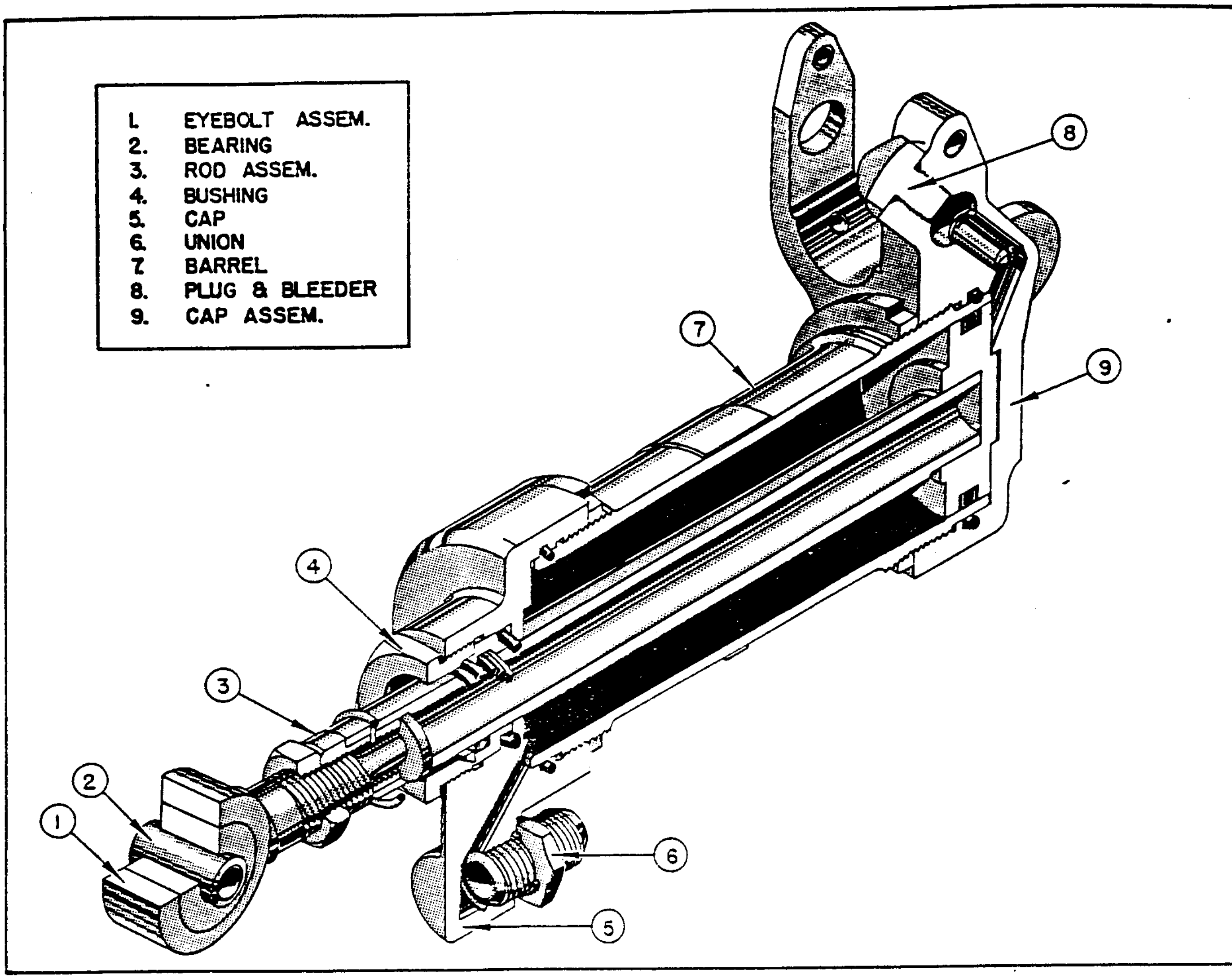


Figure 22. Rudder Actuating Cylinder

2. The inboard elevon-actuating cylinders are located in the trailing edge of the wing section outboard of engines number one and four. The outboard cylinders are located in the trailing edge of the wing section at the outboard ends of the elevons. The two cylinders for each elevon are mounted in brackets, one on the rear wing spar, the other attached to the elevon. See figure 26.

3. A slot-door-actuating cylinder incorporating a restrictor at the mounting cap end, is installed in each outer wing section. See figure 27.

(b) REMOVAL.- The cylinders are accessible through removable fairings on the underside of the wing.

1. Relieve all pressure in the hydraulic system.

2. Disconnect and immediately plug all hydraulic lines to the actuating cylinder to be removed.

3. Remove the bolts attaching the cylinder to its mounting bracket, and remove the cylinder.

(c) DISASSEMBLY. (See figures 22 through 24.)- The disassembly of all the actuating cylinders is similar, though not identical. Refer to cross-sections of the cylinders, figures 22 through 24, to aid in assembly and disassembly.

1. Loosen the lock nut and unscrew the rod end.

2. Cut the lock wire, where necessary, and remove the packing gland.

3. Loosen end-cap lock nuts and remove end caps.

4. Withdraw the piston.

5. This stage of disassembly is sufficient to permit inspection, cleaning, and the replacement of packing.

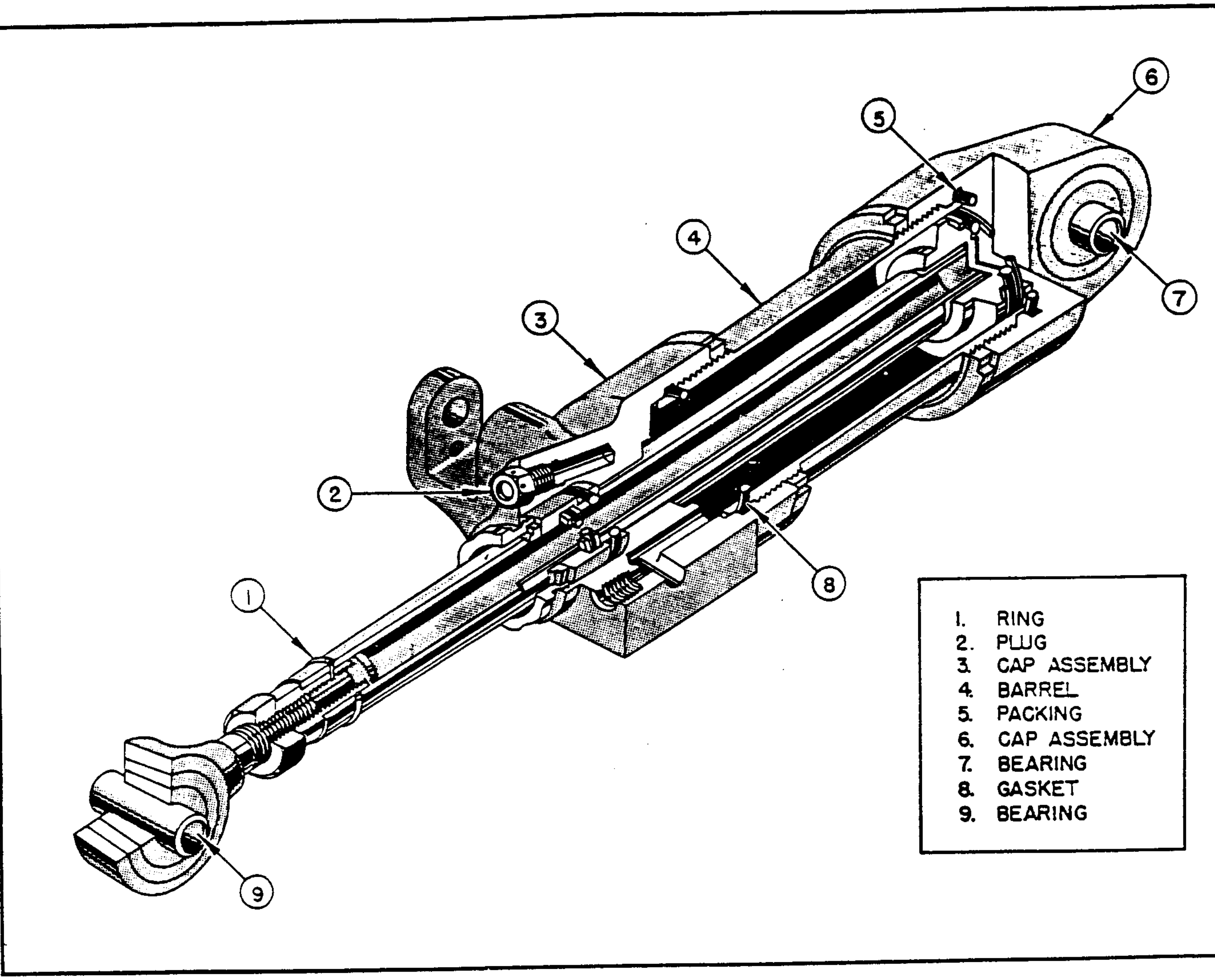


Figure 23. Elevon Actuating Cylinder

(d) ASSEMBLY. (See figures 22 through 24.)

1. Lubricate all "O" rings, leather back-up rings, and sliding parts with hydraulic fluid.

2. Insert the piston in the cylinder body.

3. Install the packing gland. Replace the safety wire.

4. Screw in the rod end and tighten the lock nut.

CAUTION

Be certain that restrictor is installed in the wing slot cylinder at the mounting cap end.

(e) TESTS.- The servo unit for each elevon cylinder is a part of the cylinder assembly and the two units may be tested together. Tests are also given for the rudder and slot door cylinders.

1. ELEVON CYLINDER AND SERVO VALVE.- Before starting the test, tighten the bolts holding the servo valve to a torque of 50 to 75 foot-pounds.

a. Determine the force required to move the spool in the servo valve. This force should not exceed five pounds in either direction.

b. Connect the swivel fittings to the test bench. Install a micronic filter (Purolator 31550) in the pressure supply line.

c. Apply 500 psi and actuate the cylinder several times by moving the servo valve spool.

d. Place the servo valve spool in the cylinder-extended position and apply 3000 psi for three minutes. There should be no external leakage at any part of the assembly. Release pressure. There should be no evidence of permanent set.

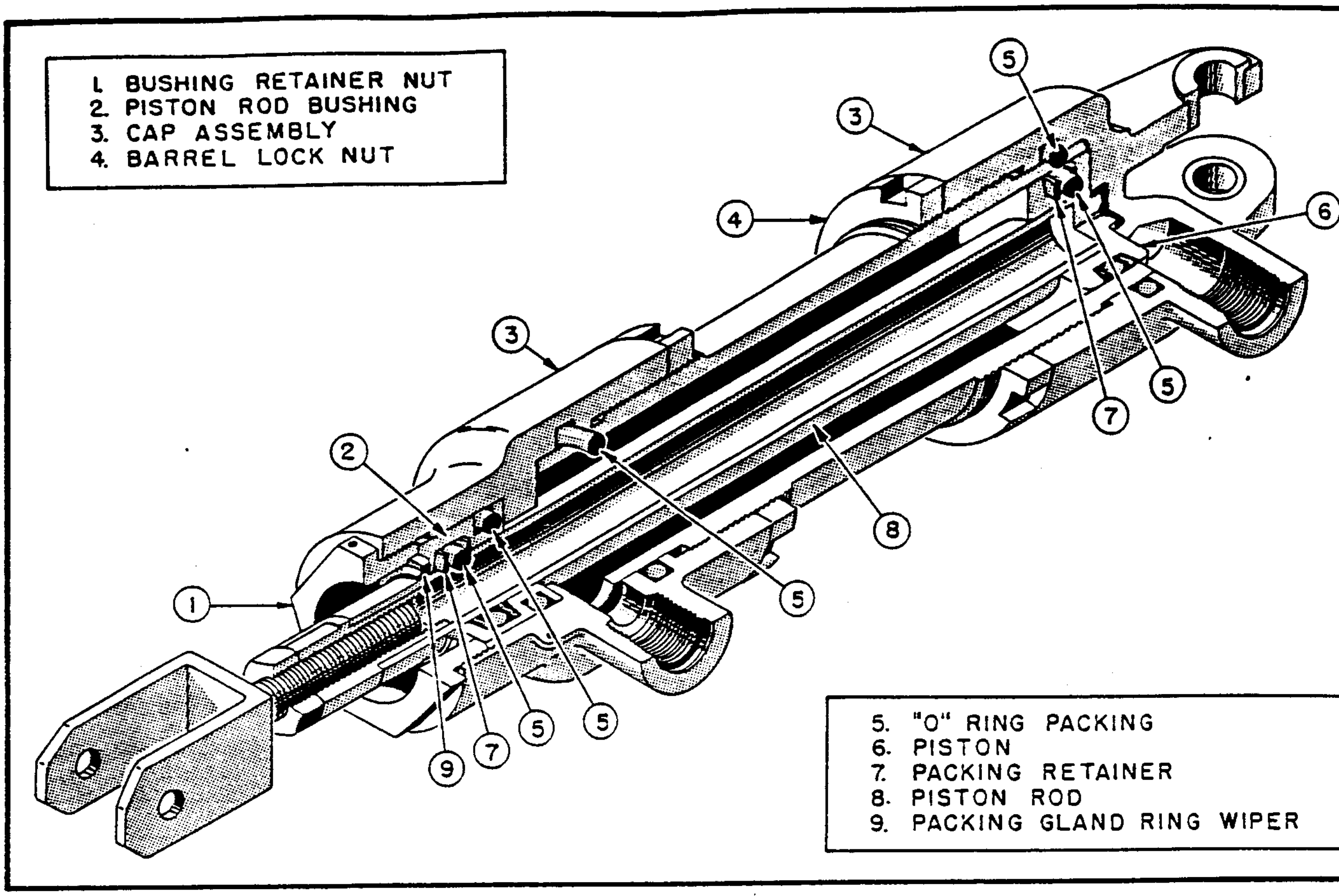


Figure 24. Wing Slot Door Actuating Cylinder

e. Place the servo valve spool in the "cylinder compressed" position and repeat test d.

f. Repeat test a.

2. RUDDER CYLINDER.- If a new cylinder is to be installed, two tests should be run: one for the cylinder itself and another with the swivel assembly. The two tests are given below.

a. CYLINDER TEST.- A suitable fixture must be made in order to connect the hydraulic pressure line to the base end of the cylinder.

1. Attach the cylinder to a 3000 psi four-way valve.

2. Cycle the cylinder at reduced flows and pressures to bleed all air.

3. Cycle the cylinder through 10 complete cycles allowing the pressure to build up to 2000 psi at each end of the stroke.

NOTE

Total leakage during this test should not be sufficient to cause accumulation of fluid at the piston shaft seal which will run down the gland face.

4. To each port, successively apply 3000 psi and 10 psi for three minutes at each pressure. Allowable leakage at eac[h] pressure is two drops.

5. Place the cylinder piston approximately in the mid-stroke position. Breakaway pressure should not exceed 15 psi

b. CYLINDER AND SWIVEL ASSEMBLY.- The assembly should be mounted in a fixture which will hold the attaching end of the swivel and produce a rotating movement in th[e] swivel as the cylinder piston extends and re[-]tracts.

1. Connect the assembly to a four-way valve.

2. Apply 1000 psi. Operate th[e] cylinder several times to check for binding conditions and to bleed the cylinder of air

3. Increase the pressure to 20[00] psi. Cycle 10 times. There should be no e[x]ternal leakage.

4. Apply 3000 psi for three minutes first to one end and then to the ot[her] end of the cylinder. There should be no external leakage.

5. Repeat test 4 at 10 psi.

3. SLOT DOOR CYLINDER TEST.

a. Connect the cylinder to a 3000 psi four-way valve.

b. Cycle the unit several times at reduced flows and pressures to bleed all air.

c. Apply 2000 psi and then cycle through 10 complete cycles allowing the pressure to build up to 2000 psi at the end of each stroke.

NOTE

Total leakage during this test should not be sufficient to cause accumulation of fluid at the piston shaft seal which will run down the gland face.

d. To each port, successively apply 3000 psi and 10 psi for three minutes at each pressure. Allowable leakage at each pressure is two drops.

e. Place the cylinder piston approximately in the mid-stroke position. Breakaway pressure should not exceed 15 psi.

(f) INSTALLATION. (See figures 25 through 27.)- Install the cylinder and attaching bolts. Connect the hydraulic lines and bleed the system.

(13) RUDDER AND ELEVON SERVO VALVES.

(a) RUDDER SERVO.

1. DESCRIPTION. (See figures 25 and 28.)- A rudder servo valve is installed near each of the rudder actuating cylinders. The valve is activated by pressure on the rudder control pedals which in turn directs pressure to actuate the rudder cylinders.

2. REMOVAL. (See figure 25.)

a. Disconnect and immediately plug the hydraulic pressure lines.

b. Remove the bolt connecting the control rod and valve shaft.

c. Remove the four nuts from the valve studs which hold it in place, and remove the valve.

3. DISASSEMBLY AND REPAIR.- If the valve does not function properly, replace it, as repairs are not practicable.

4. INSTALLATION. (See figure 25.)

a. Replace the four nuts which hold the valve in position.

b. Remove the plugs from the hydraulic pressure lines and connect them to the valve.

c. Install the bolt connecting the control rod to the valve shaft.

5. TEST.

a. DIRECTION OF FLOW; FLOW IN PRESSURE PORT. (Refer to figure 29, test set-up "A".)

1. With the threaded end of the spool depressed, the pressure port shall connect to cylinder "A" port, and cylinder "B" port to the tank port.

2. With the threaded end of the spool extended, the pressure port shall connect to cylinder "B" port, and cylinder "A" port to the tank port.

b. FLOW RATE AT 1000 PSI.

1. A minimum flow of 9.80 gpm should be obtained with the spool fully depressed and the cylinder ports interconnected. (See figure 29, test set-up "A.")

2. A minimum flow of 8.85 gpm should be obtained with the spool fully extended and the cylinder ports interconnected. (See figure 29, test set-up "A.")

c. NEUTRAL LEAKAGE AT 1000 PSI.

1. The valve should be mounted in a fixture which incorporates a means of measuring the spool travel in thousandths of an inch.

2. Connect the valve as shown in figure 29, test set-up "A".

3. Determine the neutral position by measurement of total travel in both directions and by setting spool at the mid-point of the total travel.

4. Apply 1000 psi to the pressure port and adjust the spool to obtain the lowest flow reading. Measure leakage from tank port; leakage must be within the limits of .05 to .20 gpm and the spool position must be within .012 total variation from the neutral position as determined by step 3 preceding.

d. SPOOL FRICTION.

NOTE

Before conducting the following tests, tighten all fittings to 250 inch-pounds.

1. The force required to move the spool in any rotational position, at zero psi, should not exceed five pounds.

2. The valve should be connected as shown in figure 29, test set-up "B." The force required to move the spool in any rotational position, at 2000 psi should not exceed five pounds. Forces should be measured at neutral (point at which pressure gages read the same) and at .06 and .125 displacement each side of neutral.

6. ADJUSTMENT.- Remove the snap ring on the clevis and loosen the lock nut. Adjust

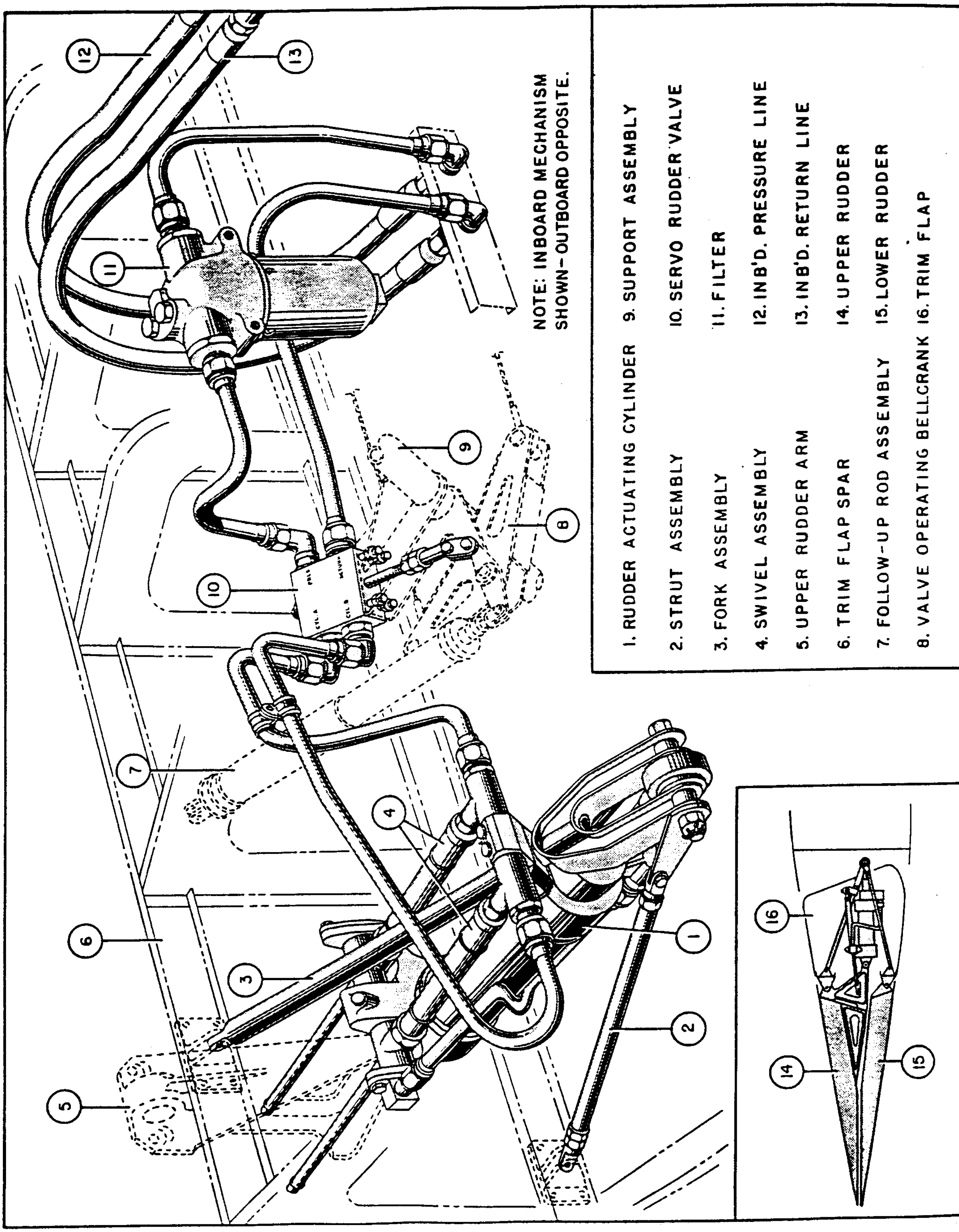


Figure 25. Rudder Actuating Mechanism

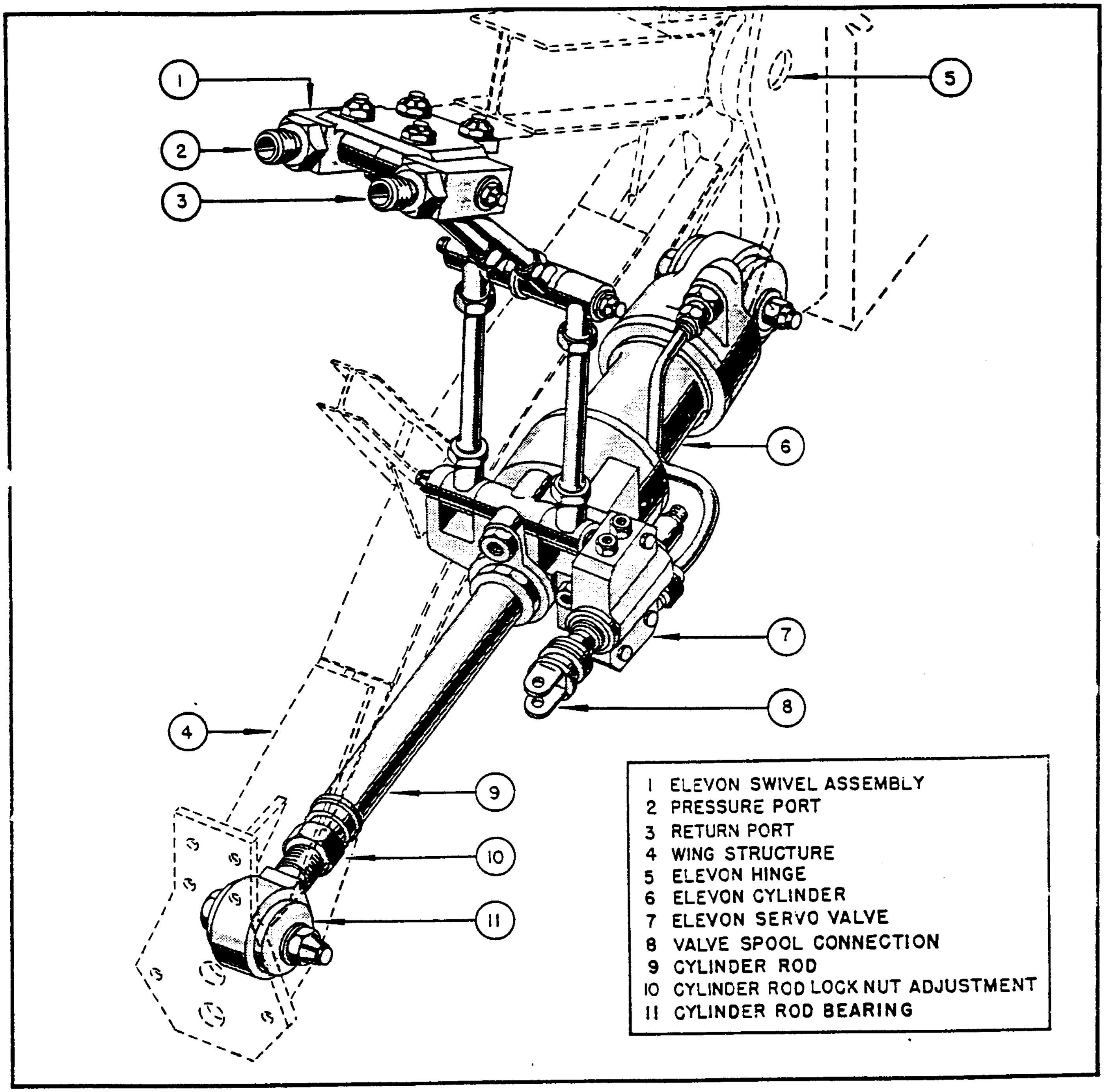


Figure 26. Elevon Actuating Mechanism

the valve spool to the desired position, then line the slot in the spool with the hole in the clevis, assemble the snap ring and tighten the lock nut.

(b) ELEVON SERVO. (See figure 30.)- The description, removal, installation and adjustment of the elevon servo valve in general is the same as that for the rudder servo unit. Detailed information is not yet available.

1. TEST. (See figure 31.)

a. DIRECTION FLOW.

1. With the threaded end of the spool depressed, the pressure port shall be connected to cylinder "B"; and the return port to cylinder "A." Refer to figure 31.

2. With the threaded end of the spool extended, the pressure port shall be connected to cylinder "A"; and the return port to cylinder "B."

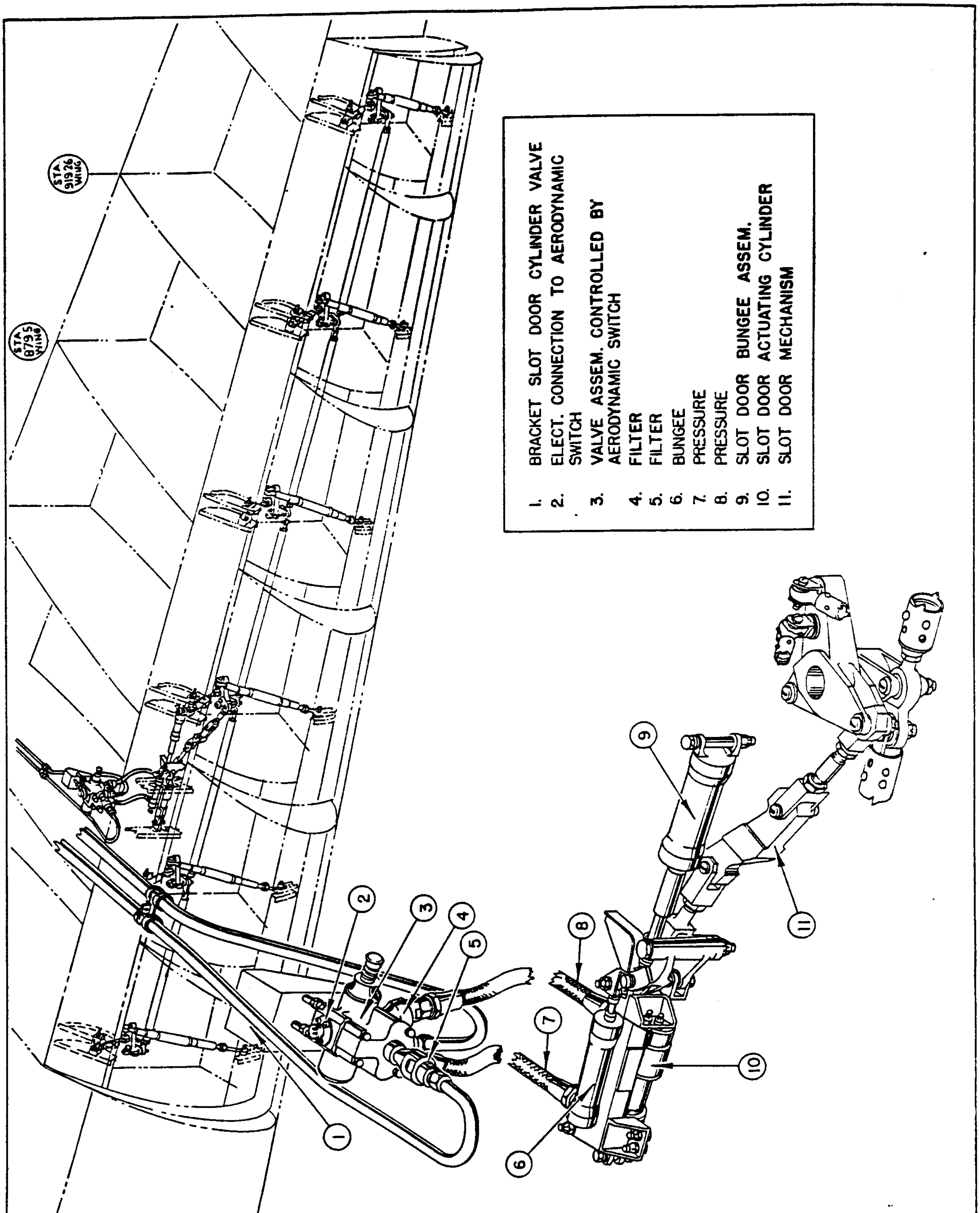


Figure 27. Wing Slot Door Actuating Mechanism

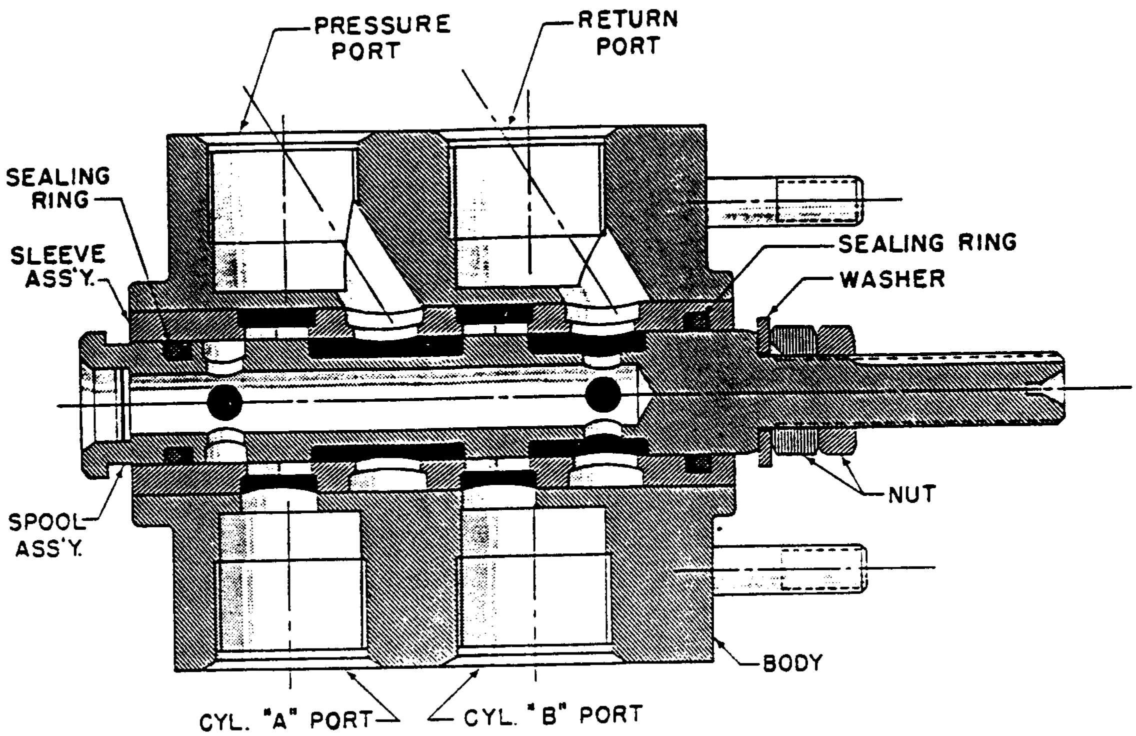


Figure 28. Rudder Servo Valve

b. FLOW RATE AT 1000 PSI.

1. The valve should be mounted in a test fixture so designed as to permit measurement of spool travel in thousandths of an inch.

2. Connect the pressure source to the pressure port; connect cylinder "A" and cylinder "B;" return flow is out of the return port through a flow meter.

3. Maintain input pressure at 1000 psi. The flow rate at the extreme spool travel, each way, should be within the limits of 3.3 to 4.3 gpm.

c. NEUTRAL LEAKAGE AT 1000 PSI.

1. Mount valve as in test b 1 preceding.

2. Connect valve as in test b 2 preceding.

3. Determine the neutral position by measuring total travel in both directions and setting spool at the mid-point of the total travel.

4. Apply 1000 psi to the pressure port and measure leakage from the return port. Leakage must be within the limits of .05 to .20 gpm. If the flow rate is greater than specified, adjust the spool to obtain the lowest flow reading. This point must be within .012 total variation of the neutral position as determined by test c 3 preceding.

d. OUTER SPOOL FRICTION FORCE.

1. The spool shall move freely in all rotational positions and shall not exceed six pounds operating force in any position with no pressure on the valve.

e. INNER SPOOL PRESSURE DROP.

1. Apply pressure to cylinder "A" port and out the return port; 100 psi hydraulic gages at cylinder "A" port and the return port. Plug the pressure port and cylinder "B" port.

2. Lock outer spool in neutral. Fully depress the threaded end of the inner spool.

3. Pressure drop should not exceed 75 psi at four gpm.

4. Repeat the above tests with the valve outer spool in neutral position; threaded end of the inner spool fully extended; and with pressure and cylinder "A" plugged.

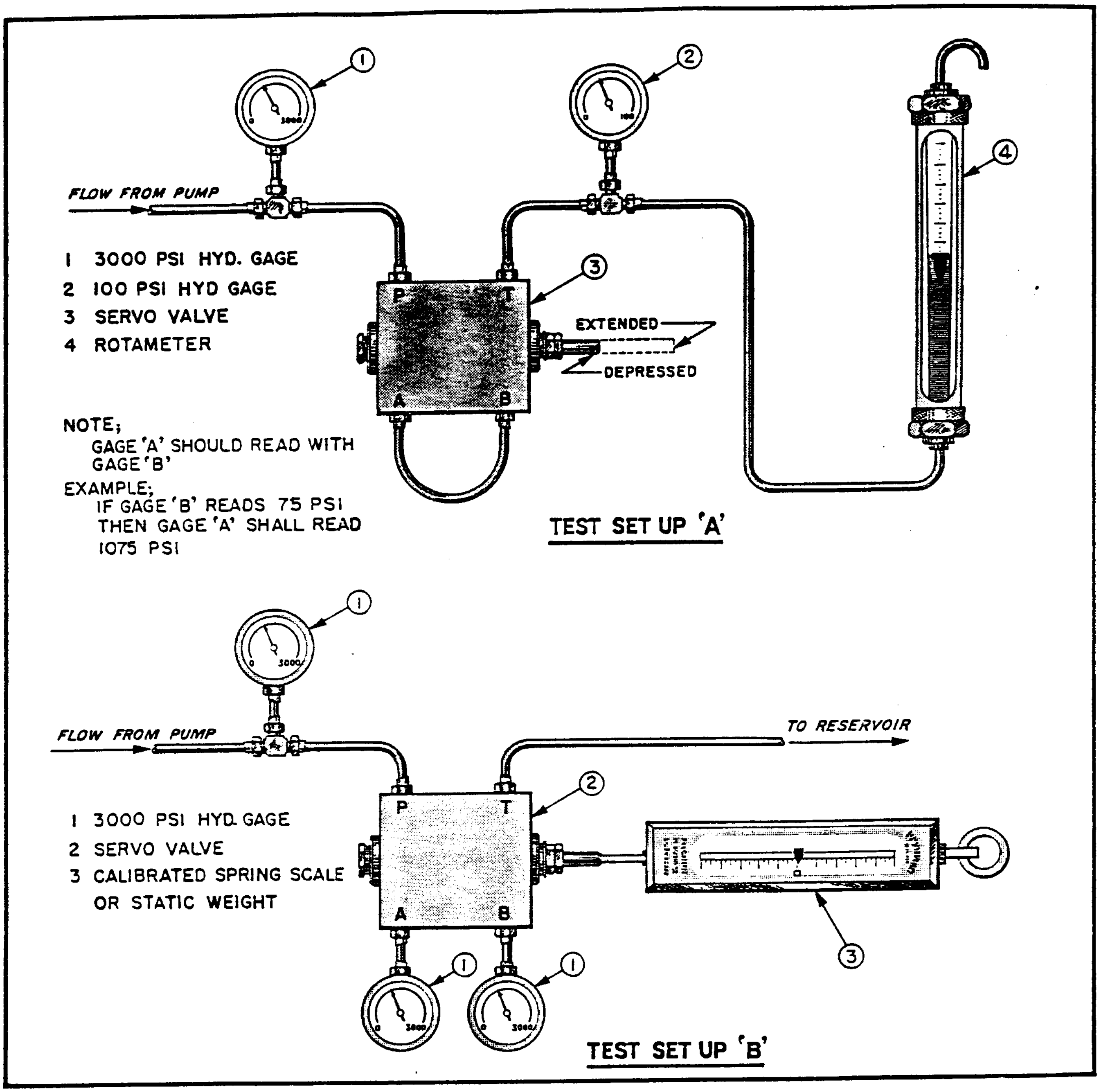


Figure 29. Rudder Servo Valve Test Set-Up

5. Pressure drop should not exceed 75 psi at 3.2 gpm.

f. INNER SPOOL SPRING AND FRICTION FORCE.

1. Lock outer spool in neutral.

2. With no pressure on the valve, measure full travel of the inner spool by depressing the threaded end.

3. Measure the force required to depress the inner spool to a point .010 less than full travel.

4. This force shall not exceed 46 pounds.

5. The force required to start depressing the inner spool shall not be less than 20 lbs.

g. INNER SPOOL SPRING AND FRICTION FORCE AT 2000 PSI.

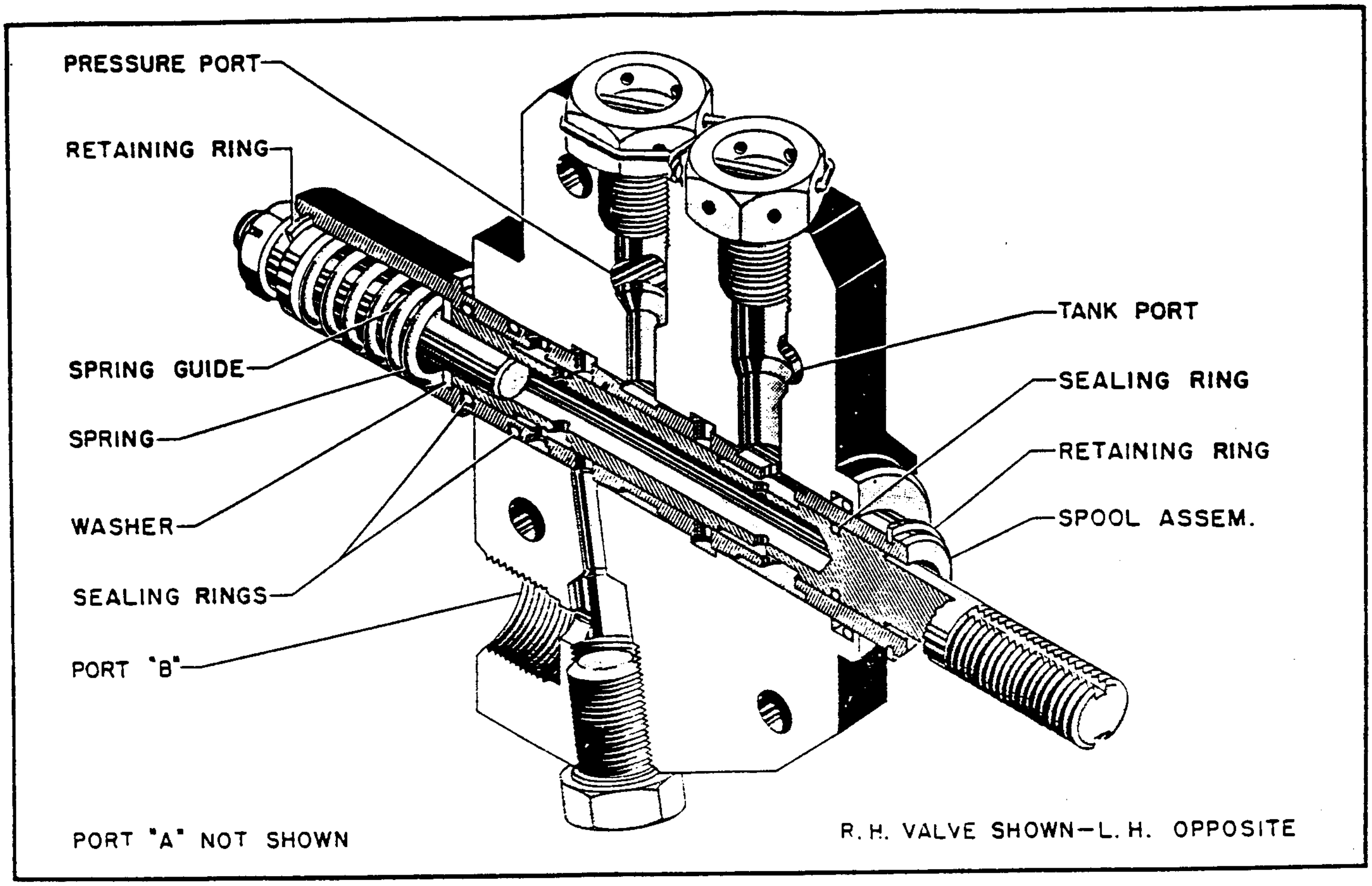


Figure 30. Elevon Servo Valve

1. Apply 2000 psi to the pressure port; cylinder ports connected.

2. Lock outer spool in neutral.

3. Force required to start depressing inner spool <u>shall not be less than</u> 20 pounds.

4. The force required to depress the inner spool to a point .010 less than full travel <u>shall not exceed</u> 46 pounds.

(14) CHECK VALVES. (See figures 32, 33, and 34.)

(a) DESCRIPTION.- Check valves are used throughout the hydraulic system to permit flow of fluid in one direction only. Four check valves (two Bendix, an AN6207, and a Parker) are used in this system. The Bendix check valves are used at the pumps and for the system; the AN check valve is used for the elevon actuating units; and the Parker check valve is used in the air line of the aspirator for the reservoir.

(b) REMOVAL.- Relieve all pressure in the system. Disconnect and immediately plug the hydraulic lines.

(c) DISASSEMBLY AND ASSEMBLY.- The fitting on one or both ends of the valve will

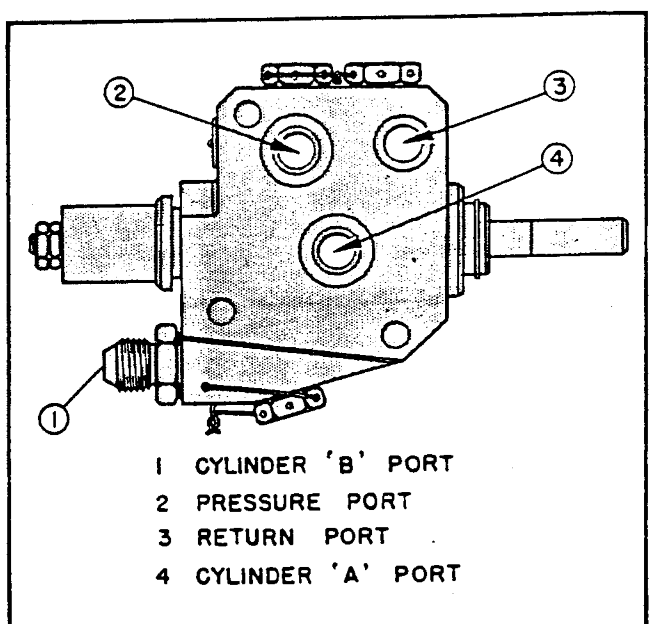


Figure 31. Elevon Servo Valve Test Reference

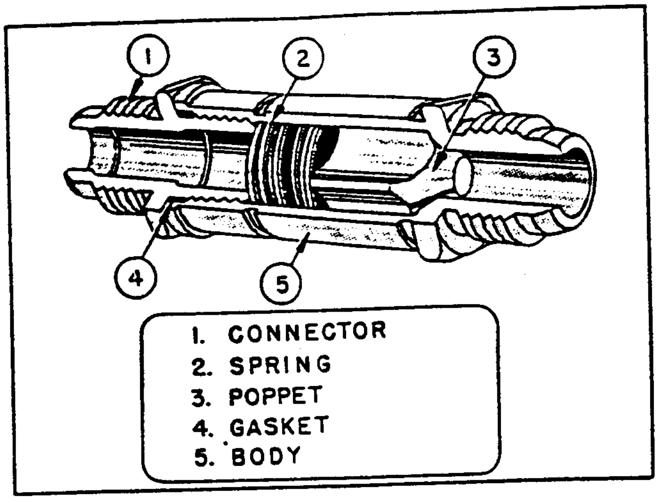


Figure 32. Pump Check Valve

unscrew to provide access for replacement of the spring or packings.

(d) TEST.

1. BENDIX CHECK VALVES.

a. Apply hydraulic pressure in the direction of the arrow on the unit. The valve should open at 4 to 8 psi.

b. Apply 10 psi against arrow for three minutes. Allowable leakage is two drops per minute. Allow one minute for valve to seat before starting leakage test.

c. Increase pressure to 3000 psi for three minutes. There should be no leakage.

2. PARKER CHECK VALVE.

a. Make test set-up as shown in figure 36.

b. Apply pressure at port "A." It should not require more than seven inches of mercury to open the check valve.

c. Apply a pressure of five psi to port "B." Leakage should not exceed two drops in three minutes. Wait one minute after applying pressure before making the leakage check.

d. Plug port "B" and apply a pressure of 225 psi at port "A." There should be no external leakage.

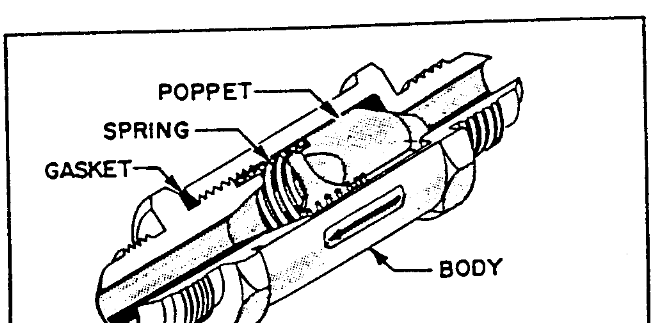


Figure 33. System Check Valve

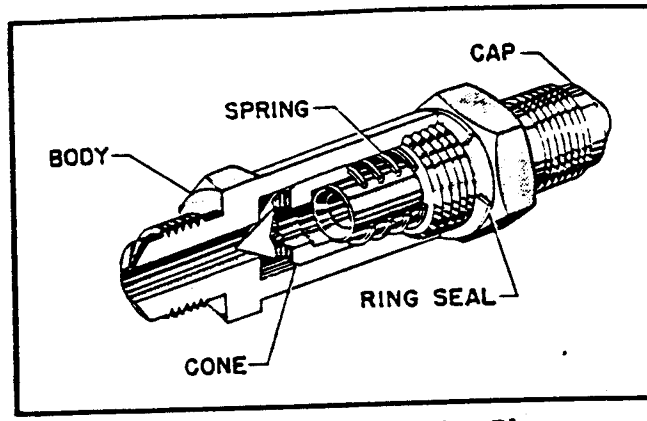


Figure 34. Check Valve for Elevon Actuating Units

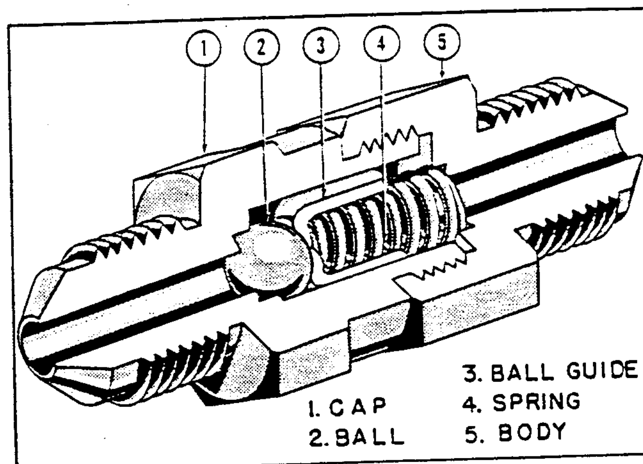


Figure 35. Aspirator Air Check Valve

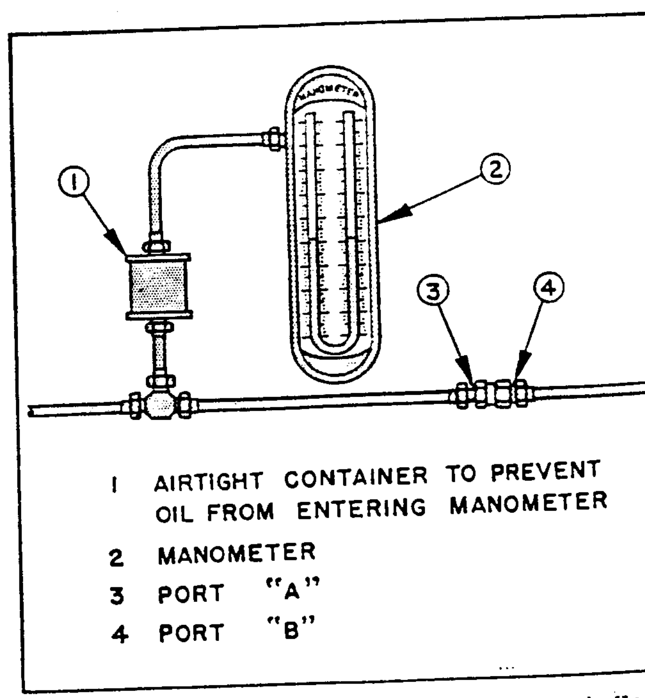


Figure 36. Test Set-Up for Parker Check Val

3. AN6207 CHECK VALVE.

a. Apply hydraulic pressure in the direction of the arrow on the unit. The valve must open and permit flow at 4 to 8 psi.

b. Apply 10 psi in the opposite direction of the arrow. Allowable leakage after the first minute is two drops per minute.

c. Increase pressure to 2250 psi for three minutes. There should be no leakage.

(e) INSTALLATION.- Remove the plugs from the hydraulic lines. Connect the lines to the valve and bleed the system.

(15) FILTERS. (See figures 37, 38 and 39.)

(a) DESCRIPTION.- The locations of filters used throughout the hydraulic system are shown in figures 1 and 2. Each reservoir is provided with an integral set of filters (see figure 11) and the aspirator which pressurizes the reservoir receives outside air through an air filter. Ahead of the aspirator, in the pressurizing line to each reservoir, a restrictor type filter (Purolator) is installed. The pressure lines to the actuating cylinders for the elevons and rudders are equipped with micronic type filters (Purolator), and the four-way solenoid valves for the slot doors are each equipped with three filters using a Purolator element; this type filter should be inspected every 100 hours.

(b) REMOVAL.- The reservoir filters are removed by removing and disassembling the reservoir. The other filters are removed by disconnecting and capping the attaching lines. Remove the mounting bolts on the filters for the rudder and elevon units.

(c) DISASSEMBLY, ASSEMBLY, AND REPLACEMENT.- The units are easily disassembled and assembled for cleaning or replacement of elements. See figures 37, 38, and 39.

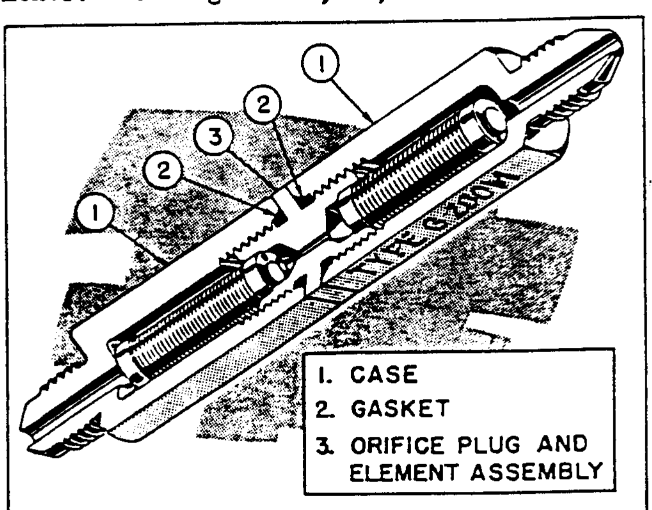


Figure 37. Reservoir Return Line Filter and Restrictor

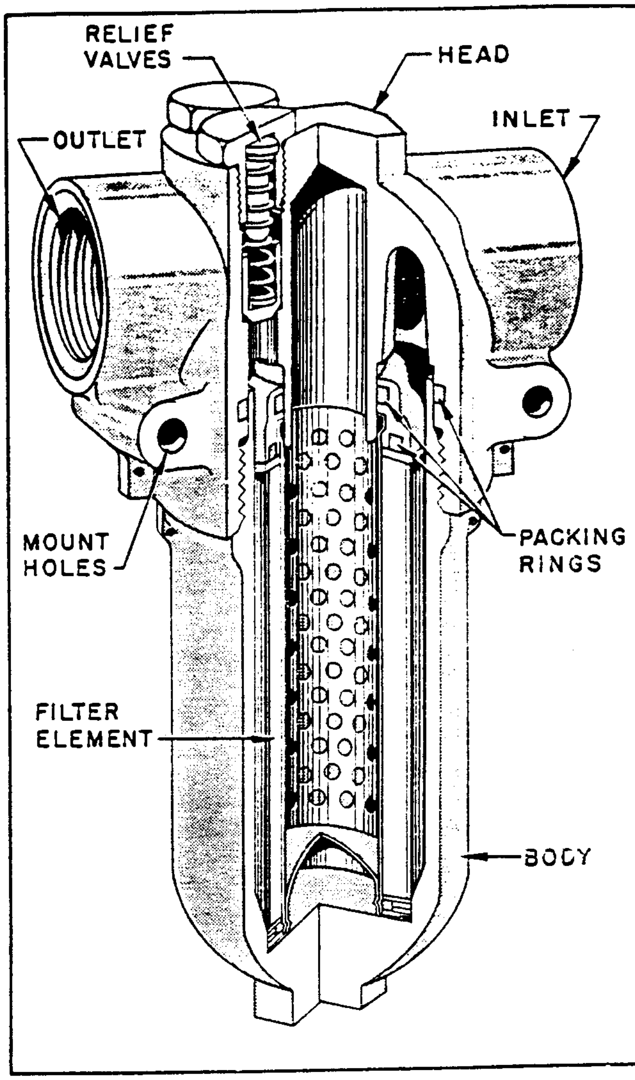


Figure 38. Filter - Rudder and Elevon Actuating Units

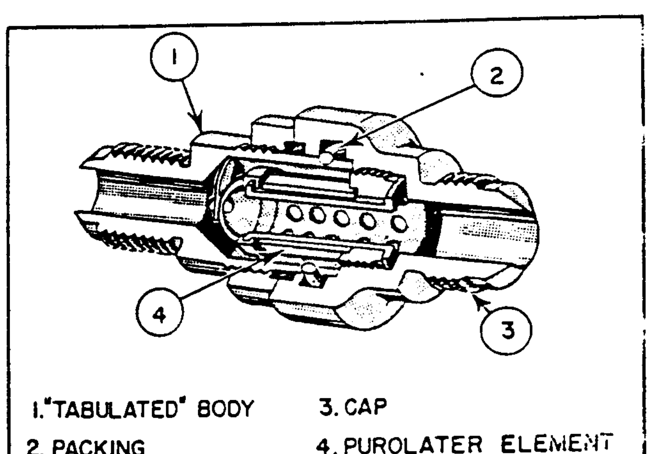


Figure 39. Wing Slot Door Filter

(d) TEST.

1. FILTER AND RESTRICTOR (Purolator 29513).

a. Connect a hydraulic pressure line to one end of the unit.

b. Apply 2000 psi to the unit and measure the flow from the opposite end. This flow rate should be within the limits of .60 to .70 gpm.

c. Cap the open port and apply 10 psi for three minutes. There should be no leakage. Release all pressure.

d. Increase pressure to 3000 psi for three minutes. There should be no leakage. Release all pressure.

2. FILTER (Purolator 31550).

a. Check for free flow through the filter in direction of the arrow.

b. Plug outlet port. Apply 4500 psi to the inlet port for three minutes. There should be no leakage.

c. Repeat test b with 10 psi. There should be no leakage.

3. FILTER (Northrop 458394).

a. Check for free flow through the filter in the direction of the arrow.

b. Plug outlet port. Apply 4500 psi to the inlet port for three minutes. There should be no leakage.

c. Repeat test b with 10 psi. There should be no leakage.

(e) INSTALLATION.- Unplug and connect the hydraulic lines to the filter, then bleed the system.

k. INDIVIDUAL UNITS OF THE NOSE WHEEL STEERING AND BRAKE SYSTEM.- Those units in the emergency air brake system and the brake units of the hydraulic brake and steering system are treated in paragraphs 5 and 6 of Section IV. Only the main units of the system are dealt with in this paragraph.

(1) HYDRAULIC PUMP. (NY Air Brake Type F1, No. 67V190 pump, Vard No. 2820 motor and gear box.)

(a) DESCRIPTION. (See figure 40.)- Each pump assembly consists of three units: the pump, the electric motor, and the interconnecting drive mechanism. The pump is of the constant pressure, variable delivery type with integral system-pressure regulation and with an integral unloading means. At 2250 rpm the unit pumps three gpm at 2800 psi. The motor operates on 208 volt, 3 phase 400 cycle a.c. taken from the nose sectionalizing panel (main pump) and the nose wheel well sectionalizing panel (auxiliary pump). The current for the main pump is closed by a re-

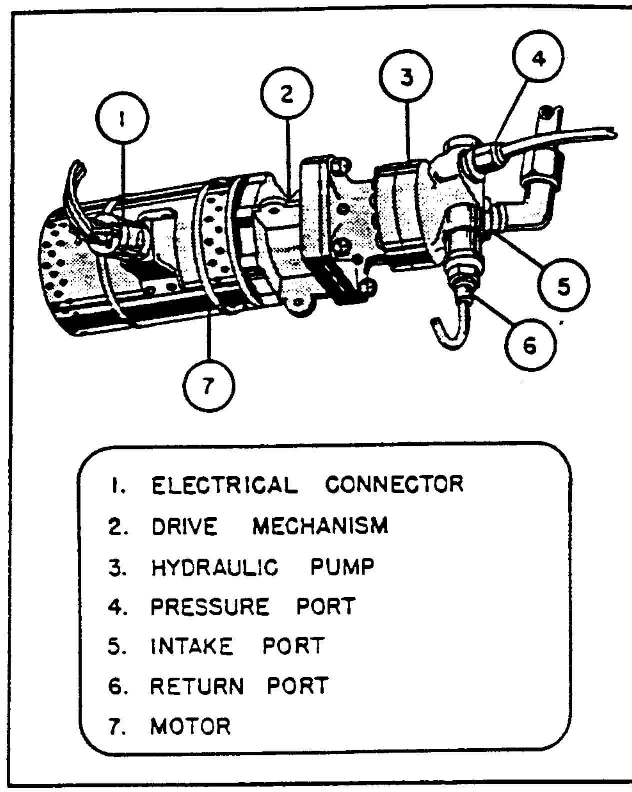


Figure 40. Motor Pump Assembly

lay which is controlled by micro switches actuated when the main gear is fully extended An emergency override switch is also provided on the flight engineer's lower switch panel. The auxiliary pump is likewise controlled by a relay which is actuated by a hydraulic pressure switch, which completes the circuit through a micro switch when the nose strut is slightly compressed. The circuit also incorporates a circuit breaker installed on the pilots' pedestal. The pressure switch closes the circuit to the pump relay when hydraulic pressure drops. Refer to paragraph 16 k (6) following. The drive mechanism form the connection and gear reduction between the motor and pump.

(b) REMOVAL.- (See figure 41.)- The pump assemblies are mounted on similar brackets; the main pump is located in the auxiliary oil-tank bay forward of the right wing front spar, outboard of the crew nacelle and is accessible through an access door in the top wing surface. The auxiliary pump is installed in the nose wheel well. Before removing either pump, kill system pressure and shut off electrical power. Remove electrical connections and disconnect hydraulic lines. Cap the hydraulic lines and remove the unit.

(c) DISASSEMBLY, ASSEMBLY, AND REPAIR. The unit can be disassembled into the three main assemblies; pump, gear mechanism, and motor. Further disassembly is not recommende and repairs should be made by the manufacture Refer to figure 42 for a cross-section of th pump.

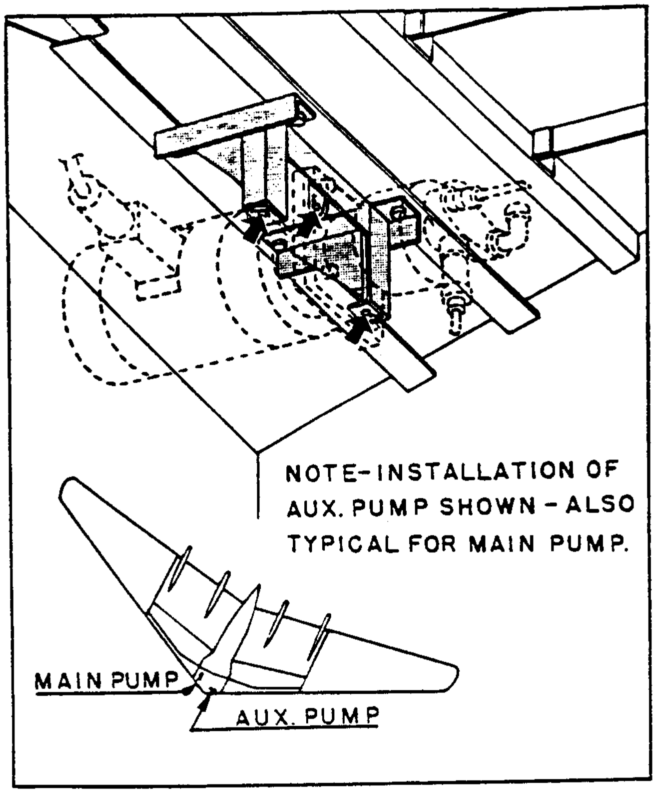


Figure 41. Typical Pump Installation

(d) ADJUSTMENT.- The pump has been factory tested. The control valve is adjusted for 3100 minimum regulated pressure and should not require further adjustment. However, if the pump needs adjustment, it must be adjusted to 3150 (± 50) psi, to enable the pressure regulator to unload before the pump levels off at its maximum pressure.

WARNING

If adjustment is necessary, do not use a screwdriver. Prevent possible damage and malfunctioning by using a special tool or a Dzus fastener type screwdriver.

(e) TEST.

1. PUMP.- Inspect pumps visually by opening all ports and rotating the unit by hand to insure freedom of operation.

2. GEAR BOX AND DRIVE.

a. Assemble drive, motor, and pump.

b. Make test set-up as shown in figure 43.

c. Open the bleed valve and start the motor. Run for three minutes at zero psi. Gradually close the bleed valve until pressure ceases to rise. This should be 3150 (± 25) psi.

d. Open and close the bleed valve several times to make sure that the pump returns to its maximum pressure setting when the bleed valve is closed.

e. Run for five minutes at 3150 psi and observe for any undue vibration and excessive heat rise in the motor pump assembly. Do not operate pump beyond five minutes.

(f) INSTALLATION. (See figure 41.)

1. Mount pump unit on bracket.

2. See that all current is off, and make the electrical connection.

3. Connect hydraulic lines.

4. Bleed the system.

(2) RESERVOIR.

(a) DESCRIPTION. (See figure 44.)- A 2.2 gallon capacity reservoir is mounted in the crew nacelle to the left of center just aft of the leading edge. The tank incorporates a visual level gage with an internal filter. The reservoir is filled through the top surface of the wing.

(b) REMOVAL. (See figure 45.)

1. Kill system pressure.

2. Open the drain valve for the reservoir and allow it to drain completely.

3. Disconnect and immediately plug all hydraulic lines attached to the reservoir.

4. Remove the reservoir mounting bolts.

(c) DISASSEMBLY AND ASSEMBLY. (See figure 44.)- The unit is easily disassembled for cleaning or replacement of gaskets.

(d) TEST.

1. Plug all outlets except one. Install air valve fitting in remaining outlet.

2. Apply five psi air pressure for five minutes.

3. Submerge reservoir in water and check for leaks. Release pressure.

4. Check reservoir for any signs of deformation or permanent set.

(e) INSTALLATION. (See figure 45.)

1. Bolt reservoir in place and attach hydraulic lines.

2. Check drain valve for closed position.

3. Bleed the system and operate the various hydraulic controls.

4. Recheck the fluid level of the reservoir.

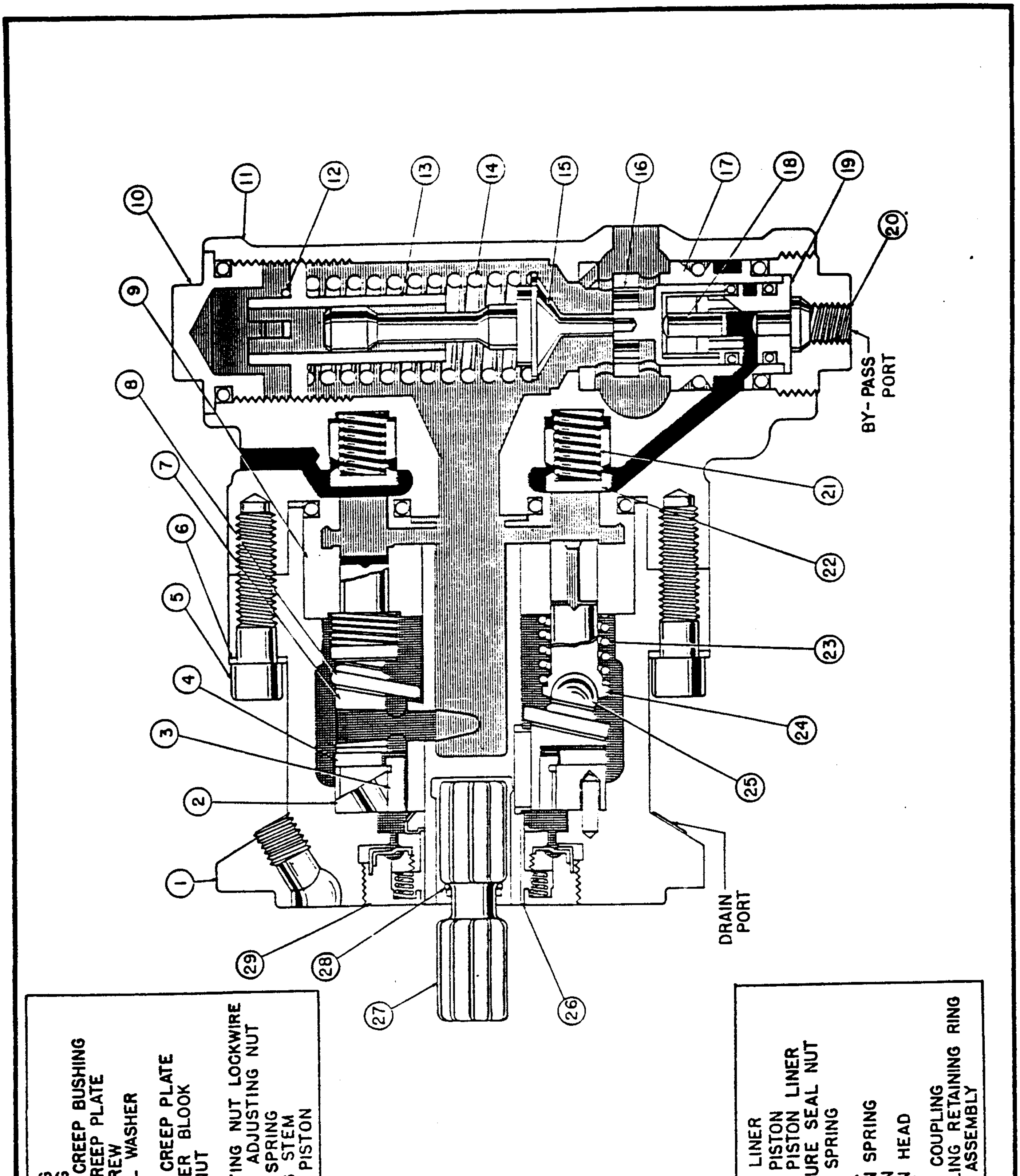


Figure 42. Hydraulic Pump

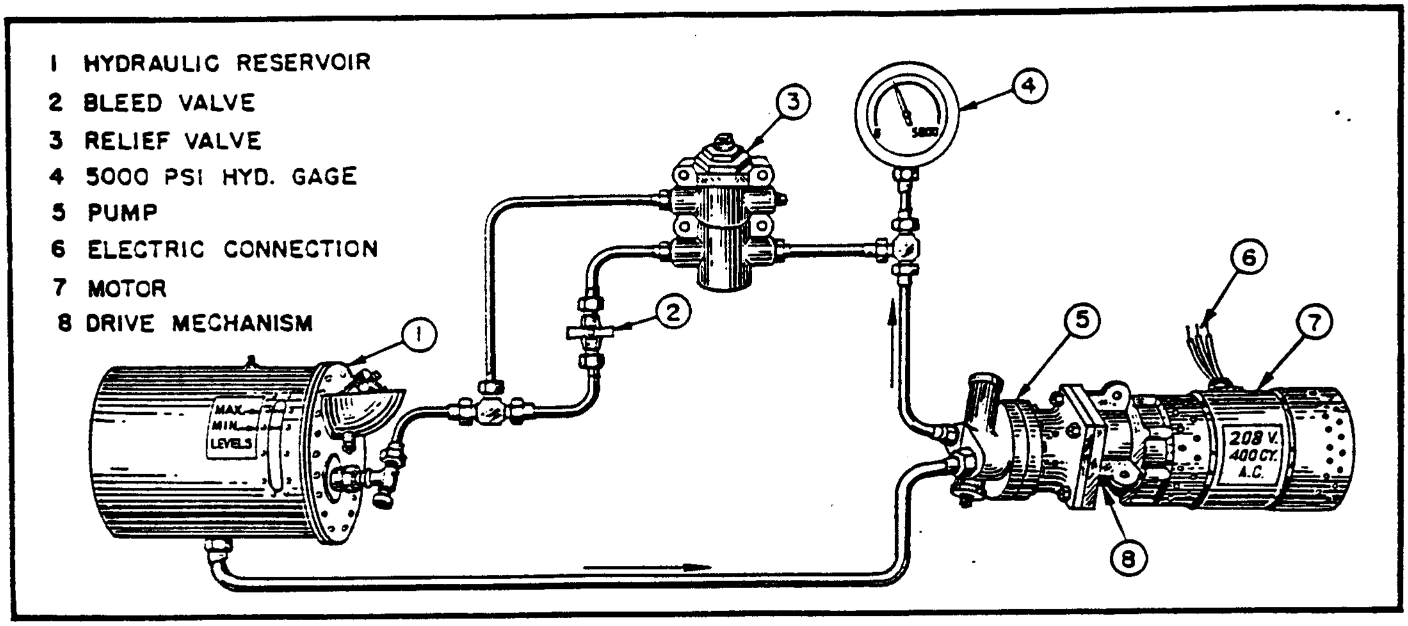


Figure 43. Hydraulic Pump, Gear Box, and Motor Test Set-Up

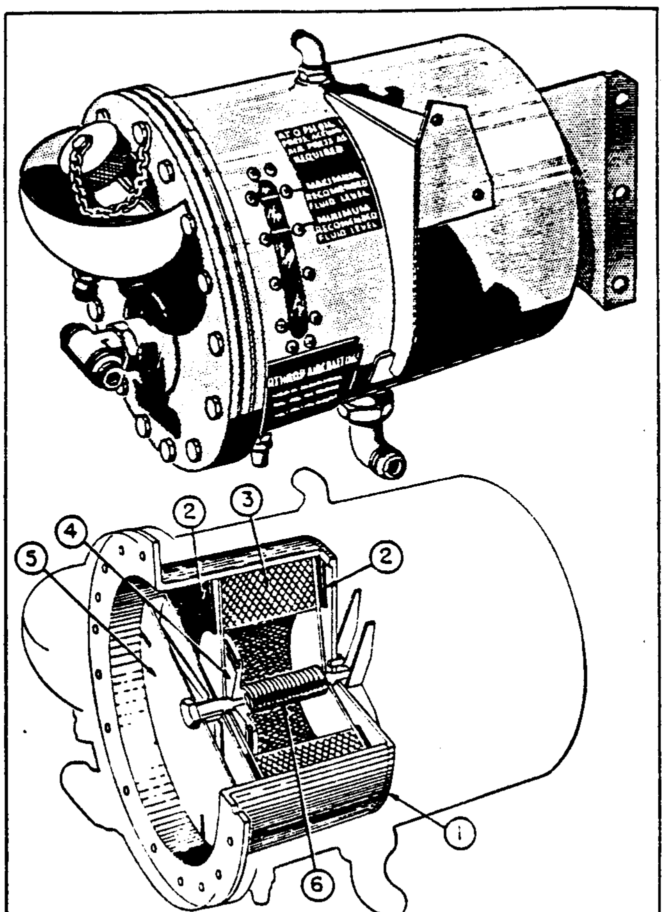


Figure 44. Hydraulic Reservoir

(3) RELIEF VALVE. (Vickers AA-11348)- The relief valve is the same as that used in the power boost system described in paragraph 16 j (6), except that the cracking pressure is 3150 psi.

(a) TEST.

1. Make test set-up as shown in figure 15.

2. Open the manual shut-off valve. Gradually open the pressure valve until 3150 psi cracking pressure is reached. Oil must break from the fitting and flow over the sides to determine cracking pressure. The valve must not show signs of seepage below 2840 psi. However, a leakage of four to five drops per minute above 2500 psi is normal.

3. Close the manual shut-off valve and increase the pressure until six gpm is flowing through the Rotometer. Pressure must not exceed 3460 psi at six gpm.

4. Gradually reduce pressure to 3000 psi. Open the manual shut-off valve and allow the valve one minute to seat. Leakage must not exceed five drops per minute. The valve must reseat above 2840 psi.

5. Remove the unit from test set-up and cap both return ports and one pressure port. Apply 4500 psi for three minutes to the pressure port. There should be no external leakage. Release pressure.

(4) PRESSURE REGULATOR. (Bendix 406600.)

(a) DESCRIPTION. (See figure 46.)- The pressure regulator maintains pump pressure between 2600 psi (+100 psi -50 psi) and 3000 psi (± 50 psi). This is accomplished by the operation of a pilot valve assembly which controls the closing and opening of a poppet valve to direct the hydraulic pump's discharge either

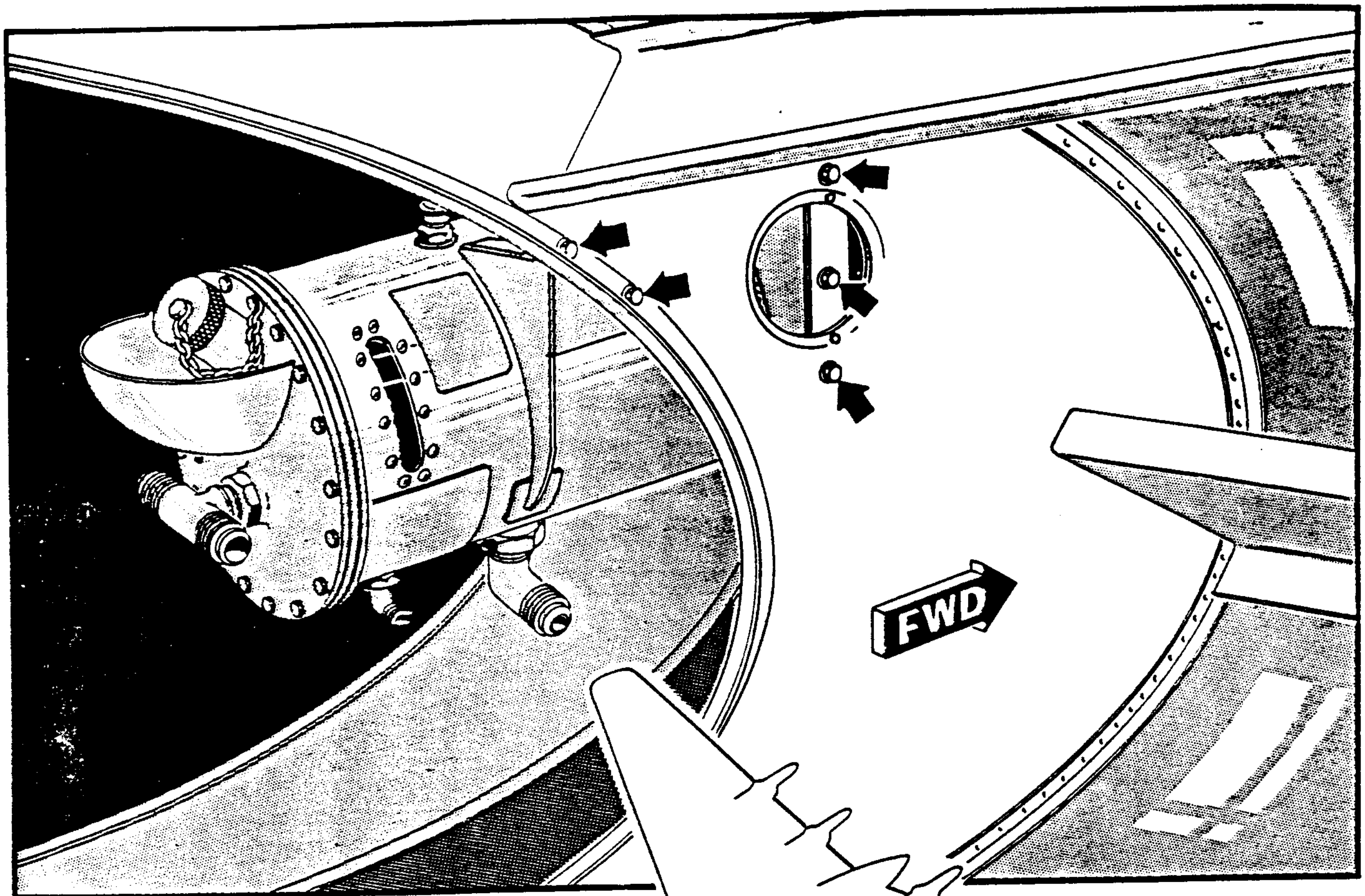


Figure 45. Hydraulic Reservoir Installation

to the accumulator, until the specified pressure has been reached, or to the reservoir after the specified pressure has been reached. All the parts are retained in the body of the valve by a removable cap.

(b) OPERATION. (See figure 46.)

1. The regulator maintains pressure in the accumulator and bypasses fluid after the accumulator is charged, thereby relieving the load on the hydraulic pump. This is accomplished by the pilot-valve assembly which is adjusted for desired cut-in and cut-out pressures.

2. As pressure increases (refer to figure 46) from the pressure port to the accumulator port, it works on the seat (15) and packing area moving the assembly upward and unseating the poppet (9). Fluid then flows through the poppet shaft and through internal passages to the piston (19). The piston, in moving, unseats the poppet (18). This allows fluid at the pump port to pass through to the return port.

3. When the pressure in the accumulator is released by actuation of any unit in the system, the regulator, by closing the internal poppets, will allow the pump to recharge the system.

(c) REMOVAL. (See figure 47.)

1. Kill system pressure.

2. Disconnect and cap all hydraulic lines to the unit.

3. Remove the four mounting bolts attaching the valve to the bracket.

(d) DISASSEMBLY AND INSPECTION.- For disassembly refer to figure 46. Inspection information is not yet available.

(e) ASSEMBLY.- For assembly refer to figure 46.

(f) TEST.

1. Make the test set-up as shown in figure 48. Apply pressure to the pressure port until the regulator unloads. This should be at 3000 ± 50 psi. Open the bleed valve until the regulator loads. This should be 2600 +100 or -50 psi. Vary the rate of bleed-off, from one half to five gpm. Adjust the regulator as required to maintain pressures noted above during approximately 10 cycles of operation.

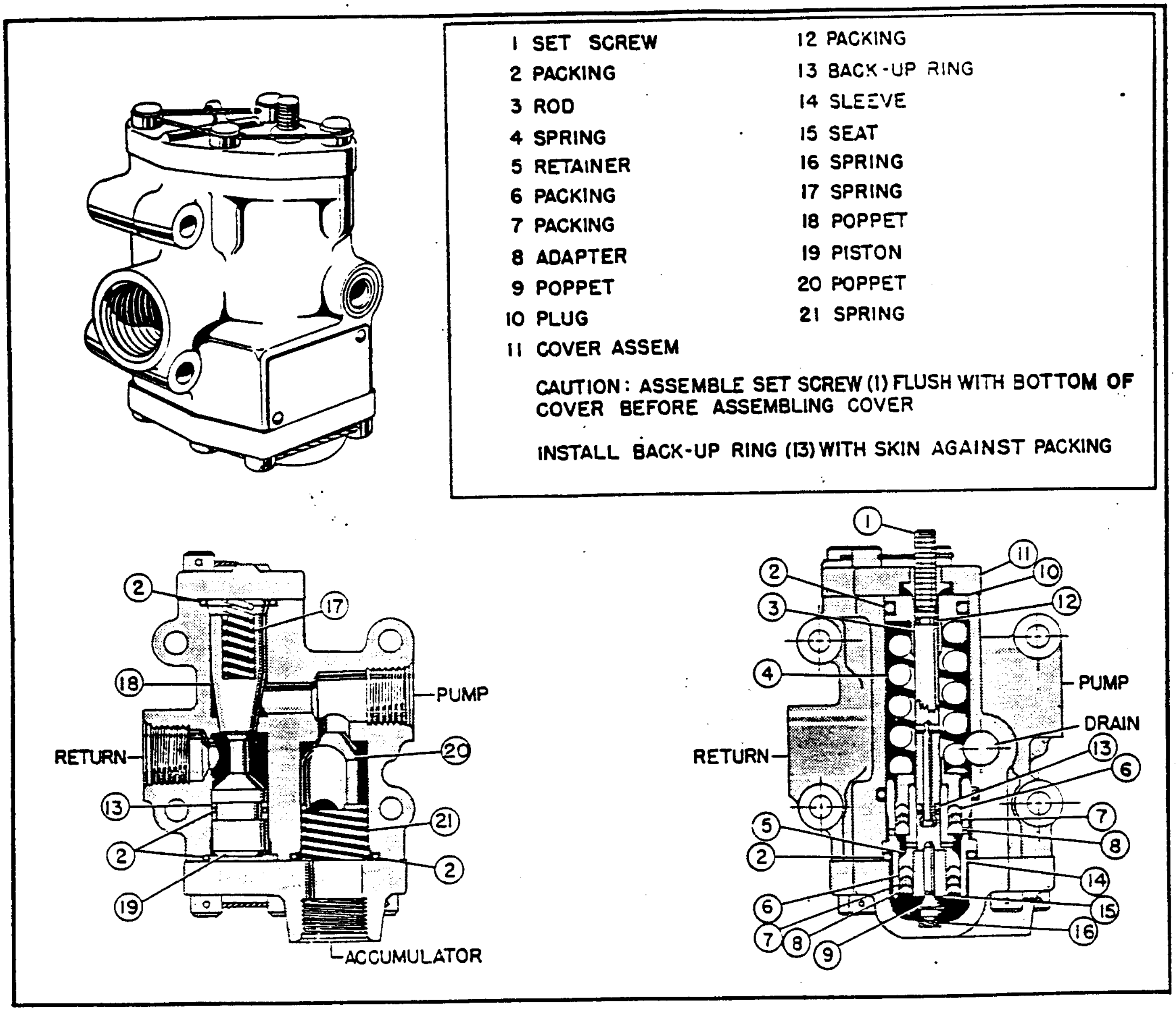


Figure 46. Pressure Regulator

2. Disconnect from the test set-up. Plug the system port, and apply 50 psi to the pressure port for three minutes. Leakage from the drain port should not exceed three drops per minute. Release pressure.

3. Plug the return port, and apply 4500 psi to the pressure port for three minutes. Leakage from the drain port should not exceed three drops per minute. There should be no external leakage. Release pressure.

4. Plug the system port and apply 2700 psi to the pressure port. Leakage from the return port should not exceed seven drops per minute. Leakage from the drain port should not exceed two drops per minute. Release pressure.

5. Plug the system and pressure ports. Apply 750 psi to the return port for three minutes. Leakage from the drain port should not exceed three drops per minute. Release pressure.

6. Plug the return port and apply 3000 psi to the system port. Leakage from the pressure port should not exceed four drops in five minutes. Leakage from the drain port should not exceed 12 drops the first minute, and six drops in the next five minutes. Release pressure.

7. Plug the return, system and pressure ports. Apply five psi to the drain port for three minutes. There should be no external leakage. Release pressure.

(g) INSTALLATION.

1. Mount the valve on the bracket with the four attaching bolts.

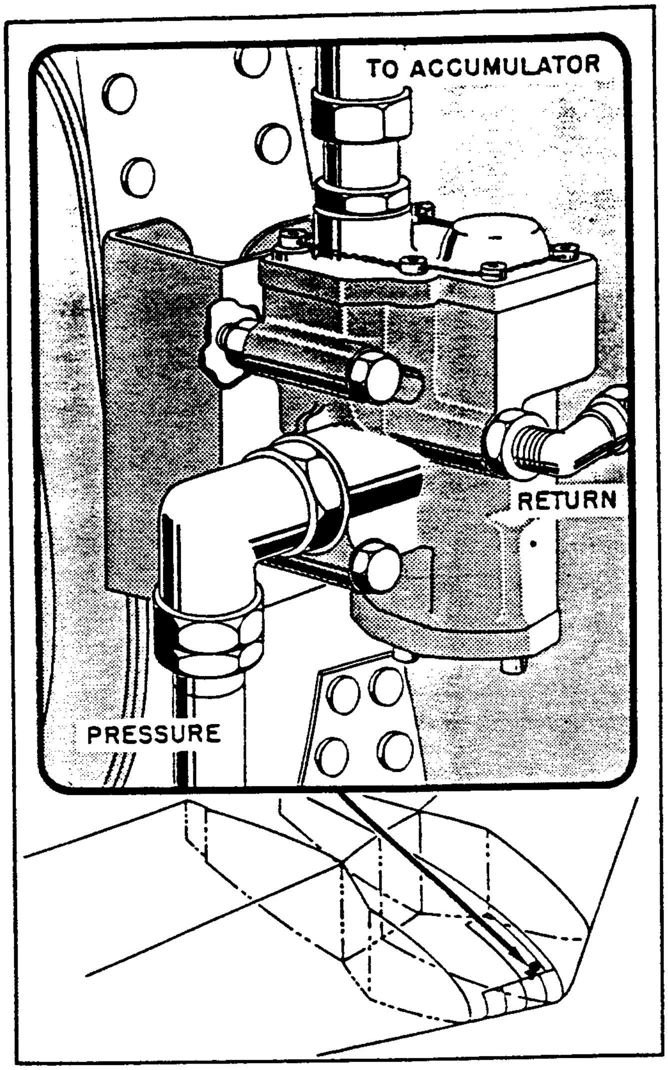


Figure 47. Pressure Regulator Installation

2. Connect the hydraulic lines.

3. Bleed the system.

(5) ACCUMULATOR.

(a) DESCRIPTION. (See figure 49.)- A hydraulic accumulator is installed in the pressure line beyond the pressure regulator. It is located in the nose section aft and above the system reservoir. The unit is divided into two compartments by a neoprene diaphragm and is preloaded to 600 psi air pressure in the lower compartment.

(b) REMOVAL. (See figure 50.)

1. Kill system pressure.

WARNING

Relieve all air pressure from the accumulator before removal. To do so, loosen the valve body at the bottom of the accumulator. Depressing the valve stem may damage the core.

2. Disconnect the hydraulic lines at the accumulator and plug immediately.

3. Remove the elbow on top of the accumulator and remove the lower bracket bolts.

4. Loosen the bolts holding the accumulator in the brackets, and lift the unit free.

(c) DISASSEMBLY. (See figure 49.)

1. Remove the cotter pin securing the retainer ring in the bottom of the accumulator.

2. Unscrew the retainer ring and remove the cap assembly. It will be necessary to hold the accumulator shell with a strap wrench when removing the ring.

3. Lift out the cap.

4. Remove the bladder. This can best be accomplished by collapsing the bladder inside with a small wooden hammer handle or a smooth piece of wood. Grasp the fold of the bladder firmly and pull outward, twisting at the same time.

CAUTION

Do not attempt to pry the bladder out with a sharp instrument or tool, or the bladder may be punctured.

5. Remove the stop and washer on the bottom of the bladder by removing the screw.

NOTE

It is not necessary to remove the stop and washer on the bottom of the bladder unless the bladder has been damaged, necessitating replacement, or unless there is evidence of oil leaking on the inside of the bladder through the stop and washer.

(d) CLEANING.- Flush out the inside of the shell with solvent, Federal Specification P-S-661, or equivalent, to remove any foreign material that might discharge into the system.

(e) ASSEMBLY. (See figure 49.)

1. Replace the washer and stop on the bottom of the bladder with the washer on the inside of the bladder. Make certain the screw is tight in order to prevent air leaks from the bladder. Stake the screw lightly in two places.

2. Install the bladder assembly in the accumulator shell. This can best be done by rolling up the bladder first. Make certain the bladder is fitted all around the inside of the shell and that the lip on the top of the bladder is over the shoulder on the inside of the shell near the top.

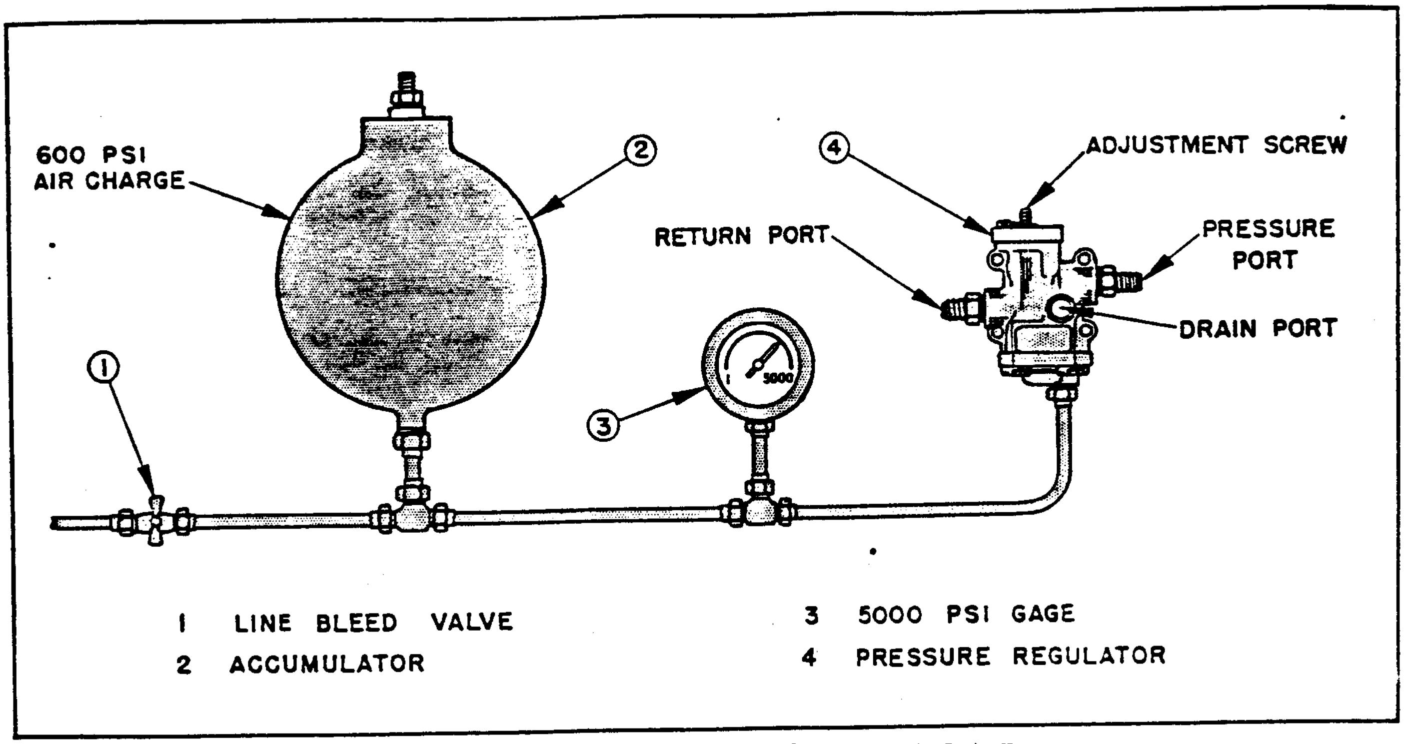


Figure 48. Pressure Regulator Test Set-Up

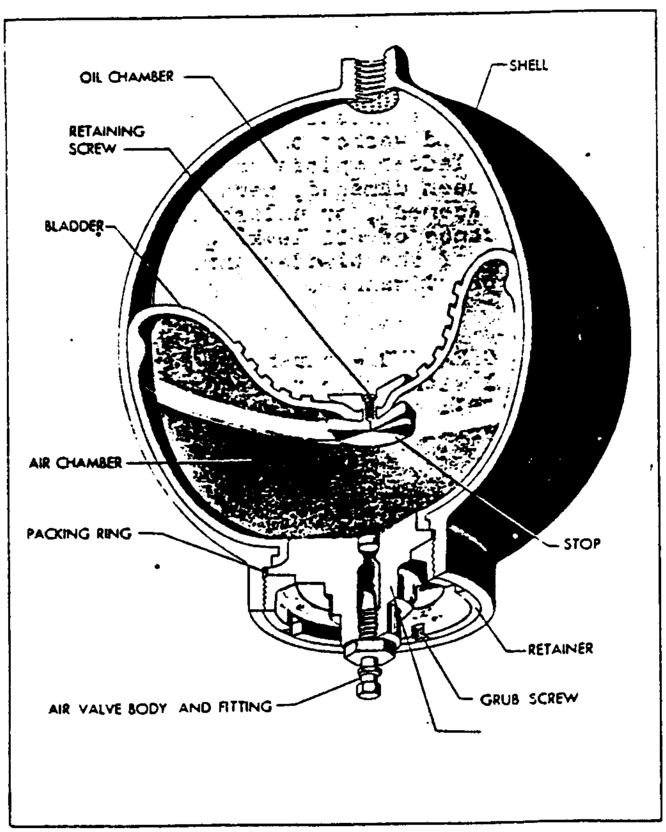


Figure 49. Accumulator

3. Place the cap assembly in the top of the accumulator, making certain that the bladder is not pushed down inside or distorted in any way. Push the cap against the bladder and seat with a slight rocking motion.

4. Screw in the retainer ring, holding the cap in place. The retainer ring should be turned until it bottoms against the cap. Then tighten with a retainer wrench. Turn the ring down as tight as it can be pulled without using any mechanical means other than the retainer wrench.

NOTE

If the accumulator is to be used in zero or sub-zero weather, tighten the ring approximately 1/4 turn more.

5. The retainer ring should be secured by a cotter pin through the lip of the shell assembly to prevent the ring from turning.

6. The valve-assembly cap should be seated with a small wrench to an approximate torque of 15 to 25 inch-pounds. Finger-tightness will not consistently hold the pressure.

(f) TEST.

1. Remove air valve. Then apply 6000 psi minimum oil pressure to fluid port for three minutes. There should be no leakage or failure. Install the air valve.

2. With all fluid discharged, charge accumulator with 600 psi air pressure. Apply 3000 psi hydraulic pressure for three minutes. There should be no leakage or failure.

3. Release all air pressure and drain all oil.

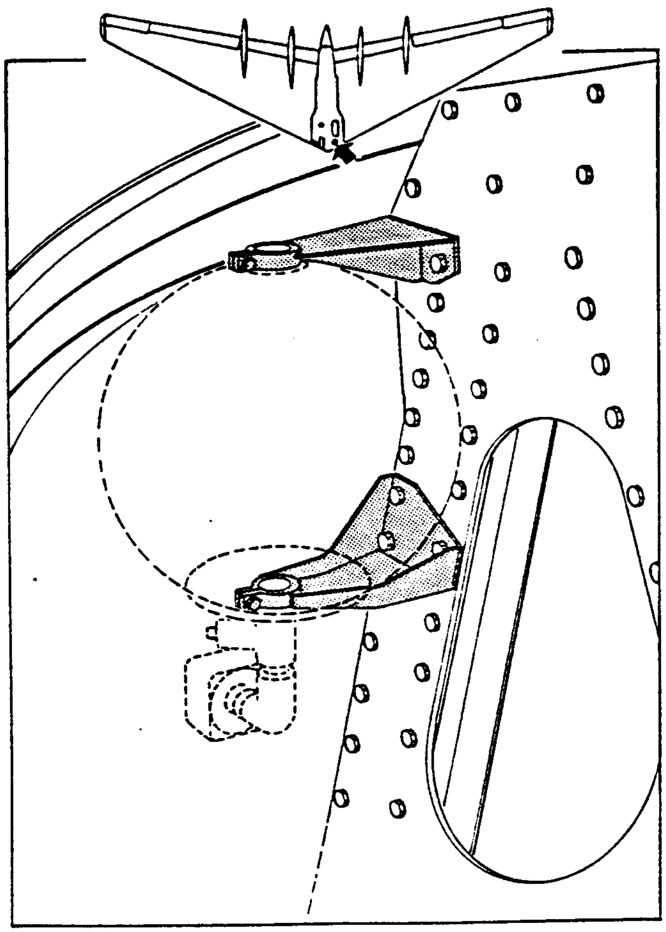


Figure 50. Accumulator Installation

(g) INSTALLATION. (See figure 50.)

1. Place the accumulator (with air valve on bottom) in place, and replace the lower bracket with the accumulator mounting trunnions in the brackets.

2. Tighten bolts on the lower bracket and adjust the accumulator so it is free, and resting mainly on the lower bracket.

3. Tighten the bolts holding the trunnions of the accumulator.

4. Replace the elbow on top of the accumulator.

5. Bleed the system.

(6) PRESSURE SWITCH. (Bendix 407780)

(a) DESCRIPTION.- The pressure switch used in this system operates on the hydraulic line pressure to actuate a relay which cuts in power for the auxiliary motor pump. The switch opens the circuit to the relay when the pressure rises to approximately 2750-2800 psi. Cut-in pressure for the switch is 2200 psi.

(b) TEST.

1. Connect a hydraulic pressure line to the inlet port. Connect a 24 volt d.c. battery and light to the switch to check the opening and closing pressures.

2. Apply hydraulic pressure to the unit. The light should be on until 2750-2800 psi. Release the pressure slowly; the light should go on at approximately 2200 psi. Repeat the test as required until correct setting is obtained.

3. Apply 4500 psi for three minutes. There should be no leakage; release pressure.

(c) ADJUSTMENT.- Adjustment of the pressure setting may be made by loosening the lock nut and turning the cylinder cap <u>in</u> to raise cut-out pressure, or <u>out</u> to lower it.

17. ELECTRICAL SYSTEMS

17. ELECTRICAL.

a. GENERAL.

(1) The airplane utilizes both alternating and direct current to operate the various electrical controls and equipment. The negative terminals of the battery and generators are grounded to the airplane's structure, which is used as the return conductor for practically all d.c. currents. The wiring for the a.c. and d.c. circuits is bundled separately in open bundles. Each wire is identified every 15 inches by a code number which corresponds to the wire numbers shown on the wiring diagrams reproduced in this section. Some of the more important control circuits, and the principle a.c. and d.c. power circuits are wired in multiple with different routings for safety. Pressurized plugs are used for circuits passing through the crew nacelle walls. The a.c. circuits are protected from overload by limiters, and the d.c. circuits by circuit breakers and limiters. A static ground wire is installed on the nose landing gear strut.

(2) The d.c. system operates on current supplied by one 24 volt battery, and two motor-generators with an output of 28 volts d.c. The a.c. system is supplied with current by two engine driven alternators. Whenever possible, external power should be used to operate equipment while on the ground. External power plug receptacles are provided for this purpose.

NOTE

Diagrams of the various electrical circuits may be found at the end of this section.

b. TROUBLE SHOOTING.

b. TROUBLE SHOOTING.- The general method of testing is from power source to equipment. If no trouble is found then a check of the individual piece of equipment is made.

WARNING

When trouble shooting complete electrical installations, it is often necessary to remove plugs and work near exposed high voltage or high amperage circuits. Extreme care must be exercised. The safest procedure is to shut down the power to the equipment, make the necessary changes, then apply the power.

(1) MOTOR TESTING.- The following may be used as a general guide for electrical tests to be made on faulty motors at the time of disassembly. Test with a 110 volt a.c. or d.c. line having a lamp in series.

(a) D.C. MOTORS.

1. To test for a shorted armature, use a "growler" if available. If not, examine commutator to make certain that no two adjacent bars are jointed electrically by foreign matter, such as copper chips, solder, or carbon dust. If armature windings appear to be burned, indicating weakened insulation, the armature should be replaced.

2. To test for a grounded armature, touch one side of 110-volt lamp circuit to the armature shaft. Touch the other terminal of the lamp circuit to the commutator bars. If the armature is grounded, the lamp will light.

3. To test for open armature, inspect the commutator for black or burned commutator bars, and be sure that all conductors are firmly soldered into the riser. Loose conductors or blackened commutator bars indicate the possibility of an open circuit.

4. To test for an open field circuit, connect the two terminals of 110-volt lamp circuit to the two field coil terminals. The lamp will light if there is no open circuit. If the circuit is open, replace the field coil unit.

5. To test for grounded field circuit, connect one terminal of 110-volt lamp circuit to one of the field terminals, the other field terminal being free. Touch the other terminal of the lamp circuit to the yoke momentarily. The lamp will light if the field is grounded. If grounded, replace the motor housing assembly.

(b) A.C. MOTORS.

1. To test for an open field, connect the test wires to the motor leads, two at a time. The lamp will light if there is no open circuit. If the circuit is open replace the coil.

2. To test for a grounded field connect one of the test wires to the motor housing and the other to each of the motor leads, in turn. If the indicator lamp lights the field is grounded. If the field is grounded replace the motor housing assembly.

3. Check rotor for particles of metal, dirt, and grime.

4. If motor tends to overheat excessively, check the bearings for wear and also check to see that the rotor turns freely and does not strike the field poles.

BATTERY

TROUBLE	PROBABLE CAUSE	REMEDY
Battery will not hold its charge.	Battery worn out.	Remove and give it a capacity test on approved Air Corps battery capacity tester.
	Charging rate not set right.	Check output of generators; check battery relay switch.
	Discharge to great to replace.	Too much use of electrical equipment while on the ground. (Use external power source.)
	Standing too long (hot climate).	Battery will require removal and recharge if airplane left unused for a week or more depending upon the temperature. For example, a fully charged battery will lose approximately one-half its charge in the following number of days for the temperature given: 60° F..........90 days 80° F..........45 days 100° F..........14 days 120° F.......... 6 days
	Equipment left on accidentally.	Remove and recharge battery.
	Short circuit, or ground, in wiring.	Check wiring and correct trouble.
	Broken cell partition.	This is usually indicated by two or more adjacent cells running down continually, particularly if left standing a few days. Replace battery.
Battery life is short.	Level of electrolyte below top of plates.	Keep electrolyte level 3/8 inch above the protector plate.
	Frequent discharges.	This is due to excessive use of equipment from the battery while on the ground, and then recharging in the air which uses the battery excessively. Use external power source wherever possible to conserve the battery.
	Sulphated plates.	This occurs when the battery is left in a discharged or undercharged (one half or less) condition for a period of time, or electrolyte is not maintained at its proper level. Charge at the normal rate until the specific gravity does not rise for two hours and then give a 60 hour overcharge at 10 percent of the normal charging rate of the battery. Capacity tests on approved Air Corps battery capacity tester.

TROUBLE	PROBABLE CAUSE	REMEDY
Battery life is short.	Improper storage.	Batteries stored for too long a period without charging, allow the plates to sulphate. Charge as for sulphated battery in paragraph above.
Cracked cell jars.	Hold-down loose.	Replace the battery and tighten hold down clamps.
	Frozen battery. This is caused by one of the following: a. Adding water in cold weather without charging the battery sufficiently afterward to thoroughly mix the water with the electrolyte before allowing it to stand. b. Allowing the battery to become discharged which permits it to freeze on account of its low specific gravity under these conditions. c. Low specific gravity of the electrolyte caused by improper filling.	Replace battery with fully charged one.
Compound on top of battery melts.	Electrolyte on top of cells.	Electrolyte on top of the cells caused by overfilling or improper operation of the ventilating system may short circuit the battery. The resulting heat will then soften the battery compound. To correct this condition, remove the battery then be sure the ventilating lines are clear and remove any electrolyte from the top of the battery and neutralize with sodium bicarbonate. Then wash the top of the battery thoroughly, charge and reinstall in the plane.
Electrolyte runs out of vent caps.	Too much water added to battery.	Remove excess with self-leveling syringe.
Excessive corrosion inside container.	Spillage.	Remove corrosion as outlined above.
	This is usually caused by over-filling, although in some cases may be caused by cracked or melted sealing compound.	Remove excessive electrolyte. Reseal if necessary.
	Vent lines leaking or clogged.	Clean out vent lines and replace any leaky hose.
Battery freezes.	Discharged battery (see table following).	Replace with fully charged battery.
	Water added and battery not charged immediately. This	

TROUBLE	PROBABLE CAUSE	REMEDY
Battery freezes.	is an important point. Water should never be added in freezing weather when batteries are to be left standing before charging. About half hour charge will mix the water with the electrolyte. The freezing point will then be in accordance with the table following.	
	Leaking cell jar.	Water was added which froze. Replace battery.
	Extreme cold (see table).	In these cases it is generally necessary to replace the battery, although in case of a partial freezing, thawing in a warm room may save it. It should be thoroughly checked before being used in the airplane.
Battery polarity reversed.	Battery connected backwards on charger.	Slowly discharge battery completely and then charge correctly and test with an Air Corps battery capacity tester.
	Battery connected backwards on airplane.	
Battery consumes excessive water.	Electrolyte runs out of vent caps.	Level of electrolyte too high. Adjust level to 3/8 inch above protector plate.
Battery will not come up on charge.	Battery worn out.	Give battery capacity test on Air Corps capacity tester.
	Battery badly sulphated.	Caused by standing idle in discharged condition. Charge as for sulphated battery preceding.

Freezing Point

Specific Gravity	Freezing Point
1.300	-95° F
1.275	-80° F
1.250	-62° F
1.225	-35° F
1.200	-16° F
1.175	- 4° F
1.150	+ 5° F
1.125	+13° F
1.100	+19° F

BATTERY CIRCUIT RELAY

TROUBLE	PROBABLE CAUSE	REMEDY
Switch inoperative.	Discharged battery.	Recharge battery.
	Improper connections.	Check wiring (see figure 12).
	Defective control	Test control switch and replace, if necessary.
	Defective wiring.	Check for open control circuit wiring, defective insulation, or grounding.
	Relay holding coil shorted, burned out or grounded.	Replace; send unit to repair depot.

REVERSE CURRENT RELAY

TROUBLE	PROBABLE CAUSE	REMEDY
Relay fails to pick-up.	Improper calibration.	Recalibrate at repair depot.
	Dirt or metal chips.	Clean and recalibrate.
Relay fails to drop out.	Improper calibration.	Recalibrate at repair depot.
	Dirt or metal chips.	Clean and recalibrate at repair depot.
Relay operates erratically.	Poor connection.	Tighten and clean. (Refer to Par. d (2) (j) 2 a.)
	Foreign matter obstructing armature.	Clean. (Refer to Par. d (2) (j) 2 a.)
	Short or ground in coil.	Replace coil at repair depot.
	Wrong contact clearances.	Readjust clearances. (Refer to Par. d (2) (j) 2 f.)
	Too weak spring tensions.	Readjust with more tension. (Refer to Par. d (2) (j) 2 d.)
Relay switch fails to operate.	Broken lead.	Reconnect.
	Burned out coil.	Replace at repair depot.
	Burned contacts.	Clean contacts. (Refer to Par. d (2) (j) 2 b 2.)
	Broken resistor.	Replace.
	High resistance connection.	Clean and tighten. (Refer to Par. d (2) (j) 2 a.)
Contactor fails to operate.	High resistance connection.	Locate and clean. (Refer to Par. d (2) (j) 2 a.)
	Broken wire.	Locate and repair.
	Burned out coil.	Replace at repair depot.
	Spring out of calibration.	Recalibrate at repair depot.
Relay contacts do not close.	Relay may be badly out of adjustment.	Recalibrate at repair depot.
	Armature ears rubbing on steel frame instead of on bronze bearing.	Replace frame assembly or file frame until bronze bearing overhangs .005 inch. Paint field surface with aluminum paint.
	Foreign matter, such as iron filings, etc., in the air gap may be obstructing the armature motion.	Clean. (Refer to Par. d (2) (j) 2 a and c.)
	Open circuit in the main winding, sometimes due to a poor connection between terminal and insert in front coil washer.	Clean and tighten connections.
	Open circuit in resistor.	Clean and check connection.
	Defective permanent magnet.	Replace at repair depot.
Sluggish contact operation.	Defective armature adjustment.	Readjust and clean. (Refer to Par. d (2) (j) 2 c 2.)

MOTOR GENERATOR

TROUBLE	PROBABLE CAUSE	REMEDY
Short brushes.	Brushes may have been overloaded.	Check electrical system for possibility of overloads.
	Wrong brush shift.	Remove and send to depot for correction.
	Untreated brushes used for flights above 20,000 or 25,000 feet.	Use brushes, grade 417 RC, Part No. 8-D-2527-7.
Burned brushes.	Generator overloaded or sufficient cooling not available.	Replace brushes. Check electrical output of generator. Check electrical system for possibility of overloads. Check cooling system for leaks or restrictions.
Yellow deposit on brushes.	Generator overloaded or sufficient cooling not available.	Clean yellow deposit out of brush boxes, and make the same check as for burned brushes.
Loose rocker ring mounting threads worn.	Excessive vibration.	Replace rocker ring clamping plates and screws with new heat treated plates and screws identified by "X" stamped on surface.

c. A.C. POWER SUPPLY.

(1) DESCRIPTION.- A.C. power is generated by two alternators which are engine driven and contained in two auxiliary power units (see figure 1). Each unit is controlled from the engineer's auxiliary a.c. power control panel (figure 2) and may be started with the battery or with external d.c. power through electrical controls, or, in an emergency with a hand crank. Either alternator will supply sufficient electricity to operate the airplane's electrical system in an emergency. An external ground-power receptacle is installed to supplant the alternators for testing equipment or starting the engines when the airplane is on the ground. Removal and installation of the auxiliary power unit is described in paragraph 7 c.

(2) ALTERNATORS.

(a) DESCRIPTION.- Each alternator is a part of the auxiliary power unit which is composed mainly of a modified Franklin Air-cooled, 113 h.p. gasoline engine; a starter-exciter (JH12150); a 208 volt, 3 phase, 400 cycle alternator (JH12140); and one voltage control unit (JH12275). One auxiliary power unit is installed in bomb bay three, and the other in bomb bay six.

(b) ALTERNATOR POWER OUTPUT WIRING.- The power leads from the alternator enter the voltate control box on the power unit, pass through two current transformers and a paralleling relay, then emerge and run to an a.c. sectionalizing panel in the aft end of the respective bomb bay. See figure 4.

(c) OPERATION.- The generating units and power output are controlled by the flight engineer by means of switches and regulators mounted on the auxiliary a.c. power control panel. (Figure 2.) The units may be operated individually, or both may be operated simultaneously by synchronizing their output voltages and frequencies. Either unit will deliver sufficient electrical energy to operate the electrical system of the airplane under emergency conditions. The operating condition of the equipment and the various circuits is shown on instruments and by indicator lights installed on the control panel.

1. OPERATION STARTING SEQUENCE FOR AUXILIARY POWER UNIT.

NOTE

Starting procedure is given in Pilot's Handbook, Report No. HB-18.

a. When the speed control switch is held in the "IDLE" position, until the white indicator lamp lights, a small motor mounted on the engine drives the engine governor spring to a position which causes the engine to idle after starting. When the governor spring reaches this position a limit switch cuts off the current to the motor and lights the idle speed indicator lamp.

b. When the two magento switches are closed, two relay coils are energized causing the normally closed contacts (which short the magento primary breaker points) to open, and the normally open contacts (in series with the two green magneto indicator lights) to close, and the lamps to light. The green lights indicate that the magneto circuits are ready for operation.

c. When the starter switch is held in the "START" position the coil of a relay (which has three sets of normally open contacts) is energized and its contacts close the circuit from the battery to the exciter shunt field, energize the starter relay coil, and energize the fuel shut-off solenoid valve, supplying fuel to the carburetor. The starter relay coil, when energized, applies the battery current across the starter-exciter armature and series field, and cranks the engine. The shunt field of the starter-exciter unit is placed directly across the battery at a slight time interval ahead of the battery voltage which is applied to the armature, so that the starting current will be held to a minimum.

d. Throwing the priming switch causes the priming solenoid to be energized and forces raw fuel directly into cylinders two and three.

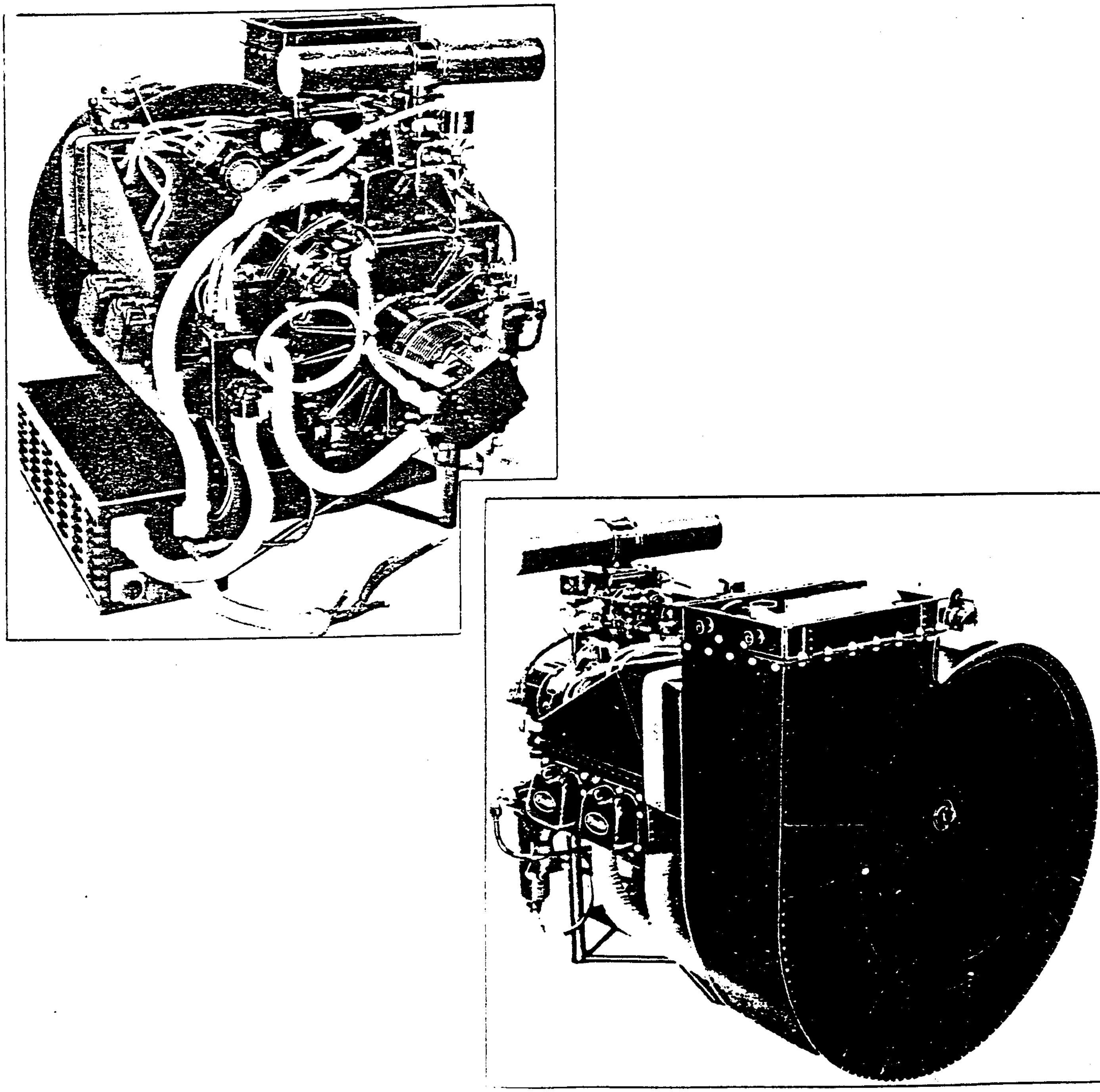


Figure 1. Auxiliary Power Unit

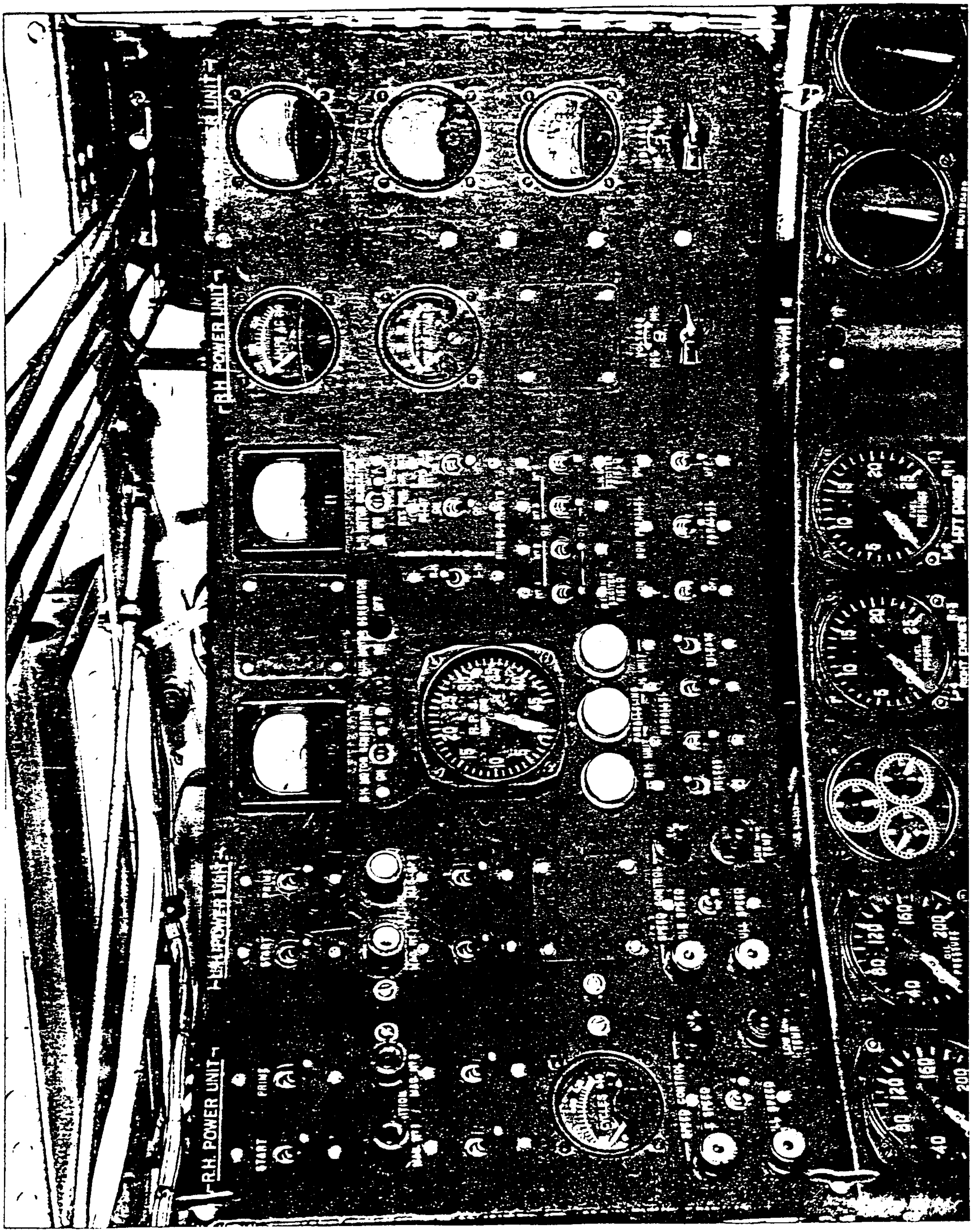


Figure [illegible]. E[illegible]'s A[illegible] Power Panel

e. Releasing the starter switch after the engine has started removes the battery from the armature and series field of the starter-exciter unit and at the same time de-energizes the relay coil, removing the exciter shunt field from the battery. As soon as the engine starts, its oil pressure increases and actuates a pressure switch which closed a circuit to the fuel valve solenoid keeping it energized and open.

NOTE

> If the oil pressure falls below the critical value of 12 psi, the pressure switch will open the circuit and shut-off the fuel supply.

f. The red low-oil temperature light goes out when the engine has warmed up indicating that the temperature which actuates the oil-temperature-actuated switch is above its normal setting of 50°F.

2. ADJUSTING THE POWER OUTPUT.

a. After the engine has been brought up to full speed, place the exciter-field switch in the "ON" position.

CAUTION

> Do not throw the exciter field into the alternator field circuit until the engine has been brought up to full speed, as the alternator field would draw an excessive current at slow speeds. The field over-heats because the ventilation at sub-synchronous speed is insufficient.

A centrifugal switch is mounted on the hub of the alternator field, and wired in series with the alternator field. It closes when the engine speed reaches approximately 1150 rpm. This permits the exciter-field switch, through a relay, to close the circuit between the exciter and the alternator field.

b. Adjust the voltage, by means of the voltage regulator control switch, to 208 volts. The voltage regulator potential coil is connected through a transformer-rectifier unit and a reactive load division network to the alternator.

c. Adjust the frequency of the current, by using the speed control switch to change the engine speed, until a reading of 400 cycles is registered on the frequency meter. This frequency will occur when the tachometer reading is approximately 2160 rpm. The frequency meter and the voltmeter will register only when placed in the circuit by a double throw switch being thrown to the proper position for the unit being tested.

d. If only one generating unit is to be kept on the line, move the switch that is located between the exciter-field switches to "NON-PARALLEL" position. This will remove the reactive load division network by short-circuiting the network transformer.

3. PARALLELING THE ALTERNATOR UNITS.

a. Place the switch between the exciter-field switches in "PARALLEL" position.

b. Adjust the voltage of both units by means of the voltage regulators, and the frequency of the incoming unit to the frequency of the loaded unit with the speed control switches. As the voltages and frequencies of the two units become nearly the same the white paralleling lights go on and off at slip frequency. The proper time to synchronize is when the lamps are dark. At this moment move the two paralleling switches to "PARALLEL" position.

NOTE

> It is best to come in at slightly excessive speed and then to adjust the loads with the speed control switches.

The paralleling switch energizes a paralleling contactor coil and an auxiliary relay coil. This closes three normally open contacts, throwing the unit on the line. The auxiliary relay keeps the paralleling contactor energized after the paralleling switch is released.

c. A unit is removed from the line by moving the release switch to "RELEASE" position, and the switch between the exciter field switches to "NON-PARALLEL" position.

4. STOPPING THE AUXILIARY POWER UNIT.- To stop the engine of a unit, cut the ignition with the ignition switches after running the engine at idle speed for at least thirty seconds

(3) AUXILIARY POWER UNIT.

(a) The unit is started by a d.c. starter exciter directly connected to the engine, supplied by 24 volt d.c. from the airplane's storage battery and controlled by a switch on the control panel. The starter-exciter, in addition to functioning as a starter motor, also serves as a generator to supply d.c. excitation for field coils of the alternator. For more detailed information on the auxiliary power unit refer to paragraph 7 c.

(4) EXTERNAL POWER. (Figure 3.)

(a) DESCRIPTION.- An external power receptacle (Type RB-AN3102-32-17) is located in the forward part of bomb bay four to obtain 208 volt, 3 phase, 400 cycle, a.c. from an external power source for operating the electrical system of the airplane. Access to the receptacle is through a door in the lower skin of the wing just aft of the front spar.

(b) WIRING. (See figure 33.)- The ground power current passes through limiters mounted on the crew nacelle wall at the engineer's station, and to a remote controlled contactor mounted just above the limiters. The contactor (relay) is controlled by a double throw, on-off switch mounted on the engineer's a.c. panel (#552795). The control circuit is protected by a switch-type circuit breaker mounted beside

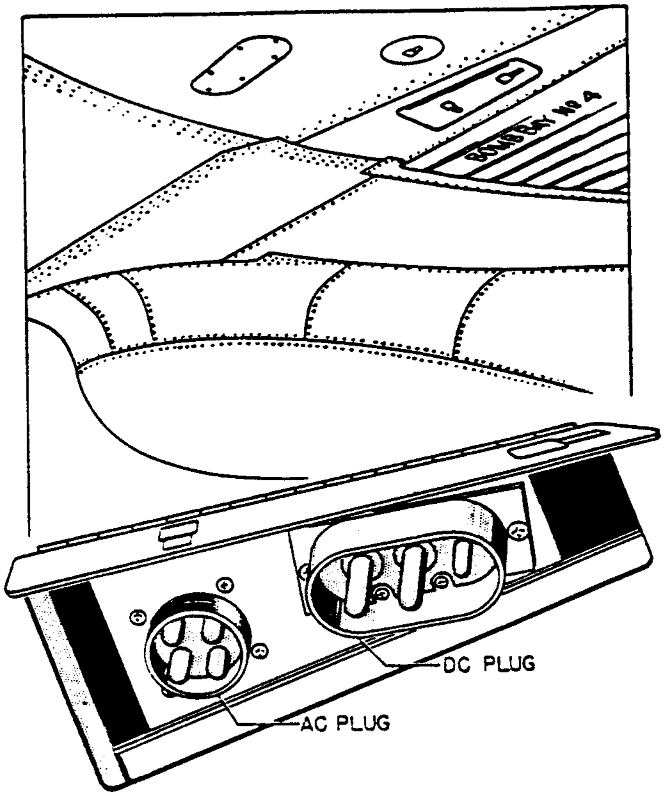


Figure 3. External Power Receptacles

the control switch. The contactor control circuit operates on 24 volts d.c. which is wired to the auxiliary control panel from the engineer's lower electrical panel (#552672). From the contactor the power circuit is routed to the ring bus for distribution.

(5) A.C. POWER DISTRIBUTION. (Refer to figure 4.)

(a) 208 VOLT A.C. (See figure 20.)- The current from the alternators is lead directly to the bomb bay #3 a.c. sectionalizing panel (#552947) in the left wing, and to the bomb bay #6 a.c. sectionalizing panel (#552947-1) in the right wing. From these panels the power is distributed to some of the motors in the inner wings and to the ring bus in the crew nacelle. From the ring bus the power is routed to the several panels in the outer wings, inner wings, and crew nacelle for distribution to the various motors.

1. RING BUS. (See figure 5.)- The a.c. ring bus is essentially a continuous three phase bus used for distributing the current from the alternators. Four remote controlled contactors (relays) are installed in series within its circuit and are controlled by individual switches on the engineer's auxiliary a.c. power control panel. The control circuits are protected by a switch-type circuit breaker mounted above the control switches. The power from each alternator is fed into the ring bus through its respective contactor, affording an interconnection of the power from both alternators. Four contactors have been installed in the ring bus to permit a future installation of four alternators, which will be driven by power take-offs from the propeller gear boxes. Two spare fuses for the contactors are mounted in clips at the top and bottom of the ring bus panel for use in the ring bus contactors and external contactor.

NOTE

All four "RING BUS RELAY" (contactor) switches must be on before power can be completely distributed.

(b) LOW VOLTAGE A.C. (See figures 6 and 30).- 208 volt, 3 phase, 400 cycle, a.c. current is wired to a transformer panel from the ring bus and, by means of various transformers, the voltage is reduced to the values required for the operation of equipment using low voltage a.c.

1. TRANSFORMERS. (See figure 7).- One three phase transformer delivers 120 volt, 3 phase, 400 cycles a.c. to the pilot's instrument panel. One single-phase transformer delivers 3 volt, 1 phase, 400 cycle a.c. to the bombardier's control panel. Three single phase transformers deliver 30 volt, 1 phase, 400 cycle, a.c. to the engineer's junction panel. Single wires from the 208 volt, 3 phase a.c. ring bus leads, are routed through the transformer panel to supply 120 volt, 1 phase, 400 cycle, a.c. to the engineer's junction panel for distribution.

d. D.C. POWER SUPPLY.

(1) DESCRIPTION.- Two motor generators (figure 8) supply 28 volt d.c. power; each is driven by 208 volts, 3 phase, 400 cycles, a.c. current. Each unit is controlled from the engineer's auxiliary a.c. control panel and is started by throwing the individual control switch to "ON." A 24 volt, 17 ampere hour battery is utilized in the d.c. system for use when the generators are not in operation. The battery circuit is controlled by a switch on the engineer's upper electrical panel. An external d.c. power receptacle is installed in the forward part of bomb bay four.

CAUTION

Due to the limited capacity of the battery, operation of d.c. equipment should be kept to a minimum when motor-generators are not operating, or when external d.c. power is not available.

(2) MOTOR-GENERATORS. (See figure 9.)

(a) DESCRIPTION.

1. The two motor-generators, one located in each main gear wheel well, operate on 208 volts, 3 phase, 400 cycle, a.c. input

ITEM	DESCRIPTION	LOCATION
1	A.C. SECTIONALIZING PANEL	STA. 870 REAR SPAR R.H.
2	A. C. SECTIONALIZING PANEL	STA. 560 REAR SPAR R.H.
3	A. C. SECTIONALIZING PANEL	STA. 523 FRONT SPAR R.H.
4	A. C. SECTIONALIZING PANEL	NO. 4 ENG. COMP. AFT
5	A. C. SECTIONALIZING PANEL	MAIN GEAR WELL, R.H.
6	AUX. POWER UNIT GROUND	BOMB BAY NO. 6
7	AUX. POWER UNIT, R.H.	BOMB BAY NO. 6
8	A. C. SECTIONALIZING PANEL	BOMB BAY NO. 6, AFT

ITEM	DESCRIPTION	LOCATION
9	PRESSURIZED PLUG	CREW NAC. WALL R.H.
10	GROUND POWER LIMITERS	C. N. WALL, ENG'RS STA.
11	TRANSFORMER LIMITERS	C. N. WALL, ENG'RS STA.
12	AFT CREW NACELLE LIMITERS	C. N. WALL, ENG'RS STA.
13	NO. 2 ENG. ALTERNATOR LIMITERS	C. N. WALL, ENG'RS STA.
14	RING BUS	C. N. WALL, ENG'RS STA.
15	PRESSURIZED PLUG	C. N. WALL, R. H.
16	NO. 1 ENG. ALTERNATOR LIMITERS	FRONT SPAR, ENG. STA.
17	NO. 4 ENG. ALTERNATOR LIMITERS	FRONT SPAR, ENG. STA.
18	NOSE & NOSE WHEEL WELL LIMITERS	C. N. WALL, ENG'RS STA.
19	NO. 3 ENG. ALTERNATOR LIMITERS	C. N. WALL, ENG'RS STA.
20	TRANSFORMER PANEL	C. N. WALL, ENG'RS STA.
21	GROUND POWER CIRCUIT BREAKER	C. N. WALL, ENG'RS STA.
22	A. C. SECTIONALIZING PANEL	CREW NACELLE NOSE
23	GROUND POWER RECEPTACLE	BOMB BAY NO. 4, AFT
24	PRESSURIZED PLUG	C. N. WALL, L. H.
25	NOSE WHEEL WELL LIMITERS	A. C. SECT. PANEL
26	A. C. SECTIONALIZING PANEL	NOSE WHEEL WELL
27	PRESSURIZED PLUGS	C. N. WALL, L. H.
28	PRESSURIZED PLUG	C. N. WALL, L. H
29	A. C. SECTIONALIZING PANEL	CREW NAC., REAR SPAR
30	AUX. POWER UNIT, L. H.	BOMB BAY NO. 3
31	AUX. POWER UNIT GROUND	BOMB BAY NO. 3
32	A. C. SECTIONALIZING PANEL	BOMB BAY NO. 3, AFT
33	A. C. SECTIONALIZING PANEL	MAIN GEAR WELL, L. H.
34	A. C. SECTIONALIZING PANEL	NO. 1 ENG. COMP. AFT
35	A. C. SECTIONALIZING PANEL	STA. 523, FRONT SPAR L.H.
36	A. C. SECTIONALIZING PANEL	STA. 560, REAR SPAR L.H.
37	A. C. SECTIONALIZING PANEL	STA. 870, REAR SPAR L.H.

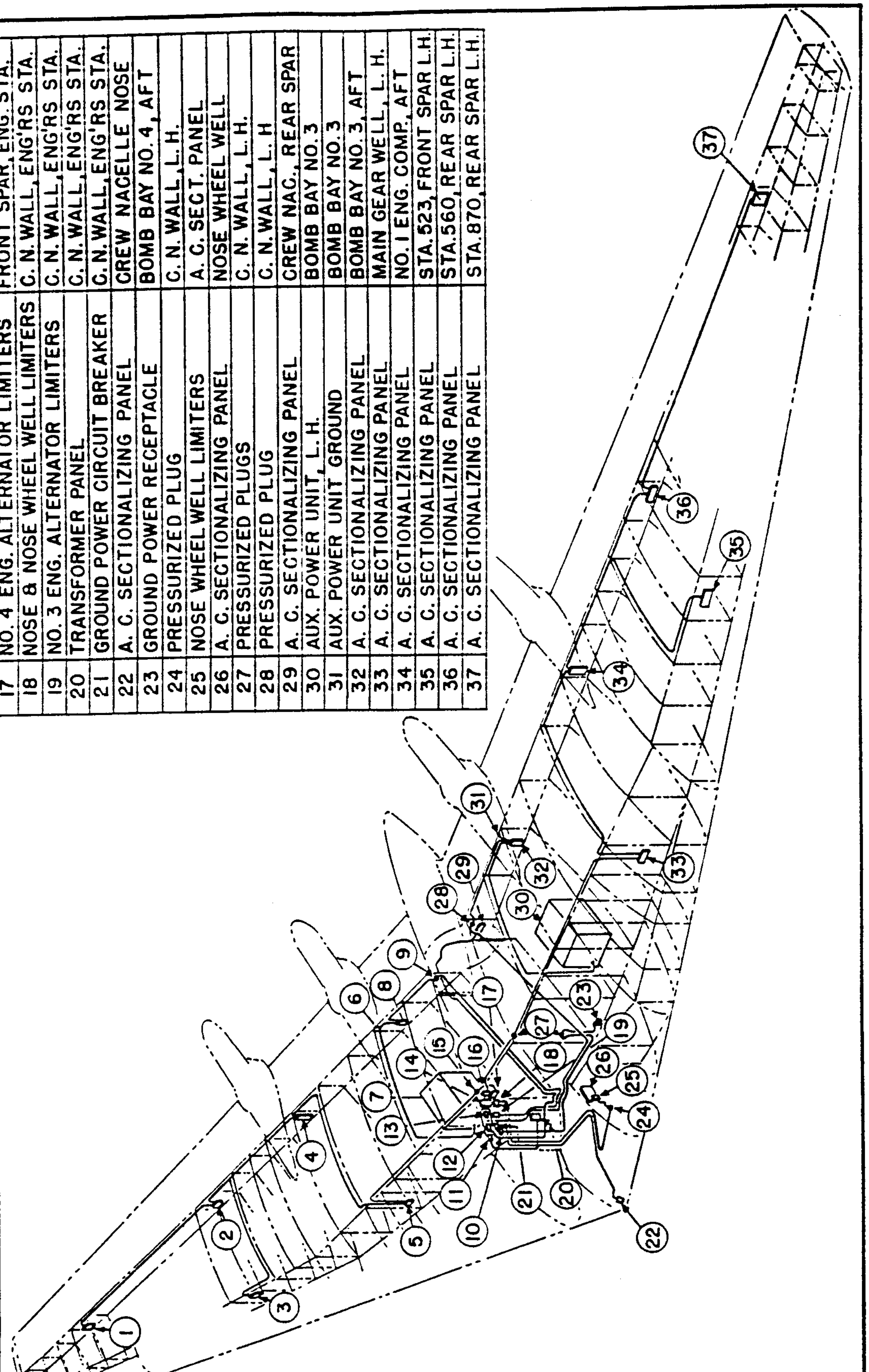


Figure 4. AC Power Distribution

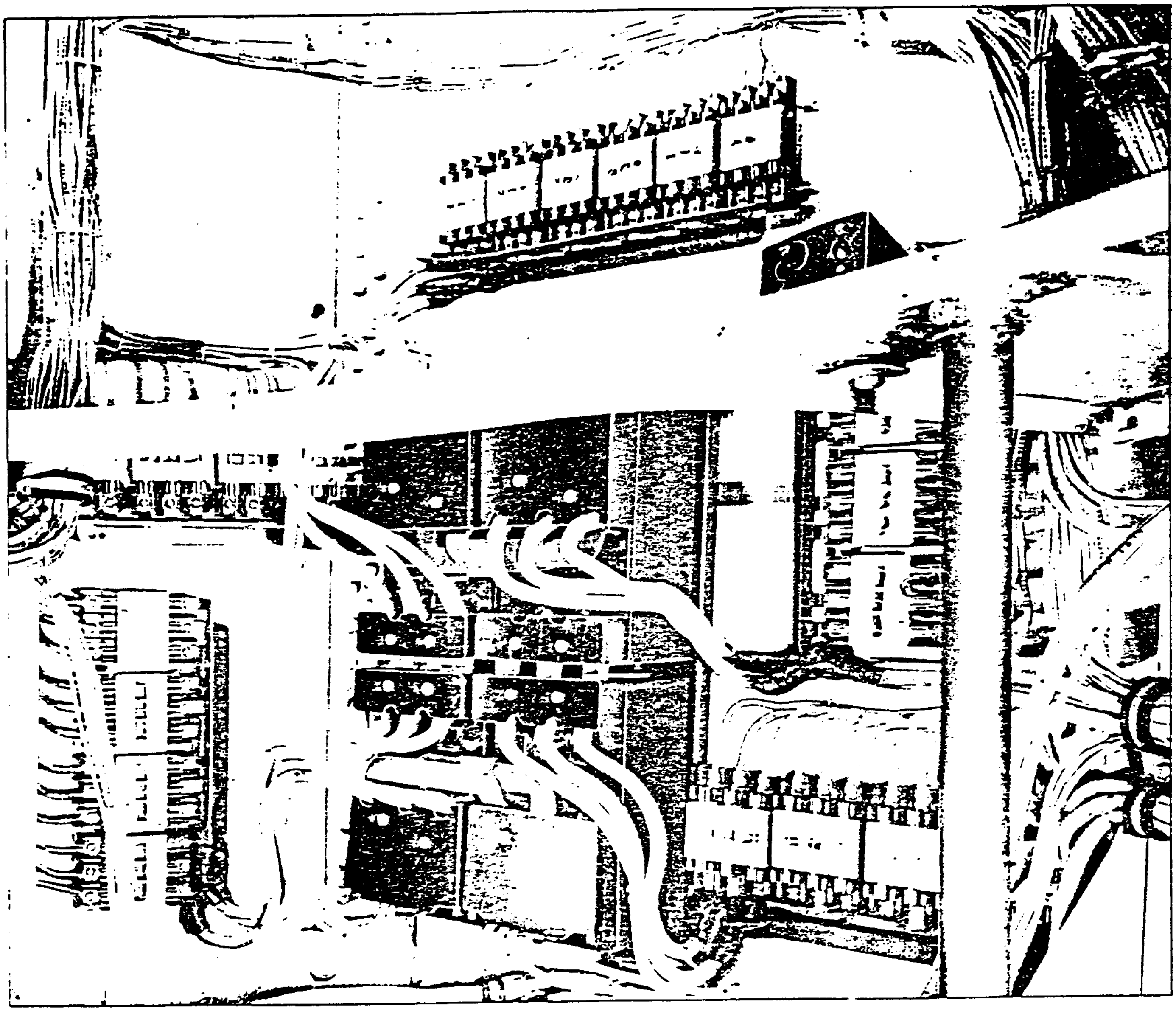


Figure 5. AC Ring Bus

to deliver an output d.c. voltage between 26 and 30, at a continuous load of 200 amperes. In an emergency the electrical output of one unit will maintain normal functioning of the airplane's electrical system. However, both units are normally in operation at the same time with the output voltage of the two units equalized by a paralleling line between them.

2. A reverse current relay, mounted on the unit eliminates reverse current flow thru the generator and connects the generator to the battery or load bus when its voltage is high enough.

(b) WIRING. (See figures 27 to 29.)

1. The a.c. operating power for the units is wired from the a.c. sectionalizing panel (bomb bay #3, panel #552047 L.H.; bomb bay #6, panel #552047-1 R.H.), to the unit through a remote controlled relay mounted on each unit. The relay is operated by a 28 volt d.c. circuit controlled by an on-off switch on the engineer's auxiliary a.c. power control panel.

2. The 28 volt d.c. output is wired to the main gear well d.c. power distribution panel (#554189 L.H., #554189-1 R.H.). An ammeter shunt, from which leads are connected to an ammeter on the engineer's auxiliary a.c. power control panel, is installed in the output circuit. A paralleling line connects the two units for equalizing the current.

(c) OPERATION.- Either unit may be operated individually or in parallel, by the use of two separate control switches mounted on the engineer's auxiliary a.c. power control panel (#550593).

ITEM	DESCRIPTION	LOCATION
1	RING BUS	ENGINEER'S STATION
2	LIMITERS	ENGINEER'S STATION
3	TRANSFORMER PANEL	ENGINEER'S STATION
4	TRANSFORMERS, G.E. 70G81	TRANSFORMER PANEL
5	TRANSFORMER, G.E. 70G159	TRANSFORMER PANEL
6	TRANSFORMER, G.E. 70G151	TRANSFORMER PANEL
7	TRANSFORMER, G.E. 70G77	TRANSFORMER PANEL
8	BOMBARDIER'S CONTROL PANEL	BOMBARDIER'S STATION
9	PILOT'S INSTRUMENT PANEL	PILOT'S & CO-PILOT'S STATION
10	ENGINEER'S JUNC. PANEL	BENEATH ENGINEER'S FLOOR

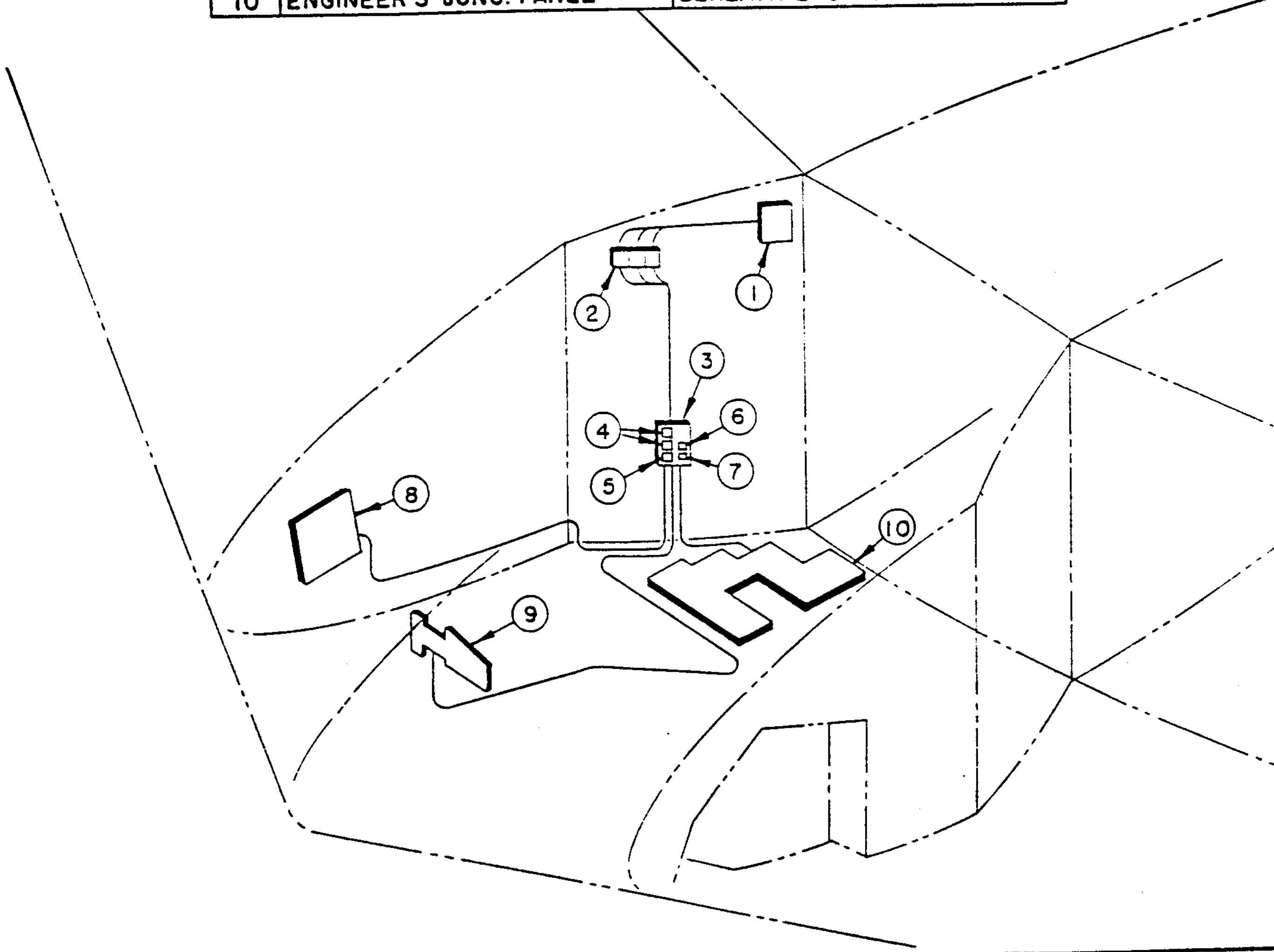


Figure 6. Low Voltage AC Distribution

(d) REMOVAL.

1. Make sure all electrical current is off.

2. Disconnect and tag all leads connected to the unit.

3. Disconnect cooling duct at the generator end by loosening the clamp.

4. Remove the four mounting bolts of the unit.

5. Remove the unit.

(e) INSTALLATION.

1. Make sure all electrical current is off.

2. Secure the unit in place with the four mounting bolts

3. Make all electrical connections.

4. Connect air cooling duct to the generator unit.

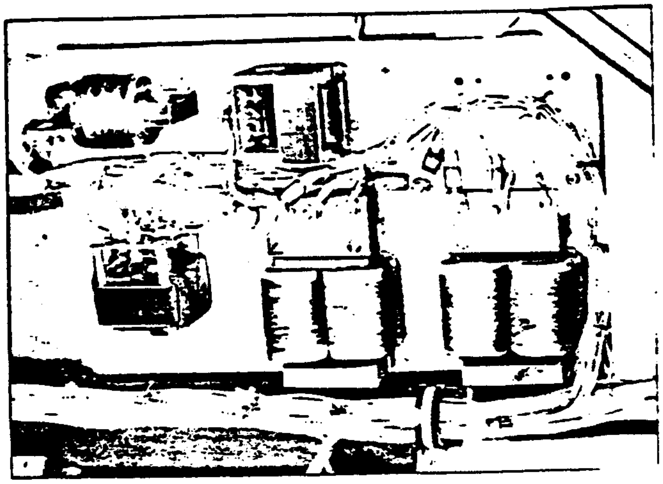


Figure 7. Transformers

(f) MAINTENANCE.

1. BRUSHES.- The generators are equipped with brushes having Westinghouse part No. 8-D-2527-5. These are altitude treated brushes, grade MP36XH and are stamped with code W-10.

NOTE

Tests have shown that brush part No. 8-D-2527-7 has longer life at high altitude. These are grade 417RC. The latter grade of brush should be used for replacements when all brushes are replaced and the commutator re-finished.

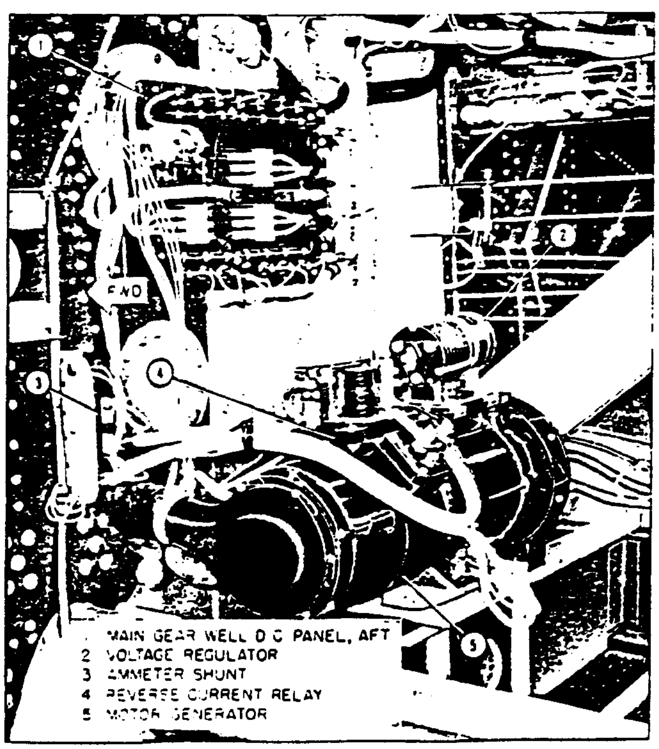


Figure 8. Motor Generator (Installed)

Partial replacements of damaged brushes should be made with the same brush grade as the rest of the set.

2. BRUSH REPLACEMENT.- During periodic inspections replace all brushes which have less than 1/4 inch left below the edges of the rivets.

a. Make sure that brushes are inserted correctly so that face of brush rests against commutator surface, as brush holders are not perpendicular to commutator.

b. Locate the brush shunts so they will have no sharp bends and so they will allow the brush to move down in the brush holders freely.

c. Check all brushes not replaced to make sure that they move freely in the brush holders and that shunt connections are tight and safety wired.

NOTE

If commutator has been refinished brushes should be run in at 50% to 100% load until a film is built up on the commutator surface, and there is 100% arc contact at some point on each brush. The time of run-in may be reduced by sanding the brushes to fit the commutator after the rocker ring is assembled in the bracket, and before energizing the machine.

3. CORRECT SETTING OF BRUSHES.- The performance of the generator and the life of the brushes are greatly affected by the brush setting. Therefore, it is extremely important that the brushes are set in the proper location. On these generators the brushes should be set exactly on neutral. The neutral position, as determined at the factory, is marked with a stripe of red paint on the edge of one of the front bracket openings, opposite a corresponding stripe on the edge of the rocker ring. Ordinarily it will not be necessary to change this setting.

(g) AMMETER.- Refer to "INSTRUMENTS" Section IV, paragraph 23.

(h) POWER CONTROL RELAY (Cutler Hammer #9565H1 Type 653).- (See figure 8.) This relay closes the 208 volt a.c. circuit to drive the motor generator. It is a 50 amp., 3 pole, single throw contactor. A relay is mounted on each unit and is remotely controlled by its respective switch on the engineer's auxiliary a.c. power control panel. The relay requires no adjustment by field personnel, and if defective should be replaced.

(i) VOLTAGE REGULATOR. (Figure 9.)

1. DESCRIPTION.- The carbon pile type voltage regulator mounted on the motor generator maintains a constant voltage in the electrical system regardless of varying electrical loads. The voltage regulator automatically regulates the voltage by controlling the amount of resistance in the generator field circuit. Normally it requires no attention on the part of flight personnel.

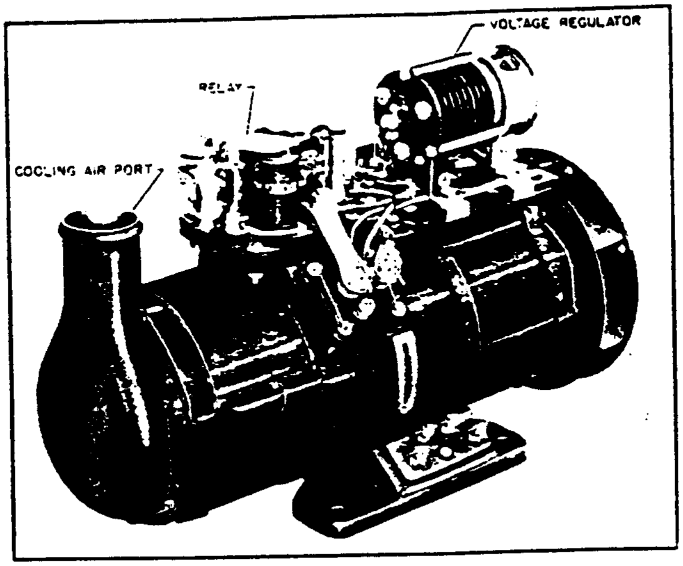


Figure 9. Motor Generator

2. ADJUSTMENT.- For adjustment, one precision type portable voltmeter, stock No. 7800-961000, or one tester assembly, portable aircraft accessory, stock No. 7800-808000, with necessary test leads for connecting to the airplane structure and voltage regulator terminals, is the only special instrument required.

NOTE

These test instruments must be handled carefully as they will not maintain accuracy under conditions of mishandling, or vibration and shock.

a. Only qualified personnel should make adjustments of the regulators. The adjusting should be done by two men, one at the controls and one at the voltage regulator.

b. Do not use the airplane voltmeter for adjustment (except in an emergency) as these voltmeters are for approximate voltage indication only.

1. Place all generator switches "OFF."

2. Plug in the 208 volts, 3 phase a.c. external power to operate the motor-generators, and place the switch for the generator being tested in the "ON" position.

3. Connect the negative terminal of the portable voltmeter to ground. The structure around the motor generator makes a satisfactory ground. The "G" or ground terminal on the regulator sub-base should not be used for the negative voltmeter connection.

4. Connect the positive terminal of the portable voltmeter to the "B" terminal of the voltage regulator.

5. The voltmeter should indicate 28.0 volts. If it does not, adjust the voltage regulator to give a reading of 28.0 on the voltmeter by turning the knurled adjusting knob. Turning the knob to the right will increase the voltage, and turning it to the left will decrease it.

6. When using tester, stock No. 7800-808000, to make these adjustments, open and close the generator field circuit several times and observe the voltmeter after each time that the field circuit is closed. This procedure will cause the carbon pile to operate to the extremes (minimum and maximum) of its resistance, and furnish a check of regulator stability. If the voltage does not return to previously set value after each interruption of the field circuit, the regulator is defective and must be replaced.

NOTE

In case no voltage is obtained from the generator, check the system as outlined in the Trouble Shooting Chart.

(j) REVERSE CURRENT RELAY (AVR-14-B).

1. DESCRIPTION. (See figures 9 and 10.)

a. The generator control relay switch, commonly called a "reverse-current cut-out," mounted on the generator is designed to eliminate reverse-current flow and to connect the generator to the battery or load bus when its voltage is sufficient to supply the load. Two major parts comprise the relay switch; the magnetic contactor, which consists of the plus connection to the battery, flexible shunt, holding contact coil, and the contactor contacts. The reverse-current relay consists of a plus connection to the generator, voltage adjustment screws, a balast resistor, and a relay coil.

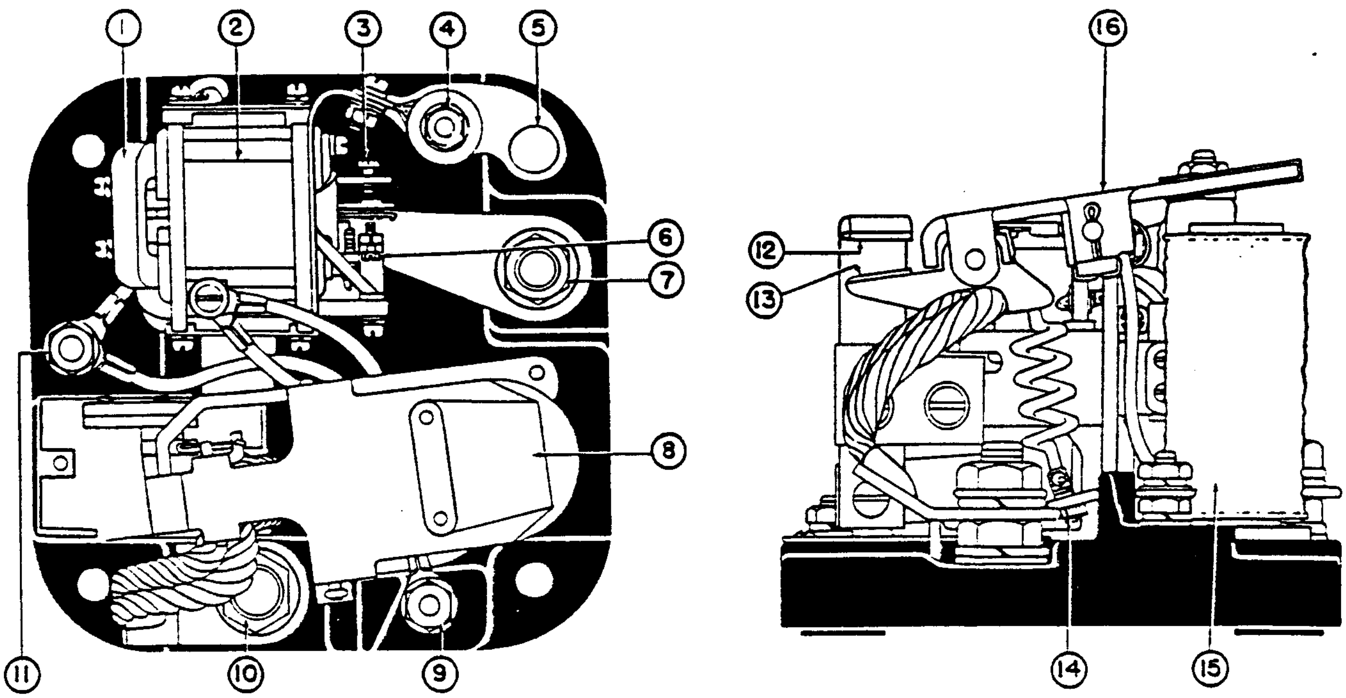
b. The contactor is designed to break currents up to 500 amperes. The continuous current rating is 200 amperes. The relay operates at from 26.0 to 28.0 volts. The drop-out reverse-current is from 16 to 18 amperes at 25 to 26 volts.

CAUTION

When current is on, never close the relay by manually pressing the contacts together, as serious damage may result to the relay or the electrical system and severe burns to the individual closing the contacts.

2. MAINTENANCE. (Refer to figure 10.)

a. OPERATING CONDITIONS.- Blow out dust or other debris. If magnetic chips are present in the relay they will usually be found standing on edge in the air gaps between the poles and the armature. Considerable care is required in removing them. Make sure the power is off and then operate the contactor several times by hand to see that the motion is free. Similarly, operate the relay with a sensitive touch to see that it is not obstructed. While more ruggedly built than a meter, the relay must operate with instrument accuracy. Handle it accordingly.



1. MAGNET
2. REVERSE CURRENT RELAY COIL WITH ARMATURE ASSEM.
3. VOLTAGE ADJUSTMENT STEP SCREW
4. RESISTER
5. GROUND
6. REVERSE CURRENT ADJUSTMENT SCREW
7. GENERATOR CONNECTION (POSITIVE)
8. CONTACTOR ASSEMBLY
9. A.P.P. CONNECTION
10. BATTERY CONNECTION (POSITIVE)
11. S.W. CONNECTION
12. STATIONARY CONTACT
13. MOVING CONTACT
14. CONTACT ADJUSTMENT SCREW
15. HOLDING COIL
16. ARMATURE

Figure 10. Reverse Current Relay

b. CONTACTOR CONTACTS.

1. GENERAL.- In normal duty as "reverse-current cut-out," the contactor contacts should not need attention between overhaul periods. If they show excessive burning, look for the cause in voltage regulator "hunting" or relay trouble which may be causing the contactor to operate too frequently. They condition may be caused by an intermittent generator short circuit produced by a broken brush shunt. Inspect the generator carefully. Notice the rolling action of the moving contact as it closes and opens. This causes the arc to be broken at the tips, leaving the remainder of the surface relatively clean. It is normal for the tips to become roughened when rupturing high currents. The heels of the contact may show some marks due to closing on high currents, but this does not affect the ability to carry rated current. The rolling action is accompanied by a slight scrubbing motion which tends to cut through surface film and dust to give a good contact.

2. BURNED CONTACTS.- Clean the heavy contactor contacts, both the stationary contact and the moving contact. To clean these contacts use No. 00 sandpaper or finer or a very fine contact file. Do not alter the shape of the contacts or remove any appreciable amount of the base contact metal. If less than 30 per cent of the contact surface is free of pits and burned spots, replace the stationary and moving contacts.

c. RELAY CONTACTS.

1. GENERAL.- The relay contacts should seldom need cleaning except at the regular overhaul periods. Fine crocus cloth may be used in extreme cases, but must be followed by a paper-burnishing to remove the particles of abrasive. After cleaning the contacts always check the pick-up voltage and drop-out current calibration. When the disc of contact material on the relay armature contact springs wear half way through, the relay switch should be sent to the depot for overhaul.

CAUTION

If excessive dust or oil vapor conditions make cleaning necessary at intermediate periods,

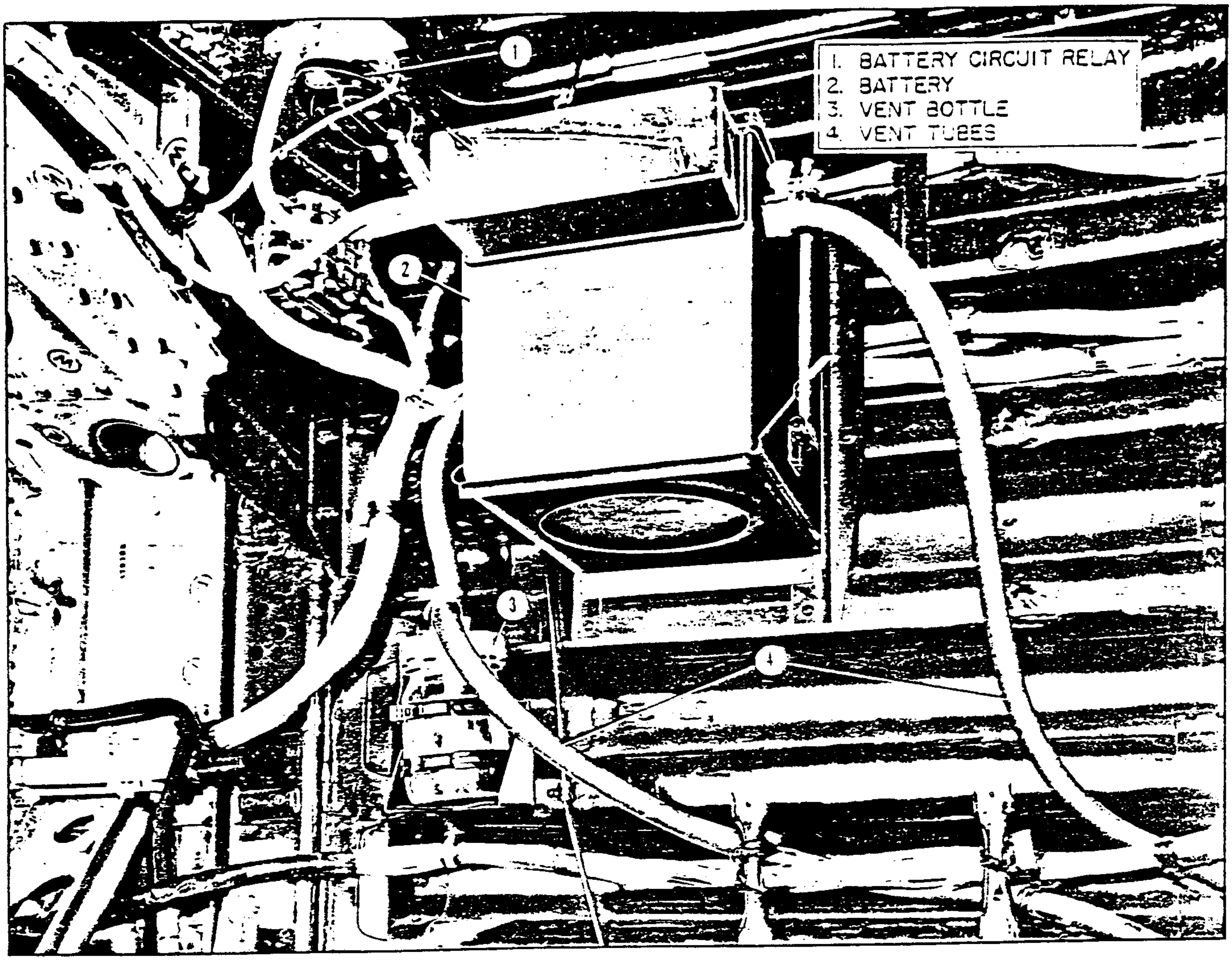


Figure 11. Battery and Vent Bottle

it usually will be sufficient to burnish the contacts by drawing a clean piece of writing paper through them several times, while pressing them lightly together.

2. PITTED RELAY CONTACTS.- Clean the small relay contact on the contact spring which is attached to the armature, and the contact on the relay contact screw. If the contact on the contact spring has a pit more than halfway through, replace the armature completely. Care must be taken in handling the armature, as a very small strain on the part will ruin its high magnetic properties. If it should become bent from careless handling it must be discarded.

d. IMPROPER RELAY SPRING PRESSURE.- Adjust the relay contact spring. It should have a deflection of 0.006 to 0.010 inch before it goes solid against the rivet head. The restraining cliphook over the end of the spring must not touch the spring but must clear by 0.010 to 0.015 inch. Adjust carefully by bending with a pair of small needle-nosed pliers or tweezers.

e. SLUGGISH CONTACTOR OPERATION.- If the contactor appears sluggish in operation or requires abnormally high coil voltage for closing, replace the relay.

f. RELAY PICK-UP VOLTAGE ADJUSTMENT.- To make a slight change in pick-up voltage, adjust the stop screw (figure 10). Screwing the stop screw inward lowers the pick-up voltage. Screwing the hexhead contact screw inward (figure 10) lowers the reverse-current setting. After the adjustment is made, check the gap between the contacts. It must be at least 0.010 inch. In addition there must be a clearance of 0.006 to 0.010 inch inside of the U-shaped contact spring, allowing that much contact deflection before the contact becomes solid. The restraining clip hooked over the end of the contact spring must not actually touch the spring, but should clear by 0.010 to 0.015 inch. It may be adjusted by careful use of small needle-nosed pliers or tweezers. If contact gap is less than .010 inch, back out the stop screw a quarter turn and weaken the spring adjustment slightly to compensate and obtain the same voltage setting. Raise the voltage slowly while watching the relay contact.

It must move briskly when the correct voltage is reached and not drift or hesitate. If the latter condition exists, there is excessive friction, or else the adjustment was made with the armature too far toward the right.

(3) BATTERY.

(a) DESCRIPTION.- (See figure 11.) A type F-1 (AN3151), 24 volt, 17 ampere hour, lead-acid storage battery is provided. The battery is located in the nose wheel well and secured in a rack with tie-down rods and wing-nuts. The battery is ventilated by outside air flowing over the battery and thru a jar containing a felt pad saturated with sodium bicarbonate (baking soda) in solution.

(b) WIRING.- (See figure 32.) The positive terminal is connected to the bus in the nose wheel well d.c. power distribution panel (#454362) through a remote controlled relay in the nose wheel well relay panel (#552738). The relay is controlled by an "EMERGENCY STOP ALL ENGINES" switch and an on-off switch which are both in series with the battery and relay coil. A push-type circuit breaker and the crash switch are mounted on the pilot's pedestal panel (#552409); the on-off switch is installed on the engineer's upper electrical panel (#552722). If either switch is in the "OFF" position, the battery is disconnected from the system.

(c) OPERATION.- In normal operation the contacts of the relay are held closed by current from the battery energizing the relay coil, thereby connecting the battery to the d.c. power system. This permits the motor-generators to charge the battery, or if the motor-generators are not operating, allows the battery to supply current for the operation of d.c. equipment.

(d) REMOVAL.

1. Place the battery switch in the "OFF" position.

2. Cut safety wire and remove wing nuts and cover from the battery terminal box.

3. Disconnect battery cables and vent tubes.

4. Cut safety wire and remove wing nuts and cover from battery case.

5. Remove battery.

(e) CLEANING.- External corrosion of terminals and leads is due to spilled electrolyte, excessive gassing, or overflow due to a poor seal. Remove the corrosion with a wire brush, wash the area with baking soda, and rinse thoroughly with water. If a brush and soda are not available, ordinary soap and water applied with a bristle brush or cloth will be effective. Apply a light coat of vaseline to the terminals.

CAUTION

When using a wire brush, the battery should be removed from the airplane, as accidential shorting of terminals may cause a strong spark and constitute a fire hazard.

(f) INSTALLATION.- Before installing a battery, check to see that it is fully charged, and that the electrolyte is at the proper level.

1. Place battery in position on battery rack.

2. Replace cover and clamp tightly with wing nuts; lock with safety wire.

3. Connect battery leads to proper terminals.

NOTE

The lock washer should not be placed next to the wing nut, because the protruding ends would scrape the lead coating from the nut and hasten corrosion. In no case should battery wing nuts be drilled and locked with safety wire.

4. Replace cover plate on battery terminal box and clamp with wing bolts and lock with safety wire.

5. Connect battery vent tubes.

NOTE

Saturate the felt pad in the battery vent bottle with a solution of baking soda and water if necessary.

(g) BATTERY VENT BOTTLES. (See figure 11.)

1. DESCRIPTION.- The vent bottle is mounted below the battery and is connected to it by a flexible hose. Another flexible hose vents the bottle thru the bottom skin of the airplane. The bottle contains a felt pad saturated with a solution of sodium bicarbonate (baking soda).

2. REMOVAL.

a. Detach the two rubber hoses from the cover by loosening the clamps.

b. Loosen the metal clamps holding the bottle, and remove the bottle.

NOTE

Before reinstalling bottle make sure that the felt pad is saturated with sodium bicarbonate (baking soda).

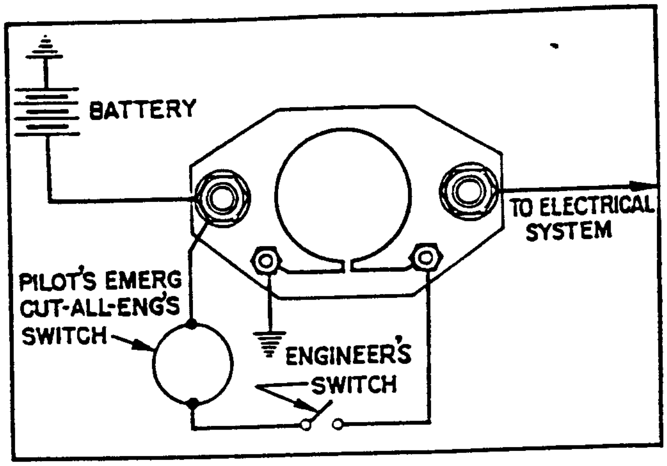


Figure 12. Battery Wiring Diagram

3. INSTALLATION.

a. Place bottle in bracket and snap the metal clamps in place.

b. Connect the rubber vent hoses to the cover and tighten the clamps.

(h) BATTERY CIRCUIT RELAY. (Figure 12.)

1. DESCRIPTION.- The type B-4 battery circuit relay used is designed to provide a means of remotely controlling the opening and closing of the battery circuit and will withstand continuous operation of 29.0 volts d.c. The relay is mounted on the nose wheel well relay panel.

2. OPERATION.- The operation of the relay is dependent on the voltage of the battery and is actuated by closing the control switch on the engineer's upper electrical panel and the pilot's "EMERGENCY STOP ALL ENGINES" switch. The engineer's control switch opens and closes the holding coil circuit which, in turn, causes the opening and closing of the main contacts.

3. MAINTENANCE.- Correctly installed, the unit should require little or no attention. In event that the circuit controlled by the relay becomes inoperative, short-out the relay by connecting a heavy jumper cable across the two heavy contact studs to determine whether the control switches or the relay is at fault.

4. REMOVAL.

a. Remove the battery lead from the No. 2 terminal post on the relay.

CAUTION

This lead is "hot" and should be handled carefully.

b. Tape the lead to prevent grounding.

c. Remove the remaining leads and tage the wires for identification.

d. Remove the two mounting bolts.

5. INSTALLATION.- Mount the relay on the panel and connect all leads. connecting the battery lead last. Refer to wiring diagram if necessary (figure 12).

(4) EXTERNAL POWER. (Figure 3.)

(a) DESCRIPTION.- An external power receptacle (Type AN2552-1) is located in the forward part of bomb bay four to obtain 24 volt d.c. from an external power source for operating the d.c. equipment. Access to the receptacle is through a door in the lower skin of the wing just aft of the front spar.

(b) WIRING. (See figure 33.)- The ground power current passes through a relay to a bus on the L.H. main gear well d.c. power distribution panel (#554189) where it ties into the airplane's d.c. electrical system. The relay is energized when the external power plug is inserted into the receptacle.

(5) D.C. POWER DISTRIBUTION. (See figures 13 and 27.)

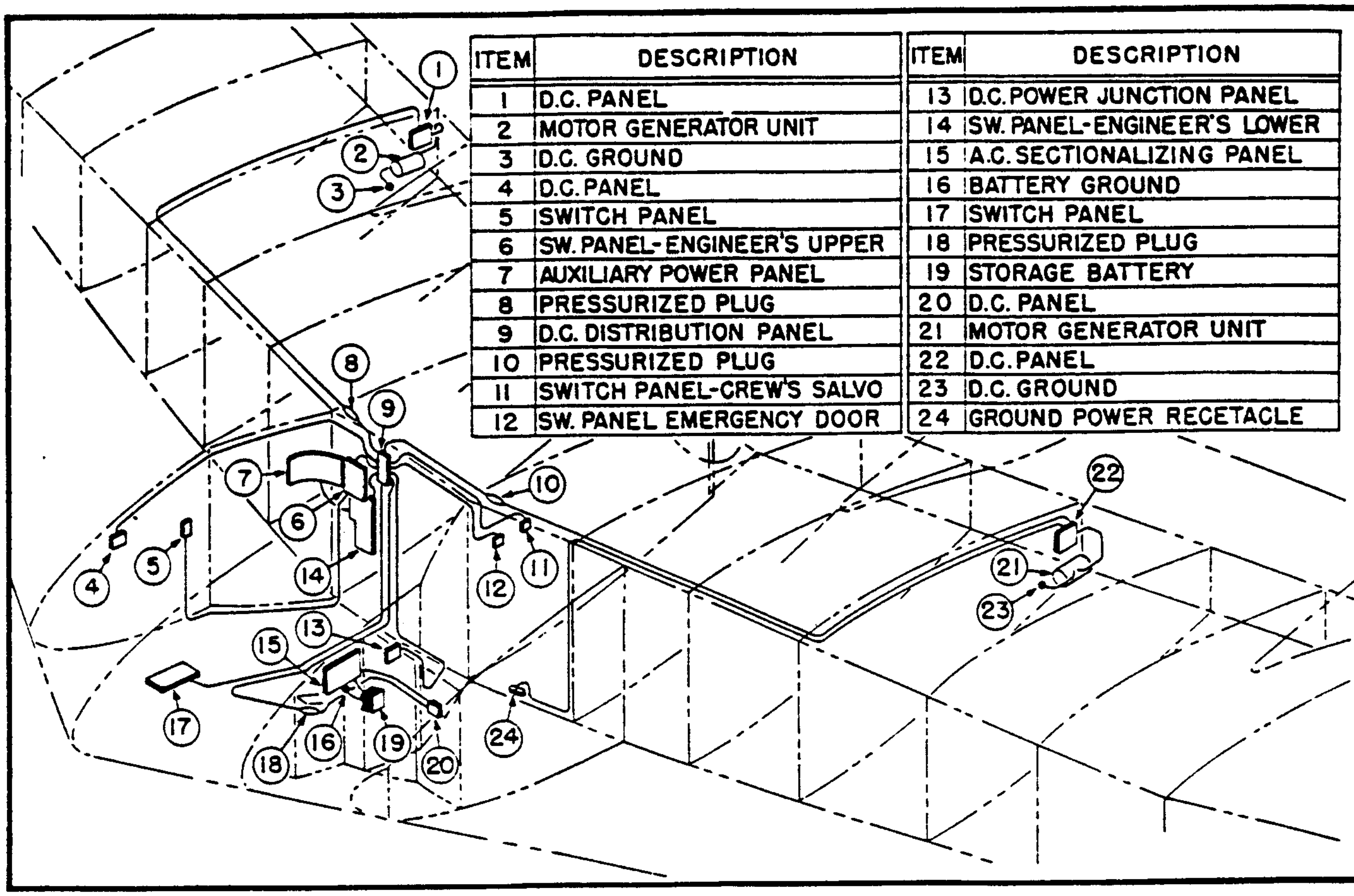
(a) The d.c. output of the motor-generators is wired to the bus on the main gear well d.c. power distribution panel (#554189 L.H.; #554189-1 R.H.) installed on the inboard bulkhead just forward of the rear spar. From this panel it is wired to the engineer's d.c. distribution panel and then distributed to the engineer's junction panel, engineer's lower d.c. panel (#552672), engineer's upper d.c. panel (#552722), radio operator's junction panel (#514911), bombardier's limiter panel (#55159), pilot's pedestal switch panel (#552409), and the nose wheel well d.c. power panel (#454362). From the nose wheel well d.c. power panel the power passes to the nose wheel well relay panel (#552738), and from this panel to the battery.

(b) The various circuits are protected with circuit breakers or limiters. A built-in reverse-current relay in each motor generator unit prevents the battery from discharging through the motor-generator when it is not in operation.

e. ELECTRICAL PANELS.

(1) DESCRIPTION.- Electrical panels are installed throughout the airplane to distribute and control the current to the various operating equipment. Types of panels used for a.c. and d.c. current are: switch, sectionalizing, distribution, junction, relay, pressure-temperature, circuit breaker, and auxiliary a.c. power control.

(a) SWITCH PANELS.- Control switch panels are provided at the various crew stations. The control panels for the pilot and copilot are: pilot's pedestal panel (figure 14), landing flap panel (on the pilot's pedestal), and pilot's salvo panel (below the left rail of the pilot's canopy (see Section IV, paragraph 22). The control panels for the engineer are: auxiliary a.c. power control panel (see figure 2), engineer's upper electrical panel (see figure 15),



ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	D.C. PANEL	13	D.C. POWER JUNCTION PANEL
2	MOTOR GENERATOR UNIT	14	SW. PANEL-ENGINEER'S LOWER
3	D.C. GROUND	15	A.C. SECTIONALIZING PANEL
4	D.C. PANEL	16	BATTERY GROUND
5	SWITCH PANEL	17	SWITCH PANEL
6	SW. PANEL-ENGINEER'S UPPER	18	PRESSURIZED PLUG
7	AUXILIARY POWER PANEL	19	STORAGE BATTERY
8	PRESSURIZED PLUG	20	D.C. PANEL
9	D.C. DISTRIBUTION PANEL	21	MOTOR GENERATOR UNIT
10	PRESSURIZED PLUG	22	D.C. PANEL
11	SWITCH PANEL-CREW'S SALVO	23	D.C. GROUND
12	SW. PANEL EMERGENCY DOOR	24	GROUND POWER RECETACLE

Figure 13. DC Power Distribution-Schematic

engineer's lower electrical panel (see figure 16), and fire extinguisher panels (see Section IV, paragraph 15). The bombardier's, navigator's and radio operator's stations are each provided with a control panel. Two panels are provided at the crew nacelle escape hatch, one for the emergency operation of the door for bomb bay four, and the other for the emergency salvo of the bombs (or equipment) in bomb bay four (see Section IV, paragraph 22).

(b) ELECTRICAL INSTRUMENT PANELS.- Refer to Section IV, paragraph 23.

NOTE

The engineer's electrical switches for the propeller governor control are mounted on the flight engineer's instrument panel.

(c) OTHER ELECTRICAL PANELS.- For various other types of electrical panels and their location, refer to figure 17.

f. LIMITERS.

(1) DESCRIPTION.- The Burndy three-phase limiter which is used on this airplane consists of a fuse block and fuse. The fuse is made up of a heat and arc resisting molded housing having individual compartments for each of the three fuse links. Each fuse link is firmly cemented into the housing with the contact blades protruding from the sides of the housing. A retangular glass window is on the top surface of the fuse to provide for visual inspection of each fuse link. Both sides of the housing have a ledge so that the piece may be easily gripped with the fingers for extracting from the base. These three-phase limiters are also used in d.c. power circuits where three-duplicate lines are run between panels for safety. For location of these limiters refer to diagrams at the end of this paragraph.

(2) LIMITER SIZES.- The range of three-phase limiters used consists of six fuse sizes and two fuse block sizes. The ten thru thirty ampere sizes are used with one base while the forty thru sixty are used with a larger base. The following list gives the ampere ratings and catalog numbers for the limiters:

Ampere Rating	Fuse Catalog Number	Fuse Block Catalog Number
10	F3L10	F3H1
20	F3L20	F3H1
30	F3L30	F3H1
40	F3L40	F3H2
50	F3L50	F3H2
60	F3L60	F3H2

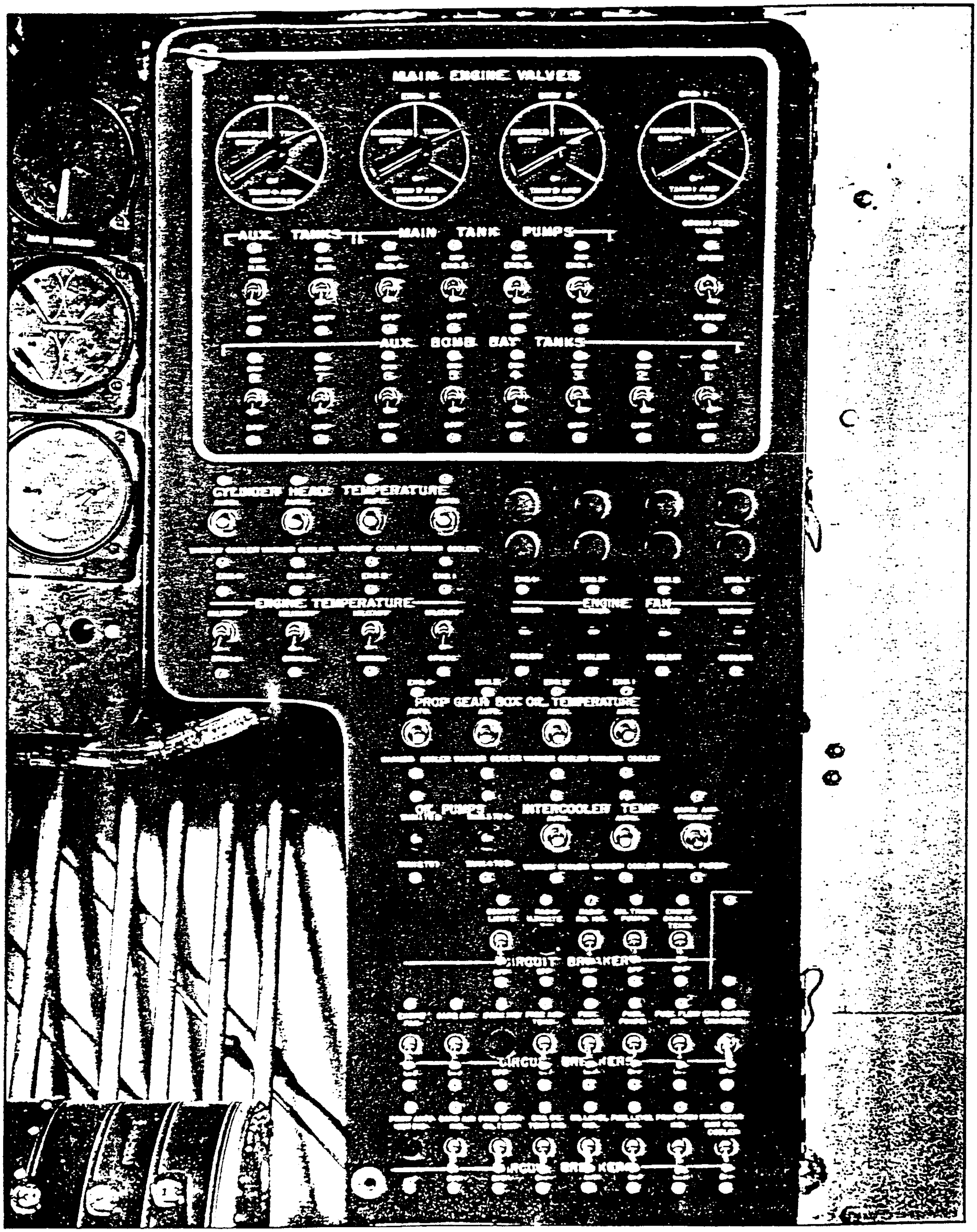


Figure [illegible]. Engineer's [illegible] Electrical Panel

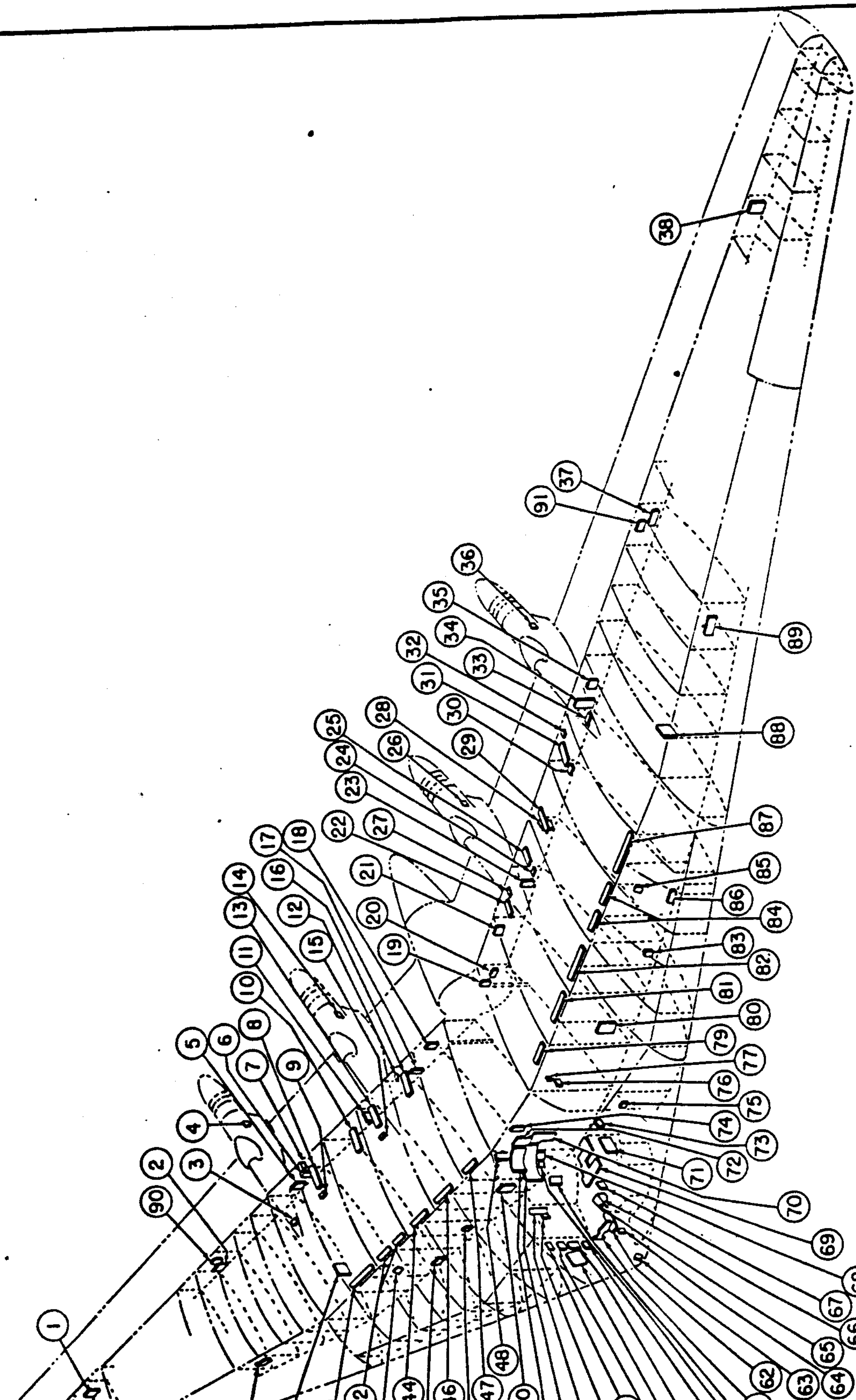


Figure 17. Electrical Panels - Schematic (Sheet 1 of 4 Sheets)

ITEM	DESCRIPTION	LOCATION	DWG. NO.
1	AC Sectionalizing Panel	Wing Station 870, Rear Spar RH	553293-1
2	AC Sectionalizing Panel	Wing Station 560, Rear Spar RH	553472-1
3	Pressure-Temperature Panel	Engine No. 4 Compartment	554881
4	Junction Panel	Propeller Gear Box No. 4	584587
5	Relay Panel	Engine No. 4 Compartment, Aft	584574
6	AC Sectionalizing Panel	Engine No. 4 Compartment, Aft	552956-1
7	Relay Box, Propeller No. 4	Bomb Bay No. 8, Aft	554805-1
8	Relay Panel	Bomb Bay No. 8, Aft	584630
9	Pressure-Temperature Panel	Bomb Bay No. 8	554881
10	Relay Panel	Main Gear Well, Aft, RH	584644
11	DC Panel	Main Gear Well, Aft, RH	554189-1
12	Relay Box, Propeller No. 3	Bomb Bay No. 6 Aft	554804-1
13	Relay Panel	Bomb Bay No. 7 Aft	584632
14	Junction Panel	Propeller Gear Box No. 3	584721
15	Pressure-Temperature Panel	Bomb Bay No. 7	554881
16	Relay Panel	Bomb Bay No. 6, Aft	584634
17	AC Sectionalizing Panel	Bomb Bay No. 6, Aft	552947-1
18	Power Relay Box	Bomb Bay No. 5, Aft	557738-1
19	Relay Panel, Landing Flap	Crew Nacelle, Rear Spar	555490
20	Sectionalizing Panel	Crew Nacelle, Rear Spar	555392
21	Power Relay Box	Bomb Bay No. 4, Aft	557738
22	Relay Panel	Bomb Bay No. 3, Aft	584633
23	AC Sectionalizing Panel	Bomb Bay No. 3, Aft	552947
24	Pressure-Temperature Panel	Bomb Bay No. 2	554881
25	Relay Panel	Bomb Bay No. 2, Aft	584631
26	Junction Panel	Propeller Gear Box No. 2	584721
27	Relay Box, Propeller No. 2	Bomb Bay No. 3, Aft	554804
28	DC Panel	Main Gear Well, Aft, LH	554189
29	Relay Panel	Main Gear Well, Aft, LH	584643
30	Pressure-Temperature Panel	Bomb Bay No. 1	554881
31	Relay Panel	Bomb Bay No. 1, Aft	584629
32	Relay Box, Propeller No. 1	Bomb Bay No. 1, Aft	554805
33	Pressure-Temperature Panel	Engine No. 1 Compartment	554881
34	AC Sectionalizing Panel	Engine No. 1 Compartment, Aft	552956
35	Relay Panel	Engine No. 1 Compartment, Aft	584573
36	Junction Panel	Propeller Gear Box No. 1	584587
37	AC Sectionalizing Panel	Wing Station 560, Rear Spar, LH	553472

Figure 17. Electrical Panels - Schematic (Sheet 2 of 4 Sheets)

ITEM	DESCRIPTION	LOCATION	DWG. NO.
38	AC Sectionalizing Panel	Wing Station 870, Rear Spar, LH	553293
39	AC Sectionalizing Panel	Wing Station 523, Front Spar, RH	553458-1
40	Disconnect Box, Engine No. 4	Engine No. 4 Compartment	524572
41	Relay Panel	Bomb Bay No. 8, Fwd.	584600
42	Relay Panel	Main Gear Well, Fwd., RH	584606
43	Junction Box, Engine No. 4 Turbo	Turbo Nacelle, RH	584550
44	Relay Panel	Bomb Bay No. 7, Fwd.	584604
45	AC Sectionalizing Panel	Main Gear Well, Fwd., RH	553163-1
46	Relay Panel	Bomb Bay No. 6, Fwd.	584602
47	Relay Panel	Bomb Bay No. 5, Fwd.	584598
48	Circuit Breaker Panel, Ring Bus	Engineer's Station	555321
49	Junction Box, Engine No. 3 Turbo	Bomb Bay No. 7, Fwd.	558937-1
50	Disconnect Box, Engine No. 3	Bomb Bay No. 6, Fwd.	584569-1
51	Auxiliary Power Panel	Engineer's Station	556593
52	Instrument Panel	Engineer's Station	551057
53	Instrument Panel	Navigator's Station	550199
54	Switch Panel	Navigator's Station	452655
55	DC Panel	Bombardier's Station	543466
56	Relay Panel	Bombardier's Station	554012
57	Control Panel	Bombardier's Station	550985
58	Junction Panel	Bombardier's Station	
59	Relay Panel, Cooling Flap	Bombardier's Station	456596
60	Transformer Panel	Engineer's Station	554669
61	Instrument Panel	Pilot's and Copilot's	551052
62	Switch Panel	Pilot's Pedestal	552409
63	AC Sectionalizing Panel	Crew Nacelle Nose	452919
64	Relay Panel, Nose Steering and Brake	Crew Nacelle Nose	455100
65	Switch Panel, Landing Flap	Pilot's Pedestal	452442
66	Relay Panel, Pilot's	Beneath Pilot's Pedestal	552374
67	Switch Panel, Pilot's Salvo	Pilot's Station	555049
68	Panel, Fire Extinguisher	Engineer's Station	553068
69	Junction Panel, Engineer's	Beneath Engineer's Floor	551144
70	Switch Panel, Engineer's Lower	Engineer's Station	552672
71	AC Sectionalizing Panel	Nose Wheel Well	552738
72	Switch Panel, Enginner's Upper	Engineer's Station	552722

Figure 17. Electrical Panels - Schematic (Sheet 3 of 4 Sheets)

ITEM	DESCRIPTION	LOCATION	DWG. NO.
73	Junction Panel, DC Power	Radio Operator's Station	514911
74	DC Distribution Panel	Engineer's Station	554151
75	DC Panel	Nose Wheel Well	454362
76	Junction Box, Main Turbo	Crew Nacelle, Center Section	551140
77	Switch Panel, Emergency Door	Crew Nacelle, Center Section	456015
78	Relay Panel	Bomb Bay No. 4, Fwd.	584597
79	Disconnect Box, Engine No. 2	Bomb Bay No. 3, Fwd.	584569
80	Relay Panel	Bomb Bay No. 3, Fwd.	584601
81	Relay Panel	Bomb Bay No. 2, Fwd.	584603
82	Junction Box, Engine No. 2 Turbo	Bomb Bay No. 2, Fwd.	558937
83	Relay Panel	Main Gear Well, Fwd., LH	584605
84	Junction Box, Engine No. 1 Turbo	Turbo Nacelle, LH	584549
85	AC Sectionalizing Panel	Main Gear Well, Fwd., LH	553163
86	Relay Panel	Bomb Bay No. 1, Fwd.	584599
87	Disconnect Box Engine No. 1	Engine No. 1 Compartment	584571
88	AC Sectionalizing Panel	Wing Station 523, Front Spar LH	553458
89	Relay Panel, Elevon Control	Wing Station 560, Rear Spar RH	457662
90	Relay Panel, Elevon Control	Wing Station 560, Rear Spar LH	457662
91	Auxiliary Fire Extinguisher Panel	Engineer's Station	558244

Figure 17. Electrical Panels - Schematic (Sheet 4 of 4 Sheets)

ITEM	DESCRIPTION	LOCATION
1	POSITION LIGHT	WING TIP-R.H.
2	A.C. SECTIONALIZING PANEL	WING STA. 870-REAR SPAR-R.H.
3	LANDING LIGHT-RETRACT.	OUTER WING-R.H.
4	D.C. PANEL	MAIN GEAR WELL-AFT R.H.
5	PRESSURIZED PLUG	W. STA. 44 (R.H.)
6	PRESSURIZED PLUG	W. STA. 44 (L.H.)
7	CIRCUIT BRK'R-LAND'G L'TS	PILOT'S PEDESTAL PANEL
8	CIRCUIT BRK'R-POSITION LTS	PILOT'S PEDESTAL PANEL
9	SWITCH-POSITION LIGHTS	PILOT'S PEDESTAL PANEL
10	SWITCH-LANDING LIGHTS	PILOT'S PEDESTAL PANEL
11	SWITCH-LANDING LIGHTS	PILOT'S PEDESTAL PANEL
12	SWITCH PANEL	PILOT'S PEDESTAL
13	JUNCTION PANEL-ENGINEER'S	BENEATH ENGINEER'S FLOOR
14	D.C. PANEL	MAIN GEAR WELL-AFT L.H.
15	LANDING LIGHT-RETRACTABLE	OUTER WING-L.H.
16	A.C. SECTIONALIZING PANEL	W. STA. 870-REAR SPAR-L.H.
17	POSITION LIGHT	WING TIP-L.H.

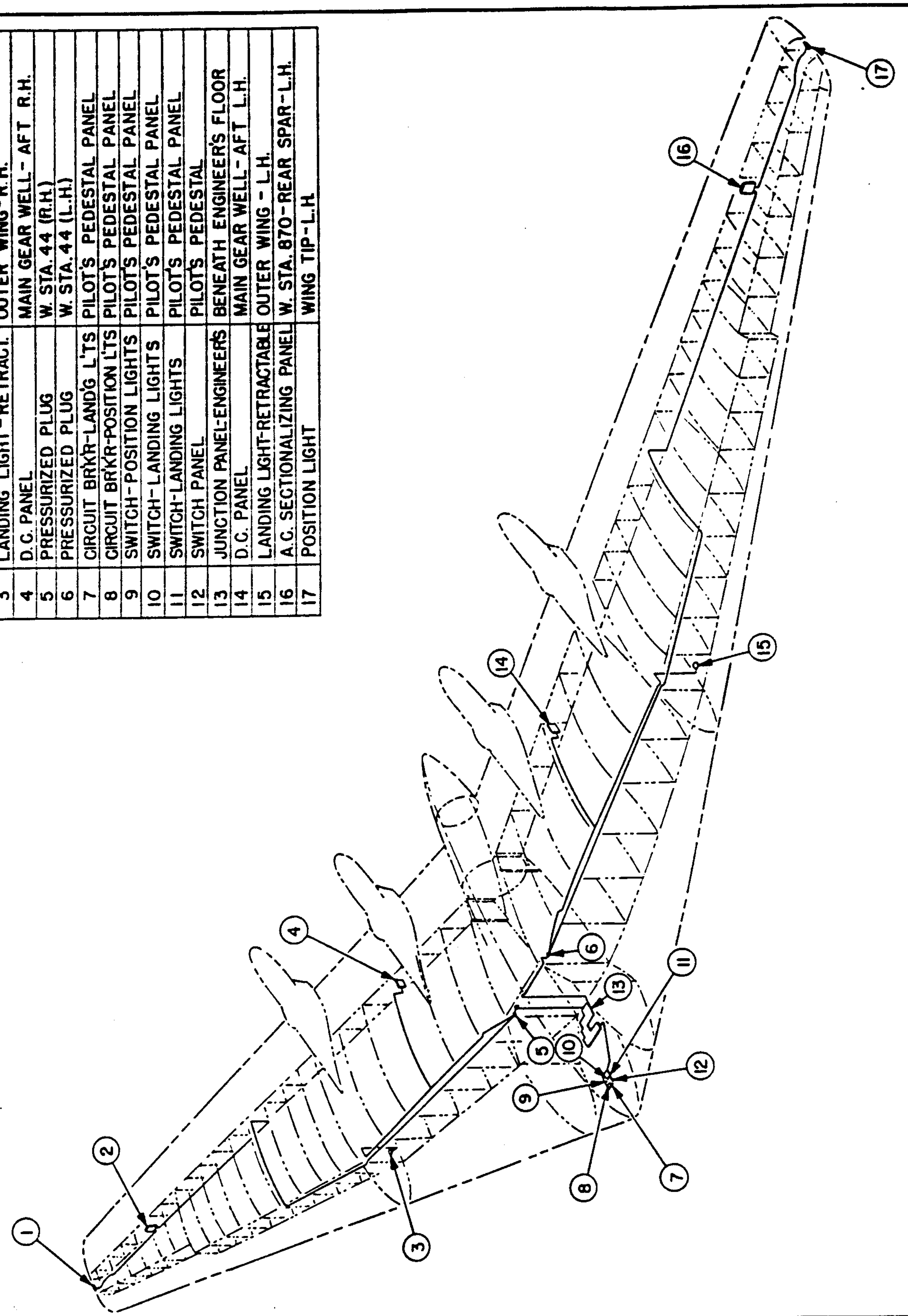


Figure 18. Exterior Lighting - Schematic

(5) INSTALLATION.- The fuse is assembled to the block by placing the fuse on the base with the glass face up and the blades resting on the clips. The fuse is then pushed into the clips as far as it will go.

g. CIRCUIT BREAKERS.- Three types of circuit breakers are used in the various circuits of the d.c. system; the switch type, push type, and automatic reset type. The switch and push type are usually mounted near the control switch for the circuit it protects, or in a group of circuit breakers on the control panel. The automatic reset circuit breakers used are installed on panels in the wing. (See diagrams at the end of this paragraph.)

h. LIGHTING SYSTEM.

(1) EXTERIOR. (Refer to figure 18.)

(a) LANDING LIGHTS.- A retractable landing light (AN3095-3 600 watt) is mounted flush with the undersurface of each outer wing aft of the front spar. The lights are controlled by two switches on the pilot's pedestal. The control circuits are protected by a push type circuit breaker installed on the same panel. One switch controls the extension and retraction of the lights, the other their illumination. The switch for illumination controls a relay on each main wheel well d.c. panel. The relay connects the lighting circuit to a 28 volt d.c. bus on the same panel.

1. REMOVAL OF LIGHT.- Remove the entire light unit from the wing by removing the screws in the mounting flange. Disconnect the wiring by removing the plug connector from its receptacle on the motor housing.

2. INSTALLATION OF LIGHT.- Connect wires using wiring diagram if necessary, and secure the unit in place with the mounting screws. The lock nut rings which engage the mounting screws are riveted on a reinforcement plate which is part of the light assembly.

3. REPLACEMENT OF SEALED BEAM UNIT.

a. Extend the light by using the switch on the pilot's pedestal.

b. Place control and light switches "OFF."

c. Remove the retainer ring.

d. Disconnect the wire leads from the sealed beam unit.

e. Install a new sealed beam unit with the metal reflector in the unit on the inboard side.

f. Connect wire leads to unit and replace retainer ring.

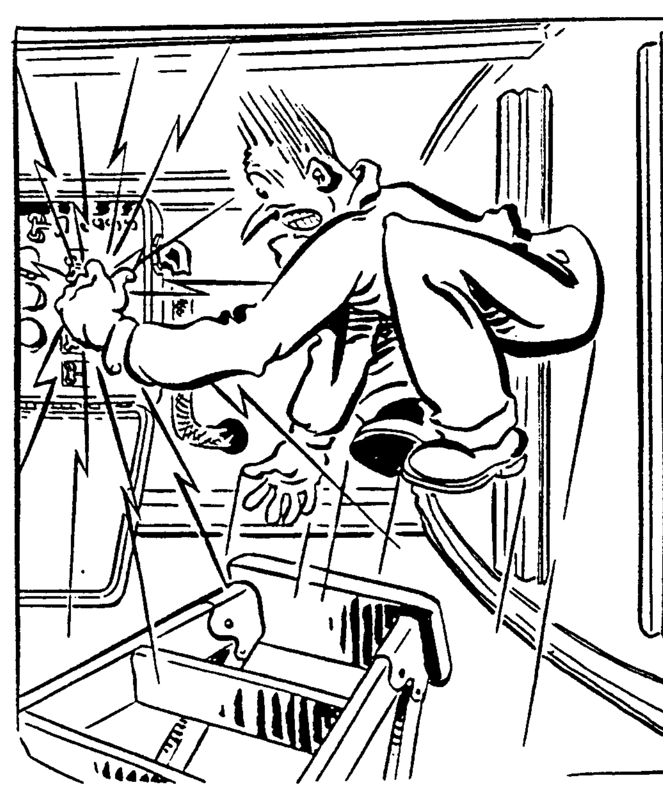
4. TEST AFTER INSTALLATION.- Test the landing lights by operating the control switch (extend and retract switch) and observing to see that they stop at the proper maximum extended and retracted positions, illuminate when extended approximately 10° and are extinguished when retracted to within 10° of the flush position. Do not leave the landing lights on for more than a few seconds when testing them. The sealed beam unit has a very short operating life and should not be used unnecessarily. Check light illumination by operating the light switch. This switch controls a relay which supplies current for the lamps. If test is unsatisfactory, consult the wiring diagram (figure 93), and if necessary run a continuity test.

(b) POSITION LIGHTS.- The airplane is equipped only with wing tip position lights, the white tail lights being omitted. A three position switch controls either the dim or bright illumination of the position lights. The control switch is located on the pilot's pedestal panel. The circuit is protected by a push type circuit breaker on the same panel.

(2) INTERIOR LIGHTING. (See figure 19.)

(a) BOMB BAY AND WHEEL WELL LIGHTS.- Each bomb bay and wheel well is provided with a vapor proof lamp (AN3039). Switches for the lights are located on the aft side of the front spar in their respective bomb bay or wheel well; the switch for the nose wheel well light is mounted on the wall of the nose wheel well at wing station 58.00. (See stations diagram Section I.)

(b) CREW NACELLE LIGHTING.- The chart below lists the type and location of lights and switches in the crew nacelle.



ITEM	DESCRIPTION	ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	BOMB BAY LIGHT	26	CIRCUIT BREAKER	51	TERMINAL PANEL
2	SWITCH	27	RELAY PANEL LDG. FLAP	52	FLUORESCENT LAMP (C-8)
3	WHEEL WELL LIGHT	28	EXTENSION LAMP (B-7A)	53	RESISTOR BOX
4	SWITCH	29	RESISTOR BOX	54	DOME LIGHT & SWITCH
5	BOMB BAY LIGHT	30	COCKPIT LAMP (C-4A)	55	RESISTOR BOX
6	SWITCH	31	FLUORESCENT LAMP (C-8)	56	EXTENSION LAMP (B-7A)
7	BOMB BAY LIGHT	32	SWITCH PANEL	57	FLUORESCENT LAMPS (C-8)
8	SWITCH	33	CIRCUIT BREAKER	58	DOME LIGHT & SWITCH
9	BOMB BAY LIGHT	34	FLUORESCENT LAMP (C-8)	59	RESISTOR BOX
10	SWITCH	35	COCKPIT LAMP (C-4A)	60	FLUORESCENT LAMP (C-8)
11	BOMB BAY LIGHT	36	FLUORESCENT LAMP (C-8)	61	RESISTOR BOX
12	SWITCH	37	RESISTOR BOX	62	FLUORESCENT LAMP (C-8)
13	BOMB BAY LIGHT	38	TABLE LAMP (A-11)	63	COCKPIT LAMP (C-4A)
14	SWITCH	39	RESISTOR BOX	64	SWITCH PANEL, ENG'RS. LOWER
15	BOMB BAY LIGHT	40	RESISTOR BOX	65	CIRCUIT BREAKERS
16	SWITCH	41	TERMINAL PANEL	66	FLUORESCENT LAMP (C-8)
17	WHEEL WELL LIGHT	42	COCKPIT LAMP (C-4A)	67	TERMINAL PANEL
18	SWITCH	43	FLUORESCENT LAMP (C-8)	68	FLUORESCENT LAMP (C-8)
19	WHEEL WELL LIGHT	44	COCKPIT LAMP (C-4A)	69	RESISTOR BOX
20	SWITCH	45	FLUORESCENT LAMP (C-8)	70	COCKPIT LAMP (C-4A)
21	D.C. PANEL	46	TERMINAL PANEL	71	EXTENSION LAMP (B-7A)
22	D.C. PANEL	47	FLUORESCENT LAMP (C-8)	72	JUNCTION PANEL, D.C. POWER
23	DOME LIGHT & SWITCH-FWD.	48	TERMINAL PANEL	73	CIRCUIT BREAKER
24	DOME LIGHT & SWITCH-AFT.	49	CIRCUIT BREAKERS	74	DOME LIGHT & SWITCH
25	CIRCUIT BREAKER PANEL	50	SWITCH PANEL	75	SWITCH
				76	VAPOR PROOF DOME LIGHT
				77	A.C. SECTIONALIZING PANEL

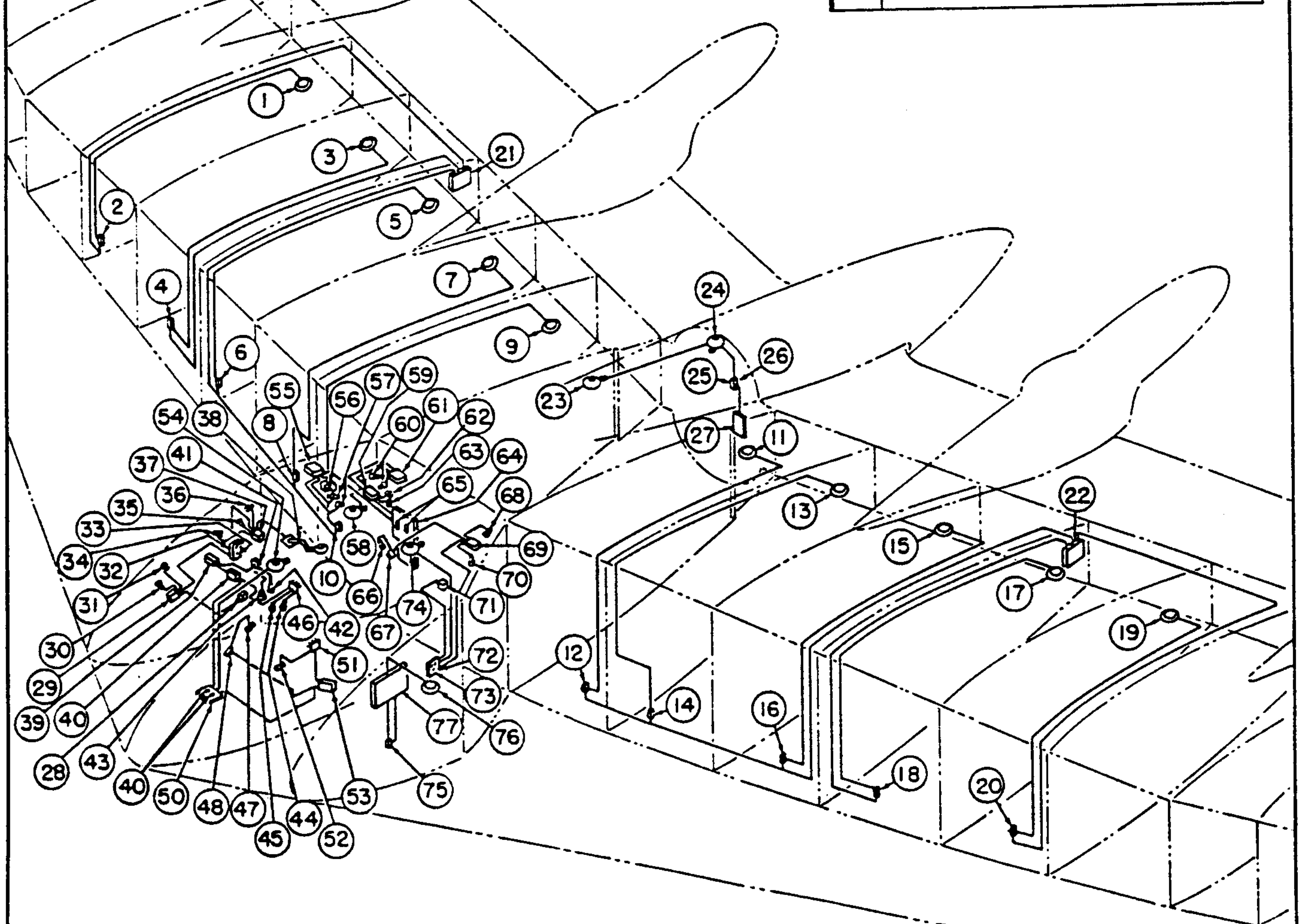


Figure 19. Interior Lighting - Schematic

NAME & LOCATION OF LIGHTS	NO. OF LIGHTS	TYPE	NO. & TYPE OF SWITCH	LOCATION OF SWITCHES
Dome light; forward cabin, L.H. cabin, R.H. cabin and two in center cabin.	5	AN-L-12	5 AN3022-2	On same panel as lamp.
Extension light mounted above co-pilot's, engineer's, and radio operator's stations.	3	B-7a	3 AN3015	On lamp panel.
Cockpit light; behind and above pilot's, co-pilot's, flight engineer's, radio operator's, navigator's and bombardier's stations.	6	C-4a	6 SA-1013-A Rheostat	On rear of lamp housing.
Cockpit light (fluorescent); one each above and behind pilot's and co-pilot's stations, one on each side of canopy rail for pilot, two overhead for navigator, one above bombardier's station, and five at the engineer's station.	14	C-8	14 Rheostat	On rear of lamp housing
Table light; at navigator's station.	1	A-11		
Interior light circuit breakers.				1. Flt. Eng's lower switch panel (#552672) 2. Pilot's pedestal switch panel (#552409) 3. Radio operator's junction box (#554911)

1. WIRING DIAGRAM INDEX.

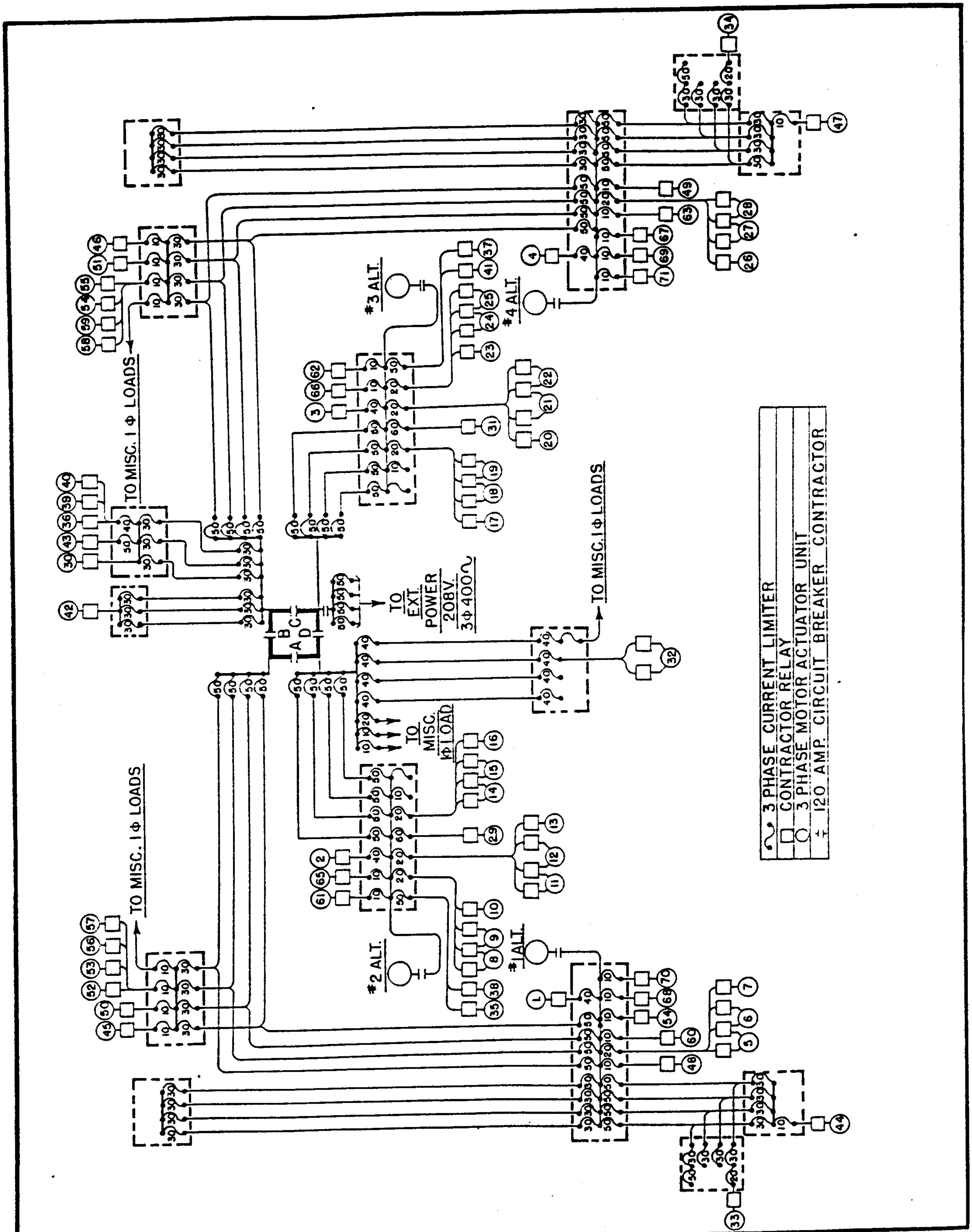
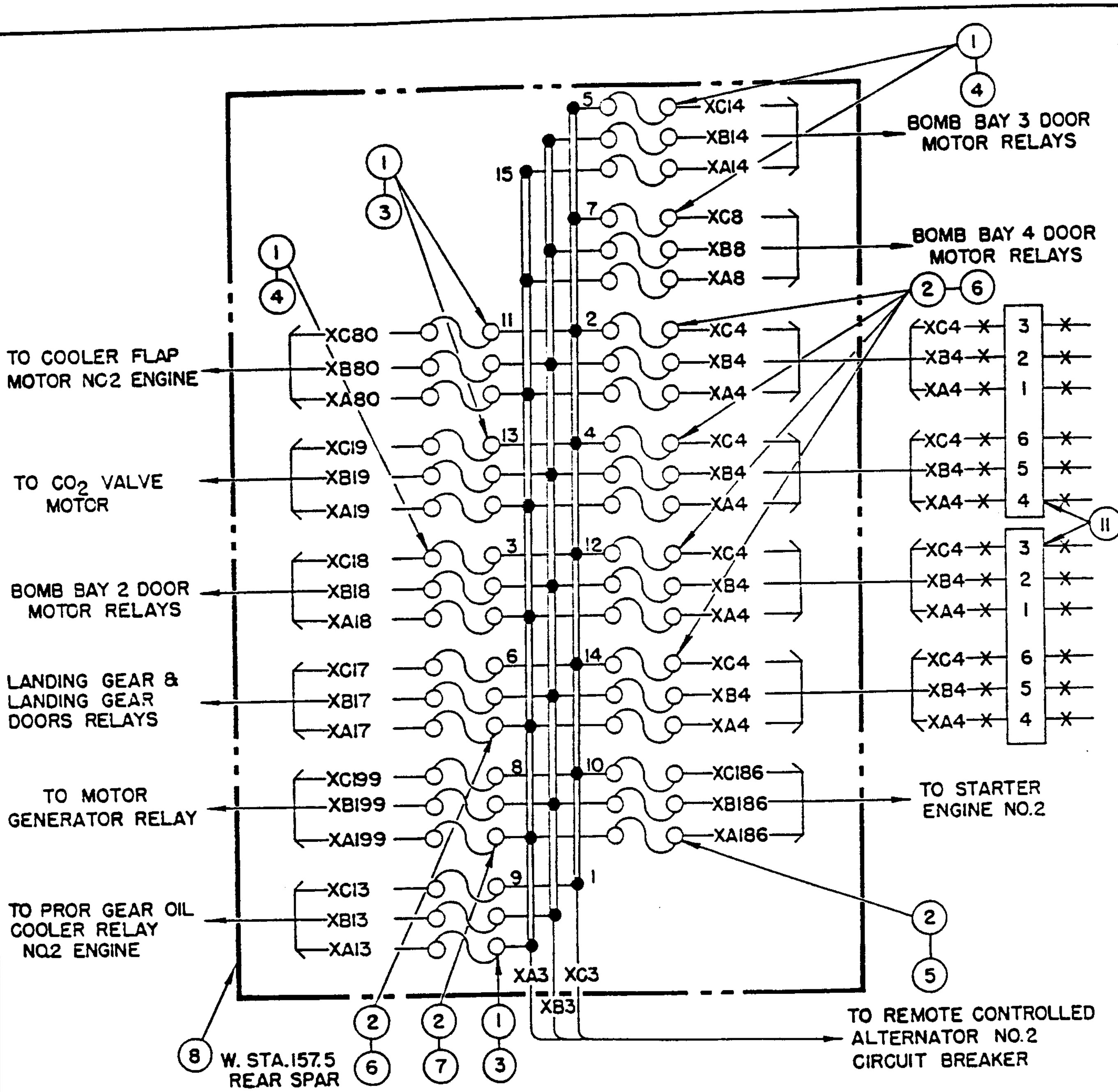


Figure 20. AC Power Load Distribution (Sheet 1 of 2 Sheets)

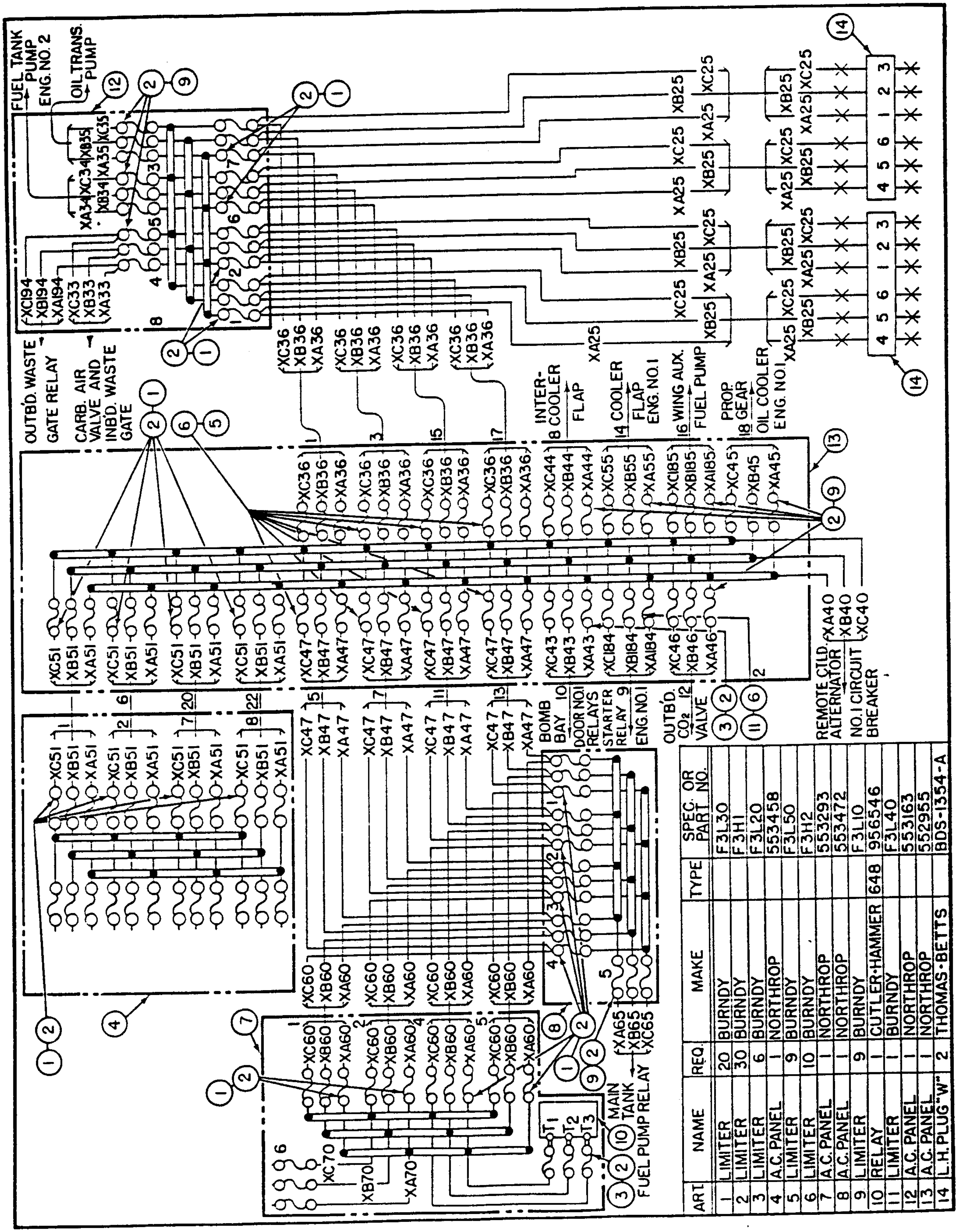
1. Starter No. 1 Engine
2. Starter No. 2 Engine
3. Starter No. 3 Engine
4. Starter No. 4 Engine
5. Bomb Bay No. 1 Door Open Motor
6. Bomb Bay No. 1 Door Close Motor
7. Bomb Bay No. 1 Fuel Pump
8. Bomb Bay No. 2 Door Open Motor
9. Bomb Bay No. 2 Door Close Motor
10. Bomb Bay No. 2 Fuel Pump
11. Bomb Bay No. 3 Door Open Motor.
12. Bomb Bay No. 3 Door Close Motor
13. Bomb Bay No. 3 Fuel Pump
14. Bomb Bay No. 4 Door Open Motor
15. Bomb Bay No. 4 Door Close Motor
16. Bomb Bay No. 4 Fuel Pump
17. Bomb Bay No. 5 Fuel Pump
18. Bomb Bay No. 5 Door Close Motor
19. Bomb Bay No. 5 Door Open Motor
20. Bomb Bay No. 6 Fuel Pump
21. Bomb Bay No. 6 Door Close Motor
22. Bomb Bay No. 6 Door Open Motor
23. Bomb Bay No. 7 Fuel Pump
24. Bomb Bay No. 7 Door Close Motor
25. Bomb Bay No. 7 Door Open Motor
26. Bomb Bay No. 8 Fuel Pump
27. Bomb Bay No. 8 Door Close Motor
28. Bomb Bay No. 8 Door Open Motor
29. Motor - Generator Set - LH Wing
30. Motor - Generator Set - Nose Wheel Well
31. Motor - Generator Set - RH Wing
32. Actuator - Landing Flap
33. Motor - LH Wing Trim Flap
34. RH Wing Station 870 Sectionalizing Panel
35. Actuator - LH Landing Gear
36. Actuator - Nose Landing Gear
37. Actuator - RH Landing Gear
38. Actuator - LH Landing Gear Door
39. Actuator - Fwd. Nose Landing Gear Door
40. Actuator - Aft Nose Landing Gear Door
41. Actuator - RH Landing Gear Door
42. Motor- Nose Steering and Brakes Hydraulic Pump
43. Motor - Secondary Hydraulic Pump
44. Motor - No. 1 Main Fuel Tank Pump
45. Motor - No. 2 Main Fuel Tank Pump
46. Motor - No. 3 Main Fuel Tank Pump
47. Motor - No. 4 Main Fuel Tank Pump
48. Motor - LH Wing Auxiliary Fuel Tank Pump
49. Motor - RH Wing Auxiliary Fuel Tank Pump
50. Motor - LH Wing Oil Transfer Pump
51. Motor - RH Wing Oil Transfer Pump
52. Motor - LH Wing Outboard Carburetor Air Valve
53. Motor - LH Wing Inboard Carburetor Air Valve
54. Motor - RH Wing Inboard Carburetor Air Valve
55. Motor - RH Wing Outboard Carburetor Air Valve
56. Motor - LH Outer Wing Anti-Icer Waste-gate
57. Motor - LH Inner Wing Anti-Icer Waste-gate
58. Motor - RH Inner Wing Anti-Icer Waste-gate
59. Motor - RH Outer Wing Anti-Icer Waste-gate
60. Actuator - LH Wing Outboard Oil Cooler
61. Actuator - LH Wing Inboard Oil Cooler
62. Actuator - RH Wing Inboard Oil Cooler
63. Actuator - RH Wing Outboard Oil Cooler
64. Motor - LH Wing Outboard Engine Cooler Flap
65. Motor - LH Wing Inboard Engine Cooler Flap
66. Motor - RH Wing Inboard Engine Cooler Flap
67. Motor - RH Wing Outboard Engine Cooler Flap
68. Motor - LH Wing Intercooler Flap
69. Motor - RH Wing Intercooler Flap
70. Motor - LH Wing Fire Extinguisher Valve
71. Motor - RH Wing Fire Extinguisher Valve

Figure 20. AC Power Load Distribution (Sheet 2 of 2 Sheets)



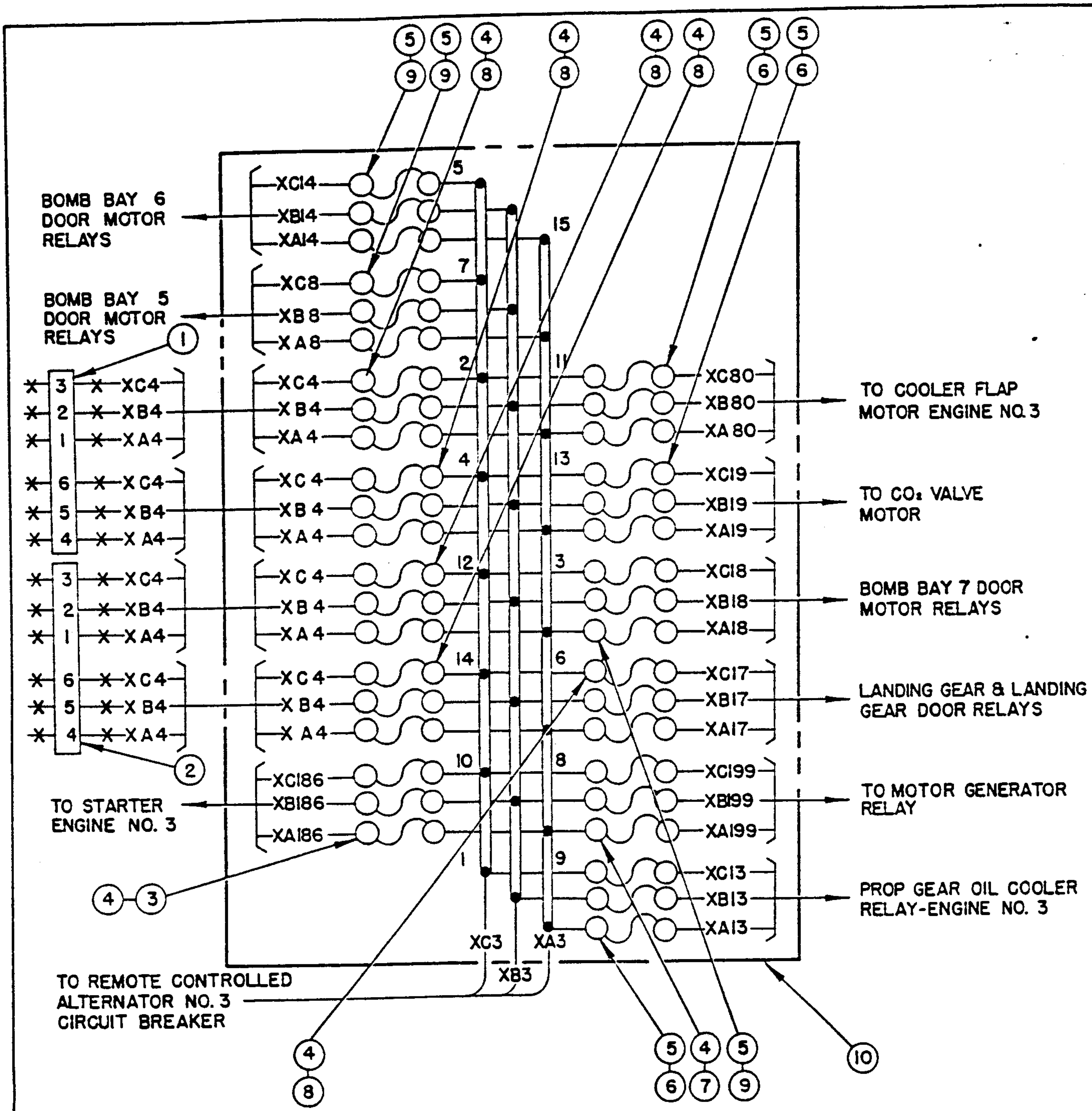
ART.	NAME	REQ.	MAKE	TYPE	SPEC. OR PART NO.
1	LIMITER BASE	6	BURNDY		F3H1
2	LIMITER BASE	7	BURNDY		F3H2
3	LIMITER	3	BURNDY		F3L10
4	LIMITER	3	BURNDY		F3L20
5	LIMITER	1	BURNDY		F3L40
6	LIMITER	5	BURNDY		F3L50
7	LIMITER	1	BURN		F3L60
8	A.C. PANEL	1	NORTHROP		552947
9	L.H. PRESSURIZED PLUG	2	THOMAS & BETTS		BDS-1354-A

Figure 21. AC Power Distribution (LH Inboard)



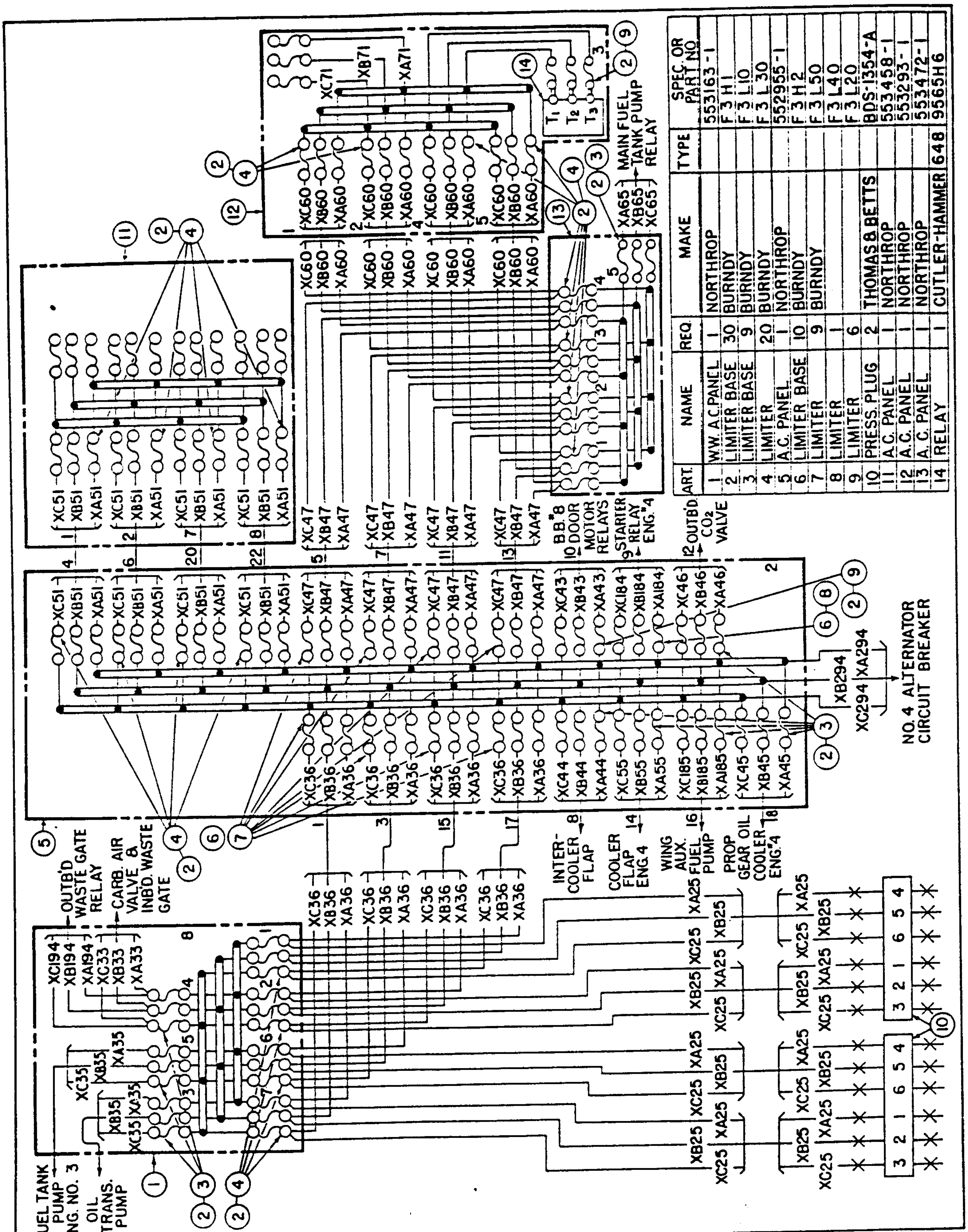
ART	NAME	REQ.	TYPE	MAKE	SPEC. OR PART NO.
1	LIMITER	20		BURNDY	F3L30
2	LIMITER	30		BURNDY	F3H1
3	LIMITER	6		BURNDY	F3L20
4	A.C. PANEL	1		NORTHROP	553458
5	LIMITER	9		BURNDY	F3L50
6	LIMITER	10		BURNDY	F3H2
7	A.C. PANEL	1		NORTHROP	553293
8	A.C. PANEL	1		NORTHROP	553472
9	LIMITER	9		BURNDY	F3L10
10	RELAY	1	648	CUTLER-HAMMER	956546
11	LIMITER	1		BURNDY	F3L40
12	A.C. PANEL	1		NORTHROP	553163
13	A.C. PANEL	1		NORTHROP	552955
14	L.H. PLUG "W"	2		THOMAS-BETTS	BDS-1354-A

Figure 22. AC Power Distribution (LH Outboard)



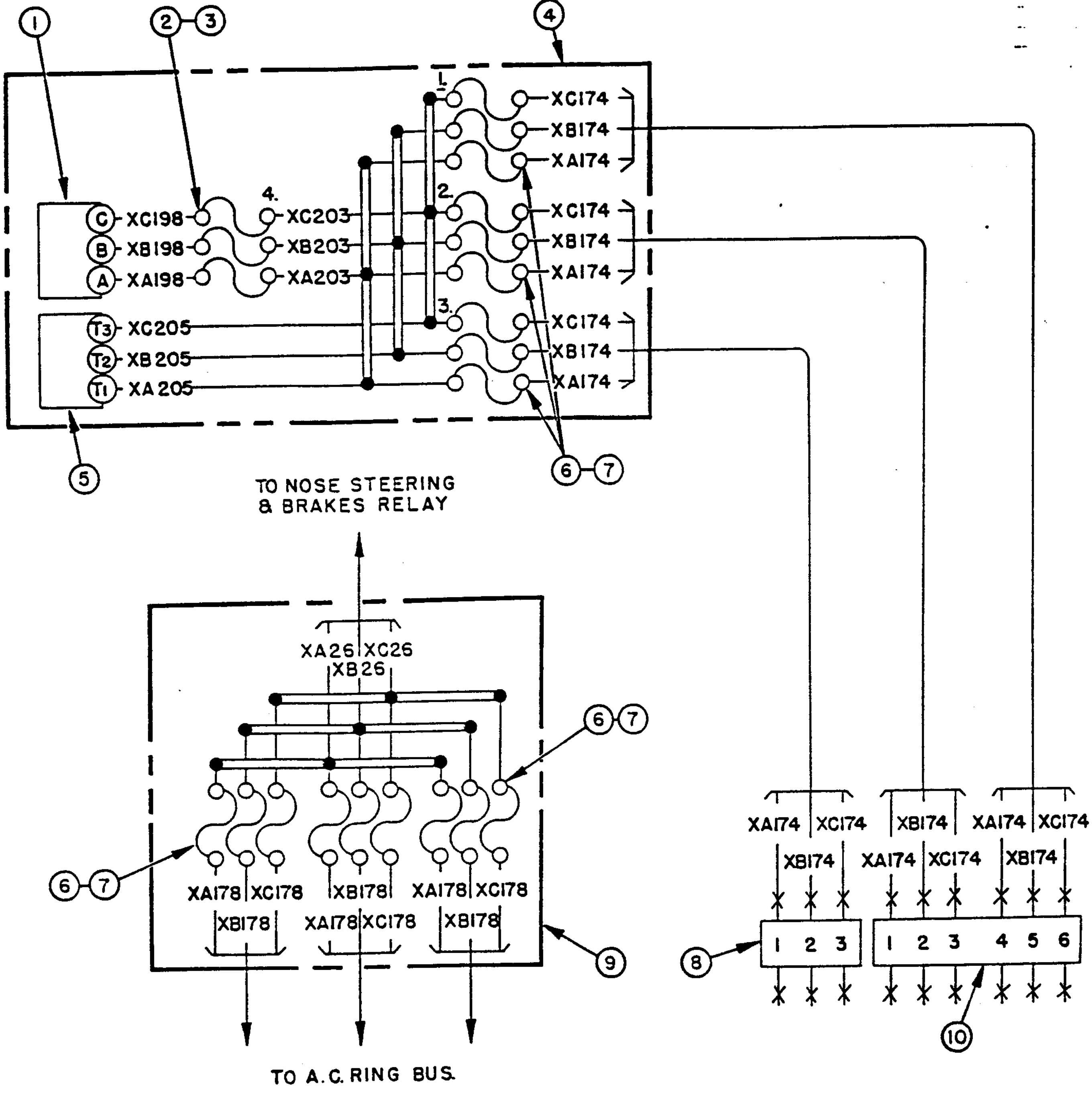
ART	NAME	REQ	MAKE	TYPE	SPEC. OR PART NO.
1	R.H. PRESSURIZED PLUG "Y"	1	THOMAS & BETTS		BDS 1354 A
2	R.H. PRESSURIZED PLUG "Z"	1	THOMAS & BETTS		BDS 1354 A
3	LIMITER	1	BURNDY		F3L40
4	LIMITER BASE	7	BURNDY		F3H2
5	LIMITER BASE	6	BURNDY		F3H1
6	LIMITER	3	BURNDY		F3L10
7	LIMITER	1	BURNDY		F3L60
8	LIMITER	5	BURNDY		F3L50
9	LIMITER	3	BURNDY		F3L20
10	A C PANEL	1	NORTHROP		552947-1

Figure 23. AC Power Distribution (RH Inboard)



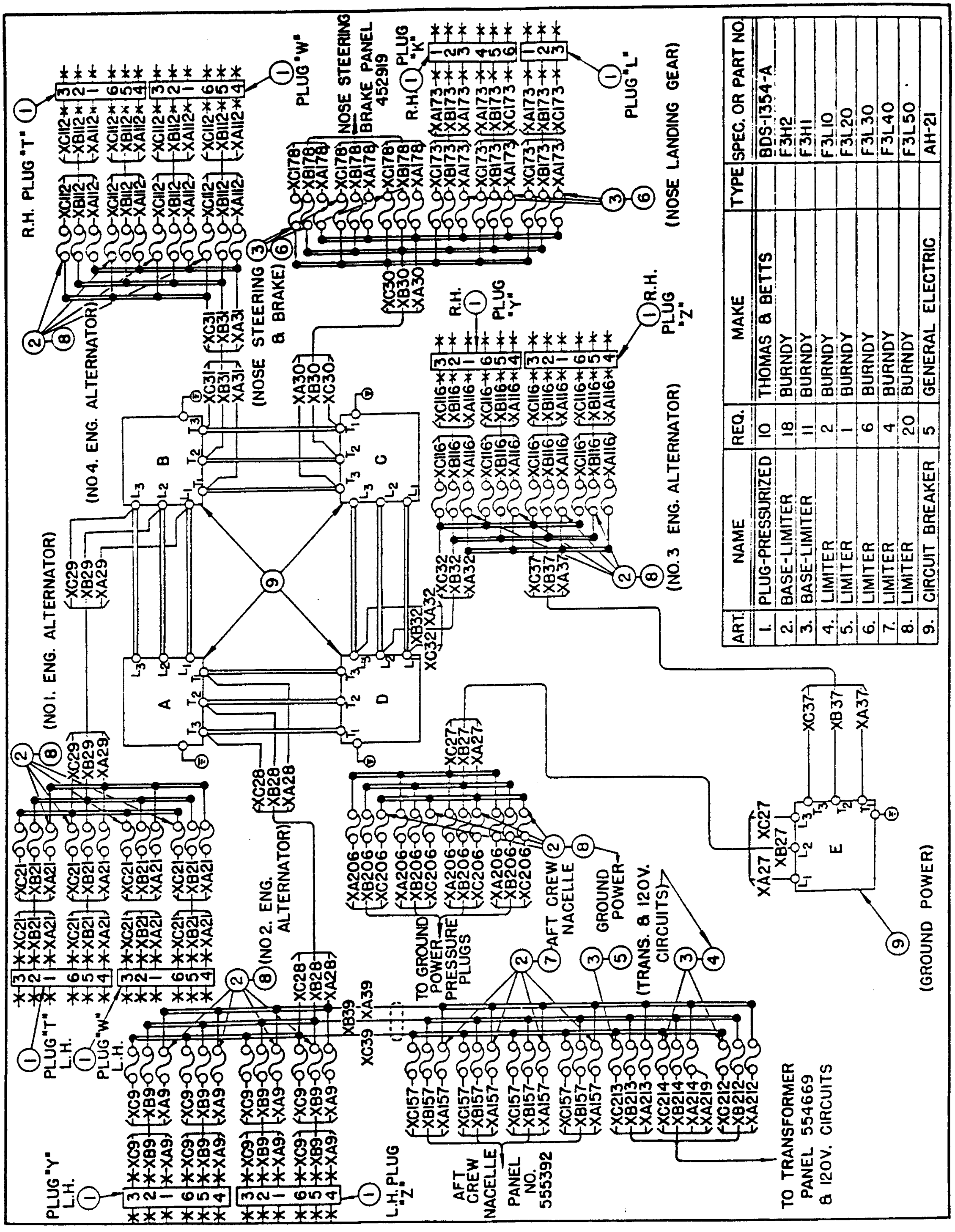
ART.	NAME	REQ.	MAKE	TYPE	SPEC. OR PART NO.
1	WW. A.C. PANEL	1	NORTHROP		553163-1
2	LIMITER BASE	30	BURNDY		F3H1
3	LIMITER BASE	9	BURNDY		F3L10
4	LIMITER	20	BURNDY		F3L30
5	A.C. PANEL	1	NORTHROP		552955-1
6	LIMITER BASE	10	BURNDY		F3H2
7	LIMITER	9	BURNDY		F3L50
8	LIMITER	1			F3L40
9	LIMITER	6			F3L20
10	PRESS. PLUG	2	THOMAS & BETTS		BDS-1354-A
11	A.C. PANEL	1	NORTHROP		553458-1
12	A.C. PANEL	1	NORTHROP		553293-1
13	A.C. PANEL	1	NORTHROP		553472-1
14	RELAY	1	CUTLER-HAMMER	648	9565H6

Figure 24. AC Power Distribution (RH Inboard)



ART.	NAME	REQ.	MAKE	TYPE	SPEC. OR PARTS NO.
1	RELAY	1	CUTLER-HAMMER	648	956 5H6
2	LIMITER BASE	1	BURNDY		F3H2
3	LIMITER	1	BURNDY		F3L40
4	A.C. PANEL	1	NORTHROP		552738
5	RELAY MOTOR GENERATOR	1	CUTLER- HAMMER	653	9565H1
6	LIMTER BASE	3	BURNDY		F3H1
7	LIMITER	3	BURNDY		F3L30
8	PRESSURIZED PLUG "L"	1	THOMAS- BETTS		BDS-1354-A
9	A. C. PANEL	1	NORTHROP		452919
10	PRESSURIZED PLUG "K"	1	THOMAS-BETTS		BDS-1354-A

Figure 25. AC Power Distribution Nose Section



ART.	NAME	REQ.	MAKE	TYPE	SPEC. OR PART NO.
1.	PLUG-PRESSURIZED	10	THOMAS & BETTS		BDS-1354-A
2.	BASE-LIMITER	18	BURNDY		F3H2
3.	BASE-LIMITER	11	BURNDY		F3H1
4.	LIMITER	2	BURNDY		F3L10
5.	LIMITER	1	BURNDY		F3L20
6.	LIMITER	6	BURNDY		F3L30
7.	LIMITER	4	BURNDY		F3L40
8.	LIMITER	20	BURNDY		F3L50
9.	CIRCUIT BREAKER	5	GENERAL ELECTRIC		AH-21

Figure 26. AC Ring Bus

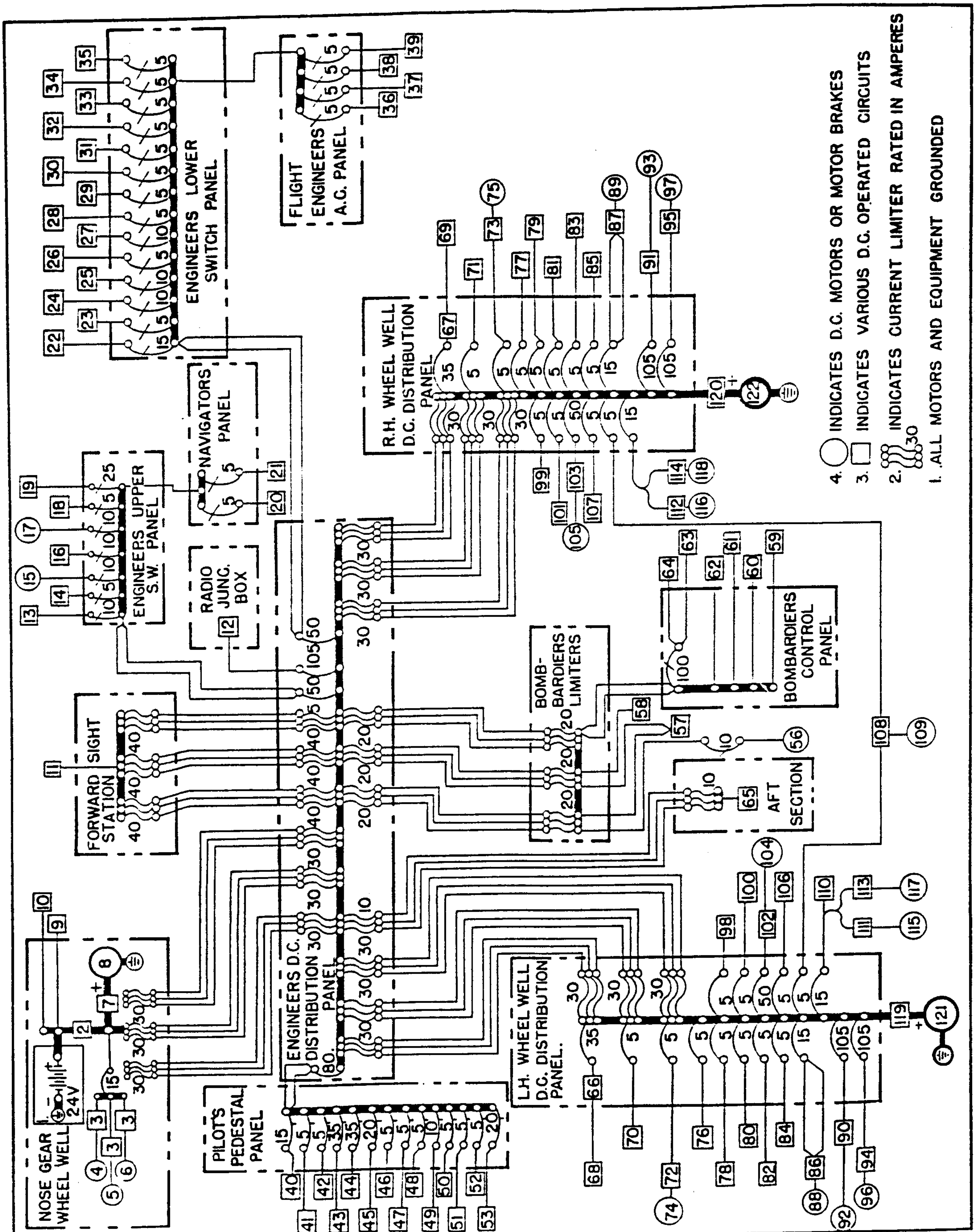


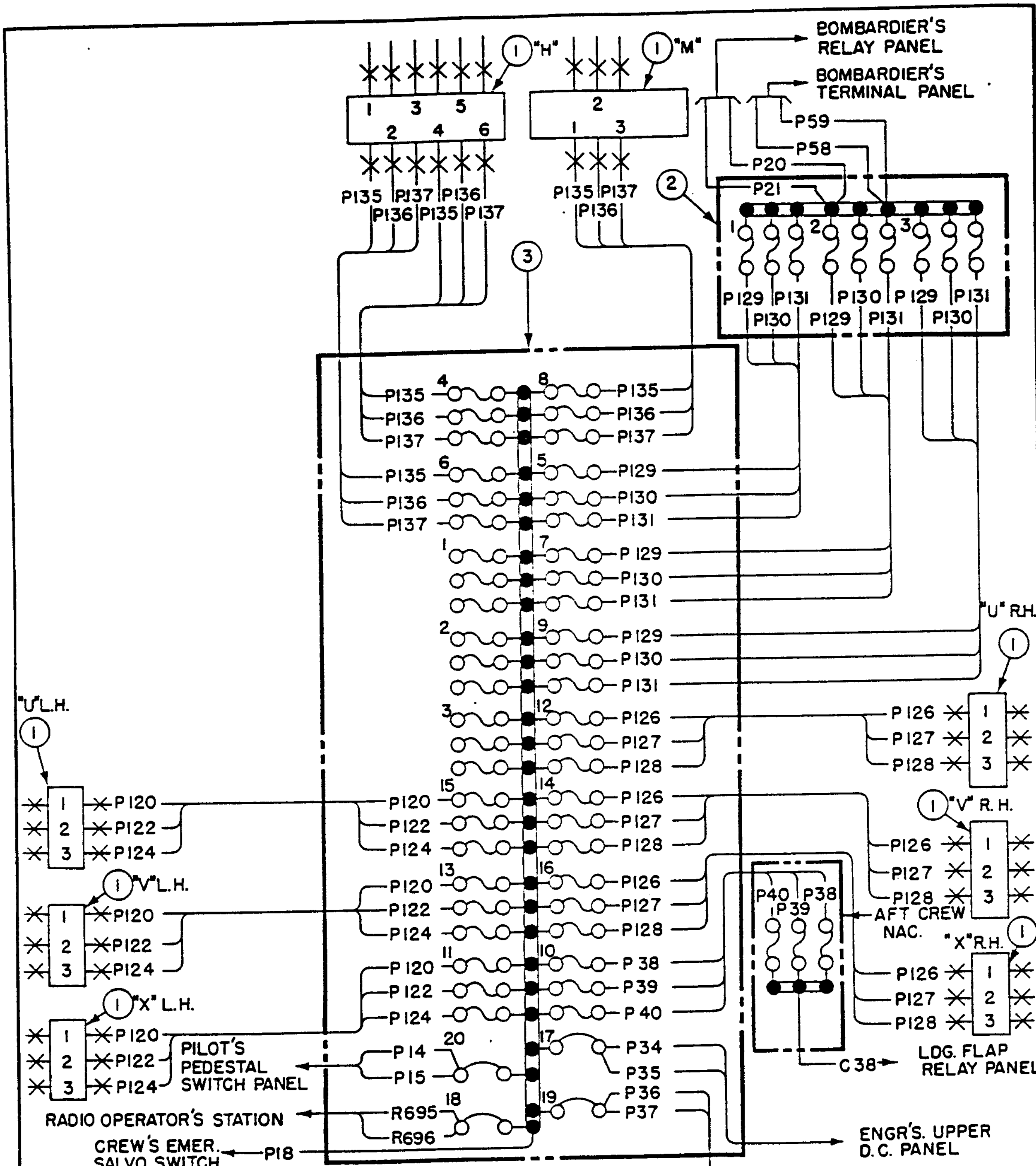
Figure 27. 28 Volt DC Power Distribution (Sheet 1 of 3 Sheets)

1. Battery
2. Battery - Disconnect Relay
3. Motor Brake Control Relay
4. Nose Gear Actuator Motor Brake
5. Nose Gear Fwd. Door Motor Brake
6. Nose Gear Aft Door Motor Brake
7. Auxiliary Motor Generator Ammeter Shunt
8. Auxiliary Motor Generator
9. Emergency Alarm Circuit
10. Pilot's Bomb Salvo Circuit
11. Upper Turret Control Box
12. Radio
13. Altitude Warning Signal
14. Wing Anti-Icer Control
15. Turbo Selector Valve Motor
16. Primer and Oil Dilution Solenoids
17. Cabin Temperature Control Valve Motor
18. Starter Control Relays
19. Fire Extinguisher Control
20. Navigator's Free Air Temperature Indicator
21. Gyro Compass
22. Fuel Valve
23. Fuel Pump
24. Engine Fan Speed Control Motors
25. Carburetor Air Valve Control Relays
26. Oil Transfer Pumps
27. RC-103 Radio
28. Cylinder Head Temperature
29. Free Air Temperature Indicator
30. Carburetor Air Temperature Indicator
31. Propeller Gear Box Oil Temperature Indicator
32. Engine Oil Temperature Indicator
33. Oil Level Indicator
34. Fuel Level Indicator
35. Propeller Gear Box Oil Temperature Control Relays
36. Remote Controlled Circuit Breakers
37. LH Motor Generator Control Relay
38. RH Motor Generator Control Relay
39. Auxiliary Motor Generator Control Relay
40. Ignition
41. Nose Steering and Brakes Control
42. Landing Flap Control Relays
43. Landing Gear Control and Gear Lock Motors
44. Auto Pilot
45. Elevon Emergency Control
46. Free Air Temperature Indicator (Pilots')
47. Landing Gear and Flap Indicator
48. Bank and Turn Indicator
49. Landing Light Control
50. Wing Slots Control
51. Trim Flap Control
52. Trim Flap Indicator
53. Automatic Propeller Control
54. Bomb Bay No. 4 Door and Bomb Salvo
55. Crews Emergency Salvo
56. Bombardier's Windshield Wiper Motor
57. Bomb Bay Fuel Tank Release Power
58. Glide Angle Attachment
59. Bomb Intervalometer
60. Bomb Door Control
61. Bombardier's Salvo Door and Release
62. Bomb Release Formation Light
63. Bomb Release Power, Nose Fusing
64. Bomb Bay Fuel Tank Release Control and Directional Stab
65. Flap Actuator Indicator Light
66. LH Landing Light and Motor Relay
67. RH Landing Light and Motor Relay
68. LH Landing Light and Motor
69. RH Landing Light and Motor
70. LH Inner Wing Anti-Icer Control Relay

Figure 27. 28 Volt DC Power Distribution (Sheet 2 of 3 Sheets)

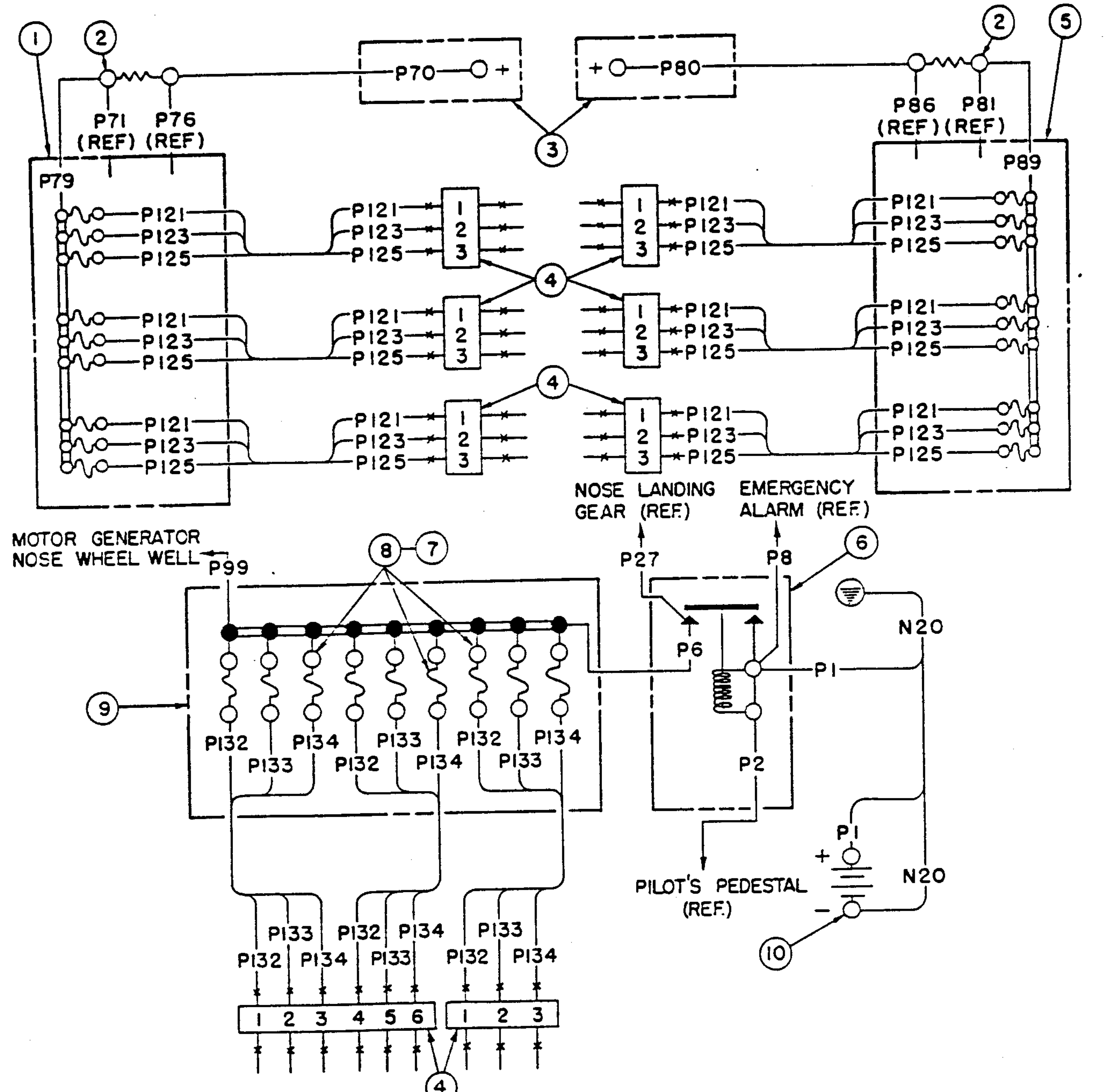
71. RH Inner Wing Anti-Icer Control Relay
72. LH Inner Wing Anti-Icer Valve Motor Relay
73. RH Inner Wing Anti-Icer Valve Motor Relay
74. LH Inner Wing Anti-Icer Valve Motor
75. RH Inner Wing Anti-Icer Valve Motor
76. Bomb Bay No. 1 Rack Selector
77. Bomb Bay No. 8 Rack Selector
78. Bomb Bay No. 2 Rack Selector
79. Bomb Bay No. 7 Rack Selector
80. Bomb Bay No. 3 Rack Selector
81. Bomb Bay No. 6 Rack Selector
82. Bomb Bay No. 4 Rack Selector
83. Bomb Bay No. 5 Rack Selector
84. LH Aspirator Valve Motor and Modulator
85. RH Aspirator Valve Motor and Modulator
86. LH Trim Flap Motor Brake Relay
87. RH Trim Flap Motor Brake Relay
88. LH Trim Flap Motor Brake
89. RH Trim Flap Motor Brake
90. No. 1 Engine Propeller Feathering Motor Relay
91. No. 4 Engine Propeller Feathering Motor Relay
92. No. 1 Engine Propeller Feathering Motor
93. No. 4 Engine Propeller Feathering Motor
94. No. 2 Engine Propeller Feathering Motor Relay
95. No. 3 Engine Propeller Feathering Motor Relay
96. No. 2 Engine Propeller Feathering Motor
97. No. 3 Engine Propeller Feathering Motor
98. LH Hydraulic Power Boost - No. 1 Propeller Shaft Housing
99. RH Hydraulic Power Boost - No. 4 Propeller Shaft Housing
100. LH Hydraulic Power Boost - No. 2 Propeller Shaft Housing
101. RH Hydraulic Power Boost - No. 3 Propeller Shaft Housing
102. LH Emergency Elevon Control Motor Relay
103. RH Emergency Elevon Control Motor Relay
104. LH Emergency Elevon Control Motor
105. RH Emergency Elevon Control Motor
106. LH Carburetor Air Valve Control
107. RH Carburetor Air Valve Control
108. Nose Steering and Brake Hydraulic Pump Motor Relay
109. Nose Steering and Brake Hydraulic Pump Motor
110. Landing Gear Safety Control Solenoid
111. LH Landing Gear Actuator Motor Brake Relay
112. RH Landing Gear Actuator Motor Brake Relay
113. LH Landing Gear Door Motor Brake Relay
114. RH Landing Gear Door Motor Brake Relay
115. LH Landing Gear Actuator Motor Brake
116. RH Landing Gear Actuator Motor Brake
117. LH Landing Gear Door Motor Brake
118. RH Landing Gear Door Motor Brake
119. LH Motor Generator Shunt
120. RH Motor Generator Shunt
121. LH Motor Generator and Voltage Regulator 200 Amp.
122. RH Motor Generator and Voltage Regulator 200 Amp.

Figure 27. 28 Volt DC Power Distribution (Sheet 3 of 3 Sheets)



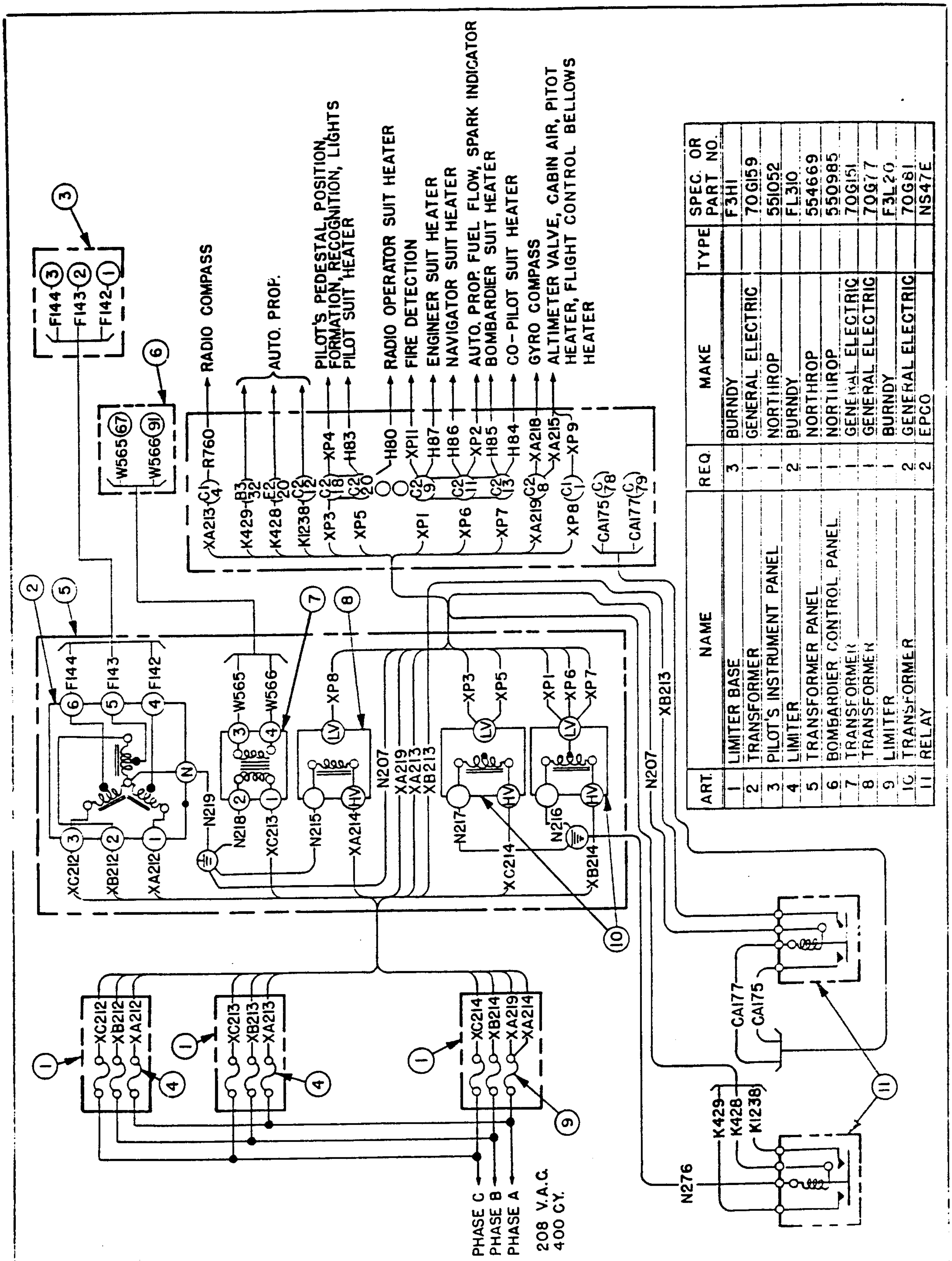
ART.	NAME	REQ.	MAKE	TYPE	SPEC. OR PART NO.
1	PRESSURIZED PLUG	8	THOMAS & BETTS		BDS-1354-A
2	BOMBDR'S LIMTR. PANEL	1	NORTHROP		551159
3	ENGR'S D. C. DISTRIB PANEL	1	NORTHROP		554151

Figure 28. Distribution System Crew Nacelle



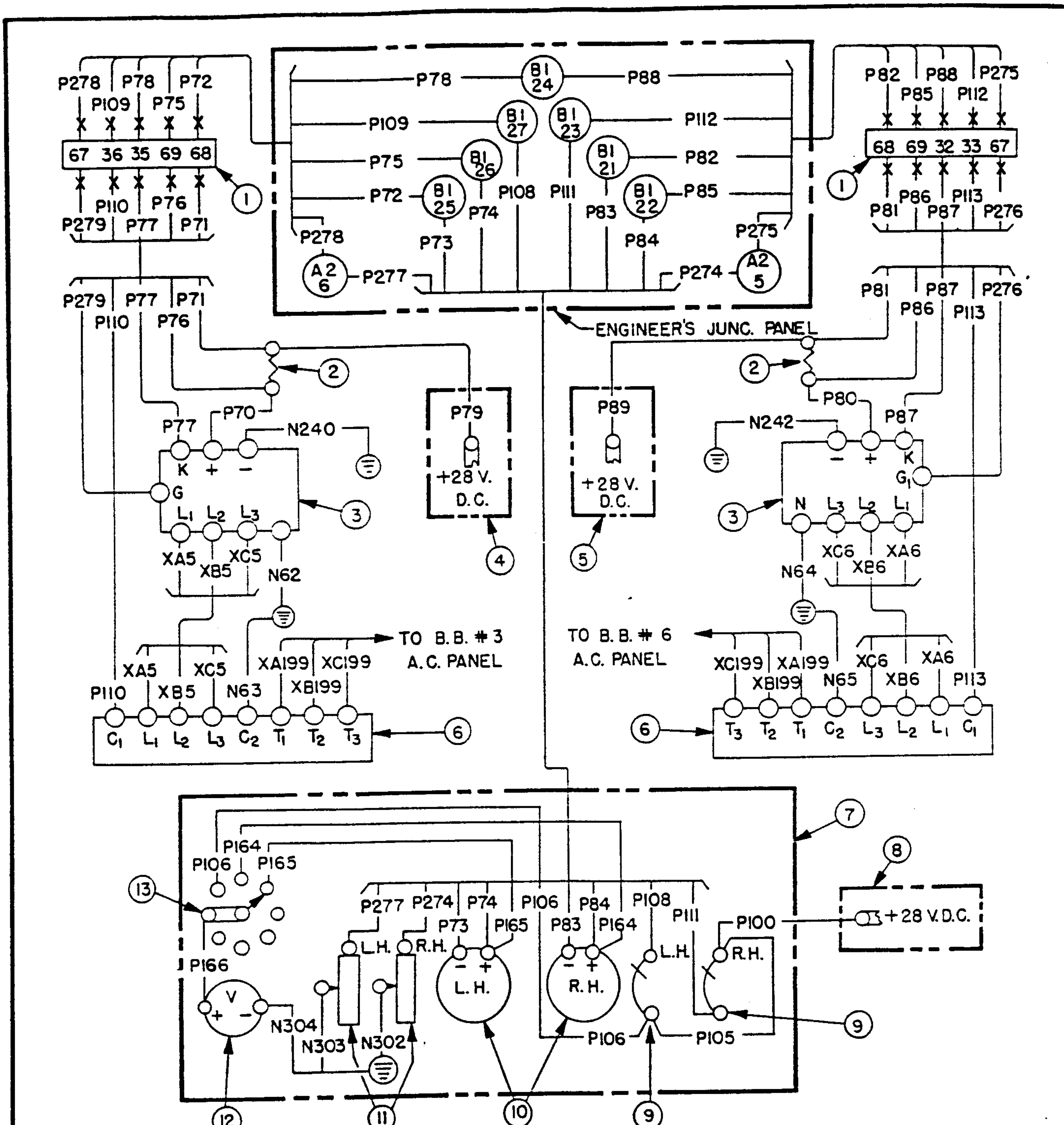
ART	NAME	REQ	MAKE	TYPE	SPEC OR PART NO
1	WHEEL WHEEL D.C. DIST. PANEL	1	NORTHROP		554189
2	AMMETER SHUNT	2		AN	3200-300
3	MOTOR GENERATOR	2	WESTINGHOUSE		AC-6
4	PRESSURIZED PLUG	8	THOMAS & BETTS		8DS-1354-A
5	WHEEL WELL D.C. DIST. PANEL	1	NORTHROP		554189-1
6	NOSE WHEEL WELL RELAY PANEL	1	NORTHROP		552738
7	LIMITER BASE	3	BURNDY		F3H1
8	LIMITER	3	BURNDY		F3L30
9	NOSE WHEEL WELL D.C. POWER PANEL	1	NORTHROP		454362
10	BATTERY	1		AN	3151

Figure 29. DC Distribution System Nose Section - RH Wing, LH Wing



ART.	NAME	REQ.	MAKE	TYPE	SPEC. OR PART NO.
1	LIMITER BASE	3	BURNDY		F3H1
2	TRANSFORMER	1	GENERAL ELECTRIC		70G159
3	PILOT'S INSTRUMENT PANEL	1	NORTHROP		551052
4	LIMITER	2	BURNDY		FL310
5	TRANSFORMER PANEL	1	NORTHROP		554669
6	BOMBARDIER CONTROL PANEL	1	NORTHROP		550985
7	TRANSFORMER	1	GENERAL ELECTRIC		70G151
8	TRANSFORMER	1	GENERAL ELECTRIC		70G77
9	LIMITER	1	BURNDY		F3L20
10	TRANSFORMER	2	GENERAL ELECTRIC		70G81
11	RELAY	2	EPCO		NS47E

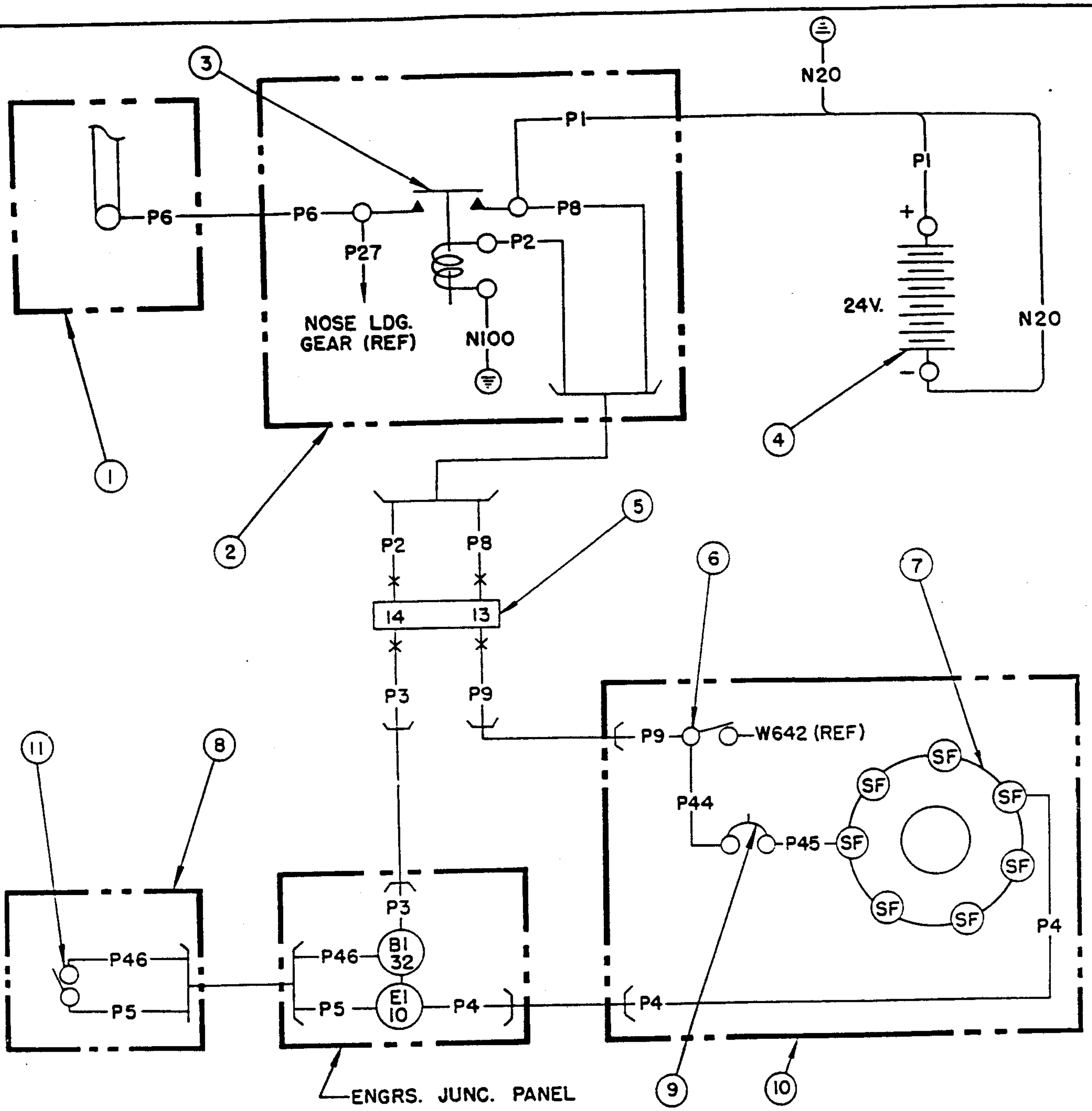
Figure 30. Transformer Panel



ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	PLUG-PRESS.	THOS.-BETTS		BDS-1354-B
2	AMMETER SHUNT		AN	3200-300
3	MOTOR-GEN.	WESTINGH'SE		AC-6
4	PANEL-D.C. DIST.	NORTHROP		554189
5	PANEL-D.C. DIST.	NORTHROP		554189-1
6	RELAY	C. & H.	653	9565H1
7	PANEL-ENG. A.C.	NORTHROP		552795

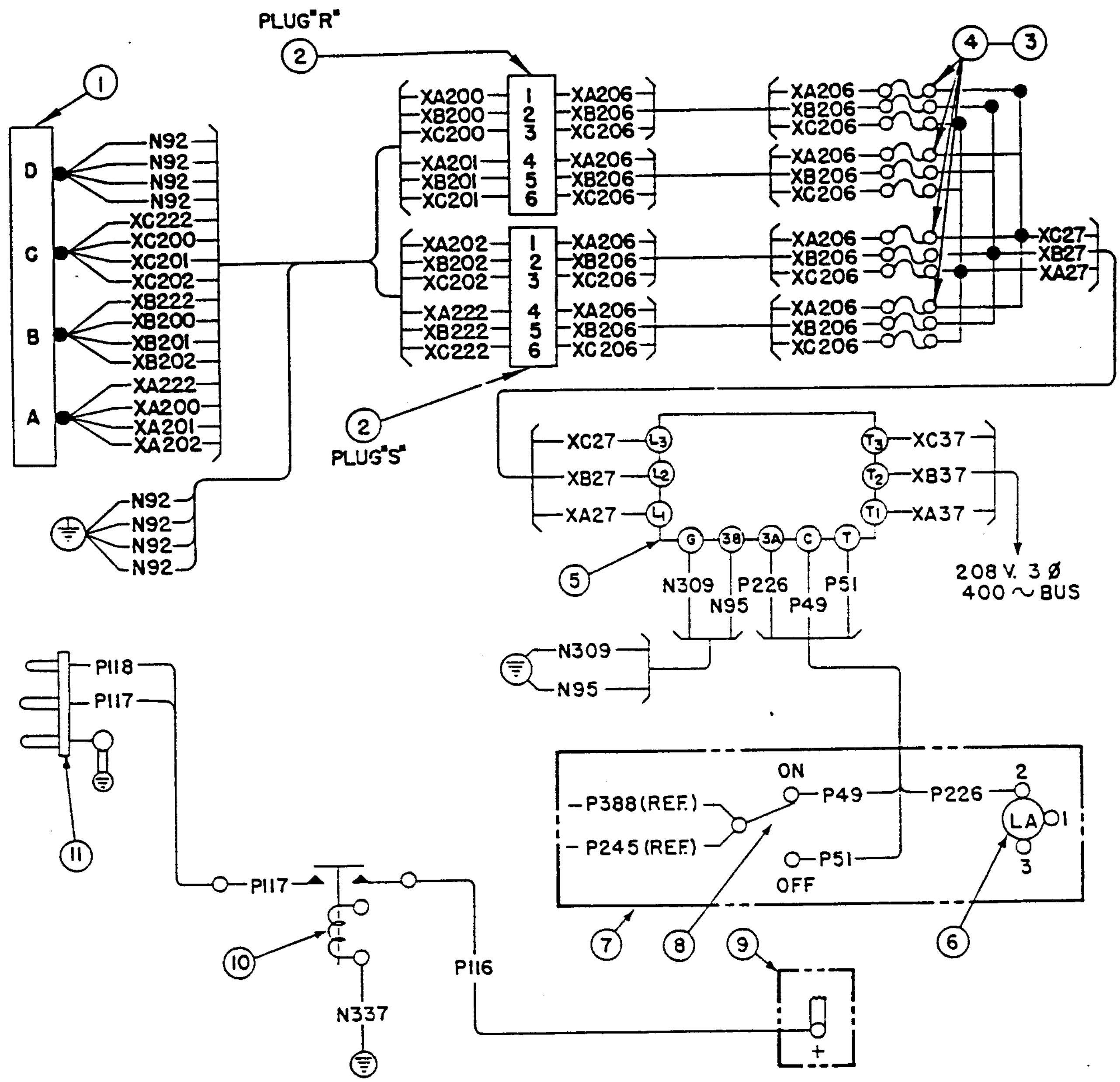
ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
8	PANEL-ENGINEERS	NORTHROP		552672
9	CIRCUIT BREAKER		AN	3160-5
10	AMMETER		AN	3201A300
11	RHEOSTAT		AN	3155-25-11
12	VOLTMETER		AN	3203V30
13	SWITCH-SEL.		AN	3211-1

Figure 31. Motor Generator Converters



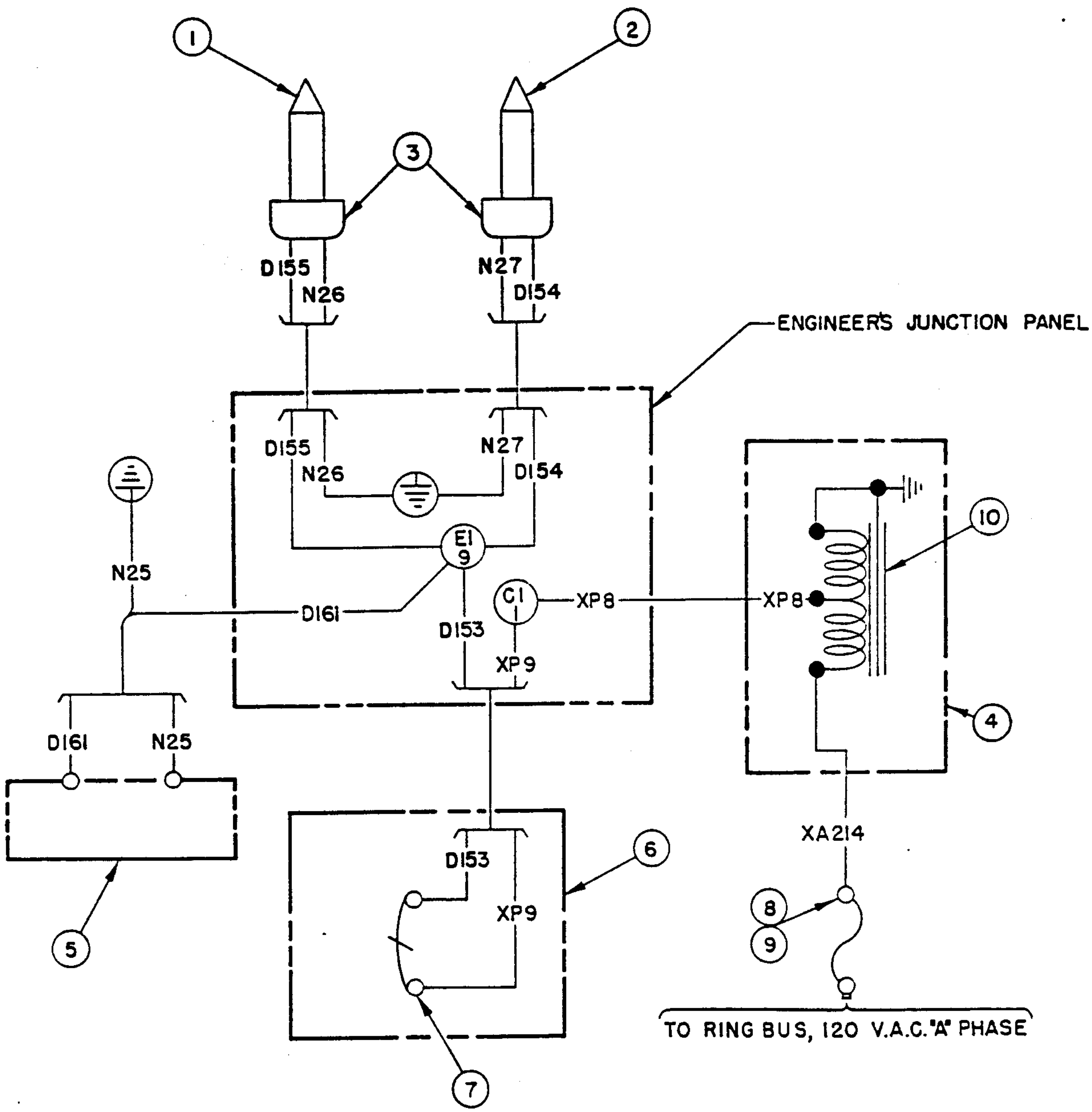
ART.	NAME	REQ.	MAKE	TYPE	SPEC. OR PART NO.
1	NOSE W. W. D. C. POWER DISTR. PANEL	1	NORTHROP		454362
2	NOSE W. W. RELAY PANEL	1	NORTHROP		552738
3	RELAY	1		B4	
4	BATTERY	1		F1	AN3151
5	PLUG-PRESSURIZED	1	THOMAS & BETTS		BDS-1354-B
6	SWITCH - EMERGENCY ALARM	1			AN3022-2
7	SWITCH-IGNITION CRASH	1	POLLAK CO.		A852
8	PANEL-ENGR. UPPER SWITCH	1	NORTHROP		552722
9	CIRCUIT BREAKER - IGNITION	1			AN3161-15
10	PANEL - PILOT'S PEDESTAL	1	NORTHROP		552409
11	SWITCH- BATTERY	1		AN	3022-2

Figure 32. Battery Control



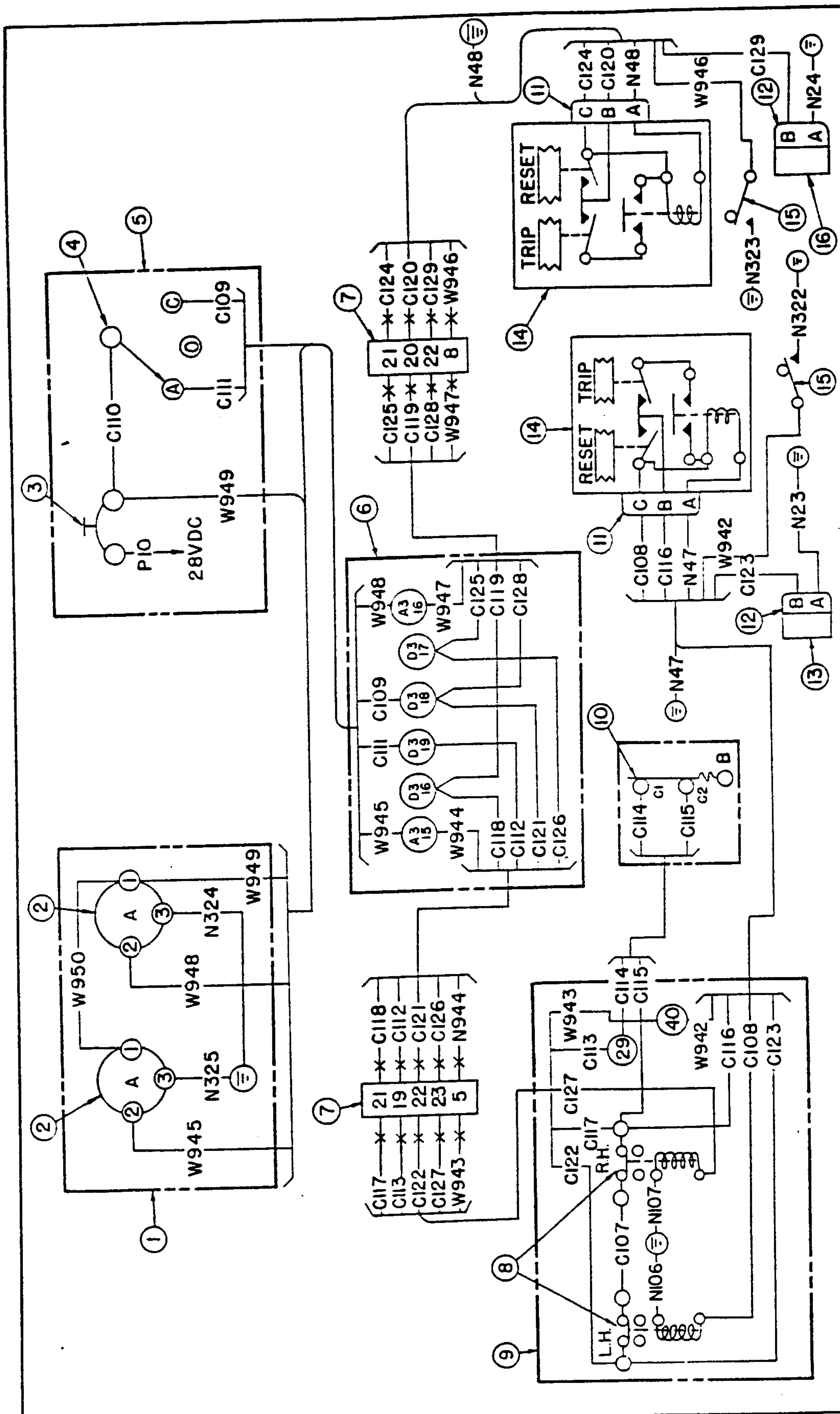
ART.	NAME	REQ.	MAKE	TYPE	SPEC. OR PART NO.
1	RECEPTACLE-A.C. POWER	1		AN	3102-32-17P
2	PRESSURIZED PLUG	2	THOMAS & BETTS		BDS-1354-A
3	LIMITER BASE	1	BURNDY		F3H2
4	GROUND POWER LIMITER	1	BURNDY		F3L50
5	REMOTE CONTROLLED CIRCUIT BREAKER	1	G.E.		AH21
6	LAMP ASSEMBLY	1		AN	44A18454-4
7	ENGINEER'S A. C. PANEL	1	NORTHROP		
8	SWITCH	1		AN	3023-3
9	D.C. POWER DIST. PANEL	1	NORTHROP		554189
10	RELAY	1	LEACH		7220-24
11	RECEPTACLE-D.C. POWER	1		AN	2552-1

Figure 33. External Power



ART.	NAME	REQ.	MAKE	TYPE	SPEC. OR PART NO.
1	LOWER PITOT TUBE	1		AN	5814-2
2	UPPER PITOT TUBE	1		AN	5816-2
3	PLUG	1		AN	3115-1
4	TRANSFORMER PANEL	1			
5	CALROD HEATER	1	G-E		O.W. 700-2A
6	ENGINEERS UPPER ELECTRIC PANEL	1			552722
7	CIRCUIT BREAKER	1		AN	3160-20
8	LIMITER	1	BURNDY		F3L20
9	BASE-LIMITER	1	BURNDY		F3H1
10	TRANSFORMER	1	G-E		70677

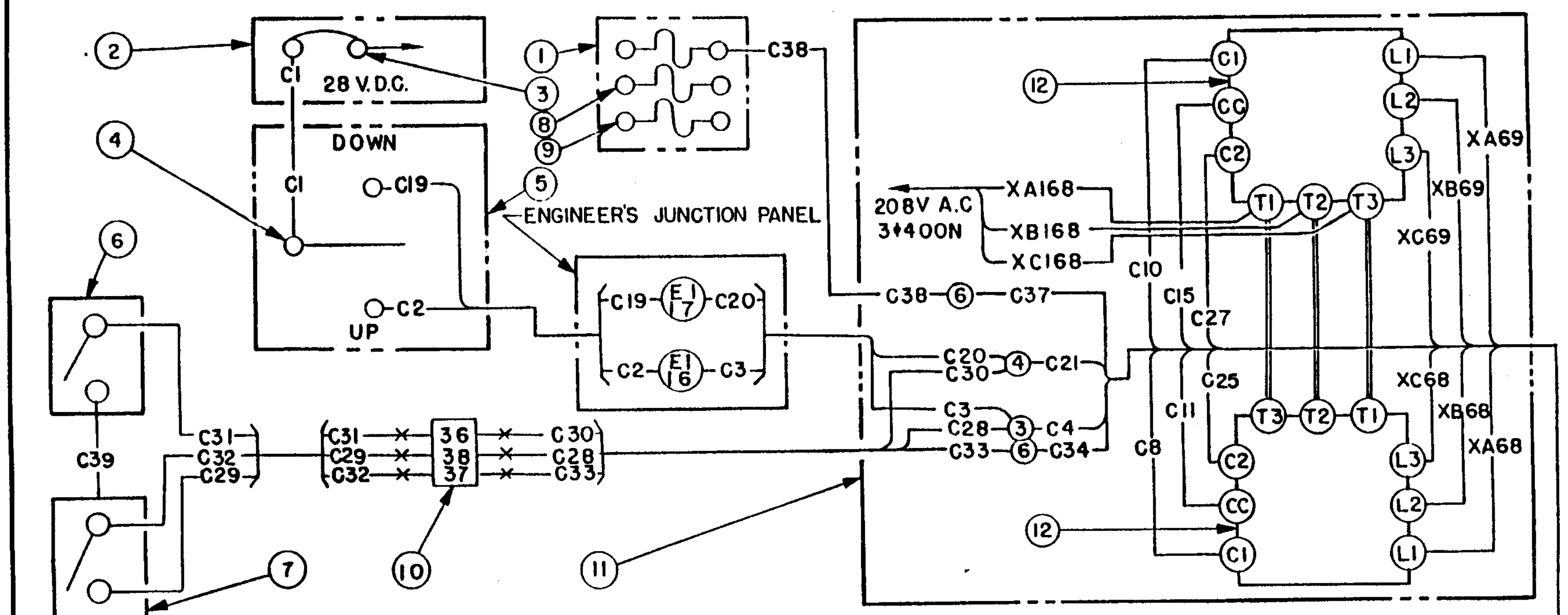
Figure 34. Pitot and Bellows Heater



ART	NAME	REQ	MAKE	TYPE	SPEC OR PART NO.
1	PILOT'S INSTR. PANEL	1			551052
2	LAMP ASSEMBLY	2		AAF	44A18454-4
3	CIRCUIT BREAKER	1		AN	3161-5
4	SWITCH	1		AN	3022-1
5	PILOT'S PEDESTAL	1			552409
6	ENGINEER'S JCT. PANEL				
7	PRESSURIZED PLUG	2	THOM. & BETTS		BDS-1354-B
8	RELAY	2	EPCO		ND-47E

ART	NAME	REQ	MAKE	TYPE	SPEC OR PART NO.
9	W.W. RELAY PANEL	1			584605
10	HYD. PUMP SWITCH	1	MICRO		BZ-3YT
11	PLUG	2		AN	3106-10SL-3S
12	PLUG	2		AN	3108-10SL-4S
13	SOLENOID VALVE	1	AIREON MFG. CO.		62086
14	AERODYMANIC SWITCH	2	SCHWIEN		26000
15	SWITCH	2	MICRO	AN	3210-1
16	SOLENOID VALVE	1	AIREON MFG. CO.		62086-1

Figure 35. Wing Slots



ART.	NAME	REQ.	MAKE	TYPE	SPEC. OR PART NO.
1	ENGINEER'S D.C. DIST. PANEL	1	NORTHROP		554151
2	PILOT'S PEDESTAL	1	NORTHROP		552409
3	CIRCUIT BREAKER	1		AN	3161-5
4	SWITCH	1		AN	3022-1
5	LD'G FLAP SWITCH PANEL	1	NORTHROP		452442
6	SWITCH FLAP DOWN	1	MICRO		YZ-R31
7	SWITCH FLAP UP	1	MICRO		YZ-R31
8	LIMITER	1	BURNDY		F3L30
9	LIMITER BASE	1	BURNDY		F3H1
10	PRESSURIZED PLUG "F" R.H.	1	THOMAS & BETTS		BDS1354-4
11	RELAY CONTROL PANEL	1	NORTHROP		555490
12	RELAY	2	CUTLER & HAMMER	650	956H8
13	ACTUATOR MOTOR	2	GENERAL ELECTRIC		K8705113
14	PLUG	2		AN	3106-22-34S
15	RECEPTACLE	1		AN	3102-18-1P
16	PLUG	1		AN	3106-18-1S
17	POWER UNIT	1	NORTHROP		554700
18	INDICATOR LIGHT	1		AAF	44A18454-6
19	SWITCH-FLAP DOWN LIMIT	1	MICRO		WZ-R31
20	SWITCH-EMER. RELEASE	1		AN	3027-2
21	SWITCH-FLAP UP LIMIT	1	MICRO		WZ-R31

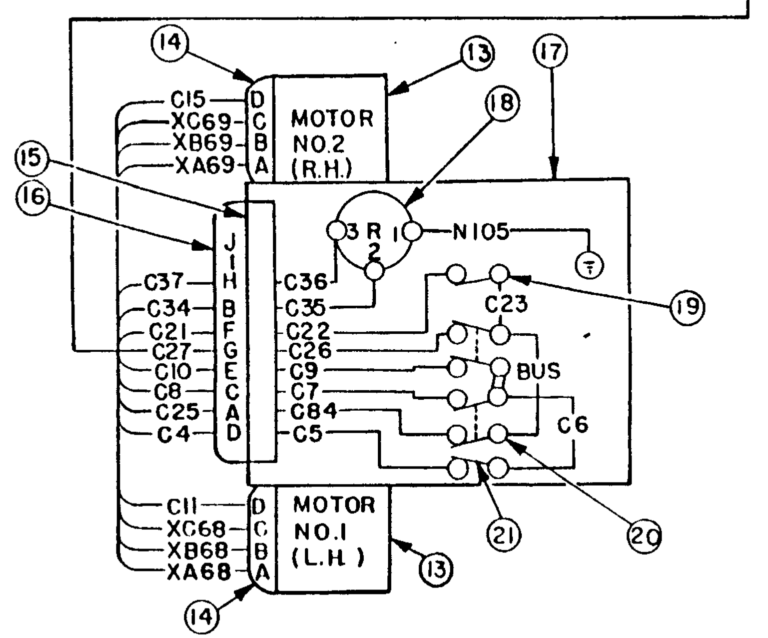
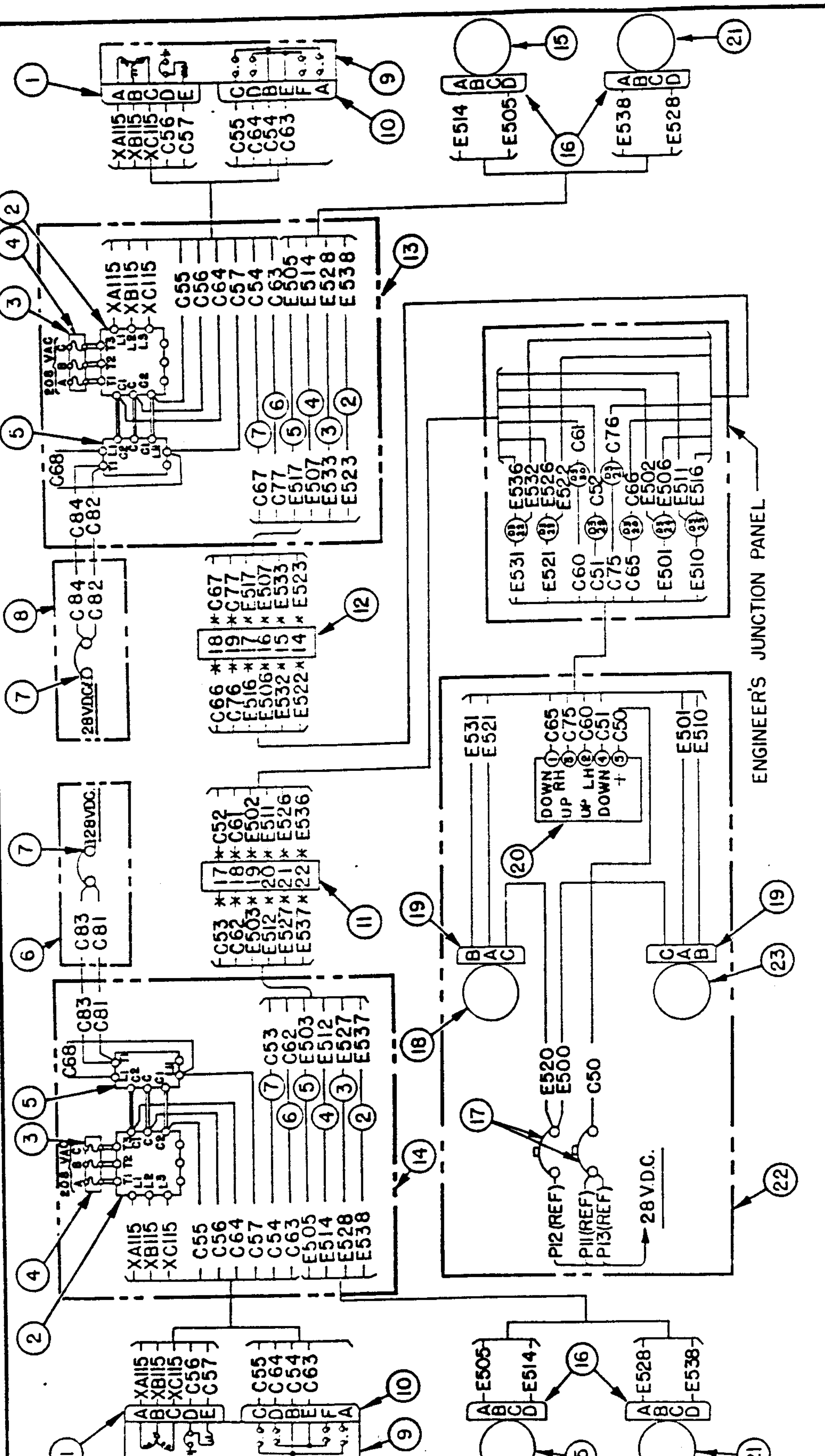


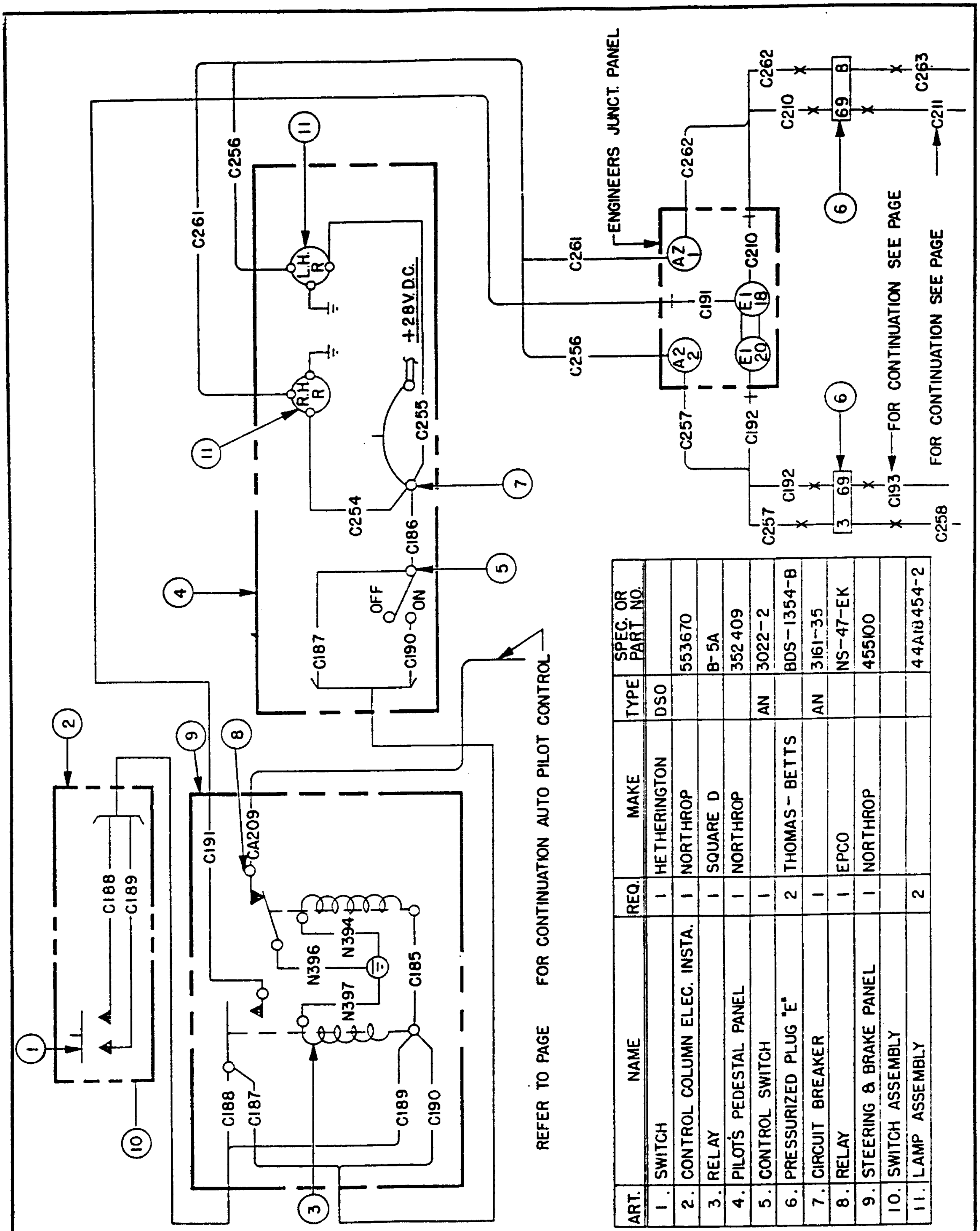
Figure 36. Landing Flap Control



ART.	NAME	REQ.	MAKE	TYPE	SPEC. OR PARTS NO
1	PLUG	1		AN	3106-18-29S
2	RELAY	2	CUTLER-HAMMER	648	9565H6
3	LIMITER	2	BURNDY		F3L20
4	BASE	2	BURNDY		F3H1
5	RELAY	2	CUTLER-HAMMER	652	9565H12A
6	DC. PANEL	1			554189
7	CIRCUIT BREAKER	2			PA-15
8	DC. PANEL	1			554189-1
9	MOTOR	2	DELCO		EX88432
10	PLUG	2		AN	3106-14S-6S
11	L.H. PLUG "A" – PRESS.	1	THOMAS-BETTS		BDS-1354A
12	R.H. PLUG "A" – PRESS.	1	THOMAS-BETTS		BDS-1354A

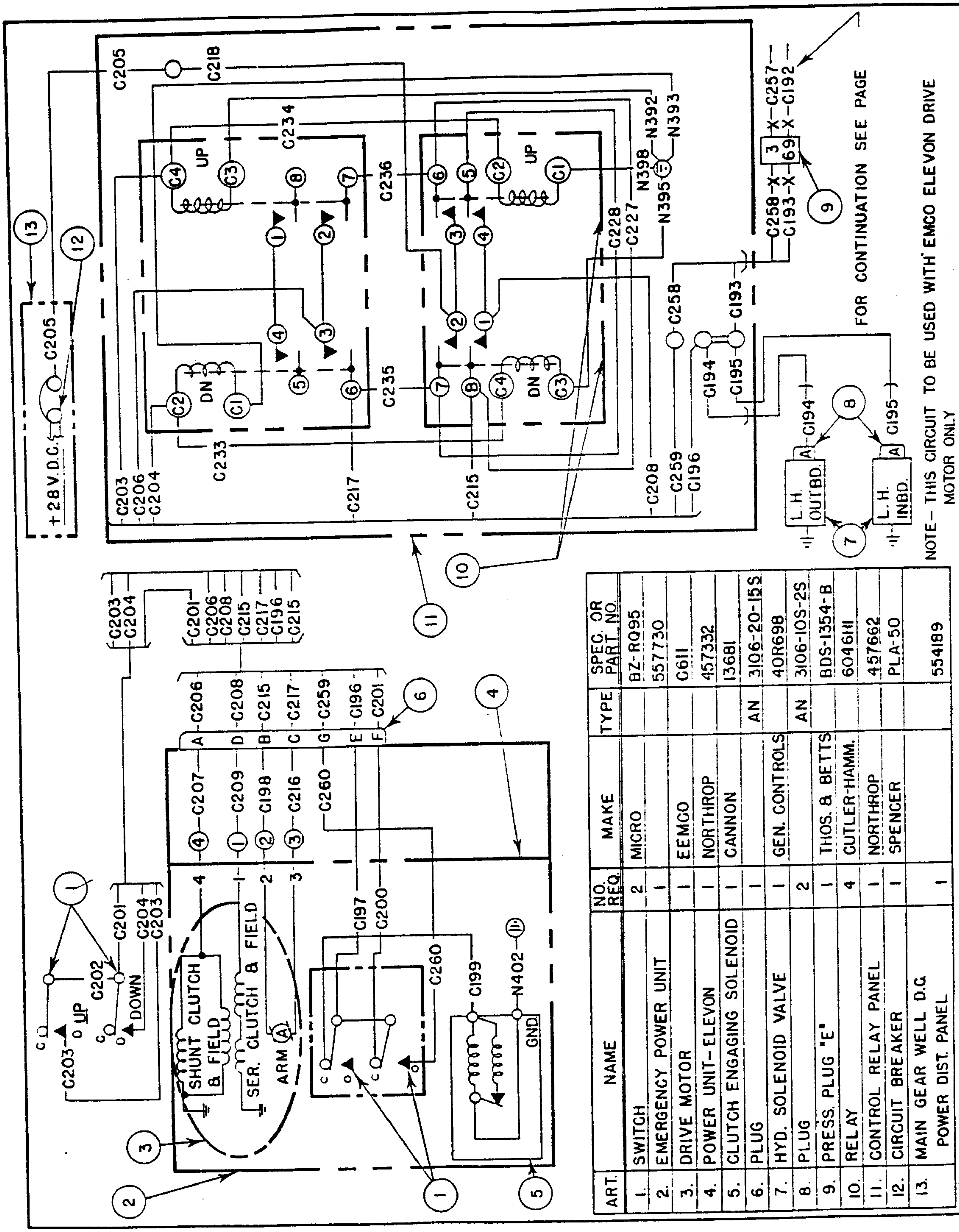
ART.	NAME	REQ.	MAKE	TYPE	SPEC. OR PARTS NO
13	PANEL	1			553293-1
14	PANEL	1			553293
15	ELEVON TRANS.	2	GENERAL ELECT.		8TJ19 AAH
16	PLUG	4		AN	3106-14S-2S
17	CIRCUIT BREAKER	2		AN	3161-5
18	AILERON INDICATOR	1			8DJ17ABM
19	PLUG	2		AN	3106-14S-1S
20	SWITCH	1			CH8916K657
21	AILERON TRANSFORMER	2	GENERAL ELECT		8TJ19AAH
22	PILOT'S PEDESTAL	1			552409
23	ELEVON INDICATOR	1			8DJ17ABL

Figure 37. Trim Flap Control and Indicator



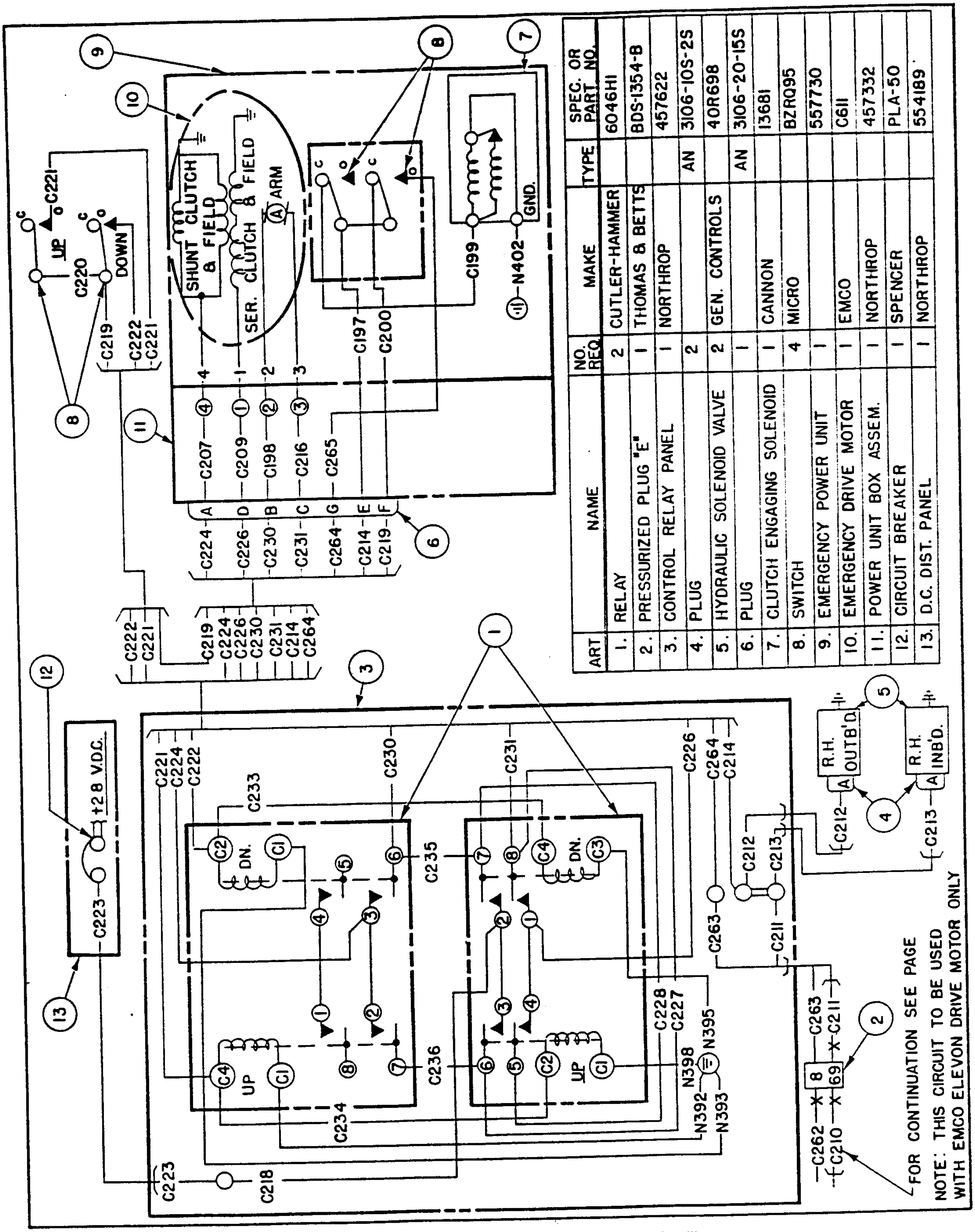
ART.	NAME	REQ.	MAKE	TYPE	SPEC. OR PART NO.
1.	SWITCH	1	HETHERINGTON	DSO	
2.	CONTROL COLUMN ELEC. INSTA.	1	NORTHROP		553670
3.	RELAY	1	SQUARE D		B-5A
4.	PILOT'S PEDESTAL PANEL	1	NORTHROP		352409
5.	CONTROL SWITCH	1		AN	3022-2
6.	PRESSURIZED PLUG "E"	2	THOMAS-BETTS		BDS-1354-B
7.	CIRCUIT BREAKER	1		AN	3161-35
8.	RELAY	1	EPCO		NS-47-EK
9.	STEERING & BRAKE PANEL	1	NORTHROP		455100
10.	SWITCH ASSEMBLY				
11.	LAMP ASSEMBLY	2			44A18454-2

Figure 38. Emergency Elevon Control - Crew Nacelle



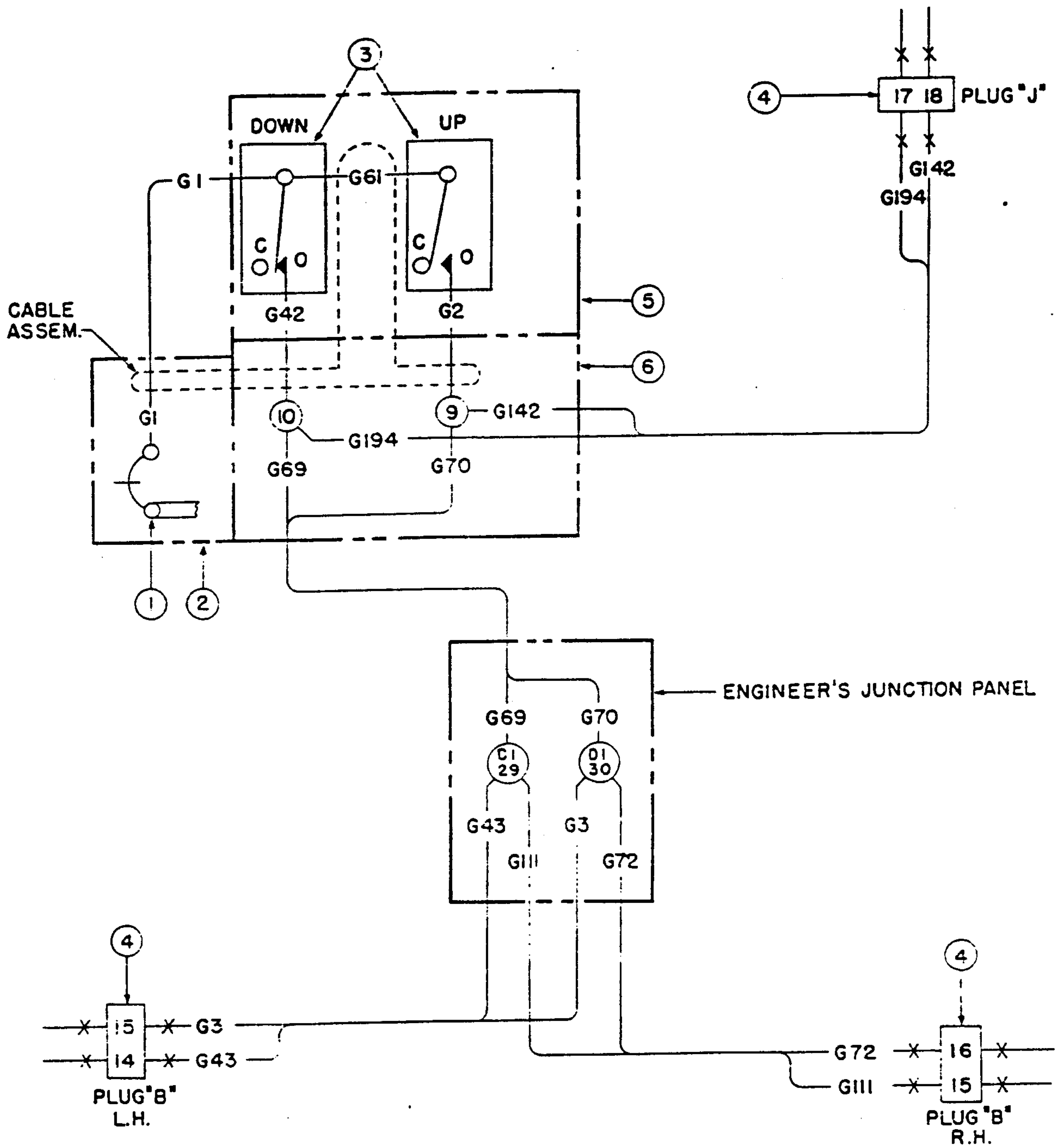
ART.	NAME	NO. REQ.	MAKE	TYPE	SPEC. OR PART NO.
1.	SWITCH	2	MICRO		BZ-RQ95
2.	EMERGENCY POWER UNIT	1			557730
3.	DRIVE MOTOR	1	EEMCO		C611
4.	POWER UNIT–ELEVON	1	NORTHROP		457332
5.	CLUTCH ENGAGING SOLENOID	1	CANNON		13681
6.	PLUG	1		AN	3106-20-15S
7.	HYD. SOLENOID VALVE	1	GEN. CONTROLS		40R698
8.	PLUG	2		AN	3106-10S-2S
9.	PRESS. PLUG "E"	1	THOS. & BETTS		BDS-1354-B
10.	RELAY	4	CUTLER-HAMM.		6046H1
11.	CONTROL RELAY PANEL	1	NORTHROP		457662
12.	CIRCUIT BREAKER	1	SPENCER		PLA-50
13.	MAIN GEAR WELL D.C. POWER DIST. PANEL	1			554189

Figure 39. Elevon Emergency Control - LH Wing



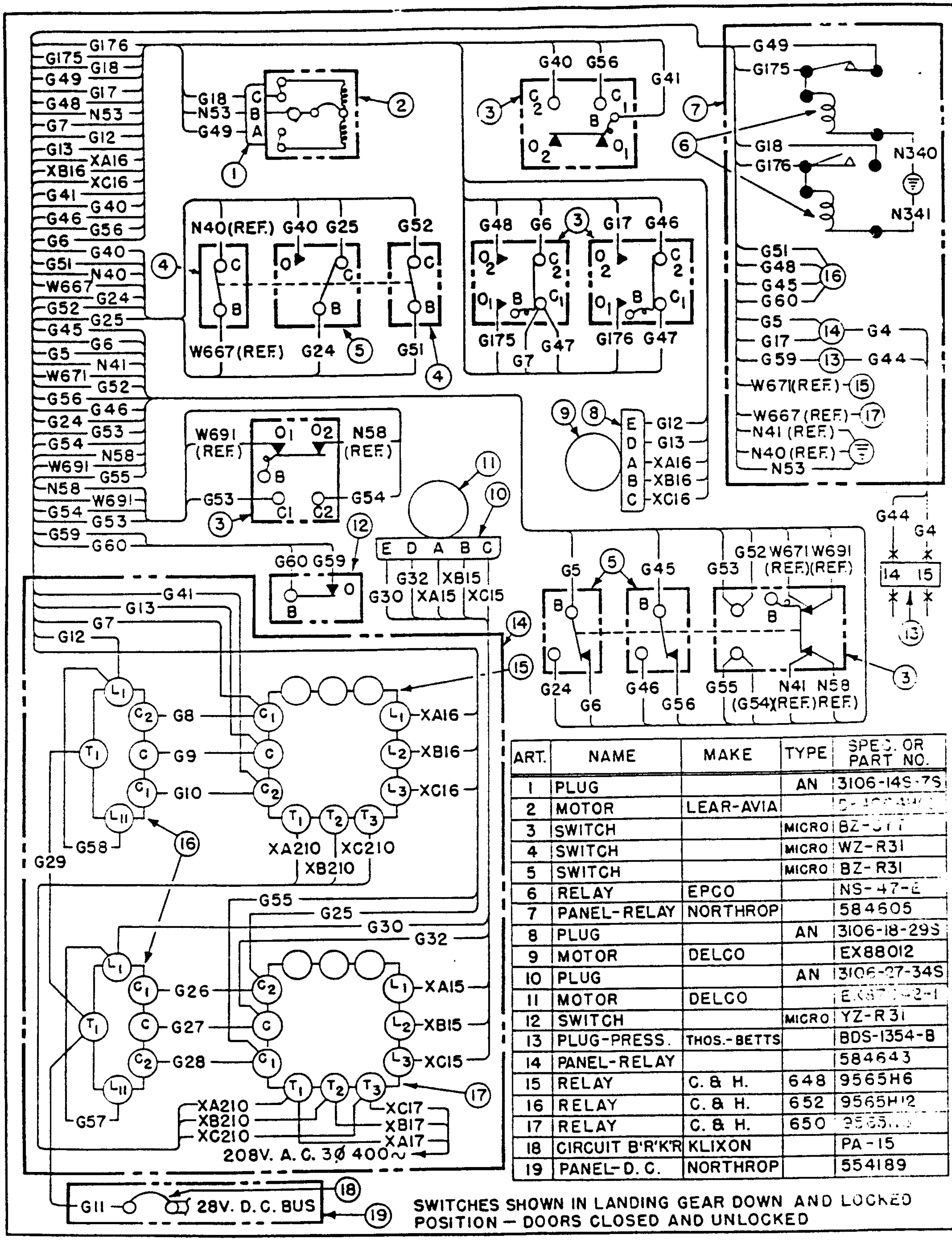
ART	NAME	NO. REQ	MAKE	TYPE	SPEC. OR PART NO.
1.	RELAY	2	CUTLER-HAMMER		6046HI
2.	PRESSURIZED PLUG "E"	1	THOMAS & BETTS		BDS-1354-B
3.	CONTROL RELAY PANEL	1	NORTHROP		457622
4.	PLUG	2		AN	3106-10S-2S
5.	HYDRAULIC SOLENOID VALVE	2	GEN. CONTROLS		40R698
6.	PLUG	1		AN	3106-20-15S
7.	CLUTCH ENGAGING SOLENOID	1	CANNON		13681
8.	SWITCH	4	MICRO		BZRQ95
9.	EMERGENCY POWER UNIT	1			557730
10.	EMERGENCY DRIVE MOTOR	1	EMCO		C611
11.	POWER UNIT BOX ASSEM.	1	NORTHROP		457332
12.	CIRCUIT BREAKER	1	SPENCER		PLA-50
13.	D.C. DIST. PANEL	1	NORTHROP		554189

Figure 40. Elevon Emergency Control - RH Wing



ART.	NAME	MAKE	TYPE	SPEC OR PART NO.
1	CIRCUIT BREAKER		AN	3161-35
2	PILOT'S PEDESTAL	NORTHROP		552409
3	SWITCH		MICRO	BZ-R31
4	PRESSURIZED PLUG	THOMAS & BETTS		BDS-1354-B
5	CONTROL HANDLE L.G.	NORTHROP		553491
6	PANEL- PEDESTAL RELAY	NORTHROP		552374

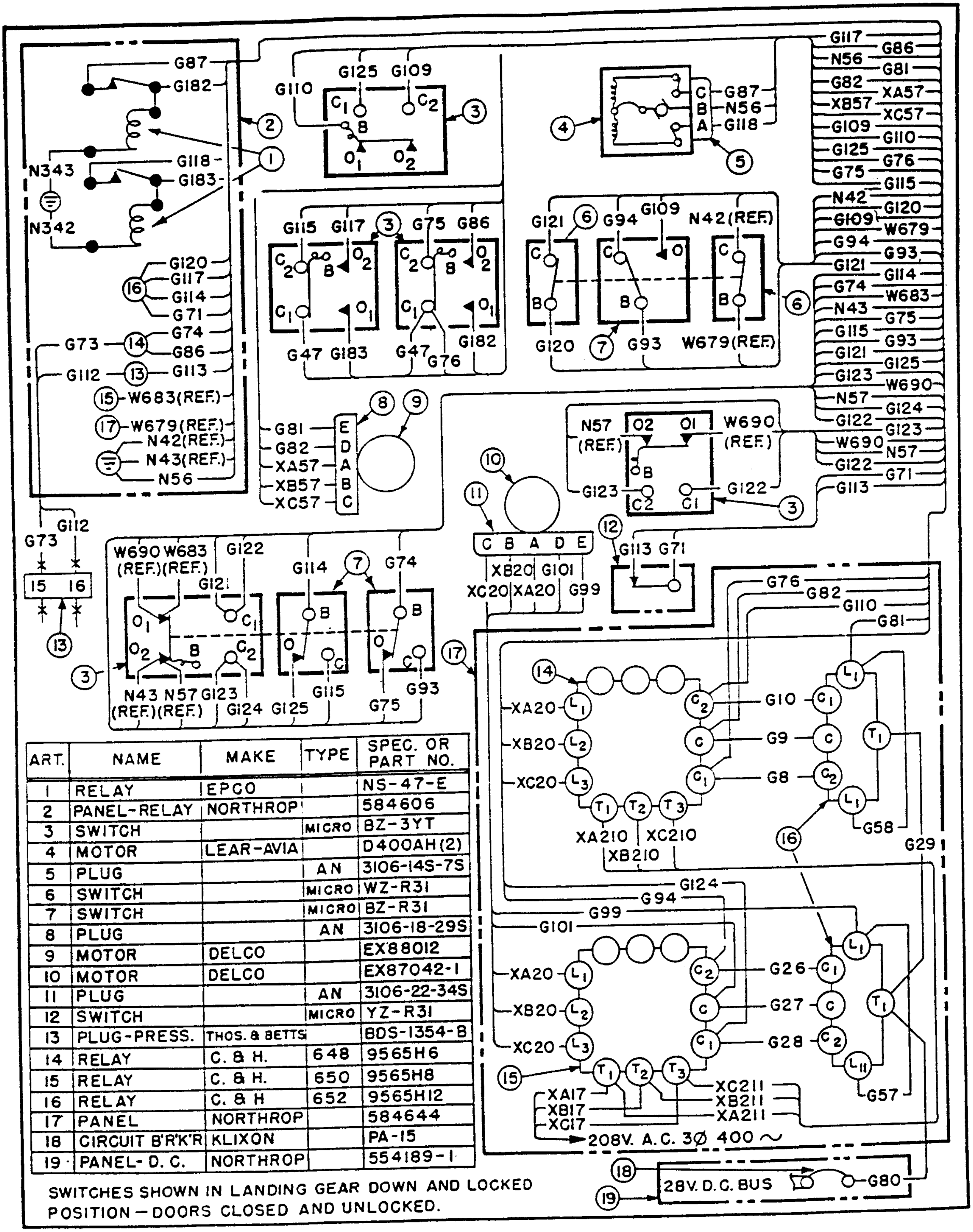
Figure 41. Landing Gear Control - Crew Nacelle



ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	PLUG		AN	3106-14S-7S
2	MOTOR	LEAR-AVIA		[illegible]
3	SWITCH		MICRO	BZ-[illegible]
4	SWITCH		MICRO	WZ-R31
5	SWITCH		MICRO	BZ-R31
6	RELAY	EPCO		NS-47-E
7	PANEL-RELAY	NORTHROP		584605
8	PLUG		AN	3106-18-29S
9	MOTOR	DELCO		EX88012
10	PLUG		AN	3106-27-34S
11	MOTOR	DELCO		E[illegible]-2-1
12	SWITCH		MICRO	YZ-R31
13	PLUG-PRESS.	THOS.-BETTS		BDS-1354-B
14	PANEL-RELAY			584643
15	RELAY	C. & H.	648	9565H6
16	RELAY	C. & H.	652	9565H12
17	RELAY	C. & H.	650	9565[illegible]
18	CIRCUIT B'R'K'R	KLIXON		PA-15
19	PANEL-D.C.	NORTHROP		554189

SWITCHES SHOWN IN LANDING GEAR DOWN AND LOCKED POSITION — DOORS CLOSED AND UNLOCKED

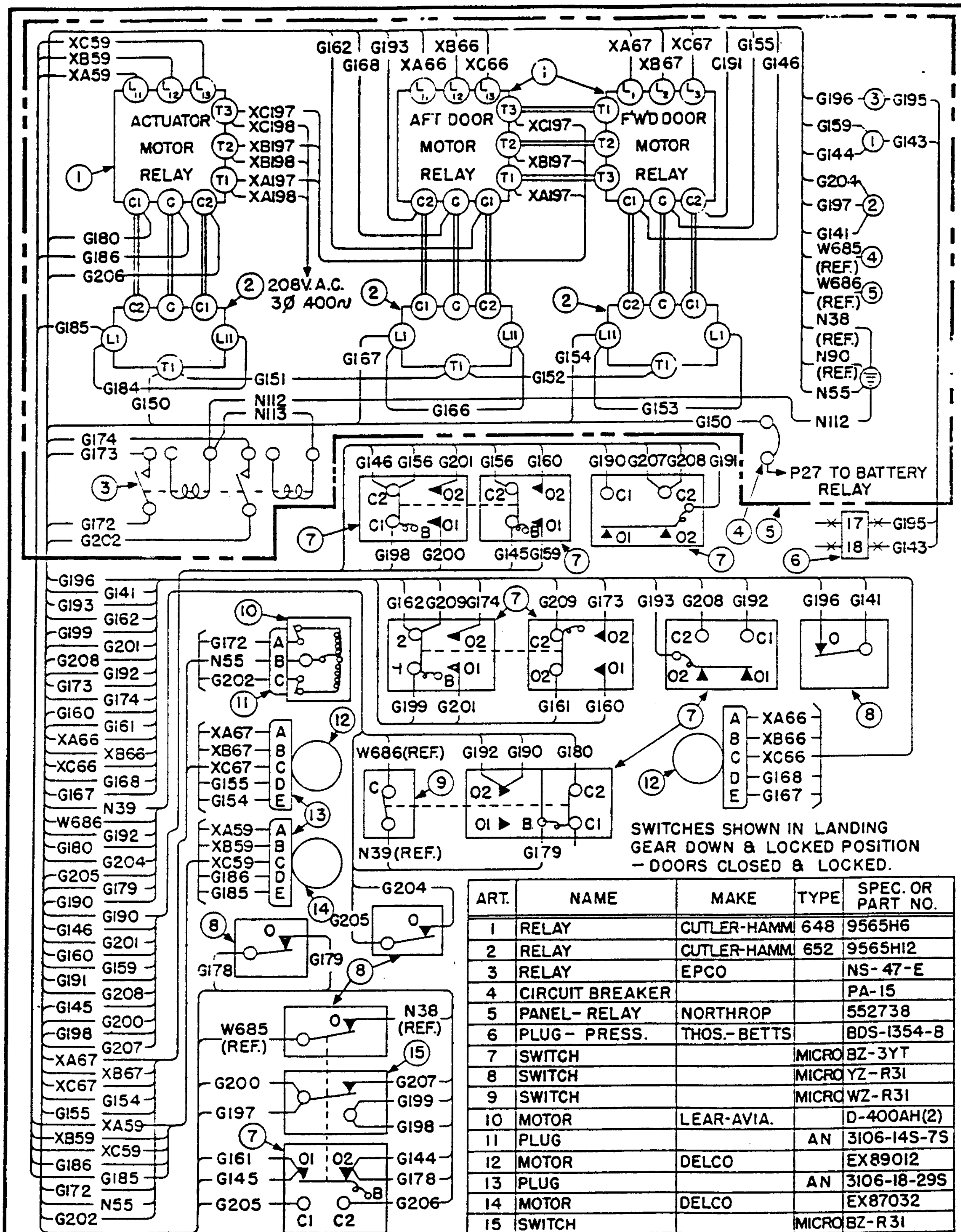
Figure 42. Landing Gear Control - LH Wing Main



ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	RELAY	EPCO		NS-47-E
2	PANEL-RELAY	NORTHROP		584606
3	SWITCH		MICRO	BZ-3YT
4	MOTOR	LEAR-AVIA		D400AH(2)
5	PLUG		AN	3106-14S-7S
6	SWITCH		MICRO	WZ-R31
7	SWITCH		MICRO	BZ-R31
8	PLUG		AN	3106-18-29S
9	MOTOR	DELCO		EX88012
10	MOTOR	DELCO		EX87042-1
11	PLUG		AN	3106-22-34S
12	SWITCH		MICRO	YZ-R31
13	PLUG-PRESS.	THOS. & BETTS		BDS-1354-B
14	RELAY	C. & H.	648	9565H6
15	RELAY	C. & H.	650	9565H8
16	RELAY	C. & H	652	9565H12
17	PANEL	NORTHROP		584644
18	CIRCUIT B'R'K'R	KLIXON		PA-15
19	PANEL- D. C.	NORTHROP		554189-1

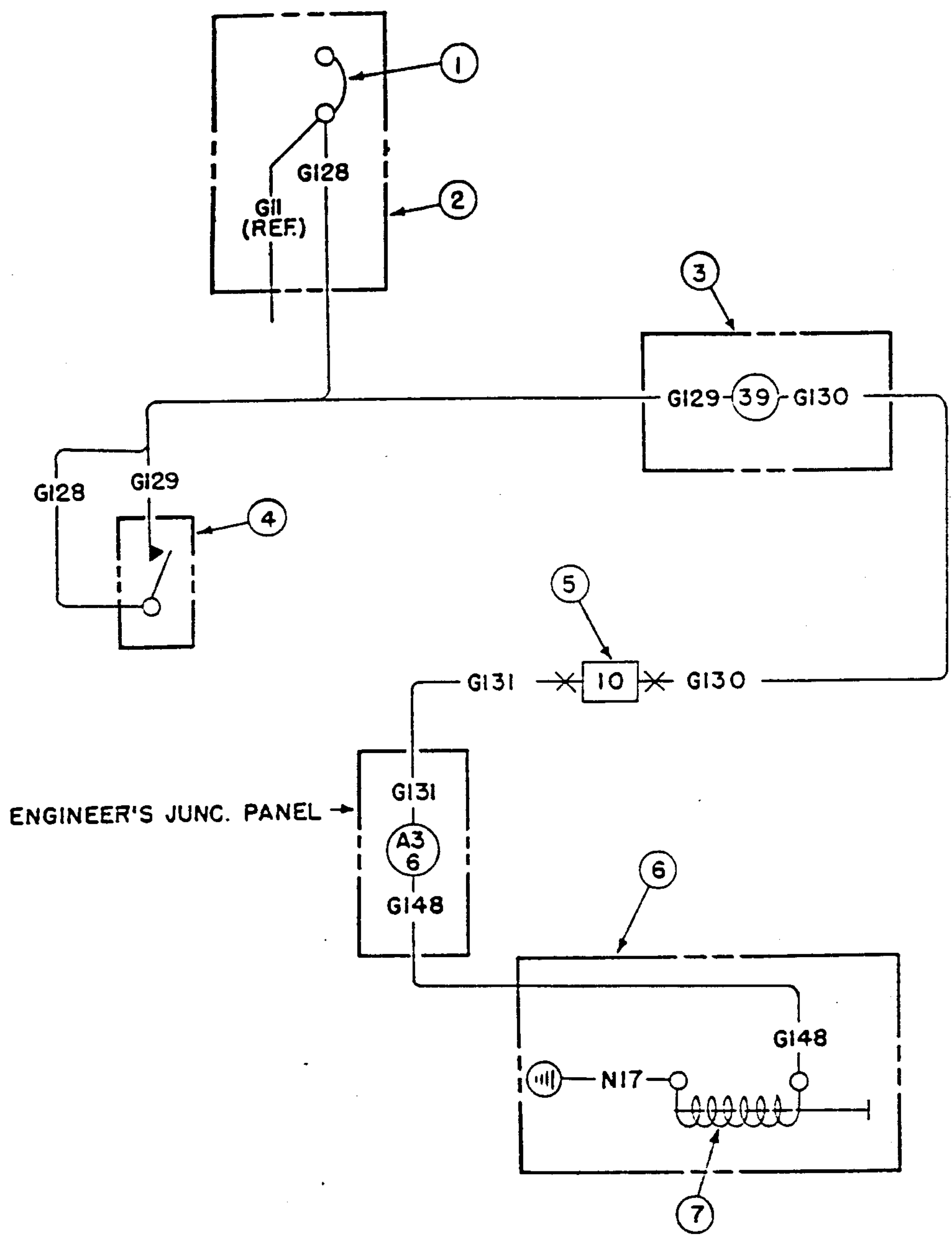
SWITCHES SHOWN IN LANDING GEAR DOWN AND LOCKED POSITION—DOORS CLOSED AND UNLOCKED.

Figure 43. Landing Gear Control - RH Wing Main



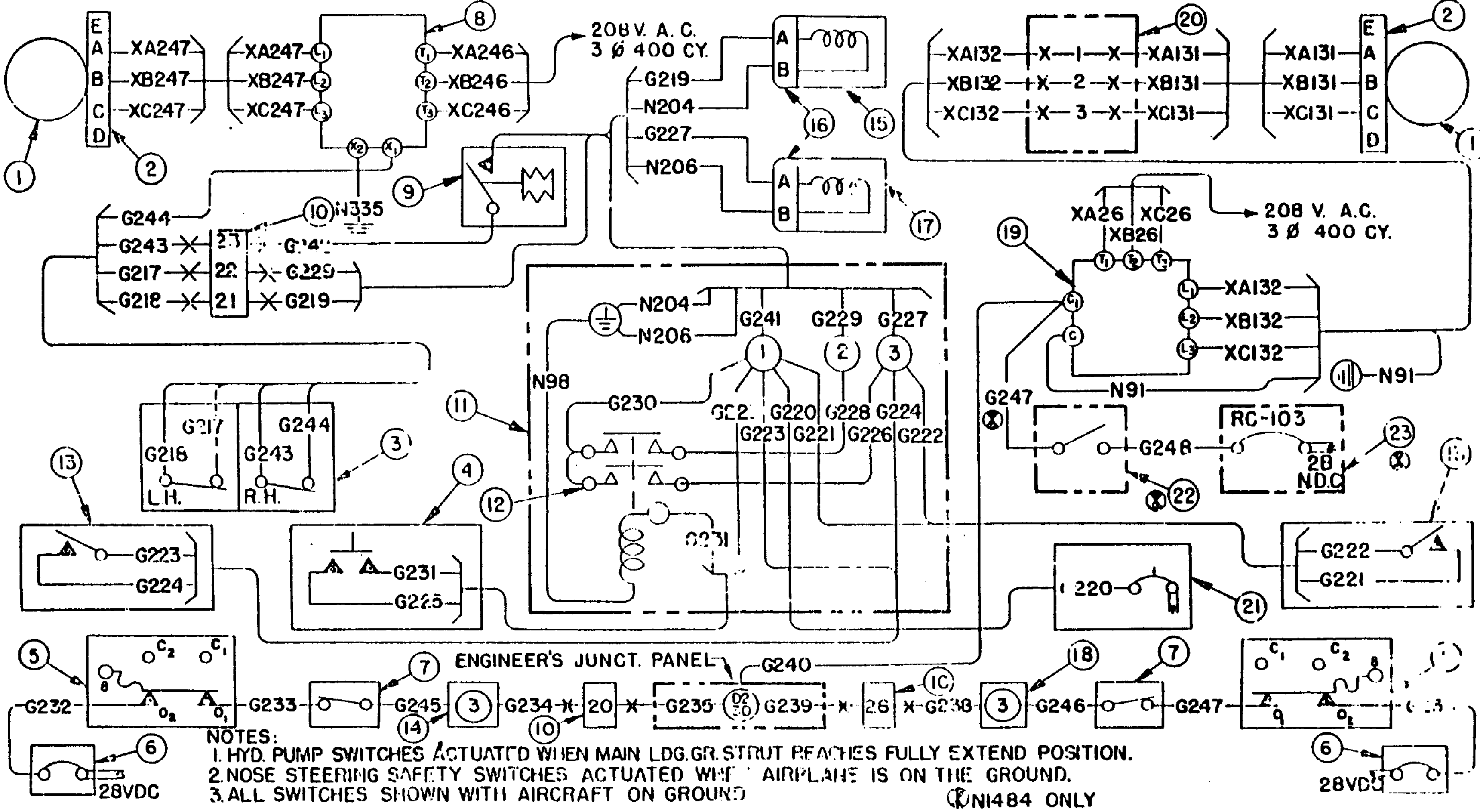
ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	RELAY	CUTLER-HAMM	648	9565H6
2	RELAY	CUTLER-HAMM	652	9565H12
3	RELAY	EPCO		NS-47-E
4	CIRCUIT BREAKER			PA-15
5	PANEL-RELAY	NORTHROP		552738
6	PLUG-PRESS.	THOS.-BETTS		BDS-1354-B
7	SWITCH		MICRO	BZ-3YT
8	SWITCH		MICRO	YZ-R31
9	SWITCH		MICRO	WZ-R31
10	MOTOR	LEAR-AVIA.		D-400AH(2)
11	PLUG		AN	3106-14S-7S
12	MOTOR	DELCO		EX89012
13	PLUG		AN	3106-18-29S
14	MOTOR	DELCO		EX87032
15	SWITCH		MICRO	BZ-R31

Figure 44. Landing Gear Control - Nose Gear



ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	CIRCUIT BREAKER	KLIXON		PA-15
2	D. C. PANEL	NORTHROP		554189
3	F'W'D RELAY PANEL	NORTHROP		584605
4	SWITCH		MICRO	YZE-7RNTN2
5	PLUG-PRESSURIZED	THOS. & BETTS		8DS-1354-8
6	CONTROL HANDLE INSTALL.	NORTHROP		553491
7	SOLENOID	CANNON		11445

Figure 45. Landing Gear Safety Control

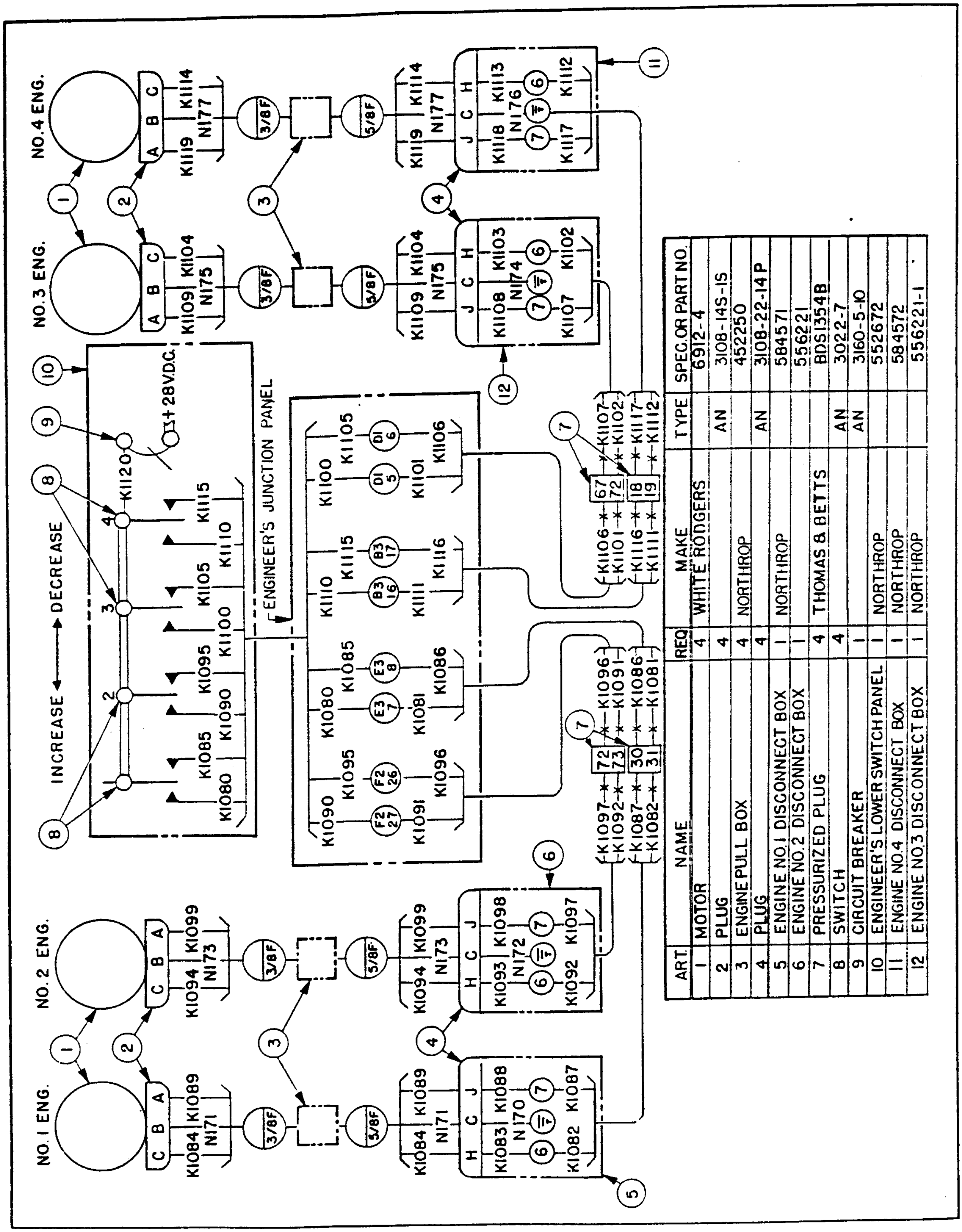


NOTES:
1. HYD. PUMP SWITCHES ACTUATED WHEN MAIN LDG.GR. STRUT REACHES FULLY EXTEND POSITION.
2. NOSE STEERING SAFETY SWITCHES ACTUATED WHEN AIRPLANE IS ON THE GROUND.
3. ALL SWITCHES SHOWN WITH AIRCRAFT ON GROUND.

ⓧ N1484 ONLY

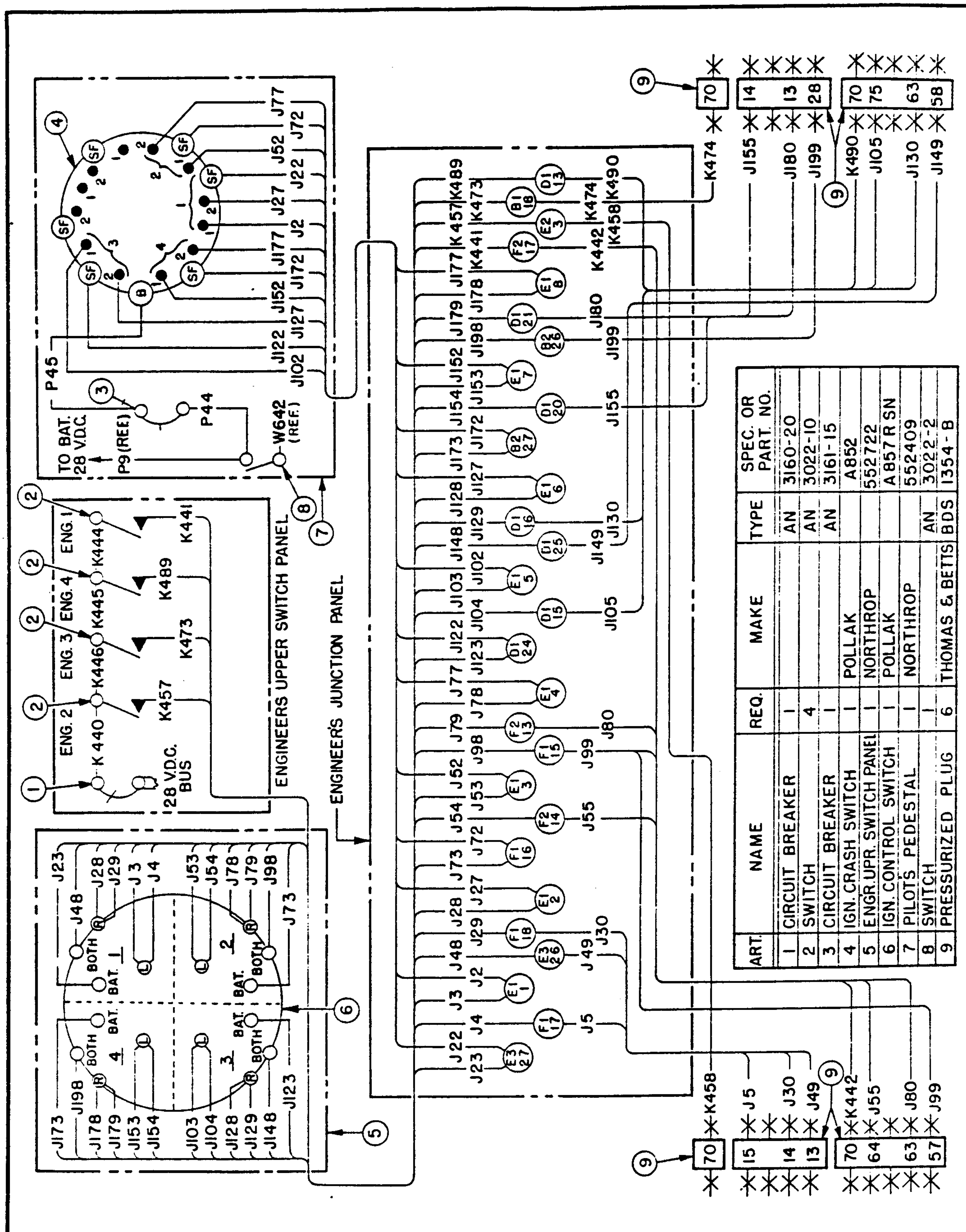
ITEM	DESCRIPTION	REQ	TYPE	PART NO.	MAKE	ITEM	DESCRIPTION	REQ	TYPE	PART NO.	MAKE
1	MOTOR-HYRAULIC PUMP	2		E-2820	VARD	13	SWITCH-BRAKE (CONT. WHEEL)	2		981	SQUARE D
2	PLUG-ELECT. CONN. STRAIGHT	2		AN-3106-22-34S		14	PANEL-LH. W.W. POWER RELAY	1		584605	NORTHROP
3	SWITCH-NOSE STEERING SAFETY	1		WZE-7RNTNI	MICRO SWITCH	15	SOLENOID-STEERING	1		62083	AIREON
4	SWITCH-STEERING HANDLE	1		CRI070-CI0353	GEN.ELECT.	16	PLUG-ELECT. CONN. 90° ANGLE	1		AN-3108-10SL-4S	
5	SWITCH-MICRO	2		BZ-3YT	MICRO-SWITCH	17	SOLENOID-BRAKES	1		28061	AIREON
6	CIRCUIT BREAKER	2		PA-5	KLIXON	18	PANEL-RH. W.W. POWER RELAY (FWD)	1		584606	NORTHROP
7	SWITCH-GEAR DOOR LIMIT	2		AN-3210-1		19	RELAY	1	649	9565H2B	CUTLER HAMMER
8	RELAY	1	653	9565H1	CUTLER-HAMMER	20	PLUG-PRESSURIZED	1		BDS-1354-A	THOMAS & BETTS
9	SWITCH-PRESSURE	1		407780	BENDIX	21	CIRCUIT BREAKER	1		AN3161-5	
10	PLUG-PRESSURIZED	3		BDS-1354-B	THOMAS & BETTS	22	ⓧ FLT. ENG. LWR. INSTR. PANEL	1		553042	NORTHROP
11	PANEL-TERMINAL	1		455100	NORTHROP	23	ⓧ ENG. LWR. ELECT. PANEL	1		552672	NORTHROP
12	RELAY	1		NS43A	EPCO						

Figure 46. Landing Gear Brakes and Nose Wheel Steering



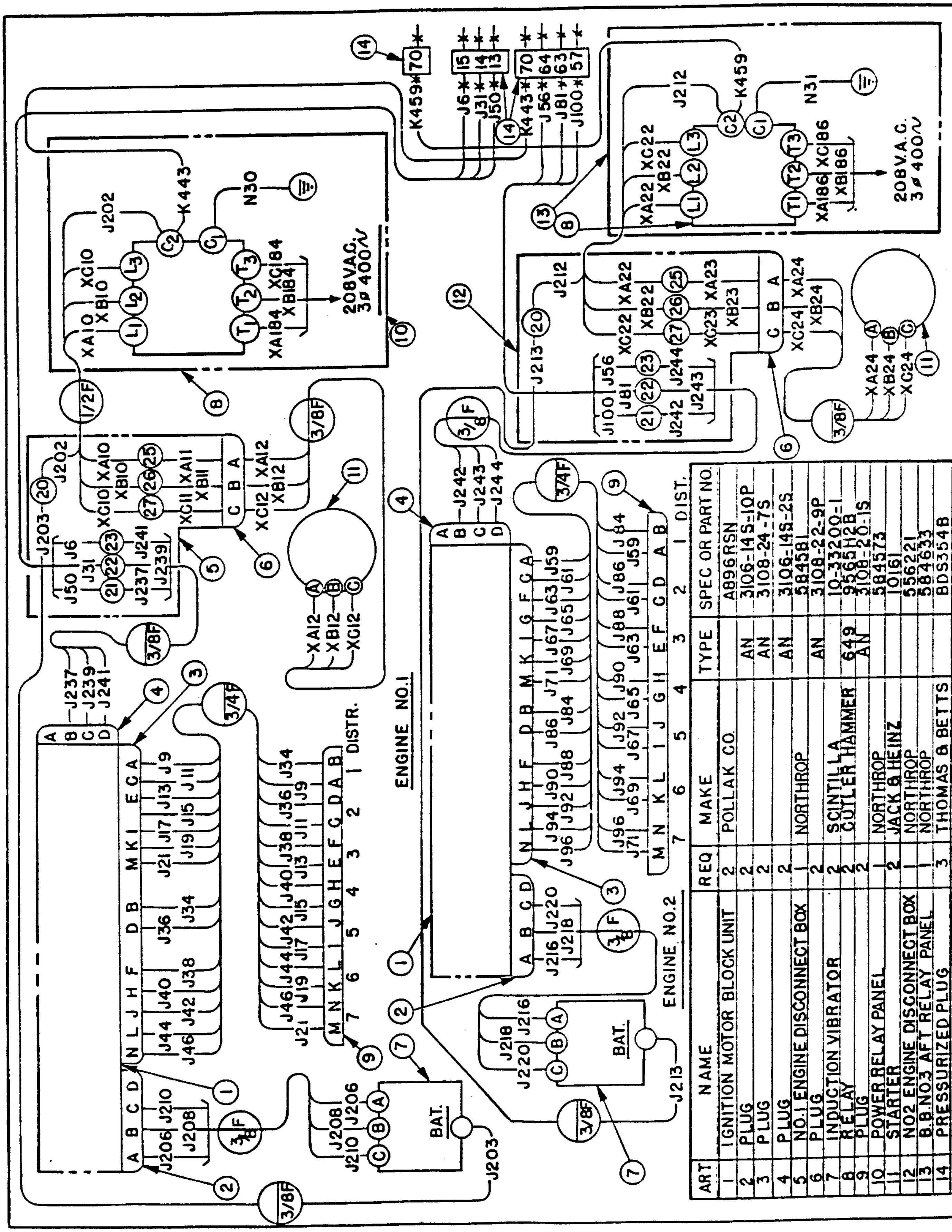
ART.	NAME	REQ.	MAKE	TYPE	SPEC. OR PART NO.
1	MOTOR	4	WHITE RODGERS		6912-4
2	PLUG	4		AN	3108-14S-1S
3	ENGINE PULL BOX	4	NORTHROP		452250
4	PLUG	4		AN	3108-22-14 P
5	ENGINE NO. 1 DISCONNECT BOX	1	NORTHROP		584571
6	ENGINE NO. 2 DISCONNECT BOX	1			556221
7	PRESSURIZED PLUG	4	THOMAS & BETTS		BDS1354B
8	SWITCH	4		AN	3022-7
9	CIRCUIT BREAKER	1		AN	3160-5-10
10	ENGINEER'S LOWER SWITCH PANEL	1	NORTHROP		552672
11	ENGINE NO. 4 DISCONNECT BOX	1	NORTHROP		584572
12	ENGINE NO. 3 DISCONNECT BOX	1	NORTHROP		556221-1

Figure 47. Engine Fan Speed Control



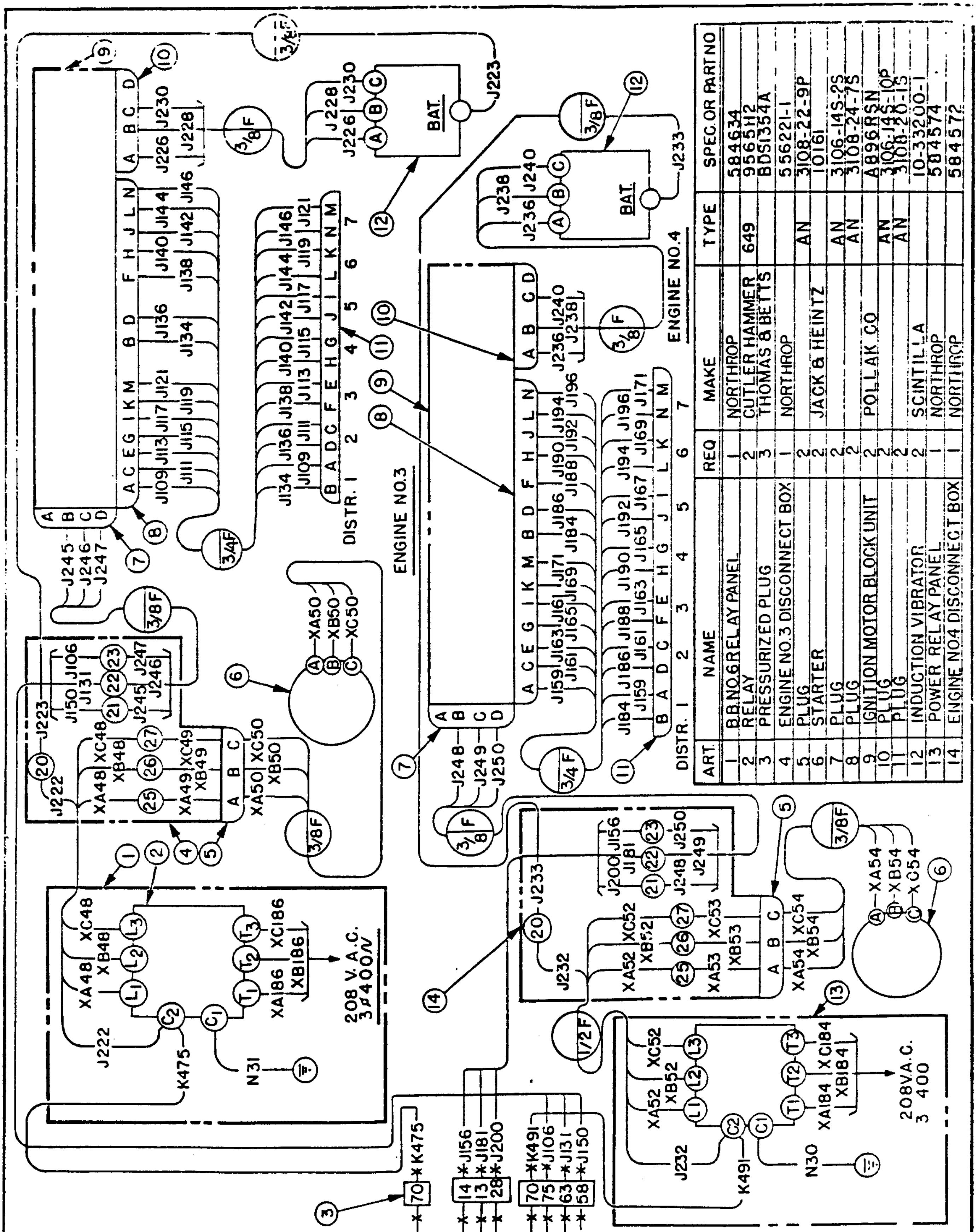
ART.	NAME	REQ.	MAKE	TYPE	SPEC. OR PART NO.
1	CIRCUIT BREAKER	1		AN	3160-20
2	SWITCH	4		AN	3022-10
3	CIRCUIT BREAKER	1		AN	3161-15
4	IGN. CRASH SWITCH	1	POLLAK		A852
5	ENGR. UPR. SWITCH PANEL	1	NORTHROP		552722
6	IGN. CONTROL SWITCH	1	POLLAK		A857 R SN
7	PILOTS PEDESTAL	1	NORTHROP		552409
8	SWITCH	1		AN	3022-2
9	PRESSURIZED PLUG	6	THOMAS & BETTS	BDS	1354-B

Figure 48. Ignition and Starter Circuits - Crew Nacelle



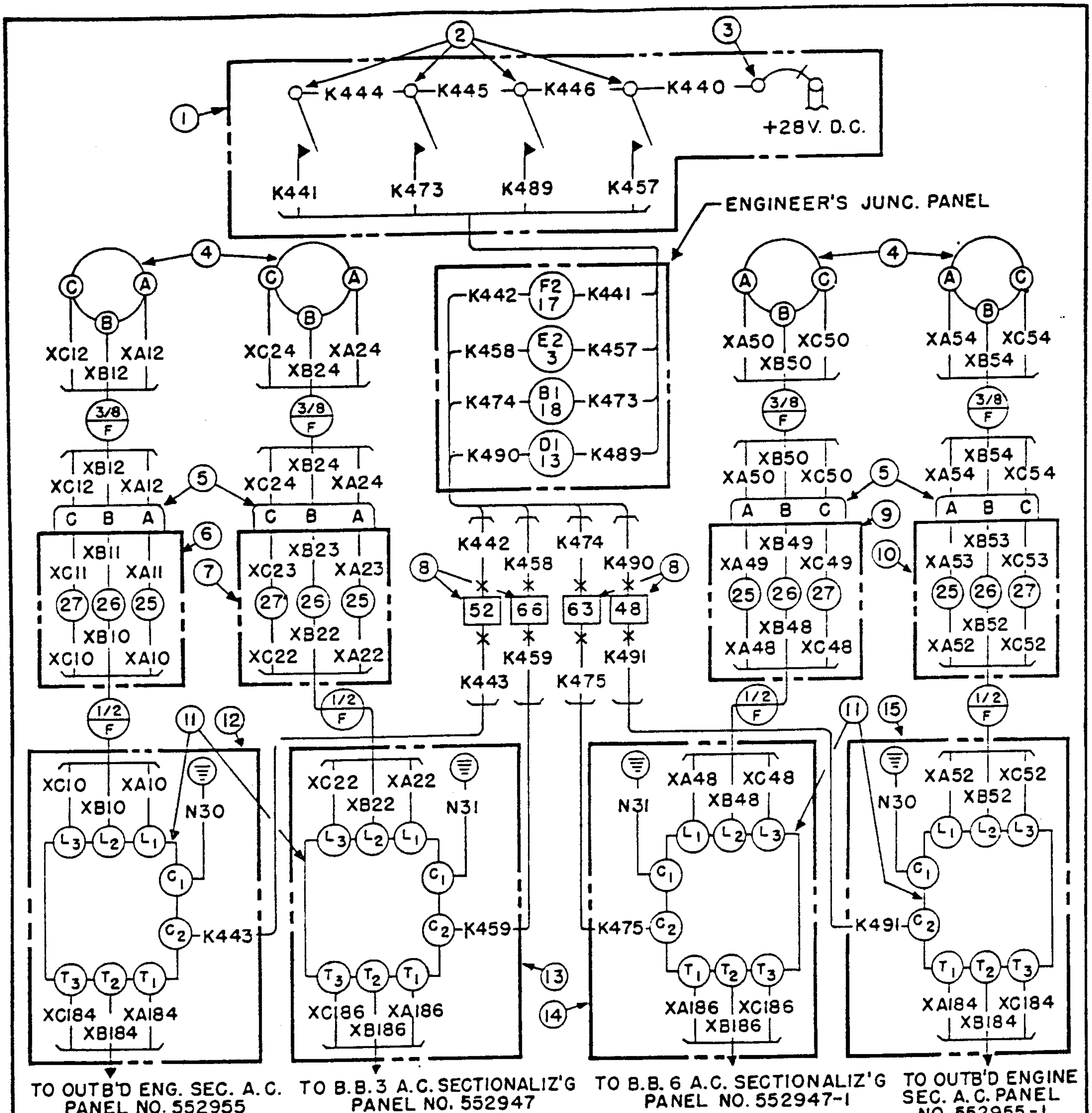
ART	NAME	REQ	MAKE	TYPE	SPEC OR PART NO.
1	IGNITION MOTOR BLOCK UNIT	2	POLLAK CO.		A896RSN
2	PLUG	2		AN	3106-14S-10P
3	PLUG	2		AN	3108-24-7S
4	PLUG	2		AN	3106-14S-2S
5	NO.1 ENGINE DISCONNECT BOX	1	NORTHROP		584581
6	PLUG	2		AN	3108-22-9P
7	INDUCTION VIBRATOR	2	SCINTILLA		10-33200-1
8	RELAY	2	CUTLER HAMMER	649	9565H2B
9	PLUG	2		AN	3108-20-1S
10	POWER RELAY PANEL	1	NORTHROP		584573
11	STARTER	2	JACK & HEINZ		10161
12	NO2 ENGINE DISCONNECT BOX	1	NORTHROP		556221
13	B.B.NO3 AFT RELAY PANEL	1	NORTHROP		584633
14	PRESSURIZED PLUG	3	THOMAS & BETTS		BDS354B

Figure 49. Ignition and Starter Circuits - LH Wing



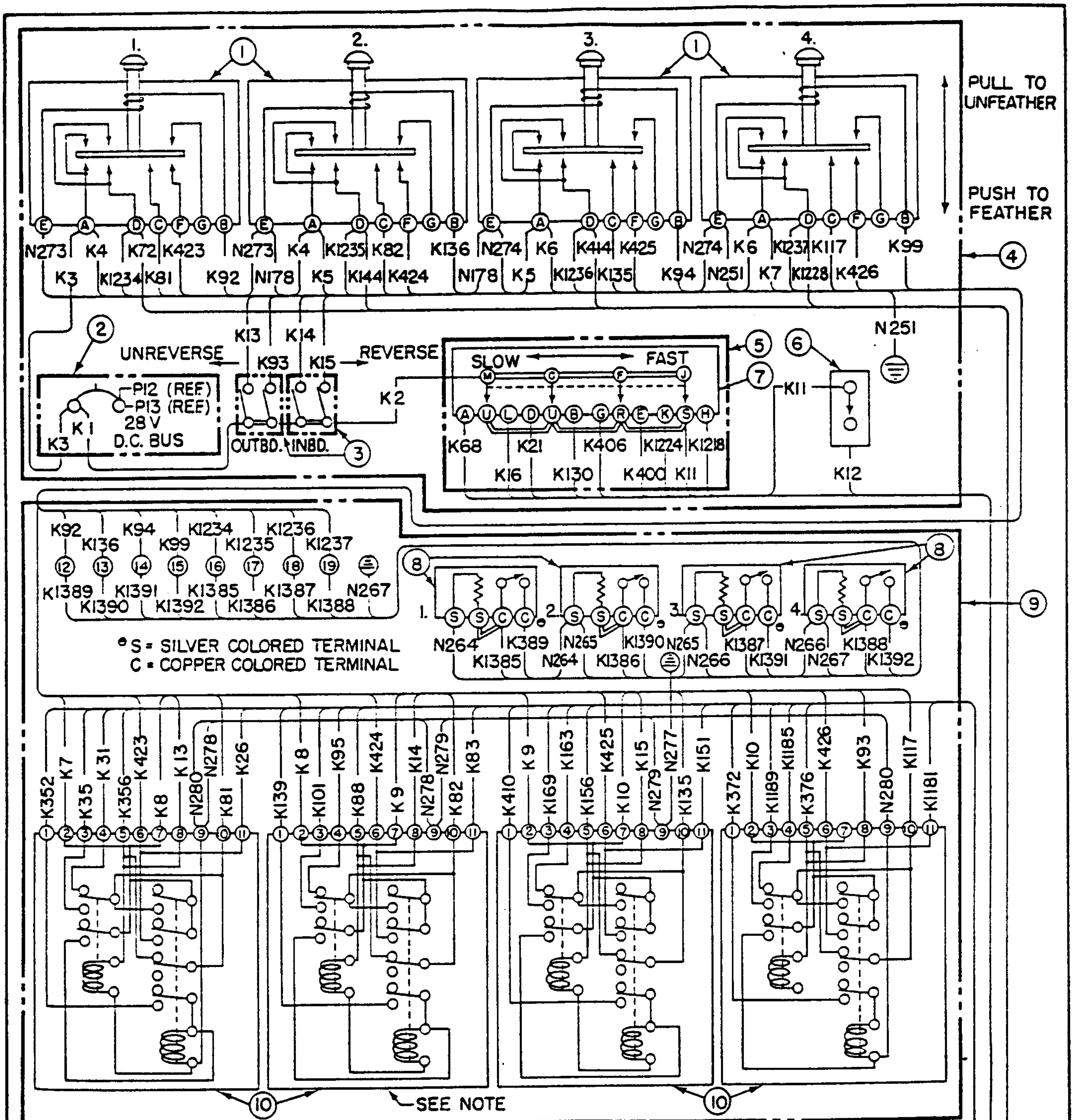
ART.	NAME	REQ	MAKE	TYPE	SPEC. OR PART NO
1	B.B. NO.6 RELAY PANEL	1	NORTHROP		584634
2	RELAY	2	CUTLER HAMMER	649	9565H2
3	PRESSURIZED PLUG	3	THOMAS & BETTS		BD51354A
4	ENGINE NO.3 DISCONNECT BOX	1	NORTHROP		556221-1
5	PLUG	2		AN	3108-22-9P
6	STARTER	2	JACK & HEINTZ		10161
7	PLUG	2		AN	3106-14S-2S
8	PLUG	2		AN	3108-24-7S
9	IGNITION MOTOR BLOCK UNIT	2	POLLAK CO		A896RSN
10	PLUG	2		AN	3106-14S-10P
11	PLUG	2		AN	3108-20-15
12	INDUCTION VIBRATOR	2	SCINTILLA		10-33200-1
13	POWER RELAY PANEL	1	NORTHROP		584574
14	ENGINE NO4 DISCONNECT BOX	1	NORTHROP		584572

Figure 50. Ignition and Starter Circuits - RH Wing



ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	PANEL-SWITCH	NORTHROP		552722
2	SWITCH		AN	3022-10
3	CIRCUIT B'R'K'R		AN	3160-20
4	STARTER	J. & H.		10161
5	PLUG		AN	3108-22-9P
6	JUNC. BOX	NORTHROP		584571
7	DISC. BOX	NORTHROP		556221
8	PLUG-PRESS.	T. & B.		BDS-1354-B
9	DISC. BOX	NORTHROP		556221-1
10	JUNC. BOX	NORTHROP		584572
11	RELAY	C. & H.	649	9565H2
12	RELAY BOX	NORTHROP		584573
13	PANEL-RELAY	NORTHROP		584633
14	PANEL RELAY	NORTHROP		584634
15	RELAY BOX	NORTHROP		584574

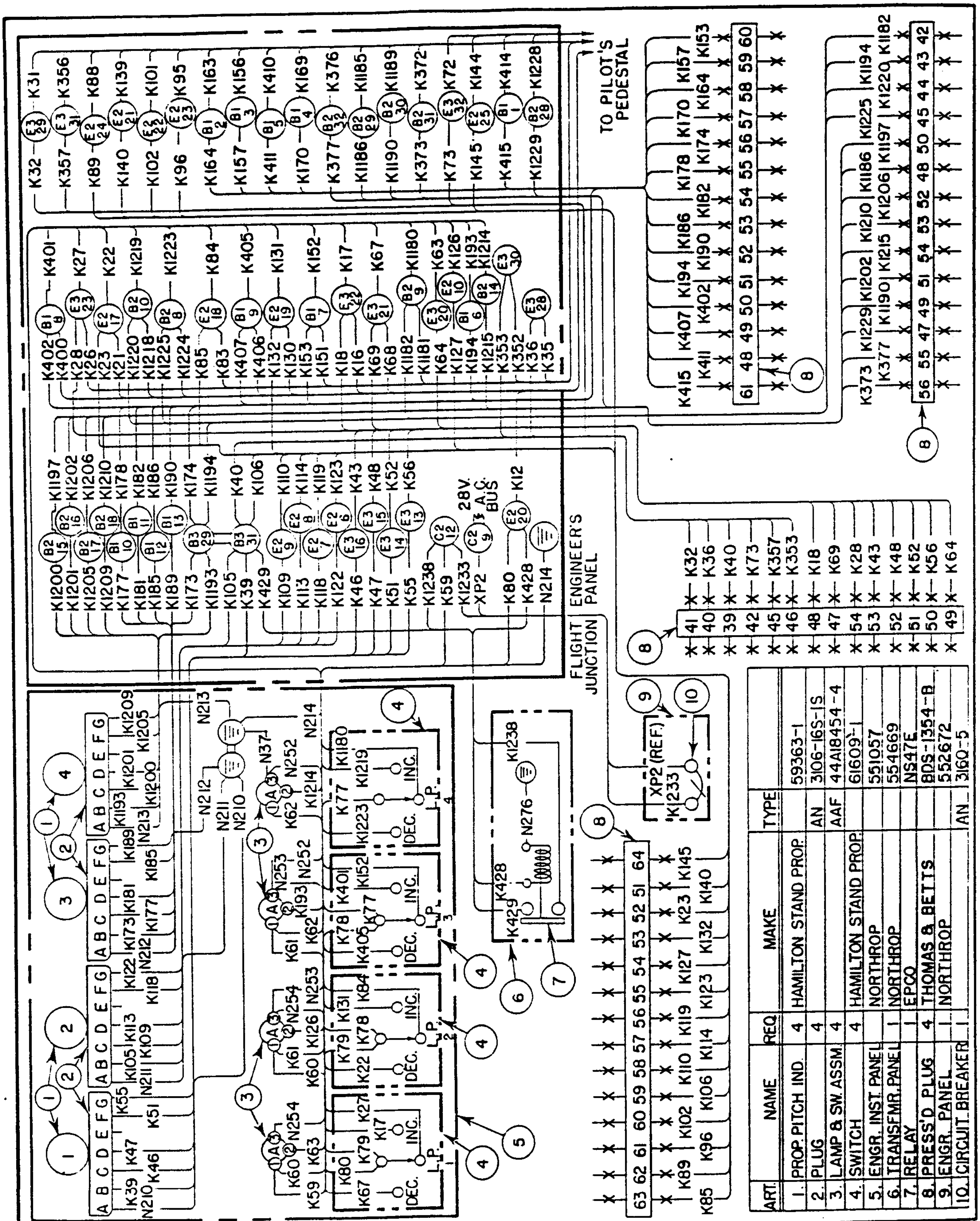
Figure 51. Starter Control



ART.	NAME	REQ.	MAKE	TYPE	SPEC. OR PART NO.
1	FEATHERING PUSHBUTTON	4	HAMILTON STAND. PROP.		65725-1
2	CIRCUIT BREAKER	1		AN	3161-20
3	SWITCH	2		AN	3023-2
4	PILOT'S PEDESTAL	1	NORTHROP		552409
5	SWITCH ASSEMBLY	1	NORTHROP		454257
6	SWITCH	1		AN	3022-2
7	GOVERNOR SWITCH	1	HAMILTON STAND. PROP.		58701
8	THERMAL TIMER	4	HAMILTON STAND. PROP.		67373
9	PEDESTAL RELAY PANEL	1	NORTHROP		552374
10	RELAY	4	HAMILTON STAND. PROP.		65759

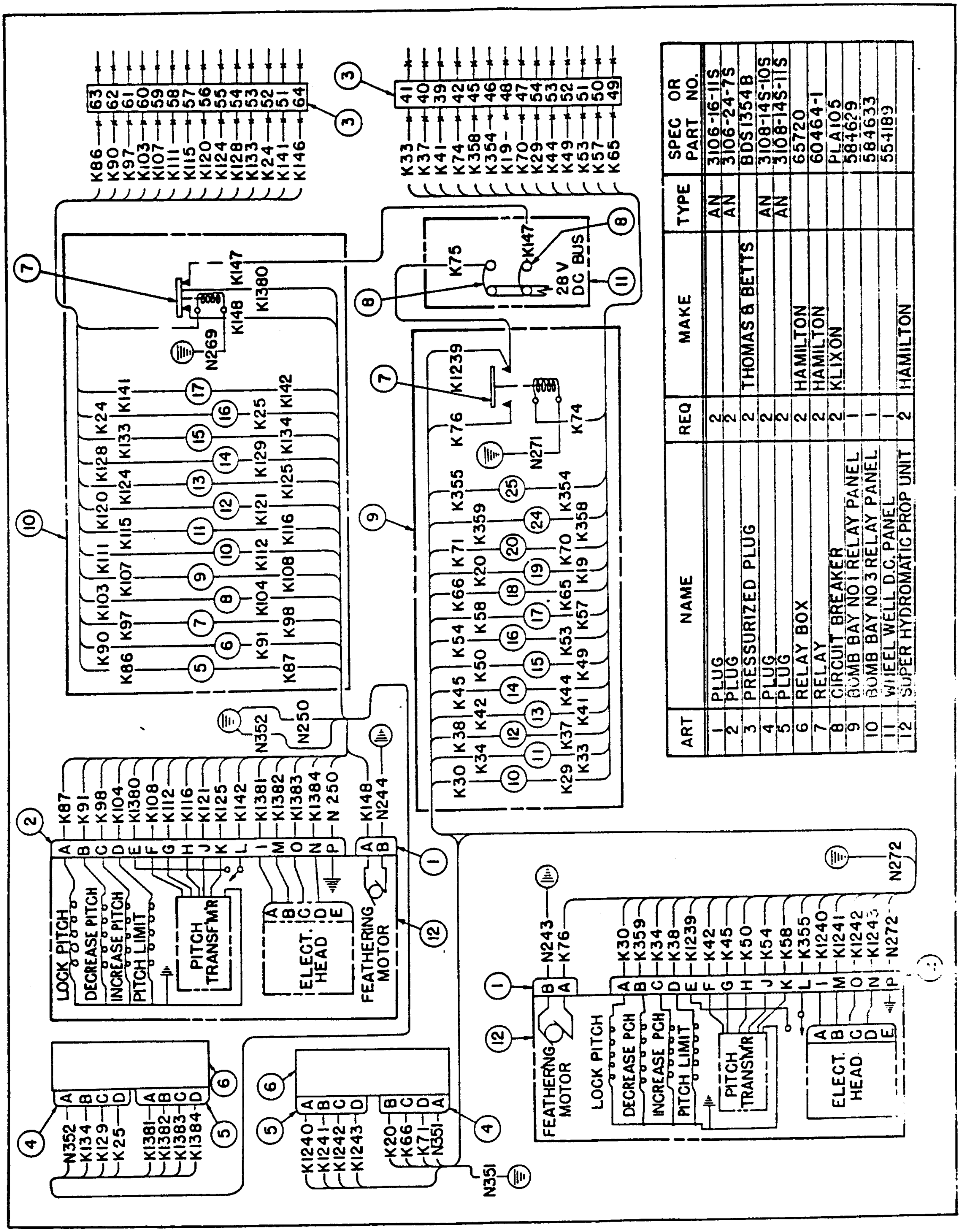
NOTE: ON FEATHERING RELAY H.S.P. NO. 65759 REMOVE ORIGINAL WIRE CONNECTING TERMINALS 3 AND 5, AND CONNECT JUMPER WIRE BETWEEN TERMINALS 5 AND 8.

Figure 52. Automatic Propeller Control - Pilot's Pedestal



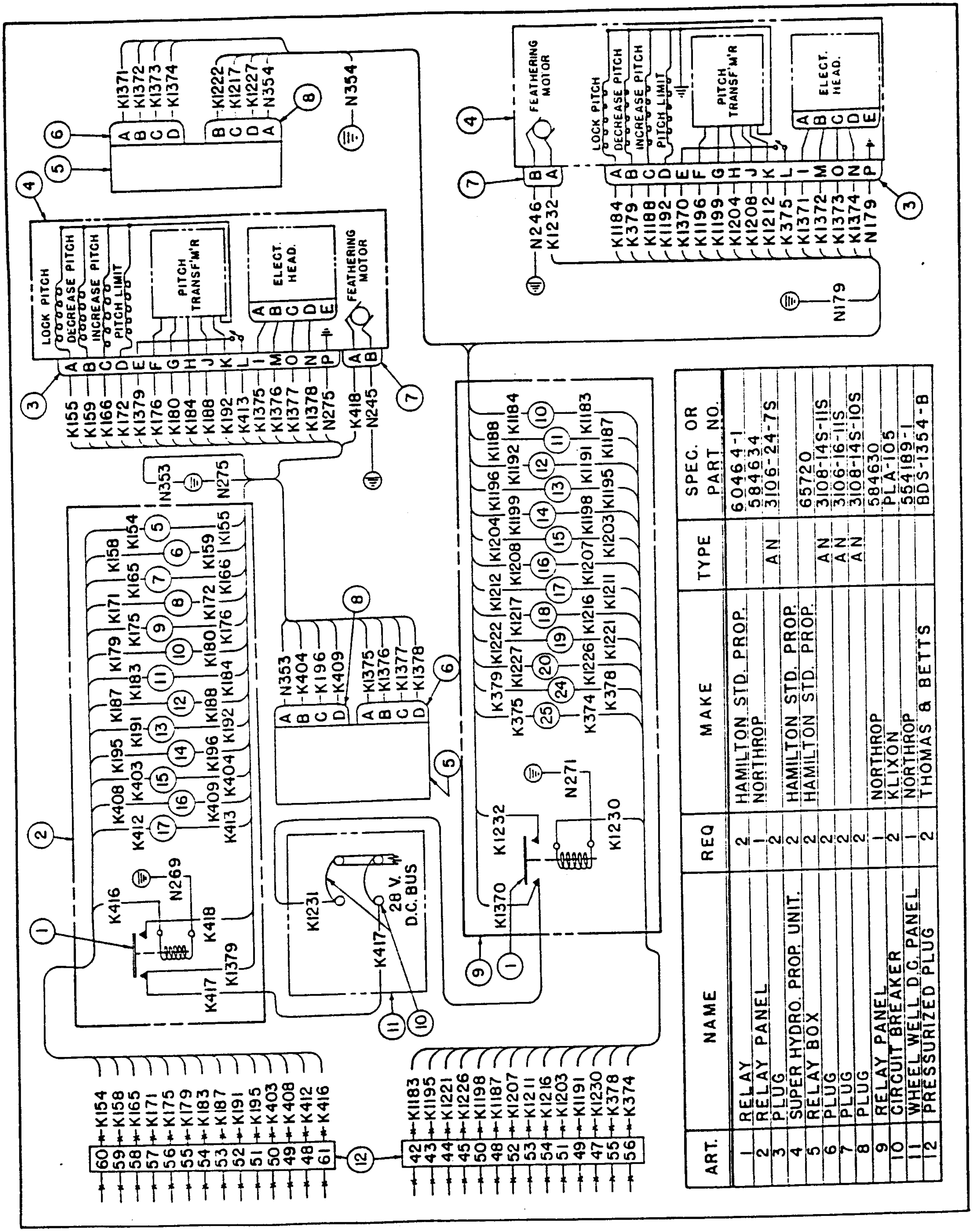
ART.	NAME	REQ	MAKE		TYPE
1.	PROP. PITCH IND.	4	HAMILTON STAND PROP.		59363-1
2.	PLUG	4		AN	3106-16S-1S
3.	LAMP & SW. ASSM.	4		AAF	44A18454-4
4.	SWITCH	4	HAMILTON STAND PROP.		61609-1
5.	ENGR. INST. PANEL		NORTHROP		551057
6.	TRANSFMR. PANEL	1	NORTHROP		554669
7.	RELAY	1	EPCO		NS47E
8.	PRESS'D PLUG	4	THOMAS & BETTS		BDS-1354-B
9.	ENGR. PANEL	1	NORTHROP		552672
10.	CIRCUIT BREAKER	1		AN	3160-5

Figure 53. Automatic Propeller Control - Crew Nacelle



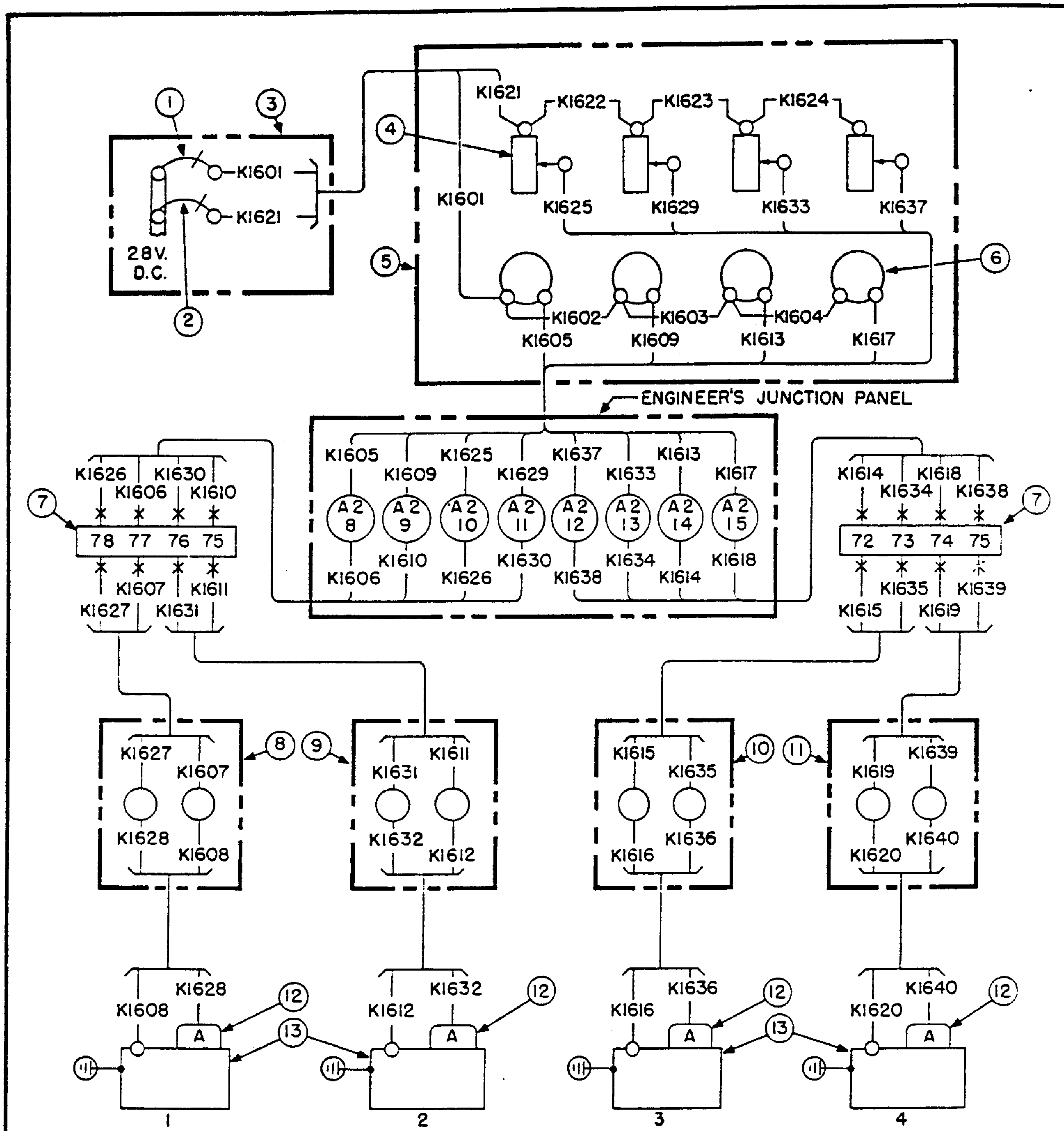
ART	NAME	REQ	MAKE	TYPE	SPEC OR PART NO.
1	PLUG	2		AN	3106-16-11S
2	PLUG	2		AN	3106-24-7S
3	PRESSURIZED PLUG	2	THOMAS & BETTS		BDS1354B
4	PLUG	2		AN	3108-14S-10S
5	PLUG	2		AN	3108-14S-11S
6	RELAY BOX	2	HAMILTON		65720
7	RELAY	2	HAMILTON		60464-1
8	CIRCUIT BREAKER	2	KLIXON		PLA105
9	BOMB BAY NO 1 RELAY PANEL	1			584629
10	BOMB BAY NO 3 RELAY PANEL	1			584633
11	WHEEL WELL D.C. PANEL	1			554189
12	SUPER HYDROMATIC PROP UNIT	2	HAMILTON		

Figure 54. Automatic Propeller Control - LH Wing



ART.	NAME	REQ	MAKE	TYPE	SPEC. OR PART NO.
1	RELAY	2	HAMILTON STD. PROP.		60464-1
2	RELAY PANEL	1	NORTHROP		584634
3	PLUG	2		AN	3106-24-7S
4	SUPER HYDRO. PROP. UNIT.	2	HAMILTON STD. PROP.		
5	RELAY BOX	2	HAMILTON STD. PROP.		65720
6	PLUG	2		AN	3108-14S-11S
7	PLUG	2		AN	3106-16-11S
8	PLUG	2		AN	3108-14S-10S
9	RELAY PANEL	1	NORTHROP		584630
10	CIRCUIT BREAKER	2	KLIXON		PLA-105
11	WHEEL WELL D.C. PANEL	1	NORTHROP		554189-1
12	PRESSURIZED PLUG	2	THOMAS & BETTS		BDS-1354-B

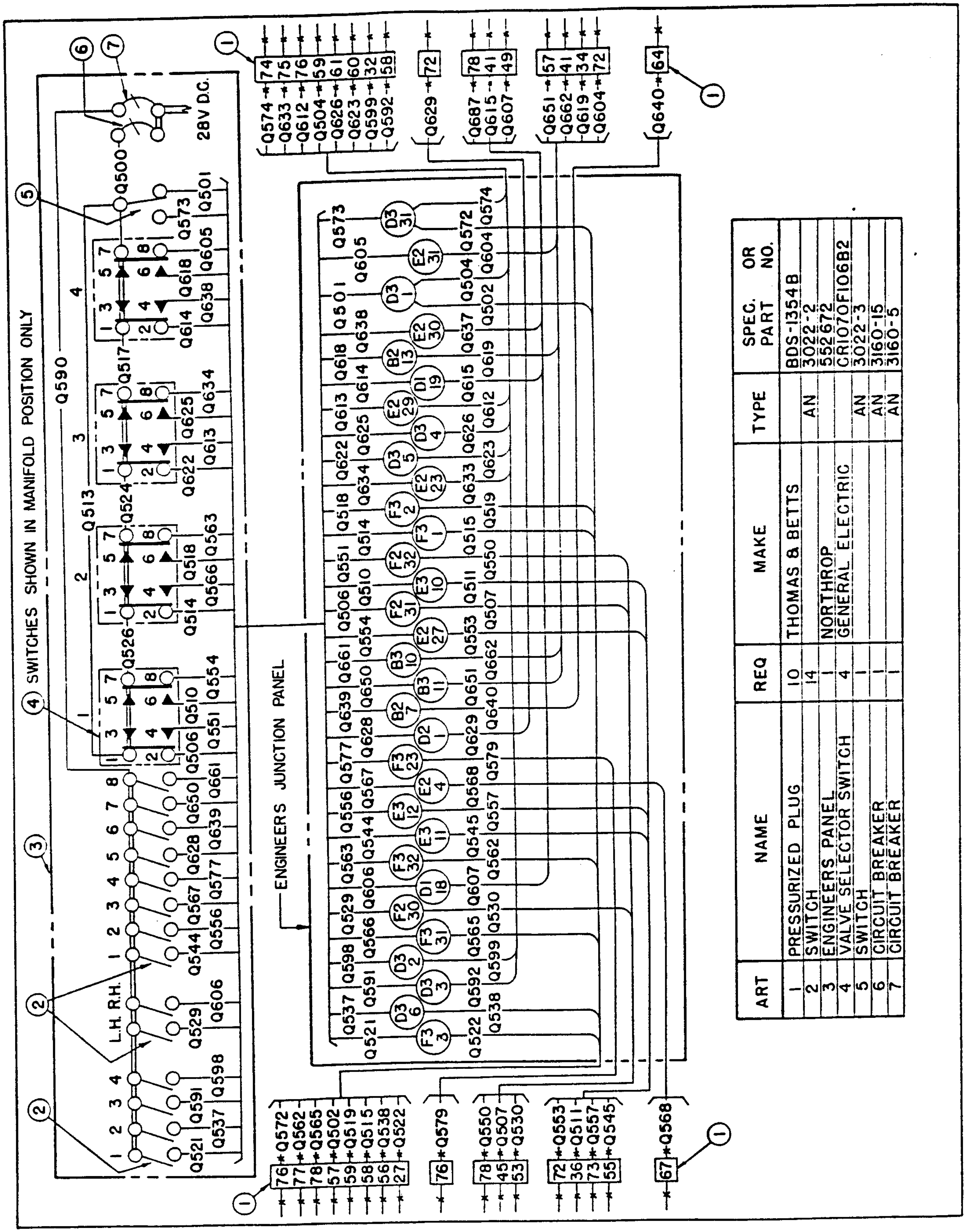
Figure 55. Automatic Propeller Control - RH Wing



ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	CIRCUIT BREAKER		AN	3160-10
2	CIRCUIT BREAKER		AN	3160-15
3	PANEL-SWITCH	NORTHROP		552672
4	RHEOSTAT		"J"	0316
5	PANEL-CONTROL			
6	GAUGE			M-954
7	PLUG-PRESS.	THOS.-BETTS		BDS-1354-B

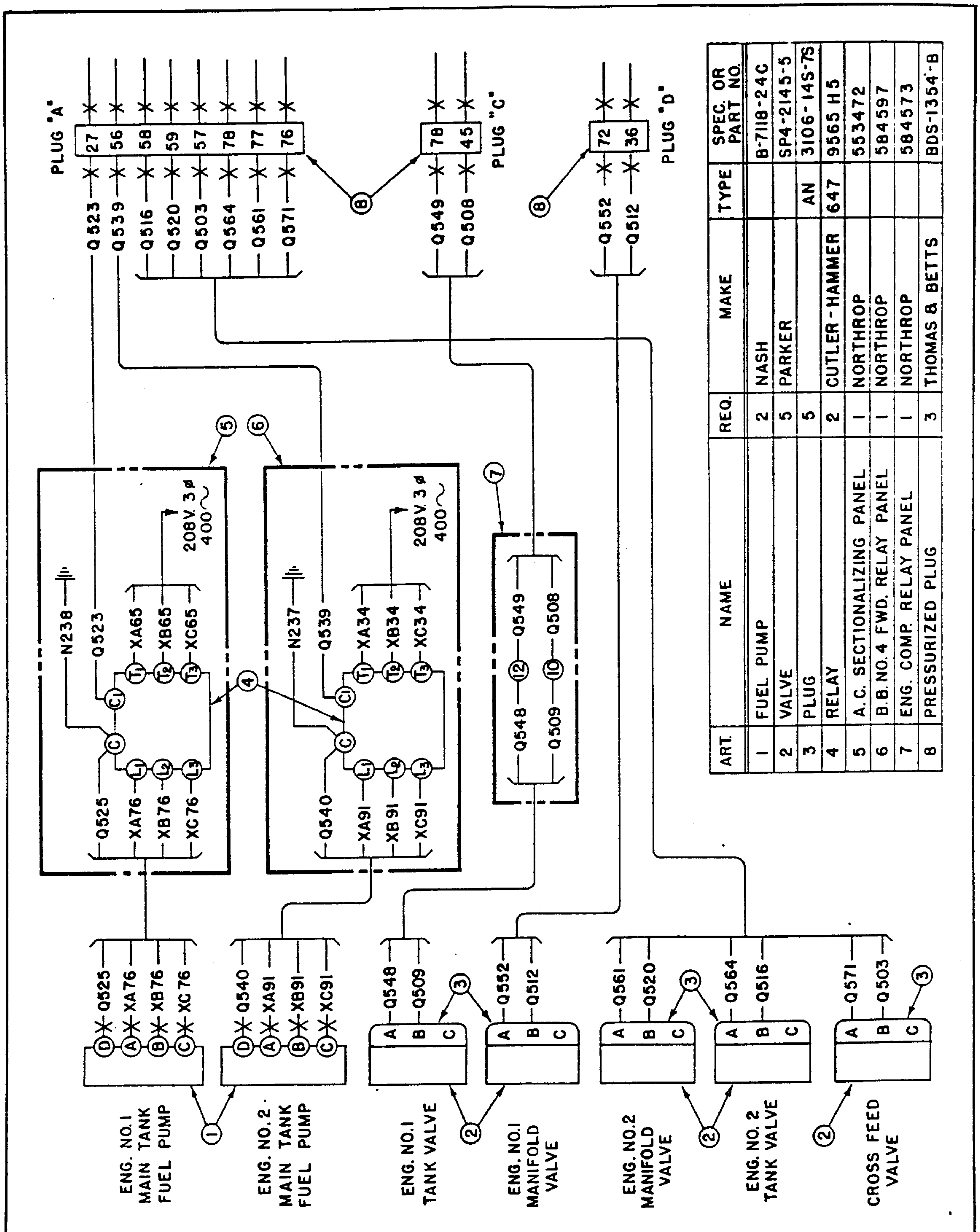
ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
8	PANEL-RELAY	NORTHROP		558201
9	PANEL-RELAY	NORTHROP		584633
10	PANEL-RELAY	NORTHROP		584634
11	PANEL-RELAY	NORTHROP		558202
12	PLUG		AN	3106-10S-2S
13	TANK UNIT			HC1648M2

Figure 56. Propeller Governor - Emergency Oil Pumps and Gauges



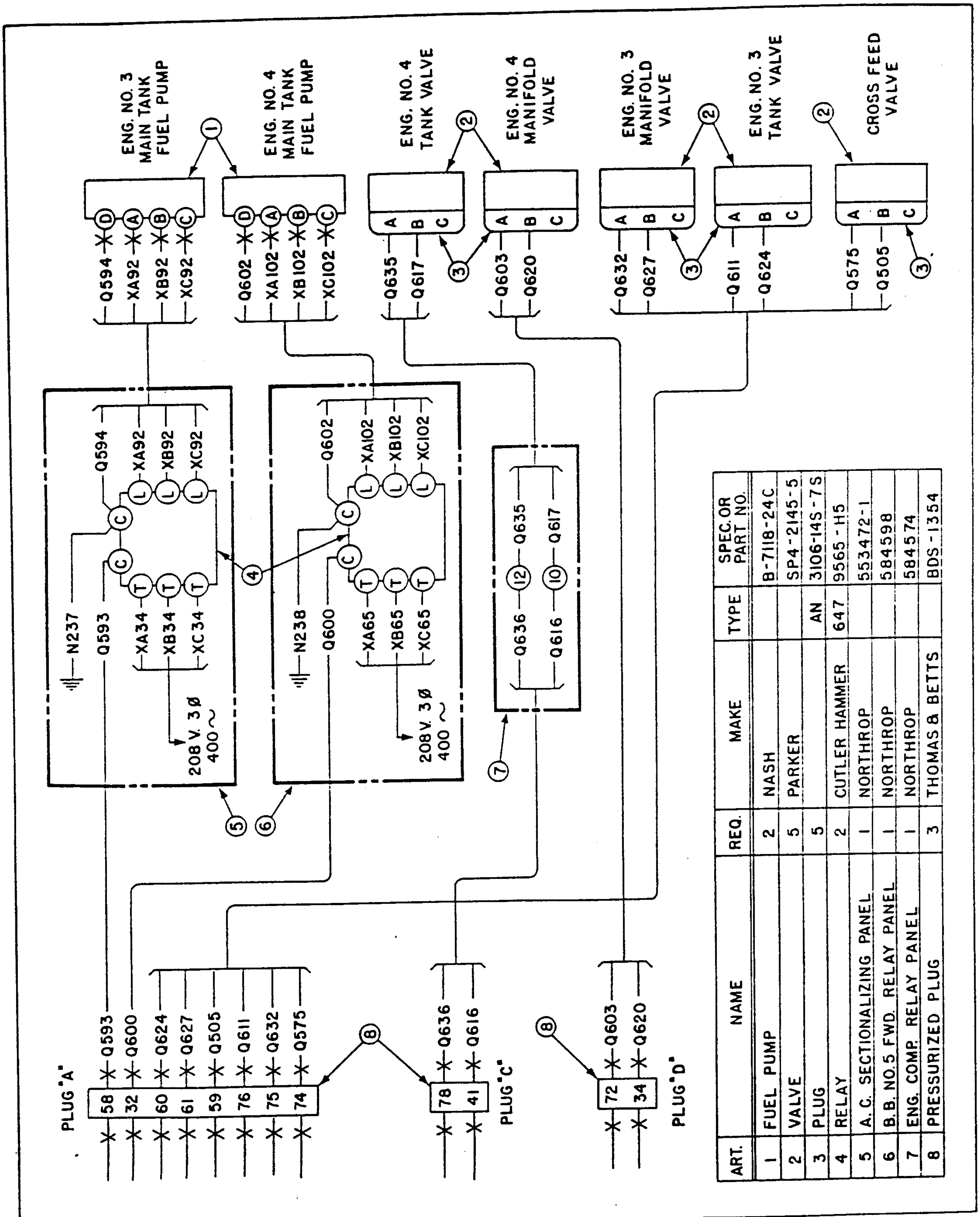
ART	NAME	REQ	MAKE	TYPE	SPEC. OR PART NO.
1	PRESSURIZED PLUG	10	THOMAS & BETTS		BDS-1354B
2	SWITCH	14		AN	3022-2
3	ENGINEERS PANEL	1	NORTHROP		552672
4	VALVE SELECTOR SWITCH	4	GENERAL ELECTRIC		CR1070F106B2
5	SWITCH	1		AN	3022-3
6	CIRCUIT BREAKER	1		AN	3160-15
7	CIRCUIT BREAKER	1		AN	3160-5

Figure 57. Fuel Pumps and Valves - Crew Nacelle



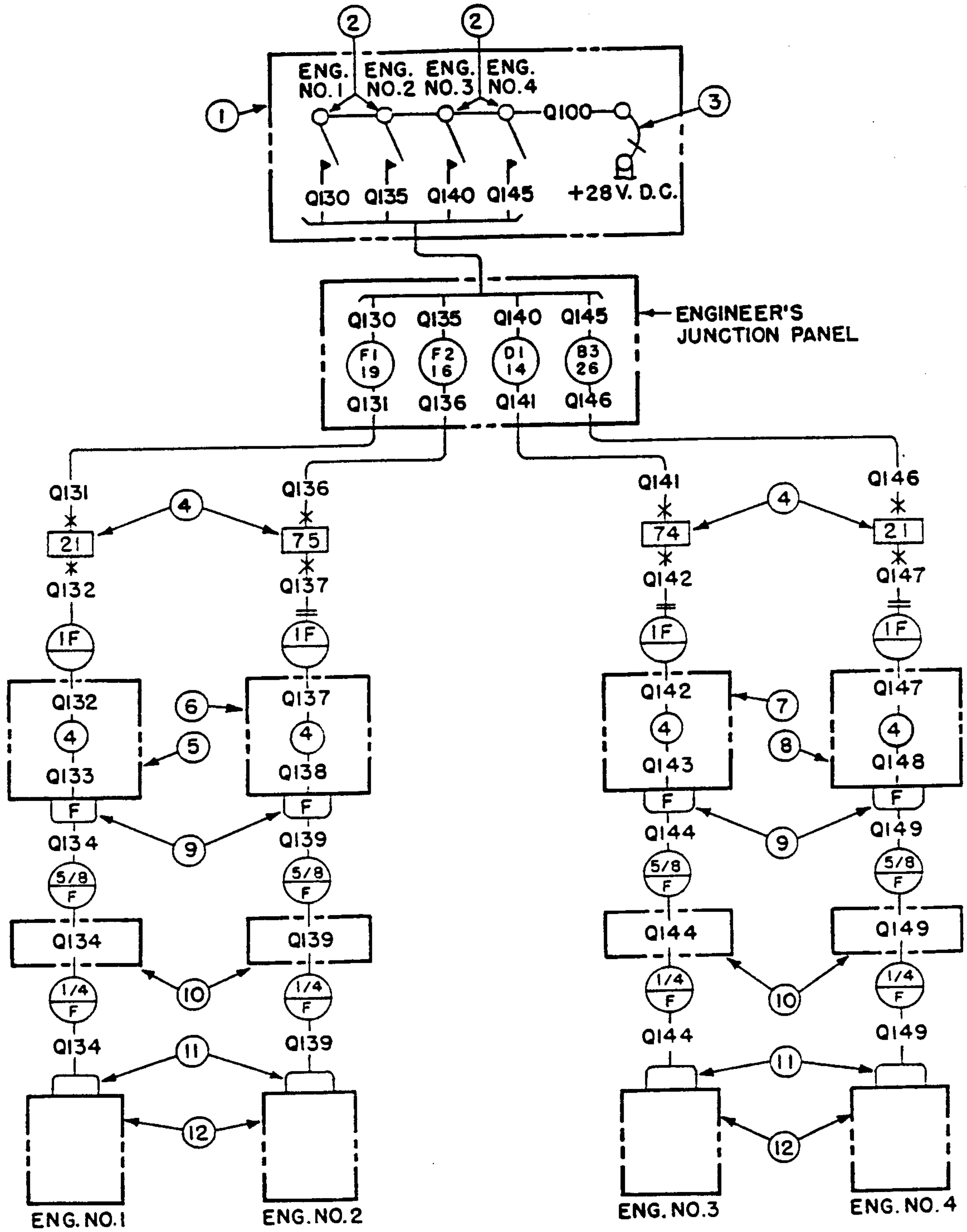
ART.	NAME	REQ.	MAKE	TYPE	SPEC. OR PART NO.
1	FUEL PUMP	2	NASH		B-7118-24C
2	VALVE	5	PARKER		SP4-2145-5
3	PLUG	5		AN	3106-14S-7S
4	RELAY	2	CUTLER-HAMMER	647	9565 H5
5	A.C. SECTIONALIZING PANEL	1	NORTHROP		553472
6	B.B. NO.4 FWD. RELAY PANEL	1	NORTHROP		584597
7	ENG. COMP. RELAY PANEL	1	NORTHROP		584573
8	PRESSURIZED PLUG	3	THOMAS & BETTS		BDS-1354-B

Figure 58. Fuel Pumps and Valves - LH Wing



ART.	NAME	REQ.	MAKE	TYPE	SPEC. OR PART NO.
1	FUEL PUMP	2	NASH		B-7118-24C
2	VALVE	5	PARKER		SP4-2145-5
3	PLUG	5		AN	3106-14S-7S
4	RELAY	2	CUTLER HAMMER	647	9565-H5
5	A. C. SECTIONALIZING PANEL	1	NORTHROP		553472-1
6	B.B. NO.5 FWD. RELAY PANEL	1	NORTHROP		584598
7	ENG. COMP. RELAY PANEL	1	NORTHROP		584574
8	PRESSURIZED PLUG	3	THOMAS & BETTS		BDS-1354

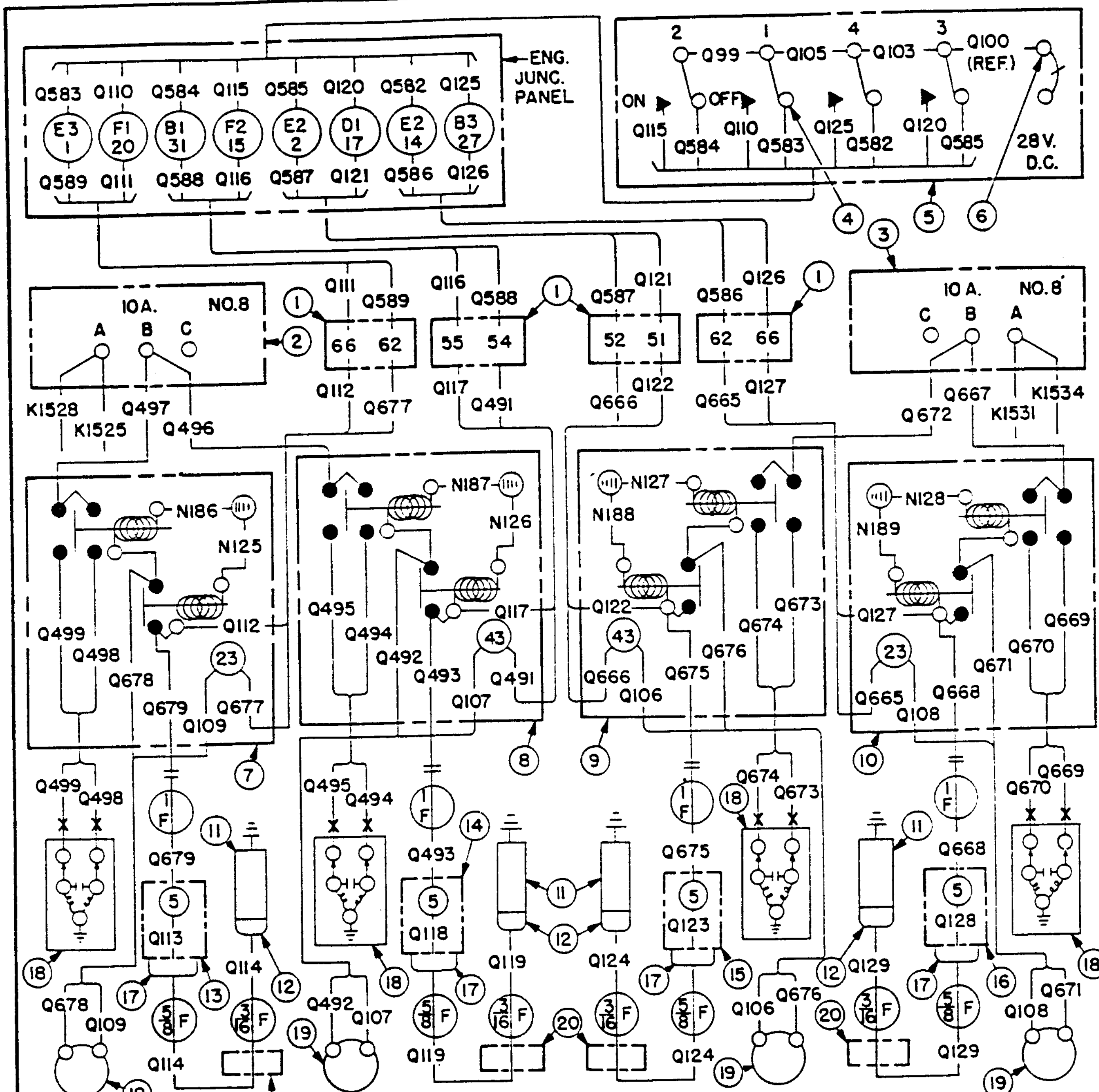
Figure 59. Fuel Pumps and Valves - RH Wing



ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	PANEL-ENG.	NORTHROP		552722
2	SWITCH		AN	3022-10
3	CIRCUIT B'R'K'R		AN	3160-10
4	PLUG-PRESS.	THOS.-BETTS		BDS-1354-B
5	DISCONNECT BOX	NORTHROP		584571
6	DISCONNECT BOX	NORTHROP		556221

ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
7	DISCONNECT BOX	NORTHROP		556221-1
8	DISCONNECT BOX	NORTHROP		584572
9	PLUG		AN	3108-22-14P
10	ENG. PULL BOX	NORTHROP		452250
11	PLUG		AN	3106-12S-4S
12	PRIMER	BENDIX		392436

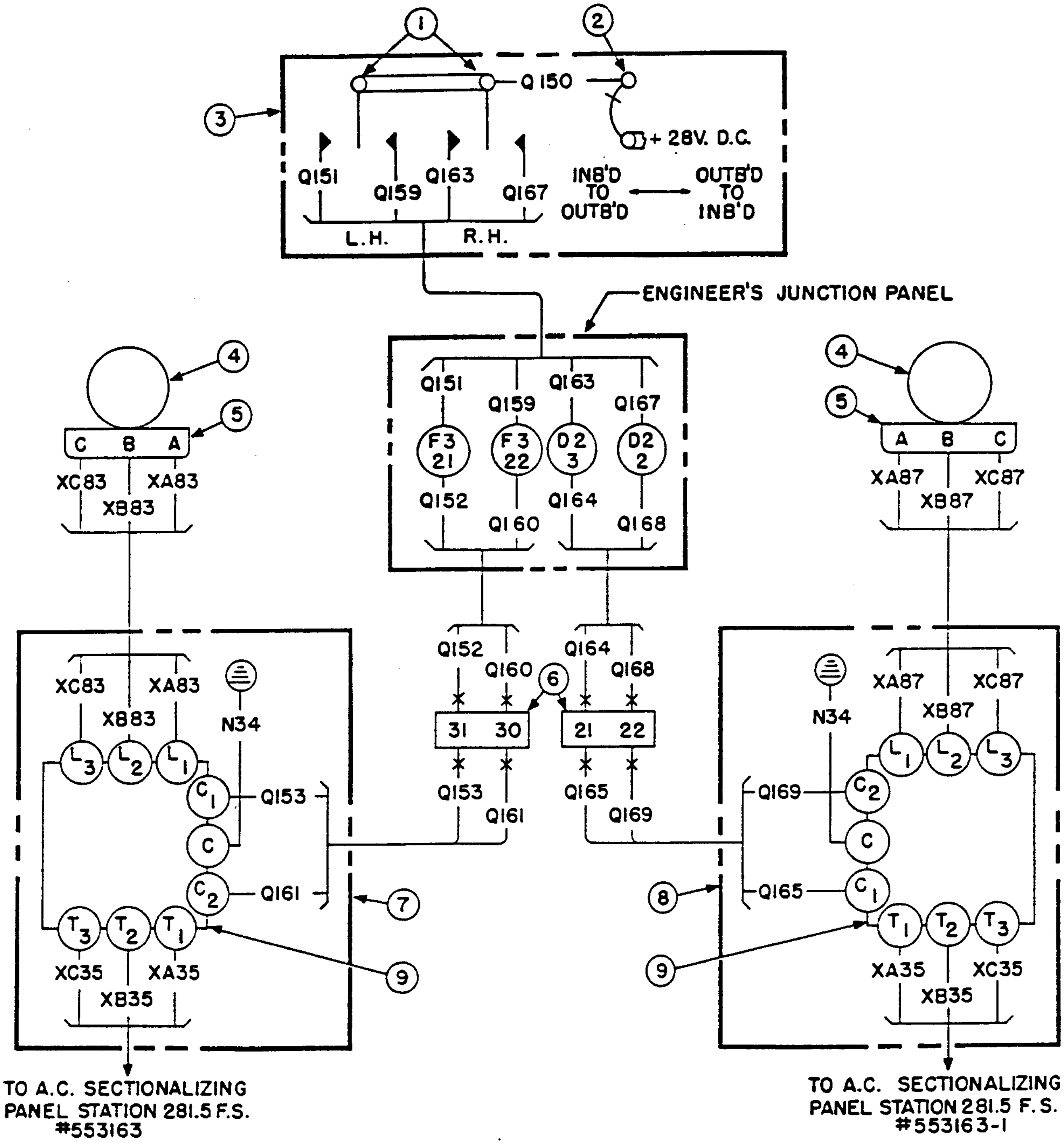
Figure 60. Primer Solenoids



OIL DIVERTER INSTALLED BUT NOT USED ON 1484

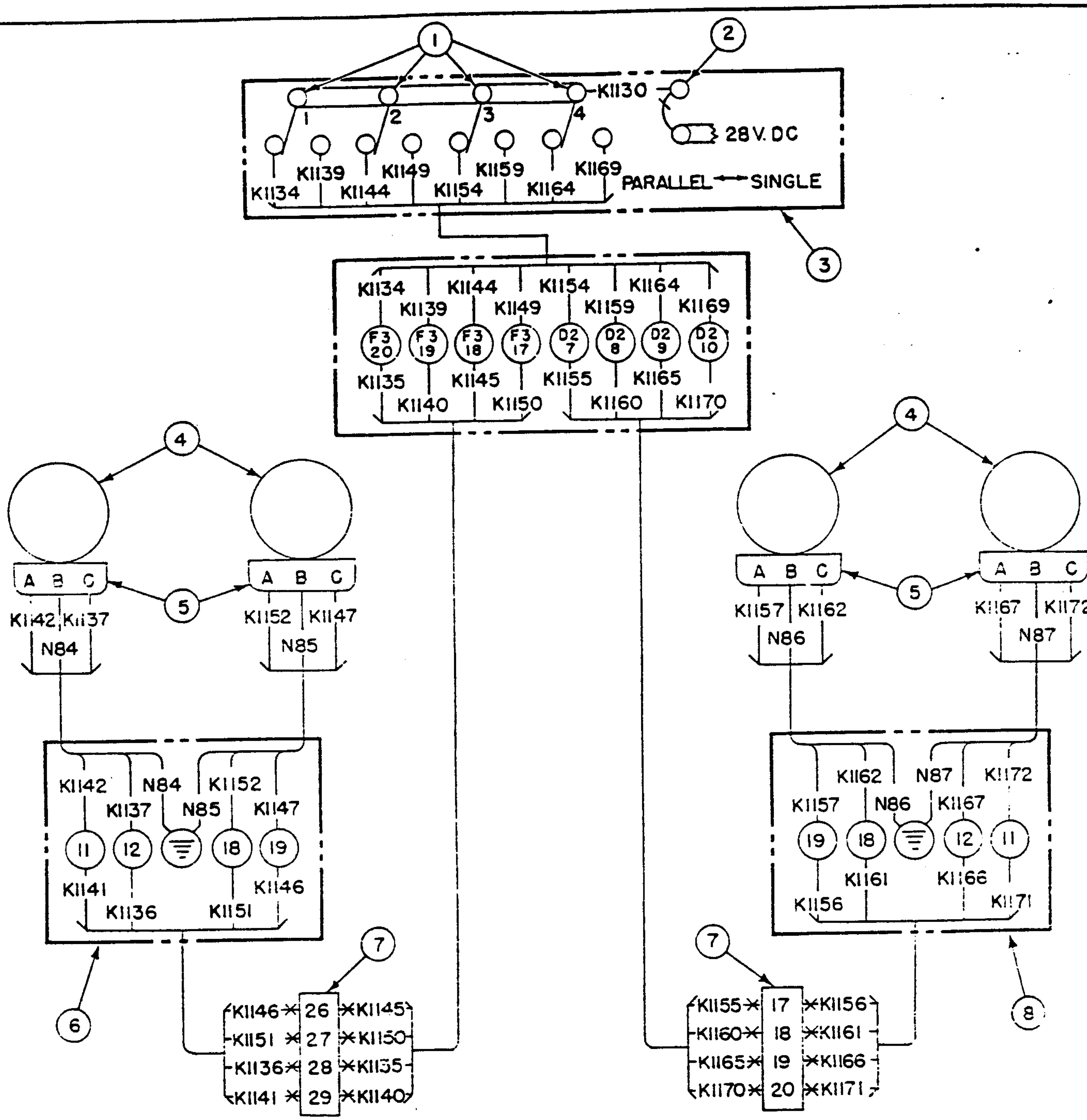
ART.	NAME	MAKE	TYPE	PART NO.	ART.	NAME	MAKE	TYPE	PART NO.
1	PRESS. PLUG	T & B		BDS-1354-B	11	SOLENOID	KOEHLER		K-1170-8
2	SEC. PANEL	NORTHROP		553163	12	PLUG		AN	3106-8S-1S
3	SEC. PANEL	NORTHROP		553163-1	13	DISC. BOX	NORTHROP		584571
4	SWITCH		AN	3022-11	14	DISC. BOX	NORTHROP		556221
5	ENG'R'S PANEL	NORTHROP		552722	15	DISC. BOX	NORTHROP		556221-1
6	CIRCUIT BR'K'R		AN	3160-10	16	DISC. BOX	NORTHROP		584572
7	RELAY PANEL	NORTHROP		584599	17	PLUG		AN	3108-22-14P
8	RELAY PANEL	NORTHROP		584603	18	DIV. VALVE	AIRSEARCH		12027-2
9	RELAY PANEL	NORTHROP		584604	19	THERMOSTAT	AIRSEARCH		11608
10	RELAY PANEL	NORTHROP		584600	20	PULL BOX	NORTHROP		452250

Figure 61. Oil Dilution and Oil Diverter Valve



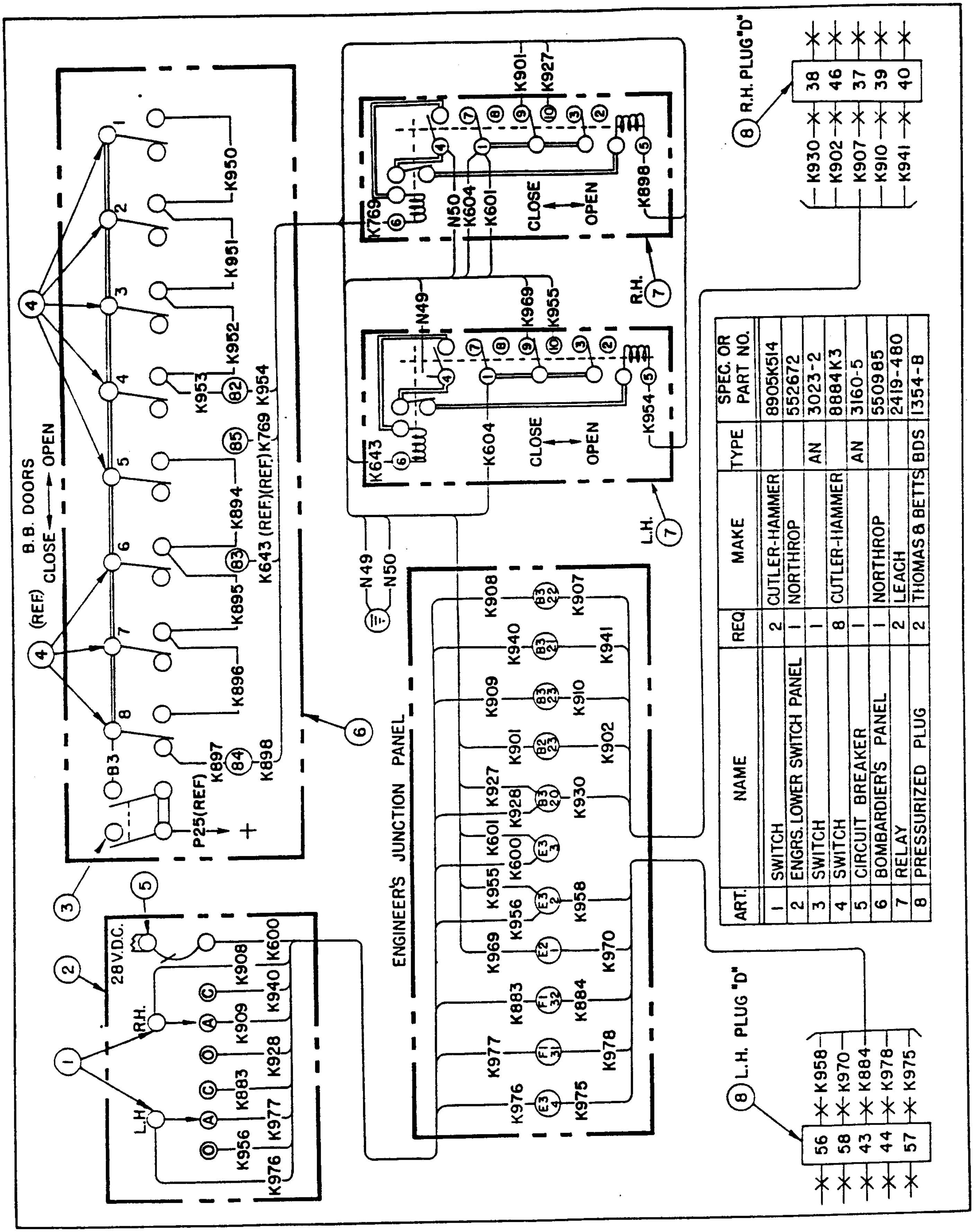
ART	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	SWITCH		AN	3022-7
2	CIRCUIT BREAKER		AN	3160-5
3	PANEL - ENG. SWITCH	NORTHROP		552672
4	PUMP	PESCO		S1145A
5	PLUG		AN	3106-18-29S
6	PLUG - PRESSURIZED	THOMAS & BETTS		8DS-1354-8
7	PANEL - W.W. RELAY	NORTHROP		584605
8	PANEL - W.W. RELAY	NORTHROP		584606
9	RELAY	C & H	648	9565 H6

Figure 62. Oil Transfer Pumps



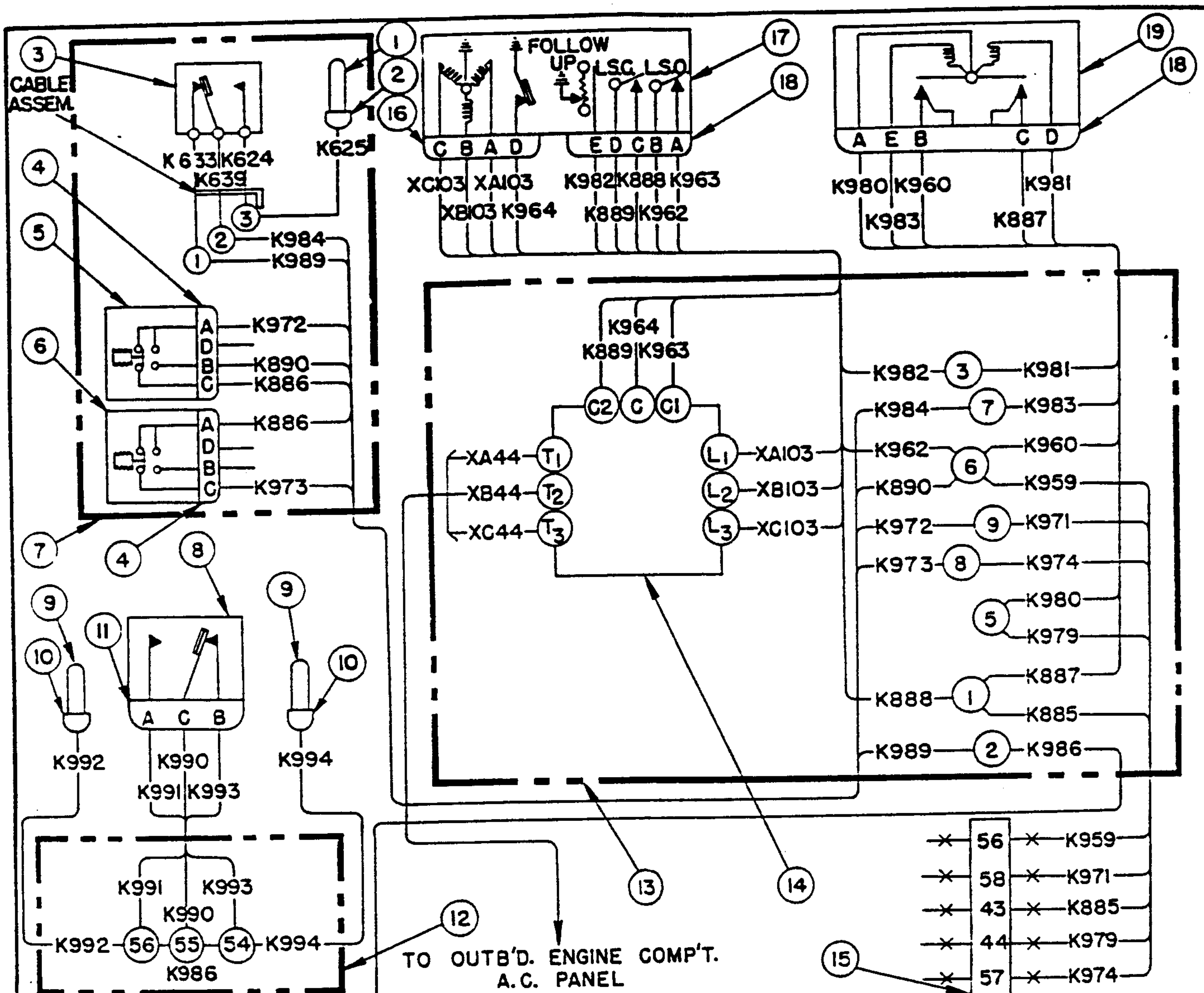
ART.	NAME	REQ.	MAKE	TYPE	SPEC. OR PART NO.
1	SWITCH	4		AN	3022-3
2	CIRCUIT BREAKER	1		AN	3160-10
3	ENGR. SWITCH PANEL	1			552722
4	TURBO VALVE MOTOR	4	WHITE-RODGERS		6912-4
5	PLUG	4		AN	3106-14S-1S
6	L.H.W.W. FWD. RELAY PANEL	1			584605
7	PRESSURIZED PLUG	2	THOMAS-BETTS		BDS-1354-8
8	R.H.W.W. FWD. RELAY PANEL	1			584606

Figure 63. Engine Turbo Selector



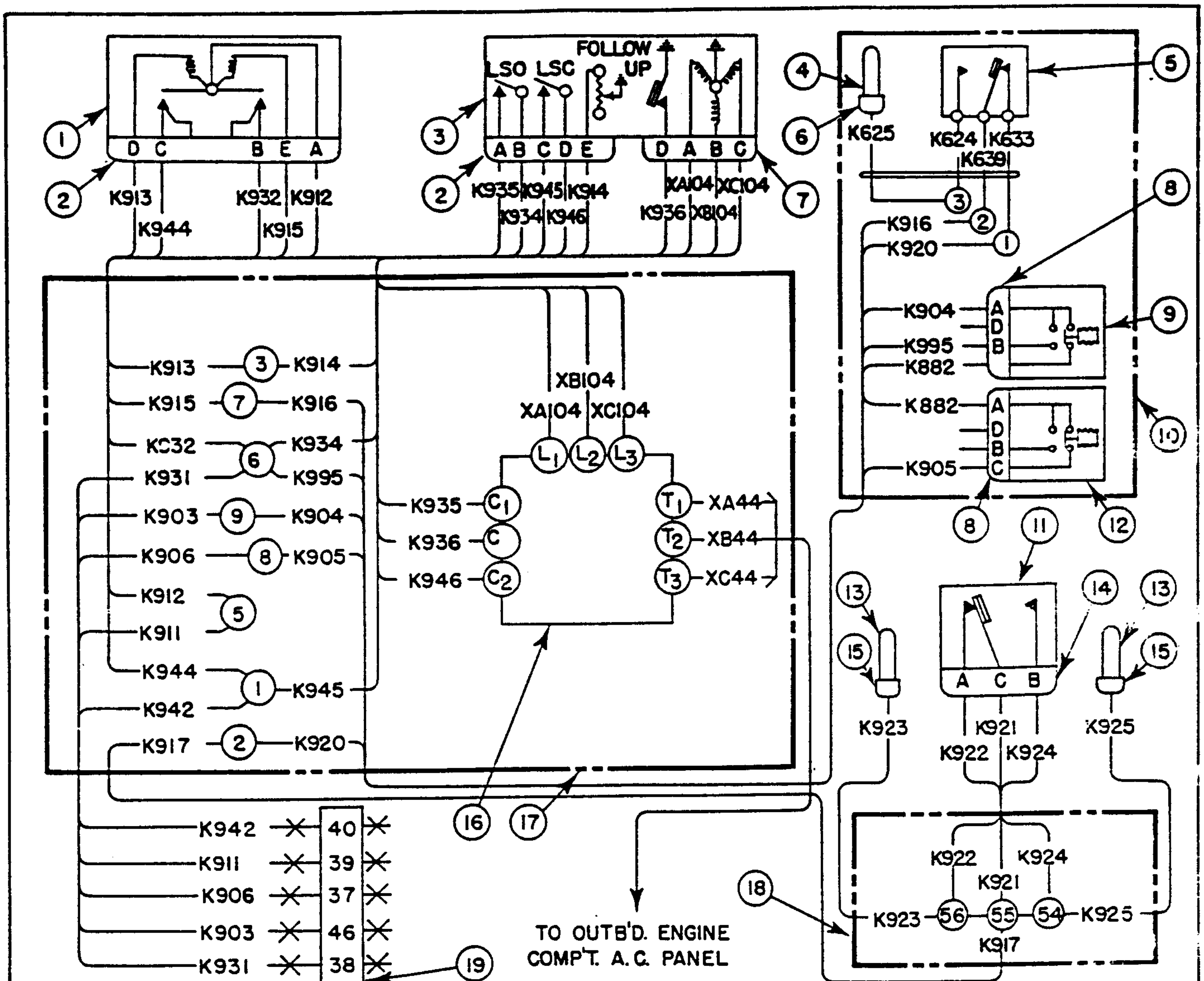
ART.	NAME	REQ	MAKE	TYPE	SPEC. OR PART NO.
1	SWITCH	2	CUTLER-HAMMER		8905K514
2	ENGRS. LOWER SWITCH PANEL	1	NORTHROP		552672
3	SWITCH	1		AN	3023-2
4	SWITCH	8	CUTLER-HAMMER		8884K3
5	CIRCUIT BREAKER	1		AN	3160-5
6	BOMBARDIER'S PANEL	1	NORTHROP		550985
7	RELAY	2	LEACH		2419-480
8	PRESSURIZED PLUG	2	THOMAS & BETTS	BDS	1354-B

Figure 64. Intercooler Temperature - Crew Nacelle



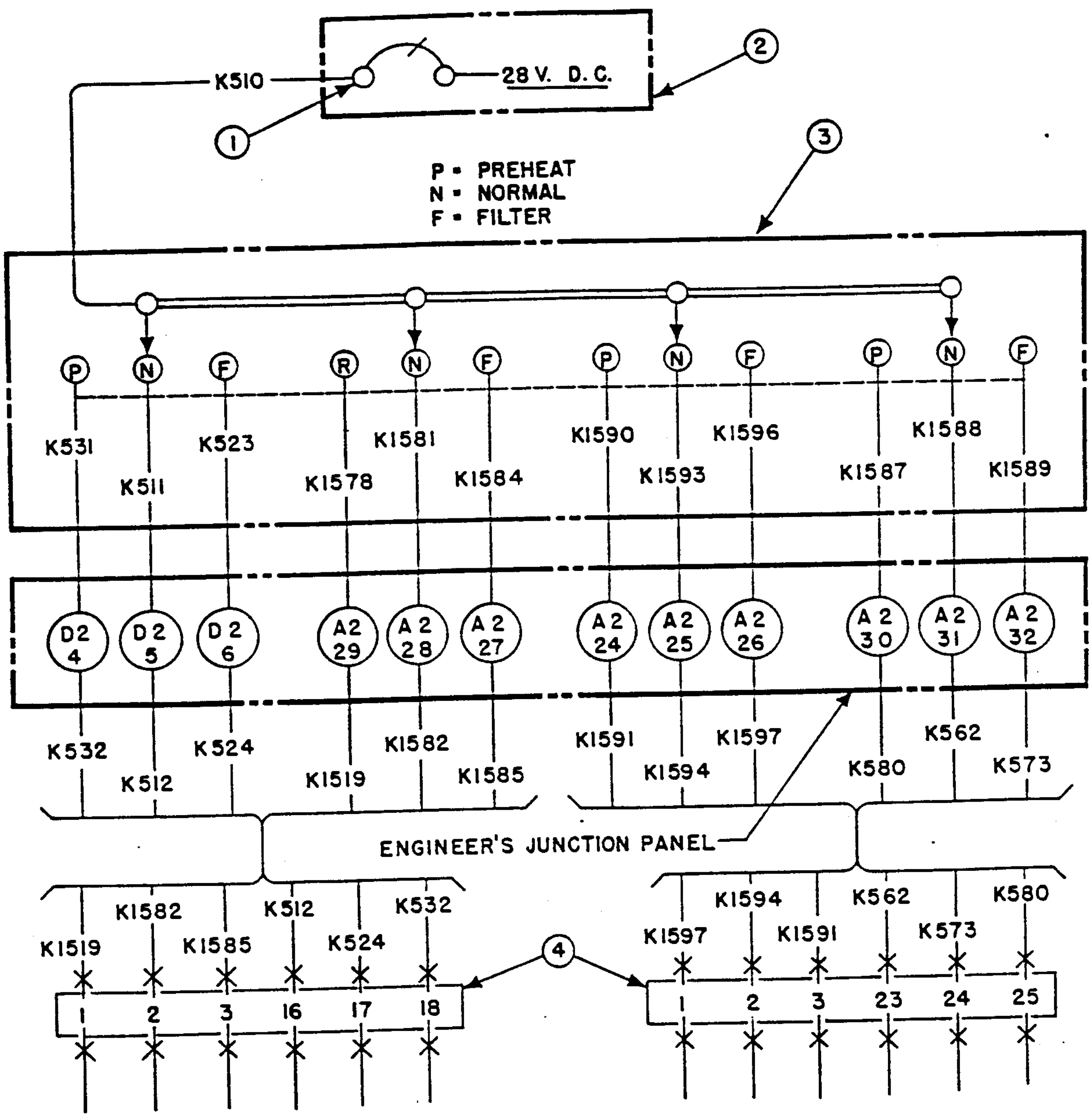
ART.	NAME	REQ.	MAKE	TYPE	SPEC. OR PART NO.
1.	ELEMENT-THERMO SENSITIVE	1	GENERAL ELECTRIC CO.		CR2992 A101A4
2.	PLUG-ELECT. CONN. 90° ANGLE	1			AN3108-8S-1S
3.	THERMOSTAT-TRANSFER	1	GENERAL ELECTRIC CO.		CR2992B100A4
4.	PLUG-ELECT. CONN.	2	AMPHENOL		97-3106 12S14-844S
5.	SWITCH-PRESSURE	1	GENERAL ELECTRIC CO.		2927D100J13
6.	SWITCH-PRESSURE	1	GENERAL ELECTRIC CO.		2927D100J12
7.	PANEL-PRESSURE & TEMP.	1	NORTHROP		554881
8.	SWITCH-THERMOSTAT	1	WHITE RODGERS		6508-3
9.	ELEMENT-THERMO. SENSITIVE	2	GENERAL ELECTRIC CO.		CR2992 A101A2
10.	PLUG-ELECT. CONN. STRAIGHT	2			AN3106-8S-1S
11.	PLUG-ELECT. CONN. STRAIGHT	1			AN3106-14S-1S
12.	PANEL-B B NO. 2 FWD. RELAY	1	NORTHROP		584603
13.	PANEL-BB NO. 1 AFT. RELAY	1	NORTHROP		584629
14.	RELAY	1	CUTLER-HAMMER	648	9565H6
15.	PLUG-PRESSURIZED	1	THOMAS & BETTS		BDS-1354-B
16.	PLUG-CONN. STRAIGHT TYPE PA	1			AN3106-18-4S
17.	MOTOR	1	GENERAL ELECTRIC CO.		P42748976R1
18.	PLUG-ELECT. CONN. STRAIGHT	2			AN306-16S-1S
19.	RELAY-POLARIZED		GENERAL ELECTRIC CO.		CR2780-A104A2

Figure 65. Intercooler Temperature - LH Wing



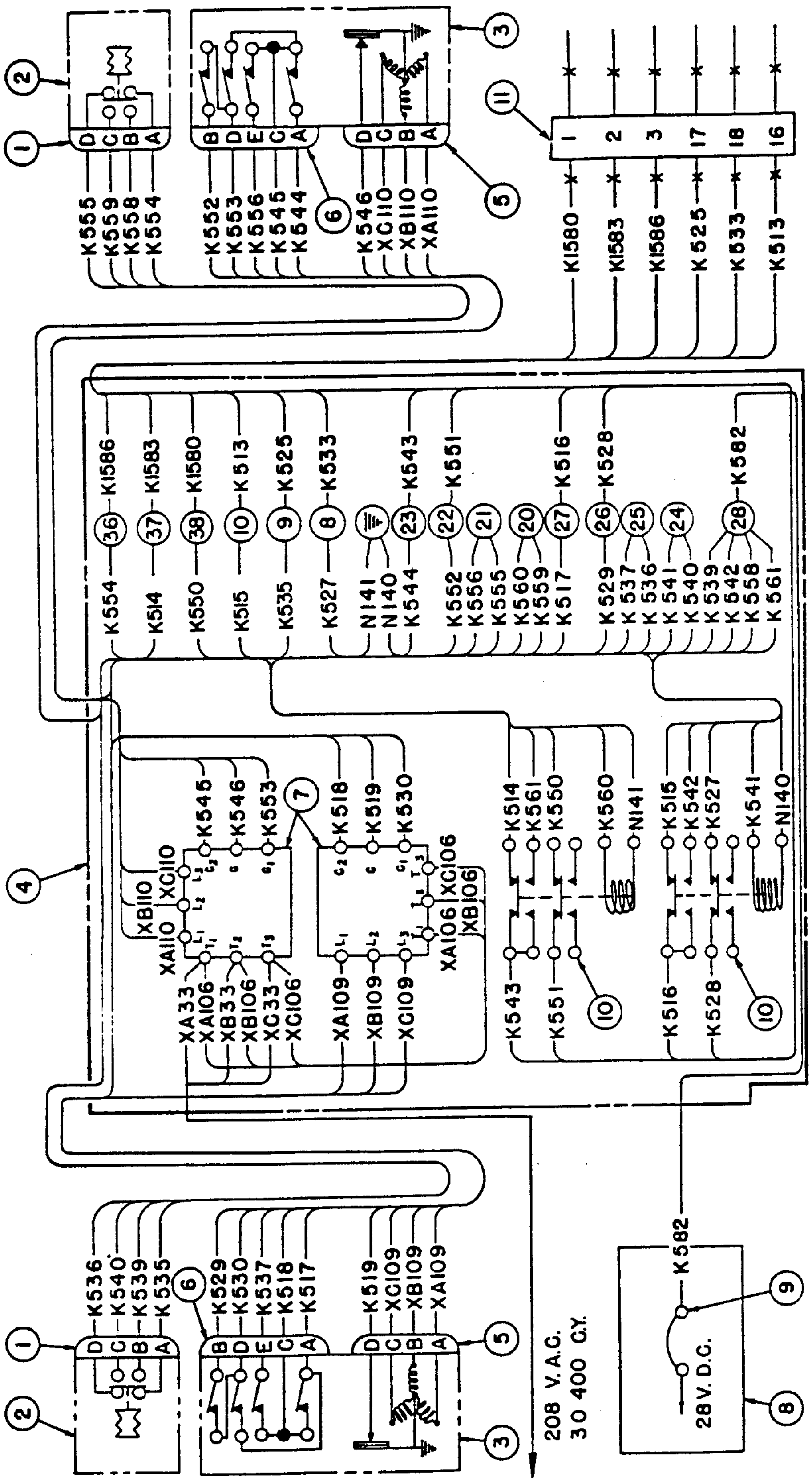
ART.	NAME	REQ.	MAKE	TYPE	SPEC. OR PART NO.
1	POLARIZED RELAY	1	GENERAL ELECTRIC		CR 2780-A104A2
2	PLUG	2		AN	3106-16S-1S
3	MOTOR	1	GENERAL ELECTRIC		P4274897 GR 1
4	THERMO SENSITIVE ELEMENT	1	GENERAL ELECTRIC		CR2992-A101A4
5	THERMOSTAT TRANSFER	1	GENERAL ELECTRIC		CR2992B100A4
6	PLUG	1		AN	3108-8S-1S
7	PLUG	1		AN	3106-18-4S
8	PLUG	2	AMPHENOL		97-3106-12S14-844S
9	PRESSURE SWITCH	1	GENERAL ELECTRIC		2927 D 100 J13
10	PRESS. & TEMPERATURE PANEL	1	NORTHROP		554881
11	THERMOSTAT SWITCH	1	WHITE-RODGERS		6508-3
12	PRESSURE SWITCH	1	GENERAL ELECTRIC		2927 D 100 J12
13	THERMO SENSITIVE ELEMENT	2	GENERAL ELECTRIC		CR 2992-A101A2
14	PLUG	1		AN	3106-14S-1S
15	PLUG	2		AN	3106-8S-1S
16	RELAY	1	CUTLER-HAMMER	648	9565 H6
17	B.B. 8 AFT RELAY PANEL	1	NORTHROP		558201-1
18	B. B. 7 FWD. RELAY PANEL	1	NORTHROP		584604
19	PRESSURIZED PLUG	1	THOMAS & BETTS	BDS	1354 B

Figure 66. Intercooler Temperature - RH Wing



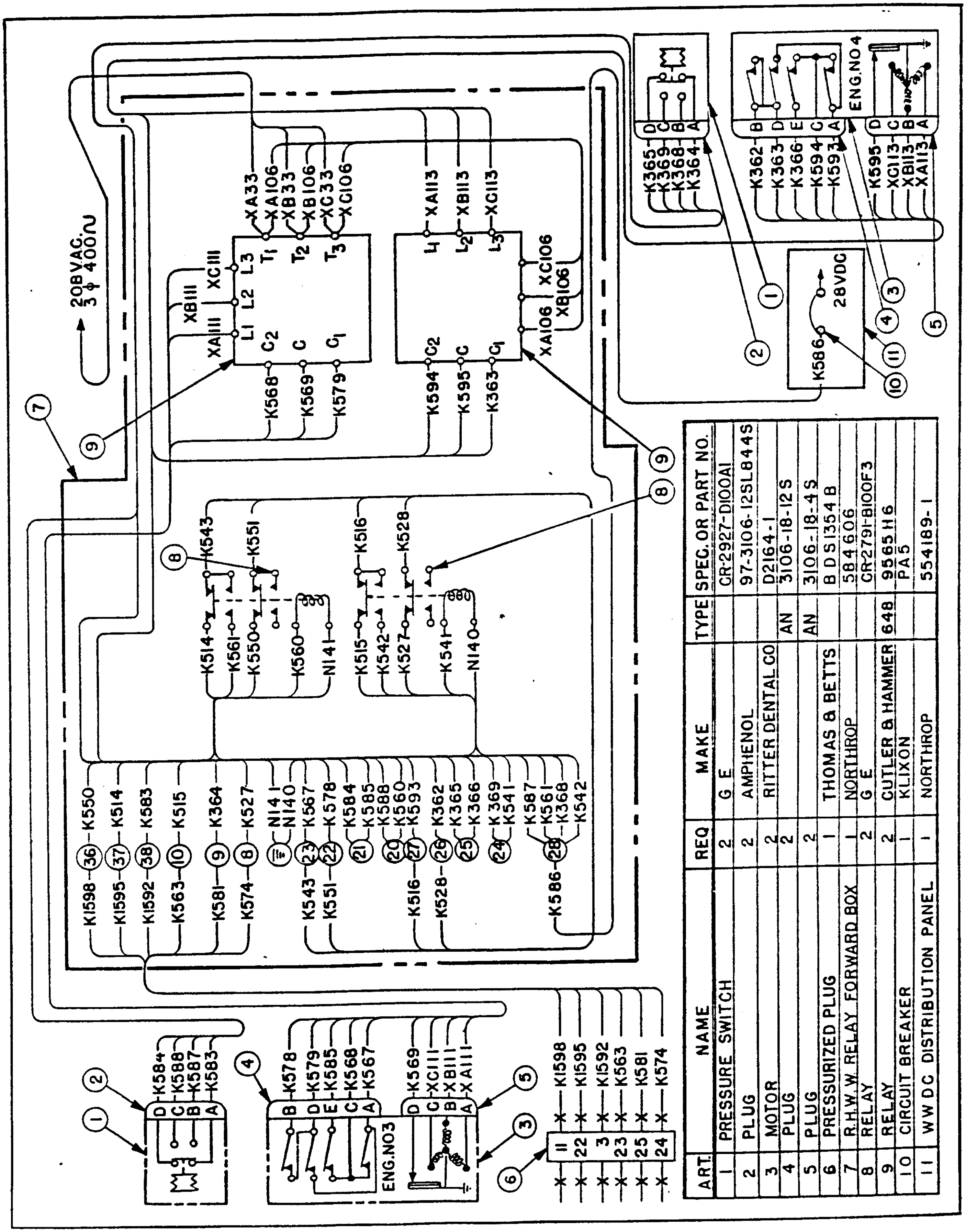
ART.	NAME	REQ.	MAKE	TYPE	SPEC. OR PART NO.
1	CIRCUIT BREAKER	1		AN	3160-10
2	ENG. LOWER SW. PANEL	1	NORTHROP		552672
3	SWITCH ASSEMBLY	1	NORTHROP		559513
4	PRESSURIZED PLUG	2	THOMAS & BETTS		BDS-1354-8

Figure 67. Carburetor Air Valve Control - Crew Nacelle



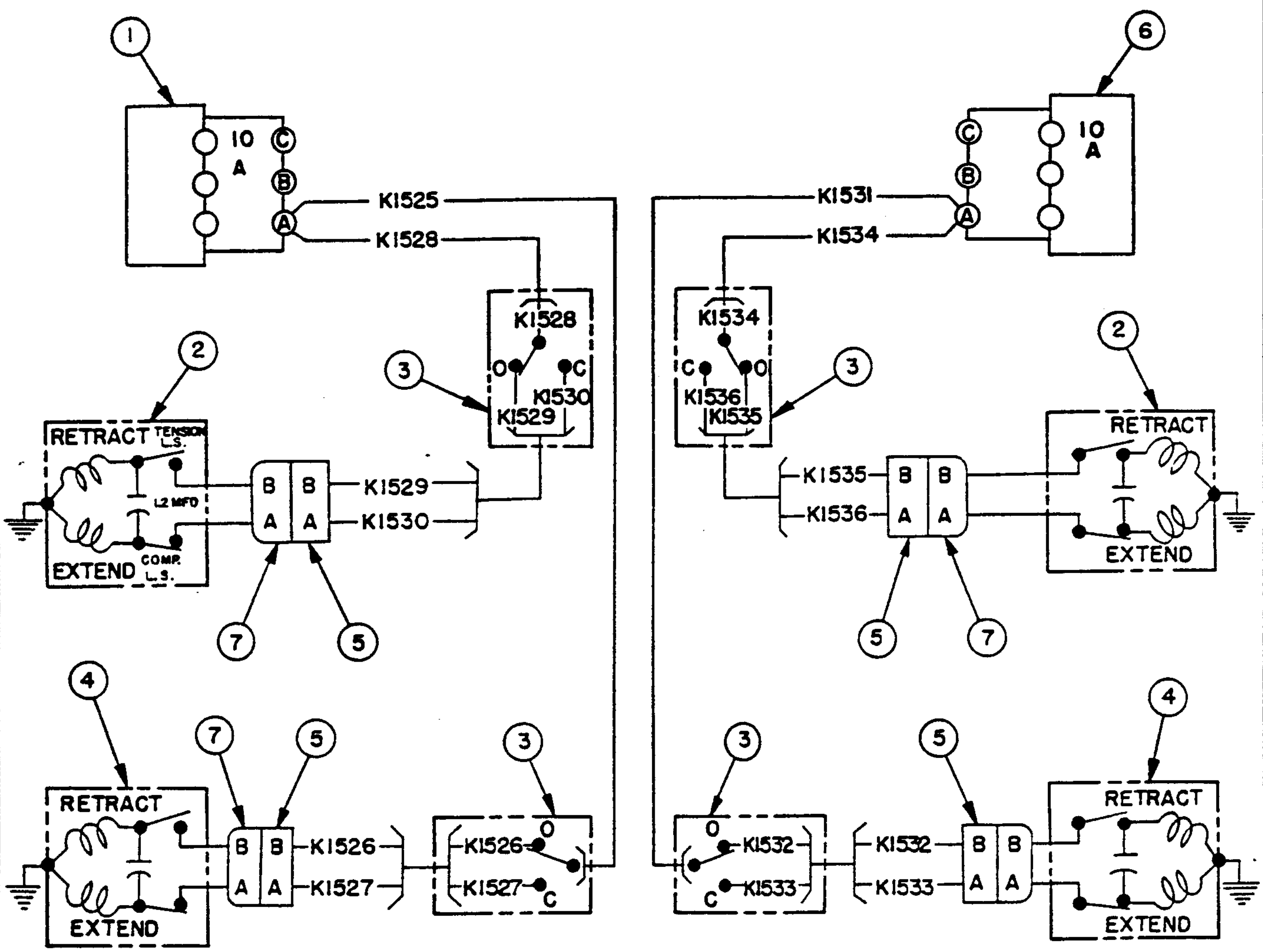
ART	NAME	REQ	MAKE	TYPE	SPEC. OR PART NO.
1	PLUG	2	AMPHENOL		97-3106-12SL-844S
2	PRESSURE SWITCH	2	GENERAL ELECTRIC CO.		CR-2927-D100A1
3	MOTOR	2	RITTER DENTAL CO.		D-2161-1
4	WHEEL WELL POWER RELAY BOX	1	NORTHROP		584605
5	PLUG	2		AN	3106-18-4S
6	PLUG	2		AN	3106-18-12S
7	RELAY	2	CUTLER HAMMER	648	9565H6
8	PANEL	1	NORTHROP		554189
9	CIRCUIT BREAKER	1	KLIXON		PA5
10	RELAY	2	GENERAL ELECTRIC CO.		CR-2791-B100FS
11	PRESSURIZED PLUG	1	THOMAS & BETTS		BDS-1354-B

Figure 68. Carburetor Air Valve Control - LH Wing



ART.	NAME	REQ	MAKE	TYPE	SPEC. OR PART NO.
1	PRESSURE SWITCH	2	G E		CR-2927-D100A1
2	PLUG	2	AMPHENOL		97-3106-12SL844S
3	MOTOR	2	RITTER DENTAL CO		D2164-1
4	PLUG	2		AN	3106-18-12S
5	PLUG	2		AN	3106-18-4S
6	PRESSURIZED PLUG	1	THOMAS & BETTS		B D S1354 B
7	R.H.W.W. RELAY FORWARD BOX	1	NORTHROP		584606
8	RELAY	2	G E		CR-2791-B100F3
9	RELAY	2	CUTLER & HAMMER	648	9565H6
10	CIRCUIT BREAKER	1	KLIXON		PA5
11	WW DC DISTRIBUTION PANEL	1	NORTHROP		554189-1

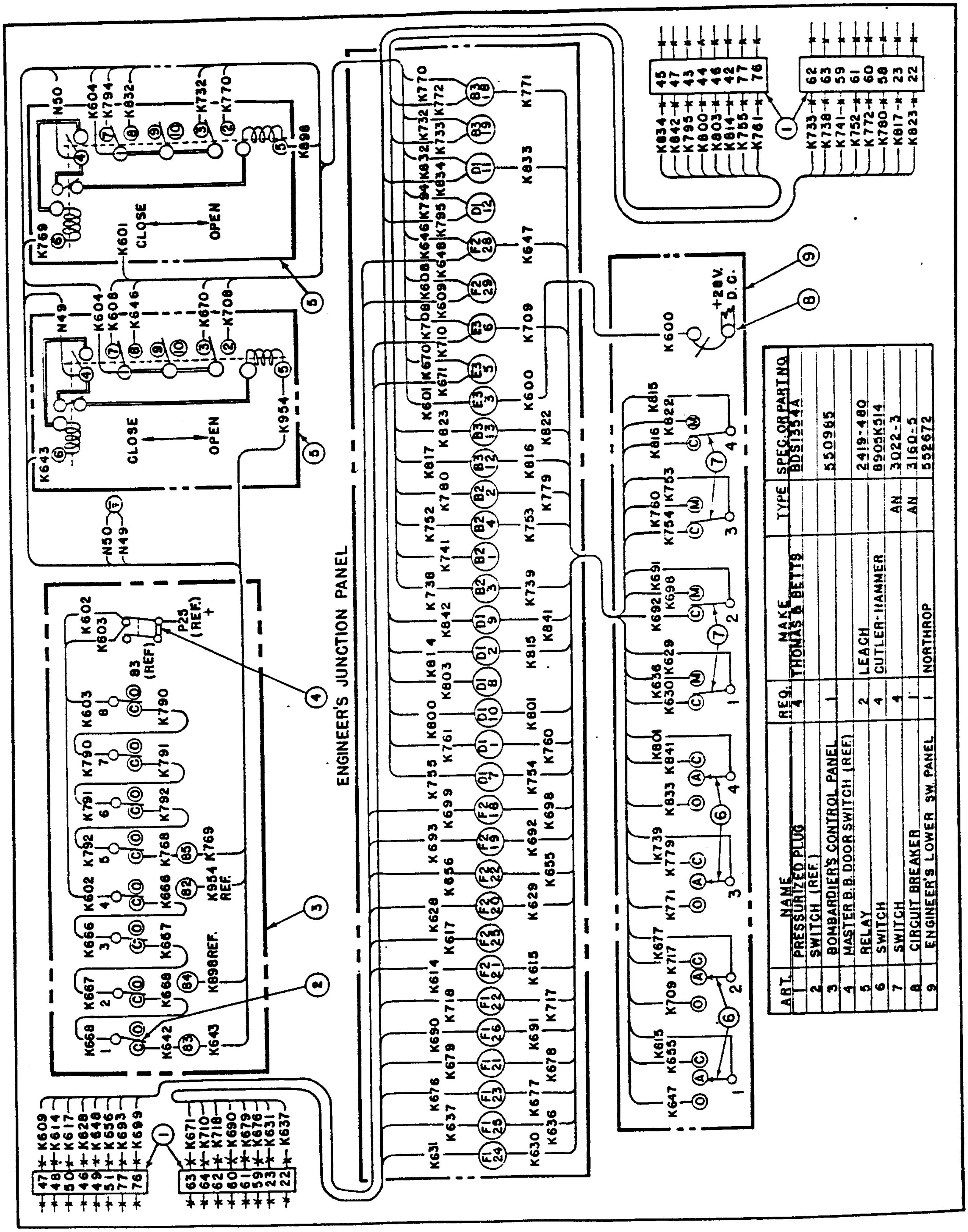
Figure 69. Carburetor Air Valve Control - RH Wing



NOTE-
CIRCUIT SHOWN WITH THE AIRPLANE ON THE GROUND, RAM AIR DOORS CLOSED, MICRO SWITCHES ACTUATED, ENGINE COMPARTMENT COOLING DOORS OPEN, AND ACTUATORS RETRACTED.

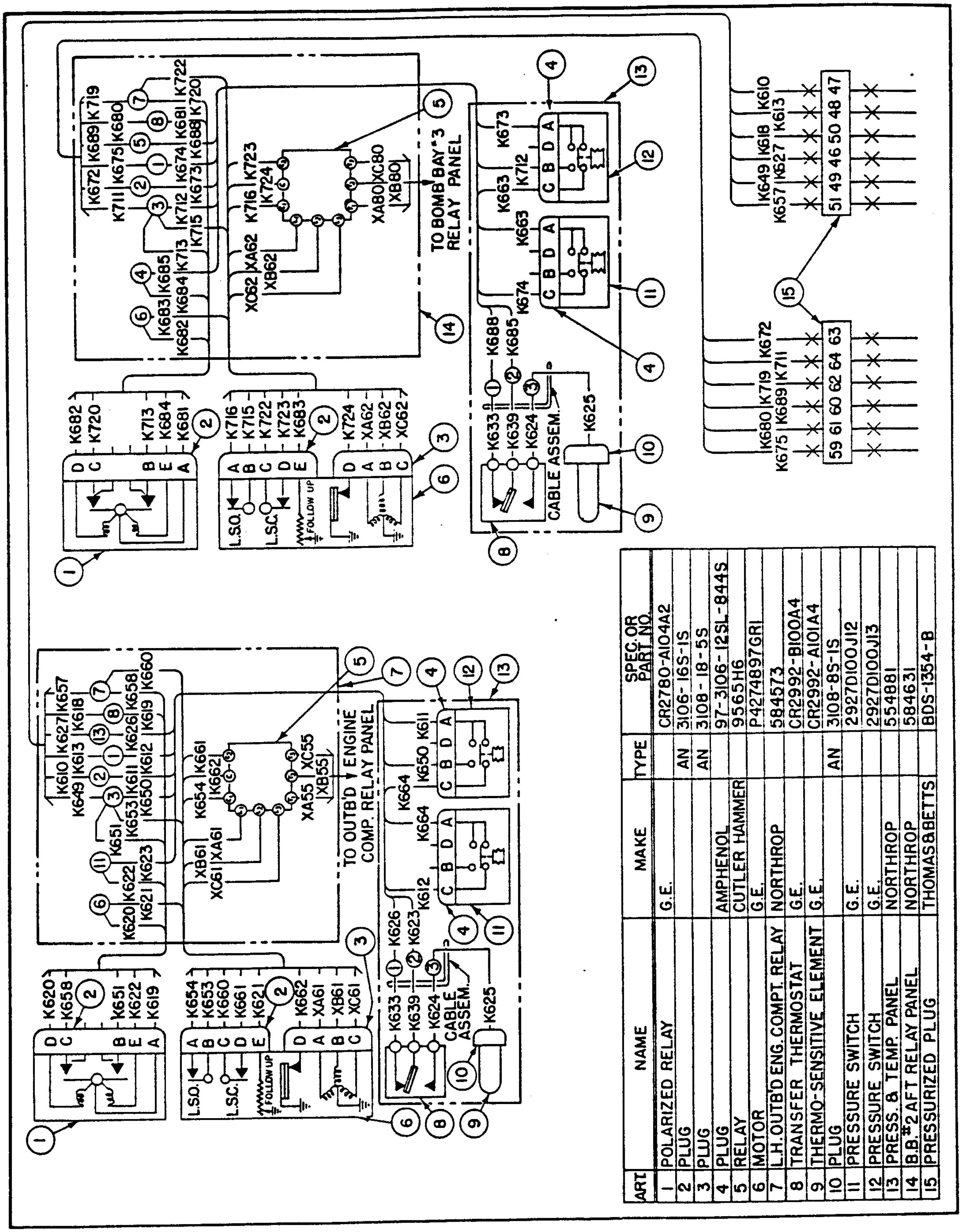
ITEM	DESCRIPTION	REQ.	MAKE	SPEC. OR PARTS NO.
1	PANEL-AC SECTIONALIZING	1	NORTHROP	553163
2	ACTUATOR-INBD. GND. COOLING VALVE	2	AIRSEARCH	28028
3	SWITCH-MICRO	4	MICRO-SWITCH	BZ-R31
4	ACTUATOR-OUTBD. GND. COOLING VALVE	2	AIRSEARCH	27091
5	RECEPTACLE	4	CANNON	AN3100-12S-3S
6	PANEL-AC SECTIONALIZING	1	NORTHROP	553163-1
7	PLUG- REF. (FURNISHED WITH ACTUATOR)			AN3106-12S-3P

Figure 70. Ground Cooling Air Valve



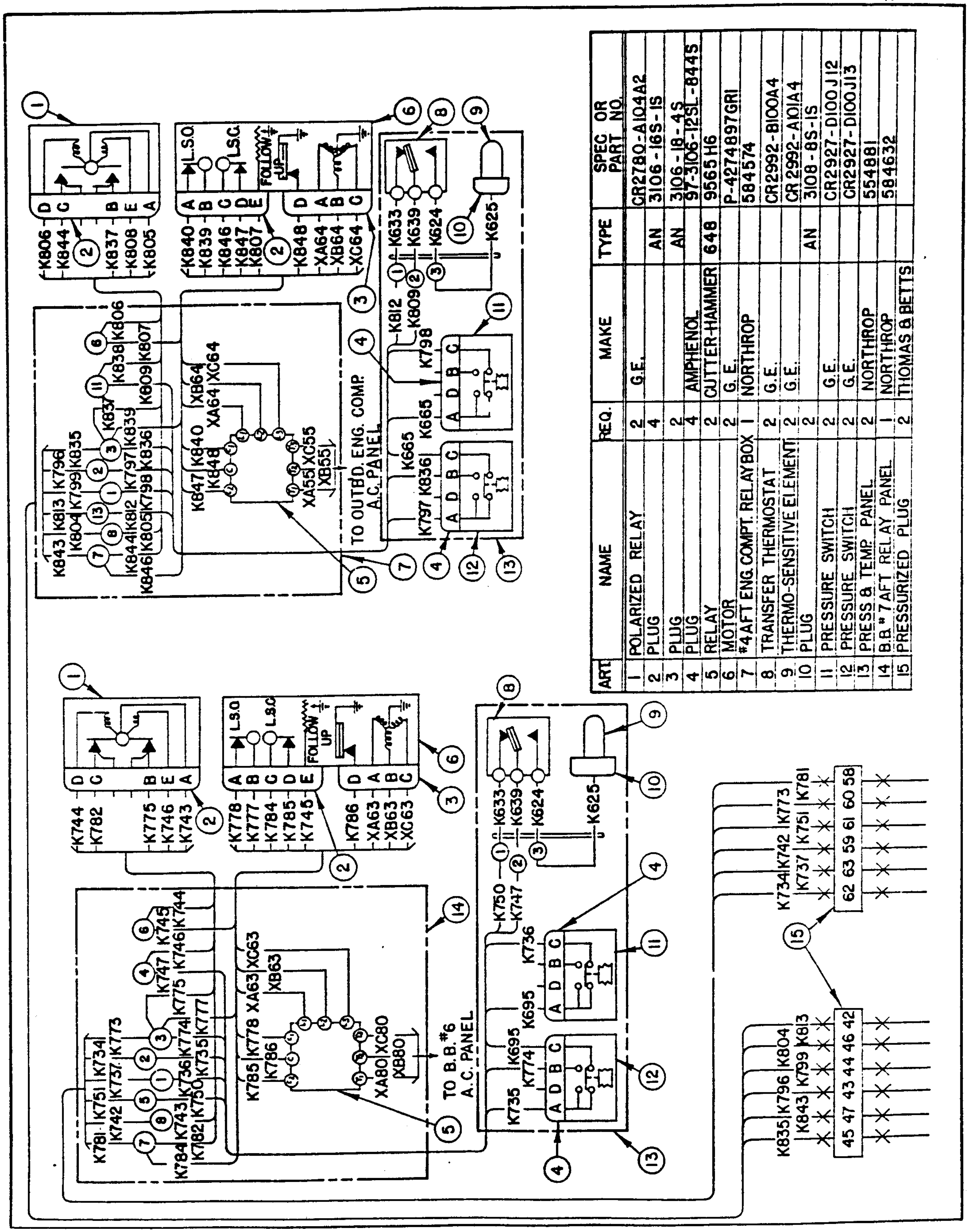
ART.	NAME	REQ.	MAKE	TYPE	SPEC. OR PART NO.
1	PRESSURIZED PLUG	4	THOMAS & BETTS		BDS1354A
2	SWITCH (REF.)				
3	BOMBARDIER'S CONTROL PANEL	1			550985
4	MASTER B.B. DOOR SWITCH (REF.)				
5	RELAY	2	LEACH		2419-480
6	SWITCH	4	CUTLER-HAMMER		8905K514
7	SWITCH	4		AN	3022-3
8	CIRCUIT BREAKER	1		AN	3160-5
9	ENGINEER'S LOWER SW. PANEL	1	NORTHROP		552672

Figure 71. Cylinder Head Temperature - Crew Nacelle



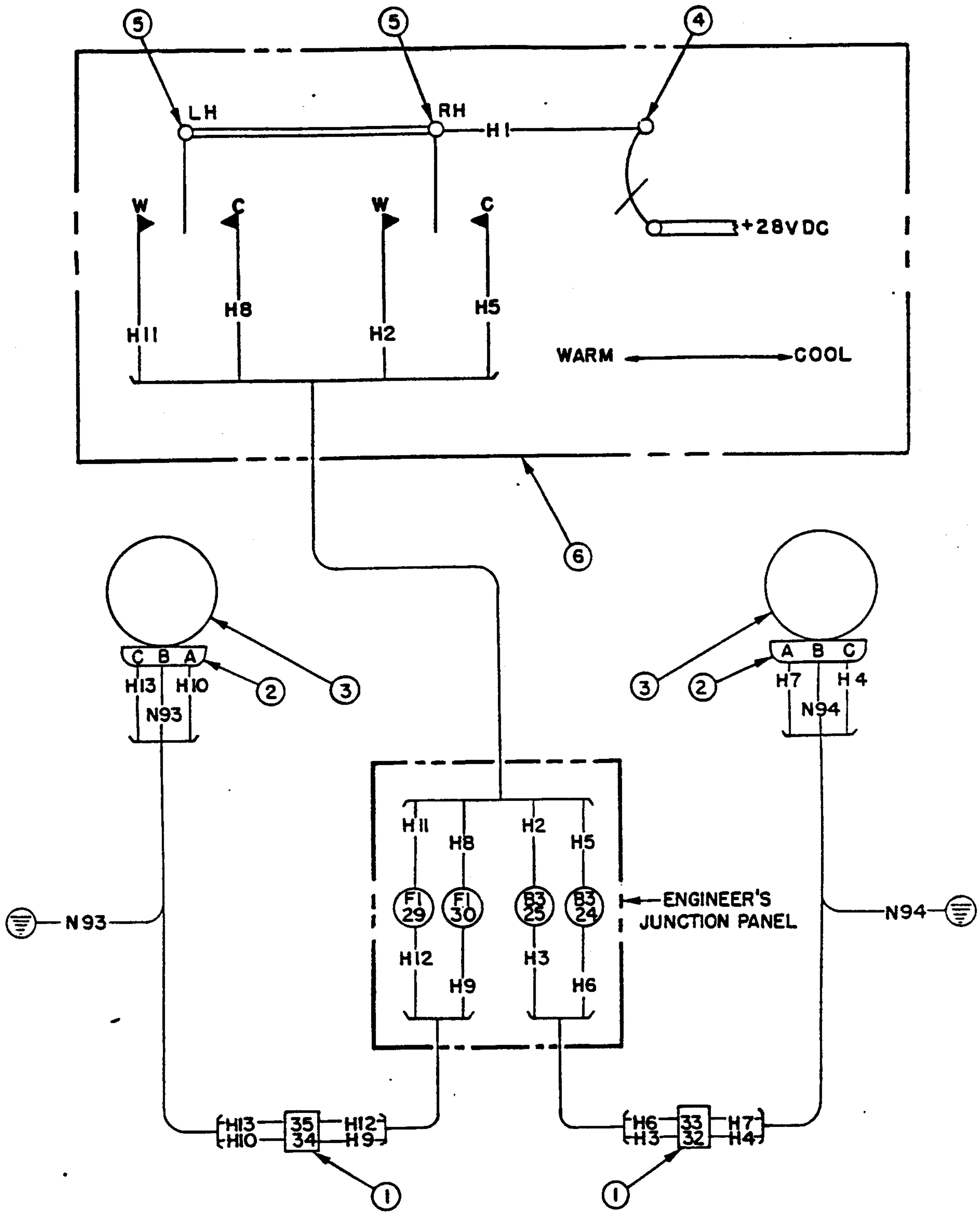
ART	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	POLARIZED RELAY	G.E.		CR2780-A104A2
2	PLUG		AN	3106-16S-1S
3	PLUG		AN	3108-18-5S
4	PLUG	AMPHENOL		97-3106-12SL-844S
5	RELAY	CUTLER HAMMER		9565H6
6	MOTOR	G.E.		P4274897GR1
7	L.H. OUTB'D ENG. COMPT. RELAY	NORTHROP		584573
8	TRANSFER THERMOSTAT	G.E.		CR2992-B100A4
9	THERMO-SENSITIVE ELEMENT	G.E.		CR2992-A101A4
10	PLUG		AN	3108-8S-1S
11	PRESSURE SWITCH	G.E.		2927D100J12
12	PRESSURE SWITCH	G.E.		2927D100J13
13	PRESS. & TEMP. PANEL	NORTHROP		554881
14	B.B. #2 AFT RELAY PANEL	NORTHROP		584631
15	PRESSURIZED PLUG	THOMAS & BETTS		BDS-1354-B

Figure 72. Cylinder Head Temperature - LH Wing



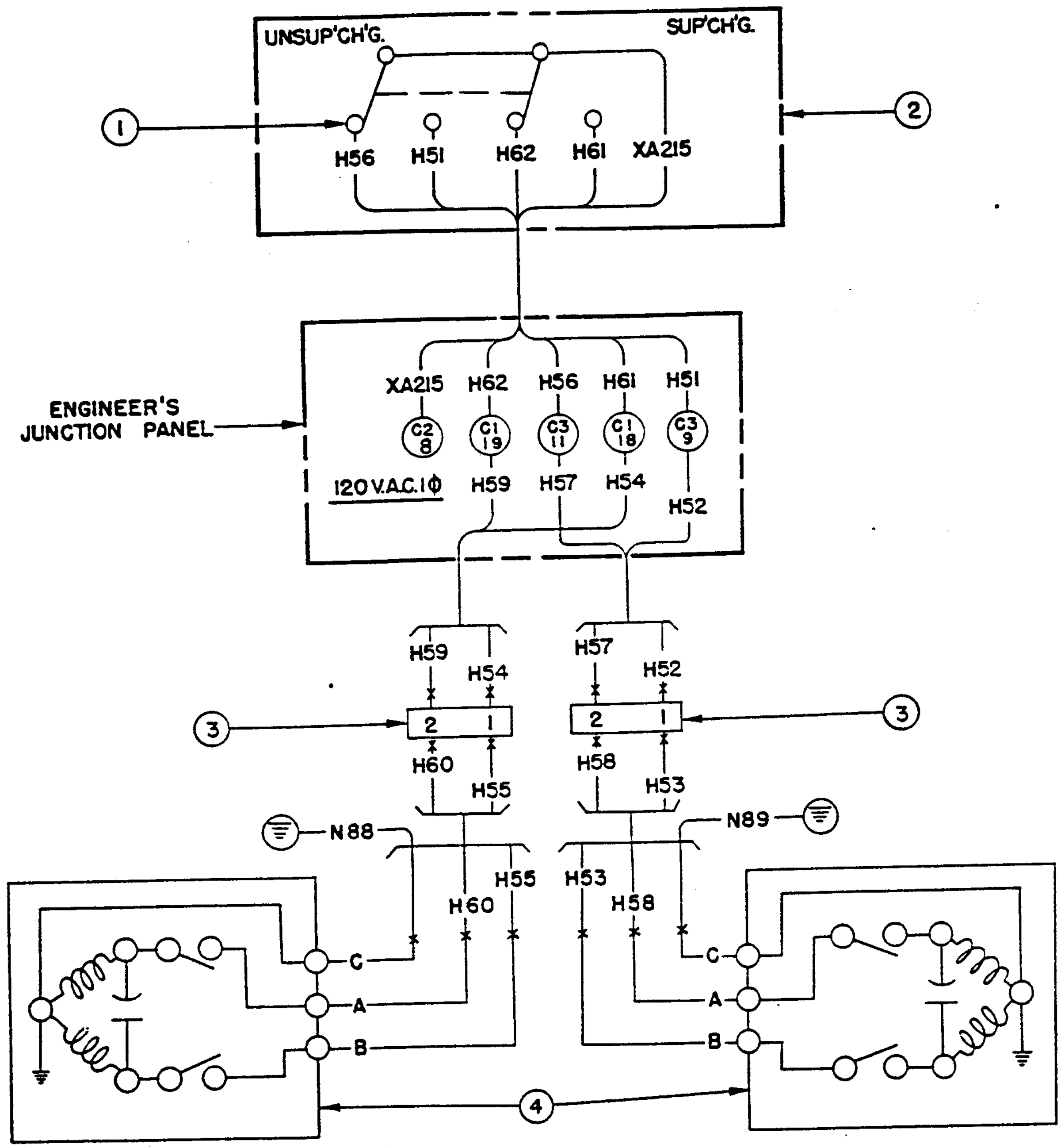
ART	NAME	REQ.	MAKE	TYPE	SPEC OR PART NO.
1	POLARIZED RELAY	2	G.E.		CR2780-A104A2
2	PLUG	4		AN	3106-16S-1S
3	PLUG	2		AN	3106-18-4S
4	PLUG	4	AMPHENOL		97-3106-12SL-844S
5	RELAY	2	CUTTER-HAMMER	648	9565H6
6	MOTOR	2	G. E.		P-4274897GR1
7	#4 AFT ENG. COMPT. RELAYBOX	1	NORTHROP		584574
8	TRANSFER THERMOSTAT	2	G.E.		CR2992-B100A4
9	THERMO-SENSITIVE ELEMENT	2	G.E.		CR 2992-A101A4
10	PLUG	2		AN	3108-8S-1S
11	PRESSURE SWITCH	2	G.E.		CR2927-D100J12
12	PRESSURE SWITCH	2	G.E.		CR2927-D100J13
13	PRESS & TEMP. PANEL	2	NORTHROP		554881
14	B.B. #7 AFT RELAY PANEL	1	NORTHROP		584632
15	PRESSURIZED PLUG	2	THOMAS & BETTS		

Figure 73. Cylinder Head Temperature - RH Wing



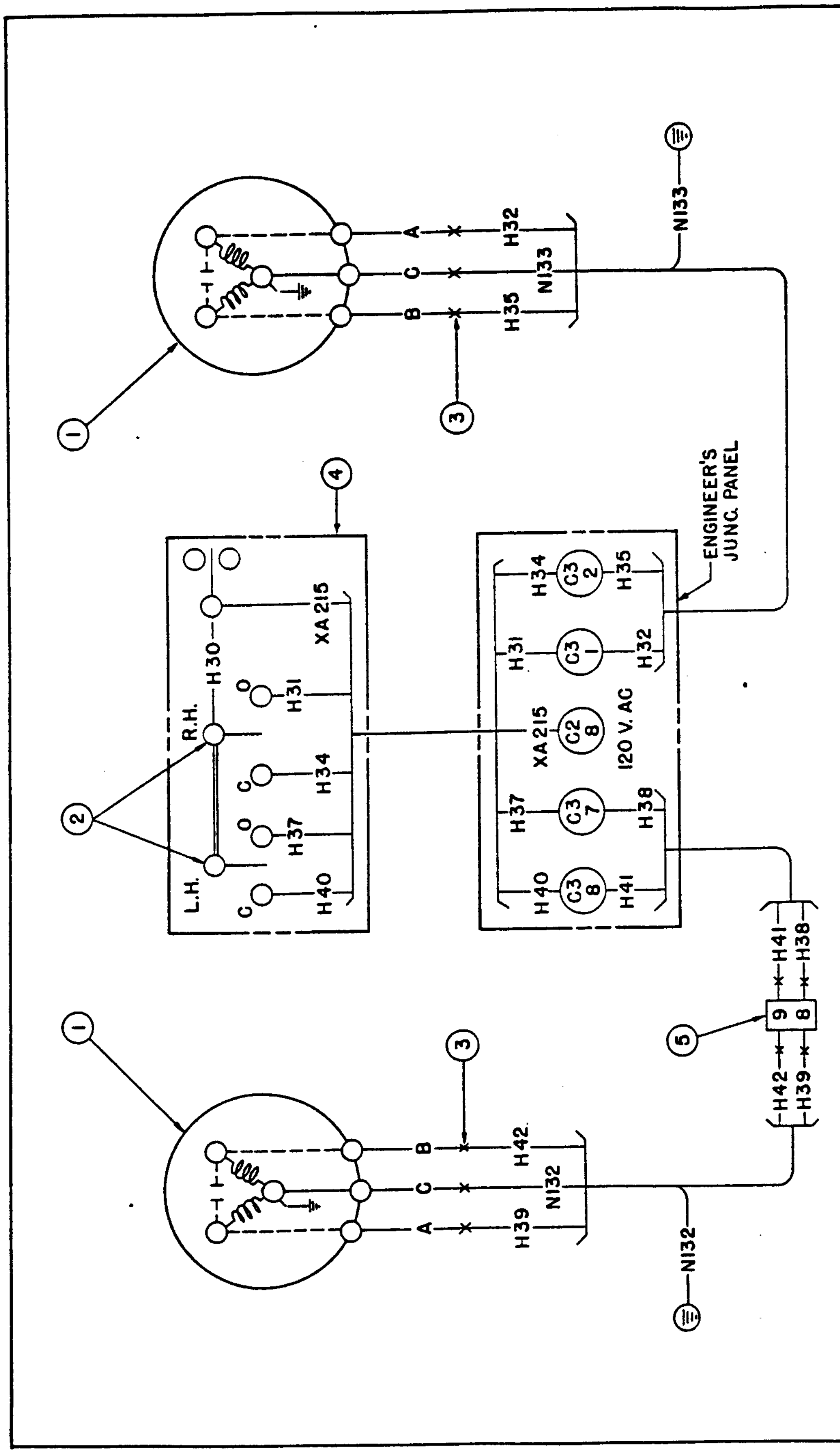
ART	NAME	REQ	MAKE	TYPE	SPEC. OR PART NO
1	PRESSURIZED PLUG	2	THOMAS & BETTS		BDS1354A
2	PLUG	2		AN	3106-14S-1S
3	MOTOR VALVE	2	WHITE-ROGERS		6913-3
4	CIRCUIT BREAKER	1		AN	3160-10
5	SWITCH	2		AN	3022-7
6	ENGINEERS UPPER SWITCH	1	NORTHROP		552722

Figure 74. Cabin Temperature Control



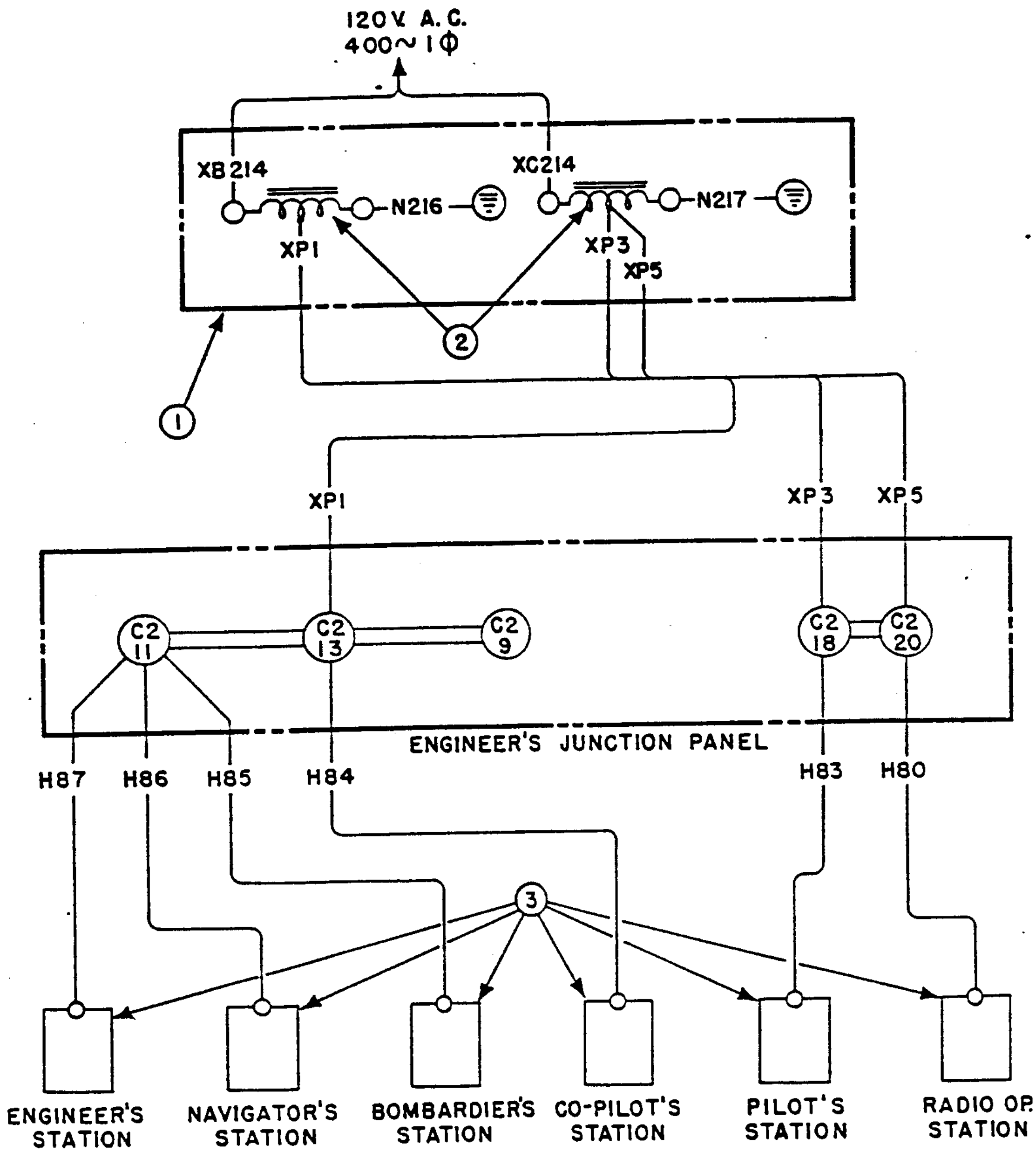
ART	NAME	REQ	MAKE	TYPE	SPEC OR PART NO.
1	SWITCH	1		AN	3023-3
2	ENGINEER'S PANEL	1			552722
3	PRESSURIZED PLUG	2	THOMAS & BETTS		BDS-1354-B
4	VALVE	2	AIRESEARCH		2913

Figure 75. Cabin Air Selector Valve Control



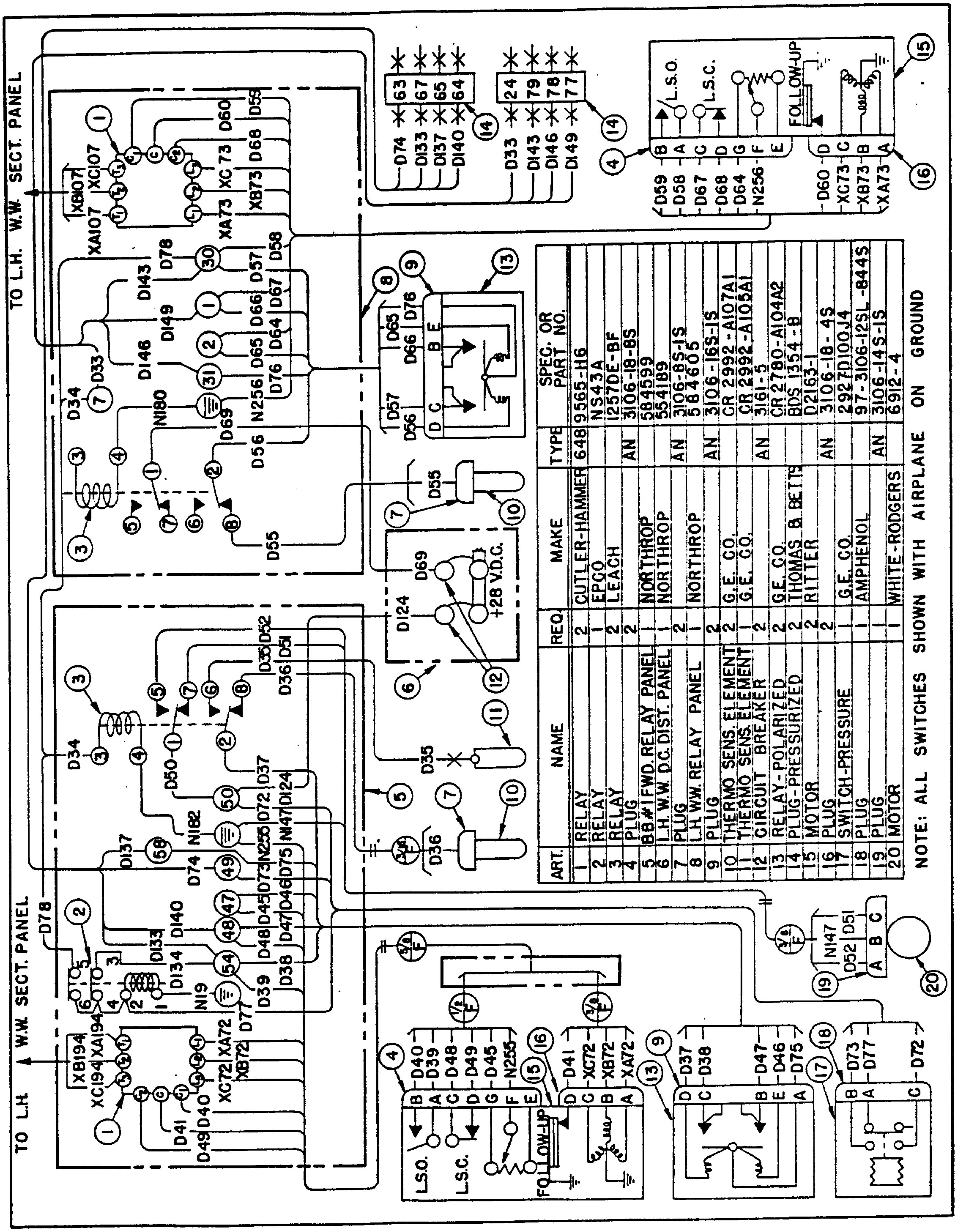
ART.	NAME	REQ.	MAKE	TYPE	SPEC. OR PART NO.
1	CHECK VALVE MOTOR	2	AIRESEARCH		90208
2	SWITCH	2		AN	3022-3
3	QUICK DISCONNECT	2		AN	753-A1
4	ENGINEERS SWITCH PANEL	1			552722
5	L.H. PRESSURIZED PLUG	1	THOMAS & BETTS		BDS-1354-B

Figure 76. Cabin Air Check Valve Control



ART.	NAME	REQ.	MAKE	TYPE	SPEC. OR PART NO.
1	TRANSFORMER PANEL	1	NORTHROP		554669
2	TRANSFORMER	2	GENERAL ELECTRIC		70G81
3	RHEOSTAT	6		Q-1B	

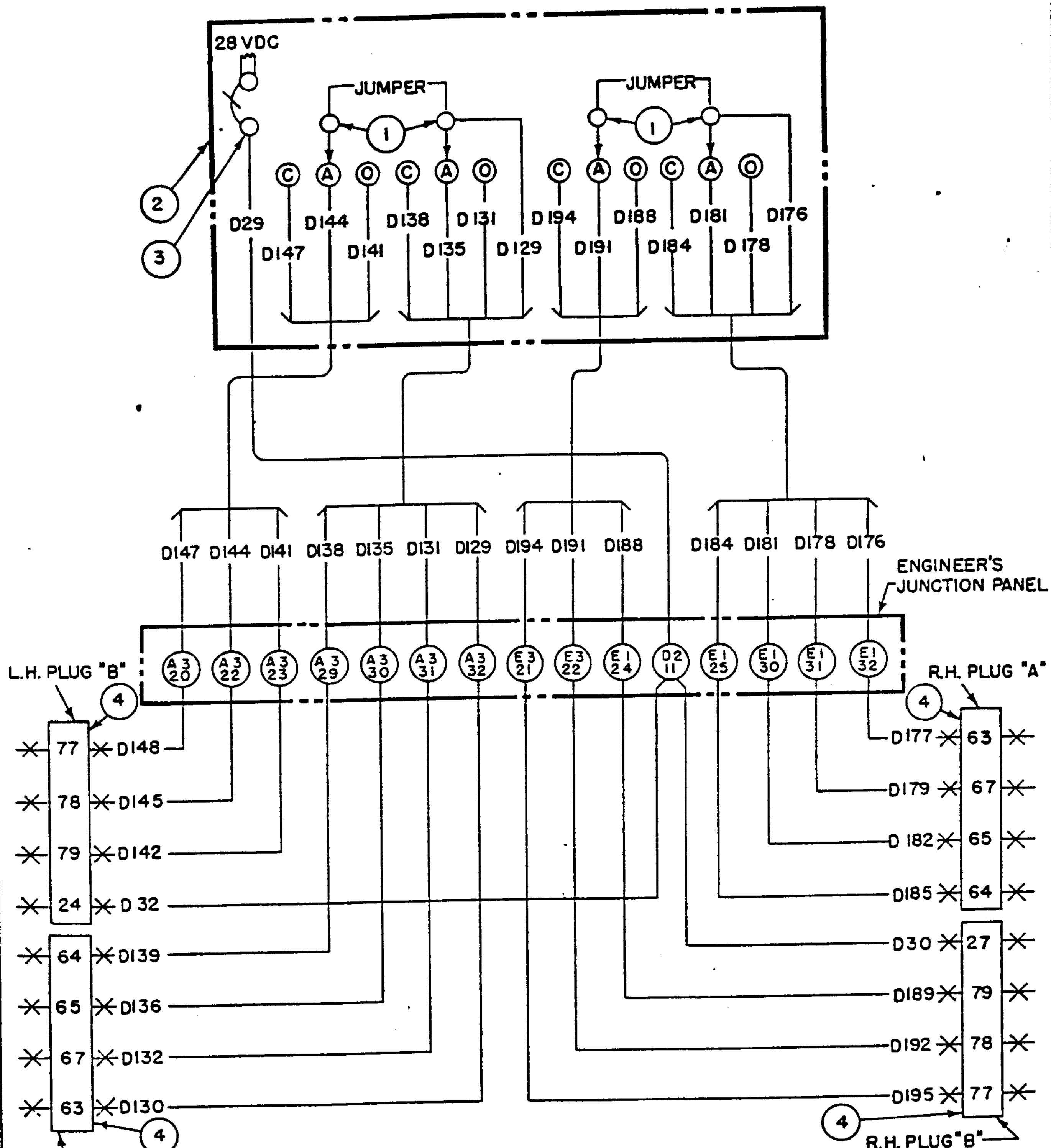
Figure 77 Heated Flying Suits



ART.	NAME	REQ.	MAKE	TYPE	SPEC. OR PART NO.
1	RELAY	2	CUTLER-HAMMER	648	9565-H6
2	RELAY	1	EPCO		NS43A
3	RELAY	2	LEACH		1257DE-BF
4	PLUG	2		AN	3106-18-8S
5	BB#1FWD. RELAY PANEL	1	NORTHROP		584599
6	L.H. W.W. D.C. DIST. PANEL	1	NORTHROP		554189
7	PLUG	2		AN	3106-8S-1S
8	L.H. WW. RELAY PANEL	1	NORTHROP		584605
9	PLUG	2		AN	3106-16S-1S
10	THERMO SENS. ELEMENT	2	G.E. CO.		CR 2992-A107A1
11	THERMO SENS. ELEMENT	1	G.E. CO.		CR 2992-A105A1
12	CIRCUIT BREAKER	2		AN	3161-5
13	RELAY-POLARIZED	2	G.E. CO.		CR 2780-A104A2
14	PLUG-PRESSURIZED	2	THOMAS & BETTS		BDS 1354-B
15	MOTOR	2	RITTER		D2163-1
16	PLUG	2		AN	3106-18-4S
17	SWITCH-PRESSURE	1	G.E. CO.		2927D100J4
18	PLUG	1	AMPHENOL		97-3106-12SL-844S
19	PLUG	1		AN	3106-14S-1S
20	MOTOR	1	WHITE-RODGERS		6912-4

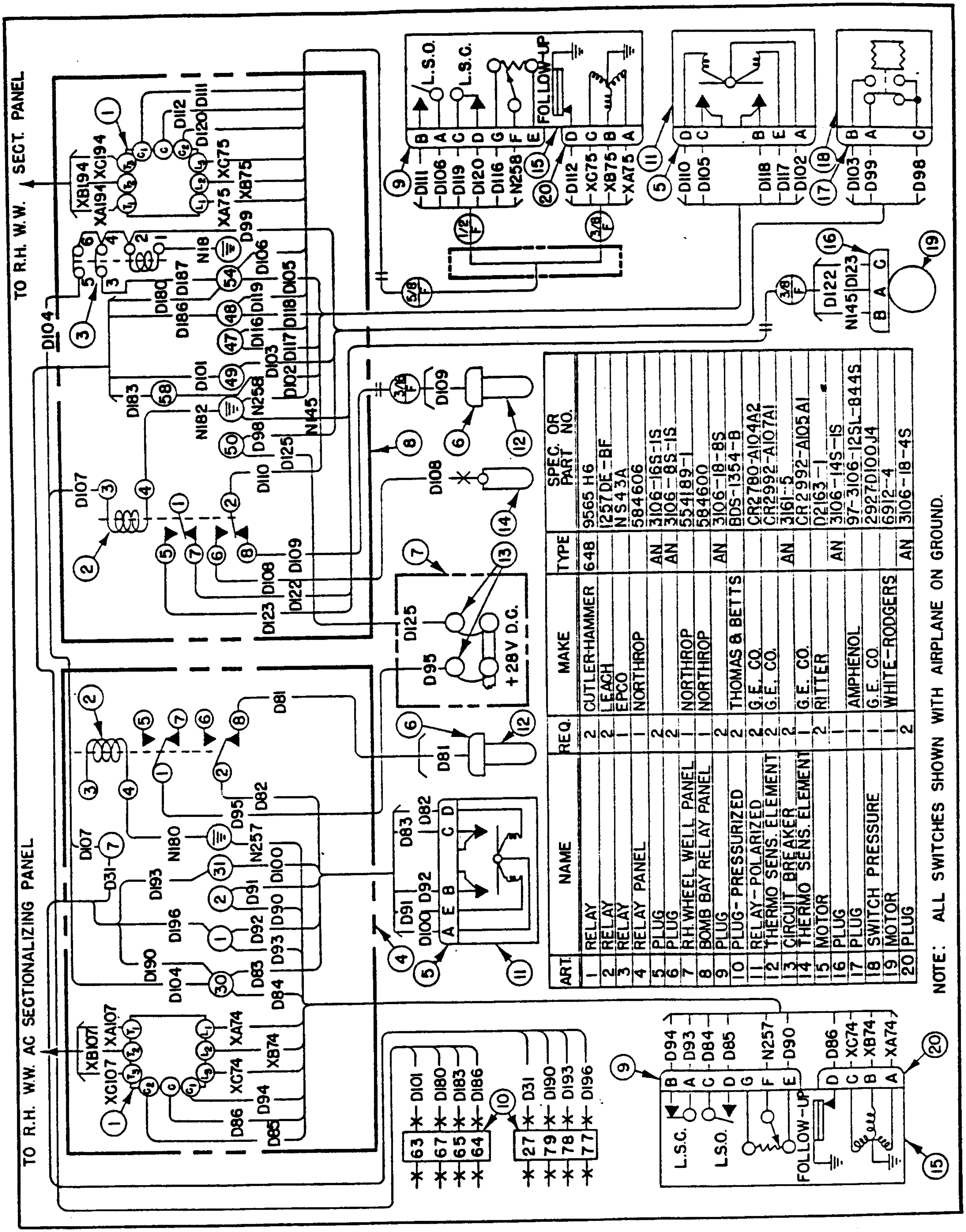
NOTE: ALL SWITCHES SHOWN WITH AIRPLANE ON GROUND

Figure 79. Anti-Icer and Exhaust System - LH Wing



ART.	NAME	REQ.	MAKE	TYPE	SPEC. OR PART NO.
1	SWITCH	4	CUTLER-HAMMER		8905K 608
2	ENGR. SWITCH PANEL	1	NORTHROP		552722
3	CIRCUIT BREAKER	1		AN	3160-5
4	PRESS. PLUG (REF)	4	THOMAS & BETTS		BDS-1354-B

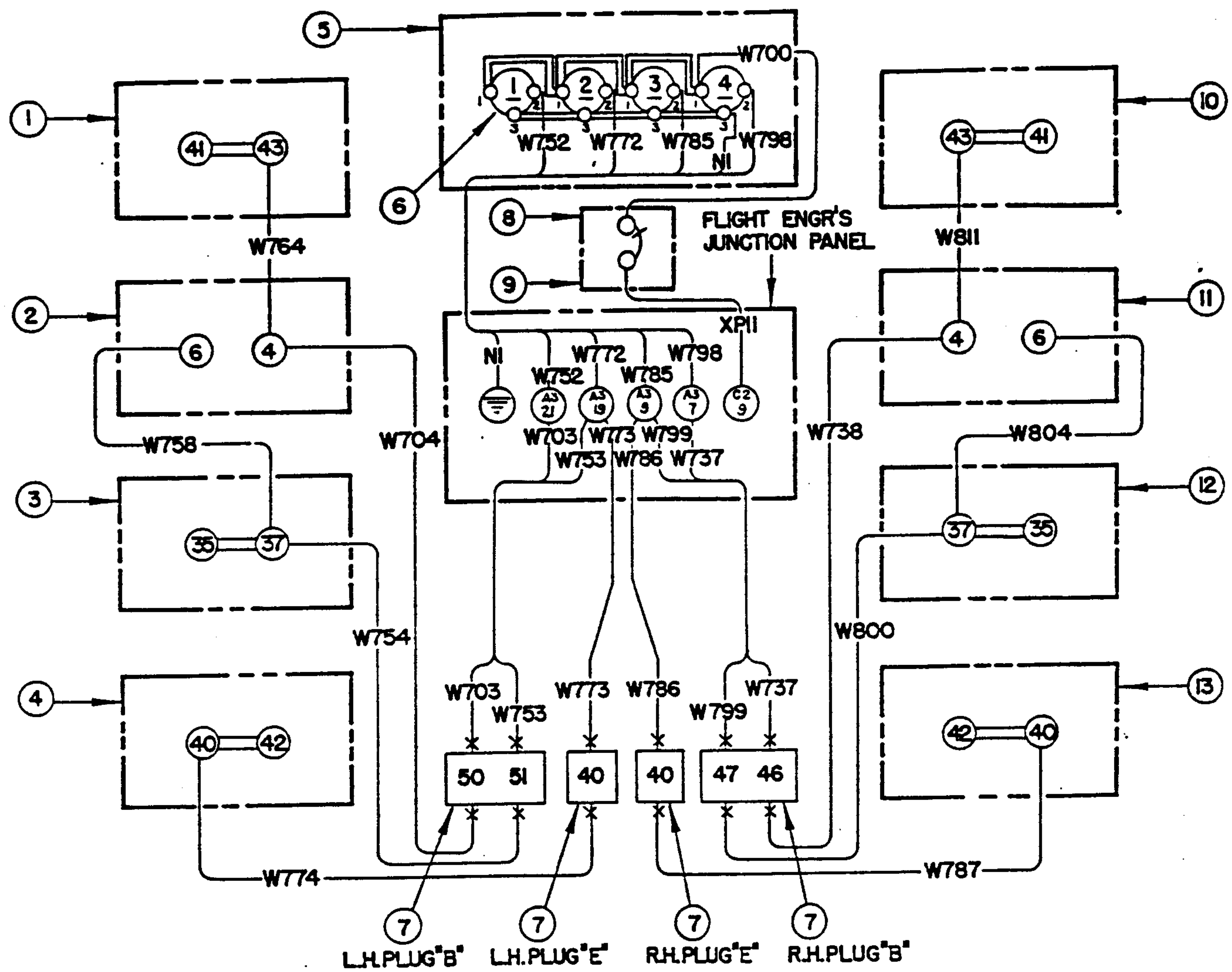
Figure 78. Anti-Icer and Exhaust System - Crew Nacelle



ART.	NAME	REQ.	MAKE	TYPE	SPEC. OR PART NO.
1	RELAY	2	CUTLER-HAMMER	648	9565 H6
2	RELAY	2	LEACH		1257DE-BF
3	RELAY	1	EPCO		NS43A
4	RELAY PANEL	1	NORTHROP		584606
5	PLUG	2		AN	3106-16S-1S
6	PLUG	2		AN	3106-8S-1S
7	R.H. WHEEL WELL PANEL	1	NORTHROP		554189-1
8	BOMB BAY RELAY PANEL	1	NORTHROP		584600
9	PLUG	2		AN	3106-18-8S
10	PLUG-PRESSURIZED	2	THOMAS & BETTS		BDS-1354-B
11	RELAY-POLARIZED	2	G.E. CO.		CR2780-A104A2
12	THERMO SENS. ELEMENT	2	G.E. CO.		CR2992-A107A1
13	CIRCUIT BREAKER	2		AN	3161-5
14	THERMO SENS. ELEMENT	1	G.E. CO.		CR2992-A105A1
15	MOTOR	2	RITTER		D2163-1
16	PLUG	1		AN	3106-14S-1S
17	PLUG	1	AMPHENOL		97-3106-12SL-B44S
18	SWITCH PRESSURE	1	G.E. CO.		2927D100J4
19	MOTOR	1	WHITE-RODGERS		6912-4
20	PLUG	2		AN	3106-18-4S

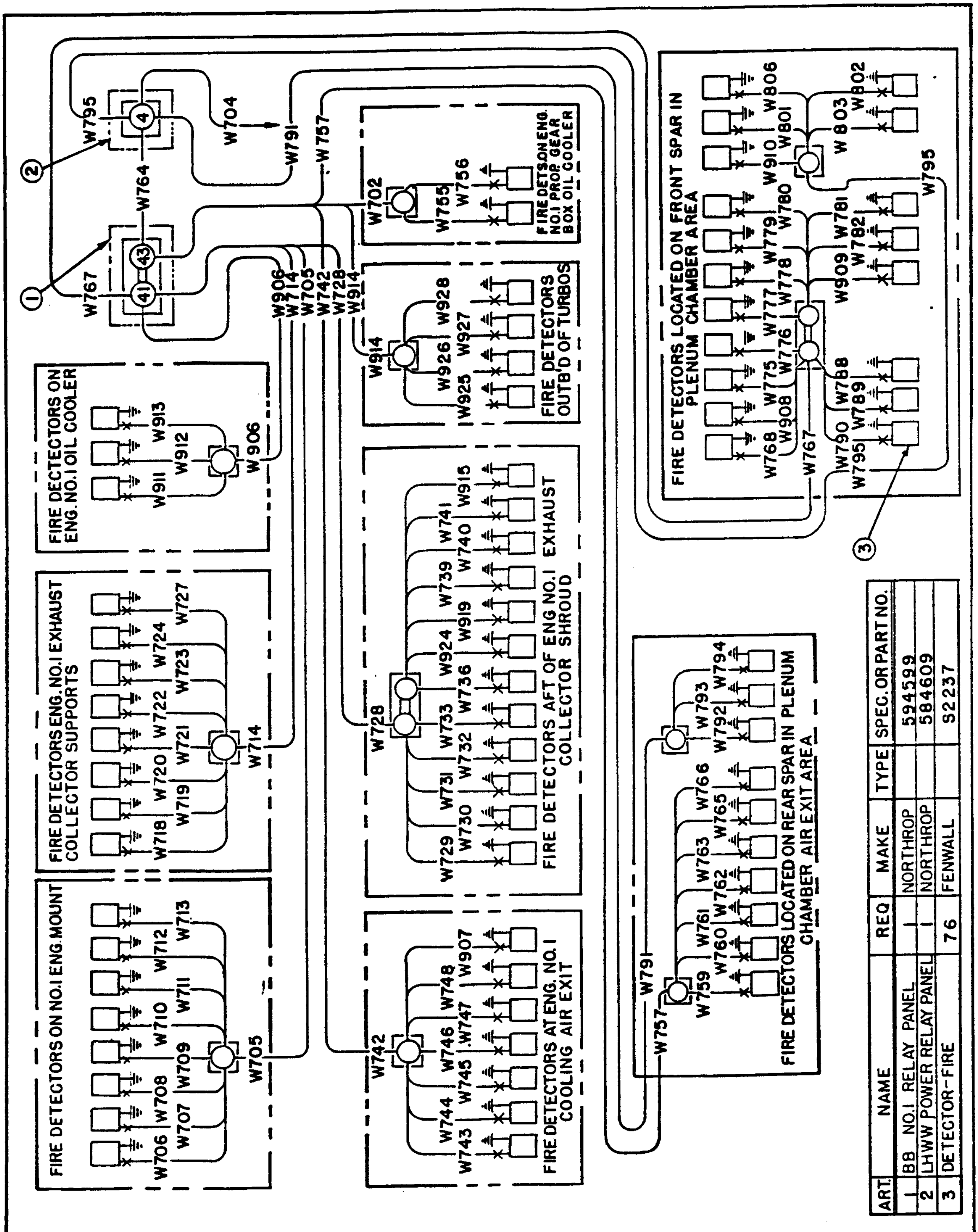
NOTE: ALL SWITCHES SHOWN WITH AIRPLANE ON GROUND.

Figure 80. Anti-Icer and Exhaust System - RH Wing



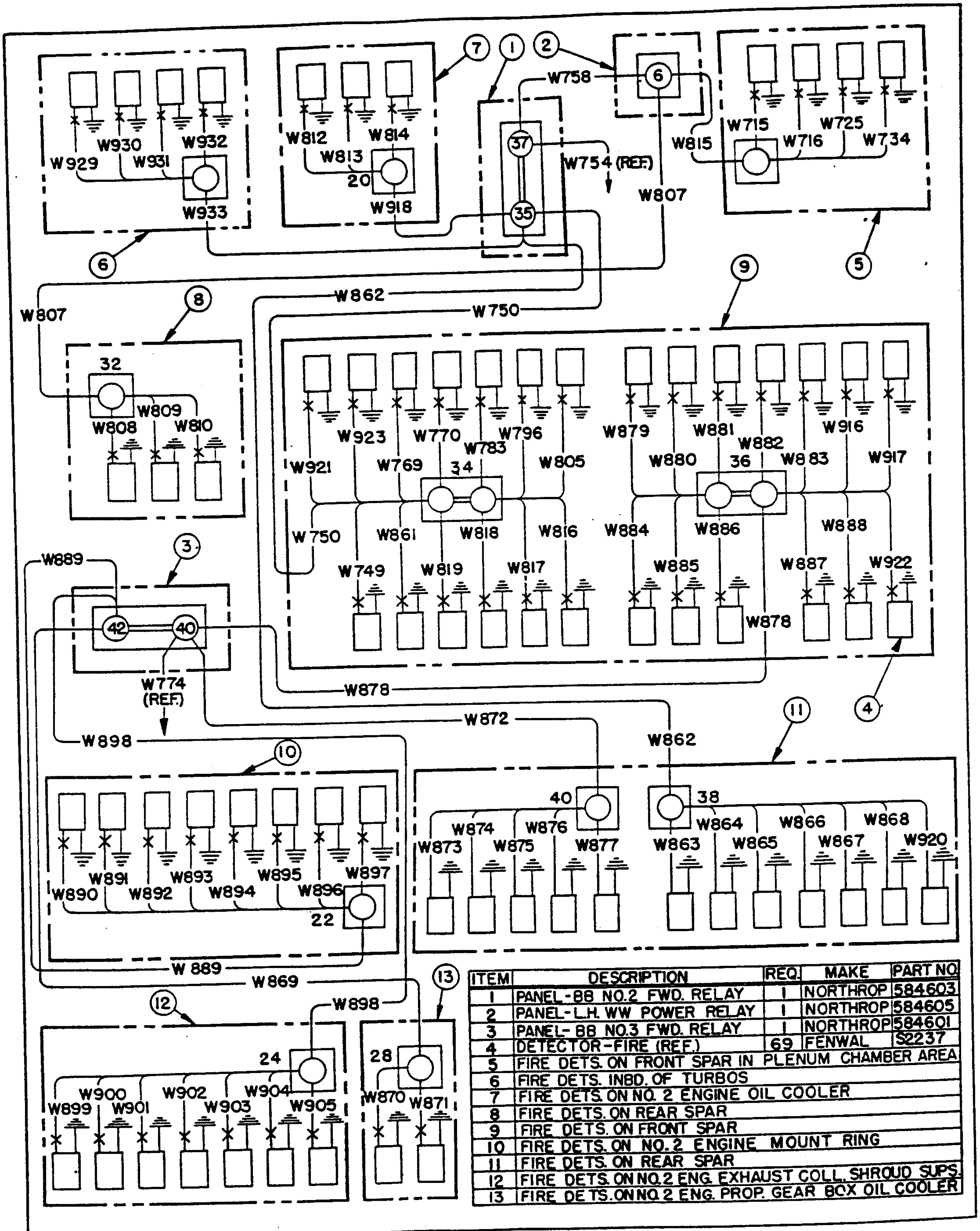
ART.	NAME	REQ.	MAKE	TYPE	SPEC. OR PART NO.
1	BOMB BAY NO.1 FWD. RELAY PANEL	1	NORTHROP		584599
2	L.H. WHEEL WELL FWD. RELAY PANEL	1	NORTHROP		584605
3	BOMB BAY NO.2 FWD. RELAY PANEL	1	NORTHROP		584603
4	BOMB BAY NO.3 FWD. RELAY PANEL	1	NORTHROP		584601
5	ENGR'S FIRE EXTIN. PANEL	1	NORTHROP		553068
6	LAMP ASSEMBLY	1			44A18454-9
7	PRESSURIZED PLUG	4	THOMAS & BETTS		BDS-1354-B
8	ENGR'S. UPPER SWITCH PANEL	1	NORTHROP		552722
9	CIRCUIT BREAKER	1		AN	3160-5
10	BOMB BAY NO. 8 FWD. RELAY PANEL	1	NORTHROP		584600
11	R.H. WHEEL WELL FWD. RELAY PANEL	1	NORTHROP		584606
12	BOMB BAY NO. 7 FWD. RELAY PANEL	1	NORTHROP		584604
13	BOMB BAY NO. 6 FWD. RELAY PANEL	1	NORTHROP		584602

Figure 81. Fire Detector - Control Panel to Relay Panel



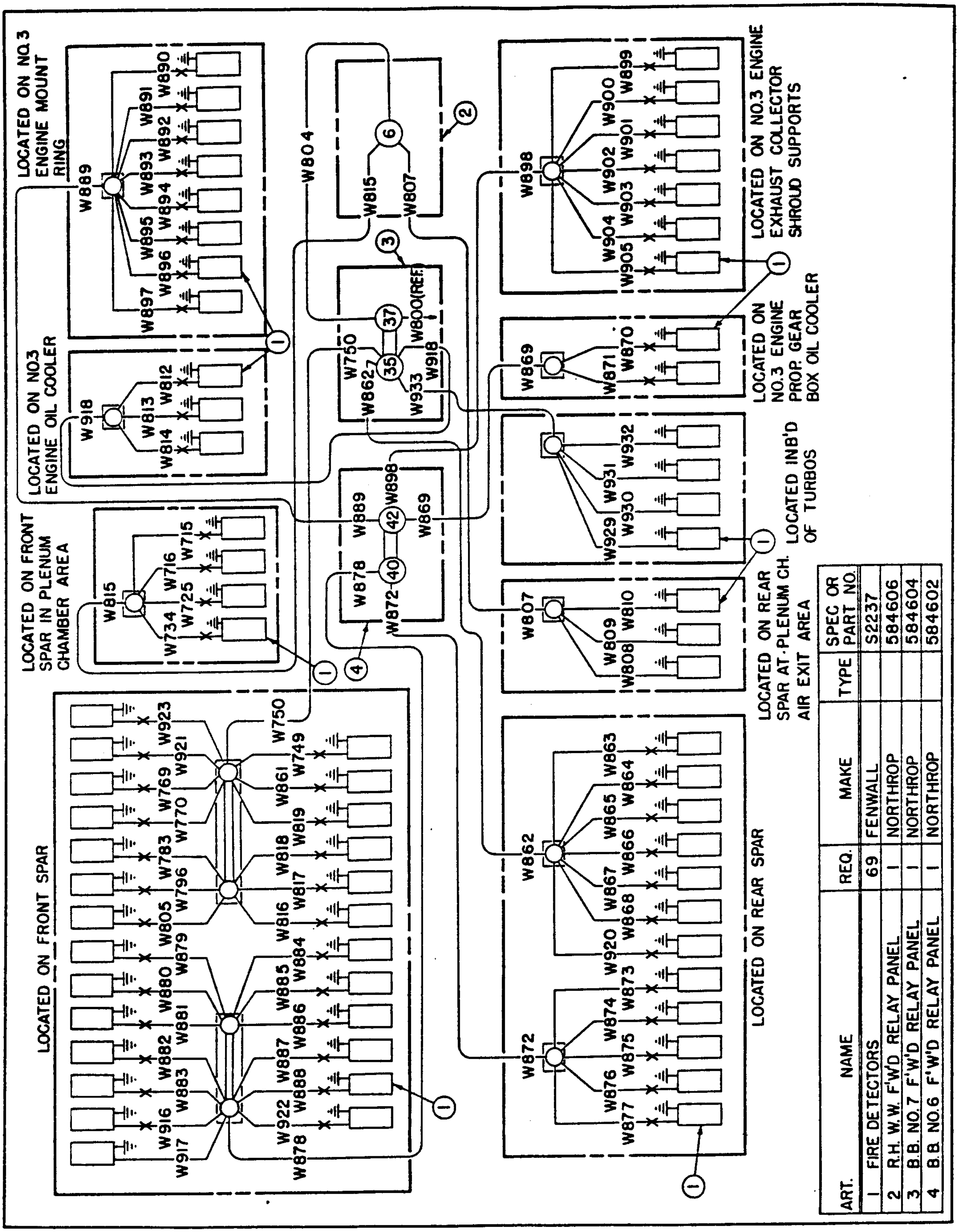
ART.	NAME	REQ	MAKE	TYPE	SPEC. OR PART NO.
1	BB NO.1 RELAY PANEL	1	NORTHROP		594599
2	LHWW POWER RELAY PANEL	1	NORTHROP		584609
3	DETECTOR-FIRE	76	FENWALL		S2237

Figure 82. Fire Detector - Zone 1



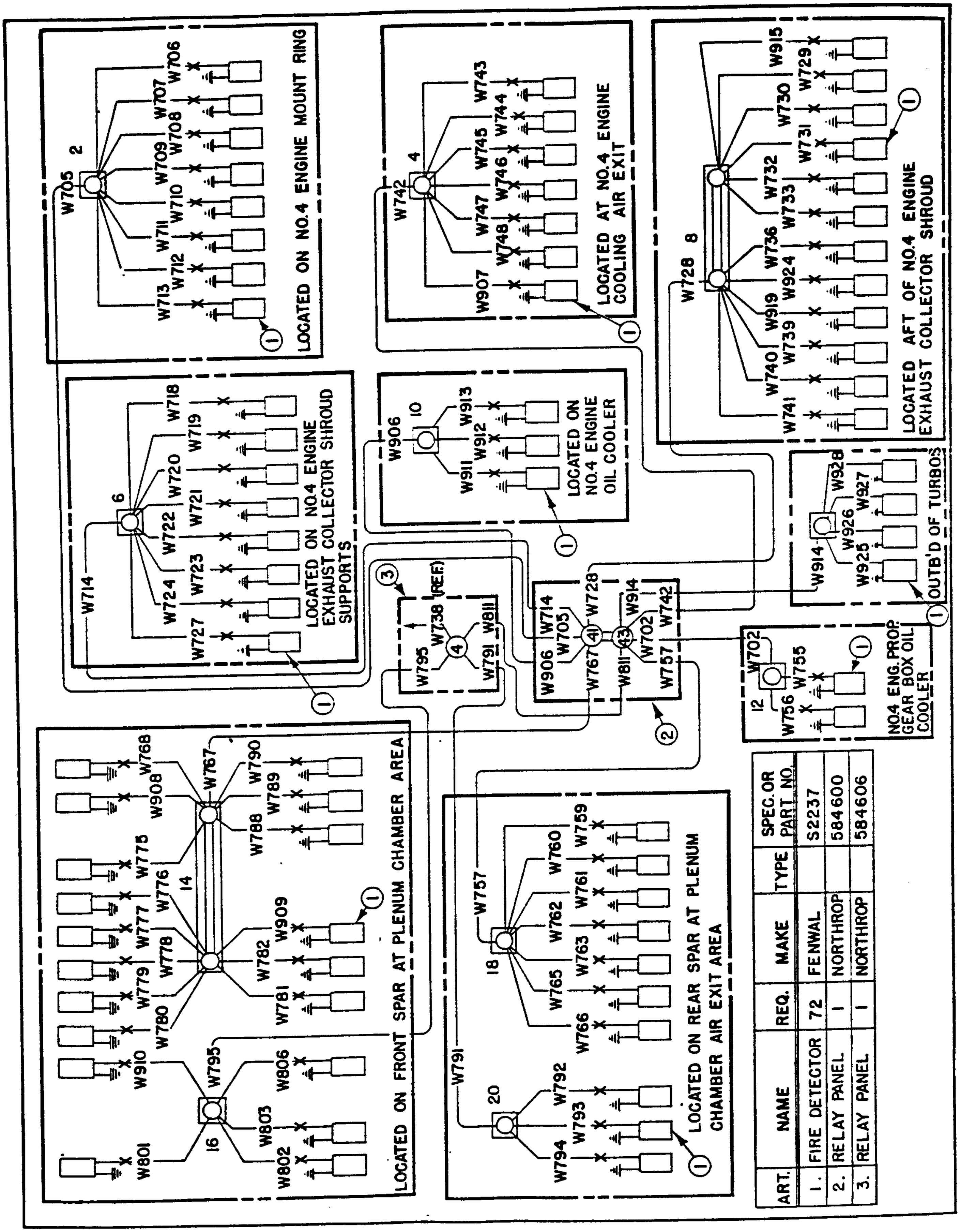
ITEM	DESCRIPTION	REQ.	MAKE	PART NO.
1	PANEL-88 NO.2 FWD. RELAY	1	NORTHROP	584603
2	PANEL-L.H. WW POWER RELAY	1	NORTHROP	584605
3	PANEL-88 NO.3 FWD. RELAY	1	NORTHROP	584601
4	DETECTOR-FIRE (REF.)	69	FENWAL	S2237
5	FIRE DETS. ON FRONT SPAR IN PLENUM CHAMBER AREA			
6	FIRE DETS. INBD. OF TURBOS			
7	FIRE DETS. ON NO. 2 ENGINE OIL COOLER			
8	FIRE DETS. ON REAR SPAR			
9	FIRE DETS. ON FRONT SPAR			
10	FIRE DETS. ON NO. 2 ENGINE MOUNT RING			
11	FIRE DETS. ON REAR SPAR			
12	FIRE DETS. ON NO.2 ENG. EXHAUST COLL. SHROUD SUPS.			
13	FIRE DETS. ON NO.2 ENG. PROP. GEAR BOX OIL COOLER			

Figure 83. Fire Detector - Zone 2



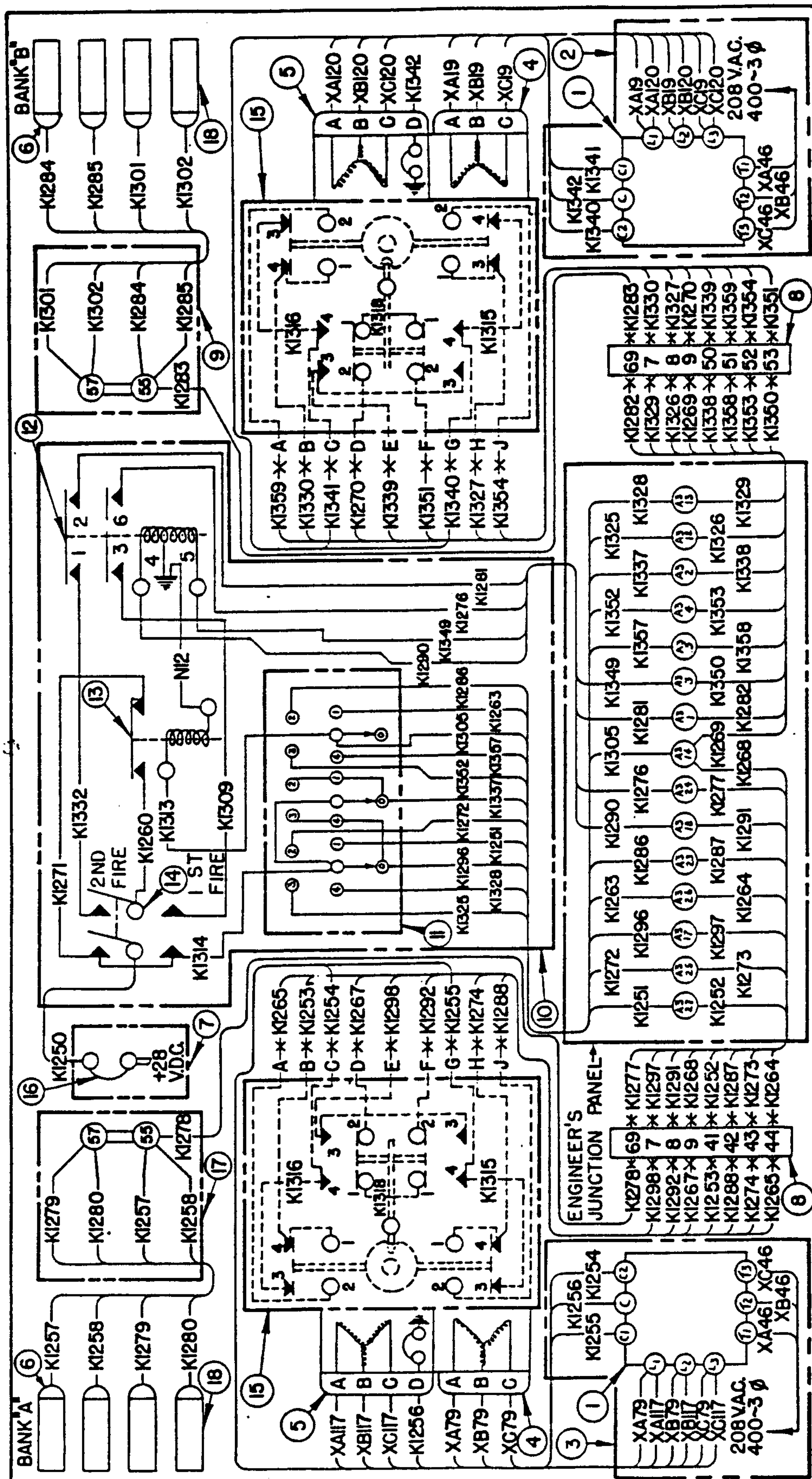
ART.	NAME	REQ.	MAKE	TYPE	SPEC OR PART NO.
1	FIRE DETECTORS	69	FENWALL		S2237
2	R.H. W.W. F'WD RELAY PANEL	1	NORTHROP		584606
3	B.B. NO.7 F'WD RELAY PANEL	1	NORTHROP		584604
4	B.B. NO.6 F'WD RELAY PANEL	1	NORTHROP		584602

Figure 84. Fire Detector - Zone 3



ART.	NAME	REQ.	TYPE	MAKE	SPEC. OR PART NO.
1.	FIRE DETECTOR	72		FENWAL	S2237
2.	RELAY PANEL	1		NORTHROP	584600
3.	RELAY PANEL	1		NORTHROP	584606

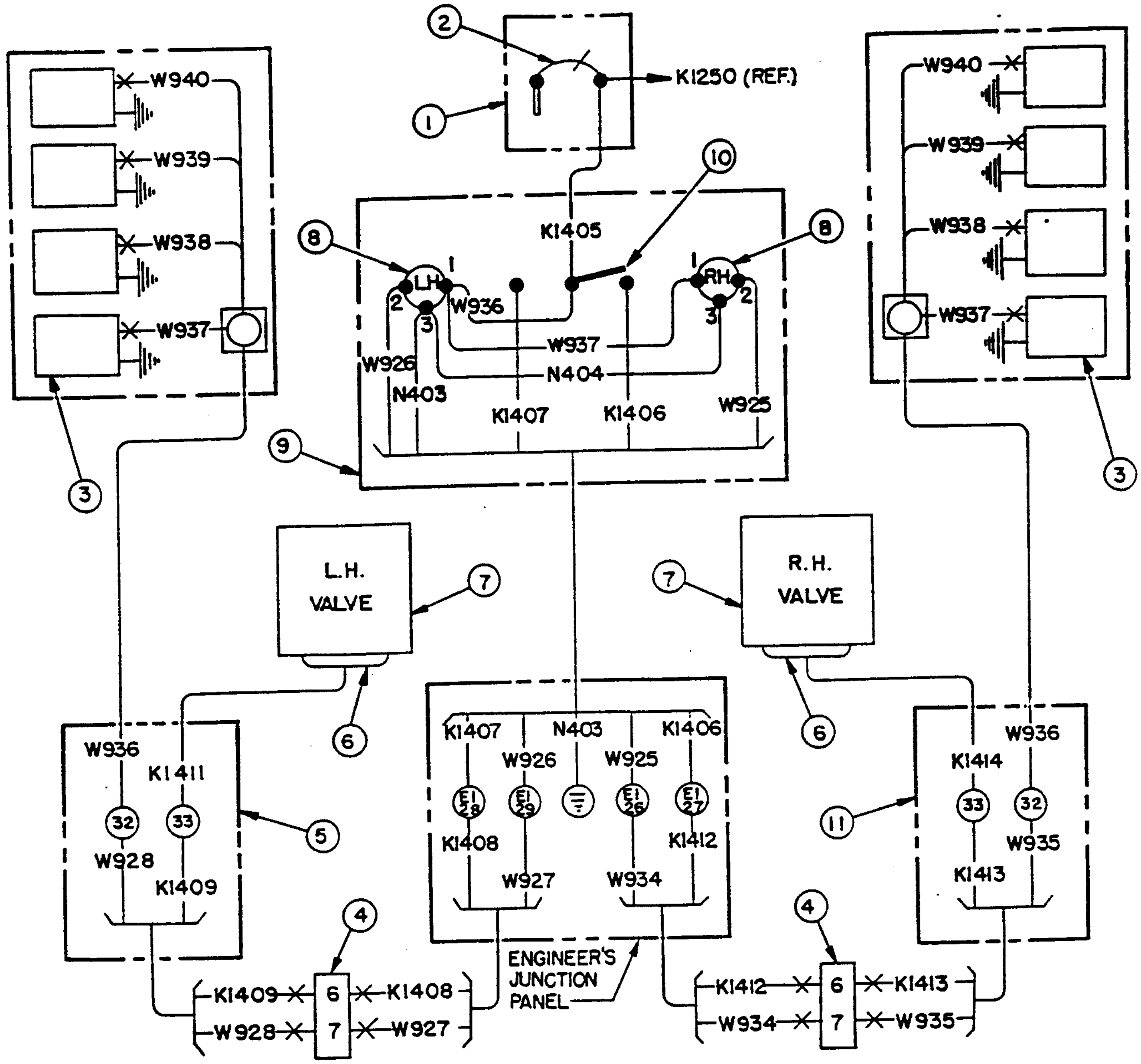
Figure 85. Fire Detector - Zone 4



ART	NAME	REQ	MAKE	TYPE	SPEC. OR PART NO.
1	RELAY	2	CUTL'R-HAMM'R	648	9565H6
2	R.H. OUTBD ENG. COMP. REL. PANEL	1	NORTHROP		584574
3	L.H. OUTBD ENG. COMP. REL. PANEL	1	NORTHROP		584573
4	PLUG-ELECT. CONN. STRAIGHT	2		AN	3106-14S-1S
5	PLUG CONN. STRAIGHT TYPE P.H.	2		AN	3108-14S-10S
6	PLUG-ELECT CONN. STRAIGHT	8		AN	3106-12S-4S
7	ENGR. UPPER SWITCH PANEL	1	NORTHROP		552727
8	PLUG-PRESSURIZED	2	THOMAS&BETTS		BDS-1354-B
9	B.B. NO.8 FWD. RELAY PANEL	1	NORTHROP		584600
10	ENGR. FIRE EX. CONT. PANEL	1	NORTHROP		553068

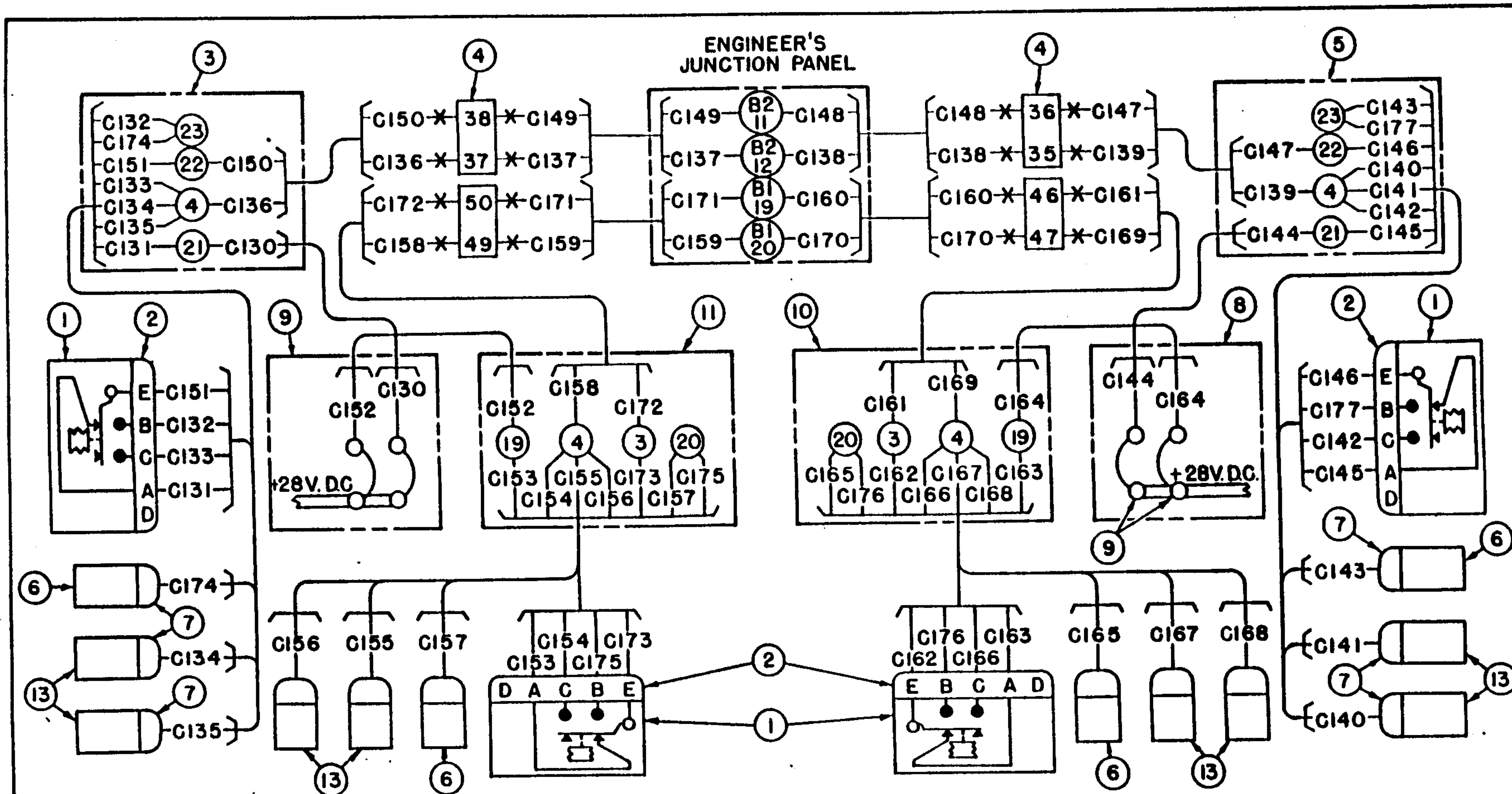
ART	NAME	REQ	MAKE	TYPE	SPEC. OR PART NO.
11	SWITCH ASSEM.	1	NORTHROP		556629
12	RELAY	1	LEACH		1254-310
13	RELAY	1	EPCO		NS47E
14	SWITCH	1		AN	3023-7
15	VALVE ASSEM.	2	NORTHROP		589714
16	CIRCUIT BREAKER	1		AN	3160-25
17	B.B.NO.1 FWD. RELAY PANEL	1	NORTHROP		584599
18	SOLENOID	8	WALTER KIDDE		66129

Figure 86. Fire Extinguisher Control



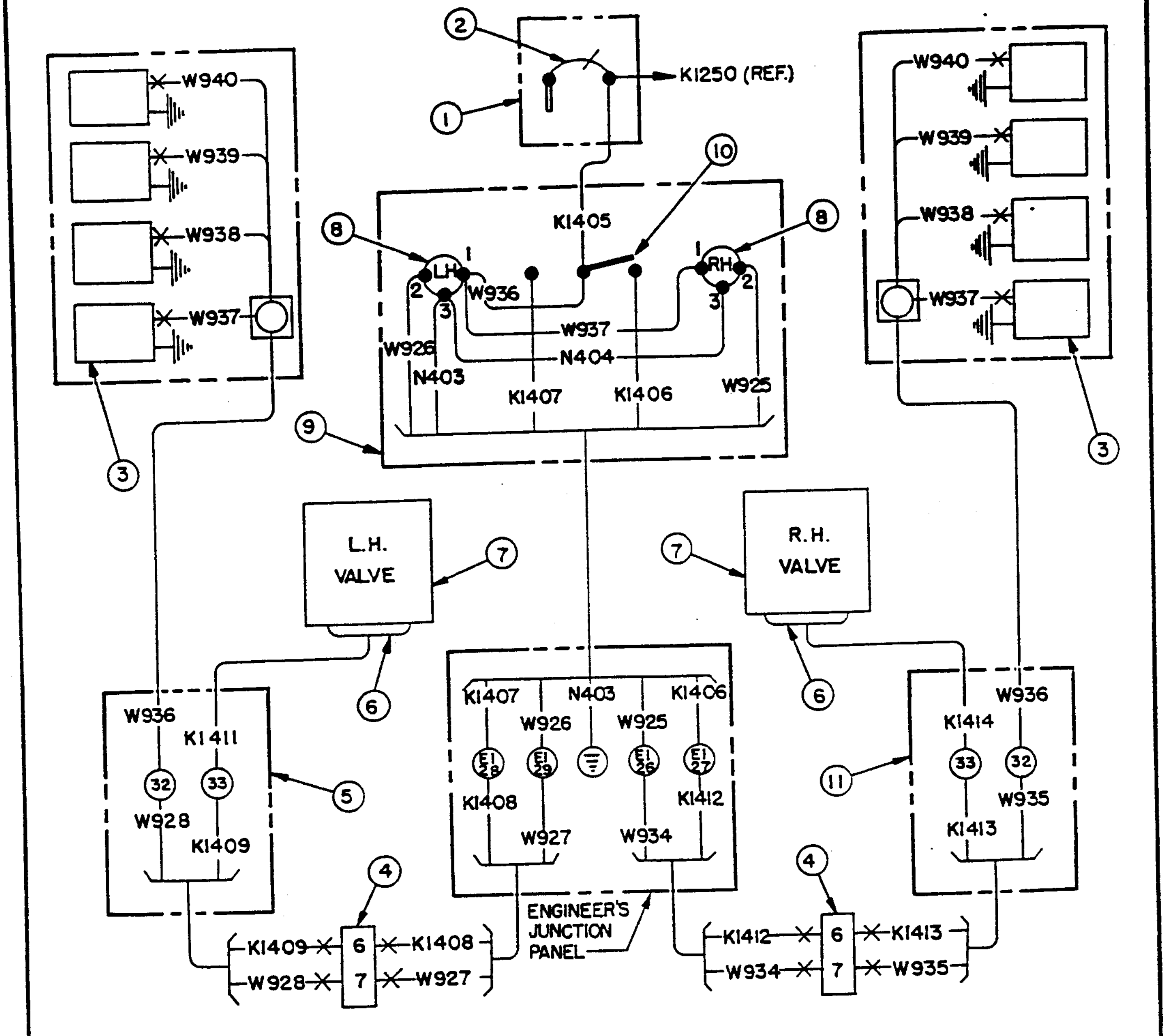
ART	NAME	REQ	MAKE	TYPE	SPEC. OR PART NO.
1	FLT. ENGRS. UPPER SW. PANEL	1	NORTHROP		552722
2	CIRCUIT BREAKER	1		AN	3160-25
3	DETECTOR FIRE	8	FENWAL		52237
4	PRESSURIZED PLUG	2	THOMAS & BETTS		BDS1354-B
5	B.B.3 FWD RELAY PANEL	1	NORTHROP		584601
6	PLUG	2		AN	3106-12S4S
7	VALVE	2	WALTER KIDDE		66129
8	LAMP ASSEMBLY	2		AAF	18454-9
9	AUX. PWR. PLANT FIRE CONTROL PANEL	1	NORTHROP		558244
10	SWITCH	1		AN	3022-7
11	B.B.6 FWD. RELAY PANEL	1	NORTHROP		584602

Figure 87. Auxiliary Power Unit Fire Detector and Control



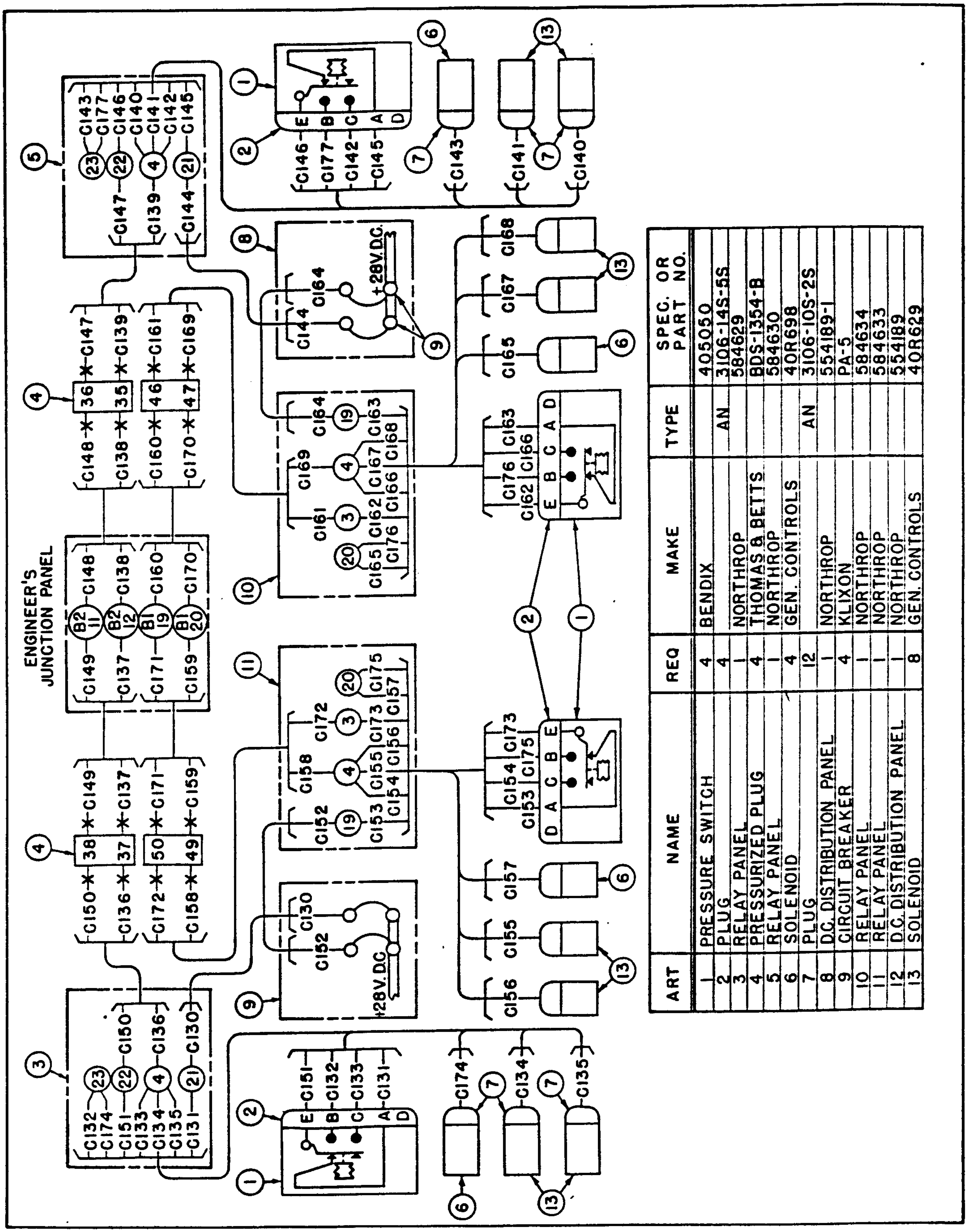
ART	NAME	REQ	MAKE	TYPE	SPEC. OR PART NO.
1	PRESSURE SWITCH	4	BENDIX		405050
2	PLUG	4		AN	3106-14S-5S
3	RELAY PANEL	1	NORTHROP		584629
4	PRESSURIZED PLUG	4	THOMAS & BETTS		BDS-1354-B
5	RELAY PANEL	1	NORTHROP		584630
6	SOLENOID	4	GEN. CONTROLS		40R698
7	PLUG	12		AN	3106-10S-2S
8	D.C. DISTRIBUTION PANEL	1	NORTHROP		554189-1
9	CIRCUIT BREAKER	4	KLIXON		PA-5
10	RELAY PANEL	1	NORTHROP		584634
11	RELAY PANEL	1	NORTHROP		584633
12	D.C. DISTRIBUTION PANEL	1	NORTHROP		554189
13	SOLENOID	8	GEN. CONTROLS		40R629

Figure 88. Hydraulic Power Boost



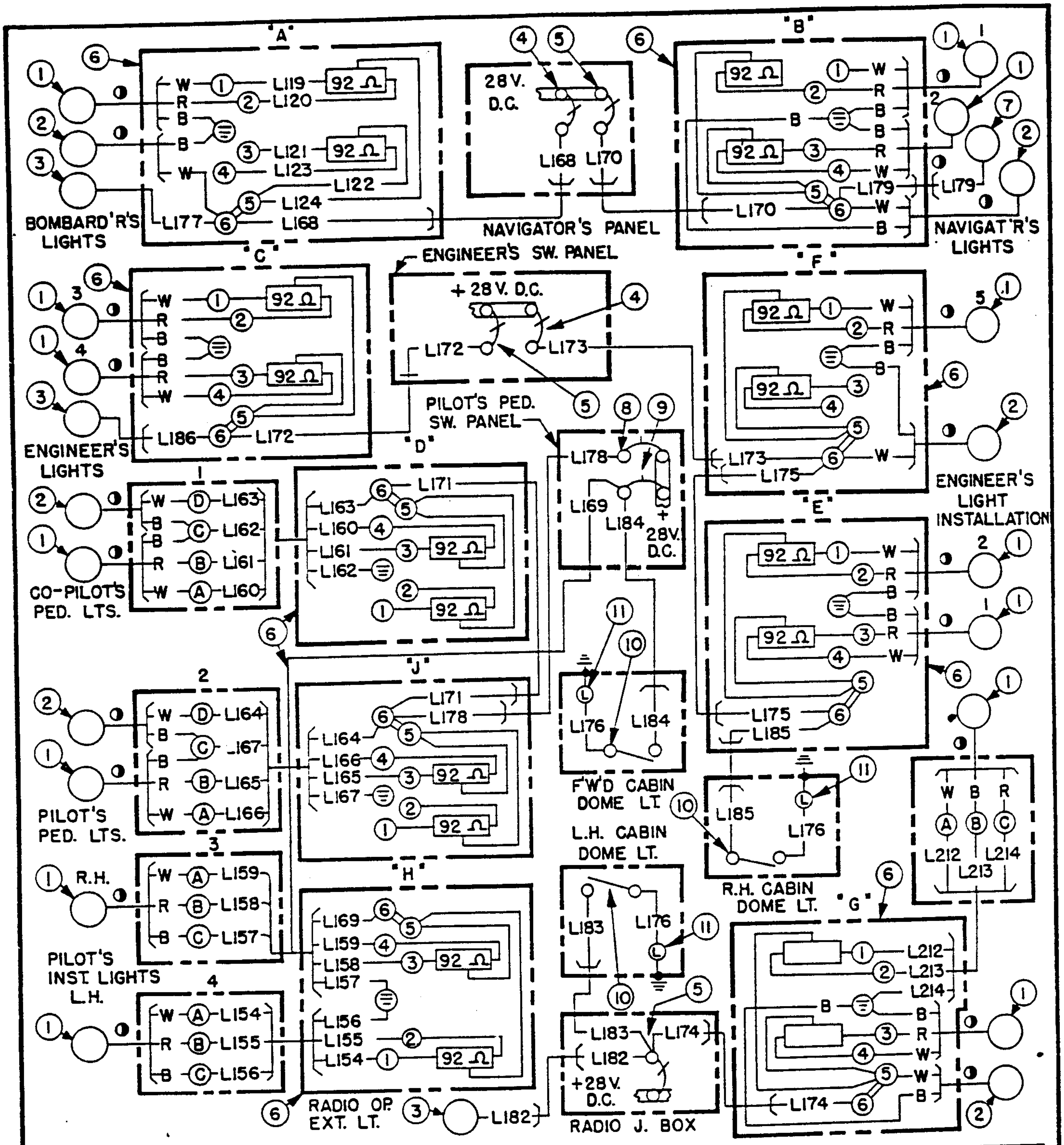
ART	NAME	REQ	MAKE	TYPE	SPEC. OR PART NO.
1	FLT. ENGRS. UPPER SW. PANEL	1	NORTHROP		552722
2	CIRCUIT BREAKER	1		AN	3160-25
3	DETECTOR FIRE	8	FENWAL		52237
4	PRESSURIZED PLUG	2	THOMAS & BETTS		BDS1354-8
5	B.B.3 FWD RELAY PANEL	1	NORTHROP		584601
6	PLUG	2		AN	3106-12S4S
7	VALVE	2	WALTER KIDDE		66129
8	LAMP ASSEMBLY	2		AAF	18454-9
9	AUX. PWR. PLANT FIRE CONTROL PANEL	1	NORTHROP		558244
10	SWITCH	1		AN	3022-7
11	B.B.6 FWD. RELAY PANEL	1	NORTHROP		584602

Figure 87. Auxiliary Power Unit Fire Detector and Control



ART	NAME	REQ	MAKE	TYPE	SPEC. OR PART NO.
1	PRESSURE SWITCH	4	BENDIX		405050
2	PLUG	4		AN	3106-14S-5S
3	RELAY PANEL	1	NORTHROP		584629
4	PRESSURIZED PLUG	4	THOMAS & BETTS		BDS-1354-B
5	RELAY PANEL	1	NORTHROP		584630
6	SOLENOID	4	GEN. CONTROLS		40R698
7	PLUG	12		AN	3106-10S-2S
8	D.C. DISTRIBUTION PANEL	1	NORTHROP		554189-1
9	CIRCUIT BREAKER	4	KLIXON		PA-5
10	RELAY PANEL	1	NORTHROP		584634
11	RELAY PANEL	1	NORTHROP		584633
12	D.C. DISTRIBUTION PANEL	1	NORTHROP		554189
13	SOLENOID	8	GEN. CONTROLS		40R629

Figure 88. Hydraulic Power Boost

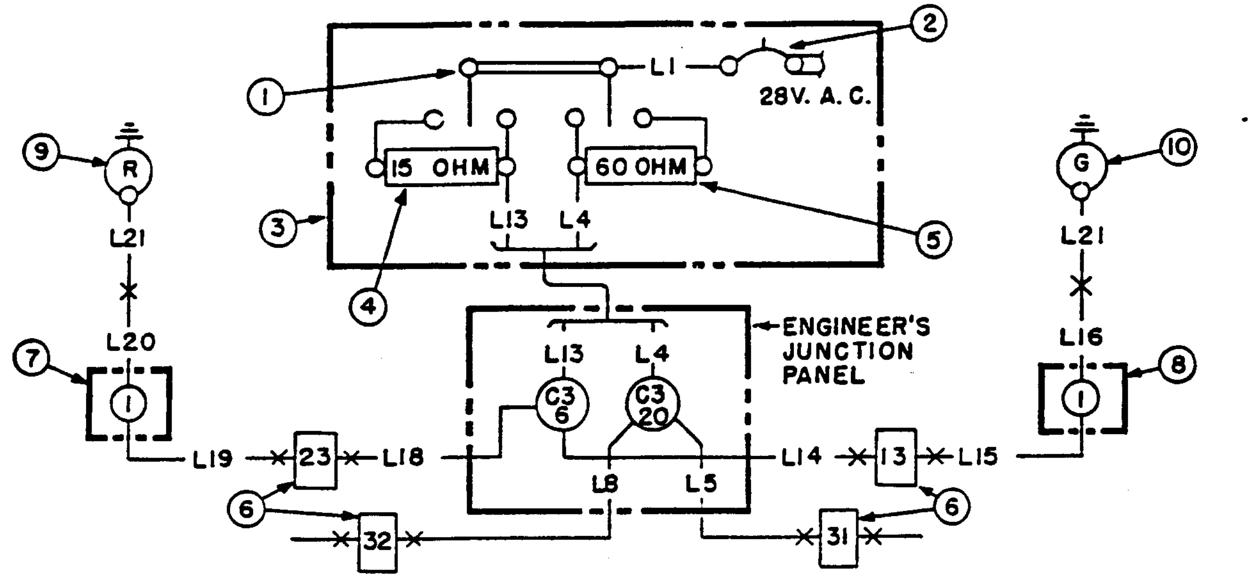


ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	LAMP ASSEM.		C-8	32451
2	LAMP ASSEM.		C-4A	SA-32294-C
3	LAMP ASSEM.		B-7A	SA-32228-B
4	CIRCUIT B'R'K'R		AN	3160-5
5	CIRCUIT B'R'K'R		AN	3160-10
6	RESISTOR BOX	NORTHROP		558970

ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
7	LAMP ASSEM.		A-11	94-32372-B
8	CIRCUIT B'R'K'R		AN	3161-5
9	CIRCUIT B'R'K'R		AN	3161-10
10	SWITCH		AN	3022-2
11	LAMP ASSEM.		AN	3037-3

◑ WIRES FURNISHED WITH LAMP ASSEMBLIES.

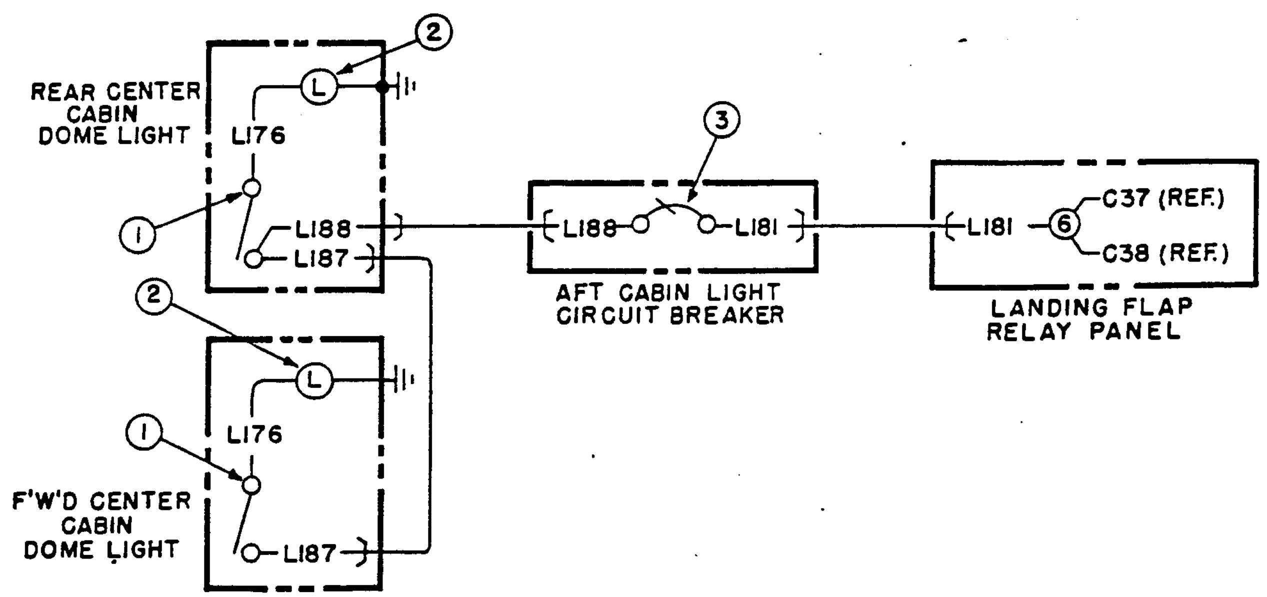
Figure 89. Cockpit and Interior Lighting



ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	SWITCH		AN	3022-1
2	CIRCUIT B'R'K'R		AN	3161-5
3	PANEL-PILOT'S	NORTHROP		552409
4	RESISTOR	OHMITE		15OHM-25W
5	RESISTOR	OHMITE		60OHM-25W

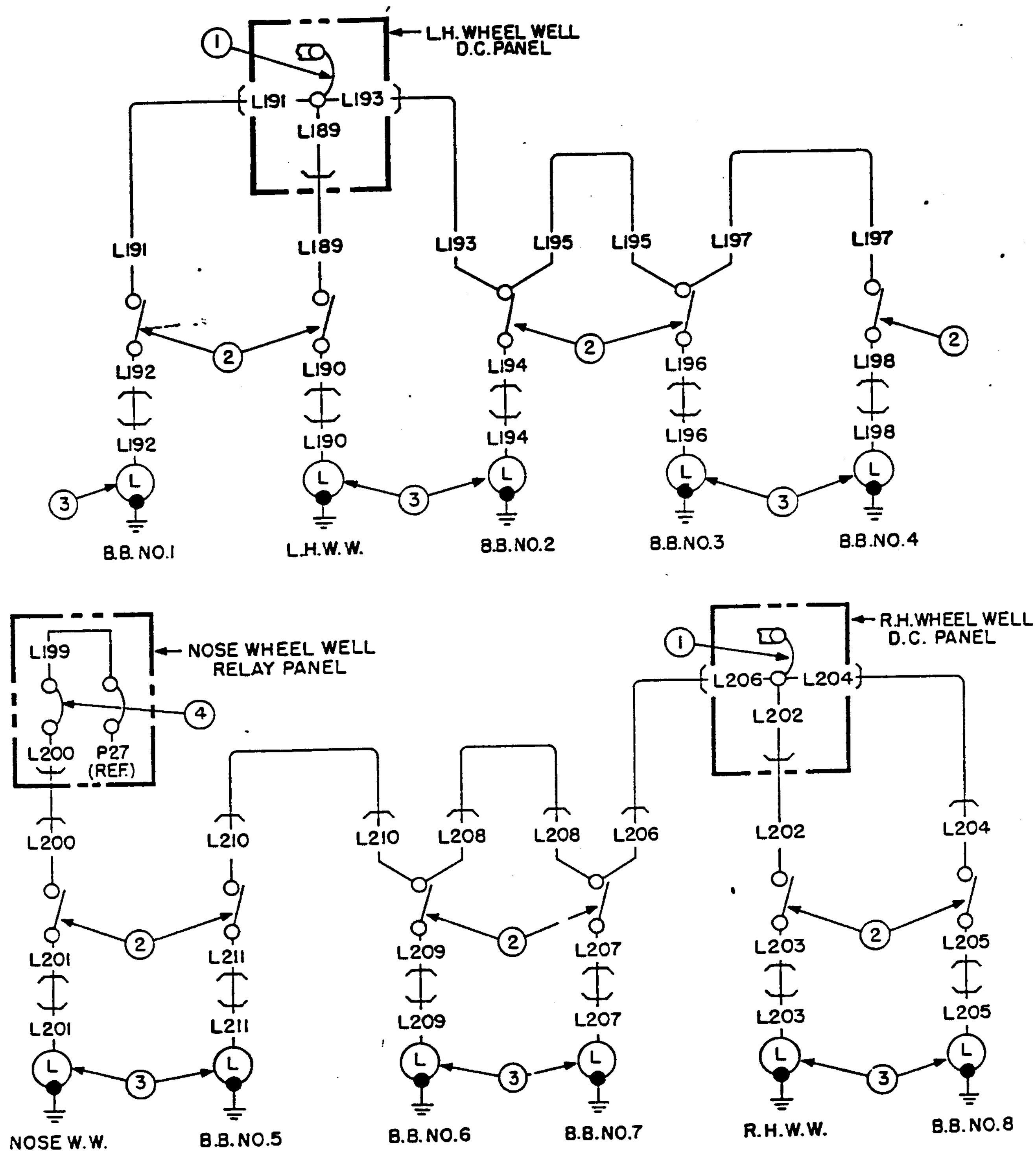
ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
6	PLUG-PRESS.	THOS. & BETTS		BDS-1354-8
7	PANEL-A. C.	NORTHROP		553293
8	PANEL-A. C.	NORTHROP		553293-1
9	WING LIGHT L.H.		AN	3033-7
10	WING LIGHT R.H.		AN	3033-8

Figure 90. Position Lights



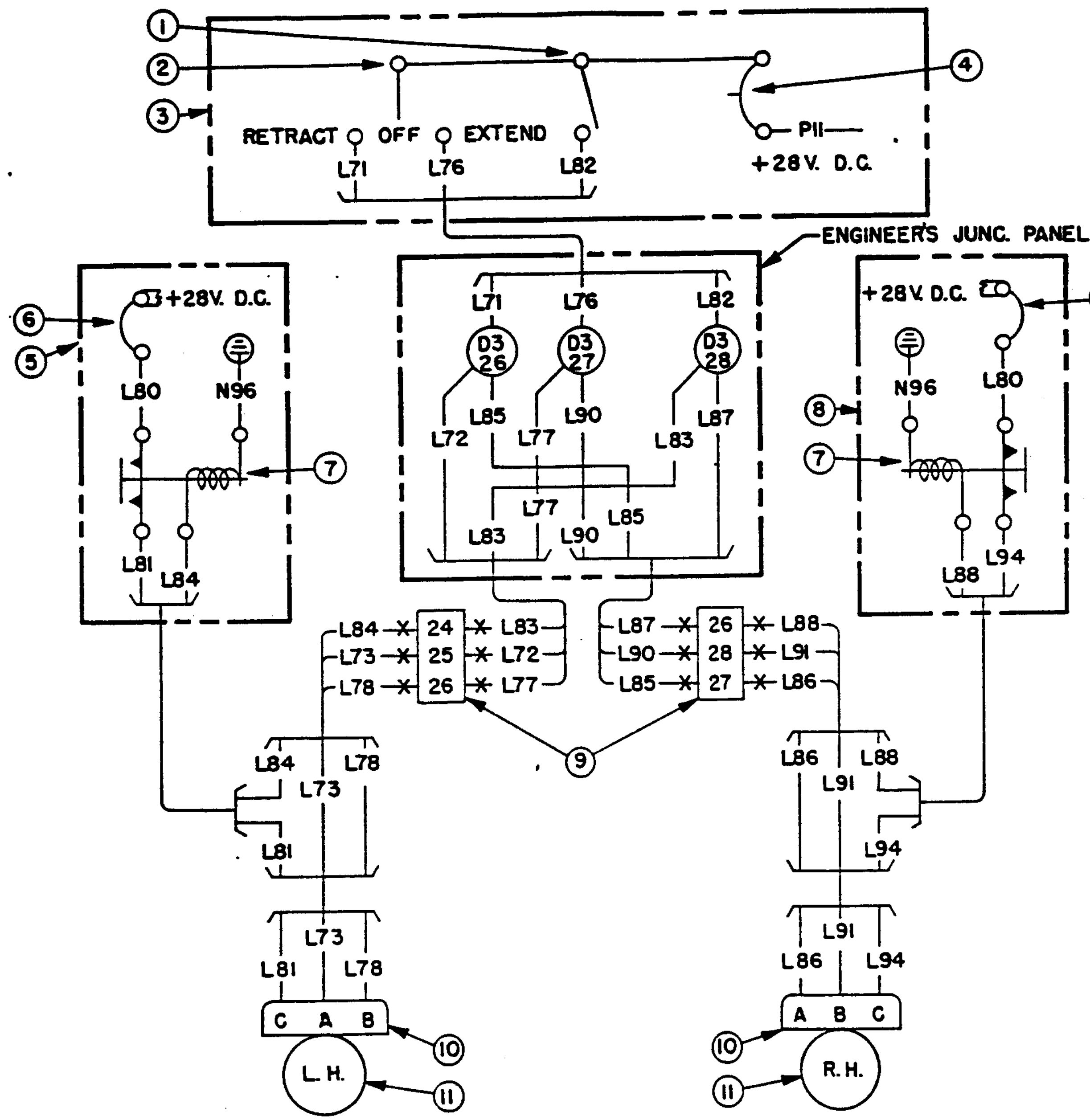
ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	SWITCH		AN	3022-2
2	LAMP ASSEMBLY		AN	3037-3
3	CIRCUIT BREAKER		AN	3161-10

Figure 91. Cabin Lighting



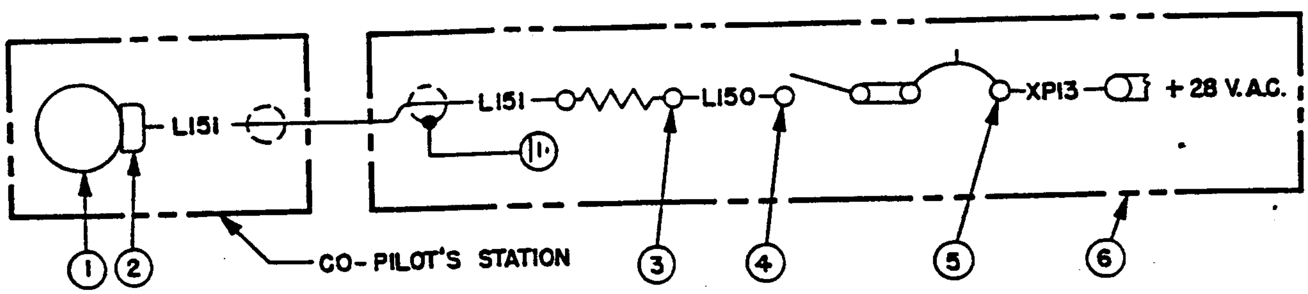
ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	CIRCUIT BREAKER	KLIXON		PA-15
2	SWITCH		AN	3022-2
3	LAMP ASSEMBLY		AN	3039-3
4	CIRCUIT BREAKER	KLIXON		PA-5

Figure 92. Wheel Well and Bomb Bay Lighting



ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	SWITCH		AN	3022-4B
2	SWITCH		AN	3022-158
3	PANEL- PILOT'S PED.	NORTHROP		552409
4	CIRCUIT BREAKER		AN	3161-10
5	PANEL- L.H. WHEEL WELL	NORTHROP		554189
6	CIRCUIT BREAKER			PA-35
7	RELAY		B5B	94-32351
8	PANEL- R.H. WHEEL WELL	NORTHROP		554189-1
9	PLUG - PRESSURIZED	THOMAS & BETTS		BDS-1354-B
10	PLUG		AN	3106-18-5S
11	LIGHT-LANDING		AN	3095-3

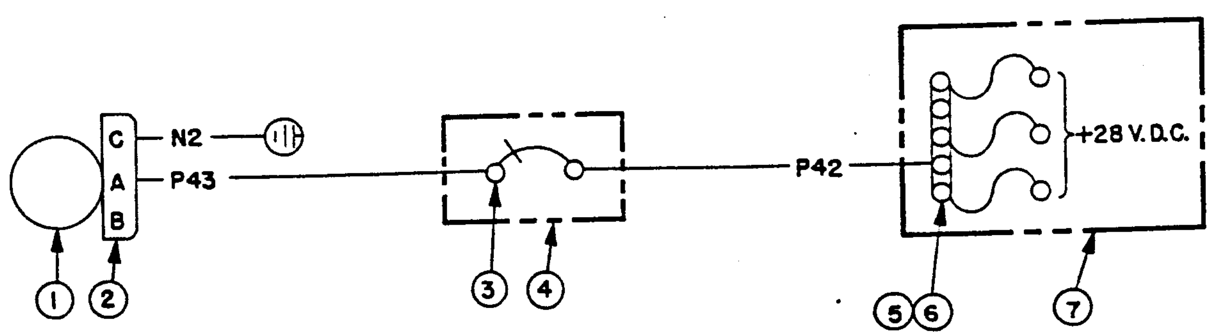
Figure 93. Landing Lights



ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	INDICATOR		AN	5733-2
2	PLUG	CANNON		A270-1
3	RESISTOR			125Ω-10W
4	SWITCH		AN	3022-2
5	CIRCUIT BREAKER		AN	3161-5
6	PILOT'S PEDESTAL	NORTHROP		552409

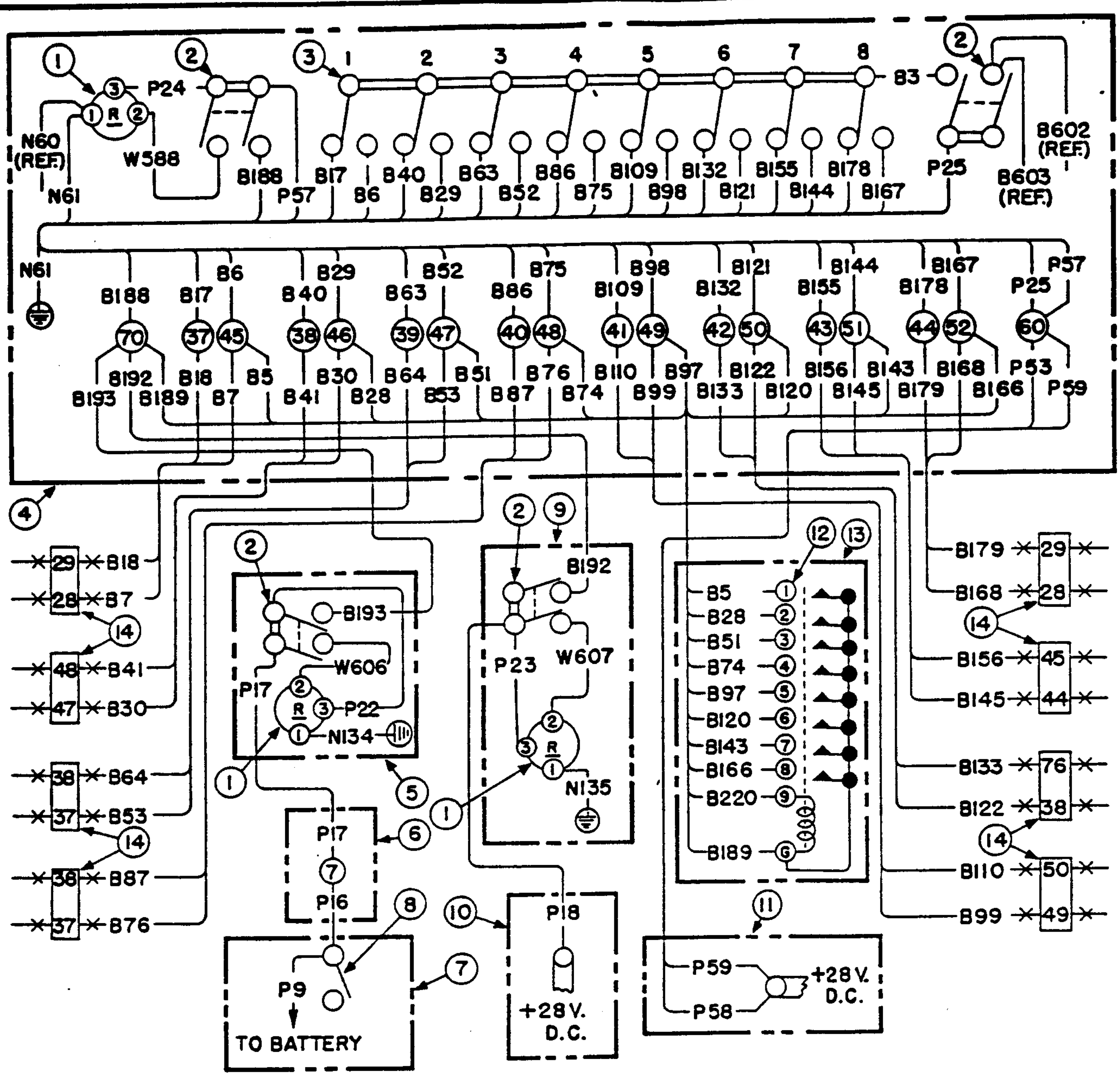
NOTE: WIRE TO BE SHIELDED AS INDICATED

Figure 94. Magnetic Compass Light



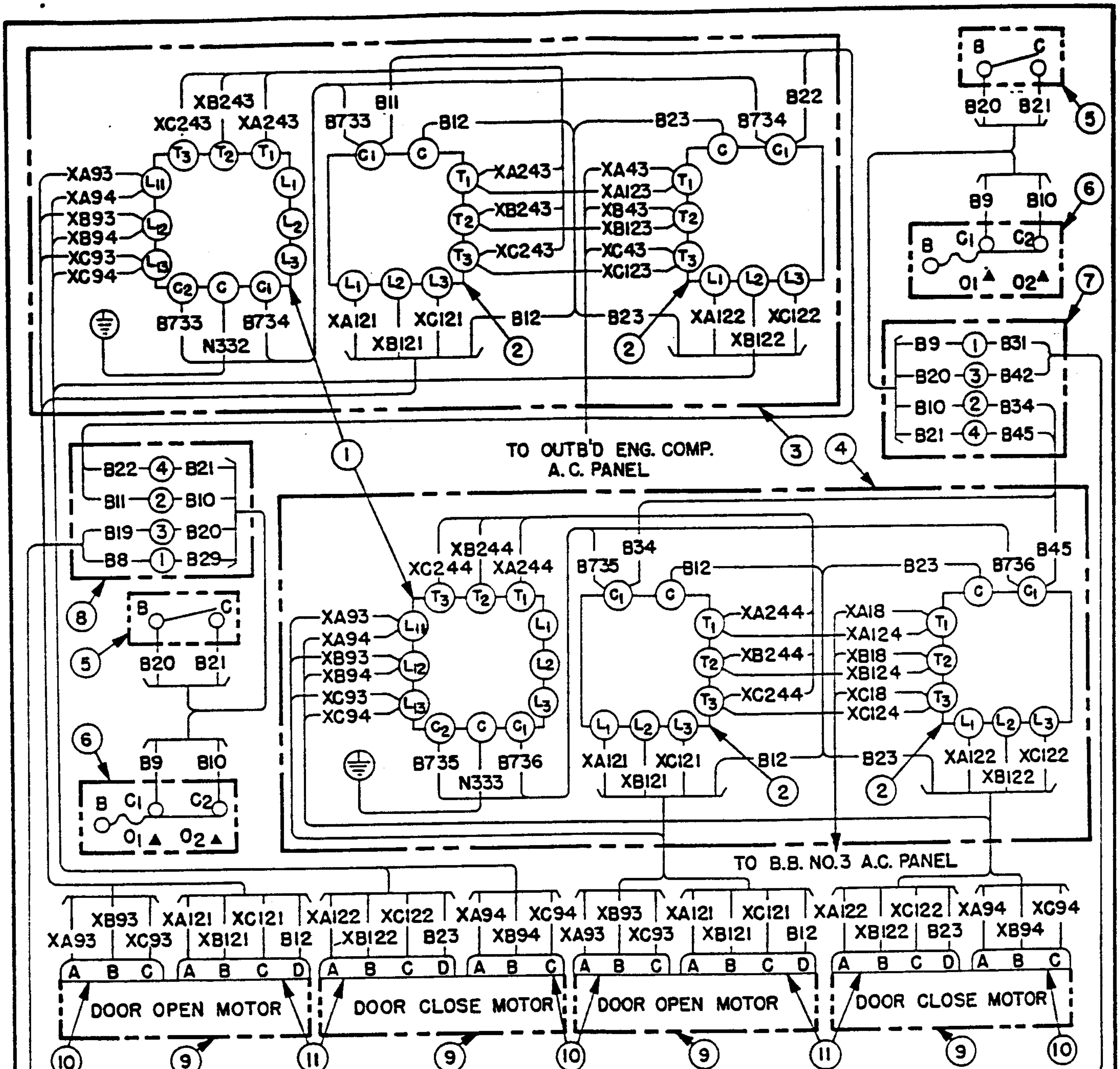
ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	WIPER MOTOR	MARQUETTE		D12364
2	PLUG		AN	3108-18-5S
3	CIRCUIT BREAKER		AN	3160-10
4	PANEL-BOMBARDIER'S	NORTHROP		550985
5	LIMITER	BURNDY		F3L-20
6	LIMITER BASE	BURNDY		F3H1
7	BOMB LIMITER INSTALL.	NORTHROP		551159

Figure 95. Windshield Wiper



ART.	NAME	MAKE	TYPE	SPEC. OR PARTS NO.
1	LIGHT- INDICATOR			44A-18454-9
2	SWITCH- SALVO		AN	3023-2
3	SWITCH -SELECTOR	CUTLER- HAMMER		8884K3
4	PANEL- CONTROL	NORTHROP		550985
5	PANEL-PILOT SWITCH	NORTHROP		555049
6	PANEL-PILOT'S RELAY	NORTHROP		552374
7	PILOT'S PEDESTAL	NORTHROP		552409
8	SWITCH-EMERG. ALARM			
9	PANEL-CREW'S SALVO	NORTHROP		456016
10	PANEL-ENG. D.C.	NORTHROP		554151
11	PANEL- LIMITER	NORTHROP		551159
12	RELAY	LEACH		1001W
13	PANEL-RELAY	NORTHROP		554012
14	PLUG- PRESSURIZED	THOMAS & BETTS		BDS-1354-B

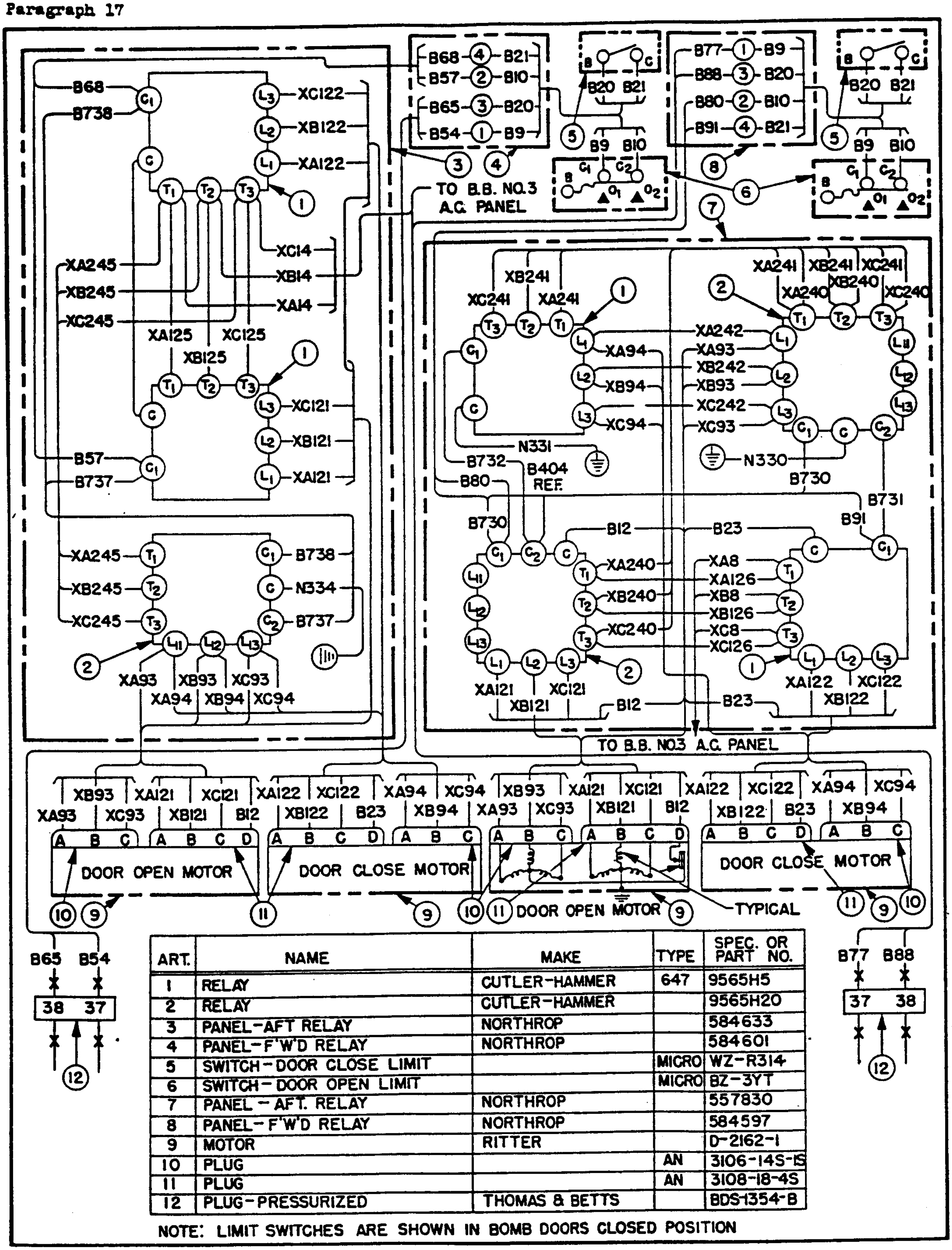
Figure 96. Bomb Bay Door Control - Crew Nacelle



ART.	NAME	REQ.	MAKE	TYPE	SPEC. OR D'W'G NO.
1	RELAY	2	CUTLER-HAMMER		9565-H35
2	RELAY	4	CUTLER-HAMMER	647	9565-H5
3	PANEL — B.B. 1 AFT RELAY	1	NORTHROP		558201
4	PANEL — B.B. 2 AFT RELAY	1	NORTHROP		584631
5	SWITCH — DOOR CLOSE LIMIT	2		MICRO	WZ-R31
6	SWITCH — DOOR OPEN LIMIT	2		MICRO	BZ-3YT
7	PANEL — B.B.2 F'W'D RELAY	1	NORTHROP		584603
8	PANEL — B.B.1 F'W'D RELAY	1	NORTHROP		584599
9	MOTOR	4	RITTER		D-2162-1
10	PLUG	4		AN	3106-14S-1S
11	PLUG	4		AN	3108-18-4S
12	PLUG — PRESSURIZED	2	THOMAS & BETTS		BDS-1354-B

NOTE — LIMIT SWITCHES ARE SHOWN IN BOMB DOORS CLOSED POSITION

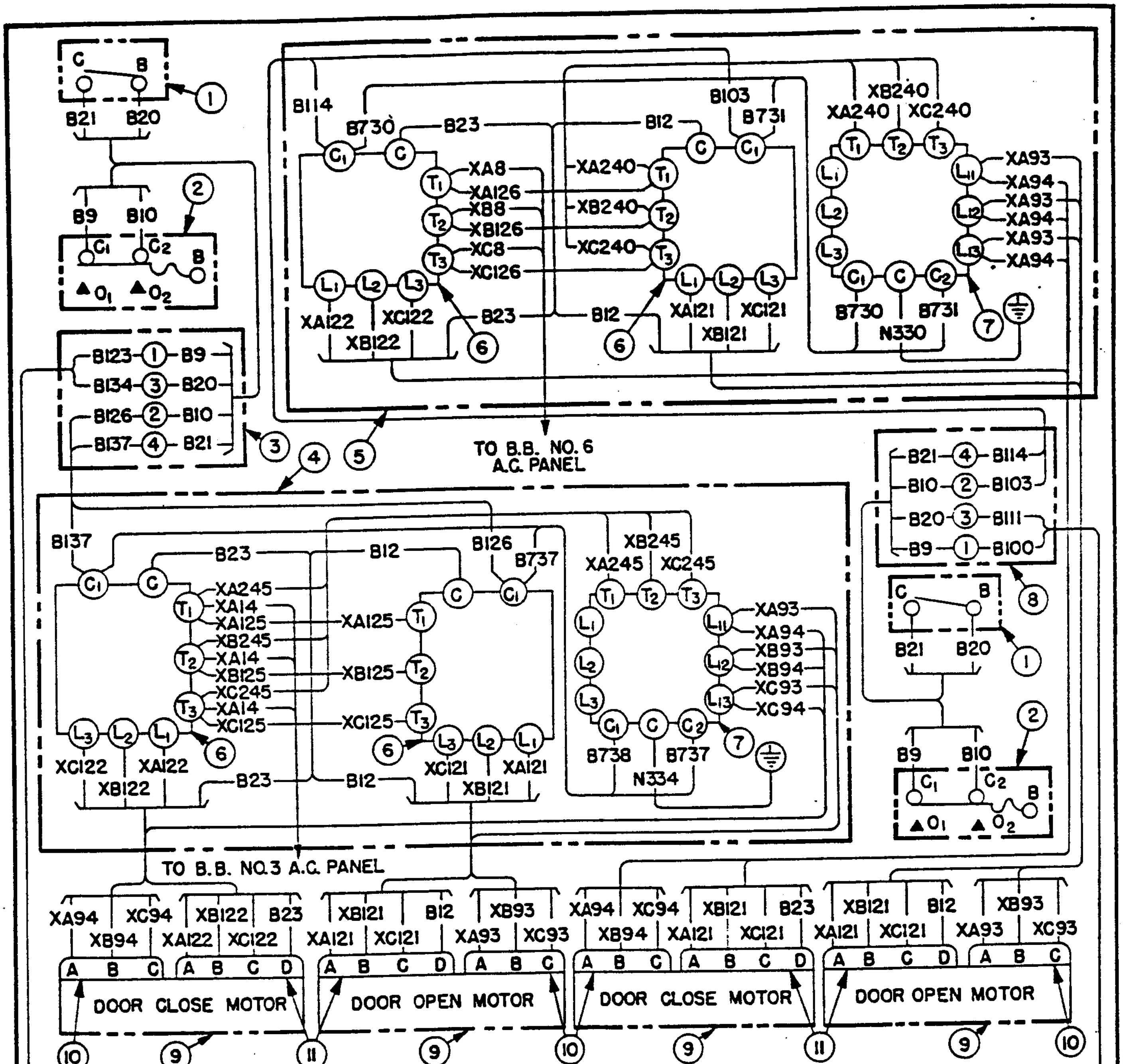
Figure 97. Bomb Bay Door Control - B.B. 1 and 2



ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	RELAY	CUTLER-HAMMER	647	9565H5
2	RELAY	CUTLER-HAMMER		9565H20
3	PANEL-AFT RELAY	NORTHROP		584633
4	PANEL-F'W'D RELAY	NORTHROP		584601
5	SWITCH-DOOR CLOSE LIMIT		MICRO	WZ-R314
6	SWITCH-DOOR OPEN LIMIT		MICRO	BZ-3YT
7	PANEL - AFT. RELAY	NORTHROP		557830
8	PANEL- F'W'D RELAY	NORTHROP		584597
9	MOTOR	RITTER		D-2162-1
10	PLUG		AN	3106-14S-1S
11	PLUG		AN	3108-18-4S
12	PLUG-PRESSURIZED	THOMAS & BETTS		BDS-1354-B

NOTE: LIMIT SWITCHES ARE SHOWN IN BOMB DOORS CLOSED POSITION

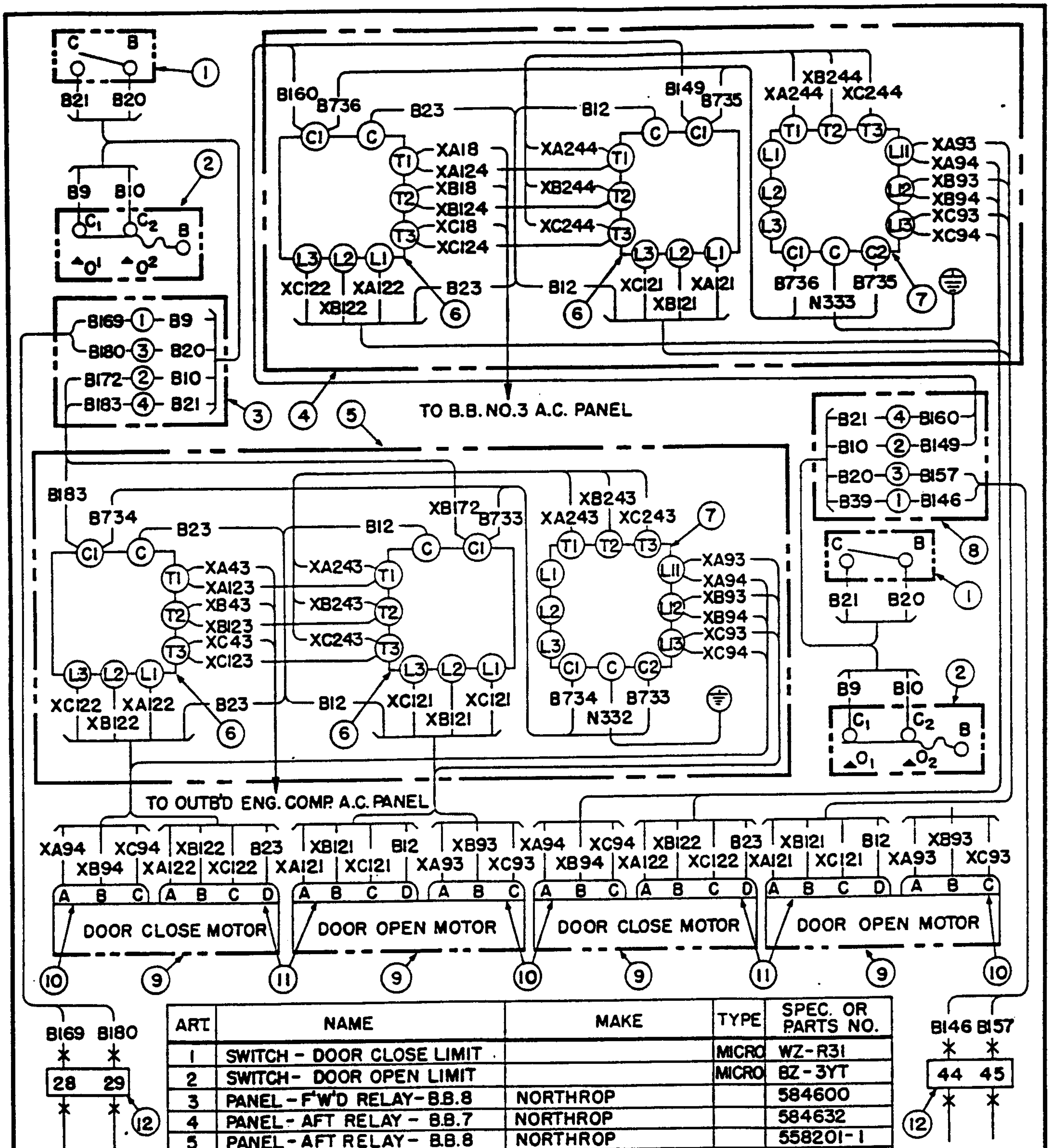
Figure 98. Bomb Bay Door Control - B.B. 3 and 4



ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	SWITCH-DOOR CLOSE LIMIT		MICRO	WZ-A31
2	SWITCH-DOOR OPEN LIMIT		MICRO	BZ-3YT
3	PANEL-F'W'D RELAY-B.B.6	NORTHROP		584602
4	PANEL-AFT RELAY-B.B.6	NORTHROP		584634
5	PANEL-AFT RELAY-B.B.5	NORTHROP		557830-1
6	RELAY	CUTLER-HAMMER	647	9565H5
7	RELAY	CUTLER-HAMMER		9565H20
8	PANEL-F'W'D RELAY-B.B.5	NORTHROP		584598
9	MOTOR	RITTER		D-2162-1
10	PLUG		AN	3106-14S-1S
11	PLUG		AN	3108-18-4S
12	PLUG-PRESSURIZED	THOMAS & BETTS		BDS-1354-B

NOTE-LIMIT SWITCHES ARE SHOWN IN BOMB DOORS CLOSED POSITION

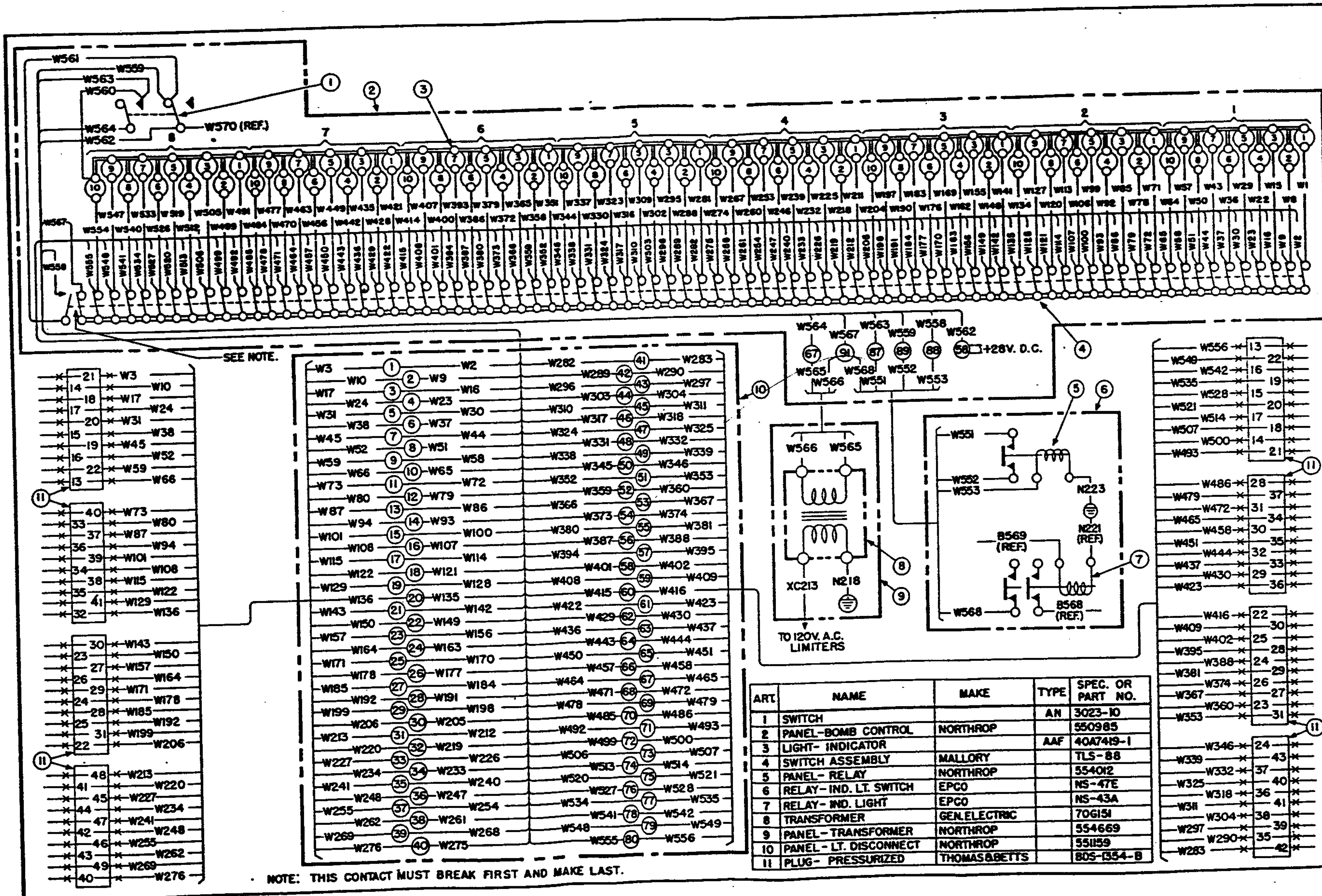
Figure 99. Bomb Bay Door Control - B.B. 5 and 6



ART	NAME	MAKE	TYPE	SPEC. OR PARTS NO.
1	SWITCH - DOOR CLOSE LIMIT		MICRO	WZ-R31
2	SWITCH- DOOR OPEN LIMIT		MICRO	BZ-3YT
3	PANEL - F'W'D RELAY-B.B.8	NORTHROP		584600
4	PANEL - AFT RELAY - B.B.7	NORTHROP		584632
5	PANEL - AFT RELAY - B.B.8	NORTHROP		558201-1
6	RELAY	CUTLER-HAMMER	647	9565H5
7	RELAY	CUTLER-HAMMER		9565H20
8	PANEL-F'W'D RELAY - B.B.7	NORTHROP		584604
9	MOTOR	RITTER		D-2162-1
10	PLUG		AN	3106-14S-1S
11	PLUG		AN	3108-18-4S
12	PLUG - PRESSURIZED	THOMAS & BETTS		BDS-1354-B

NOTE- LIMIT SWITCHES ARE SHOWN IN BOMB DOORS CLOSED POSITION.

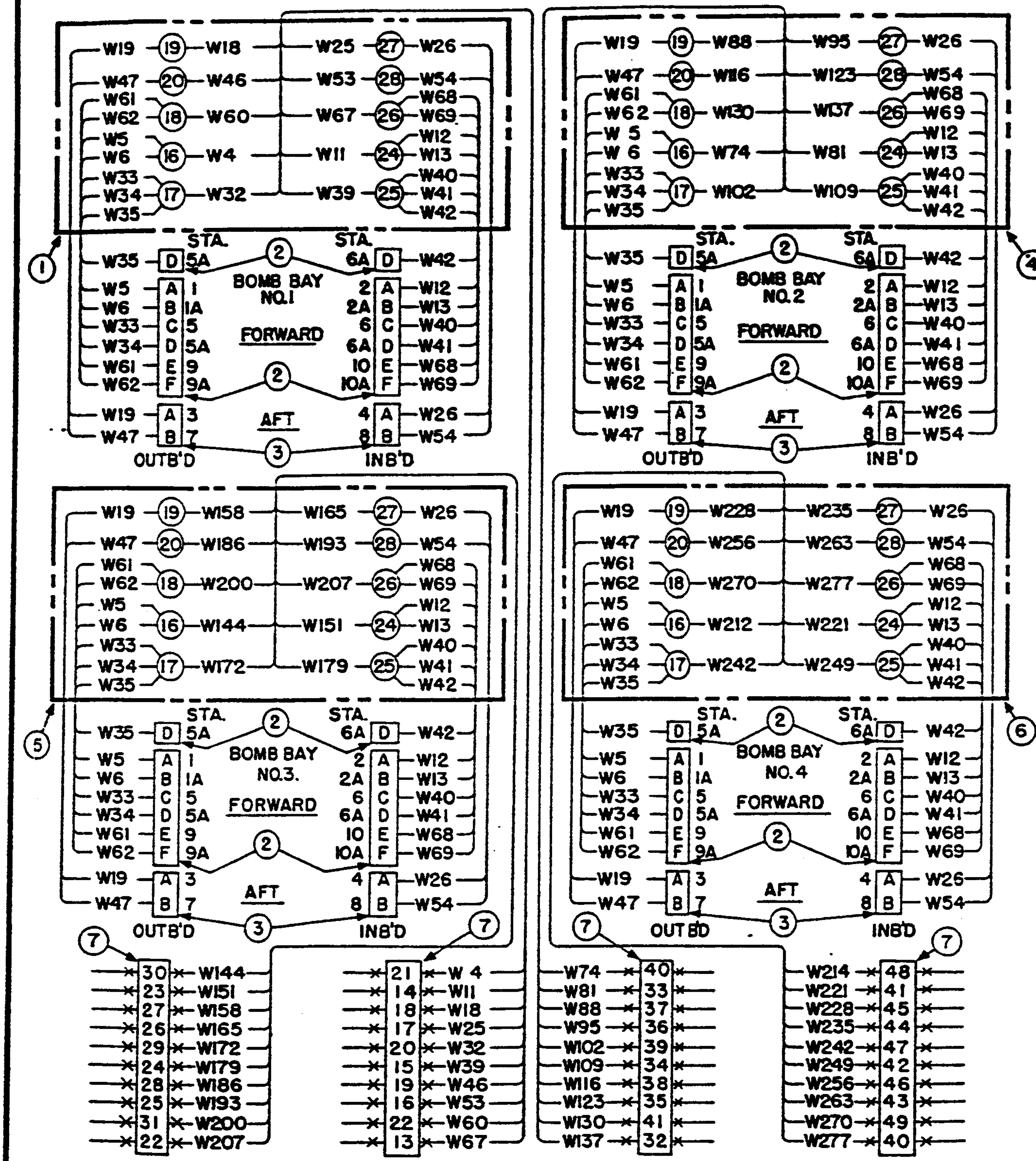
Figure 100. Bomb Bay Door Control - B.B. 7 and 8



ART	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	SWITCH		AN	3023-10
2	PANEL-BOMB CONTROL	NORTHROP		550985
3	LIGHT- INDICATOR		AAF	40A7419-1
4	SWITCH ASSEMBLY	MALLORY		TLS-88
5	PANEL- RELAY	NORTHROP		554012
6	RELAY- IND. LT. SWITCH	EPCO		NS-47E
7	RELAY- IND. LIGHT	EPCO		NS-43A
8	TRANSFORMER	GEN.ELECTRIC		706151
9	PANEL-TRANSFORMER	NORTHROP		554669
10	PANEL- LT. DISCONNECT	NORTHROP		551159
11	PLUG- PRESSURIZED	THOMAS&BETTS		805-1354-B

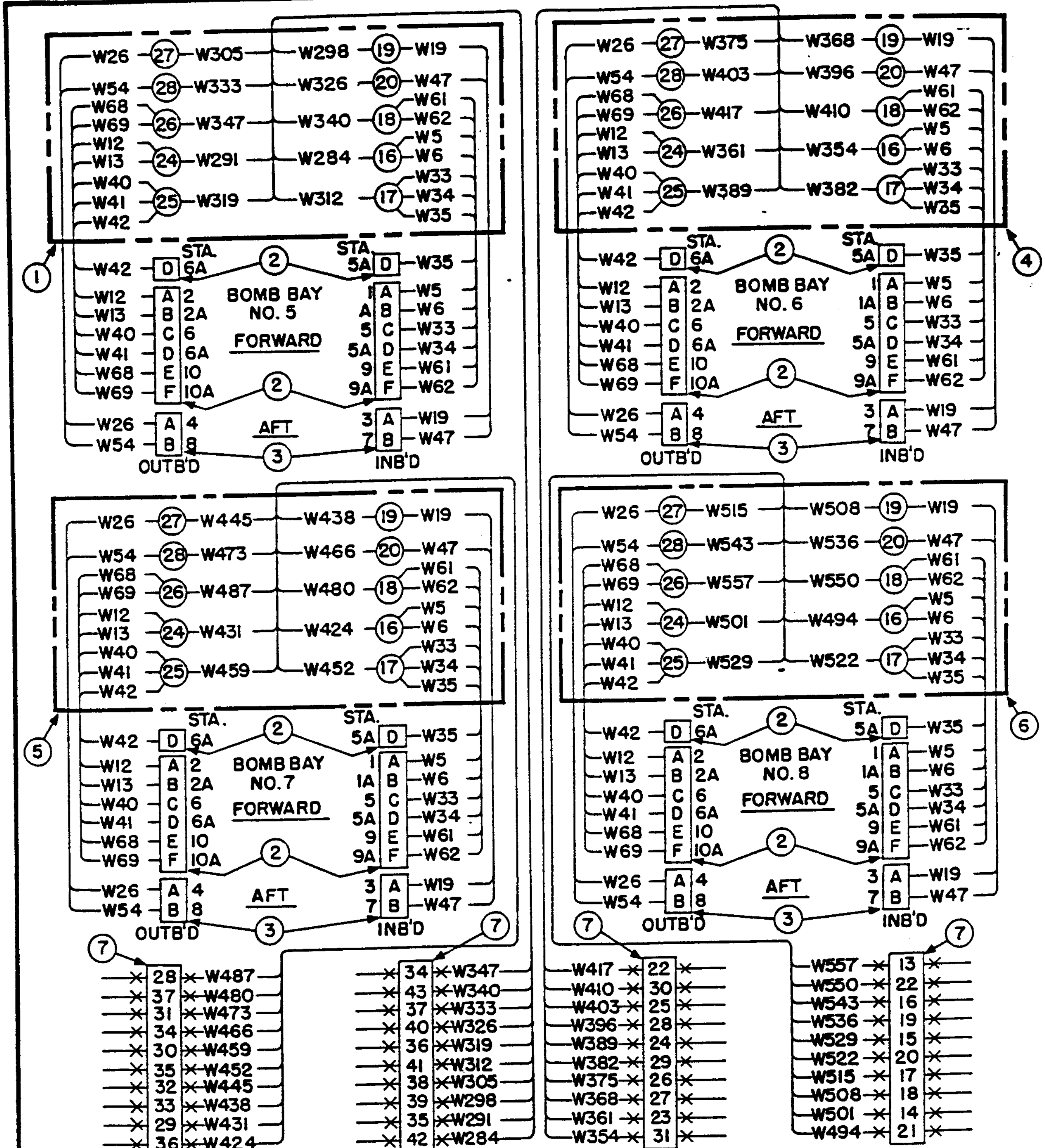
• NOTE: THIS CONTACT MUST BREAK FIRST AND MAKE LAST.

Figure 101. Bomb Station Indicator Lights - Crew Nacelle



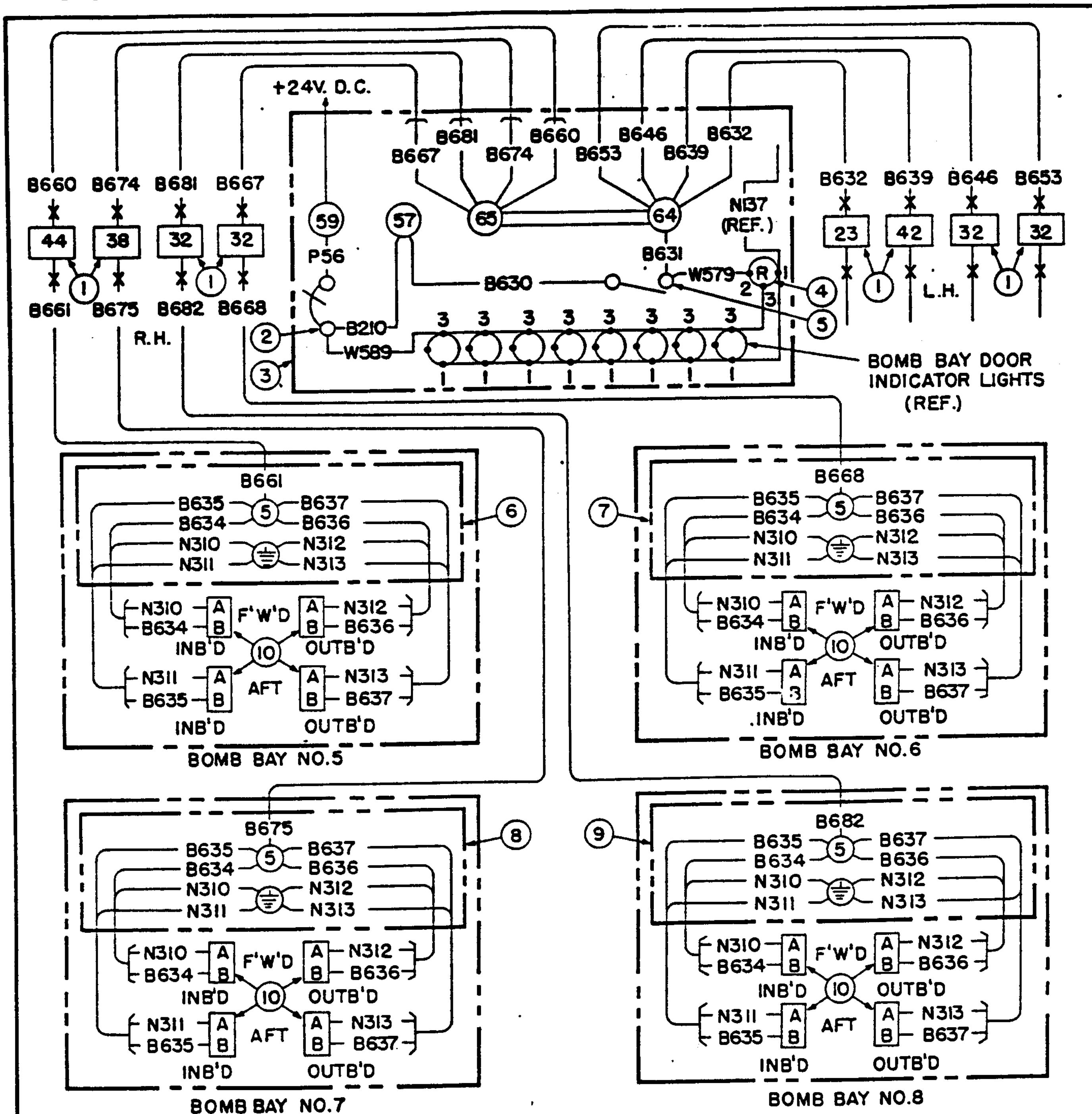
ART	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	PANEL-FWD RELAY	NORTHROP		584599
2	RECEPTACLE		AN	3100-24-5S
3	RECEPTACLE		AN	3100-22-18S
4	PANEL-FWD RELAY	NORTHROP		584603
5	PANEL-FWD RELAY	NORTHROP		584501
6	PANEL-FWD RELAY	NORTHROP		584597
7	PLUG-PRESS.	THOM.&BETTS		80S-1354-B

Figure 102. Bomb Station Indicator Lights - LH Wing



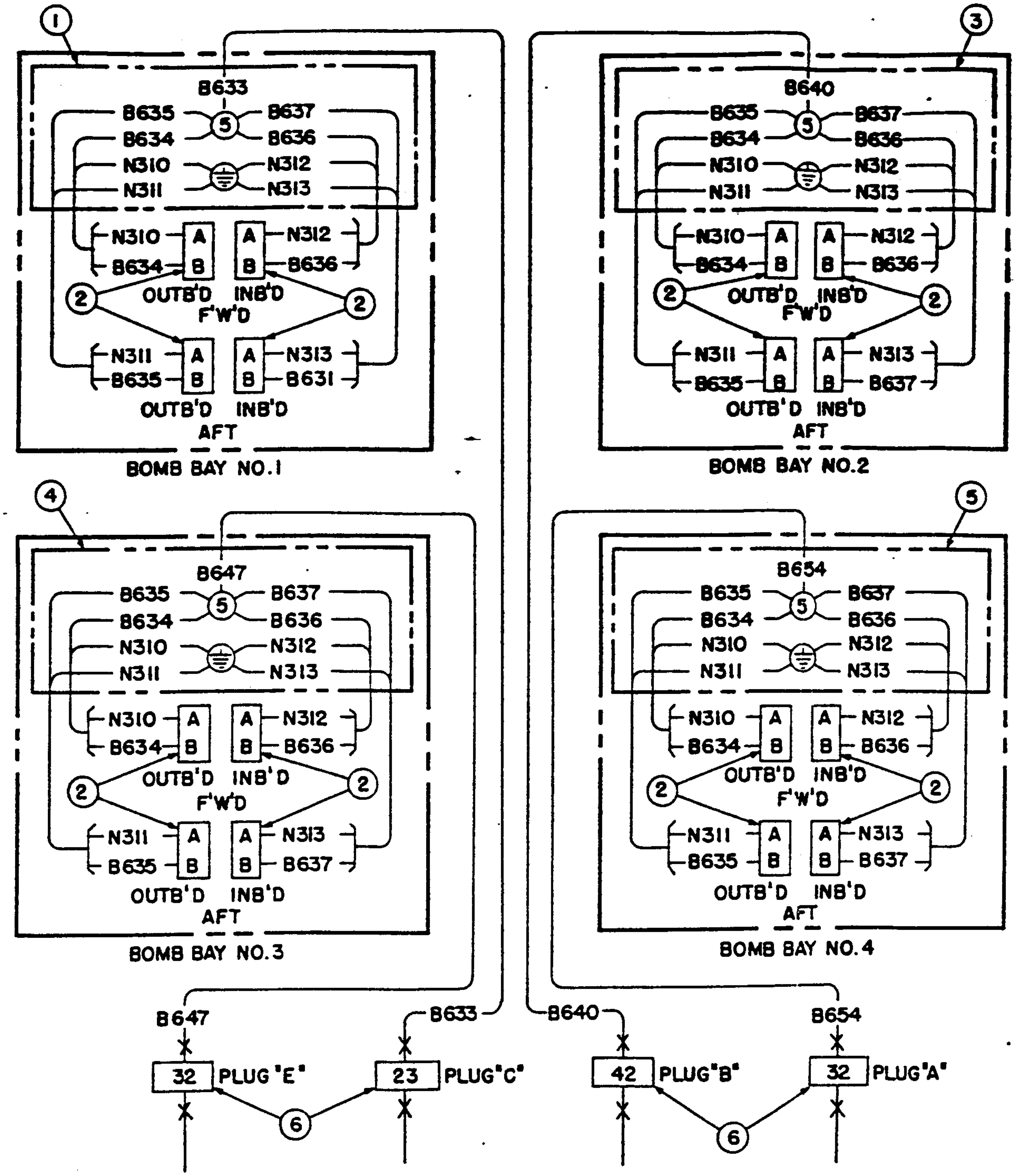
ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	PANEL-F'W'D RELAY	NORTHROP		584598
2	RECEPTACLE		AN	3100-24-5S
3	RECEPTACLE		AN	3100-22-18S
4	PANEL-F'W'D RELAY	NORTHROP		584602
5	PANEL-F'W'D RELAY	NORTHROP		584604
6	PANEL-F'W'D RELAY	NORTHROP		584600
7	PLUG-PRESS.	THOS.&BETTS		BDS-1354-8

Figure 103. Bomb Station Indicator Lights - RH Wing



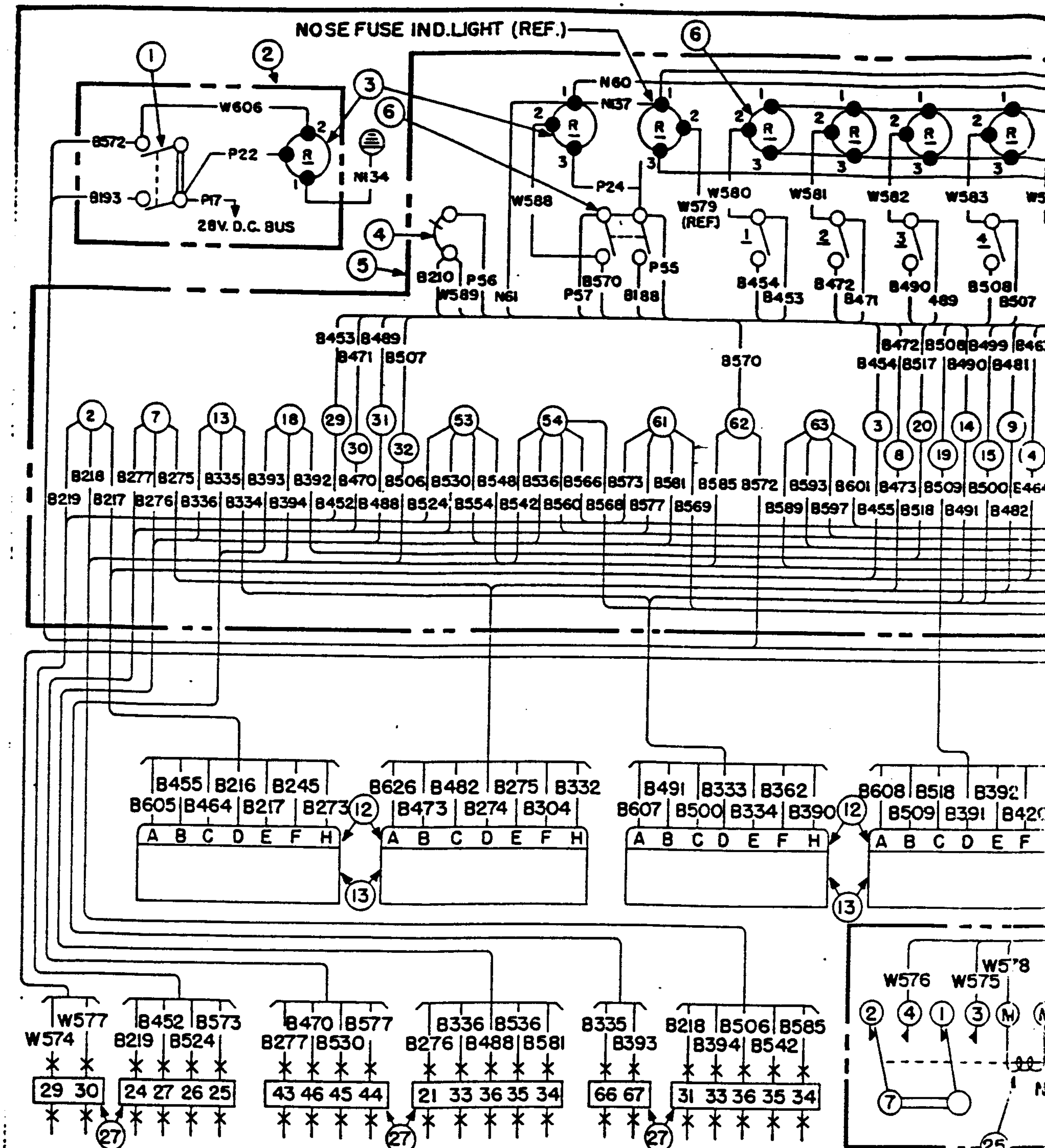
ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	PLUG-PRESSURIZED	THOMAS & BETTS		BDS-1354-B
2	CIRCUIT BREAKER	SQUARE D		9300-100B
3	PANEL- CONTROL	NORTHROP		550985
4	LAMP & SWITCH ASSEMBLY		AAF	44A-18454-2
5	SWITCH- NOSE FUSING		AN	3022-2
6	PANEL-FORWARD RELAY	NORTHROP		584598
7	PANEL-FORWARD RELAY	NORTHROP		584602
8	PANEL- FORWARD RELAY	NORTHROP		584604
9	PANEL- FORWARD RELAY	NORTHROP		584600
10	RECEPTACLE		AN	3100-14S-9S

Figure 104. Bomb Arming - Nose Fusing Control - Crew Nacelle and RH Wing



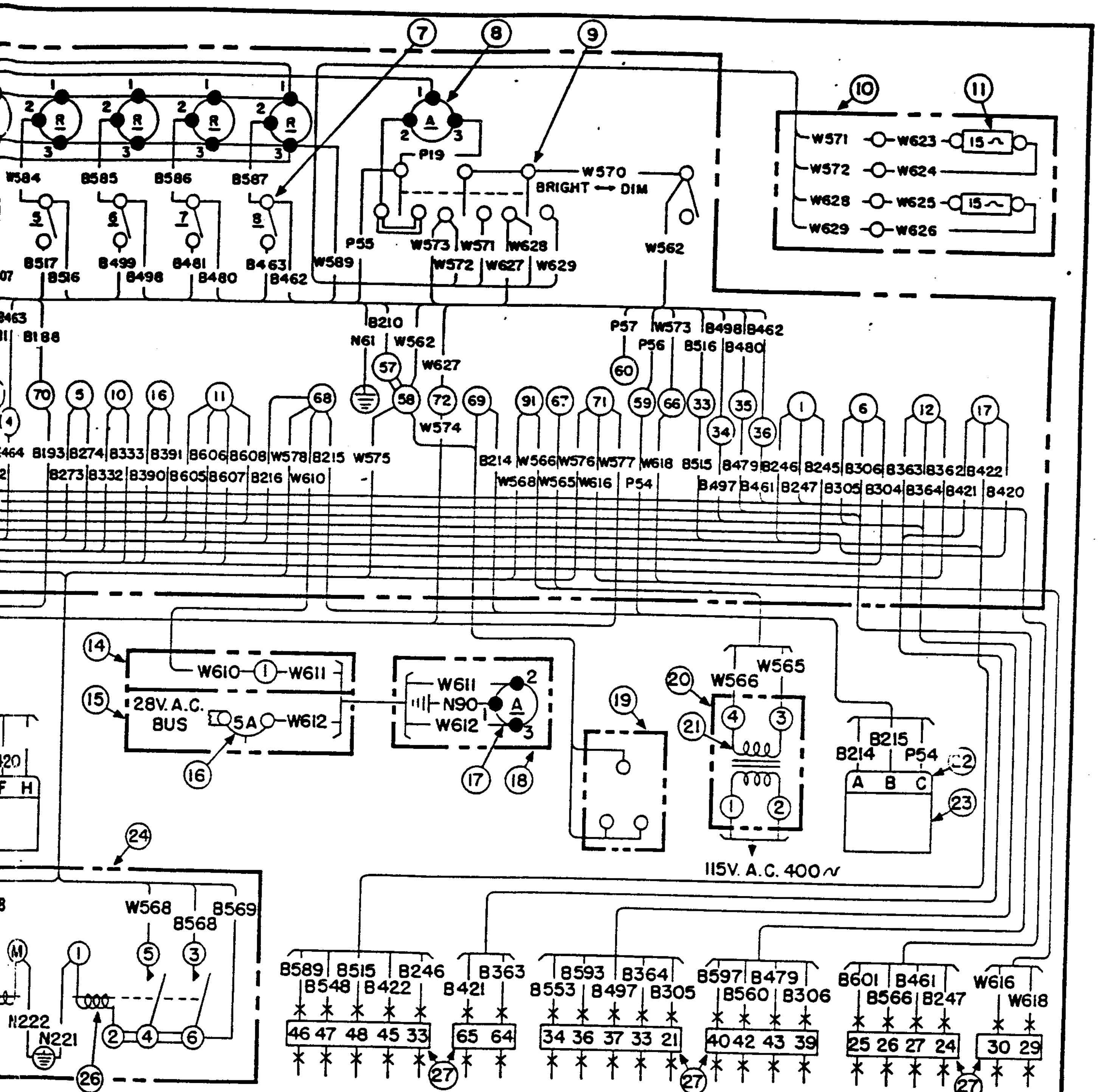
ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	PANEL - FORWARD RELAY	NORTHROP		584599
2	RECEPACLE		AN	3100-14S-9S
3	PANEL- FORWARD RELAY	NORTHROP		584603
4	PANEL- FORWARD RELAY	NORTHROP		584601
5	PANEL-FORWARD RELAY	NORTHROP		584597
6	PLUG - PRESSURIZED	THOMAS & BETTS		BDS-1354-B

Figure 105. Bomb Arming - Nose Fusing Control - LH Wing



ART	NAME	MAKE	TYPE	SPEC. OR PART NO
1	SWITCH- BOMB RELEASE		AN	3023-2
2	PANEL- PILOT'S EMERG.	NORTHROP		555049
3	LIGHT- INDICATOR			44A18454-9
4	CIRCUIT BREAKER	SQUARE D		9300100B
5	PANEL-CONTROL	NORTHROP		550985
6	LIGHT- INDICATOR			44A18454-2
7	SWITCH- SELECTOR	CUTLER-HAMMER		8882K3
8	LIGHT- INDICATOR			44A18454-4
9	SWITCH	CUTLER-HAMMER		8742K6

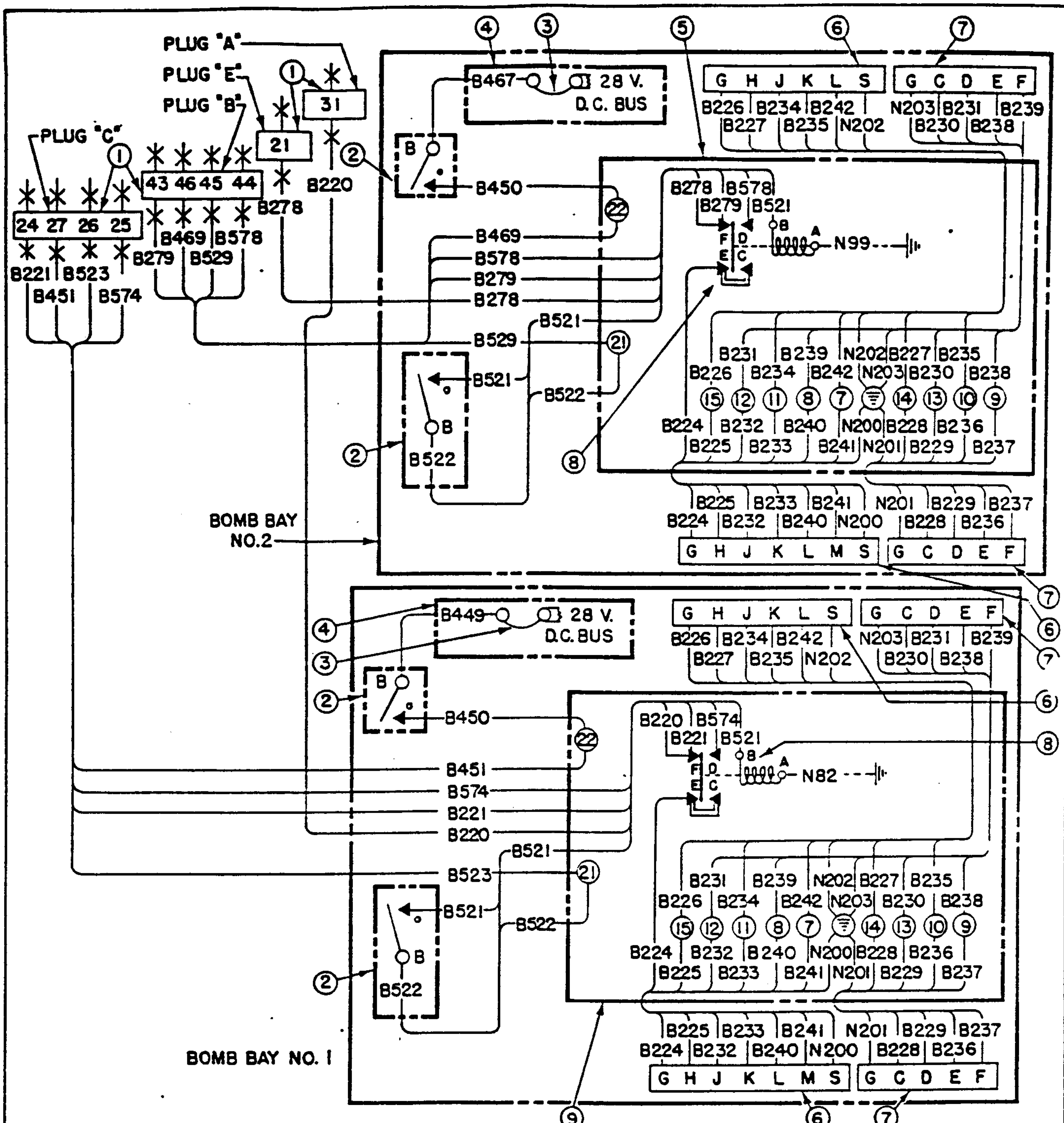
ART.	NAME	
10	RESISTOR ASSEMBLY	N
11	RESISTOR	C
12	PLUG	
13	SELECTOR RACK	M
14	PANEL-PED. RELAY	N
15	PILOT'S PEDESTAL	N
16	CIRCUIT BREAKER	
17	LIGHT- INDICATOR	
18	PANEL-INSTRUMENT	N



MAKE	TYPE	SPEC. OR PART NO
NORTHROP		459690
OHMITE		0771
	AN	3106-22-20S
MALLORY		RS2
NORTHROP		552374
NORTHROP		552409
	AN	3161-5
		44A18454-4
NORTHROP		551052

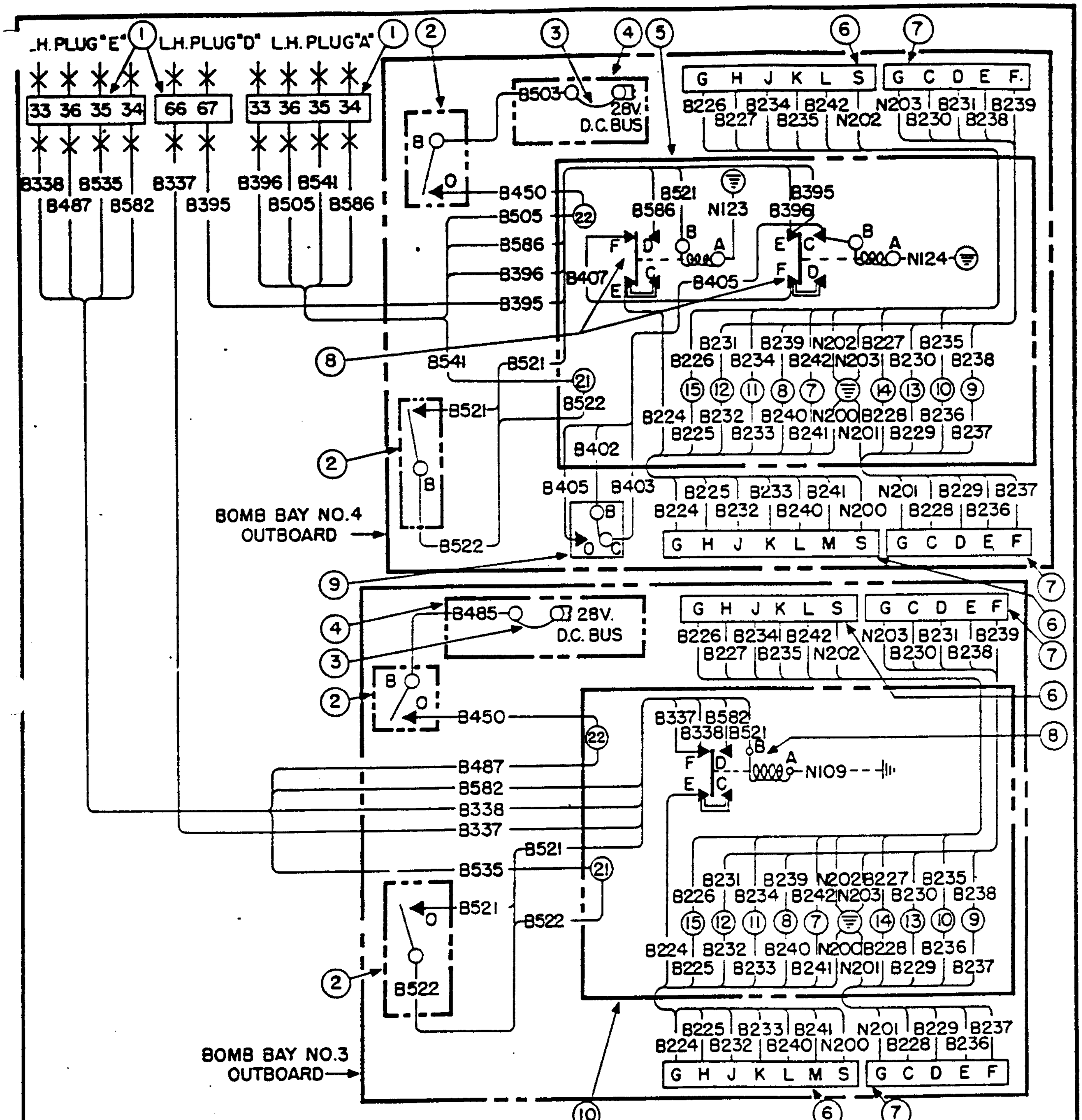
ART.	NAME	MAKE	TYPE	SPEC. OR PART NO
19	SWITCH-BOMB RELEASE			43816094
20	PANEL-TRANSFORMER	NORTHROP		554669
21	TRANSFORMER	GEN. ELECTRIC		70G-151
22	PLUG		AN	3106-14S-7S
23	INTERVALOMETER		B3A	93-24717A
24	PANEL- RELAY	NORTHROP		554012
25	RELAY	AMER. GAS ACUM.		ND21
26	RELAY	EPCO		NS-43A
27	PLUG- PRESSURIZED	THOMAS-BETTS		80S-1354-8

Figure 106. Bomb Release Control - Crew Nacelle



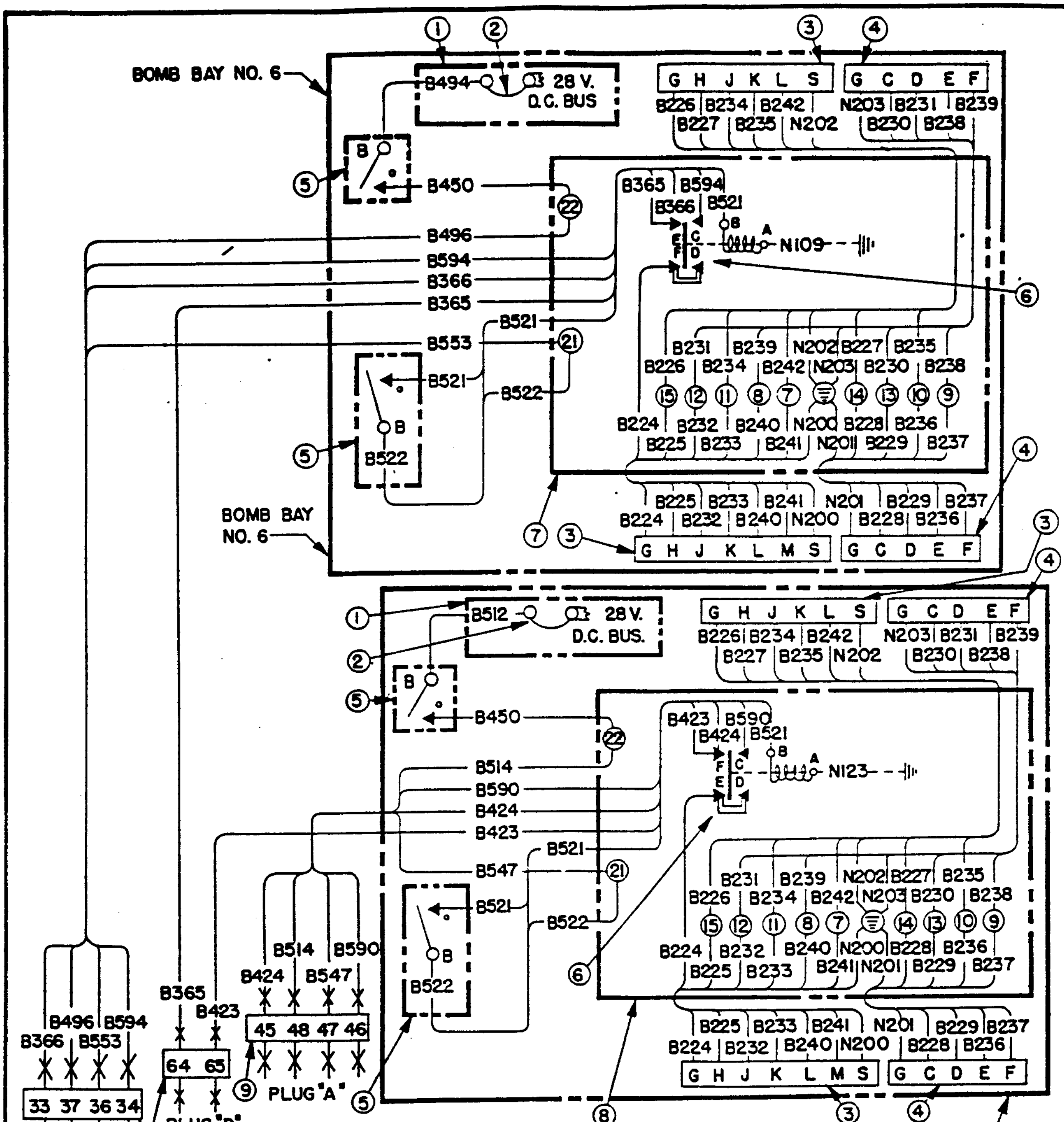
ART	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	PRESSURIZED PLUG	THOMAS & BETTS		BDS-1354-B
2	SWITCH	MICRO-SWITCH		YZ-R31
3	CIRCUIT BREAKER	KLIXON		PA5
4	W.W. D.C. DISTRIBUTION PANEL	NORTHROP		554189
5	B.B. #2 FWD. RELAY PANEL	NORTHROP		584603
6	RECEPTACLE		AN	3100-24-5S
7	RECEPTACLE		AN	3100-22-18S
8	BOMB SALVO RELAY		B-9-A	32439
9	B.B.#1 FWD. RELAY PANEL	NORTHROP		584599

Figure 107. Bomb Release - B.B. 1 and 2



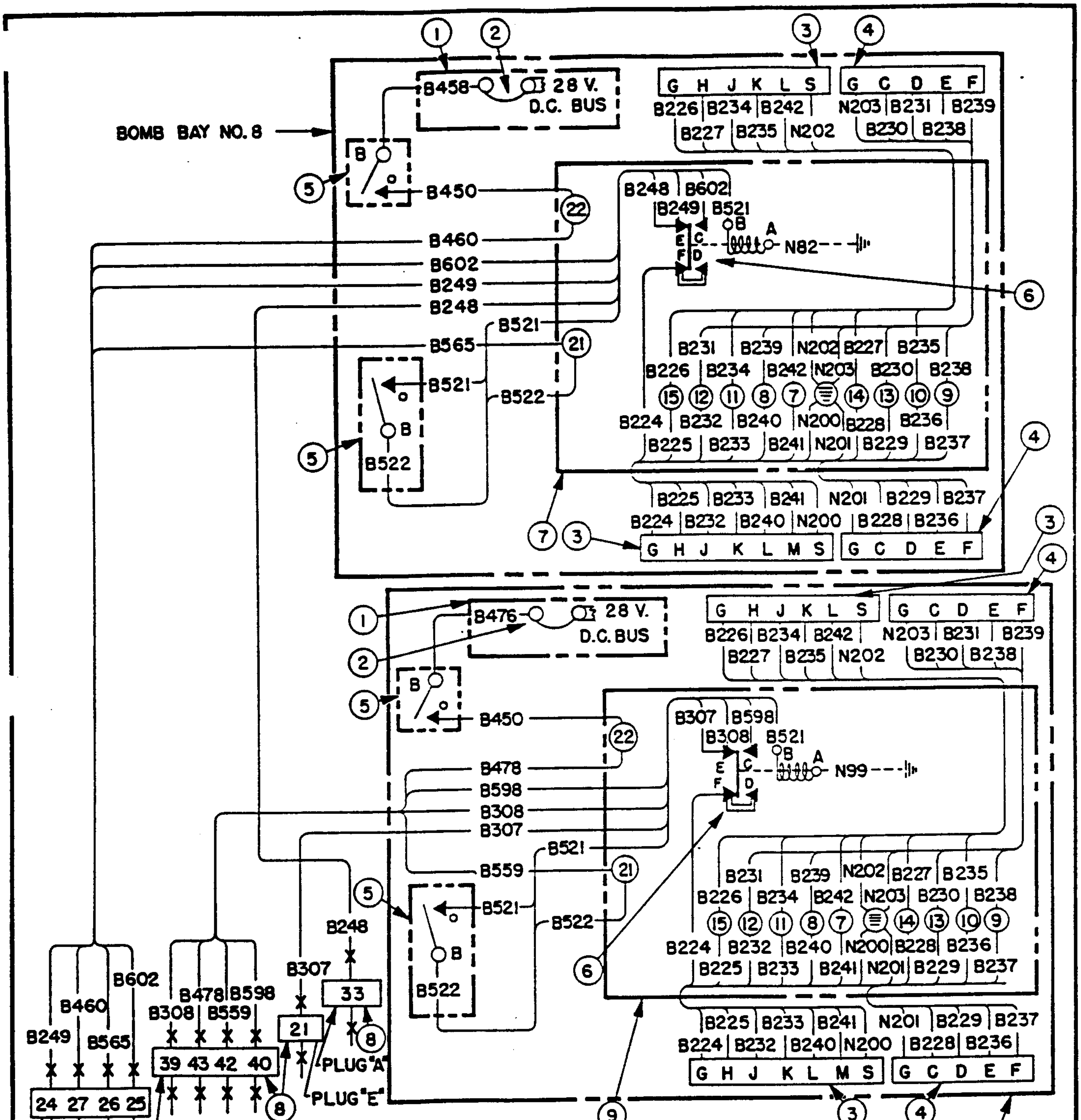
ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	PRESSURIZED PLUG	THOMAS & BETTS		BDS-1354-B
2	SWITCH	MICRO		YZ-R31
3	CIRCUIT BREAKER	KLIXON		PA5
4	W.W.D.C. DISTRIBUTION PANEL	NORTHROP		554189
5	B.B. 4 F'W'D RELAY PANEL	NORTHROP		584597
6	RECEPTACLE		AN	3100-224-5S
7	RECEPTACLE		AN	3100-22-18S
8	BOMB SALVO RELAY		B-9-A	32439
9	SWITCH	MICRO		BZ-R31
10	B.B. 3 F'W'D RELAY PANEL	NORTHROP		584601

Figure 108. Bomb Release - B.B. 3 and 4



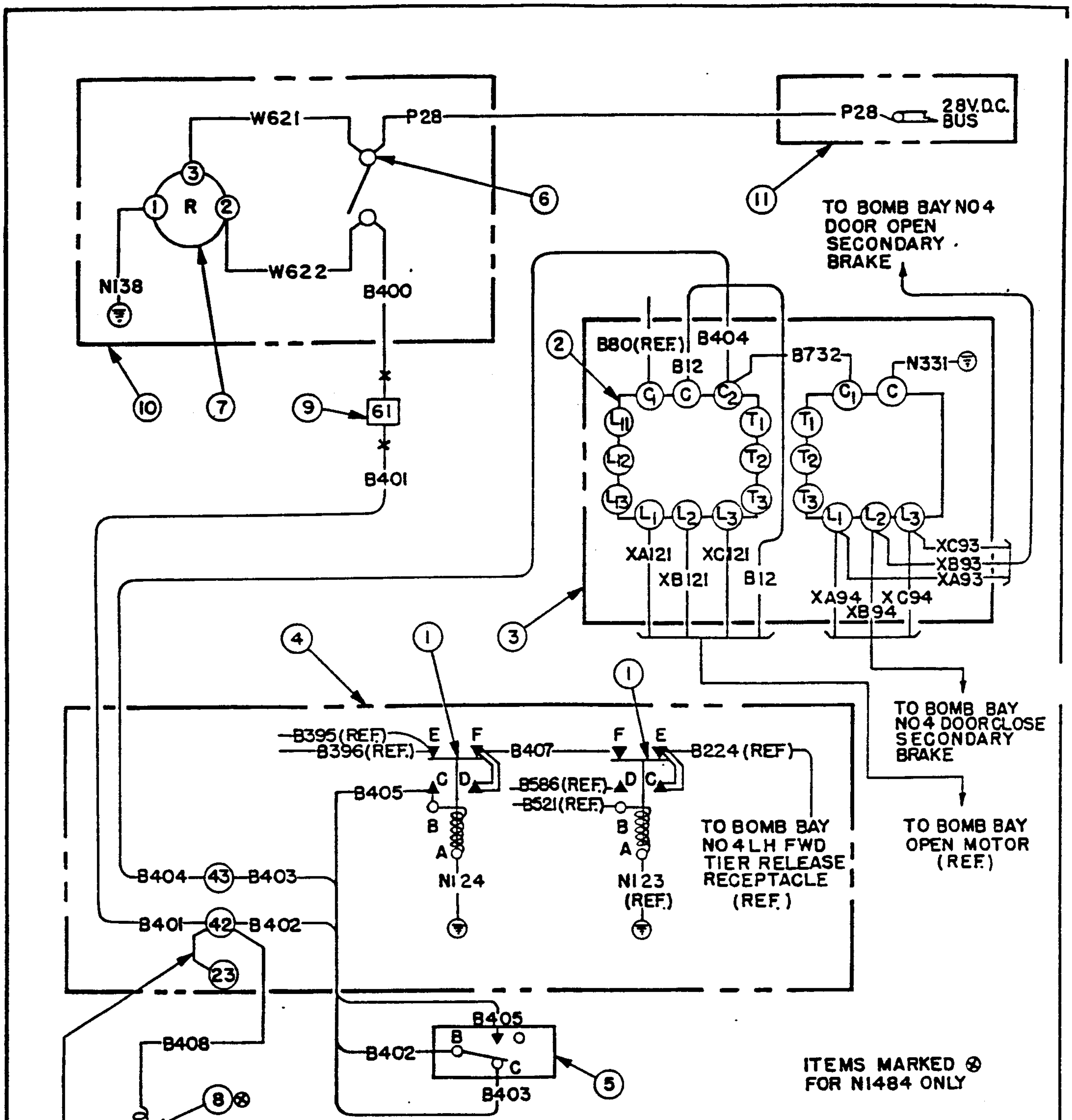
ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	W.W. D.C. DISTRIBUTION PANEL	NORTHROP		554189-1
2	CIRCUIT BREAKER	KLIXON		PA5
3	RECEPTACLE		AN	3100-24-5S
4	RECEPTACLE		AN	3100-22-18S
5	SWITCH	MICRO-SWITCH		YZ-R31
6	BOMB SALVO RELAY		B-9-A	32439
7	B.B.#6 FWD. RELAY PANEL	NORTHROP		584602
8	B.B.#5 FWD. RELAY PANEL	NORTHROP		584598
9	PRESSURIZED PLUG	THOMAS & BETTS		BDS-1354-8

Figure 109. Bomb Release - B.B. 5 and 6



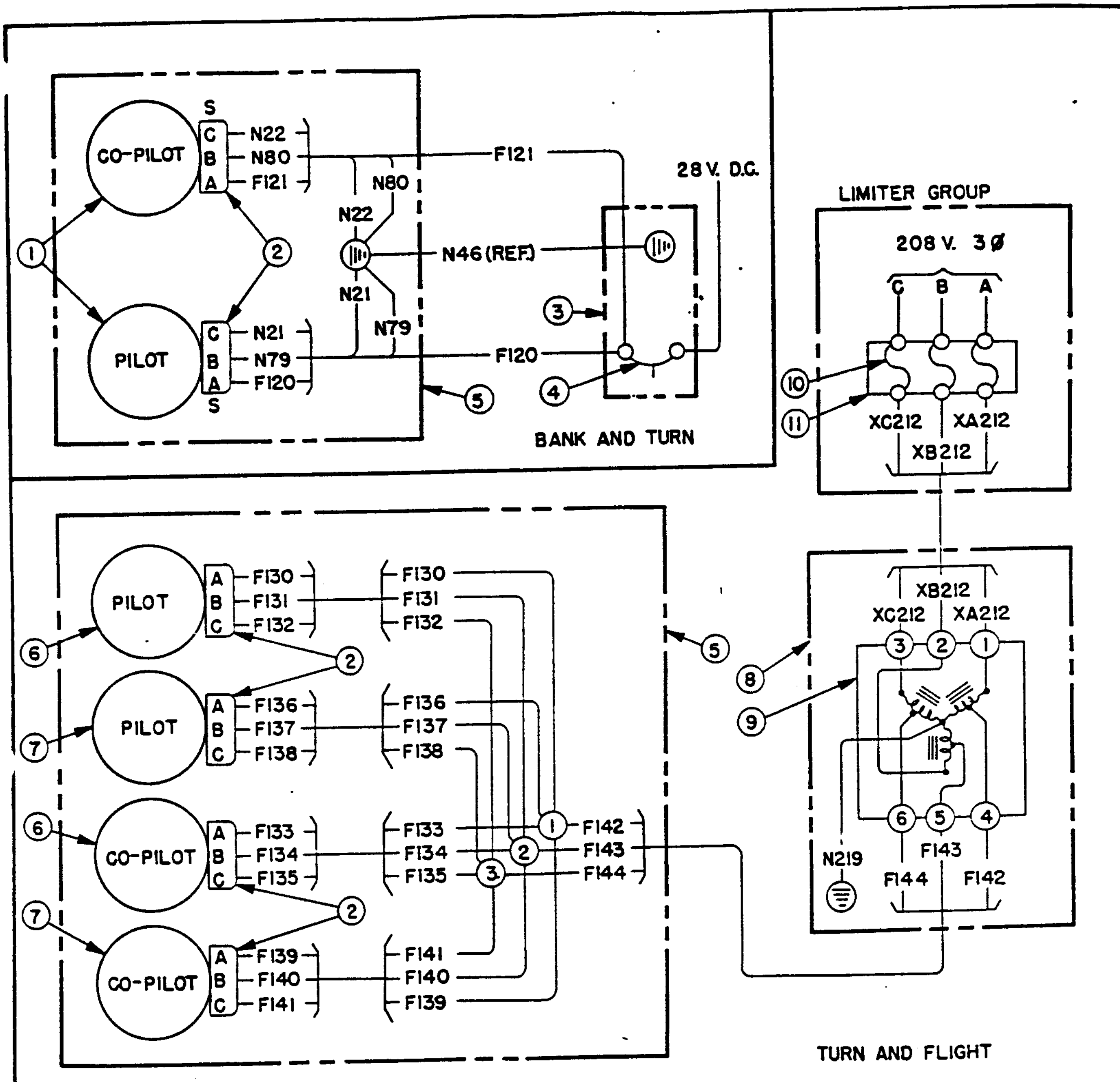
ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	W.W. D.C. DISTRIBUTION PANEL	NORTHROP		554189-1
2	CIRCUIT BREAKER	KLIXON		PA5
3	RECEPTACLE		AN	3100-24-5S
4	RECEPTACLE		AN	3100-22-18S
5	SWITCH	MICRO-SWITCH		YZ-R31
6	BOMB SALVO RELAY		B-9A	32439
7	B.B.#8 FWD. RELAY PANEL	NORTHROP		584600
8	PRESSURIZED PLUG	THOMAS & BETTS		BDS-1354-B
9	B.B.#7 FWD. RELAY PANEL	NORTHROP		584604

Figure 110. Bomb Release - B.B. 7 and 8



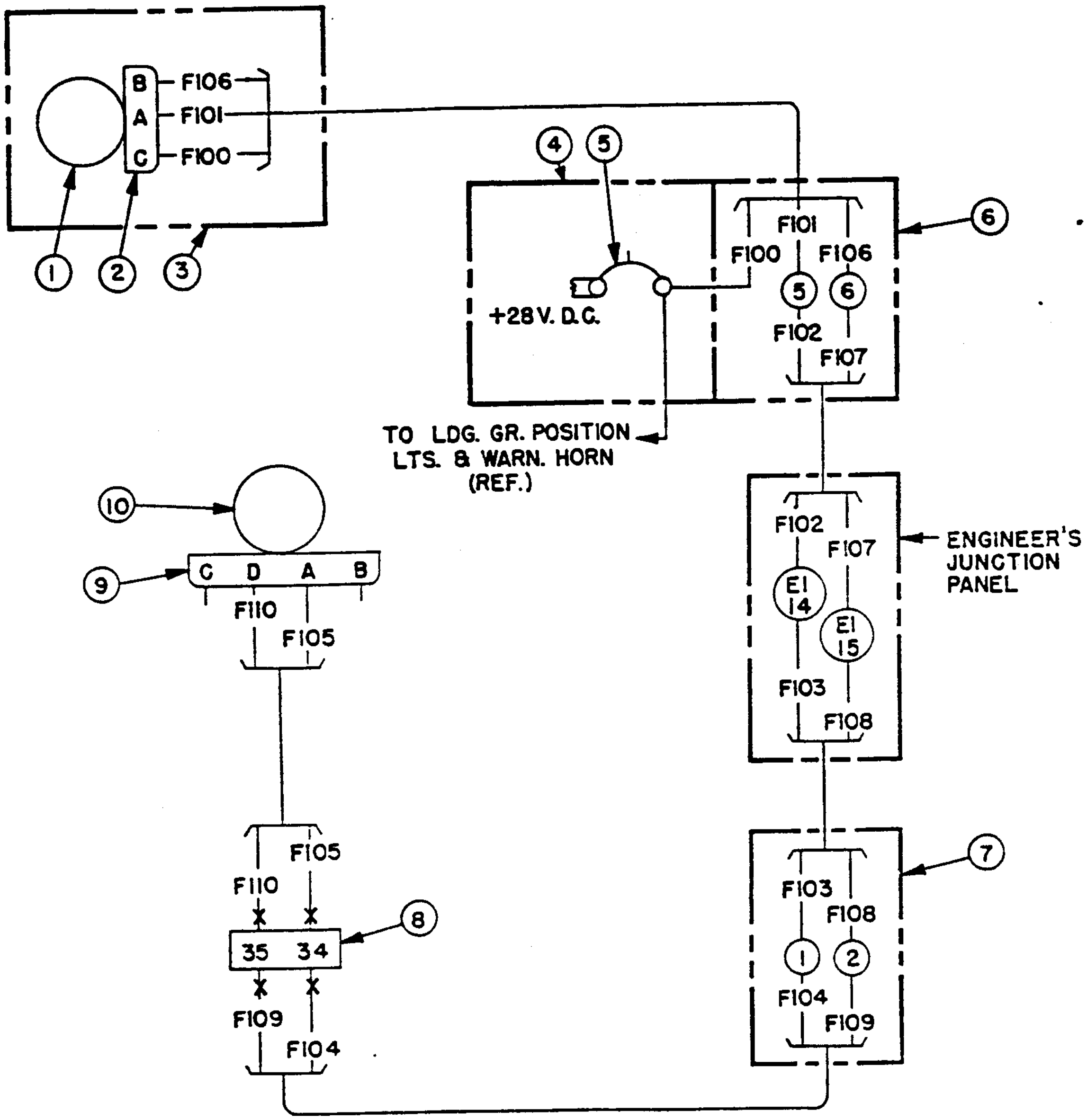
ART	NAME	REQ	MAKE	TYPE	SPEC. OR PART NO
1	RELAY	2		B9A	32439
2	RELAY	1	CUTLER-HAMMER		9565H20
3	BOMB BAY NO 4 AFT RELAY PANEL	1	NORTHROP		584583
4	BOMB BAY NO 4 F'WD RELAY PANEL	1	NORTHROP		584597
5	SWITCH	1			BZ-R31
6	SWITCH	1		AN	3022-2
7	LAMP & SWITCH ASSEMBLY	1		AAF	44A18454-9
⊗ 8	SOLENOID	1			11445-24
9	PRESSURIZED PLUG	1	THOMAS & BETTS		BDS1354B
10	B.B. NO 4 BOMB SALVO SW. PANEL	1	NORTHROP		456015
11	ENGINEER'S D.C. DIST. PANEL	1	NORTHROP		554151

Figure 111. Bomb Bay No. 4 Door and Salvo Control



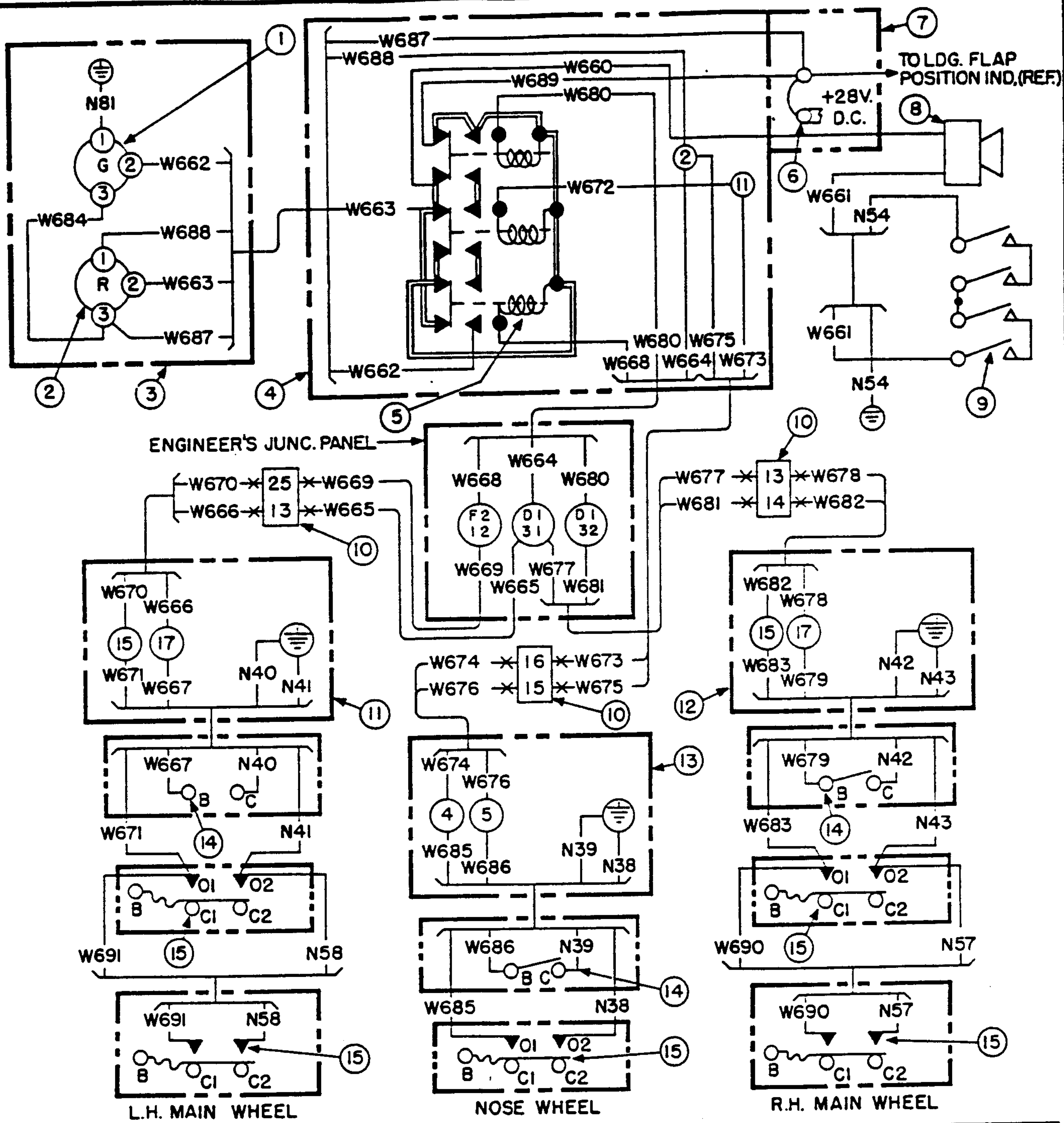
ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	INDICATOR — BANK AND TURN		CI	94-27337
2	PLUG		AN	3106-10SL-3S
3	PILOT'S PEDESTAL	NORTHROP		552409
4	CIRCUIT BREAKER		AN	3161-5
5	PANEL — INSTRUMENT	NORTHROP		551052
6	INDICATOR — FLIGHT		EI	
7	INDICATOR — TURN		CI	
8	PANEL — ENG. TRANSFORMER	NORTHROP		554669
9	TRANSFORMER	GEN. ELECTRIC		70G159
10	LIMITER	BURNDY		F3L10
11	LIMITER BASE	BURNDY		F3H1

Figures 112 and 113. Bank and Turn and Flight and Turn Indicators



ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	INDICATOR	GEN. ELECTRIC		8DJ11PFC
2	PLUG		AN	3106-14S-1S
3	PANEL-INSTRUMENT	NORTHROP		551052
4	CONTROL PEDESTAL	NORTHROP		552409
5	CIRCUIT BREAKER		AN	3161-5
6	PANEL-PED. RELAY	NORTHROP		552374
7	PANEL-LDG. FLAP	NORTHROP		555490
8	PLUG - PRESSURIZED	THOMAS & BETTS		BDS-1354-B
9	PLUG		AN	3106-14S-2S
10	TRANSMITTER		AN	5785-1

Figure 114. Landing Flap Position Indicators

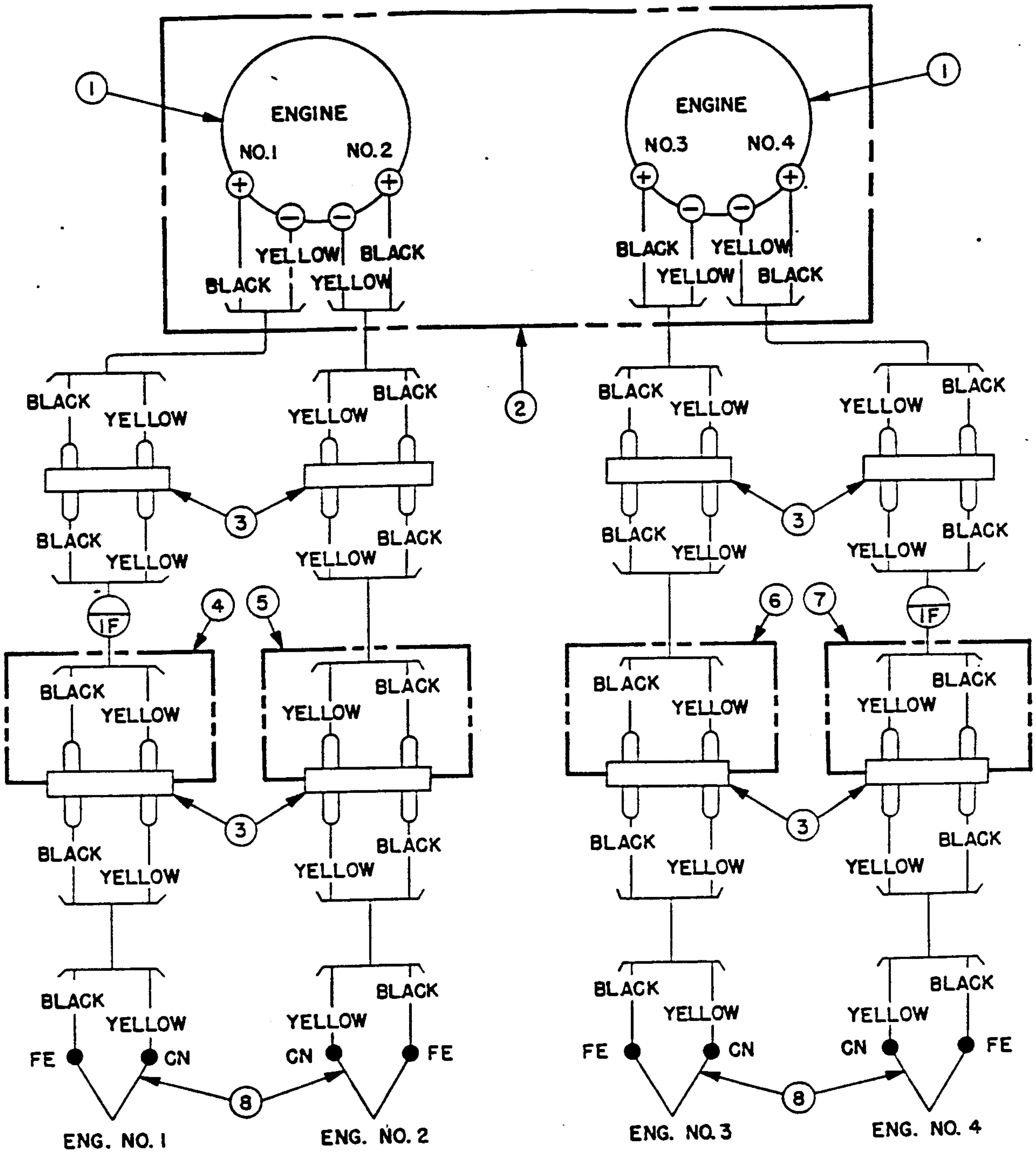


ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	LIGHT-INDICATOR			44A18454-3
2	LIGHT-INDICATOR			44A18454-2
3	PANEL-INST.	NORTHROP		551052
4	PANEL-RELAY	NORTHROP		552374
5	RELAY	EPCO		ND-47E
6	CIRCUIT B'R'K'R		AN	3161-5
7	PEDESTAL	NORTHROP		552409
8	HORN-WARN.			J2

ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
9	SWITCH		MICRO	YZR31
10	PLUG-PRESS.	THOS.-BETTS		BDS-1354-8
11	PANEL-RELAY	NORTHROP		584605
12	PANEL-RELAY	NORTHROP		584606
13	PANEL-RELAY	NORTHROP		552738
14	SWITCH		MICRO	WZR31
15	SWITCH		MICRO	BZ3YT

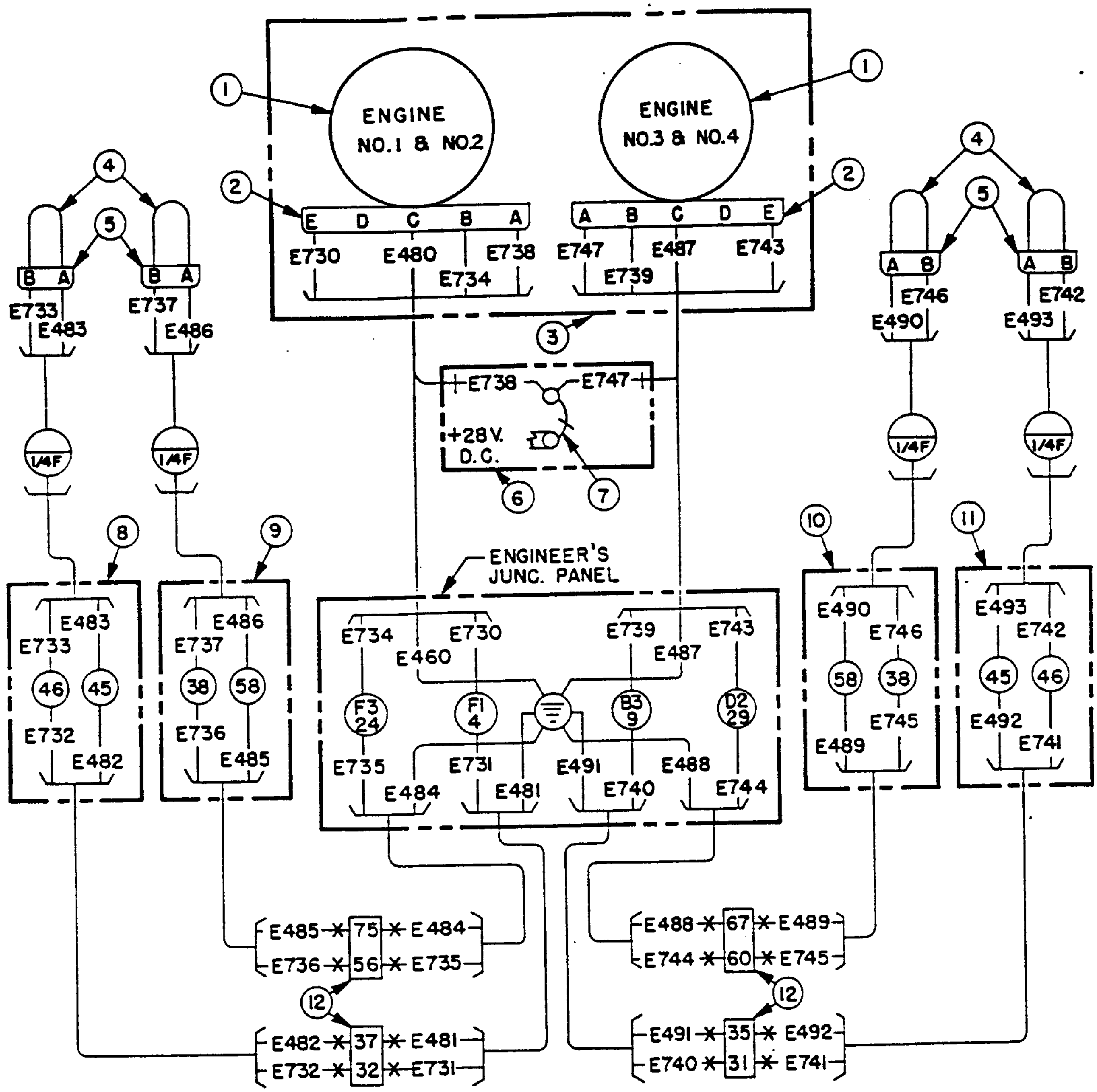
SWITCHES SHOWN IN GEAR UP & LOCKED & THROTTLE ADVANCED ABOVE MIN. CRUISING SPEED POSITION.

Figure 115. Landing Gear Position Lights and Warning Horn



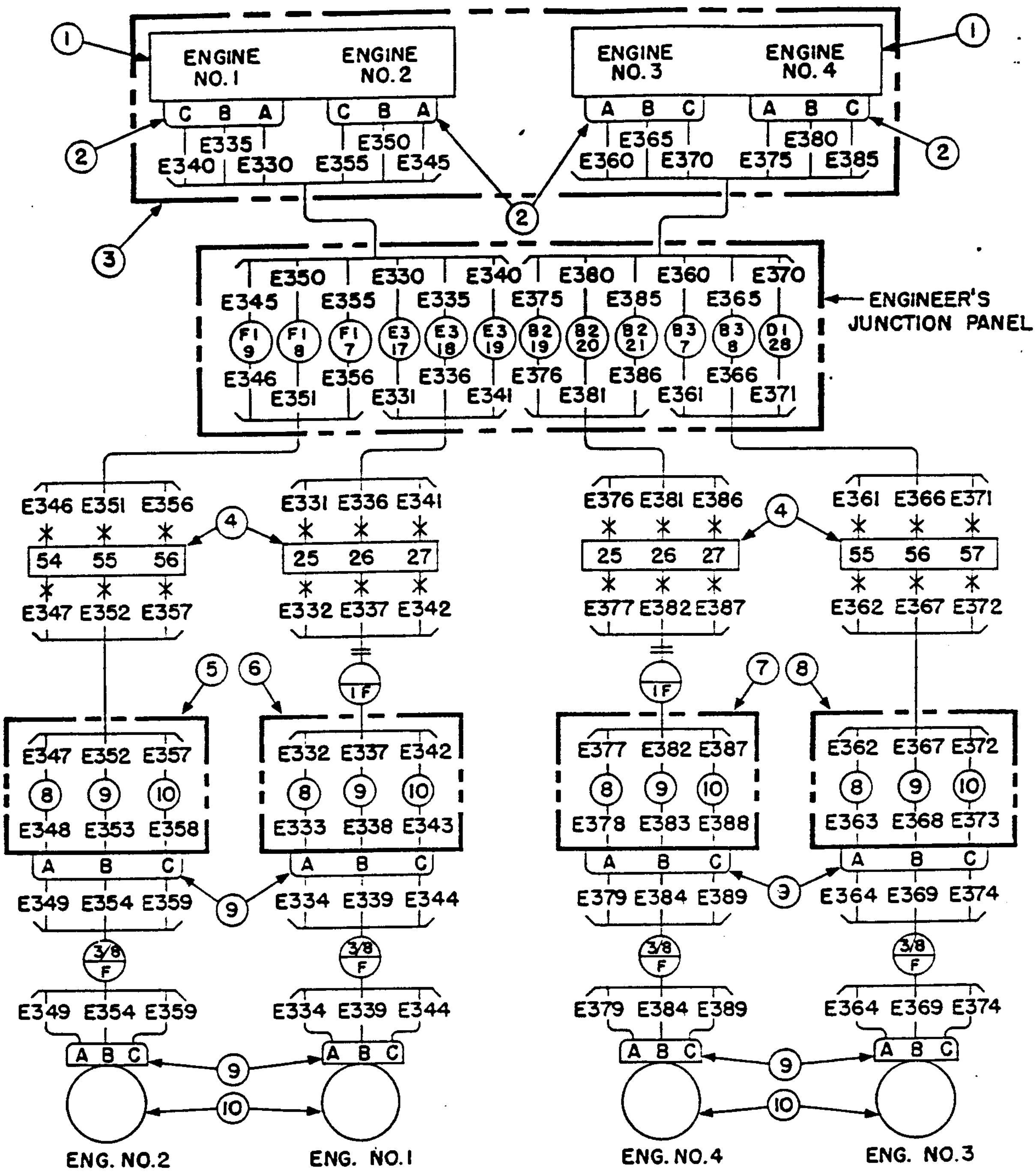
ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	INDICATOR - DUAL		AN	5536-2
2	PANEL - ENG. INST.	NORTHROP		551057
3	CONNECTOR ASSEM.	LEWIS		8T500-2
4	DISCONNECT BOX	NORTHROP		584571
5	DISCONNECT BOX	NORTHROP		556221
6	DISCONNECT BOX	NORTHROP		556221-1
7	DISCONNECT BOX	NORTHROP		584572
8	THERMOCOUPLE	NORTHROP	AN	5540-1

Figure 116. Engine Temperature Indicators



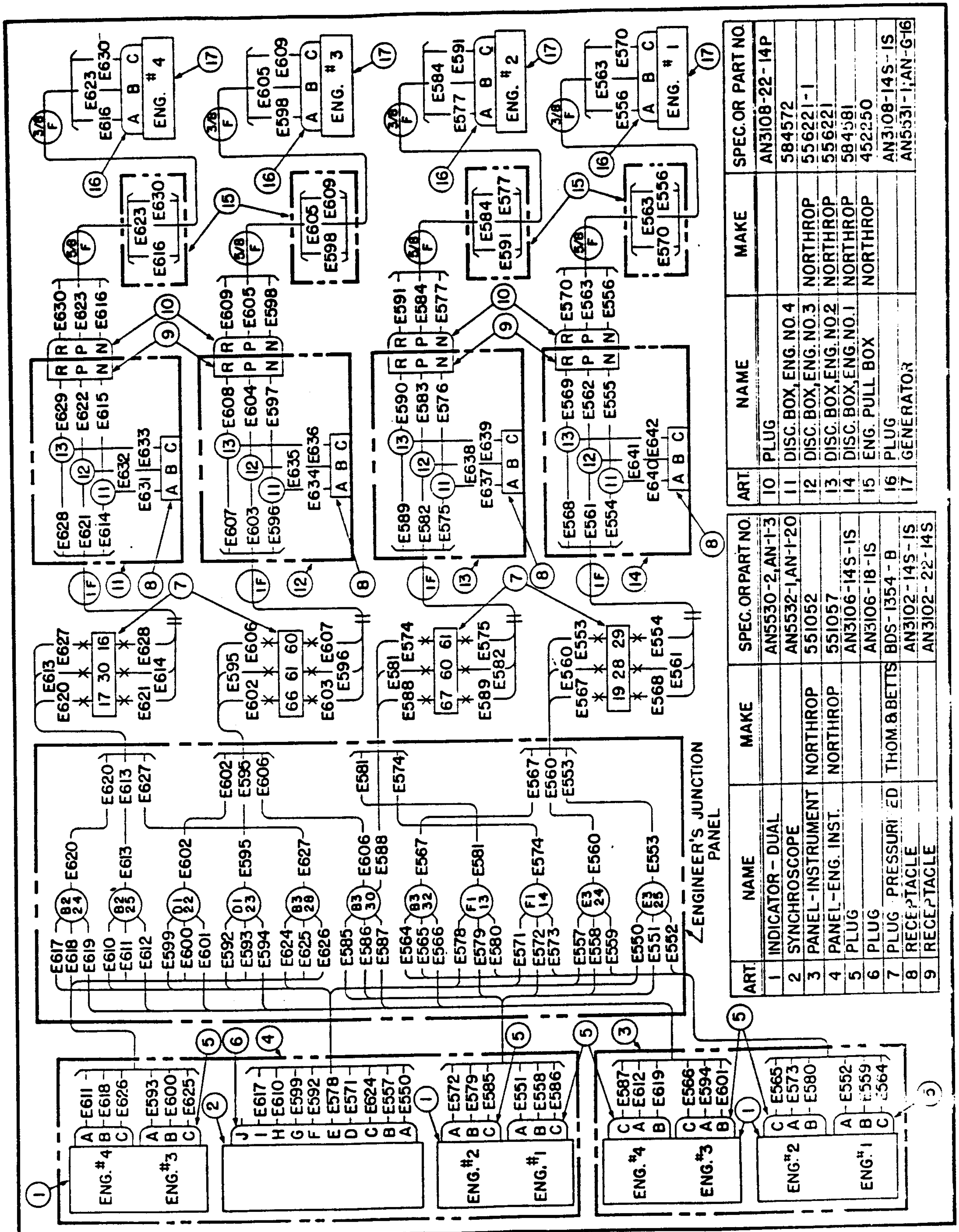
ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	INDICATOR - DUAL		AN	5795-6
2	PLUG		AN	3106 - 14S-5S
3	PANEL - ENG. INST.	NORTHROP		551057
4	THERMO SENSITIVE ELEM.		AN	5525-2
5	PLUG		AN	3106 - 12S - 3S
6	PANEL - ENG. SWITCH	NORTHROP		552672
7	CIRCUIT BREAKER		AN	3160-5
8	PANEL- B.B.1 F'WD RELAY	NORTHROP		584599
9	PANEL- B.B.2 F'WD RELAY	NORTHROP		584603
10	PANEL- B.B.7 F'WD RELAY	NORTHROP		584604
11	PANEL- B.B.8 F'WD RELAY	NORTHROP		584600
12	PLUG - PRESSURIZED	THOMAS & BETTS		BDS-1354-B

Figure 117. Carburetor Air Temperature Indicators



ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	INDICATOR-DUAL	GEN.ELECTRIC		BDJ19ABC
2	PLUG		AN	3106-14S-1S
3	PANEL- ENG. INST.	NORTHROP		551057
4	PLUG- PRESSURIZED	THOMAS & BETTS		BDS-1354-B
5	DISCONNECT BOX-ENG.NO.2	NORTHROP		556221
6	DISCONNECT BOX-ENG.NO.1	NORTHROP		584571
7	DISCONNECT BOX-ENG.NO.4	NORTHROP		584572
8	DISCONNECT BOX-ENG.NO.3	NORTHROP		556221-1
9	PLUG		AN	3108-14S-1S
10	GENERATOR-TACH.	GEN. ELECTRIC		2CM5AEEY46

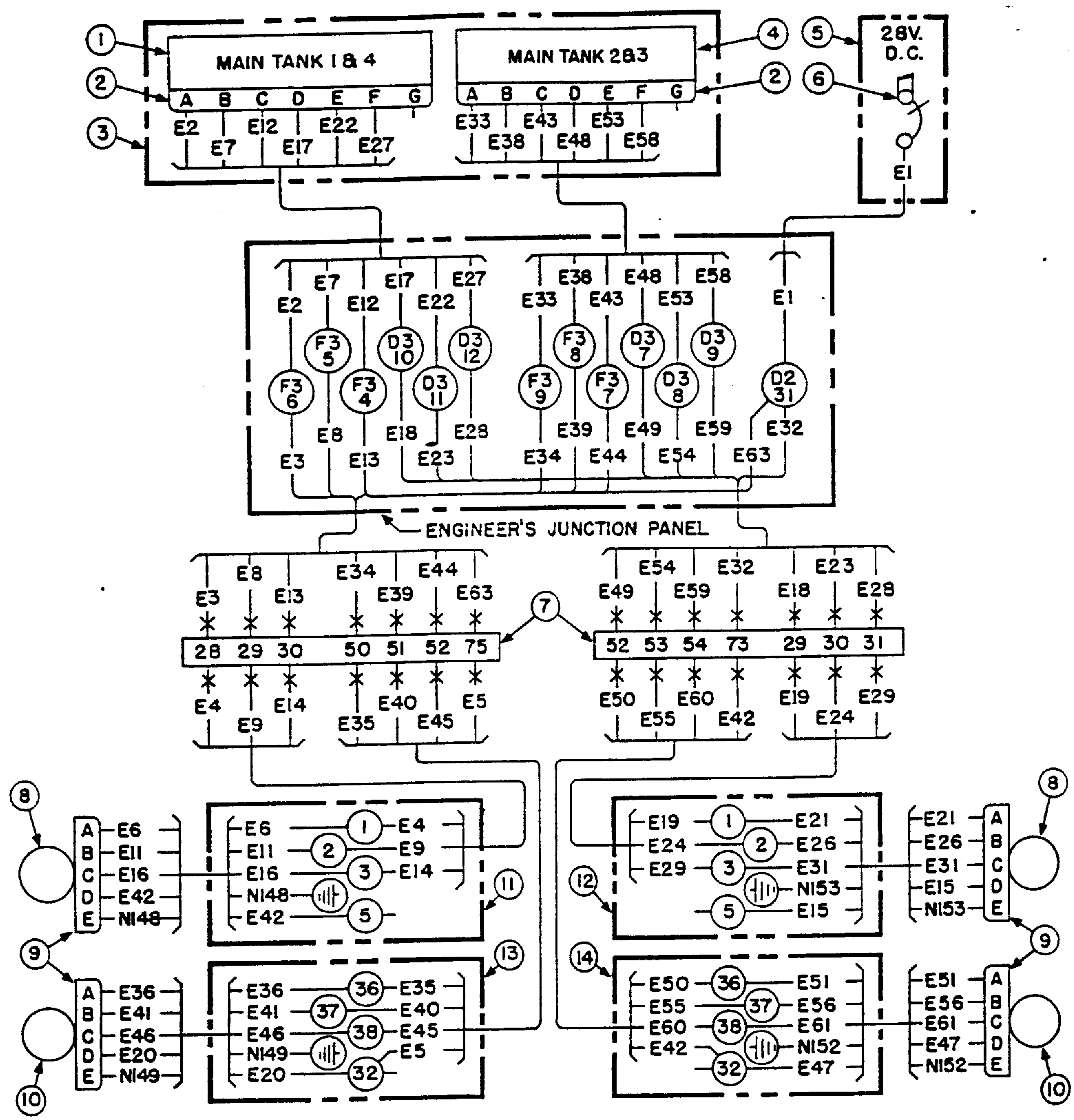
Figure 118. Engine Fan Speed Indicators



ART.	NAME	MAKE	SPEC. OR PART NO.
1	INDICATOR-DUAL		AN5530-2,AN-I-3
2	SYNCHROSCOPE		AN5532-1,AN-I-20
3	PANEL-INSTRUMENT	NORTHROP	551052
4	PANEL-ENG. INST.	NORTHROP	551057
5	PLUG		AN3106-14S-1S
6	PLUG		AN3106-18-1S
7	PLUG PRESSURIZED	THOM.&BETTS	BDS-1354-B
8	RECEPTACLE		AN3102-14S-1S
9	RECEPTACLE		AN3102-22-14S

ART.	NAME	MAKE	SPEC. OR PART NO.
10	PLUG		AN3108-22-14P
11	DISC. BOX, ENG. NO.4		584572
12	DISC. BOX, ENG. NO.3	NORTHROP	556221-1
13	DISC. BOX, ENG. NO.2	NORTHROP	556221
14	DISC. BOX, ENG. NO.1	NORTHROP	584581
15	ENG. PULL BOX	NORTHROP	452250
16	PLUG		AN3108-14S-1S
17	GENERATOR		AN5531-1,AN-G-16

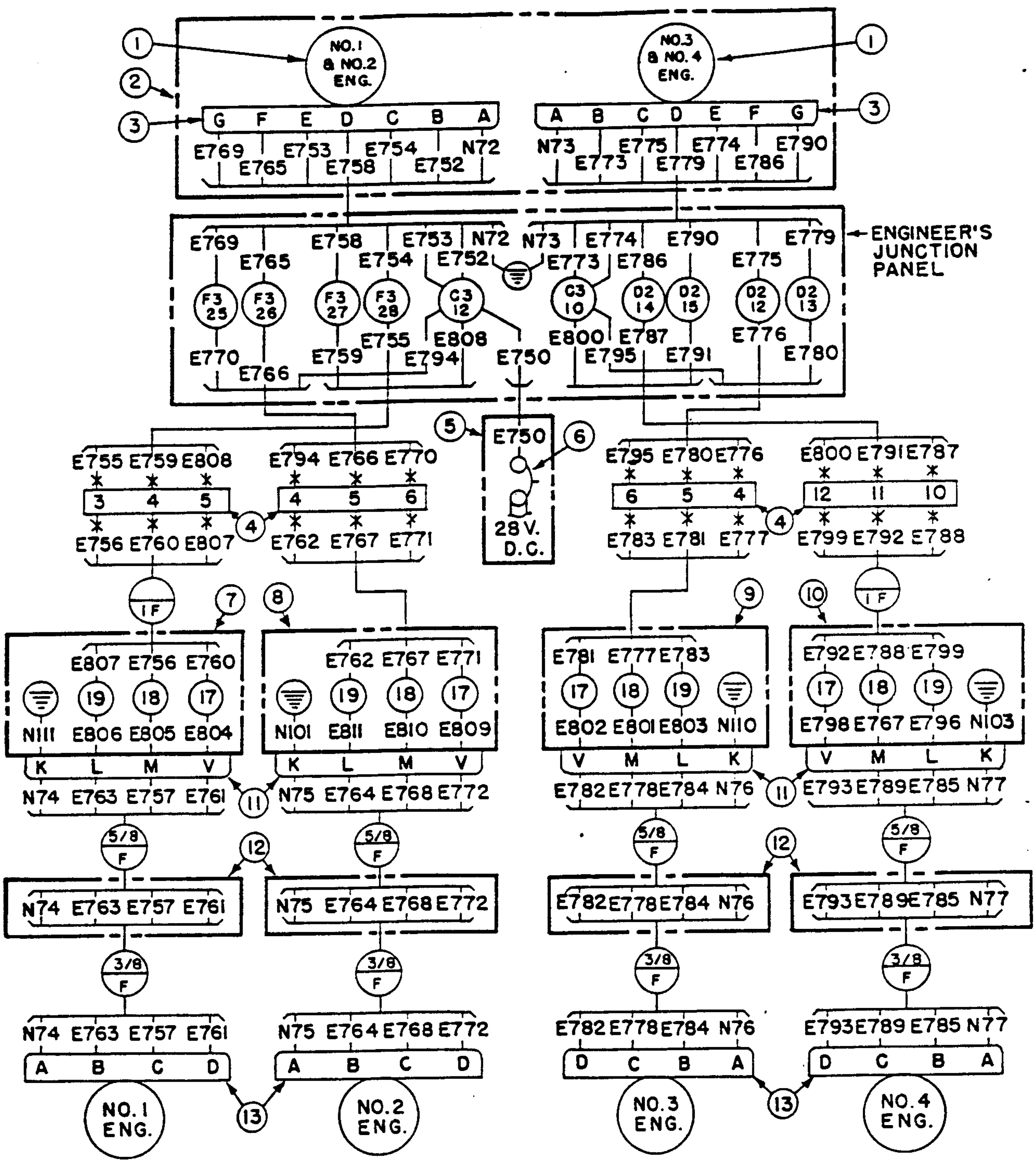
Figure 119. Tachometer and Synchroscope Indicators



ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	INDICATOR	GEN. ELEC.		8DJ2LBM
2	PLUG		AN	3106-16S-1S
3	PANEL-INST.	NORTHROP		551057
4	INDICATOR	GEN. ELEC.		8DJ2LBL
5	PANEL-SWITCH	NORTHROP		552672
6	CIRCUIT BREAKER		AN	3160-5
7	PLUG-PRESS.	THOS-BETTS		BDS1354-B

ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
8	TRANSMITTER	GEN. ELEC.		8TJ18LAL
9	PLUG		AN	3106-14S-5S
10	TRANSMITTER	GEN. ELEC.		8TJ18LAK
11	PANEL-A.C.SECT.	NORTHROP		553472
12	PANEL-A.C.SECT.	NORTHROP		553472-1
13	PANEL-RELAY	NORTHROP		584597
14	PANEL-RELAY	NORTHROP		584598

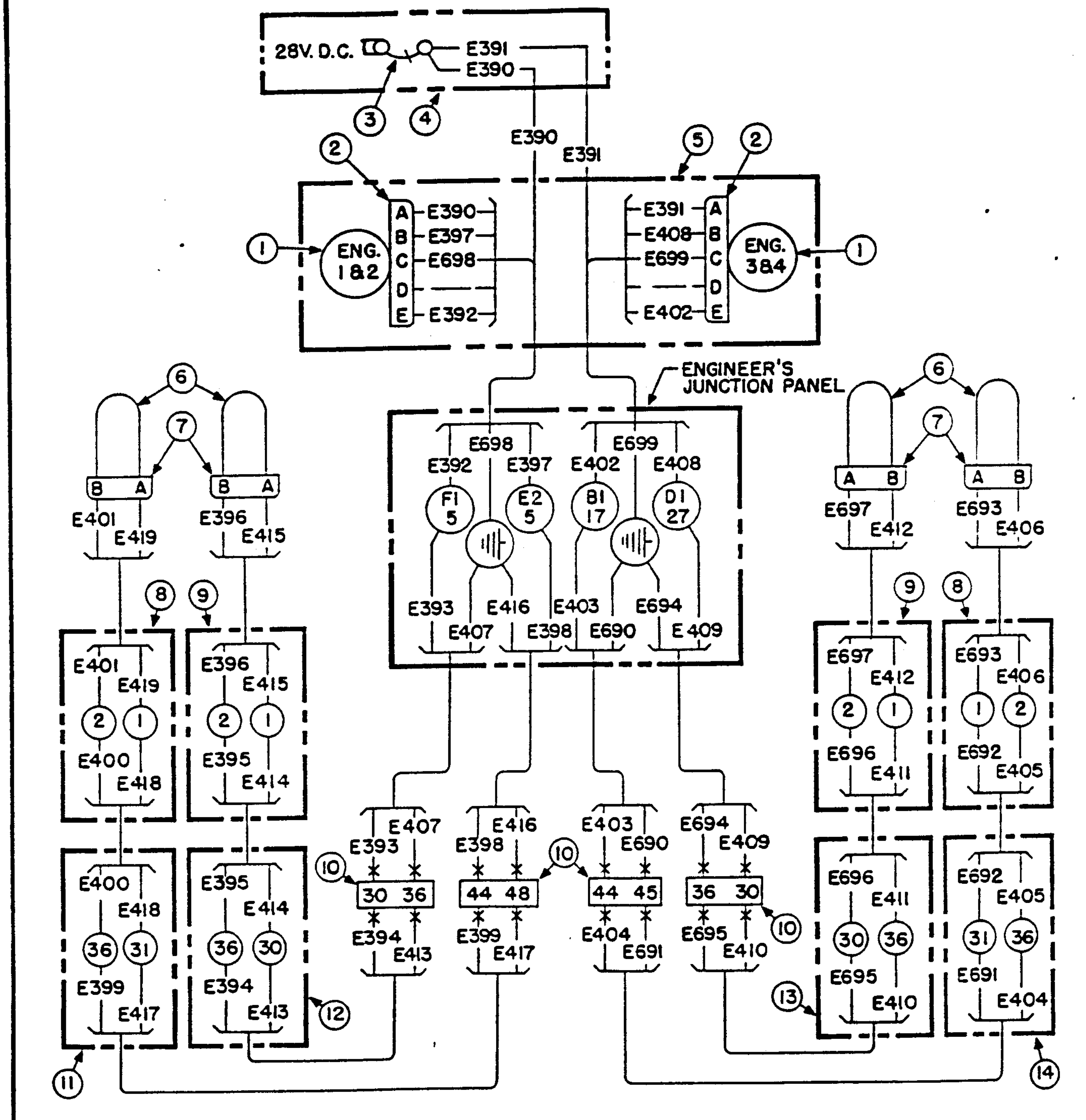
Figure 120. Fuel Level Indicators - Main Tanks



ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	INDICATOR-DUAL	NORTHROP		6007-388
2	PANEL-ENG. INST.	NORTHROP		551057
3	PLUG		AN	3106-16S-1S
4	PLUG-PRESS.	THOS-BETTS		BDS-1354-B
5	PANEL-ENG. SW.	NORTHROP		552672
6	CIRCUIT BREAK'R		AN	3160-5
7	DISC. BOX	NORTHROP		584571

ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
8	DISC. BOX	NORTHROP		556227
9	DISC. BOX	NORTHROP		556221-1
10	DISC. BOX	NORTHROP		584572
11	PLUG		AN	3108-22-14P
12	ENG. PULL BOX	NORTHROP		452250
13	PLUG		AN	3108-14S-2S
14	TRANSMITTER	PIONEER		9054-4

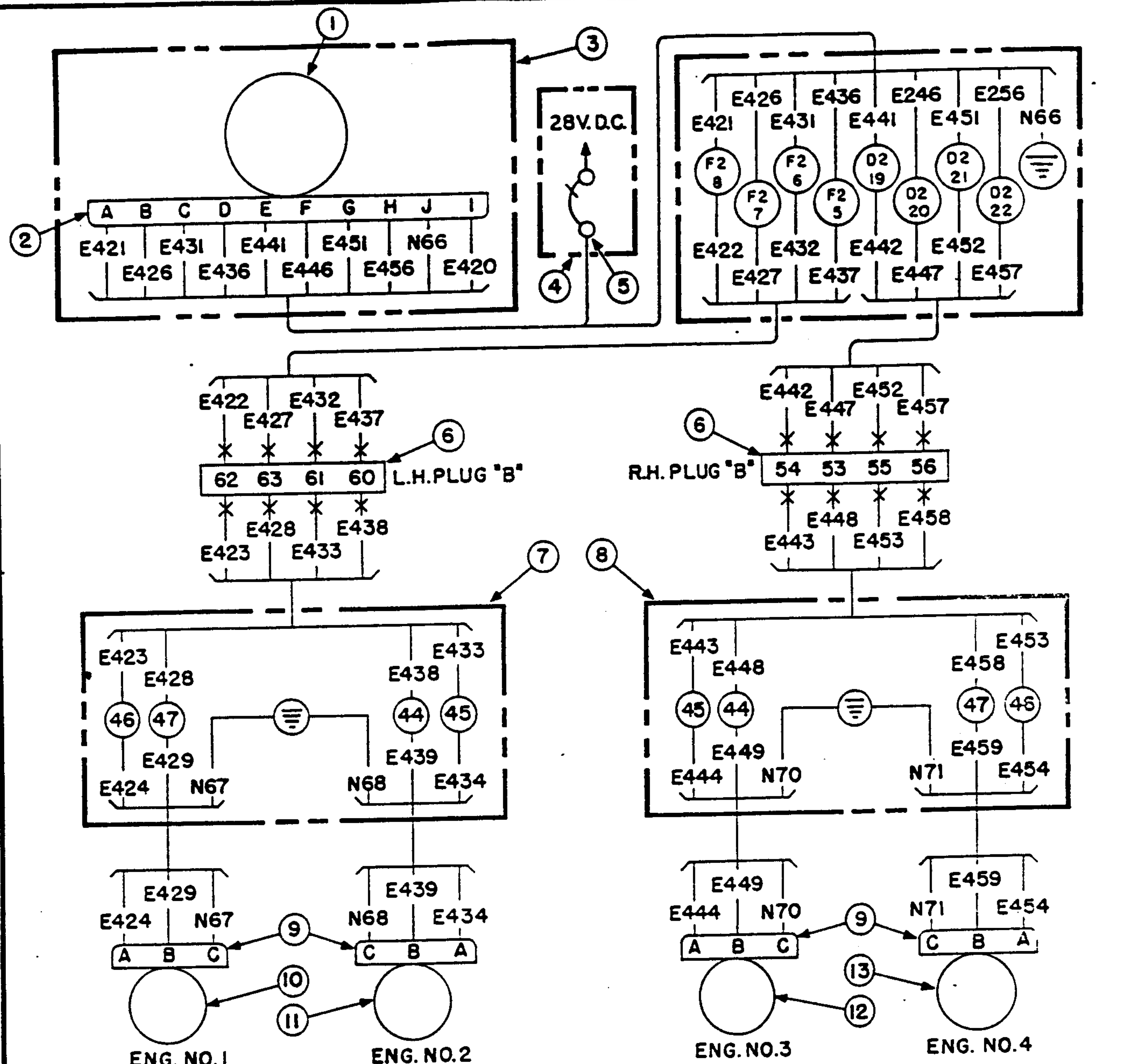
Figure 121. Fuel Flow Indicators



ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	INDICATOR		AN	5795-6
2	PLUG		AN	3106-14S6S
3	CIRCUIT BREAKER		AN	3160-5
4	PANEL- SWITCH	NORTHROP		552672
5	PANEL-ENG. INST.	NORTHROP		551057
6	RESISTANCE BULB		AN	5525-2
7	PLUG		AN	3108-12S-3S

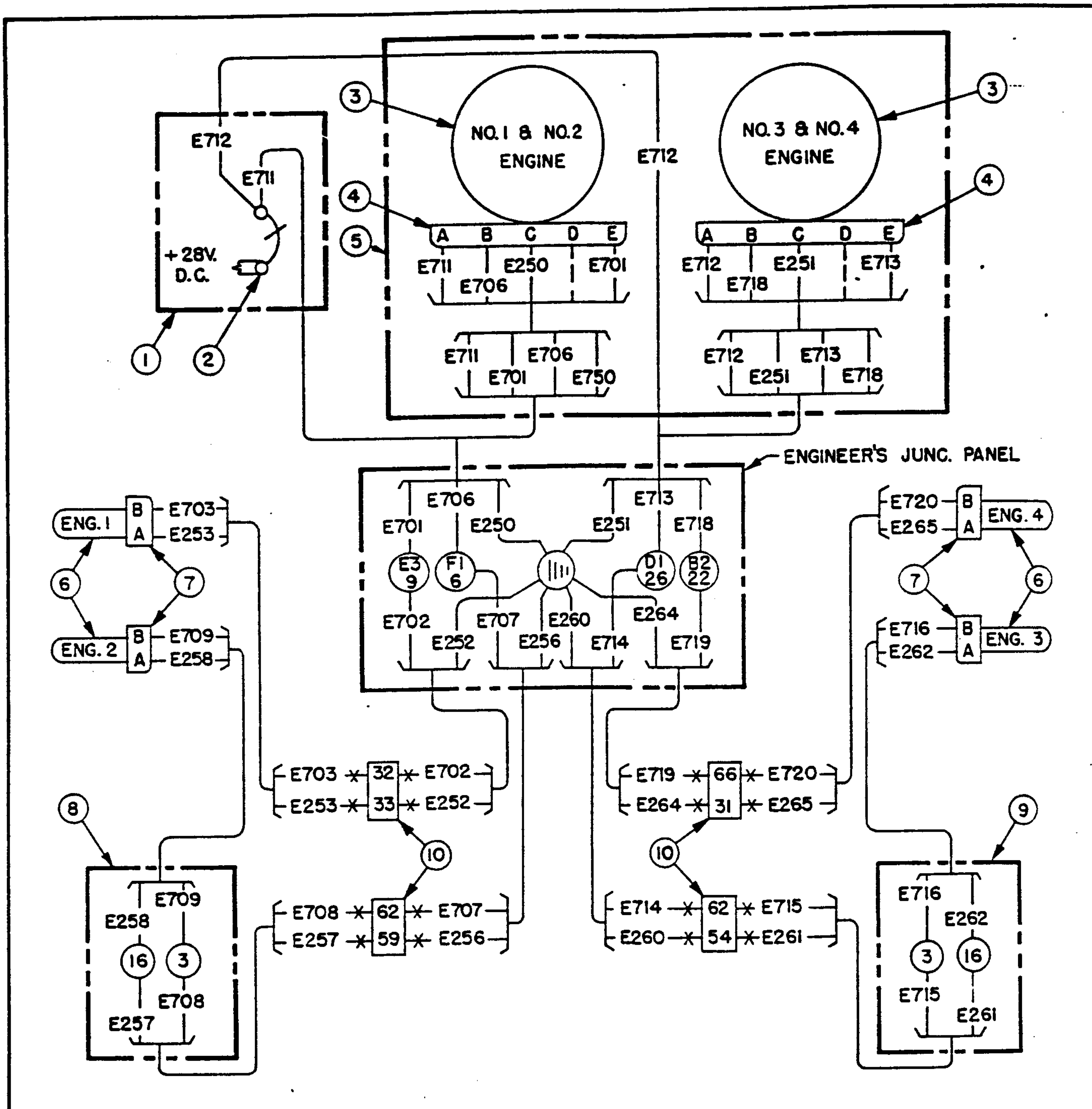
ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
8	JUNCTION BOX	NORTHROP		584721
9	JUNCTION BOX	NORTHROP		584587
10	PLUG - PRESS.	THOM.-BETTS		BDS-1354-8
11	PANEL - RELAY	NORTHROP		584601
12	PANEL - RELAY	NORTHROP		584599
13	PANEL - RELAY	NORTHROP		584600
14	PANEL - RELAY	NORTHROP		584602

Figure 122. Propeller Gear Box Oil Temperature Indicators



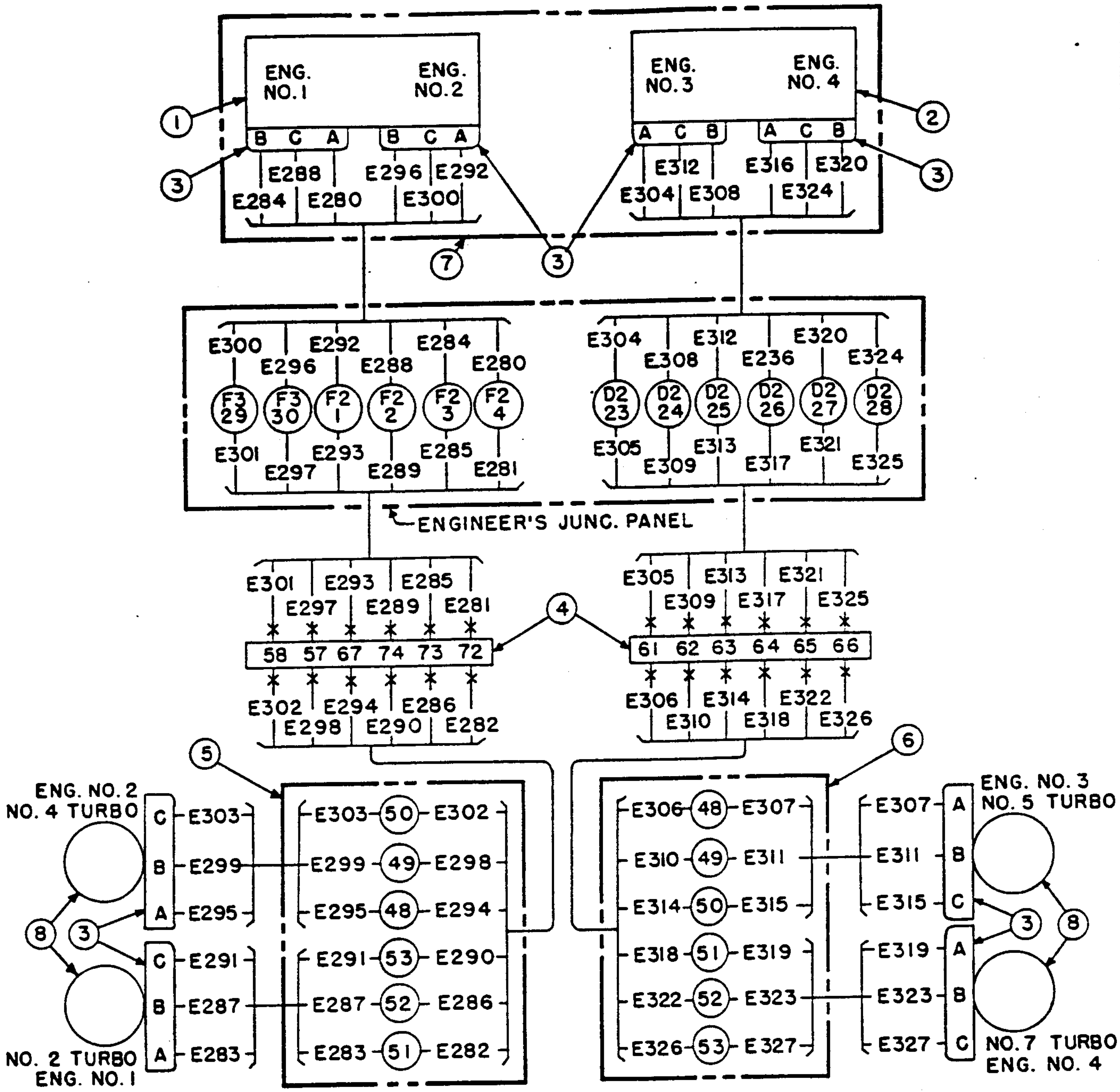
ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	INDICATOR	GEN. ELECTRIC		8DJ20ACR
2	PLUG		AN	3106-18-1S
3	PANEL- ENGINEER'S	NORTHROP		551057
4	PANEL-ENG. SWITCH	NORTHROP		552672
5	CIRCUIT BREAKER		AN	3106-5
6	PLUG- PRESSURIZED	THOMAS&BETTS		8DS-1354-B
7	PANEL-F'WD RELAY	NORTHROP		584603
8	PANEL- F'WD RELAY	NORTHROP		584604
9	PLUG		AN	3106-14S-1S
10	TRANSMITTER	GEN. ELECTRIC		8TJ17AFD
11	TRANSMITTER	GEN. ELECTRIC		8TJ17AFF
12	TRANSMITTER	GEN. ELECTRIC		8TJ17AFF
13	TRANSMITTER	GEN. ELECTRIC		8TJ17AFE

Figure 123. Engine Oil Level Indicators



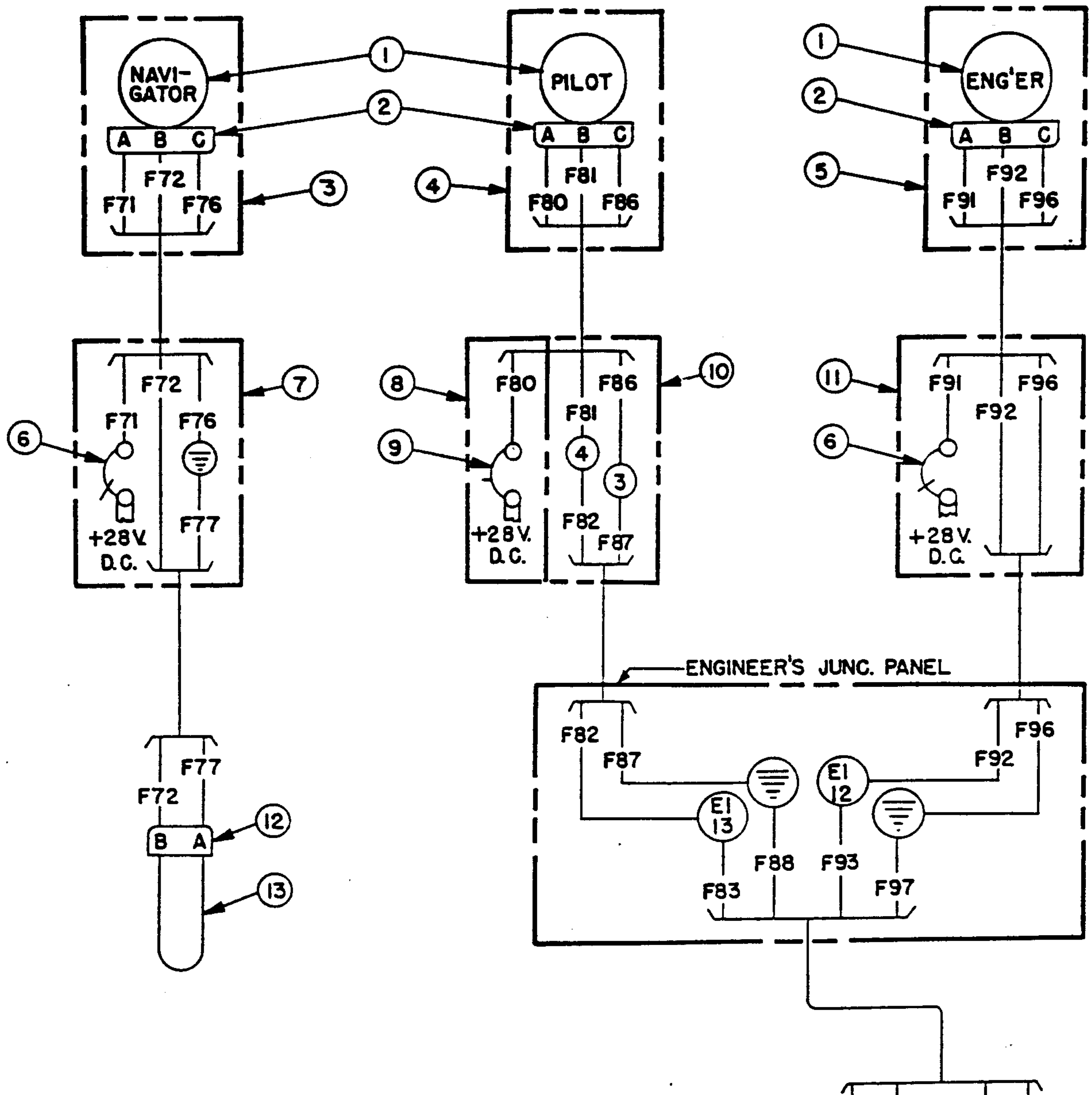
ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	PANEL - LOWER SWITCH	NORTHROP		552672
2	CIRCUIT BREAKER		AN	3160-5
3	INDICATOR		AN	5795-6
4	PLUG		AN	3106-14S-5S
5	PANEL - INSTRUMENT	NORTHROP		551057
6	RESISTANCE BULB		AN	5525-2
7	PLUG		AN	3106-12S-3S
8	DISC. BOX - L.H. INB'D ENG.	NORTHROP		556221
9	DISC. BOX - R.H. INB'D ENG.	NORTHROP		556221
10	PLUG - PRESSURIZED	THOMAS & BETTS		BDS-1354-B

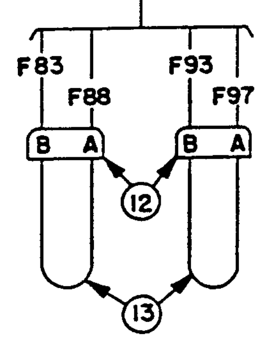
Figure 124. Engine Oil Temperature Indicators



ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	INDICATOR - DUAL	GEN. ELECTRIC		8DJ19ABA
2	INDICATOR - DUAL	GEN. ELECTRIC		8DJ19ABB
3	PLUG		AN	3106-14S-1S
4	PLUG - PRESSURIZED	THOMAS-BETTS		8DS-1354-B
5	PANEL-FORWARD RELAY	NORTHROP		584603
6	PANEL-FORWARD RELAY	NORTHROP		584604
7	PANEL-ENG. INSTRUMENT	NORTHROP		551057
8	GENERATOR-TACHOMETER	GEN. ELECTRIC		2CM5ATT

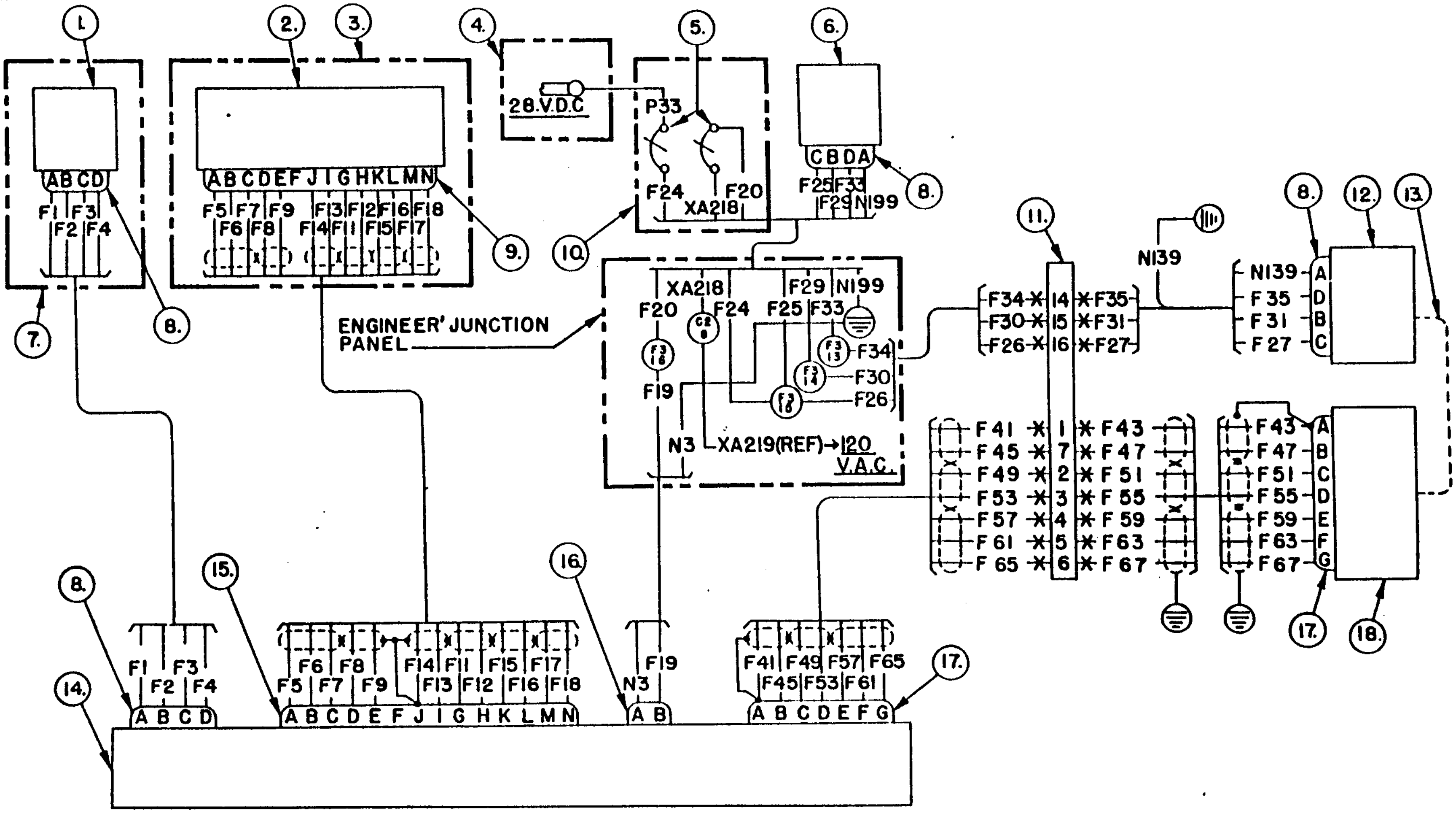
Figure 125. Turbosupercharger Speed Indicators





ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	INDICATOR		AN	5790-6
2	PLUG		AN	3106-14S-2S
3	PANEL — INSTRUMENT	NORTHROP		550199
4	PANEL- PILOT'S	NORTHROP		551052
5	PANEL-INSTRUMENT	NORTHROP		552125
6	CIRCUIT BREAKER		AN	3160-5
7	PANEL- NAVIGATOR'S	NORTHROP		452655
8	PILOT'S PEDESTAL	NORTHROP		552409
9	CIRCUIT BREAKER		AN	3161-5
10	PANEL—PED. RELAY	NORTHROP		552374
11	PANEL-ENGINEER'S	NORTHROP		552672
12	PLUG		AN	3106-12S-3S
13	RESISTANCE BULB,-70° TO 150° C.		AN	5525-1

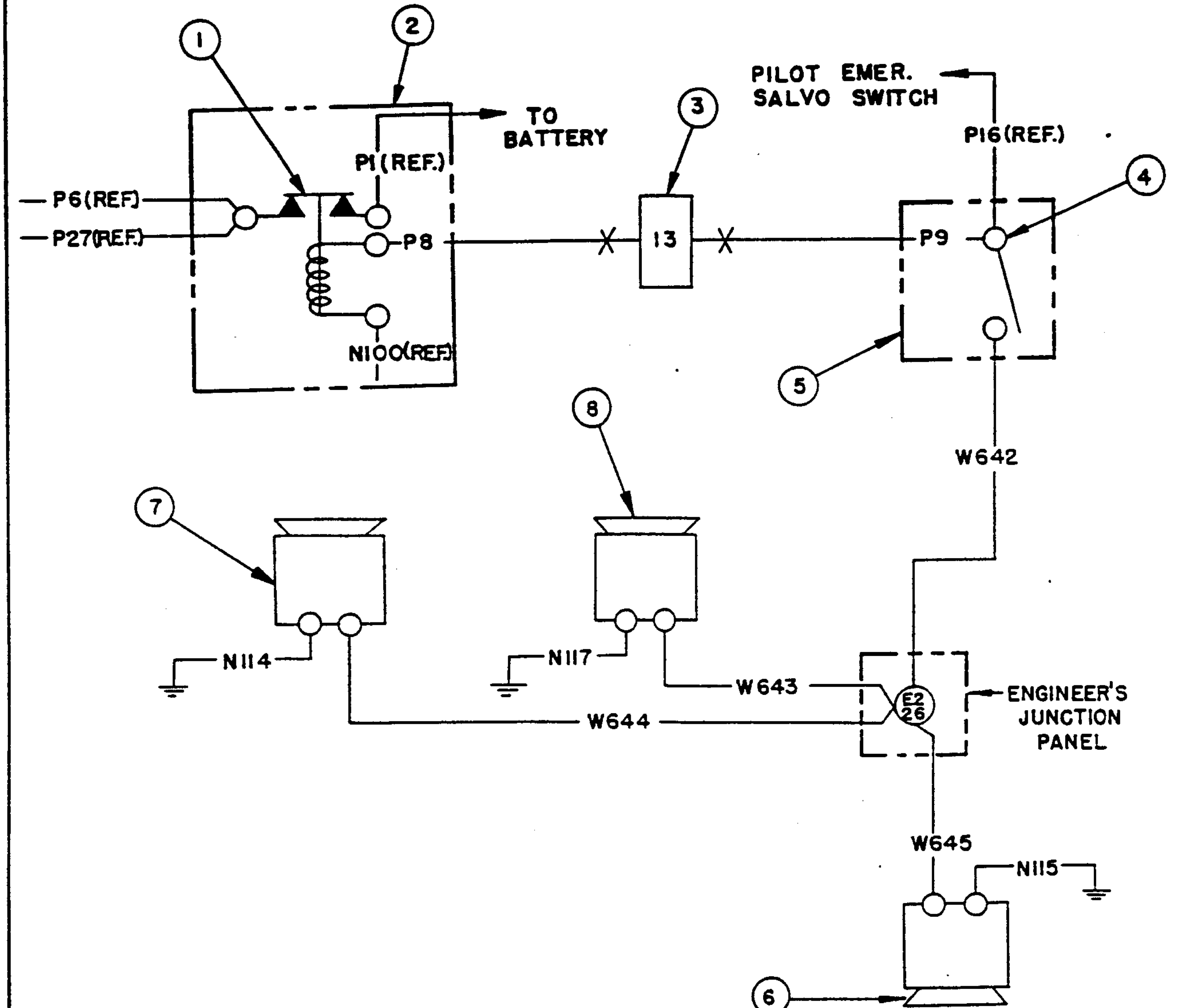
Figure 126. Free Air Temperature Indicator



ART.	NAME	REQ	MAKE	SPEC. OR PARTS NO.
1	PILOT'S INDICATOR	1		AN5730-2
2	MASTER INDICATOR	1		AN5752-1
3	NAVIGATORS PANEL	1	NORTHROP	550199
4	FLIGHT ENG. UPPER PANEL	1	NORTHROP	552722
5	CIRCUIT BREAKER	1		AN3160-5
6	CAGING SWITCH	1		AN5756-2
7	PILOTS INSTRUMENT PANEL	1	NORTHROP	551052
8	PLUG	4		AN3106-14S-2S
9	PLUG	1		AN3108-20-1S

ART	NAME	REQ	MAKE	SPEC. OR PARTS NO.
10	NAVIGATORS SWITCHPANEL	1	NORTHROP	452655
11	PLUG	1	THOM.BETTS	BDS1354-B
12	CAGING MOTOR	1		AN5754-2
13	FLEXIBLE SHAFT	1		AN5757
14	AMPLIFIER	1		AN5753-1
15	PLUG	1		AN3106-20S-1S
16	PLUG	1		AN3106-16S-4S
17	PLUG	2		AN3106-16S-1S
18	TRANSMITTER	1		AN5751-1

Figure 127. Gyro Flux Gate Compass



ITEM	DESCRIPTION	NO. REQ	MANUFACTURER	TYPE	SPEC. OR PART NO.
1	RELAY	1		B4	
2	NOSE W.W. RELAY	1	NORTHROP		552738
3	PLUG - PRESSURIZED	20	THOMAS & BETTS		BDS-1354-B
4	SWITCH	39			AN3022-2
5	PEDESTAL - PILOT'S	1	NORTHROP		552409
6	ALARM BELL - CREW'S QUARTERS	1			AAF 50291-B
7	ALARM BELL - NAVIGATOR	1			AAF 50291-B
8	ALARM BELL - ENGINEER'S	1			AAF 50291-B

Figure 128. Emergency Alarm System

18. RADIO AND COMMUNICATION

18. COMMUNICATION EQUIPMENT. (See figure 1.)

a. GENERAL DESCRIPTION.- The communication equipment of the XB-35 (AAF 42-13603) consists of three radio systems and an inner airplane telephone communication system. The radio systems installed in this airplane are the Command Radio (SCR-274N), the Radio Compass (AN/ARN-7), and the Marker Beacon Radio (AN/RC-193). The airplane's inner telephone communication system is the Interphone (AN/AIC-2). Supplementary equipment of the communication system includes antennae, microphones, headsets, jack boxes, ground crew microphone jacks and headset jacks attached to the nose landing gear, remote control boxes, filter switch boxes, relays, interphone amplifier, coded wires, cable groups, and flexible control shafts.

WARNING

All communication equipment in this airplane involves the use of high voltages which are dangerous to life. Operating personnel should be sure that the power supply to the equipment is turned "OFF" before attempting any adjustments or replacements.

(1) INTERPHONE AN/AIC-2. (See figures 1 and 2.)

(a) DESCRIPTION.- In the XB-35 airplane AAF 42-13603 (N1484) the interphone system provides telephone communication between ten crew stations -- Pilot, Copilot, Bombardier, Navigator, Engineer, Radio Operator, four stations in the aft cabin, and ground crew station. The ground crew station has two head set jacks and two microphone jacks controlled by a switch on the engineer's panel 553042, see figure 11. The other stations are equipped with jack boxes, see figure 4. These jack boxes have a five position "selector switch," a volume control, a head set jack and a microphone jack. The pilot and copilot have a filter in their jack box circuit. By means of the selector switch, limited use of the Radio Compass and the Command Radio are available to these stations in addition to intra airplane telephone service. Included in the Interphone system is an amplifier AM-26AIC installed at the Radio Operator's station on mounting MT-28/ARN-5, see figure 3.

(b) EQUIPMENT.

1. JACK BOXES. (See figure 4.)- The interphone equipment includes 7 jack boxes 452397 and 3 jack boxes 452343. All ten boxes are identical in functions and parts, the only difference being in the mounting holes and cable openings. Each jack box has eleven terminals, see figure 5. The selector switch is a four unit wiper type and has five positions. The "CALL" position is spring loaded, and the switch returns to "INTER" position when released from the "CALL" position. The "INCREASE OUTPUT" control is a variable resistance in series with the "headset" jack. A microphone jack is also provided.

2. AMPLIFIER. (See figures 3 and 6.)- The interphone amplifier AM-26/AIC is installed at the radio operator's station on mounting MT-28/ARN-5. The amplifier is an audio amplifier with an "ON-OFF" switch and a "GAIN CONTROL" mounted on the forward face. The Dynamotor DM-32-A is mounted on the same chassis aft of the amplifier housing. The mounting plate is shock mounted. A thumb screw and clamp assembly on the forward edge of the mounting plate secures the amplifier to the mounting.

3. BOX ASSEMBLIES. (See figure 4.) There are two box assemblies 414991. One at the pilot's station and one at the copilot's station. These boxes include a microphone plug, a microphone jack and a relay operated microphone switch which is controlled by a push button on the control wheel. The control wheel push buttons are wired through the steering brake panel 455100.

4. PRESSURIZED PLUGS. (See figure 7.) Pressurized plug "J" is used between the cabin and the nose wheel strut in the ground crew interphone circuit.

5. FILTERS. (See figure 4.)- Two filters FL-8 are installed in the pilot's and copilot's phone receiver circuits.

6. RADIO JUNCTION BOX. (See figures 3 and 9.)- The radio junction box 514911 is installed at the radio operator's station. In this junction box the interphone system and radio facilities are supplied with power and interconnected.

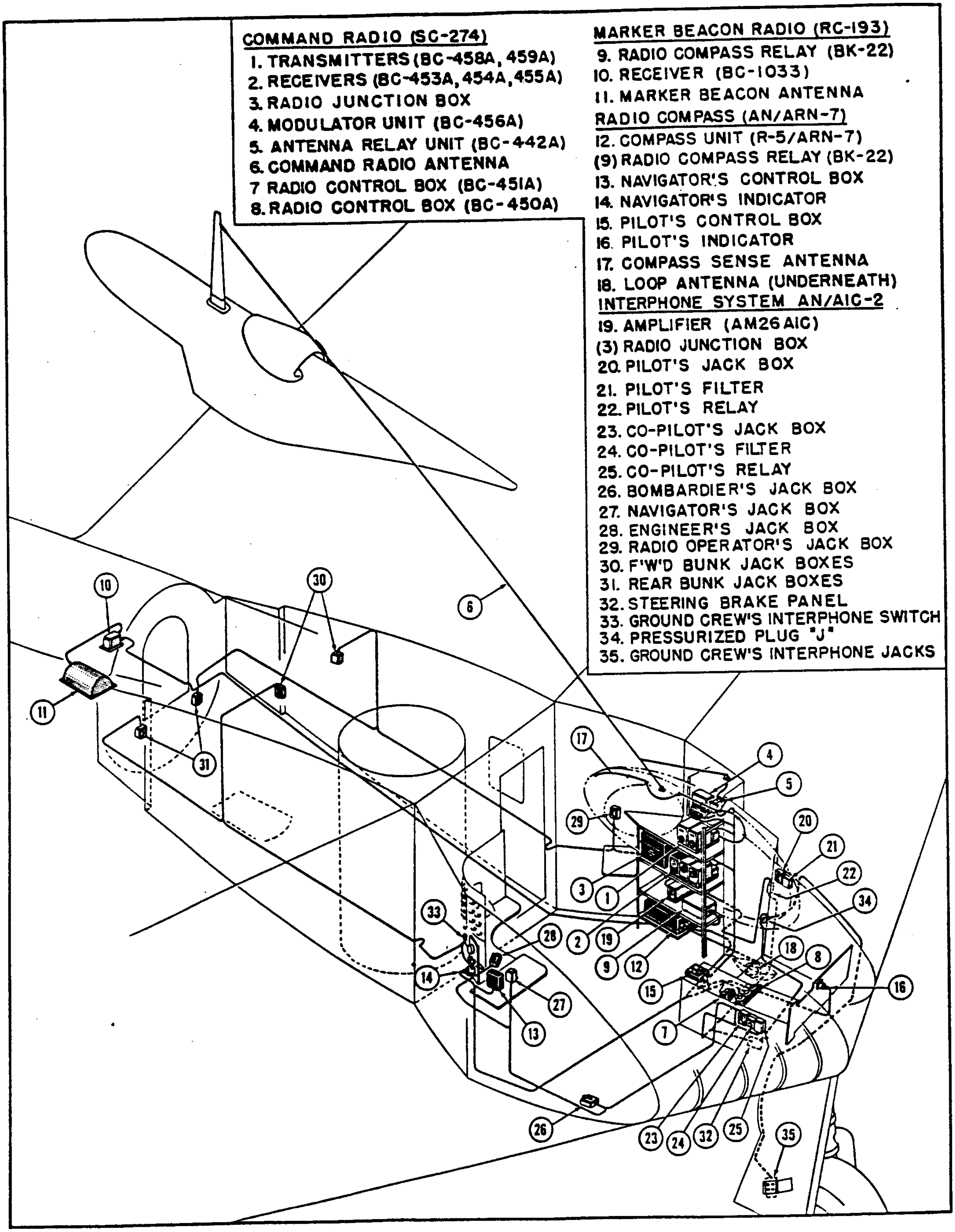
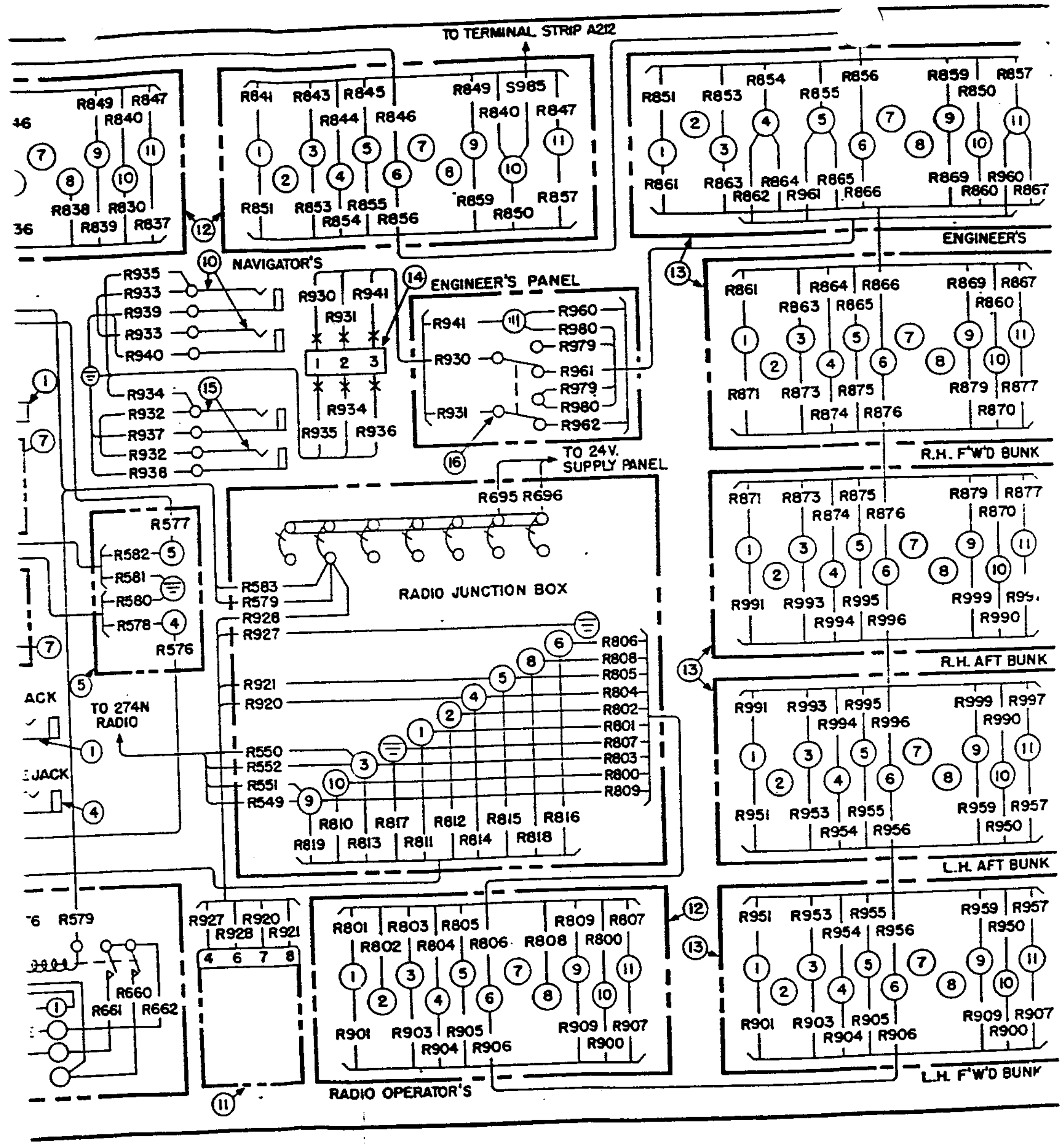


Figure 1. Radio Equipment


TO TERMINAL STRIP A212
NAVIGATOR'S
ENGINEER'S PANEL
ENGINEER'S
R.H. F'W'D BUNK
R.H. AFT BUNK
L.H. AFT BUNK
L.H. F'W'D BUNK
TO 24V.
SUPPLY PANEL
RADIO JUNCTION BOX
TO 274N
RADIO
RADIO OPERATOR'S

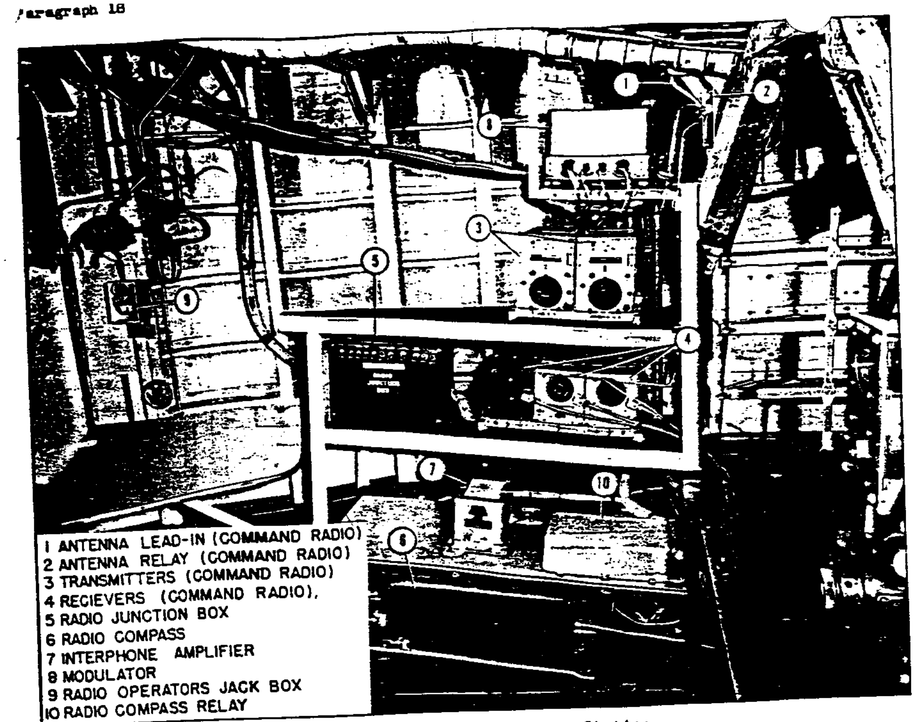


Figure 3. Radio Operator's Station

(c) OPERATION.

1. STARTING AND STOPPING INTERPHONE EQUIPMENT.

a. STARTING. Place the main airplane battery switch (located on the engineer's panel), figure 8, in the "ON" position. Make sure the "ON-OFF" switch on the interphone amplifier is in the "ON" position. (Normally this switch is safety-wired in the "ON" position.) Place the interphone circuit breaker on the radio operator's junction box No. 514991 in the "ON" position. Figure 9.

b. STOPPING. Place the main airplane battery switch in the "OFF" position.

NOTE

In case it is desired to have the main battery switch remain in the "ON" position for an extended period of time and none of the facilities of the interphone are to be used, place interphone circuit breaker switch on the 514911 junction box in the "OFF" position.

2. ADJUSTING INTERPHONE AMPLIFIER. (See figure 6.)- Adjust the "GAIN CONTROL" to the position which provides the best interphone signal for the altitude at which the airplane is flying. Suggested settings are: ground to 10,000 feet 1; 10,000 feet to 20,000 feet 2; 20,000 feet to 30,000 feet 3; above 30,000 feet 4.

NOTE

For the most satisfactory operation do not close more than one microphone switch at a time on any one facility.

3. JACK BOX OPERATION. (See figure 4.)- Place the "SELECTOR SWITCH" in the position indicated for the facility desired.

NOTE

The facilities available at the nose landing gear, figure 10, are through the engineer's jack box, and are controlled by a switch, figure 11, on the engineer's panel. There is no jack box at the landing gear station.

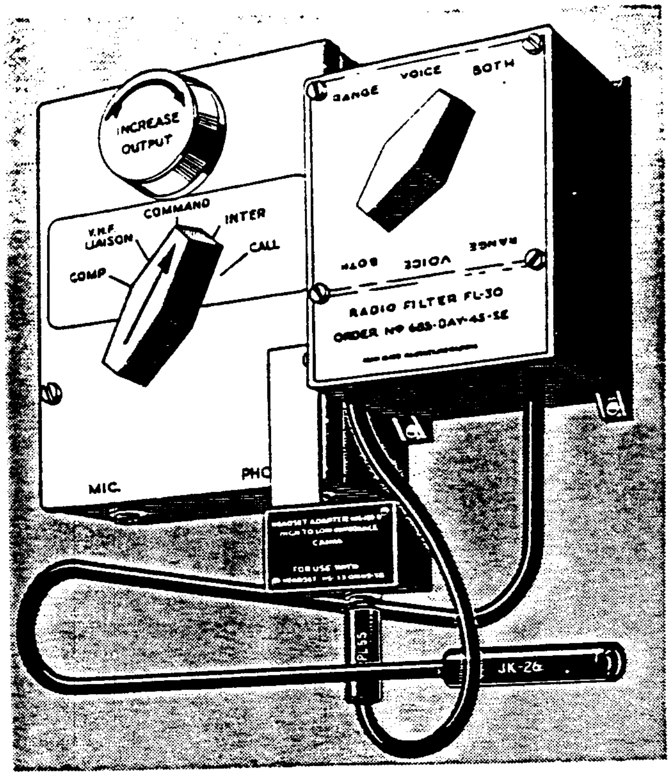


Figure 4. Interphone Jack Box, Filter, and Relay Box

The jack boxes are equipped with a volume control that functions only when receiving Command Radio signals or Radio Compass signals. Microphones and headsets are plugged into the jack boxes.

a. RADIO COMPASS. (See figure 4.)- To receive the audio output of the Radio Compass place the jack box selector switch in the "COMP" position. In this position terminal post No. 1, figure 5, of the jack box, the Radio Compass Audio circuit, is completed through the varible resistance (controlled by the "INCREASE OUTPUT" knob) to the head-set jack.

b. V.H.F. LIAISON.- This equipment is not installed in this airplane. The selector switch should not be left in this position.

c. COMMAND RADIO. (See figure 1.)- To receive the audio output and connect the microphone and headset to the "COMMAND RADIO" place the jack box selector switch in the "COMMAND" position. See figure 4. When the selector switch is in this position, see figure 5, it completes the Command Radio Audio circuit from terminal post 10 to the head set through the variable resistance and phone jack. It completes the command transmitter circuit from terminal post 3 through the microphone jack to the microphone "PRESS-TO-TALK" switch and completes the antenna relay circuit from terminal post 9 through the microphone jack to a second contact on the "PRESS-TO-TALK" switch. When the "PRESS-TO-TALK" switch is pressed it completes the microphone circuit and the antenna relay circuit, the latter disconnects the antenna from the receivers and connects it to the transmitters.

d. INTERPHONE. (See figure 4.)- To use the intra airplane telephone equipme. place the selector switch in the "INTER" position. When the selector switch is in this position, see figure 5, it completes the "Interphone Amplifier" circuit from the terminal post 5 directly to the head set through the phone jack without going through the variable resistance. (The "Increase Output" control does not function for the intra telephone.) The microphone circuit from terminal post 4 is completed through the microphone jack to the microphone switch. When the microphone switch is pressed the circuit is completed to the microphone.

e. CALL. (See figure 4.)- To use the "CALL" facility place the selector switch in the "CALL" position and hold it there. (In this position the selector switch is spring loaded and will return to "INTER" when released.) When the selector switch is in the "CALL" position the "Inter Telephone" facilities are available and through terminal post 4, see figure 5, when the "PRESS-TO-TALK" switch is pressed the voice from the calling station is heard in all headsets regardless of the position of the other selector switches, except that the navigator's, engineer's and the four bunk stations cannot be contacted should their selector switches be in the V.H.F. Liaison position for this facility is not wired to these jack boxes in this airplane.

NOTE

The "CALL" facility should only be used momentarily to call the person desired. The calling party and the called party should immediately place their selector switches in the Inter position for conversation so as not to interfere with reception of other facilities by other crew members.

(d) REMOVAL AND INSTALLATION.

1. JACK BOXES, 452343 and 452397. (See figure 4.)

a. REMOVAL.- Remove the cover by removing the two screws on the face of the cover. Remove the screws securing the terminal strip. Unsolder the wires from the terminal strip. Remove the screws attaching the box.

b. INSTALLATION.- Reverse the removal procedure.

2. AMPLIFIER - AM-26/AIC. (See figure 6.)

a. REMOVAL. Disconnect the grounding jumper and the attaching plug. Loosen the thumb screw securing the amplifier to the mounting plate and remove the amplifier.

b. INSTALLATION.- Place the amplifier on mounting plate MT-28/ARN-5 and tighten the securing thumb screw. Attach the electrical plug and the grounding jumper.

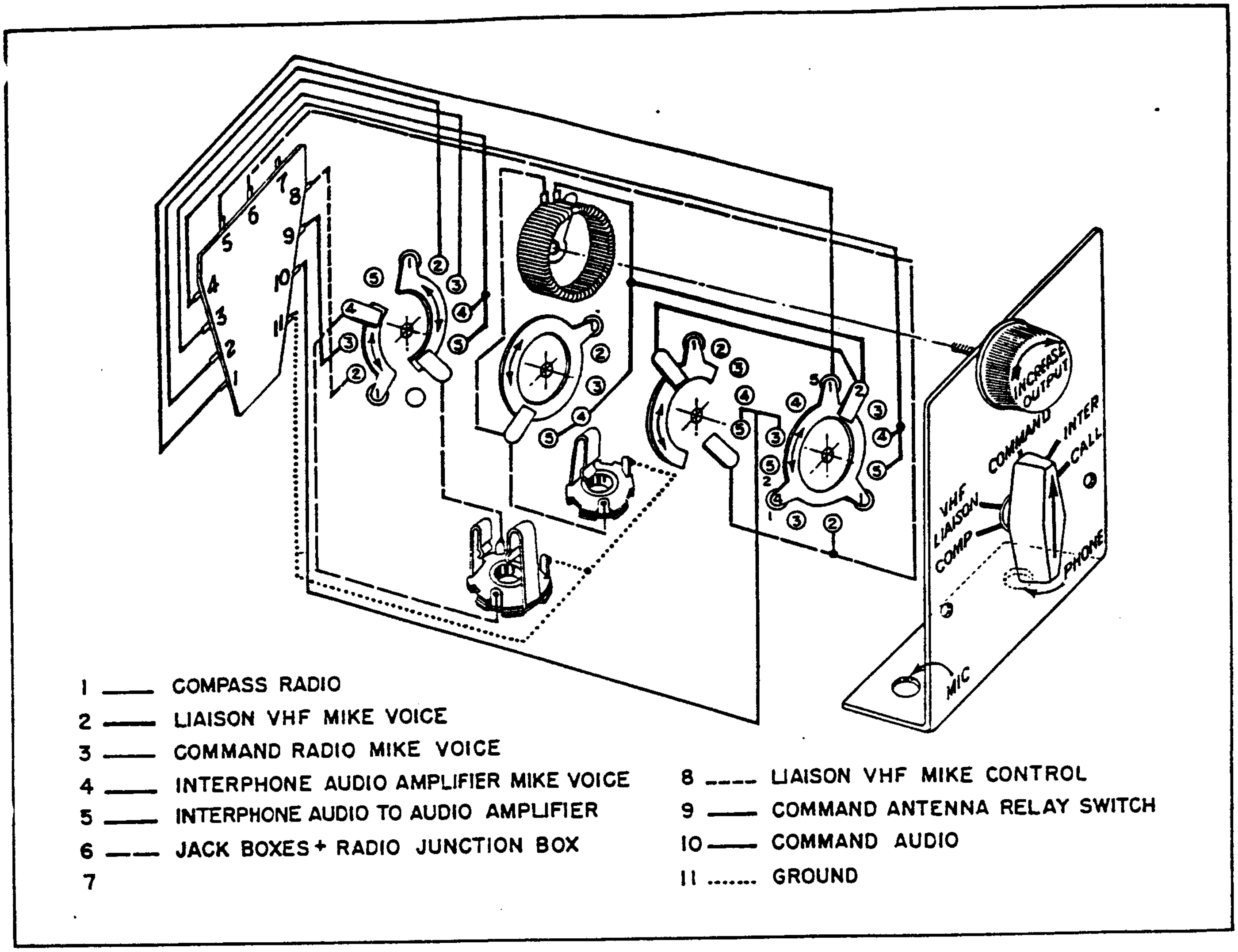


Figure 5. Interphone Jack Box Selector Switch Wiring Diagram

3. BOX ASSEMBLIES 414991. (See figure 4.)

a. REMOVAL.- Remove the cover. Disconnect the wires and remove the cable. Remove the box by removing the two attaching screws.

b. INSTALLATION.- Reverse the removal procedure.

4. RADIO JUNCTION BOX 514911. (See figure 9.)

a. REMOVAL.- Loosen the cover by freeing the 4 Dzus nuts and lift off cover. Remove the four screws securing the hinged switch panel to the sides of the box and swing the cover up. Detach wiring from the switches and the wires from the terminal strips at the back of the box and remove the cables. Remove the four screws from the back of the box and the two from the bottom edge and remove the box.

b. INSTALLATION.- Place the box in position and the spacers under the lower edge and secure box with the 6 attaching screws, insert the cables and attach the proper wires to the switches and terminal strip. Secure the hinged switch panel with the 4 bolts, washers and nuts. Replace the cover and secure with the Dzus fasteners.

5. FILTER FL-8. (See figure 4.)

a. REMOVAL.- Remove the four attaching screws.

b. INSTALLATION.- Place in position and secure with 4 attaching screws.

(e) TROUBLE SHOOTING.

1. Unsatisfactory operation of the interphone equipment may frequently be due to easily remedied causes, such as cable connections where they are fastened to connectors; loose connections in the jack boxes, relay box assemblies, and junction box; faulty phone and microphone cords, faulty tubes in the amplifier, excessive moisture or poor brush contact in the dynamotor.

NOTE

Repairing of the amplifier or dynamotor should not be attempted except by qualified repair personnel. If such personnel is not available these instruments should be replaced by ones known to be good.

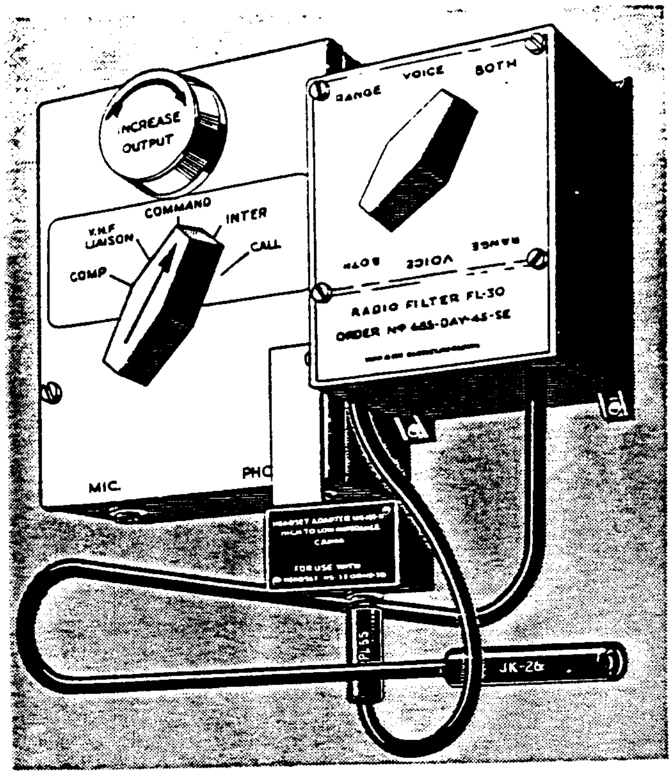


Figure 4. Interphone Jack Box, Filter, and Relay Box

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b. V.H.F. LIAISON.- This equipment is not installed in this airplane. The selector switch should not be left in this position.

c. COMMAND RADIO. (See figure 1.)- To receive the audio output and connect the microphone and headset to the "COMMAND RADIO" place the jack box selector switch in the "COMMAND" position. See figure 4. When the selector switch is in this position, see figure 5, it completes the Command Radio Audio circuit from terminal post 10 to the head set through the variable resistance and phone jack. It completes the command transmitter circuit from terminal post 3 through the microphone jack to the microphone "PRESS-TO-TALK" switch and completes the antenna relay circuit from terminal post 9 through the microphone jack to a second contact on the "PRESS-TO-TALK" switch. When the "PRESS-TO-TALK" switch is pressed it completes the microphone circuit and the antenna relay circuit, the latter disconnects the antenna from the receivers and connects it to the transmitters.

d. INTERPHONE. (See figure 4.)- To use the intra airplane telephone equipme. place the selector switch in the "INTER" position. When the selector switch is in this position, see figure 5, it completes the "Interphone Amplifier" circuit from the terminal post 5 directly to the head set through the phone jack without going through the variable resistance. (The "Increase Output" control does not function for the intra telephone.) The microphone circuit from terminal post 4 is completed through the microphone jack to the microphone switch. When the microphone switch is pressed the circuit is completed to the microphone.

e. CALL. (See figure 4.)- To use the "CALL" facility place the selector switch in the "CALL" position and hold it there. (In this position the selector switch is spring loaded and will return to "INTER" when released.) When the selector switch is in the "CALL" position the "Inter Telephone" facilities are available and through terminal post 4, see figure 5, when the "PRESS-TO-TALK" switch is pressed the voice from the calling station is heard in all headsets regardless of the position of the other selector switches, except that the navigator's, engineer's and the four bunk stations cannot be contacted should their selector switches be in the V.H.F. Liaison position for this facility is not wired to these jack boxes in this airplane.

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(d) REMOVAL AND INSTALLATION.

1. JACK BOXES, 452343 and 452397. (See figure 4.)

a. REMOVAL.- Remove the cover by removing the two screws on the face of the cover. Remove the screws securing the terminal strip. Unsolder the wires from the terminal strip. Remove the screws attaching the box.

b. INSTALLATION.- Reverse the removal procedure.

2. AMPLIFIER - AM-26/AIC. (See figure 6.)

a. REMOVAL. Disconnect the grounding jumper and the attaching plug. Loosen the thumb screw securing the amplifier to the mounting plate and remove the amplifier.

b. INSTALLATION.- Place the amplifier on mounting plate MT-28/ARN-5 and tighten the securing thumb screw. Attach the electrical plug and the grounding jumper.

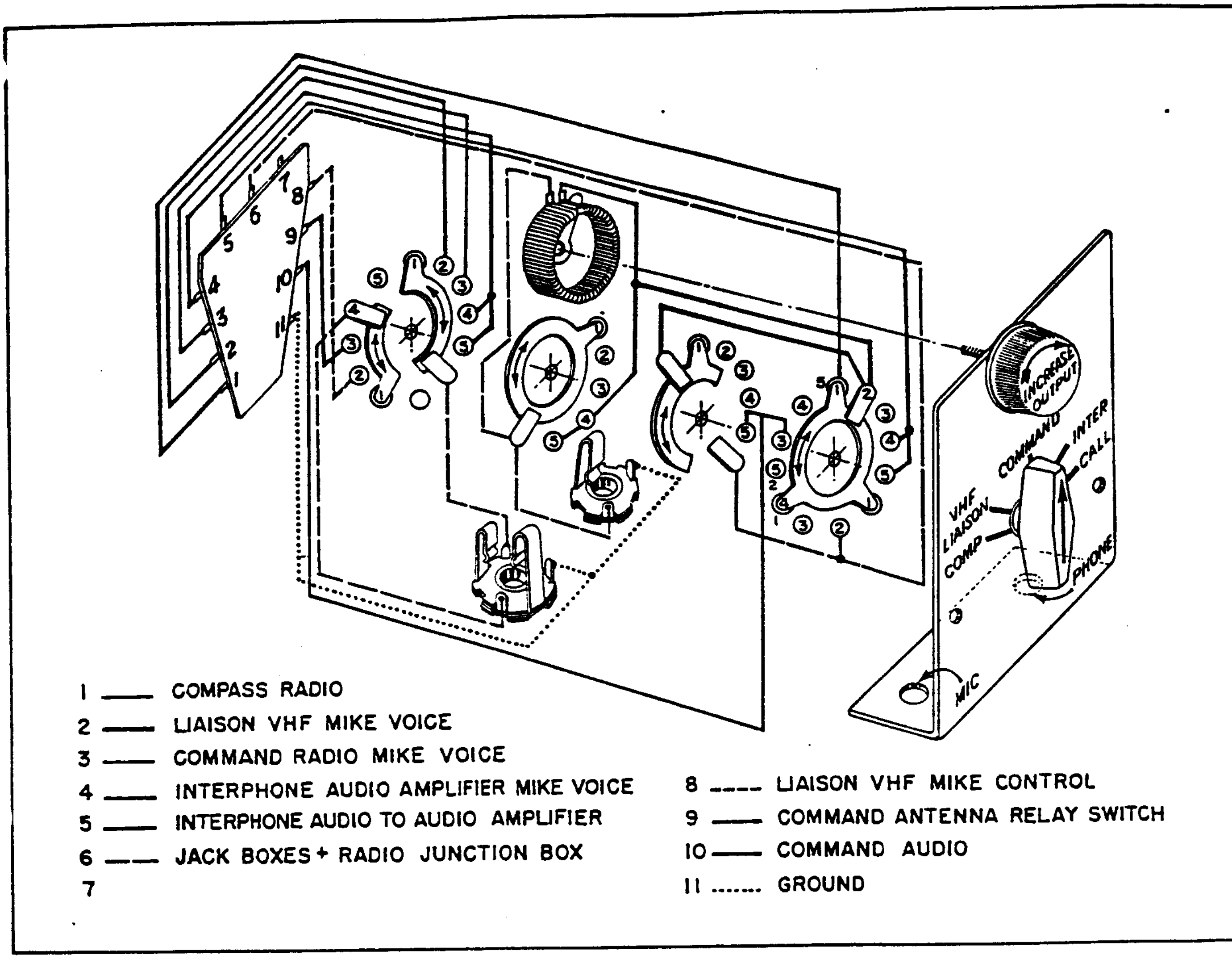


Figure 5. Interphone Jack Box Selector Switch Wiring Diagram

3. BOX ASSEMBLIES 414991. (See figure 4.)

a. REMOVAL.- Remove the cover. Disconnect the wires and remove the cable. Remove the box by removing the two attaching screws.

b. INSTALLATION.- Reverse the removal procedure.

4. RADIO JUNCTION BOX 514911. (See figure 9.)

a. REMOVAL.- Loosen the cover by freeing the 4 Dzus nuts and lift off cover. Remove the four screws securing the hinged switch panel to the sides of the box and swing the cover up. Detach wiring from the switches and the wires from the terminal strips at the back of the box and remove the cables. Remove the four screws from the back of the box and the two from the bottom edge and remove the box.

b. INSTALLATION.- Place the box in position and the spacers under the lower edge and secure box with the 6 attaching screws, insert the cables and attach the proper wires to the switches and terminal strip. Secure the hinged switch panel with the 4 bolts, washers and nuts. Replace the cover and secure with the Dzus fasteners.

5. FILTER FL-8. (See figure 4.)

a. REMOVAL.- Remove the four attaching screws.

b. INSTALLATION.- Place in position and secure with 4 attaching screws.

(e) TROUBLE SHOOTING.

1. Unsatisfactory operation of the interphone equipment may frequently be due to easily remedied causes, such as cable connections where they are fastened to connectors; loose connections in the jack boxes, relay box assemblies, and junction box; faulty phone and microphone cords, faulty tubes in the amplifier, excessive moisture or poor brush contact in the dynamotor.

NOTE

Repairing of the amplifier or dynamotor should not be attempted except by qualified repair personnel. If such personnel is not available these instruments should be replaced by ones known to be good.

2. TROUBLE CHART.

TROUBLE	PROBABLE CAUSE	REMEDY
No output on interphone, all other radio facilities OK at all junction boxes.	No 28 Volt d.c. supply voltage	Check fuses and replace, close open switches or circuit breakers in 28 Volt d.c. supply, Check plug and switch on face of amplifier.
No output on interphone, 28 Volt supply OK at all jack boxes, amplifier switch on but dynamotor non-operative.	Defective dynamotor or amplifier.	Replace dynamotor. Replace amplifier.
Low output on interphone all other radio facilities OK at all jack boxes.	Defective tubes in amplifier.	Replace defective tubes as required.
Intermittent output of interphone and radio facilities.	Short or open circuit in headset or phone cords.	Check head set and microphone cords. Replace or repair.
Unsatisfactory operation of only one jack box.	Jack box wiring or contacts.	Check for moisture and dirt, and clean. Replace jack box.
Dynamotor stops or fails to start.	No d.c. supply; open or loose connection, open circuit breaker. Brushes not seating properly, dirty, worn.	Repair connections, close circuit breaker.
	Worn bearings, armature strikes pole faces or connections.	Replace dynamotor.
Excessive arcing at brushes. Noisy reception, rapid wearing of brushes.	Poor communication: dirty, oily, or rough commutator; high mica.	Clean commutator and brushes. Replace dynamotor.
	Brushes not seating properly: dirty, sticking, worn, twisted pigtail.	Remove brushes, clean, untwist pigtail, or replace brush assembly.
	Brush spring defective; weak.	Replace brush assembly.

(f) EQUIPMENT INCLUDED IN THE INTERPHONE SYSTEM.

Quantity	NAME	PART NO.	LOCATION
7	Jack Box	452397	Pilot's station, copilot's station, engineer's station, right hand forward bunk station, right hand aft bunk station, left hand aft bunk station, left hand forward bunk station.
3	Jack Box	452343	Bombardier's station, navigator's station, radio operator's station.
2	Filter	F-8	Pilot's station, copilot's station.
2	Box Assembly	414991	Pilot's station, copilot's station.
* 1	Pressurized Plug	"J"	Nose wheel well bulkhead.

* Pressurized plug "J" is a multi-electrical plug and incorporates many electrical circuits including the interphone circuit to the landing gear.

QUANTITY	NAME	PART NO.	LOCATION
1	Amplifier	AM-26/AIC	Radio operator's station.
1	Radio Junction Box	514911	Radio operator's station.
1	Cable	455637	Radio jack box to pilot's jack box.
1	Cable	455638	Pilot's jack box to copilot's jack box.
1	Cable	455639	Copilot's jack box to bombardier's jack box.
1	Cable	455640	Bombardier's jack box to navigator's jack box.
1	Cable	455641	Navigator's jack box to engineer's jack box.
1	Cable	455642	Engineer's jack box to right hand forward bunk station jack box.
1	Cable	455643	Right hand forward bunk jack box to right hand aft bunk station jack box.
1	Cable	457381	Right hand aft bunk station jack box to left hand aft bunk station jack box.
1	Cable	455647	Left hand aft bunk station jack box to left hand forward bunk station jack box.
1	Cable	455648	Left hand forward bunk station jack box to radio operator's jack box.
1	Cable	455651	Radio operator's jack box to radio junction box.
1	Cable	455635	Radio junction box to interphone amplifier.
1	Cable	544652	Radio junction box to the pilot's and copilot's relay box assemblies.
1	Cable	455631	Engineer's panel to pressurized plug in the left crew nacelle bulkhead.
1	Cable	459053	Engineer's panel to pressurized plug "J" in nose wheel well.
1	Cable	459052	Nose wheel well pressurized plug "J" to phone and microphone jacks on right landing gear.
1	Cable	455656	Pilot's relay box assembly to steering brake panel.
1	Cable	455657	Copilot's relay box assembly to steering brake panel.
1	Cable	553670-12	Steering brake panel to the pilot's control wheel microphone switch.
1	Cable	553670-14	Steering brake panel to the copilot's control wheel microphone switch.
2	Cable	255653	Relay box assemblies to pilot's and copilot's microphone jacks.
2	Cable	252602	Pilot's and copilot's filters to phone plugs.
2	Cable	252654	Pilot's and copilot's (microphone relay) box assembly to microphone jack.

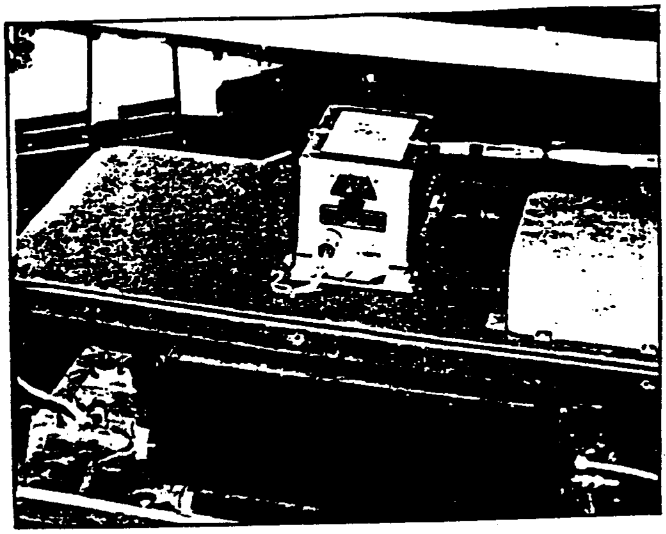


Figure 6. Interphone Amplifier

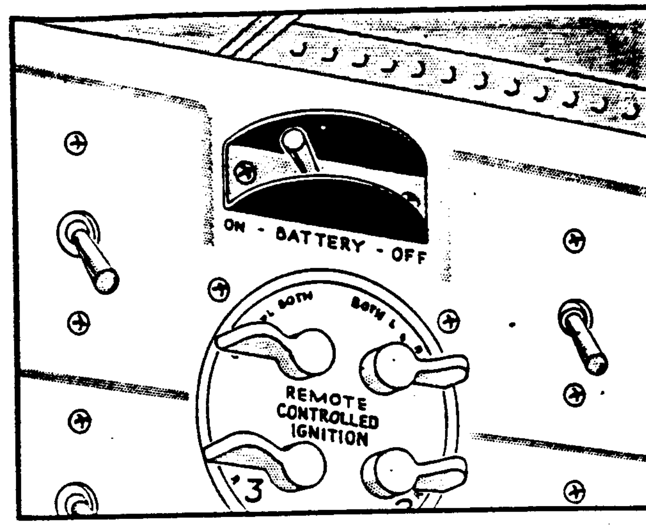


Figure 8. Battery Switch

(2) RADIO SET SCR-274-N (COMMAND). (See figures 3 and 13.)

(a) DESCRIPTION. The command radio set SCR-274-N is a short range, multi-channel receiving and transmitting unit for communication between airplane and ground, and other airplanes. This equipment can also be used for communication between crew members in an emergency.

(b) EQUIPMENT.- The equipment includes three receivers, two transmitters, a modulator, and antenna switching relay, remote control boxes and a common antenna.

1. RECEIVERS. (See figure 3.)

a. DESCRIPTION.- The receiving equipment of the Command Radio (SCR-274-N) includes three six-tube superheterodyne receivers, the BC-453 for receiving on the (190-550 KC) band, the BC-454 for receiving on the (3.10-6.0 Mc) band and the BC-455 for receiving on the (6.0-9.1 Mc) band. Each receiver is an independent complete self-contained radio signal receiving unit with its own dynamotor. All three receivers are basically alike electrically and mechanically. Each has the same compliment of tubes performing identical functions. All three are installed on the (FT 220) rack at the radio operator's station. Primary power is obtained from the airplane's 28 Volt D.C. supply. Each receiver is controlled by either the pilot or the copilot by means of the remote control box (BC-450 A), see figure 12, mounted on the pedestal convenient to both. This control box consists of three separate and complete remote control units one for each radio receiver. The control units like the receivers are identical electrically and mechanically. The only difference being in the calibration markings on the dials. All three receivers use the same antenna, see figure 14, which is also used for transmitting. An antenna relay switch (BC-442 A), see figure 15,

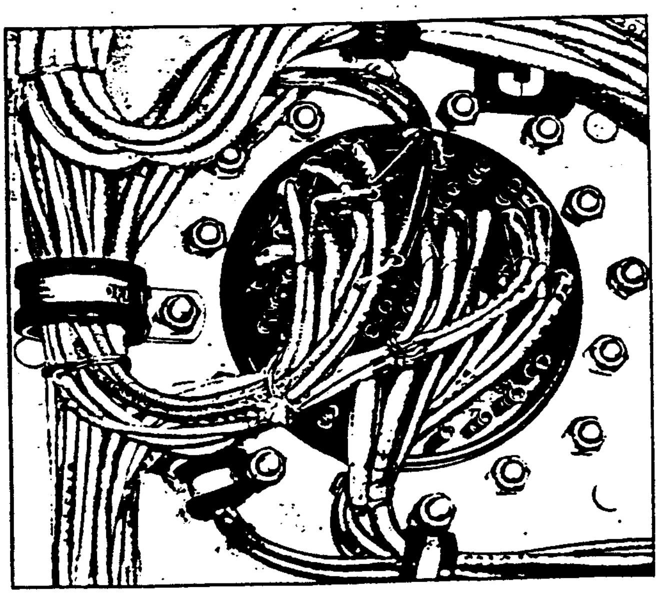


Figure 7. Pressurized Plug "J"

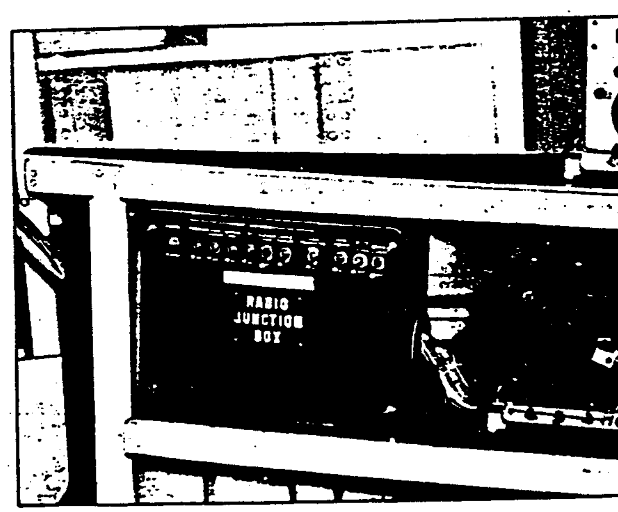


Figure 9. Radio Operator's Junction Box

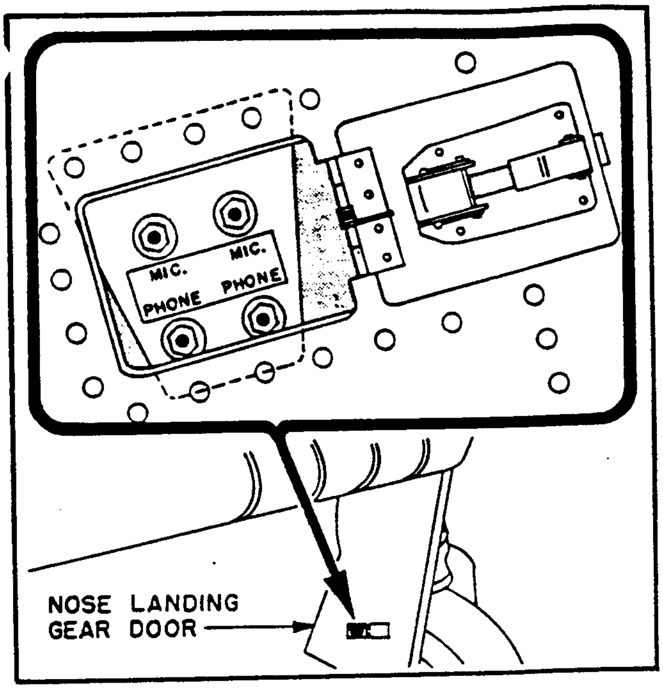


Figure 10. Ground Crew Interphone Jacks

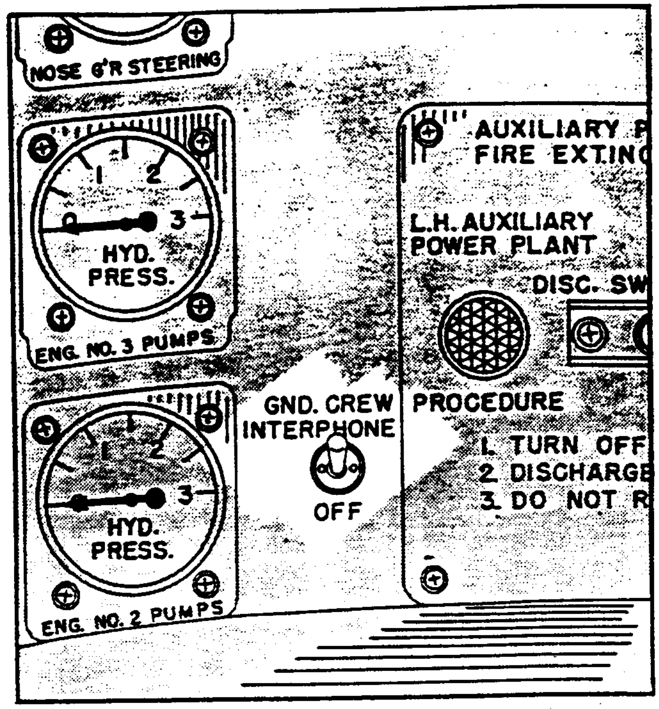


Figure 11. Ground Crew Interphone Switch

operated by the "PRESS-TO-TALK" switch disconnects the antenna from the three receivers and connects it to the transmitters when transmitting. The antenna is suspended between the pilot's canopy and the antenna mast on the L.H. inboard propeller shaft housing.

2. TRANSMITTERS. (See figure 3.)

a. DESCRIPTION.- The transmitting equipment of the Command Radio (SCR-274-N) consists of two transmitters:(BC-458 A) for transmission on the 5.3-7 Mc band and one (BC-459-A) for transmission on the 7.0-9.1 Mc band, one modulator (BC-456 A) and a transmitter remote control box (BC-451 A). (See figure 12.) Both transmitters are basically alike electrically and mechanically and are installed on a rack (FT-266 A) at the radio operator's station. Primary power is supplied from the airplane's 28 Volt d.c. current supply. Each transmitter is individually controlled by the pilot or the copilot by means of the transmitter remote control box mounted on the pedestal convenient to both, figure 12. Both transmitters use the same antenna which is also used for receiving. The antenna is normally connected to the receivers but when the power switch of the transmitter control box is turned to "ON" and transmitting is begun, the antenna is automatically disconnected from the receivers and connected to the transmitters by the antenna relay, (BC-442 A), see figure 15. Both transmitters use the same modulator. The control box incorporates the "transmitter power" switch, "transmitter selection" switch, "TONE-CW-VOICE" switch, a microphone jack, a transmitter key, and a jack for attaching an external key.

3. ANTENNA. (See figure 14.)- The common antenna for the three command receivers and the two transmitters is installed between the pilot's canopy and the antenna mast which extends from the top side of the L.H. inboard propeller shaft housing a little forward of the trailing edge. The antenna lead extends from the pilot's canopy to an antenna plug to the left of the canopy thence inside the cabin to the antenna relay at the radio operator's station.

(c) OPERATION.- All operating of the receiver and the transmitters is accomplished from the remote control units BC-450 A and BC-451 A which are accessible to the pilot and copilot.

1. RECEIVER OPERATION.

a. START AND STOP.- To start any one of the receivers turn the "CW-OFF-MCW" switch of the corresponding control unit to the "CW" or "MCW" position, see figure 12. Plug the headset into the pilot's or copilot's jack box and turn the "A-B" jack switch of the control unit to position "A." To stop, turn the "CW-OFF-MCW" switch to the "OFF" position.

b. TUNING.- To tune in the desired signal rotate the tuning dial of the remote control unit until the desired signal is heard at its maximum volume.

c. VOLUME CONTROL.- Increase or decrease the volume as desired by turning the "INCREASE OUTPUT" control knob. The volume at each jack box can be reduced further but not increased over the volume setting of the remote control unit.

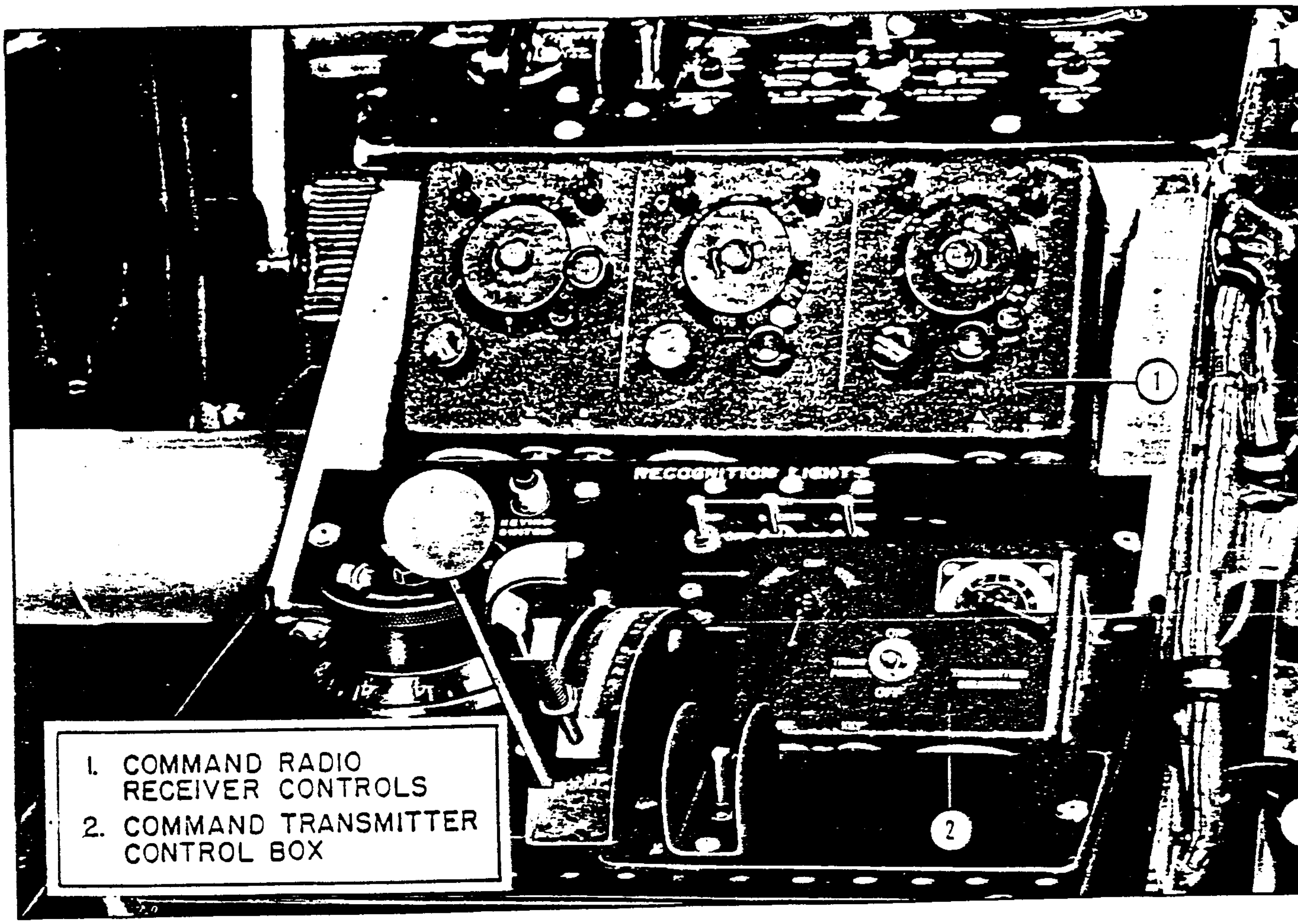


Figure 12. SCR-274N Radio Controls

NOTE

All three receivers may be operated at the same time. However, only one transmitter can be operated at a time. The receivers are automatically disconnected from the antenna when either of the transmitters is transmitting.

d. CREW FACILITIES.- Signals from the Command Radios can be received by crew members, from headsets plugged into the jack boxes, see figure 4, by turning the selector switch on the jack box to "COMMAND" position. Limited volume control can be had by turning the "INCREASE-OUTPUT" knob. When radio reception is no longer desired the selector switch on the jack box should be returned to the "INTER" position.

2. TRANSMITTER OPERATION.

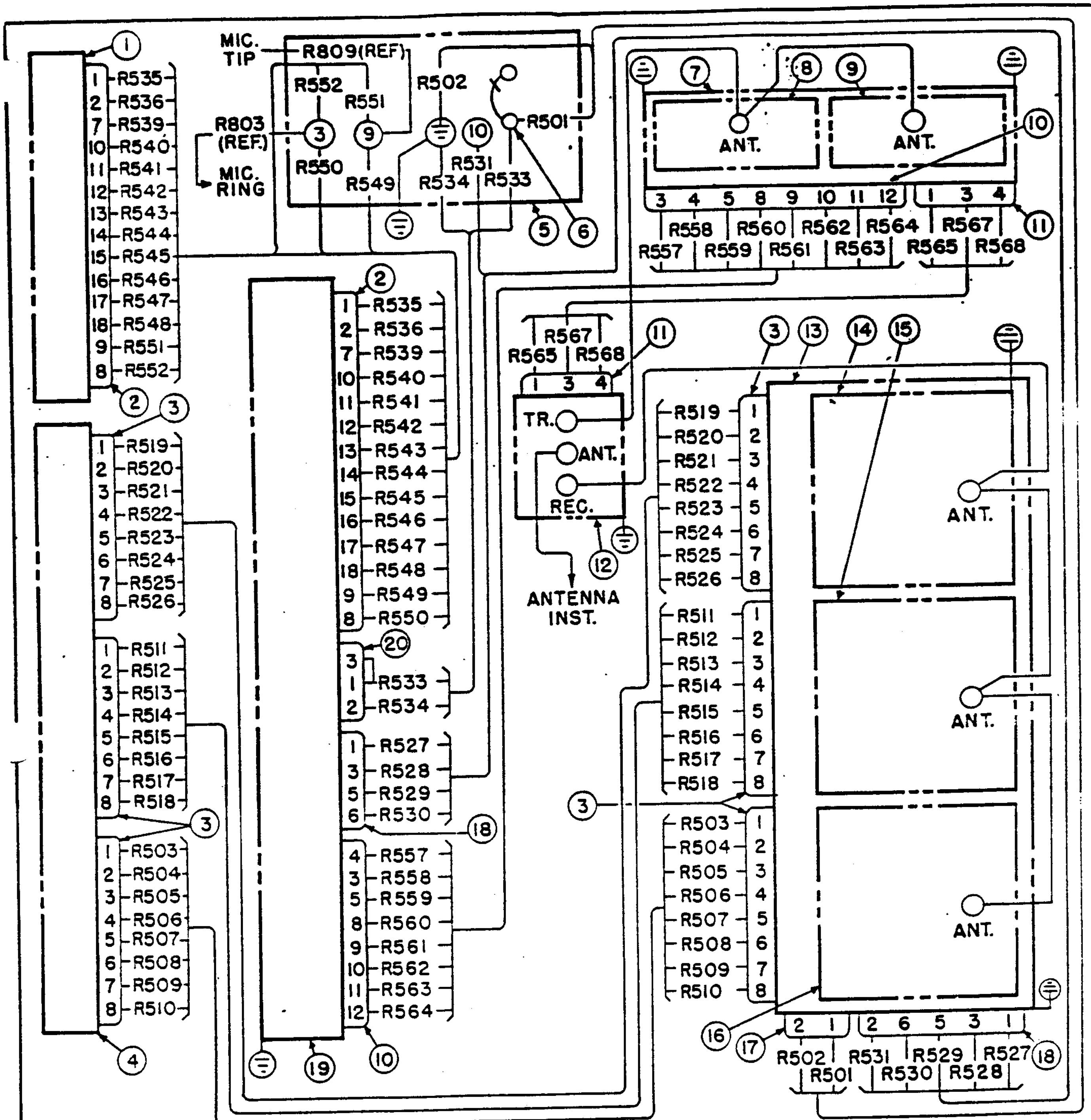
a. START AND STOP.- To start either transmitter turn the "TRANS. POWER" switch of the remote control box, see figure 12, to the "ON" position. It takes about 15 seconds for the transmitter to warm up. To turn off the transmitters turn the "TRANS. POWER" switch to the "OFF" position.

b. C. W. OPERATION.- Turn the "TRANSMITTER SELECTION" switch of the remote control box to the desired transmitter indicated on the "write-in" plate. Set the "TONE-CW-VOICE" switch to either "TONE" or "CW." To transmit press either the built-in key on the control box or a key plugged into the radio control box. To transmit from any of the jack boxes use the microphone switch as a key. The side tone from the transmitted signals can be heard in the headsets.

c. VOICE OPERATION.- Turn the "TRANSMITTER SELECTION" switch of the remote control box to the desired transmitter indicated on the "write-in" plate. Set the "TONE-CW-VOICE" switch at the "VOICE" position. Press the "PRESS-TO-TALK" button at any jack box station and speak clearly and distinctly into the microphone.

NOTE

When the "TONE-CW-VOICE" switch is in the "VOICE" position the transmitting dynamotor will not operate until the "PRESS-TO-TALK" button has been closed. When in the "TONE" or "CW" position the dynamotor runs continuously. To



ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	CONTROL BOX			BC-451-A
2	PLUG			PL-153
3	PLUG			PL-152
4	CONTROL BOX			BC-450-A
5	JUNC. BOX-RADIO	NORTHROP		514911
6	CIRCUIT BREAKER		AN	3160-35
7	RACK-TRANSMIT'R			FT-226
8	TRANSMITTER			BC-458-A
9	TRANSMITTER			BC-459-A
10	PLUG			PL-154
11	PLUG			PL-156
12	ANTENNA RELAY			BC-442
13	RACK-RECEIVER			FT-220-A
14	RECEIVER			BC-445-A
15	RECEIVER			BC-453-A
16	RECEIVER			BC-454( )
17	PLUG			PL-147
18	PLUG			PL-151
19	MODULATOR			BC-456-A
20	PLUG			PL-148

Figure 13. SCR-274N Radio Wiring Diagram

reduce power supply drain and to increase dynamotor life the signal selection switch should be left on "VOICE" except when continued use on "TONE" or "CW" is expected. The "TRANS. POWER" switch should be left "ON" during flight.

(d) REMOVAL AND INSTALLATION OF COMMAND RADIO EQUIPMENT

1. REMOVAL OF RECEIVER UNITS (BC-453, BC-454 and BC-455). (See figure 3.)- The removal and installation procedure for all three receivers is the same.

CAUTION

Be sure the power supply is shut off.

a. Disconnect the antenna lead from the receiver antenna post and the grounding jumper.

b. Disconnect the tuning shaft.

c. Remove the safety wires and loosen the knurled holding nuts at the front of the receiver far enough to allow disengagement of the receiver from the mounting rack. Slide the receiver out of the rack.

d. To remove the dynamotor from the receiver chassis remove the safety wire from the snap slides, unfasten the four snap slides and lift out the dynamotor.

2. INSTALLATION OF RECEIVER UNITS (BC-453, BC-454 and BC-455).- The installation procedure for all three is the same.

a. Place the dynamotor in position on the receiver chassis and secure by means of the four snap slides. Safety wire and snap slides.

b. Slide the receiver into position in the rack and secure by hand tightening the knurled holding nuts at the front. Safety wire these nuts.

c. Connect the tuning shaft. Tighten the lock ring.

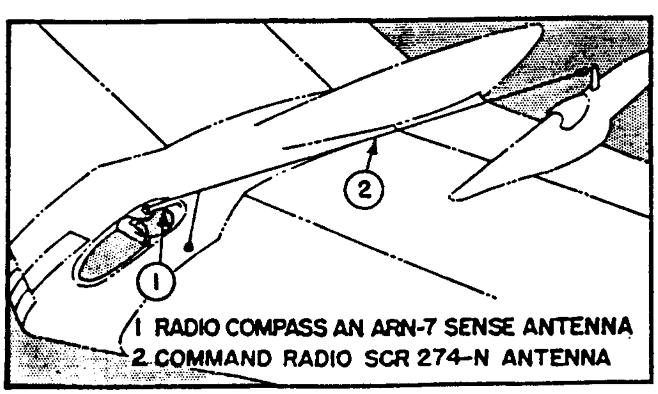


Figure 14. Antennas

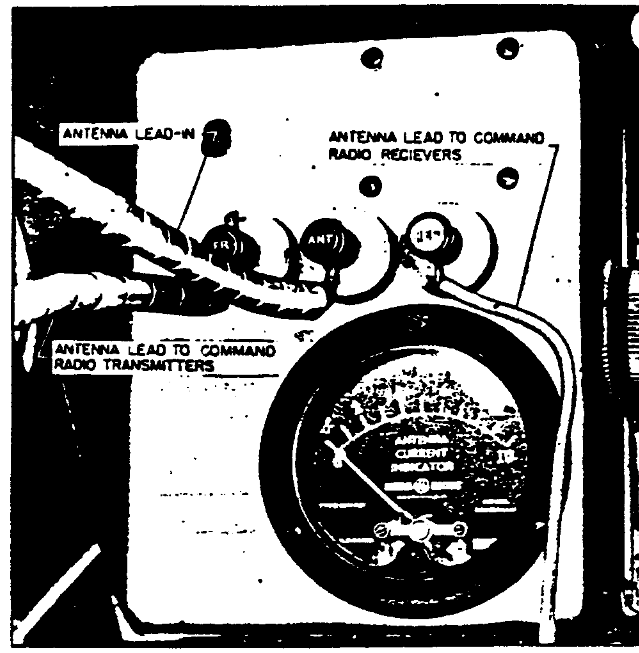


Figure 15. Antenna Relay Switch

d. Connect the antenna lead to the receiver antenna lead to the receiver antenna post.

e. Attach the grounding jumper.

3. REMOVAL OF CONTROL BOX UNIT NO. BC-450 A. (See figure 12.)- To remove the receiver's remote control box from the mounting FT-222 A:

a. Release the locking rings and disconnect the three tuning shafts and the three electrical plugs.

b. Remove the safety wire from the three snap slides and unfasten the snap slides.

c. Lift the control unit from the FT-222 A mounting.

4. INSTALLATION OF THE CONTROL BOX UNIT NO. BC-450 A.

a. Place the control box unit in position on the FT-222 A mounting and secure with the three snap slides.

b. Safety wire the snap slides.

c. Attach and secure the three tuning shafts and the three electrical plugs. Tighten the lock rings.

5. REMOVAL OF TRANSMITTERS BC-459 A AND BC-458 A. (See figure 3.)

CAUTION

Be sure the power supply is off.

a. Disconnect the antenna lead from the antenna post. Disconnect the grounding jumper.

b. Remove the safety wire from the knurled securing nuts. Loosen nuts to free the transmitter from the mounting rack.

c. Slide the transmitter out of the rack.

6. INSTALLATION OF TRANSMITTERS.

a. Slide the transmitter into position in the rack and secure by hand tightening the knurled holding nuts. Safety wire these nuts.

b. Connect the antenna lead.

7. REMOVAL OF THE ANTENNA RELAY (BC-442 A). (See figure 15.)

a. Disconnect the three antenna wires and the electrical plug.

b. Remove the safety wire from the four snap slides and free the snap slides.

8. INSTALLATION.- Reverse the removal procedure.

9. REMOVAL OF COMMAND RADIO ANTENNA. (See figure 14.)- Relieve the tension by detaching the spring assembly and detach the antenna. Cut the antenna wire where it fastens to the lucite projection on the canopy.

10. INSTALLATION OF ANTENNA.- Reverse the removal procedure using a new antenna wire.

(c) TROUBLE SHOOTING - SCR 274-N.

TROUBLE	PROBABLE CAUSE	REMEDY
No power supply.	Engineer's panel open main battery switch. Radio junction box open circuit breaker. Loose or faulty connection in 28 Volt power supply circuit.	Put main battery switch in proper position. Reset circuit breaker. Tighten or repair connection.
Receivers power supply OK, tubes do not light.	Plug connections in FT rack - faulty or damaged. Burned out tubes.	Repair or replace rack. Replace defective tubes.
Poor or noisy or no reception.	Faulty receiver. Plug connections faulty, loose connections, poor grounding connection, faulty tube that lights, faulty headset or cord, check other jack boxes for similar trouble.	Replace receiver, correct faults or replace connectors. Tighten connectors strip nuts, secure or replace grounding jumpers. Replace faulty tube. Replace faulty headset or cord. Replace jack box that is faulty.
Transmitters power supply - Power supply OK tubes do not light.	Check power supply system as directed for receivers, damaged or burned out tubes.	Replace defective tubes.
Unsatisfactory or no transmission from any crew station.	Defective tubes in transmitters or modulator, defective plug connections, loose connections, defective antenna relay, grounded or broken antenna wire. Dynamotor inoperative or arcing.	Check switches and circuit breakers. Replace defective or burned out tubes in transmitters and modulators, repair connector plugs or replace, clean contact points of relay or replace relay, repair antenna system. Replace brushes, clean commutor. Replace dynamtor.
Unsatisfactory or no transmission from one crew station.	Jack box, transmitter, transmitter switch, transmitter cord.	Repair or replace jack box, repair or replace transmitter switch. Replace cord; replace transmitter.

(f) EQUIPMENT INCLUDED IN THE COMMAND RADIO INSTALLATION SCR-274-N.

QUANTITY	NAME	PART NO.	LOCATION
1	Antenna Installation	551110	From antenna relay to aft mast on top side of L.H. inboard propeller shaft housing.
1	Antenna Relay	BC-442-A	Ceiling over radio operator's station.

QUANTITY	NAME	PART NO.	LOCATION
1	Transmitter Rack	FT-226-A	Radio operator's station.
1	Transmitter	BC-459-A	Transmitter rack radio operator's station.
1	Transmitter	BC-458-A	Transmitter rack radio operator's station.
1	Receiver rack	FT-220-A	Radio operator's station.
1	Receiver	BC-453-A	Receiver rack, radio operator's station.
1	Receiver	BC-454-A	Receiver rack, radio operator's station.
1	Receiver	BC-455-A	Receiver rack, radio operator's station.
1	Transmitter Control Box	BC-451-A	Pedestal between pilot and copilot.
1	Receiver Control Box	BC-450-A	Pedestal between pilot and copilot.
1	Modulator	BC-456-A	Radio operator's station.
1	Tuning Shaft Assembly	MC-215-145"	Receiver control box and receiver BC-455-A.
1	Tuning Shaft Assembly	MC-215-140"	Receiver control box and receiver BC-453-A.
1	Tuning Shaft Assembly	MC-215-135"	Receiver control box and receiver BC-454-A.
1	Wire Assembly	551103-4	Antenna relay to receiver BC-455-A.
1	Wire Assembly	551103-8	Receiver BC-455-A to receiver BC-453-A.
1	Wire Assembly	551103-10	Receiver BC-453-A to receiver BC-454-A.
1	Wire Assembly	152217	Radio junction box to ground.
1	Wire Assembly	551103-2	Antenna relay to transmitter BC-458-A
1	Wire Assembly	551103-6	Transmitter BC-458-A to transmitter BC-459-A.
1	Cable Assembly	452091	Receiver rack FT-220-A to modulator BC-456-A.
1	Cable Assembly	452090	Receiver rack FT-220-A to receiver control box BC-450-A.
1	Cable Assembly	452085	Receiver rack FT-220-A to receiver control box BC-450-A.
1	Cable Assembly	452086	Receiver rack FT-220-A to receiver control box BC-450-A.
1	Cable Assembly	452084	Transmitter rack FT-226-A to modulator unit BC-456-A.
1	Cable Assembly	452089	Transmitter rack FT-226-A to antenna relay unit BC-442-A.
1	Cable Assembly	452087	Modulator BC-456-A to radio junction box 514911 and transmitter control box BC-451-A.
1	Cable Assembly	452083	Modulator BC-456-A to radio junction box 514911.
1	Cable Assembly	452088	Receiver rack FT-220-A to radio junction box 514911.

(3) MARKER BEACON RADIO - RC 193 A. (See figure 16.)

(a) DESCRIPTION.- The Marker Beacon Radio Receiver BC-1033 is an ultra-high frequency, three tube, tuned radio receiver which actuates a self-contained relay. This relay closes a circuit which lights a light on the pilot's and copilot's instrument panel when the airplane is passing over a 75 megacycle Marker Beacon transmitter. The light flashes at a definite sequence identifying the transmitter station. The Marker Beacon radio and antenna is installed aft of the aft spar under the floor at station 367.

(b) OPERATION.- In the B-35 airplane the Marker Beacon radio 28 Volt power supply is wired through the Radio Compass "OFF-ON" switch. When the radio compass is turned "ON" the Marker Beacon radio operates. See figure 17. There are no other operational procedures or adjustments to be made.

(c) REMOVAL. (See figure 16.)- To remove the Marker Beacon receiver turn the Radio Compass "OFF-ON" switch to the "OFF" position. Disconnect the grounding jumper. Disconnect the antenna plug No. PL-219 from the face of the radio. Disconnect the cable by means of the attachment plug No. 108. Loosen the snap fasteners on the mounting FT-161 and lift the radio from the mounting.

(d) INSTALLATION.- Place the Marker Beacon receiver in position on the FT-161 mounting and secure with the snap fasteners. Attach the cable by means of the attaching plug. Attach the antenna lead. Attach the grounding jumper.

(e) EQUIPMENT INCLUDED IN THE MARKER BEACON RADIO AN/RC-193.

QUANTITY	NAME	PART NO.	LOCATION
1	Marker Beacon Receiver	BC-1033	Radio operator's station.
1	Mounting	FT-161	Radio operator's station.
1	Cable Assembly	452334	Relay BK-22 to Marker Beacon Receiver.
1	Cable Assembly	456190	Radio compass relay BK-22-K to indicator lamp.
1	Cord Assembly	456602	Radio beacon receiver to terminal TM-201.
1	Antenna Installation	559521	Bath tub antenna unit installed below the floor in the crew nacelle aft of aft spar, station 367.
1	Indicator Lamp	AAF 44A18454-4	Pilot's instrument panel.
1	Wire Assembly	5790	Indicator to 28 Volt supply.

(f) TROUBLE SHOOTING.

1. Unsatisfactory operation of the Marker Beacon radio may frequently be due to easily remedied causes such as cable connections where they fasten to connectors, burned out indicator light, faulty tubes, loose connections in the antenna circuit or shorting of antenna to the airplane, or excessive moisture.

NOTE

Repairs and adjustments of the receiver should only be made by qualified radio repair personnel. If such personnel is not available the receiver should be replaced by one known to be in satisfactory operating condition.

2. TROUBLE SHOOTING CHART.

TROUBLE	PROBABLE CAUSE	REMEDY
Dead set (no voltage to set).	Check power supply for open circuit.	Reconnect and secure broken connection.
Tubes V-101-1, V-101-2, V-102 fail to glow.	These tubes are connected in series, hence, if any one is out of operation all will be out.	Replace these tubes.
Tube V-103 fails to glow.	Defective tube or defective connections.	Replace tube. Secure connections.
Indicator light does not burn.	Defective connections or wiring between radio and indicator light. Defective light.	Check wiring and replace. Replace light.

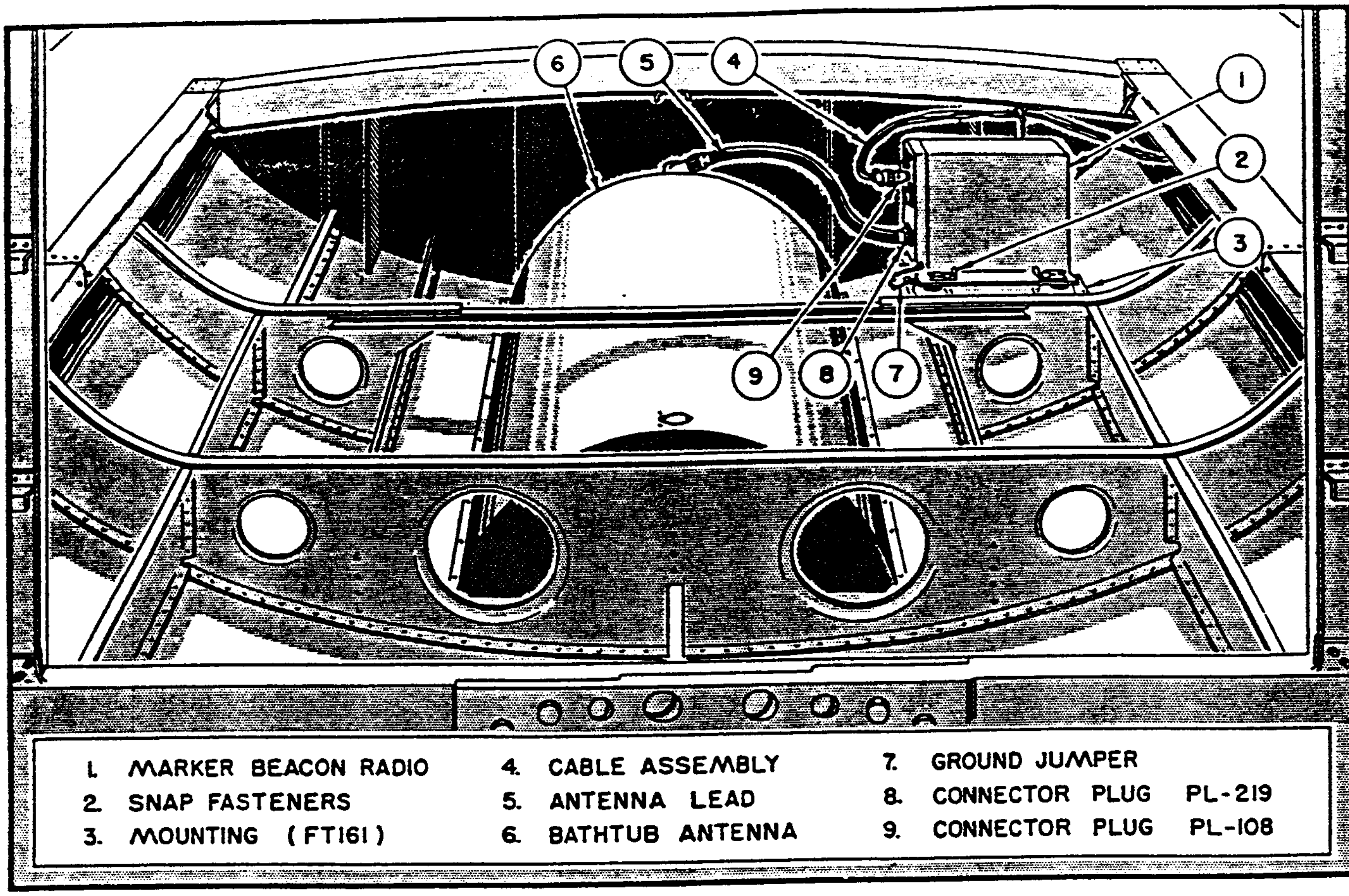


Figure 16. Marker Beacon Radio Installation.

(4) RADIO COMPASS - AN/ARN-7. (See figure 3.)

(a) DESCRIPTION.- In the B-35 No. AAF 42-13603 (N1484) airplane the Radio Compass Unit AN/ARN-7 consists of a 15 tube superheterodyne receiver R-5/ARN-7, two remote control units C-4/ARN-7, two remote indicators I-81A and one I-82A, one remotely controlled Loop Antenna Unit LP-31A, a sense antenna, and a relay BK-22-K. The Radio Compass is a navigational instrument utilizing radio signals from range, commercial, and standard broadcasting transmitters. A frequency range of 100 to 1750 Kc is covered by the receiver in four bands. Complete control of the Radio Compass is accomplished at either one of the two remote control units one of which is accessible to the pilots and the other to the navigator. The equipment is capable of performing aural reception from the sense antenna or the loop antenna, aural null directional indication of an incoming signal using the loop antenna only, visual directional indication of an incoming signal with the loop antenna. Visual indications are read in degrees from the pilot's and navigator's indicators. Aural signals are received through the headsets plugged into the interphone jack boxes with the jack box selector switch placed in the "COMP" position.

(b) MAJOR COMPONENT PARTS.

1. RADIO COMPASS UNIT - R-5/ARN-7. (See figure 3.)

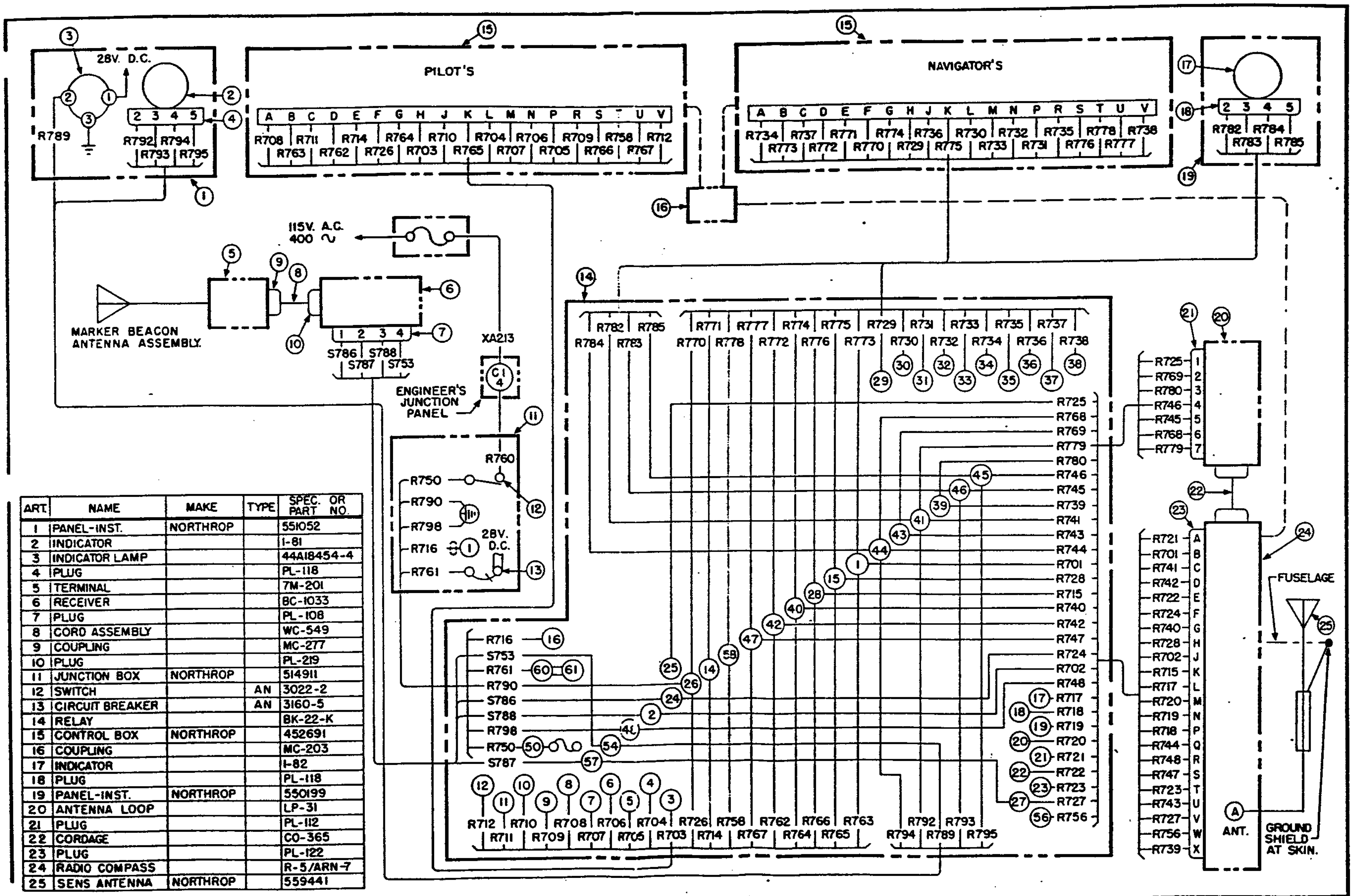
a. DESCRIPTION.- The radio compass unit includes in the one cabinet the compass circuit element, the superheterodyne receiver circuit elements, a circuit for providing aural identification of unmodulated radio stations. It is installed on the FT-213-A mounting at the radio operator's station.

b. REMOVAL AND INSTALLATION.

1. Disconnect the ground braid from the ground post, detach the plug connectors, the tuning shaft, and disconnect the antenna lead. Loosen the fasteners at the lower front corners, lift the front end and remove the receiver from the FT-213 mounting. To replace tubes loosen the knurled nut in the lower center of the face of the receiver unit and slide the receiver chassis out of the case. Detach grid caps from tubes and remove tubes.

2. The installation procedure is the reverse of the removal procedure.

2. RADIO COMPASS CONTROL UNITS C-4/ARN-7. (See figure 18.)



ART.	NAME	MAKE	TYPE	SPEC. OR PART NO.
1	PANEL-INST.	NORTHROP		551052
2	INDICATOR			I-81
3	INDICATOR LAMP			44A18454-4
4	PLUG			PL-118
5	TERMINAL			7M-201
6	RECEIVER			BC-1033
7	PLUG			PL-108
8	CORD ASSEMBLY			WC-549
9	COUPLING			MC-277
10	PLUG			PL-219
11	JUNCTION BOX	NORTHROP		514911
12	SWITCH		AN	3022-2
13	CIRCUIT BREAKER		AN	3160-5
14	RELAY			BK-22-K
15	CONTROL BOX	NORTHROP		452691
16	COUPLING			MC-203
17	INDICATOR			I-82
18	PLUG			PL-118
19	PANEL-INST.	NORTHROP		550199
20	ANTENNA LOOP			LP-31
21	PLUG			PL-112
22	CORDAGE			CO-365
23	PLUG			PL-122
24	RADIO COMPASS			R-5/ARN-7
25	SENS ANTENNA	NORTHROP		559441

Figure 17. Radio Compass and Marker Beacon Wiring Diagram

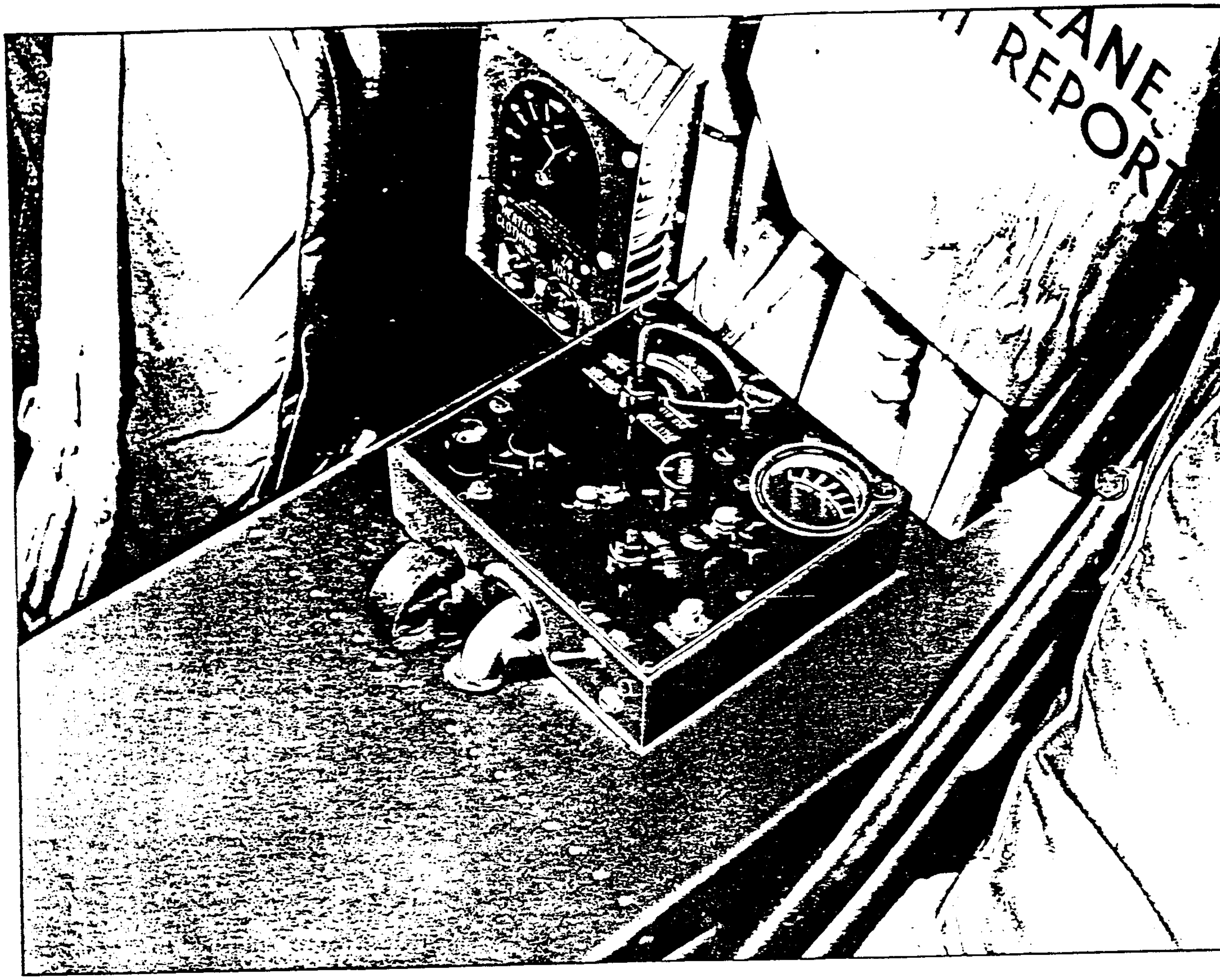


Figure 18. Radio Compass Control Box

a. DESCRIPTION.- The radio compass control units provide complete control of the Radio Compass. Either control unit can obtain control by pressing the control switch. The control boxes plug into the mount FT-224 A. Each control unit has a tuning crank, an illuminated dial, a band selector switch, a loop left-right rotation switch, control switch, function switch, a phone jack, an illuminated tuning meter, pilot light, light intensity control, audio volume control, and a "CW-VOICE" control switch.

b. REMOVAL AND INSTALLATION. (See figure 18.)- To remove the control box from the FT-224-A mount completely disengage the three captive mounting screws (216) then loosen the plug release screw (217) and remove the control box from the mounting. To install the control box reverse the removal procedure being sure to tighten the plug release screw (217) at the lower left hand corner near the tuning crank before tightening the other three captive mounting screws.

3. PILOT'S INDICATOR I-81. (See figure 19.)

a. DESCRIPTION.- This indicator is an autosyn-driven device mounted on the pilot's panel. The pointer rotates over a scale graduated at five degree intervals. Plug connections are made through the rear of the case.

b. REMOVAL AND INSTALLATION.- To remove the pilot's indicator I-81 from the instrument panel remove the 4 spring lock clamps securing the panel to the supporting pins. Move the panel out far enough to reach behind the panel and disconnect the plug connector. Remove the 4 attaching screws and lift out the indicator. To install reverse the removal procedure.

4. NAVIGATOR'S INDICATOR I-82. (See figure 20.)

a. DESCRIPTION.- This indicator is an autosyn-driven device. It shows the [illegible] position of the transmitter

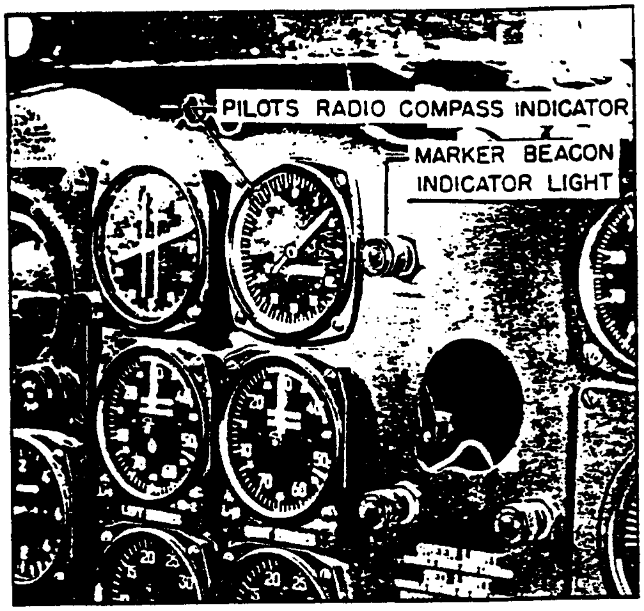


Figure 19. Pilot's Radio Compass Indicator

located in the loop assembly and gives the bearing of a radio transmitter when the loop is at the true null. It differs from the pilot's indicator in that the scale is graduated at one-degree intervals and that the scale may be rotated manually by the operator. Plug connections are made through the rear of the case.

b. REMOVAL AND INSTALLATION.- See paragraph 3 b (Pilot's Indicator).

5. RELAY BK-22 K. (See figure 3.)

a. DESCRIPTION.- The BK-22 K relay located in the radio operator's compartment is a 10 pole, double throw switch, which transfers control of the Radio Compass system from one control box to the other. It also provides for the electrical interconnection between the various components of the Radio Compass installation.

b. REMOVAL AND INSTALLATION.- To release the relay for inspection without removing the wires, remove the set mounting screws, and bend the relay panel outward. Reverse the procedure to install the relay.

6. LOOP ANTENNA LP-31. (See figure 21.)

a. DESCRIPTION.- The LP-31 Loop is installed in the blister below the pilot, it is a center-tapped, eight-turn shielded loop. It is connected to the radio compass by means of three slip rings and shielded cord assemblies. It's rotation is remotely controlled from the control boxes. A dehydrator unit removes any moisture from the air entering the loop. The loop is motor-driven and operates an autosyn transmitter. Plug receptacles on the side of the case housing are for the electrical connections.

b. REMOVAL AND INSTALLATION.- To remove the Loop detach the two electrical plugs, and remove the mounting base screws and detach the grounding strap. Installation procedure is the reverse of the removal procedure.

7. SENSE ANTENNA. (See figure 14.)

a. DESCRIPTION.- The sense antenna system consists of an antenna lead-in and an antenna wire secured to the inside surface of pilot's canopy from the middle of the left edge to the top center then aft to the aft edge of the canopy.

(b) RADIO COMPASS OPERATION.

1. To start the Radio Compass place the function switch of one of the Radio Compass control boxes to either the "COMP" the "ANT" or the "LOOP" position. The green signal light will come on if this control box has control of the equipment. If the light does not come on push in the "CONTROL SWITCH" which is to the right of the function switch. This will give this box control of the equipment. To stop, turn the function switch to "OFF."

2. Plug the headset into the adjacent interphone jack box. Place the jack box selector switch on "COMP" and turn the increase output to maximum volume. Adjust the "AUDIO" control on the control box for headset level desired.

3. Rotate the bandswitch to the frequency band desired.

4. Turn the tuning crank to the desired station kilocycle in the band. Rotate the tuner back and forth through the resonance for maximum clockwise deflection of the tuning meter to determine the exact setting of the dial. Listen for the station identification to be sure that the desired station is being received.

NOTE

For reception of keyed CW stations turn the "CW-VOICE" switch to "CW."

5. When the selector switch of the control box is in "ANT" position the equipment functions as a nondirectional receiver. When the switch is in the "LOOP" position bearings may be taken on a radio station by rotating the loop until a null (minimum signal) is found. However, cross bearings must be taken to eliminate 180 degrees ambiguity. When the switch is in the "COMPASS" position the equipment provides automatic and continuous visual indication of the direction of the received signals relative to the airplane's heading.

(d) EQUIPMENT.

1. RADIO COMPASS RECEIVER R-5/ARN-7.- Installed on mounting FT-213-A at the radio operator's station.

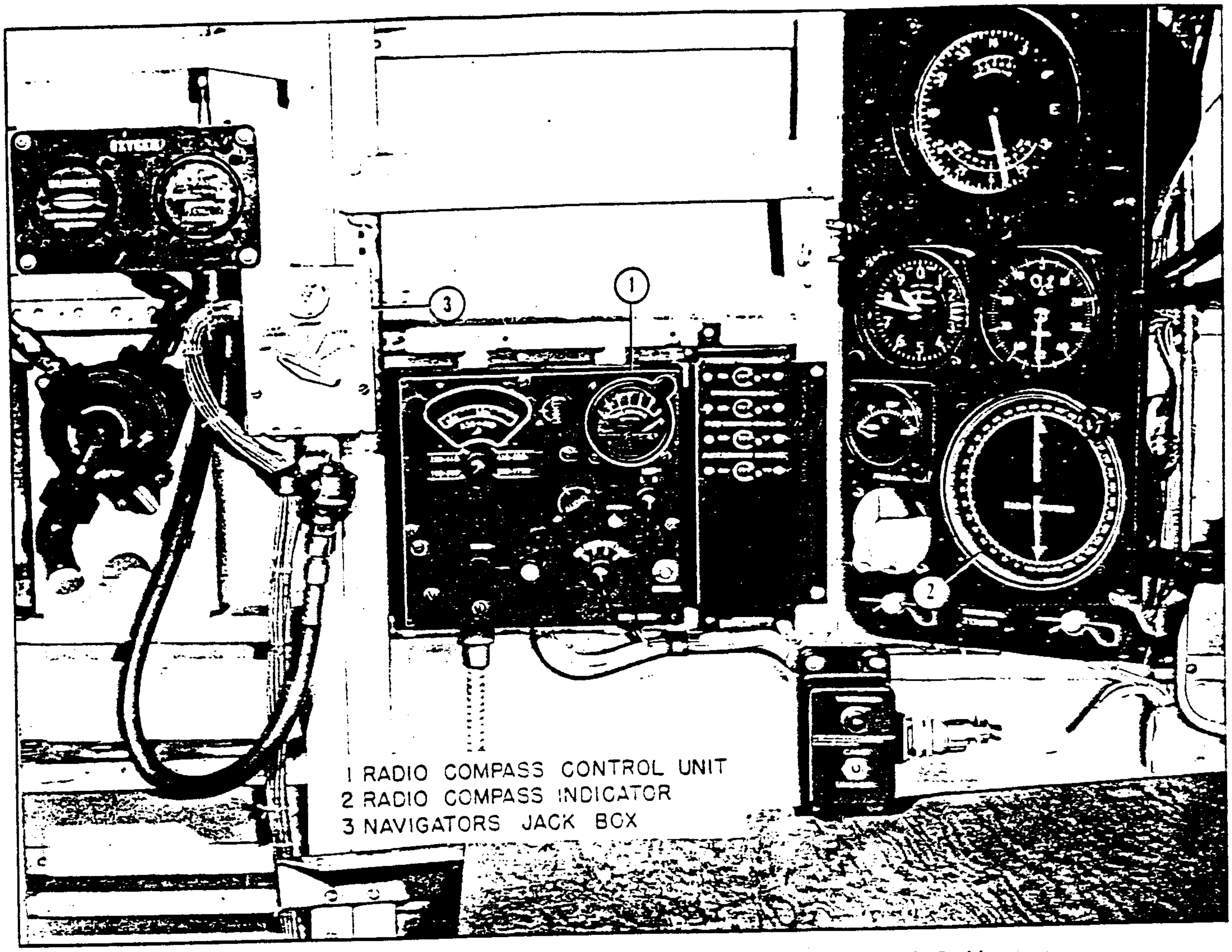


Figure 20. Navigator's Radio Compass Control Box and Indicator

2. TWO RADIO CONTROL UNITS C-4/ARN-7.- One installed on the pedestal between the pilot and copilot and one at navigator's station on mountings FT-224-A.

3. LOOP ANTENNA LP-31.- Installed in a blister on the lower face of the left wing just aft of and below the pilot.

4. SENSE ANTENNA INSTALLATION.- Secured to the inside surface of the pilot's canopy.

5. RELAY BK-22K. Installed at the radio operator's station.

6. INDICATOR I-81. Installed on the pilot's instrument panel.

7. INDICATOR I-82. Installed on the navigator's panel.

8. CABLE ASSEMBLIES.

a. 453682: Between radio junction box 514911 and engineer's junction panel 551144.

b. 454255: Between engineer's junction panel 551144 and transformer panel 551144.

c. 456187: Between relay BK-22 and navigator's control box 452691 and instrument panel.

d. 456188: Between relay BK-22 and radio compass receiver R-5/ARN-7.

e. 456189: Between relay BK-22 and loop antenna LP-31.

f. 456190: Between relay BK-22 and pilot's instrument panel.

g. 456191: Between relay BK-22 and radio junction box 514911.

h. 456192: Between relay BK-22 and pilot's control box 452691.

i. 452334: Between relay BK-22 and the Marker Beacon radio BC-1033.

j. 456602: Between Marker Beacon radio BC-1033 and terminal TM-201.

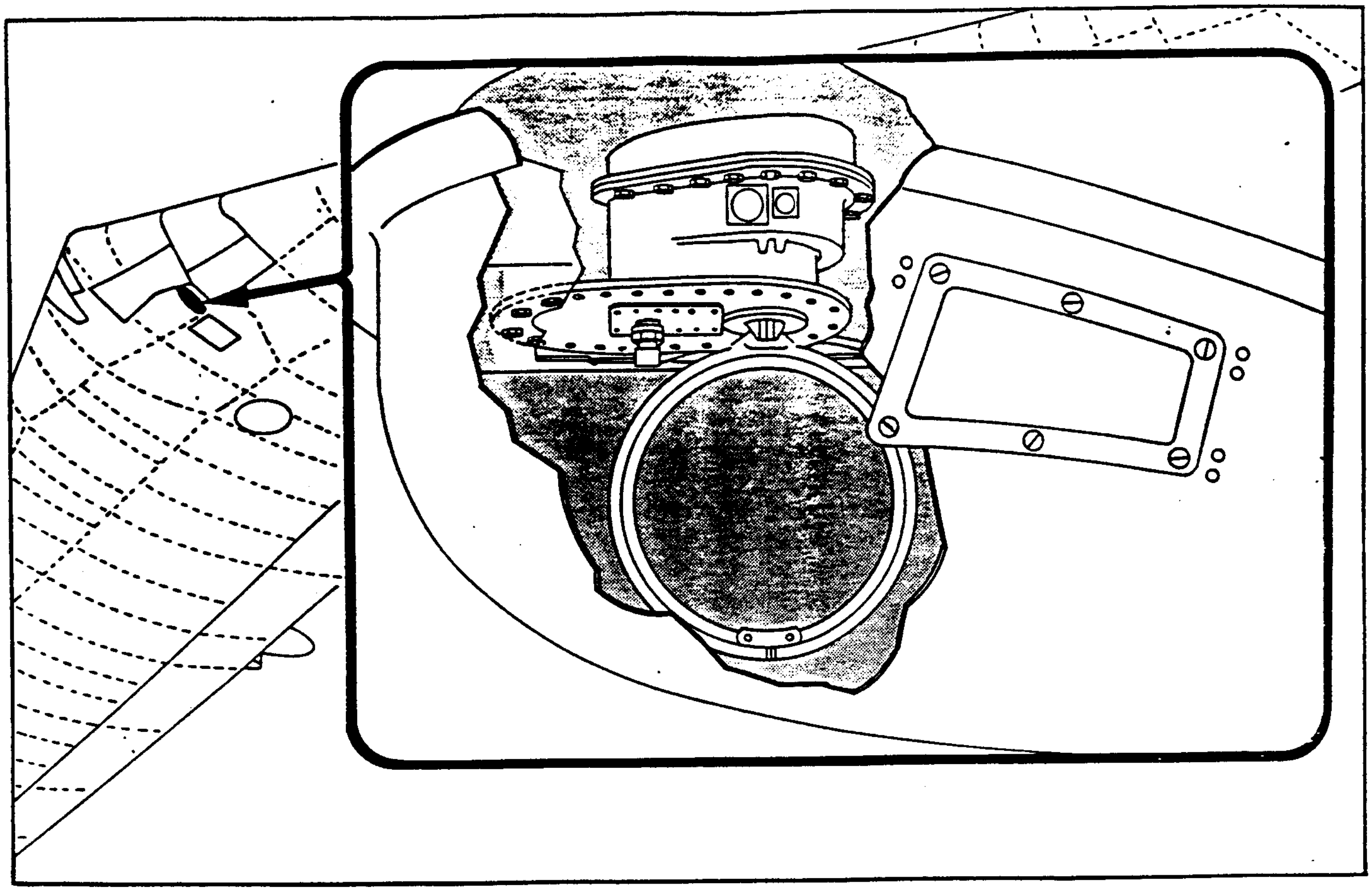


Figure 21. Radio Compass Loop Antenna

9. CORDAGE CD365: Between radio compass R-5/ARN-7 and loop antenna LP-31.

10. REMOTE TUNING CONTROL.

a. MC-203: Tuning shaft coupling.

b. 551187-2: Flexible tuning shaft between radio compass receiver R-5/ARN-7 and coupling MC-203.

c. 551187-4: Flexible tuning shaft between coupling MC-203 and pilot's control box 452691.

d. 551187-6: Flexible tuning shaft between coupling MC-203 and navigator's control box 452691.

(e) TROUBLE SHOOTING. With the exception of common electrical trouble such as loose connections, broken wires or cables, faulty plugs, tube replacements, power supply failure, no adjustments or repairs to the radio compass installation should be attempted except by trained radio personnel.

19. OXYGEN SYSTEM

19. OXYGEN SYSTEM. (See figure 1.)

a. GENERAL.

(1) DESCRIPTION.- The airplane is equipped with a low pressure, demand-type, oxygen system, operating at a working pressure of 425 psi. In a weight-empty condition, the airplane carries 2 type G-1 oxygen cylinders. In an alternate load condition, the airplane is equipped with 35 oxygen cylinders. Thirteen demand-type oxygen regulators, thirteen flow indicators, thirteen pressure gages, one filler valve, and the necessary check valves, fittings and tubing make up the oxygen system. In addition, there are three portable cylinder and regulator assemblies with six portable recharger assemblies.

WARNING

Keep oil and grease away from oxygen at all times. These substances, in contact with oxygen under pressure, may cause fire and violent explosion.

(2) PRELIMINARY LINE AND INSTRUMENT TEST.- Prior to the system pressure test, all AN type fittings shall be wrench tightened by authorized mechanics.

(a) Disconnect each oxygen bottle and reconnect the lines to temporary lines or manifolds to make a closed system which excludes the oxygen bottle.

(b) Make sure that all the connections are clean and tight and then disconnect the oxygen supply lines. This is accomplished by removing the line to the inlet connection of the type A-3 flow indicator at each oxygen panel.

(c) Attach a flexible tube to the oxygen lines at these points and run the tubes outside of the airplane and away from all oil or grease.

(d) Using breathing oxygen, Specification No. AN-O-1 grade A, connect an oxygen supply to the filler valve inlet and allow the oxygen to flow through the complete system at approximately two psi for two to three minutes. Check all outlet stations and make sure that the lines are clear and that oxygen is flowing through each of the flexible tubes.

(e) Shut off the oxygen supply, remove the flexible tubing, and reconnect the system to all crew stations.

(3) SYSTEM TEST.

WARNING

Before proceeding further, all personnel shall move away from the vicinity of the airplane and shall remain away for a period of five minutes after oxygen pressure has been applied.

(a) Turn the controls, on the regulators "OFF." Apply a pressure of 425 psi to the system, and check all connections for leaks with a bubble soap solution. Wipe off each connection with a clean cloth immediately after soap testing. Any connections found leaking will be checked with a torque wrench for proper tightness.

NOTE

Pipe threaded connections of 1/8 inch should never be torqued over 150 inch pounds. On the double flared tube ends, 125 inch pounds torque shall not be exceeded.

If the pipe threaded connections leak after tightening to the torque limit, they should be disassembled and reassembled with fresh anti-seize compound, Specification AN-C-86. If the connections still leak, new fittings must be installed. If the double flared tube ends still leak after tightening to the torque limit, replace the flares or the fittings. Do not attempt to correct leakage on this type of fitting with anti-seize compound.

(b) When all leaks have been eliminated, adjust the pressure to 425 psi and check the readings of all the pressure gages in the system. Any gage which differs by more than ± 25 psi from the average of all gages in the system must be replaced.

(c) With the pressure at 425 psi, the position of the pointer on each pressure gage shall be marked on the cover glass and the system allowed to stand for 30 minutes. At the end of this period, the position of the pointers shall be noted and if a drop in

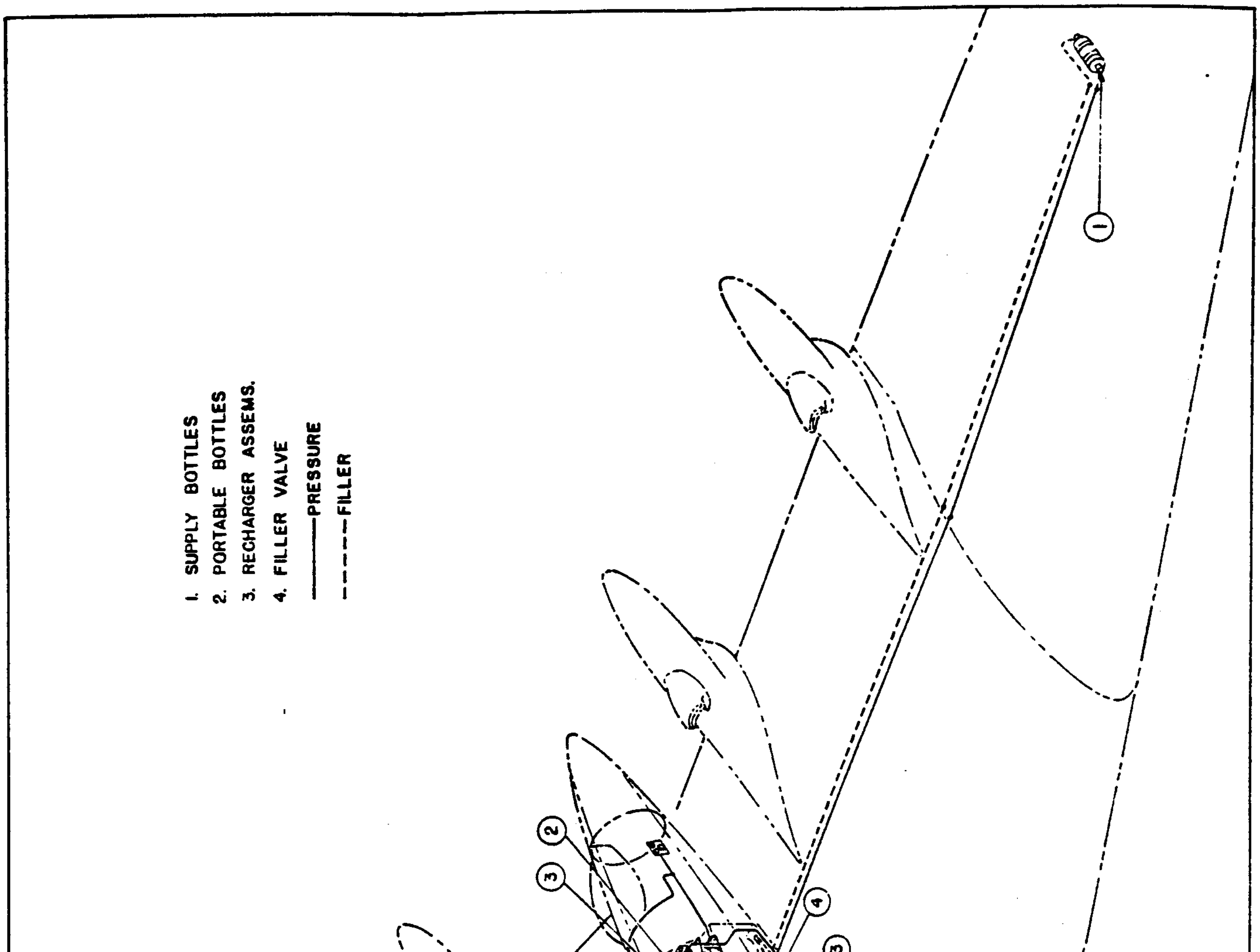


Figure 1. Oxygen System

pressure has occurred, the system must be rechecked for leaks. When the leaks have been eliminated, the system shall be re-tested for a pressure drop. No system shall be considered acceptable until there is no pressure drop over a period of 30 minutes under a pressure of 425 psi.

(d) After acceptance of the system, it shall be deflated by opening the regulator to "100% OXYGEN." Disconnect the temporary lines or manifolds and reconnect the oxygen bottles to the system.

(4) FINAL TEST OF COMPLETE OXYGEN SYSTEM.

WARNING

This test must not be made inside of a building. Personnel shall remain away from the airplane for a minimum of five minutes after pressure has been applied to the system.

(a) With the regulator in the "OFF" position, check the operation of the flow indicators by breathing normally from the mask-to-regulator tube, using a mask if possible. The flow indicator should function freely with each breath.

(b) Turn the pressure breathing knob of the regulator to "NORMAL" and apply a pressure of 425 psi. Allow the oxygen bottles to cool for thirty minutes, during which time the pressure will usually decrease from 20 to 30 psi.

(c) Reinflate the system to 425 psi. After noting the temperature, mark the position of the pointer on the cover glass of each pressure gage. Allow the system to remain unmolested for six hours, after which again note the temperature and pressure. The pressure drop shall not exceed 4 psi over the six hour period. If this tolerance is exceeded, the system should be checked for leaks and the leaks eliminated. The system shall then be pressure tested at 425 psi for six hours. The system shall be accepted when the pressure drop does not exceed four pounds psi.

(d) After the system has been accepted, the pressure shall not be allowed to go below 50 psi.

(5) RECHARGING THE OXYGEN SYSTEM.- The oxygen system filler valve is located on the underneath side, near the rear of the crew nacelle. The entire oxygen system is charged from this valve. A single line connects the filler valve with all of the cylinders. Fill the system slowly to approximately 425 psi. Feel the oxygen cylinders while they are being filled to determine if each is filling properly. The cylinder will become warm as it fills. If it remains cold it is not filling. This check should be accomplished during the filling operation as there is no other way to determine whether or not each portion of the system is being charged.

(6) TROUBLE SHOOTING.

WARNING

Before removing any part from the oxygen system, discharge all oxygen by opening the oxygen regulators to "100% OXYGEN."

TROUBLE	PROBABLE CAUSE	REMEDY
Air leaks into the regulator.	Loose tee screws, body screws, or cover screws.	Tighten all screws.
Oxygen leaks out of the regulator.	Second-stage diaphragm ruptured or deteriorated.	Replace the regulator.
	Faulty first-stage diaphragm.	Replace the regulator.
	Excessive first-stage pressure.	Replace the regulator.
	Leakage at outlet due to faulty second-stage mechanism.	Replace the regulator.
	Faulty air check valve.	Replace the regulator.
Insufficient oxygen flow through regulator.	Faulty first-stage.	Replace the regulator.
Regulator fails to deliver oxygen.	Clogged connection lines.	Disconnect the regulator and blow through the connection tubing to remove the obstruction.
Insufficient oxygen concentration.	Faulty second-stage.	Replace the regulator.

TROUBLE	PROBABLE CAUSE	REMEDY
Excessive oxygen concentration.	Faulty second-stage.	Replace the regulator.
Insufficient positive pressure and quantity of flow.	Faulty pressure breathing top assembly.	Replace the regulator.
Leakage of oxygen at second-stage relief valve.	Faulty mica.	Replace the regulator.
Oxygen pressure gage reads incorrectly.	Gage defective or clogged.	Replace the gage.
	Lines clogged.	Examine the lines and remove obstruction.
Entire system drains when one bottle is removed or punctured.	Check valves installed backward.	Examine all of the check valves and determine the direction of flow.
	Restricted check valves.	Add and release pressure through the filler line. If this does not remedy the condition, dismantle and clean the check valve.

b. OXYGEN CYLINDERS. (See figure 2.)

(1) DESCRIPTION. The type G-1 oxygen cylinder, with an internal volume of 2100 cubic inches, is used in the oxygen system.

(a) In a weight empty condition, 2 oxygen cylinders are mounted, one in each outer wing, which supplies oxygen for 15 man-hours.

(b) In an alternate load condition the airplane accommodates 35 oxygen cylinders, 18 in the left-hand outer wing and 17 in the right-hand outer wing, which supplies oxygen for 150 man hours.

(2) REMOVAL.

WARNING

Any time a cylinder is to be removed, it is essential that the pressure within the cylinder be equal to atmospheric pressure. When it is certain that a puncture has released all pressure, a cylinder may be removed without removing any other cylinder. When removing cylinders that may contain pressure above atmospheric, open the regulator control to "100% OXYGEN," allowing all oxygen to escape into a well ventilated area. An alternate, and safer, method is to attach a flexible tube to the regulators and run it outside of the airplane away from any oil or grease. Use caution while releasing the oxygen, as it reacts violently with all hydrocarbons.

(a) Release the oxygen from the cylinders.

(b) Remove the straps from each end of the cylinders by removing the nuts.

(c) Install a 1/4 inch pipe plug in the open end of the cylinder to prevent dust, moisture, or foreign particles from entering.

CAUTION

Handle oxygen cylinders gently. Dropping or denting may weaken a cylinder.

(3) CLEANING AND INSPECTION.

(a) Remove the fittings from the threaded ends of the cylinders.

(b) Examine the threads and clean them dry, without lubricant, if they are not clean.

(c) Examine the interior of the cylinder with a long, thin, electric flashlight, which can be inserted through the cylinder opening. If the cylinder is clean, nothing need be done with it. If it needs cleaning, tumble it with shot; then wash it with carbon tetrachloride and allow it to dry thoroughly.

(d) Rewash the interior with anhydrous ethyl alcohol. The carbon tetrachloride removes the grease and dirt and the alcohol removes the traces of carbon tetrachloride which would contaminate the oxygen.

(e) Be sure that all of the alcohol has been evaporated by blowing out thoroughly with dry oxygen, water pumped nitrogen, or water pumped dry air. The alcohol must be completely removed, otherwise, there is danger of explosion when the cylinder is filled with oxygen under pressure.

(f) Examine the exterior of the cylinder for chipped, scarred or corroded areas. If necessary, plug the outlets and remove the old paint with paint remover and spray with a coat of primer, zinc chromate, Specification No. AN-TT-P-656.

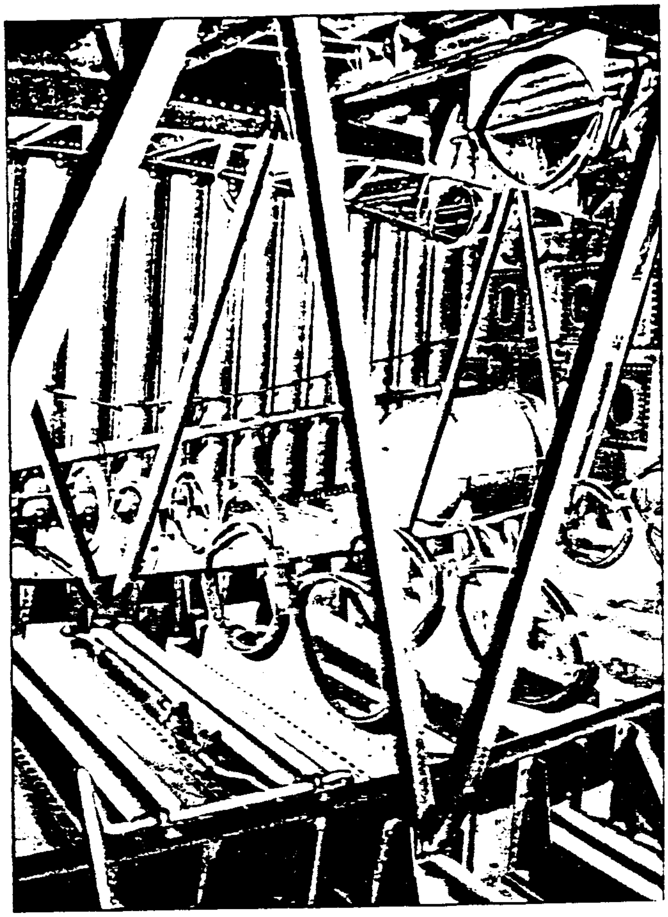


Figure 2. Oxygen Bottle Installed

CAUTION

Keep the cylinders away from oil, grease, dirt and other foreign matter, and keep pipe plugs in the cylinders when cylinders are in storage.

(4) MAINTENANCE.- Cylinders should be kept clean and dry, inside and outside, at all times. Store them in a cool dry place away from oil and grease. Maintain at least 50 psi oxygen pressure in the cylinders to prevent the accumulation of moisture caused by the breathing of the cylinder. Never lubricate the cylinder in any way.

(5) INSTALLATION.

(a) Make sure that the cylinder is free from all oil and grease.

(b) Apply anti-seize compound, Specification No. AN-C-86, lightly to the male threads. Avoid applying lubricant to the first two threads.

(c) Screw the cylinder into the check valve.

(d) Fasten the cylinder in place in the straps mounted in each outer wing. The cylinder fastens at each end.

c. OXYGEN REGULATOR. (See figure 3.)

(1) DESCRIPTION.- Type A-14 oxygen regulators are installed in the following locations The pilot's station, co-pilot's station, navigator's station, bombardier's station, flight engineer's station, forward upper gunner's station, radio operator's station, and six in the center crew nacelle. The oxygen regulator is essentially a diaphragm operated flow valve which is opened by the user's inhalation, and closes automatically when the suction ceases. The regulator is fully automatic and provides the user with the proper amount of oxygen at all altitudes and under all conditions. A demand system, as the name implies, furnishes oxygen only upon demand. That is, every time the user inhales, a quantity of oxygen in proper mixture with air, is delivered. The percentage of oxygen being delivered increases with altitude, becoming 100% at an altitude of approximately 35,000 feet. If for any reason the supply of oxygen becomes inadequate because of restrictions or faulty dilution mechanism, clockwise rotation of the pressure breathing knob will open the valve, allowing a free flow of oxygen until sufficient pressure is built up to raise the diaphragm and close the valve. It must be remembered that any other position of the knob, other than "NORMAL," causes the diluter mechanism

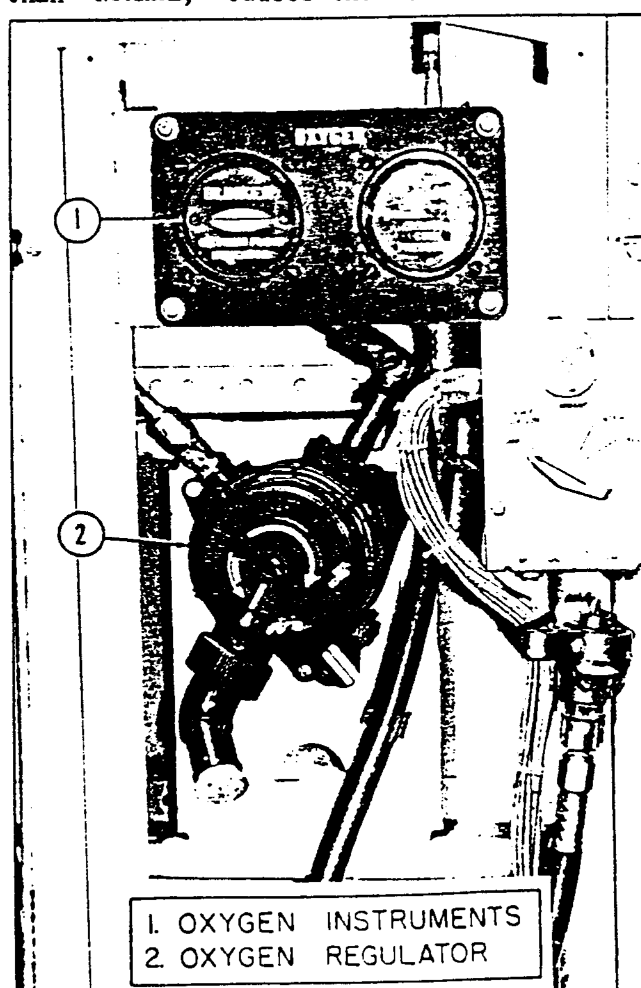


Figure 3. Oxygen Instruments

to become inoperative, and allows 100% oxygen to flow under pressure. Below 30,000 feet, this operation is uneconomical and should be used for emergency reasons only as it is extremely wasteful of oxygen.

(2) REMOVAL.

(a) Make certain that the area around the regulator is free from oil and grease.

(b) Discharge the lines by turning the pressure breathing knob to 100% oxygen.

(c) Disconnect the tubing at the inlet port and at the port to the flow indicator and close the openings with plugs and cap nuts.

(d) Pull the flexible tube from the elbow assembly on the regulator.

(e) Remove the three bolts attaching the regulator to the mounting bracket.

(3) DISASSEMBLY, ADJUSTMENT, AND REPAIR.- Service or adjustment of the internal mechanism of the regulator must be performed at an instrument overhaul base. If the regulator does not function properly, replace it.

(4) INSTALLATION.

(a) Mount the regulator on the bracket and install it with three bolts, washers, and nuts.

(b) Remove the cap nut from the oxygen inlet port and lightly apply anti-seize compound, Specification No. AN-C-86, to the connector threads.

NOTE

To avoid clogging the line, do not apply anti-seize compound to the first two threads of the connector.

(c) Attach the connector to the tube from the oxygen cylinders.

(d) Remove the plug screwed into the demand valve outlet on the regulator and paint the outlet threads with anti-seize compound.

(e) Connect the regulator to the flow indicator line.

NOTE

When installing a regulator in the airplane, attach the regulator-to-mask tube assembly to the outlet elbow of the regulator before applying pressure to the regulator. Securely tighten the nut on the outlet elbow with a suitable wrench to prevent it from working loose in service.

(5) OPERATION CHECK.

(a) Place the "AUTO MIX" lever in the "100% OXYGEN" position. Open the trap door dust cover of the mask-to-regulator tubing on the end opposite to that connected to the regulator and exert a suction similar to that in breathing by placing the mouth on the opening. A steady flow of oxygen should pass through the tubing with negligible resistance.

(b) With the dust cover held open, rotate the pressure breathing knob clockwise 90 degrees. A steady flow of oxygen indicates satisfactory performance.

(c) With the diluter control in the "100% OXYGEN" position and the pressure breathing knob at "NORMAL," blow back into the mask-to-regulator tubing. Any indication of a free passage through the regulator indicates a damaged diaphragm or air metering system.

d. PORTABLE OXYGEN REGULATOR AND CYLINDER ASSEMBLY. (See figure 4.)

(1) DESCRIPTION.- A type A-15 diluter demand oxygen regulator is used in conjunction with a type A-6 oxygen cylinder as a portable oxygen supply for use at high altitudes by the crew personnel moving about the airplane in performance of their duties, or in an emergency. The A-15 regulator delivers the correct air-oxygen mixture required at the altitude which is being flown. The regulator has a threaded inlet on the bottom of the case to connect it to the A-6 portable oxygen cylinder. The cylinder has an inter-

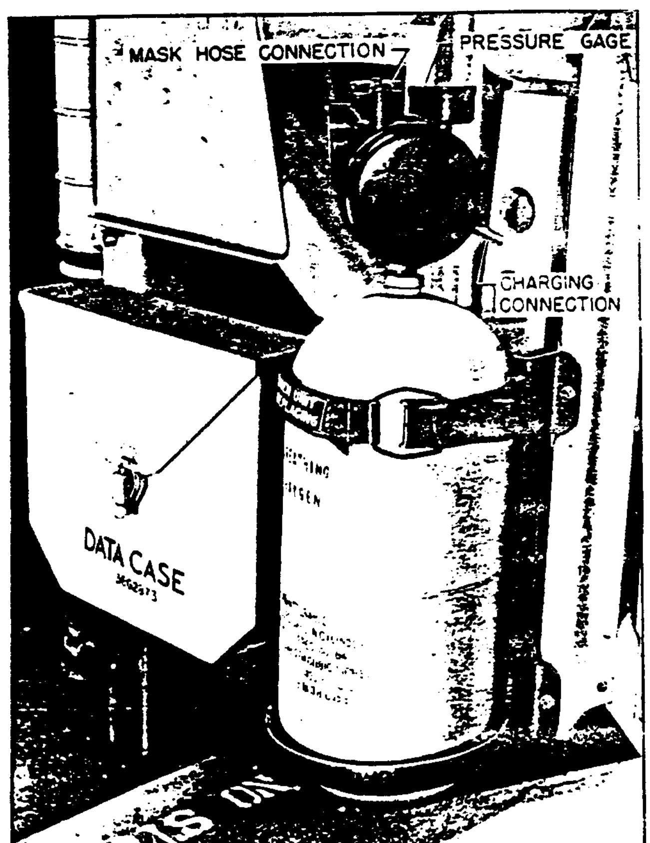


Figure 4. Portable Oxygen Bottle Assembly

nal volume of 280 cubic inches, weighs 3½ pounds, and is 14½ inches in length. There are three of the portable oxygen regulator and cylinder assemblies mounted in the airplane in the following locations; one on the aft side of the turret well in the center crew nacelle, one near the L.H. side of the pilot's station, and one at the flight engineer's station. There are six recharger assemblies in the airplane where the portable regulator and cylinder assemblies can be filled through the filler fitting on the regulator. They are located in the following places: two in the center crew nacelle, one in the radio operator's station, one in the pilot's station, one in the co-pilot's station, and one in the navigator's station.

(2) REMOVAL.

(a) Be sure that the area around the portable regulator and cylinder assembly is free from oil and grease.

(b) Release all oxygen from the cylinder through the regulator.

(c) Detach the regulator from the cylinder. Considerable force will be required to unthread this connection. A steady pull on the wrench while holding the cylinder will prove more effective than sharp blows in loosening the joint.

(d) Insert a 1/4 inch plug into the opening on the cylinder to keep out any impurities that might enter.

(3) DISASSEMBLY, ADJUSTMENT, AND REPAIR.- Service or adjustment of this assembly should be undertaken at an instrument overhaul base, only. If the assembly does not function properly, replace it.

(4) REASSEMBLY.

(a) Attach the regulator to the cylinder by first applying anti-seize compound, Specification No. AN-C-86, to the threads in the body inlet of the regulator.

(b) Using two suitable wrenches, screw the regulator and the cylinder tightly together.

(c) Refill the assembly with oxygen by inserting the filler fitting on the regulator into one of the filler valves on the airplane or a supply tank. Fill the cylinder to a gage reading of 450 psi.

(5) INSTALLATION.- Mound the portable oxygen regulator and cylinder assembly in the mounting bracket provided on the airplane.

(6) OPERATIONAL CHECK.- Before using the portable oxygen assembly, make sure that there is a sufficient supply of oxygen by checking the pressure gage mounted on the regulator.

e. FILLER VALVE. (See figure 5.)

(1) DESCRIPTION.- A type I filler valve, used in charging the oxygen system is located in a box on the underneath side of the crew nacelle just aft of the entrance hatch. It is covered by a square plate, held in place by two snap fasteners. The filler valve controls the inflow of oxygen into the system from an outside source. It is a one-way type valve, with the internal arrangement permitting oxygen to flow into the filler line, but not out again. A removable plug seals the opening when the filler valve is not in use.

(2) REMOVAL.

(a) Make certain that the area around the filler valve is free from all dirt and grease.

(b) Disconnect the tubing.

(c) Loosen the two lock screws in the mounting flange.

(d) Pull the valve outward from the mounting flange.

(3) DISASSEMBLY.

(a) Unscrew the collector end.

(b) Remove the valve and washer.

(c) Remove the two screws from the knurled head if complete disassembly is required.

NOTE

Keep all parts free from grease oil, and dirt.

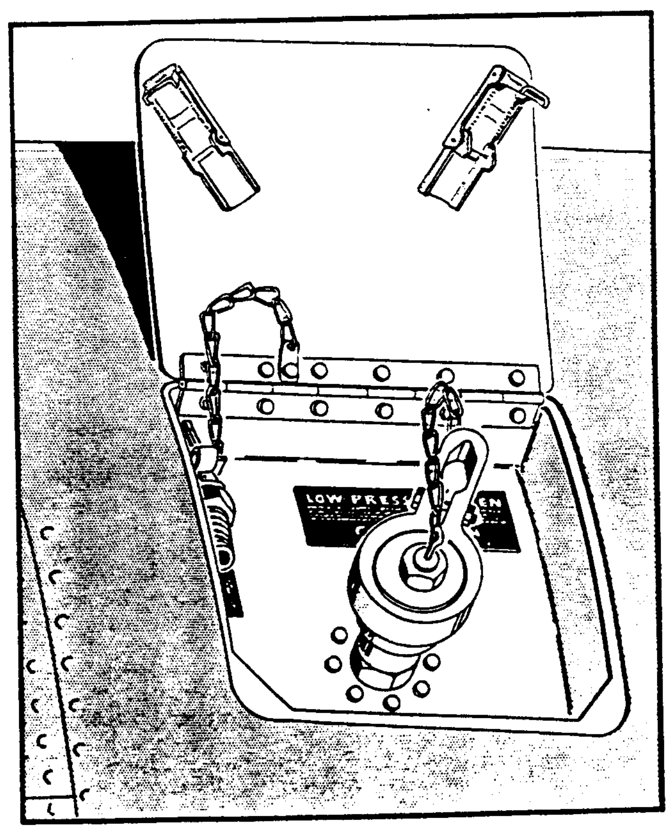


Figure 5. Oxygen Filler Valve

(4) CLEANING.

(a) Chase the threads dry, without lubricant, if they are dirty.

(b) Wash the parts with carbon tetrachloride and allow them to dry.

(c) Rewash with anhydrous ethyl alcohol.

CAUTION

Make certain that all parts are free from alcohol before reinstalling them in the system. This is accomplished by blowing off parts with dry oxygen, water pumped nitrogen, or water pumped dry air.

(5) REPLACEMENTS. The washer and internal valve are interchangeable with those of the type I check valves, Specifications No. AN-V-14 and AN-V-15, also installed in the oxygen system.

(6) ASSEMBLY.

(a) Make certain that all parts are free from grease, oil, and dirt.

(b) Apply anti-seize compound, Specication No. AN-C-86, to the connector threads.

(c) Insert the washer and valve in the connector and screw the connector into place in the housing.

(d) Reassemble the knurled head, slip it into position, and secure it to the housing with two screws.

(e) Replace and tighten the two lock screws in the mounting plate.

(7) INSTALLATION.

(a) Apply anti-seize compound, Specification No. AN-C-86, to the tubing threads.

(b) Attach the tubing to the filler valve connector.

f. CHECK VALVES.

(1) DESCRIPTION.

(a) The style G, style E, and the style D check valves are installed in the oxygen system to control the flow of oxygen through the lines and instruments.

(b) A style G, one way, check valve is installed in each oxygen cylinder and is connected to the oxygen filler line to supply oxygen to the cylinders from the filler valve.

(c) A style E, three way, check valve is installed in the oxygen distribution line near each group of three oxygen cylinders.

(d) The style D, two way, check valve is installed at the oxygen regulators and also near the cylinders.

(e) The purpose of the check valve in the oxygen system is to prevent loss of oxygen from all of the cylinders in case of damage to one of the cylinders.

NOTE

The above description covers the alternate loading condition of the airplane with the use of 35 oxygen cylinders. In the weight-empty condition, however, when only two oxygen cylinders are used, the lines and check valves are installed but are capped unless needed.

(2) REMOVAL.

(a) Be sure that the area around the regulator is free from oil, grease, and dirt.

(b) Discharge the affected oxygen lines by opening the oxygen regulators to the "100% OXYGEN" position.

(c) Disconnect the tubing.

(d) Remove the oxygen cylinder, if removing the check valve at the cylinder.

(e) Plug the cylinder opening, if the cylinder is removed, to keep free from dirt.

(f) Keep the removed check valve away from oil, grease, and dirt.

(3) DISASSEMBLY.- Unscrew the inlet and outlet connectors from the housing to gain access to the internal valves. The washer and the valves are then free to fall out.

NOTE

Keep all parts free from grease, oil, and dirt.

(4) CLEANING.

(a) Chase the threads dry, without lubricant, if they are not clean.

(b) Wash the parts with carbon tetrachloride and allow them to dry.

(c) Rewash with anhydrous ethyl alcohol.

CAUTION

Make certain that all parts are free from alcohol before reinstalling them in the system. This is accomplished by blowing off the parts with dry oxygen, water pumped nitrogen, or water pumped dry air.

(5) REPLACEMENTS.- Washers and internal valves, of inlet and outlet ports, in the check valves are interchangeable.

(6) REASSEMBLY.

(a) Make certain that all parts are free from oil, grease, and dirt.

(b) Lightly apply anti-seize compound, Specification No. AN-C-86, to the connector, tubing and the oxygen cylinder threads.

(c) Attach the check valve.

1. When attaching a check valve at a cylinder, the inlet connection attaches to the cylinder and the free flow connection to the oxygen filler line.

2. When attaching a three-way check valve in the oxygen distribution line, the inlet connections are attached to the lines from the cylinders and the free flow connection to the line connected to a two-way check valve.

3. This two-way check valve is attached with the inlet connections attached to the lines from the cylinders, and the free flow connection attached in the line to a two-way check valve near the oxygen regulator.

4. The two-way check valve, near the regulator, is attached with the inlet connections attached to the lines from the cylinders, and the free flow connection to the regulator line.

g. TUBING.

(1) DESCRIPTION.- The oxygen system tubing is joined together by conventional fittings. The oxygen distributor lines are marked with 1/2 inch bands of light green. The oxygen filler lines are marked with 1/2 inch bands of light green, yellow, and light green.

(2) REMOVAL.- Before removing any line, release the oxygen pressure by opening the regulator to the "100% OXYGEN" position.

(3) CLEANING.

(a) To remove oil and grease from the tubing and fittings, use a vapor degreasing method with trichlorethylene, Specification No. AN-T-37.

(b) Blow the tubing clean with a stream of clean, dried, water pumped air.

(c) Use metal or plastic threaded caps and plugs for the storage of oxygen lines and equipment between cleaning, inspection, and reinstallation. Do not use cello-seal caps or gummed tape.

(4) INSTALLATION.- Use anti-seize compound, Specification No. AN-C-86, on male straight threads only when necessary to prevent seizure. This may be determined by screwing the coupling nut onto the male fitting, finger tight, when the tubing is properly aligned with the male fitting. If the nut tightens, with but finger tightening, no compound is needed. If there is considerable play, new fittings should be used.

(a) All combinations of AN and AC811 fittings in the No. 5, 5/16 tube dia. size, flared tube fittings are interchangeable.

WARNING

Do not apply red lead oxide compounds to any threads in the oxygen system. Do not lubricate them with oil or grease. If either is used, fire and explosion will result.

h. OXYGEN INSTRUMENTS. See section IV paragraph 23.

20. PROPELLER ANTI-ICING

20. PROPELLER ANTI-ICER.- This airplane has not been equipped with propeller anti-icing.

21. ARMAMENT

21. ARMAMENT.- Only structural provisions have been made for the installation of armament on this airplane. Fairings have been installed on the outer wings and crew nacelle to simulate turrets and sighting stations.

22. BOMBING EQUIPMENT

22. BOMBING EQUIPMENT

a. GENERAL.- There are four bomb bays in each wing of the airplane. They are numbered from one to four in the left-hand wing and five to eight in the right-hand wing, going from left to right. Each flexible bomb bay door moves in tracks in the bay, rolling onto a drum when open. Control of each door is independent under normal conditions, but they can all be opened simultaneously in case an emergency requires immediate jettisoning of all bombs. The bomb release and indicator lights systems are based on army standard systems. All controls are electrical and are divided into five circuits as follows:

(1) Bomb bay door controls.

(2) Bomb indicator lights.

(3) Normal bomb release (selective and train).

(4) Emergency salvo release (bombs safe).

(5) Bomb bay No. 4 emergency salvo.

b. BOMB BAY DOOR CONTROLS. (See figure 1.)

(1) DESCRIPTION.- The bomb door mechanism is essentially the same for each of the eight bomb bays. The only exception is bomb bay No. 4 which has additional controls to jettison its bombs and allow emergency exit of the crew. A motor and drum assembly is used to open each door, and a motor and sprocket chain mechanism is used to close it. Control is centered in the bombardier's switch panel, but the doors can also be opened for emergency jettison of the bombs by the pilot or crew members as well as the bombardier.

(2) OPERATION.- The door-opening-motor, located at the aft end of the bomb bay, rolls the flexible door on a drum when the two-way switch on the bombardier's switch panel is placed in the "OPEN" position. Moving the switch to the "CLOSE" position activates the door closing motor, which is attached to the forward end of the door, and the door is pulled shut by sprockets attached to the motor and engaging the roller chain stretched the length of the bomb bay.

(3) ELECTRICAL. (See figure 2.)

(a) NORMAL OPERATION.- 28 volt d.c. passes through the bomb door master switch to the individual bomb door selector switches. These switches have two positions, "OPEN" and "CLOSE." Door limit switches stop the door motors and shut off power when the doors reach their extreme positions. The motors operate on 208 volts a.c. supplied through relays controlled by the selector switches.

(b) EMERGENCY (SALVO) OPERATION.- The salvo circuit is operated by either the pilot's, the bombardier's, or the crew's salvo switch. Whenever one of the salvo switches is closed, eight relays in the eight bomb bays are activated and distribute current to the door "OPEN" circuit of all of the doors. The salvo switches pick up current from different points so as to minimize possibility of failure due to damage by gunfire, etc.

(4) DOOR OPEN MECHANISM. (See figure 3.)

(a) DESCRIPTION.- A drum extending across each bomb bay at the aft end is used to roll up the flexible bomb bay door. When the door begins to open, lengths of roller chain guide it onto the drum. Motors with extension shafts through the ribs operate the drums in bomb bays 1, 2, 3, 6, 7, and 8. In bomb bays 4 and 5 each motor is on the same side of the rib as the drum and turns the drum with a roller chain-and-sprocket drive.

(b) MOTORS.

1. DESCRIPTION.- All of the door-open motors are identical. They are Ritter type D-2162 actuator motors with a maximum torque of 1800 inch-pounds at 20 rpm. Operating current is 208 volt, 400 cycle, 3 phase, alternating current supplied by the auxiliary power units. Each motor assembly consists of motor, centrifugal clutch, two (normally on) electric brakes, thermostatic switch, centrifugal switch, planetary reduction gears, ordinary reduction gears, and splined drive shaft.

2. OPERATION.- When the 208 volt current is applied to the motor through the relay, the motor brake and secondary brake are held off. At the same time the solenoid-operated clutch on the gear train of the door-closing motor is disengaged, allowing the door closing mechanism to free-wheel during the opening operation. As the motor

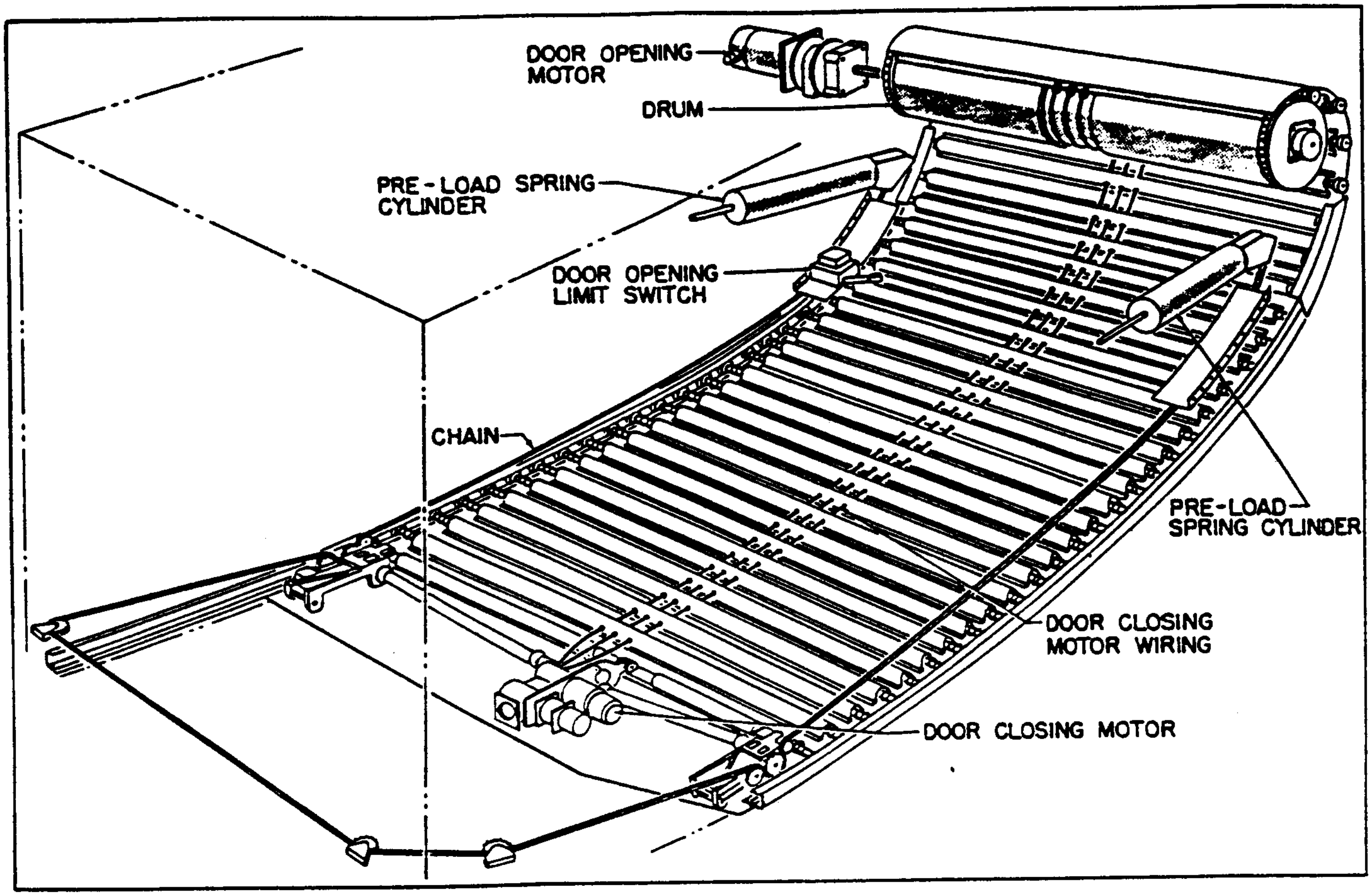


Figure 1. Bomb Door Operating Mechanism

gathers speed, the centrifugal clutch engages and the door begins to roll up. A centrifugally operated switch in the motor closes a circuit to the solenoid clutch in the door-close motor, paralleling the other circuit which operates the clutch through a limit switch. When the door has opened, it comes in contact with the limit switches and cuts the current to the door-open relays and the solenoid clutch. The power to the motor and to the brakes is thus cut off and the motor is brought to a stop by the brakes. Although the circuit through the limit switch to the solenoid clutch will be off due to the parallel circuit from the centrifugal switch to the solenoid clutch, the clutch will not be allowed to engage until the speed of the motor has dropped to 1500 rpm. As the centrifugal clutch in the motor disengages at 1600 rpm, this insures that there will be no strain on the door closing mechanism.

3. REMOVAL.- Each of the motors is held in place by four bolts and nut plates. Disconnect the electrical plugs and remove the bolts. Slide the splined shaft out of place and remove the motor. Each motor weighs approximately 25 pounds.

NOTE

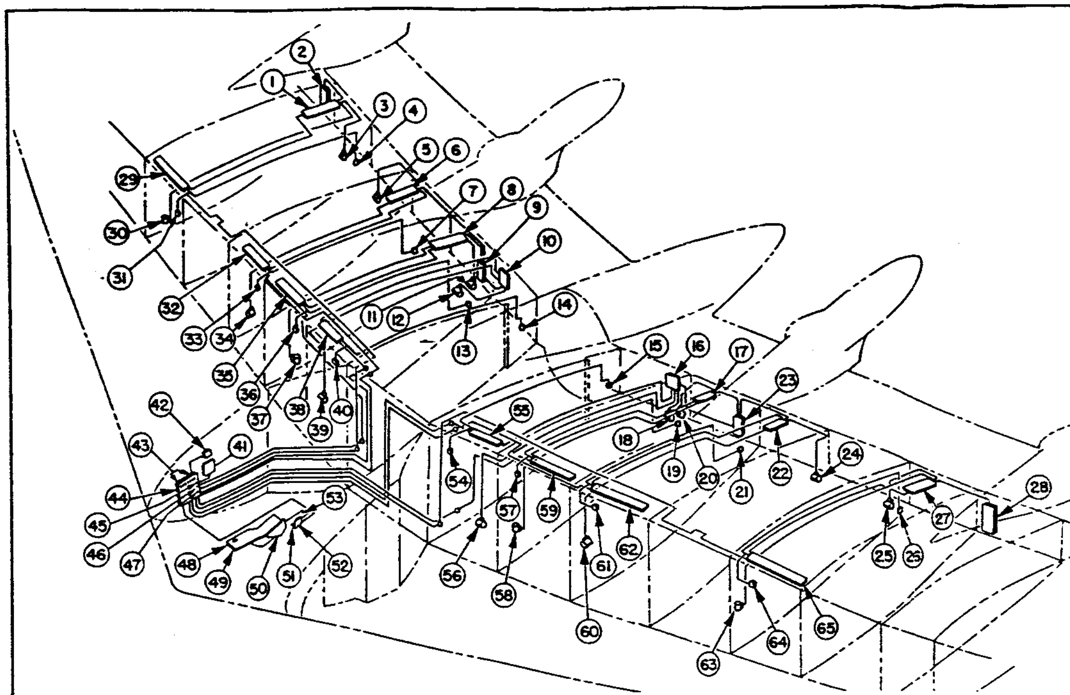
Some of the motors turn in a direction opposite to that of some of the others. Although the motors can be made to rotate in either direction by the use of the built-in reversing switch, no change in direction should be made after the original installation. Therefore, whenever the motors are removed, they should be marked in some way to insure their return to the proper place. In case of any doubt, the motors should be run before installation to determine their direction of rotation.

4. ADJUSTMENTS.

a. DIRECTION OF ROTATION.- In making an original installation or a replacement of a bomb bay door motor, the direction of rotation of the mechanism should be determined and the rotation of the motor adjusted accordingly. The reversing switch is located at the rear of the motor. Insert a screwdriver in the slot and turn 90° in either direction.

b. BRAKES.- Adjustment of the brakes may be required from time to time to take up play caused by wear.

1. MOTOR BRAKE.- Remove key and rotate cover of brake to full locked position.



ITEM	DESCRIPTION	LOCATION
1	RELAY PANEL	BOMB BAY NO 8, AFT
2	A.C. SECTIONALIZING PANEL	ENG. NO 4 COMPT., AFT
3	BOMB BAY NO.8 DOOR OPEN MOTOR	WHEEL WELL, R.H. AFT.
4	B.B. NO. 8 DOOR OPEN LIMIT SWITCH	BOMB BAY NO.8 AFT.
5	B.B. NO.7 DOOR OPEN MOTOR	WHEEL WELL, R.H. AFT.
6	RELAY PANEL	BOMB BAY NO.7 AFT.
7	B.B. NO.7 DOOR OPEN LIMIT SWITCH	BOMB BAY NO.7 AFT.
8	RELAY PANEL	BOMB BAY NO.6 AFT.
9	A.C. SECTIONALIZING PANEL	BOMB BAY NO.6 AFT.
10	POWER RELAY BOX	BOMB BAY NO.5 AFT.
11	B.B. NO.6 DOOR OPEN MOTOR	BOMB BAY NO.5 AFT.
12	B.B. NO. 5 DOOR OPEN MOTOR	BOMB BAY NO.5 AFT.
13	B.B. NO. 6 DOOR OPEN LIMIT SWITCH	BOMB BAY NO.6 AFT.
14	B.B. NO. 5 DOOR OPEN LIMIT SWITCH	BOMB BAY NO.5 AFT.
15	B.B. NO.4 DOOR OPEN LIMIT SWITCH	BOMB BAY NO.4 AFT.

ITEM	DESCRIPTION	LOCATION
16	POWER RELAY BOX	BOMB BAY NO.4 AFT.
17	RELAY PANEL	BOMB BAY NO.3 AFT.
18	B.B. NO.4 DOOR OPEN MOTOR	BOMB BAY NO.4 AFT.
19	B.B. NO.3 DOOR OPEN LIMIT SWITCH	BOMB BAY NO.3 AFT.
20	B.B. NO. 3 DOOR OPEN MOTOR	BOMB BAY NO.4 AFT.
21	B.B. NO.2 DOOR OPEN LIMIT SWITCH	BOMB BAY NO.2 AFT.
22	RELAY PANEL	BOMB BAY NO.2 AFT.
23	A.C. SECTIONALIZING PANEL	BOMB BAY NO.3 AFT.
24	B.B. NO.2 DOOR OPEN MOTOR	WHEEL WELL, L.H. AFT.
25	B.B. NO.1 DOOR OPEN MOTOR	WHEEL WELL, L.H. AFT.
26	B.B. NO.1 DOOR LIMIT SWITCH	BOMB BAY NO.1, AFT.
27	RELAY PANEL	BOMB BAY NO. AFT.
28	A.C. SECTIONALIZING PANEL	ENG. NO.1 COMPT, AFT.
29	RELAY PANEL	BOMB BAY NO.8, FWD.
30	B.B. NO.8 DOOR CLOSE MOTOR	BOMB BAY NO.8, FWD.
31	B.B. NO.8 DOOR CLOSE LIMIT SWITCH	BOMB BAY NO.8, FWD.
32	RELAY PANEL	BOMB BAY NO.7, FWD.
33	B.B. NO.7 DOOR CLOSE LIMIT SWITCH	BOMB BAY NO.7, FWD.
34	B.B. NO.7 DOOR CLOSE MOTOR	BOMB BAY NO.7, FWD.
35	RELAY PANEL	BOMB BAY NO.6, FWD.
36	B.B. NO.6 DOOR CLOSE LIMIT SWITCH	BOMB BAY NO.6, FWD.
37	B.B. NO.6 DOOR CLOSE MOTOR	BOMB BAY NO.6, FWD.
38	RELAY PANEL	BOMB BAY NO.5, FWD.
39	B.B. NO.5 DOOR CLOSE MOTOR	BOMB BAY NO.5, FWD.
40	B.B. NO.5 DOOR CLOSE LIMIT SWITCH	BOMB BAY NO.5, FWD.
41	RELAY PANEL	BOMBARDIER'S STATION
42	LIMITER PANEL	BOMBARDIER'S STATION
43	B.B. DOOR SELECTOR SWITCHES (8 REQ	BOMBDR. CONTROL PANEL
44	CONTROL PANEL	BOMBARDIERS STATION
45	SALVO INDICATOR LIGHT	BOMBDR. CONTROL PANEL
46	MASTER BOMB DOOR SWITCH	BOMBDR. CONTROL PANEL
47	EMERGENCY SALVO SWITCH	BOMBDR. CONTROL PANEL
48	EMERGENCY ALARM SWITCH	PILOT'S SWITCH PANEL
49	SWITCH PANEL	PILOT'S PEDESTAL
50	RELAY PANEL	BENEATH PILOTS PEDESTAL
51	INDICATOR LIGHT	PILOT'S SALVO SWITCH PANEL
52	SWITCH PANEL, PILOT'S SALVO	PILOT'S STATION
53	SALVO SWITCH	PILOT'S SALVO SWITCH PANEL
54	B.B. NO.4 DOOR CLOSE LIMIT SWITCH	BOMB BAY NO.4, FWD.
55	RELAY PANEL	BOMB BAY NO.4, FWD.
56	B.B. NO.4 DOOR CLOSE MOTOR	BOMB BAY NO.4, FWD.
57	B.B. NO.3 DOOR CLOSE LIMIT SWITCH	BOMB BAY NO.3, FWD.
58	B.B. NO.3 DOOR CLOSE MOTOR	BOMB BAY NO.3, FWD.
59	RELAY PANEL	BOMB BAY NO.3, FWD.
60	B.B. NO.2 DOOR CLOSE MOTOR	BOMB BAY NO.2, FWD.
61	B.B. NO.2 DOOR CLOSE LIMIT SWITCH	BOMB BAY NO.2, FWD.
62	RELAY PANEL	BOMB BAY NO.2, FWD.
63	B.B. NO.1 DOOR CLOSE MOTOR	BOMB BAY NO.1, FWD.
64	B.B. NO.1 DOOR CLOSE LIMIT SWITCH	BOMB BAY NO.1, FWD.
65	RELAY PANEL	BOMB BAY NO.1, FWD.

Figure 2. Bomb Bay Door Control

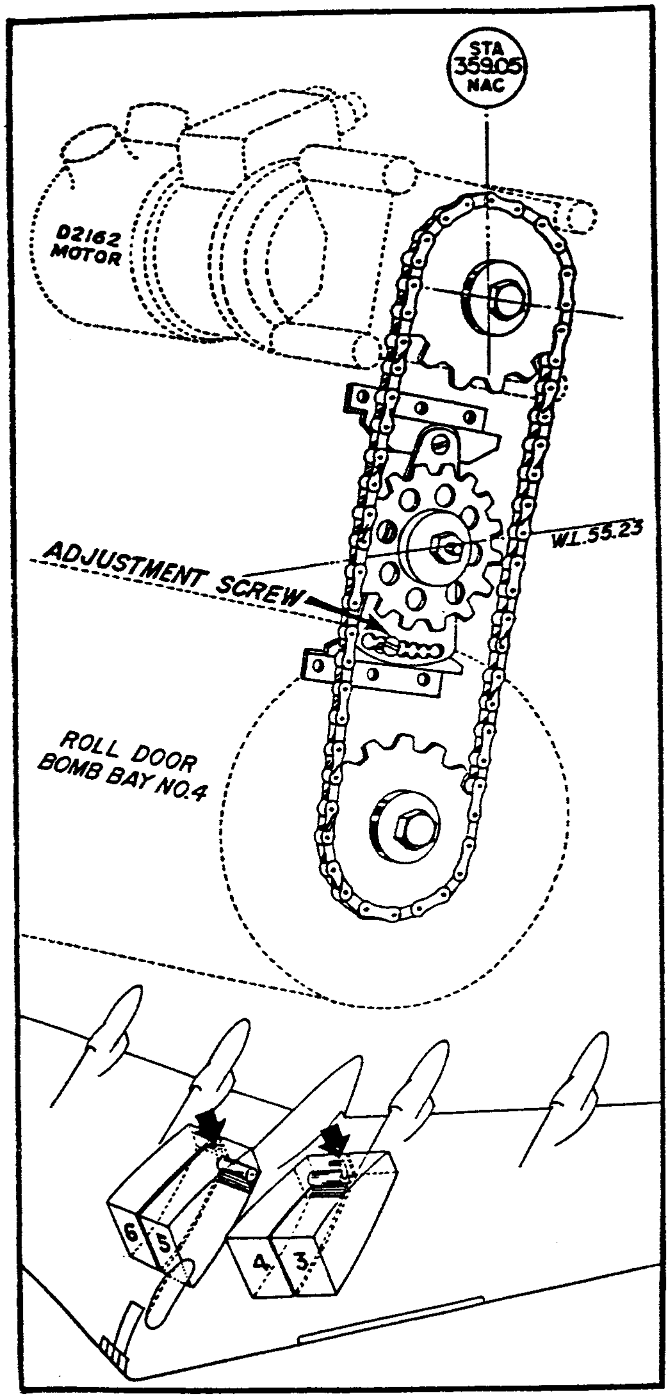


Figure 3. Door Opening Mechanism

Back off cover approximately one-third turn to provide proper brake clearance. Replace key in nearest matching slot.

2. SECONDARY BRAKE.- Remove two screws and two flange bolts holding brake cover in position. Remove cover. Cam is set at factory to be approximately 10° from vertical in locked-brake position. Loosen set screw on lever arm and rotate cam toward vertical to increase brake action; away from vertical to decrease brake action.

5. INSTALLATION.- Installation of the motor is the reverse of the removal procedure.

(c) DRUMS.

1. DESCRIPTION.- The drums upon which the bomb bay doors are rolled are hollow cylinders of laminated phenolic plastic, held in shape by plywood bulkheads and birch stringers. At the ends are fastened sections of roller chain which act as tension members to guide the door onto the drum.

2. OPERATION.- The drums in bomb bays 1, 2, 3, 6, 7, and 8 are directly driven by motors attached to the ribs. A splined shaft connects the motor drive shaft and the drum. In bomb bays 4 and 5, a roller chain-and-sprocket drive each drum. An idler sprocket is used to keep the chain tight.

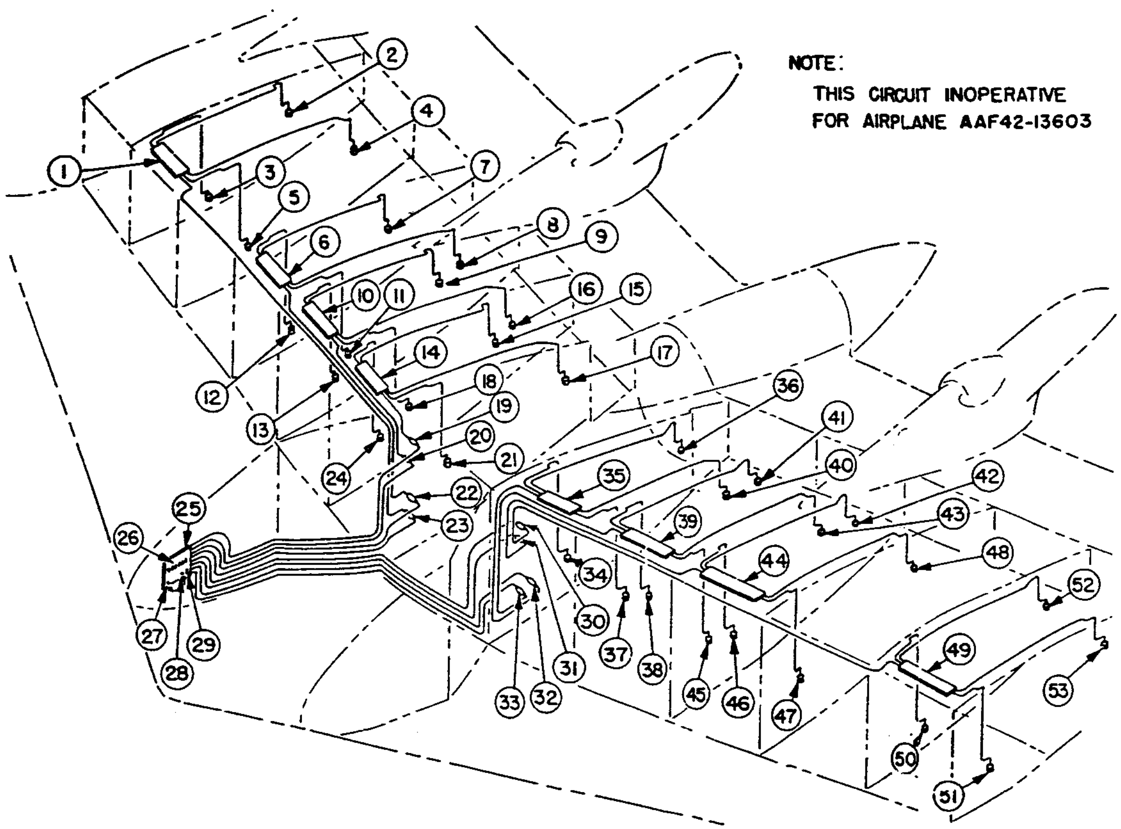
(5) DOOR-CLOSE MECHANISM.

(a) DESCRIPTION.- The door-close mechanism consists of a door-close-power unit, two drive shafts with universal joints, sprocket-driving gears, idler sprockets, and roller chain. The power unit is mounted on the inside forward end of the bomb bay door. The drive shafts are attached to the power unit's output shaft and extend to each side of the door. The driving and idler gears, at the ends of the drive shafts, mesh with the roller chain which stretches the length of the bomb bay on one side, across the front of the bay, and back along the other side.

(b) OPERATION.- Placing the door selector switch in the "CLOSE" position and throwing the master bomb bay door switch to "ON" directs 24 volt d.c. to the door-close relays and to the door-close-motor brake. The relays distribute 208 volt, 3 phase, 400 cycle, alternating current to the door-close motor and to the gear brake of the door-open motor. The door-close motor starts to pull the door shut, gaining speed as it goes. When the motor reaches 1500 rpm the centrifugal switch closes and partially completes a circuit to the solenoid clutch of the door-close motor. Contact of the door with the door-close limit switches opens the door-close relays, stopping the power to the motor and applying the door-open motor secondary brake and the door-close motor brake. One of the limit switches completes the circuit to energize the solenoid clutch to disengage the motor from the drive mechanism. This enables the motor to slow down without putting any strain on the door or chain. Below 1500 rpm the centrifugal clutch opens the circuit to the clutch, permitting the door to be pulled slightly by the last few revolutions of the motor.

(c) DOOR-CLOSE POWER UNIT.

1. DESCRIPTION.- The door-close power unit is installed on the bomb bay door at the forward end. It consists of motor with brake, centrifugal switch, solenoid clutch, planetary gears, gear train, and output shaft.



ITEM	DESCRIPTION	LOCATION
1	RELAY PANEL	BOMB BAY NO. 8 F'W'D
2	RECEPTACLE-OUTB'D	BOMB BAY NO. 8 AFT
3	RECEPTACLE-OUTB'D	BOMB BAY NO. 8 F'W'D
4	RECEPTACLE-INB'D	BOMB BAY NO. 8 AFT
5	RECEPTACLE-INB'D	BOMB BAY NO. 8 F'W'D
6	RELAY PANEL	BOMB BAY NO. 7 F'W'D
7	RECEPTACLE-OUTB'D	BOMB BAY NO. 7 AFT
8	RECEPTACLE-INB'D	BOMB BAY NO. 7 AFT
9	RECEPTACLE-OUTB'D	BOMB BAY NO. 6 AFT
10	RELAY PANEL	BOMB BAY NO. 6 F'W'D
11	RECEPTACLE-INB'D	BOMB BAY NO. 7 F'W'D
12	RECEPTACLE-OUTB'D	BOMB BAY NO. 7 F'W'D
13	RECEPTACLE-OUTB'D	BOMB BAY NO. 6 F'W'D
14	RELAY PANEL	BOMB BAY NO. 5 F'W'D
15	RECEPTACLE-OUTB'D	BOMB BAY NO. 5 AFT
16	RECEPTACLE-INB'D	BOMB BAY NO. 6 AFT
17	RECEPTACLE-INB'D	BOMB BAY NO. 5 AFT
18	RECEPTACLE-INB'D	BOMB BAY NO. 6 F'W'D
19	PRESSURIZED PLUG "A"	CREW NACELLE WALL R.H.
20	PRESSURIZED PLUG "B"	CREW NACELLE WALL R.H.
21	RECEPTACLE-INB'D	BOMB BAY NO. 5 F'W'D
22	PRESSURIZED PLUG "C"	CREW NACELLE WALL R.H.
23	PRESSURIZED PLUG "E"	CREW NACELLE WALL R.H.
24	RECEPTACLE-OUTB'D	BOMB BAY NO. 5 F'W'D
25	BOMBARDIER'S CONTROL PANEL	BOMBARDIER'S STATION
26	INDICATOR LIGHTS	BOMBARDIER'S CONTROL
27	CIRCUIT BREAKER	BOMBARDIER'S CONTROL
28	INDICATOR LIGHT	BOMBARDIER'S CONTROL PAN
29	SWITCH-NOSE FUSE ARMING	BOMBARDIER'S CONTROL PAN
30	PRESSURIZED PLUG "A"	CREW NACELLE WALL L.H.
31	PRESSURIZED PLUG "B"	CREW NACELLE WALL L.H.
32	PRESSURIZED PLUG "E"	CREW NACELLE WALL L.H.
33	PRESSURIZED PLUG "C"	CREW NACELLE WALL L.H.
34	RECEPTACLE-INB'D	BOMB BAY NO. 4 F'W'D
35	RELAY PANEL	BOMB BAY NO. 4 F'W'D
36	RECEPTACLE-INB'D	BOMB BAY NO. 4 AFT
37	RECEPTACLE-OUTB'D	BOMB BAY NO. 4 F'W'D
38	RECEPTACLE-INB'D	BOMB BAY NO. 3 F'W'D
39	RELAY PANEL	BOMB BAY NO. 3 F'W'D
40	RECEPTACLE-OUTB'D	BOMB BAY NO. 4 AFT
41	RECEPTACLE-INB'D	BOMB BAY NO. 3 AFT
42	RECEPTACLE-INB'D	BOMB BAY NO. 2 AFT
43	RECEPTACLE-OUTB'D	BOMB BAY NO. 3 AFT
44	RELAY PANEL	BOMB BAY NO. 2 F'W'D
45	RECEPTACLE-OUTB'D	BOMB BAY NO. 3 F'W'D
46	RECEPTACLE-INB'D	BOMB BAY NO. 2 FWD
47	RECEPTACLE-OUTB'D	BOMB BAY NO. 2 FWD
48	RECEPTACLE-OUTB'D	BOMB BAY NO. 2 AFT
49	RELAY PANEL	BOMB BAY NO. 1 F'W'D
50	RECEPTACLE-INB'D	BOMB BAY NO. 1 F'W'D
51	RECEPTACLE-OUTB'D	BOMB BAY NO. 1 F'W'D
52	RECEPTACLE-INB'D	BOMB BAY NO. 1 AFT
53	RECEPTACLE-OUTB'D	BOMB BAY NO. 1 AFT

Figure 4. Bomb Arming and Nose Fuse Control Circuit

All parts are completely enclosed to keep out foreign matter. The total gear ratio of the unit is 138 to 1, giving a rotation of the output shaft of 82 rpm. Maximum torque is 30 inch-pounds at full speed.

2. ADJUSTMENTS.- Adjust the centrifugal switch, solenoid spring, etc. according to the instructions attached to the unit.

3. LUBRICATION.- The unit is permanently lubricated on assembly.

(d) DRIVE SHAFTS, DRIVING GEARS, AND IDLERS.- The drive shafts are made of hollow tubing with universal joints at each end. Woodruff keys are used to connect the output shaft to the drive shafts and the drive shafts to the sprocket-driving gears. The location of the idlers, fore and aft of the sprocket-driving gear, is arranged so that the chain meshes with over half of the circumference of the sprocket-driving gear.

(e) ROLLER CHAIN.- The roller chain extends along each side of the bomb bay and across the front, being held tight by springs attached to each end at the rear. The chain should be kept clean of dirt and dust at all times.

c. NOSE FUSE ARMING CIRCUIT. (See figure 4.)- Although the nose fuse arming cockpit controls and wiring are installed, this circuit is inoperative.

d. BOMB INDICATOR LIGHTS. (See figure 5.)

(1) DESCRIPTION.- The function of the bomb indicator lights is to show the bombardier the number and location of the bombs in the bomb bay either before or after a group of bombs has been dropped. Built into the circuit is a special test circuit which enables the bombardier to test for burned out bulbs at any time.

(2) OPERATION.- When the indicator light switch is placed in the "ON" position, it activates a relay which passes 28 volt d.c. current from a bus through the indicator light switch and the indicator lights. Each indicator light is wired to the salvo locking solenoid of one of the bomb rack releases in such a way that the circuit will be completed to ground only when the release is cocked. To test for burned out bulbs, the indicator light test switch is held in the "TEST" position, with the indicator light switch "OFF." Current will flow from a 3 volt a.c. transformer through the indicator light test switch, the indicator lights, the indicator light switch, and back to the transformer. The indicator light test switch is spring loaded and must be held by hand in the "TEST" position. Sufficient current will flow through the indicator light circuit when "ON" to activate the salvo locking solenoid of the bomb rack release. Therefor the indicator lights should never be left on when dropping bombs selectively or in "TRAIN."

(3) ELECTRICAL. (See figure 5.)- Power to operate the indicator light circuit comes from a 28 volt d.c. bus in the bombardier's panel. The indicator light test circuit receives its power from the 120 volt a.c. limiter panel. A transformer reduces the voltage on the bulbs to 3 volts a.c. The auxiliary power units must be operating to check the indicator light bulbs unless an external source of power is available.

e. BOMB RELEASE SYSTEM. (TRAIN AND SELECTIVE.)

(1) DESCRIPTION.- Under normal conditions, bombs are dropped in "TRAIN" or singly so as to cover a maximum area with greatest accuracy. For this reason, and for safety, and to obtain a minimum unbalance of the airplane, control units are installed in the bomb release circuit to control such things as the interval between bombs dropped and the order in which they are dropped. The main control units are:

(a) Master bomb release power switch (circuit breaker).

(b) Bomb release switch.

(c) Bomb release interval control, type B-3A.

(d) Bomb rack selector relay.

(e) Bomb rack release.

(f) Bomb door safety switches.

(g) Bomb selector switches.

The limit switches prevent dropping the bombs except when the bomb bay doors are completely open.

(2) WIRING. (See figure 6.)- 28 volt d.c. flows from a bus in the wheel well through the safety switches, the bomb selector switches, to the rack selector relay. At the same time, 28 volt d.c. (from a bus in the crew nacelle) flows directly to the interval control. The current is also sent to the interval control by way of the master bomb release circuit breaker and the bomb release switch. The circuit also connects the interval control and the rack selector relay as well as the rack selector relay and the bomb rack release.

(3) OPERATION.- When the bomb release switch is closed, the interval control is activated and sends an impulse to the rack selector which, in turn, sends an impulse to the bomb rack release. The bomb rack release mechanically actuates the bomb shackle to release the bomb. If, for any reason, the bomb bay door is closed or partially closed, or the bomb selector switch is left "OFF," the impulse from the interval control will be automatically transferred to the next rack by the rack selectors. If any of the bomb rack releases are left uncocked because no bomb is to be dropped from the station in question, the uncocked release will automatically transfer impulses to the next releases. Also the series wiring used in each bay prevents the release of upper bombs from a tier until the bombs beneath have been dropped.

ITEM	DESCRIPTION	LOCATION
1	RELAY PANEL	BOMB BAY NO. 8 F'W'D
2	RECEPTACLE-O'TB'D	BOMB BAY NO. 8 F'W'D
3	RECEPTACLE-INB'D	BOMB BAY NO. 8 F'W'D
4	RECEPTACLE-O'TB'D	BOMB BAY NO. 8 AFT
5	RELAY PANEL	BOMB BAY NO. 7 F'W'D
6	RECEPTACLE-O'TB'D	BOMB BAY NO. 7 F'W'D
7	RECEPTACLE-INB'D	BOMB BAY NO. 7 F'W'D
8	RECEPTACLE-O'TB'D	BOMB BAY NO. 7 AFT
9	RECEPTACLE-INB'D	BOMB BAY NO. 7 AFT
10	RELAY PANEL	BOMB BAY NO. 6 F'W'D
11	RECEPTACLE-O'TB'D	BOMB BAY NO. 6 F'W'D
12	RECEPTACLE-INB'D	BOMB BAY NO. 6 F'W'D
13	RECEPTACLE-O'TB'D	BOMB BAY NO. 6 AFT
14	RECEPTACLE-INB'D	BOMB BAY NO. 6 AFT
15	RELAY PANEL	BOMB BAY NO. 5 F'W'D
16	RECEPTACLE-O'TB'D	BOMB BAY NO. 5 F'W'D
17	RECEPTACLE-INB'D	BOMB BAY NO. 5 F'W'D
18	RECEPTACLE-O'TB'D	BOMB BAY NO. 5 AFT
19	RECEPTACLE-INB'D	BOMB BAY NO. 5 AFT
20	PRESS. PLUG "A"	C.N. WALL-R.H.
21	PRESS. PLUG "B"	C.N. WALL-R.H.
22	PRESS. PLUG "C"	C.N. WALL-R.H.
23	PRESS. PLUG "E"	C.N. WALL-R.H.
24	TRANSFORMER PL.	C.N. NOSE SECTION
25	RELAY PANEL	BOMBARDIER'S STA.
26	DISCONNECT PANEL	BOMBARDIER'S STA.
27	CONTROL PANEL	BOMBARDIER'S STA.
28	CONTROL SWITCHES	CONTROL PANEL
29	INDICATOR LIGHTS	CONTROL PANEL
30	PRESS. PLUG "A"	C.N. WALL-L.H.
31	PRESS. PLUG "B"	C.N. WALL-L.H.
32	PRESS. PLUG "E"	C.N. WALL-L.H.
33	PRESS. PLUG "C"	C.N. WALL-L.H.
34	RECEPTACLE-INB'D	BOMB BAY NO.4 F'W'D
35	RELAY PANEL	BOMB BAY NO.4 F'W'D
36	RECEPTACLE-O'TB'D	BOMB BAY NO.4 F'W'D
37	RECEPTACLE-INB'D	BOMB BAY NO.4 AFT
38	RECEPTACLE-O'TB'D	BOMB BAY NO.4 AFT
39	RELAY PANEL	BOMB BAY NO.3 F'W'D
40	RECEPTACLE-INB'D	BOMB BAY NO.3 F'W'D
41	RECEPTACLE-O'TB'D	BOMB BAY NO.3 F'W'D
42	RECEPTACLE-INB'D	BOMB BAY NO.3 AFT
43	RECEPTACLE-O'TB'D	BOMB BAY NO.3 AFT
44	RELAY PANEL	BOMB BAY NO.2 F'W'D
45	RECEPTACLE-INB'D	BOMB BAY NO.2 F'W'D
46	RECEPTACLE-O'TB'D	BOMB BAY NO.2 F'W'D
47	RECEPTACLE-INB'D	BOMB BAY NO.2 AFT
48	RECEPTACLE-O'TB'D	BOMB BAY NO.2 AFT
49	RELAY PANEL	BOMB BAY NO.1 F'W'D
50	RECEPTACLE-INB'D	BOMB BAY NO.1 F'W'D
51	RECEPTACLE-O'TB'D	BOMB BAY NO.1 F'W'D
52	RECEPTACLE-INB'D	BOMB BAY NO.1 AFT
53	RECEPTACLE-O'TB'D	BOMB BAY NO.1 AFT

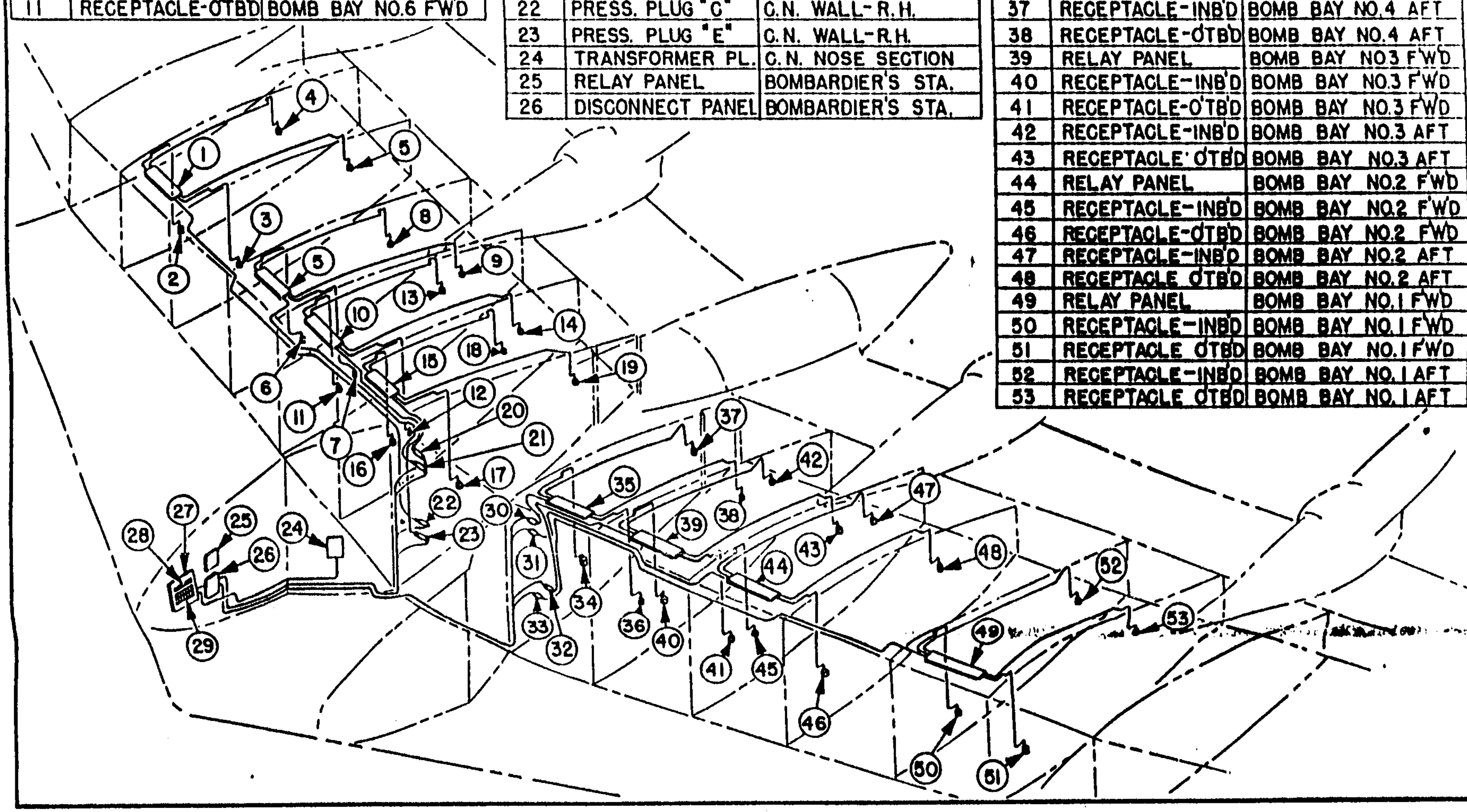


Figure 5. Bomb Indicating Light Circuit

ITEM	DESCRIPTION	LOCATION
1.	RELAY PANEL	BOMB BAY NO.8 F'W'D.
2.	SAFETY SWITCH-MICRO.	BOMB BAY NO.8 F'W'D.
3.	RECEPTACLE-OUTB'D.	BOMB BAY NO.8 F'W'D.
4.	RECEPTACLE-INB'D.	BOMB BAY NO.8 F'W'D.
5.	RECEPTACLE-OUTB'D.	BOMB BAY NO.8 AFT
6.	RECEPTACLE-INB'D.	BOMB BAY NO.8 AFT
7.	SAFETY SWITCH-MICRO.	BOMB BAY NO.8 AFT
8.	RELAY PANEL	BOMB BAY NO.7 F'W'D.
9.	RECEPTACLE-OUTB'D.	BOMB BAY NO.7 AFT
10.	D.C. DISTRIBUTION PANEL	R.H. WHEEL WELL-AFT
11.	SAFETY SWITCH-MICRO.	BOMB BAY NO.7 F'W'D.
12.	RECEPTACLE-INB'D.	BOMB BAY NO.7 F'W'D.
13.	RECEPTACLE-INB'D.	BOMB BAY NO.7 F'W'D.
14.	SAFETY SWITCH-MICRO.	BOMB BAY NO.7 AFT
15.	RECEPTACLE-OUTB'D.	BOMB BAY NO.7 F'W'D.
16.	RELAY PANEL	BOMB BAY NO.6 F'W'D.
17.	SAFETY SWITCH-MICRO.	BOMB BAY NO.6 F'W'D.
18.	RECEPTACLE-OUTB'D	BOMB BAY NO.6 F'W'D.
19.	RECEPTACLE-OUTB'D.	BOMB BAY NO.6 AFT
20.	RELAY PANEL	BOMB BAY NO.5 F'W'D.
21.	RECEPTACLE-OUTB'D.	BOMB BAY NO.5 AFT
22.	SAFETY SWITCH-MICRO.	BOMB BAY NO.6 AFT
23.	RECEPTACLE-INB'D.	BOMB BAY NO.6 AFT
24.	RECEPTACLE-INB'D.	BOMB BAY NO.5 AFT
25.	SAFETY SWITCH-MICRO.	BOMB BAY NO.5 AFT
26.	RECEPTACLE-OUTB'D.	BOMB BAY NO.5 F'W'D.
27.	RECEPTACLE-INB'D.	BOMB BAY NO.6 F'W'D.
28.	PRESSURIZED PLUG "A"	CREW NACELLE WALL R.H.
29.	PRESSURIZED PLUG "B"	CREW NACELLE WALL R.H.
30.	SAFETY SWITCH-MICRO.	BOMB BAY NO.5 F'W'D.
31.	PRESSURIZED PLUG "D"	CREW NACELLE WALL R.H.
32.	TRANSFORMER PANEL	CREW NACELLE NOSE SEC.
33.	RELAY PANEL	BOMBARDIERS STATION
34.	RACK SELECTOR-B.B.1&8	BOMBARDIERS STATION
35.	RACK SELECTOR-B.B.2&7	BOMBARDIERS STATION
36.	RACK SELECTOR-B.B.4&5	BOMBARDIERS STATION
37.	RACK SELECTOR-B.B.3&6	BOMBARDIERS STATION
38.	CONTROL PANEL	BOMBARDIERS STATION
39.	SELECTOR SWITCHES	BOMBARDIERS CONTROL PANEL
40.	INDICATOR LIGHTS	BOMBARDIERS CONTROL PANEL
41.	CIRCUIT BREAKER	BOMBARDIERS CONTROL PANEL
42.	INTERVALOMETER	BOMBARDIERS CONTROL PANEL
43.	BOMB RELEASE SWITCH	BOMBARDIERS CONTROL PANEL
44.	INDICATOR LIGHT-SALVO	BOMBARDIERS CONTROL PANEL
45.	SALVO SWITCH	BOMBARDIERS CONTROL PANEL
46.	INDICATOR LIGHT	PILOT & CO-PILOT INST. PANEL
47.	PILOT & CO-PILOT INST. PANEL	PILOTS STATION
48.	CIRCUIT BREAKER	PILOTS PEDESTAL
50.	PILOTS PEDESTAL SW. PANEL	PILOTS STATION

ITEM	DESCRIPTION	LOCATION
51.	RELAY PANEL	PILOT'S PEDESTAL
52.	INDICATOR LIGHT	PILOT'S SALVO SW. PANEL
53.	SALVO SWITCH	PILOT'S SALVO SW. PANEL
54.	PILOT SALVO SW. PANEL	PILOT'S STATION
55.	PRESSURIZED PLUG "E"	CREW NACELLE WALL R.H.
56.	PRESSURIZED PLUG "D"	CREW NACELLE WALL R.H.
57.	RECEPTACLE-INB'D.	BOMB BAY NO.5 F'W'D.
58.	SAFETY SWITCH-MICRO	BOMB BAY NO.4 F'W'D.
59.	PRESSURIZED PLUG "A"	CREW NACELLE WALL L.H.
60.	PRESSURIZED PLUG "B"	CREW NACELLE WALL L.H.
61.	RELAY PANEL	BOMB BAY NO.4 F'W'D.
62.	RECEPTACLE-INB'D	BOMB BAY NO.4 AFT
63.	SAFETY SWITCH-MICRO	BOMB BAY NO.4 AFT
64.	SAFETY SWITCH-MICRO	BOMB BAY NO.3 AFT
65.	RECEPTACLE-INB'D	BOMB BAY NO.3 AFT
66.	RECEPTACLE-OUTB'D	BOMB BAY NO.4 AFT
67.	RELAY PANEL	BOMB BAY NO.3 F'W'D.
68.	SAFETY SWITCH-MICRO	BOMB BAY NO.3 F'W'D.
69.	PRESSURIZED PLUG "C"	CREW NACELLE WALL L.H.
70.	PRESSURIZED PLUG "D"	CREW NACELLE WALL L.H.
71.	PRESSURIZED PLUG "E"	CREW NACELLE WALL L.H.

ITEM	DESCRIPTION	LOCATION
72.	RECEPTACLE-INB'D.	BOMB BAY NO.4 F'W'D.
73.	RECEPTACLE-OUTB'D.	BOMB BAY NO.4 F'W'D.
74.	RECEPTACLE-INB'D.	BOMB BAY NO.3 F'W'D.
75.	SAFETY SWITCH-MICRO	BOMB BAY NO.2 F'W'D.
76.	RECEPTACLE-OUTB'D.	BOMB BAY NO.3 F'W'D.
77.	RECEPTACLE-INB'D.	BOMB BAY NO.2 F'W'D.
78.	RELAY PANEL	BOMB BAY NO.2 F'W'D.
79.	RECEPTACLE-OUTB'D.	BOMB BAY NO.3 AFT
80.	RECEPTACLE-INB'D.	BOMB BAY NO.2 AFT
81.	SAFETY SWITCH-MICRO	BOMB BAY NO.2 AFT
82.	D.C. DISTRIBUTION PANEL	L.H. WHEEL WELL-AFT
83.	RECEPTACLE-OUTB'D.	BOMB BAY NO.2 AFT
84.	RECEPTACLE-OUTB'D.	BOMB BAY NO.2 F'W'D.
85.	SAFETY SWITCH-MICRO	BOMB BAY NO.1 F'W'D.
86.	RECEPTACLE-INB'D.	BOMB BAY NO.1 F'W'D.
87.	RECEPTACLE-OUTB'D.	BOMB BAY NO.1 F'W'D.
88.	RELAY PANEL	BOMB BAY NO.1 F'W'D.
89.	RECEPTACLE-OUTB'D.	BOMB BAY NO.1 AFT
90.	SAFETY SWITCH-MICRO	BOMB BAY NO.1 AFT
91.	RECEPTACLE-OUTB'D.	BOMB BAY NO.1 AFT

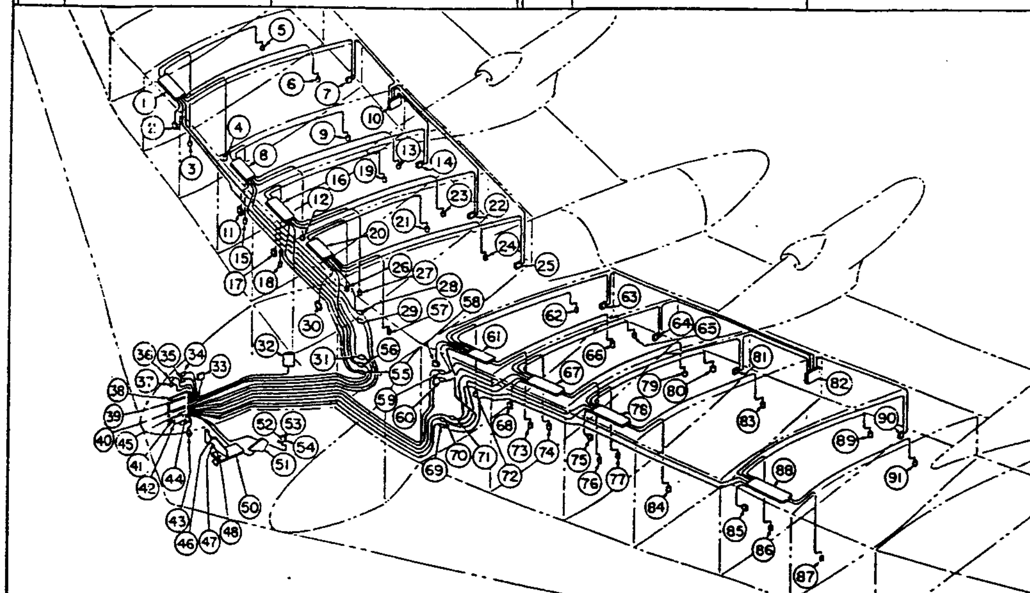


Figure 8. Bomb Release Wiring Control Circuit

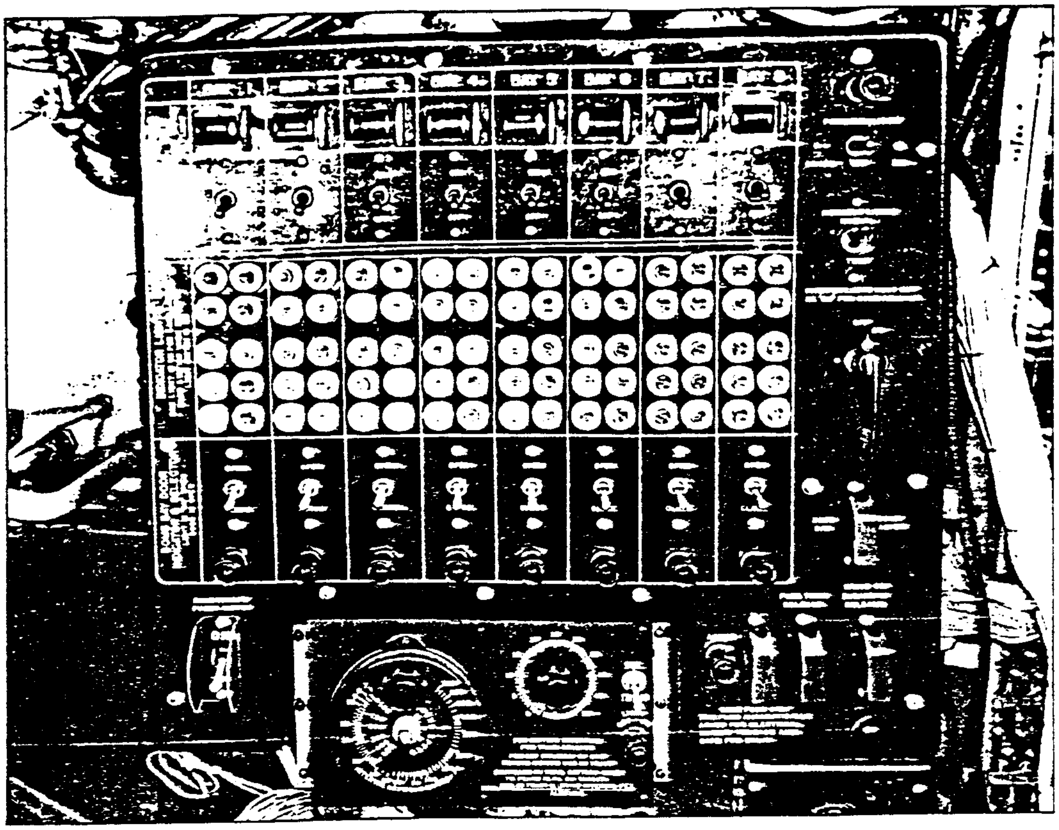


Figure 7. Bombardier's Control Panel

(4) CONTROL UNITS.

(a) BOMB RELEASE INTERVAL CONTROL.

1. DESCRIPTION. (See figure 7.)- The type B3-A bomb release interval control is used to control the release of bombs so that each of any number of bombs dropped in train will hit the ground a uniform distance apart. For adjustments it has an indicator light, a train-selector switch, a counter switch, and an interval selector dial. Markings and words are of fluorescent material so as to be visible under ultraviolet light.

2. OPERATION.

a. TRAIN SELECTOR SWITCH.- The train selector switch located directly above the indicator light is used to select either train release of bombs or, using a separate operation of the bomb release switch for each bomb, selective release. If the bombardier desires to stop a train of bombs before the total number selected for that train have been released, he has merely to throw the switch from "TRAIN" to "SELECT."

b. COUNTER SWITCH.- The counter switch is a rotary switch which selects the number of bombs to be dropped in a train. The switch must be set at least a minute before the bomb release switch is pressed. Any number of bombs from one to fifty can be selected and, if it is desired to drop more than originally selected or more than fifty, the switch can be held manually at any point above zero. Turning the selector switch to zero at any time (even when bombs are dropping) automatically stops the release of any more bombs.

c. INTERVAL SELECTOR DIAL.- The interval selector dial regulates the spacing in feet relative to ground speed of the bombs dropped in train. The bombardier sets the desired spacing of bombs against the ground speed of the airplane.

d. INDICATOR LIGHT.- The indicator light is used to indicate that the interval control has been prepared for the release of bombs. When the train selector switch is at the "SELECT" position or when the counter switch is in other than zero position and the train selector switch is at "TRAIN," the light will be illuminated to indicate that pressure on the bomb release switch will release a bomb or bombs. Failure of the indicator light will not affect the operation of the unit, but the train selector switch should be left at "TRAIN" and the counter switch at zero to prevent unnecessary drain on the power supply.

3. TROUBLE SHOOTING.

TROUBLE	PROBABLE CAUSE	REMEDY
Indicator light will not burn.	Burned out bulb.	Replace bulb with a standard miniature bayonet base Mazda No. 44, 6 to 8 volt, tubular bulb.

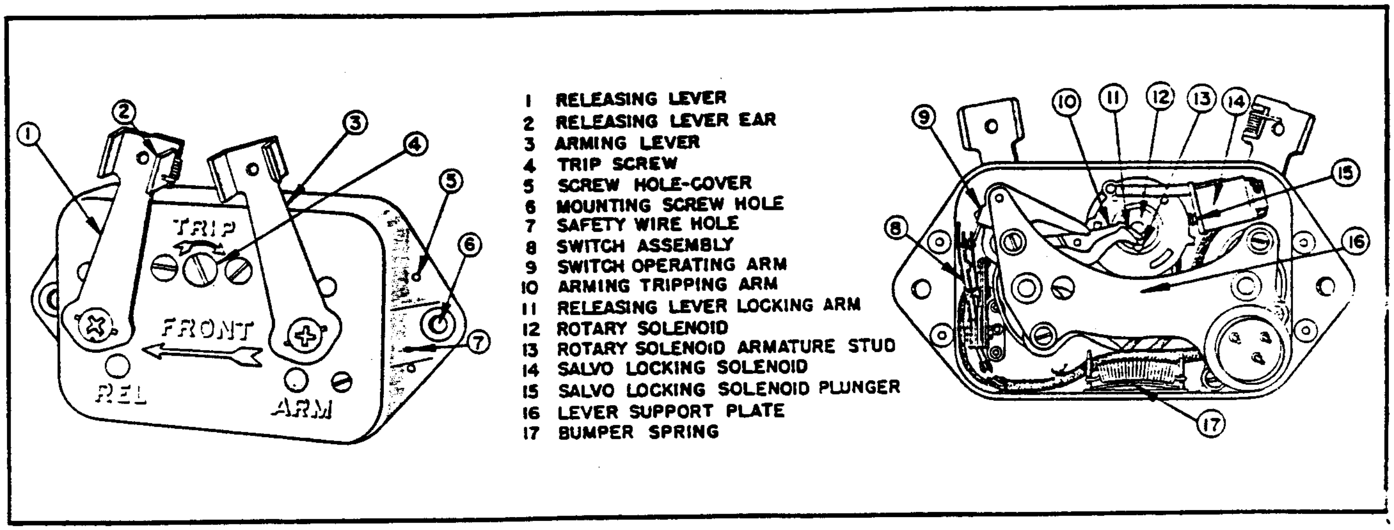


Figure 8. Type A-4 Bomb Rack Release

NOTE

Due to the complexity of the instrument, field repairs are not advisable. Damaged or defective instruments should be replaced. However, the serviceman is cautioned to be sure the trouble is in the bomb release interval control and not in some allied piece of equipment.

4. LUBRICATION.- No field lubrication is required. The lubricant applied by the manufacturer is sufficient to last the life of the instrument. Any additional lubrication might impair its operation at extremely high or low temperatures and should not be attempted.

(b) RACK SELECTOR RELAYS.

1. DESCRIPTION.- Four interconnected bomb rack selector relays are located at the bombardier's station. Their function is to distribute electrical impulses from the inter val control among the eight bomb group cir- cuits (one to each bomb bay) so that bombs wi be released in a sequence resulting in a minimum unbalanced condition of the airplane.

2. OPERATION.- In a normal release of bombs in which all of the group selector switches are "ON," the relays transfer impulses from one rack to another in a general sequence resulting in a "LAYER" release of the bombs in which the lower bombs are dropped from each rack first, then the next higher layer, etc. The normal sequence in which bombs are dropped from the bomb bays is: (1) Bay #1, (2) Bay #8, (3) Bay #2, (4) Bay #7, (5) Bay #3, (6) Bay #6, (7) Bay #4, and (8) Bay #5. The bomb release sequence will repeat itself as long as impulses are received from the interval control. If several trains of bombs are dropped, each will take up in the release sequence where the last one left off, as long as the bomb bay doors remain open and the bomb selector switches are on. If all of the bomb bay doors are closed and then reopened or the bomb selector switches are all thrown "OFF" momentarily, the next release sequence will start with bay #1. If for any reason any of the group selector switches are left "OFF" (or any of the bomb bay doors are left closed), the racks controlled by those switches will be omitted from the sequence without omitting any bombs from the train as the impulses will be transferred to the next rack without pause.

3. TROUBLE SHOOTING.

TROUBLE	PROBABLE CAUSE	REMEDY
Erratic operation.	Dirty contact points.	Remove relay. Remove cover. Clean contact points with carbon tetrachloride. Replace cover. Replace relay.
Complete failure to operate.	Loose internal wire or wires.	Remove the cover and solder the connection.
	Burned out relay coil or broken part.	Replace with new unit.

NOTE

Any part that is broken, bent, or defective is considered sufficient cause for replacement of the entire unit.

4. LUBRICATION.- No lubrication of any sort is required for the life of the unit.

(c) BOMB RACK RELEASE.

1. DESCRIPTION.- The bomb rack release type A-4 is an electrically operated, mechanical device designed to arm and release bombs from their racks. The release consists of an arming lever, a release lever, a rotary solenoid for tripping the two levers, a solenoid for salvo bombing (dropping the bombs without arming them), a releasing arm and an arming arm, a transfer switch combined with an indicator light switch plus a switch operating arm, a shock plate, a trip screw, and a three-prong electrical connector. The unit is made in left and right hand assemblies to accommodate bombs on both sides of the rack. The arming lever and the release lever are pivoted on the outside of the front of the case. (See figure 8.) The forks of the two levers engage the two levers on the bomb shackle; one to arm the bomb and the other to release it. The bomb rack release should be mounted so that the arrow on the front of the case points to the front of the airplane.

NOTE

Leave the bomb group selector switches "OFF" when installing bombs to avoid releasing a bomb prematurely.

2. OPERATION.- An impulse of current from the rack selectors to the rotary solenoid trips the levers; first the release lever, then the arming lever. At the termination of the impulse the circuit to the indicator light and to the salvo solenoid is broken, and the wire which carried the incoming impulse is automatically transferred by a switch to a circuit leading to the next station. This transfer cannot be made as long as the solenoid is energized.

NOTE

If rated voltage is applied to the solenoid continuously for a period of 30 seconds or longer, damage will probably result.

If the release is not cocked, the electrical impulse passes through the switch to the next station without energizing the solenoid. The trip screw (slotted) is located on the front of the case near the top center. It permits manual operation of the rotary solenoid to trip the two levers. By turning the trip screw in the indicated direction with a screw driver the levers are tripped and the

ITEM	DESCRIPTION	LOCATION
1	D.C. DISTRIBUTION PANEL	ENGINEER'S STATION
2	EMERGENCY RELEASE SWITCH	SWITCH PANEL-EMERGENCY DOOR
3	INDICATOR LIGHT	SWITCH PANEL EMERGENCY DOOR
4	SWITCH PANEL-EMER. DOOR	CREW NAC. CENTER SECTION
5	BOMB BAY DOOR CLOSE MOTOR	BOMB BAY NO.4-FORWARD
6	RELAY PANEL	BOMB BAY NO.4 FORWARD
7	B.B.NO.4 DOOR OPEN LIMIT SW	BOMB BAY NO.4-AFT
8	RELAY PANEL	BOMB BAY NO.4-AFT
9	BOMB BAY DOOR OPEN MOTOR	BOMB BAY NO.4-AFT

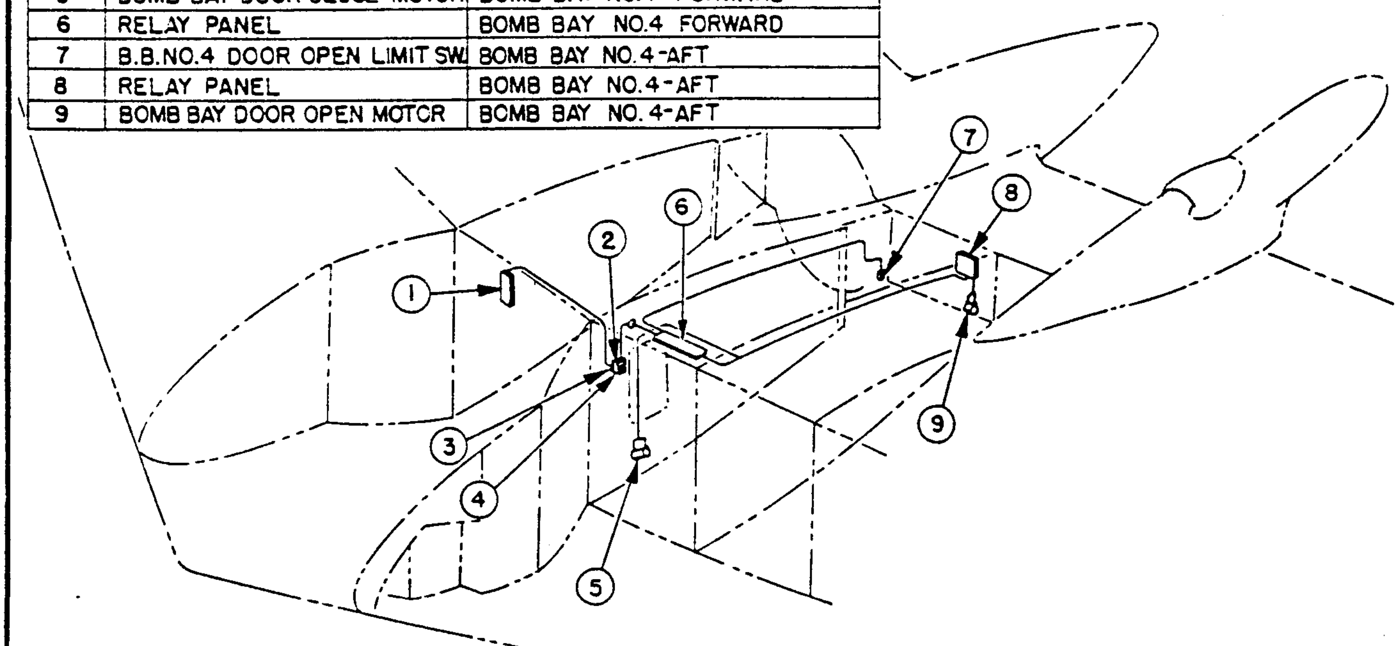


Figure 9. Bomb Bay No. 4 Door and Salvo Control

mechanism placed in the same position as though an electrical impulse had been used. This will permit manual tripping of a release in case one has been cocked by mistake.

NOTE

If release is tripped manually, the trip screw should always be returned to its original position or it will be impossible to cock the release.

When the salvo solenoid is energized simultaneously with the release (rotary) solenoid, the release lever is tripped but the arming lever is held in the cocked position by the plunger of the salvo solenoid, blocking further movement of the release solenoid. This means the bombs are dropped unarmed.

NOTE

After salvo operation, do not attempt to trip the arming lever by means of the trip screw on the front of the release. First cock the release lever and then trip both levers by means of the trip screw.

The hinged ear on the releasing lever permits releasing of the bomb during flight by prying over the bomb shackle lever with a screw driver or similar tool, in case there is failure due to gunfire or otherwise. In the XB-35 airplane, however, only bomb bay #4 is accessible from the crew nacelle in flight. To cock the release preparatory to loading the bombs, pull outward on both levers with sufficient force to overcome the springs and to make the engagement with the stud of the rotary solenoid. The arming lever has to be cocked before the release lever can be cocked.

3. REMOVAL.

a. Remove safety wires from mounting screws.

b. Remove 501A-416-12 mounting screws (2).

c. Remove unit.

4. INSTALLATION.

a. Care must be exercised to insure installing the releases at the correct stations in the rack for the bomb load desired.

b. Place the release against the rack, matching the holes in the case with those in the rack. Insert the two screws, part No. 501A-416-12, and tighten them to hold the release rigidly. The electrical connections are made automatically between the electrical connector on the back of the case and the receptacle on the rack.

c. Safety wire the screws, running the wire through the hole in the head of the screw then through the hole in the flange stiffener.

5. MAINTENANCE.- Check the releases externally for cleanliness, removing any dirt with a clean dry cloth. Kerosene or other cleaning fluids are injurious to the solenoids and should not be used. Corrosion or dirt on the electrical connector or its three prongs should be removed with emery cloth. Releases found to be faulty or in questionable condition should be replaced.

6. LUBRICATION.- The release is designed to operate without periodic lubrication. It must be kept free of oil, dirt, and other foreign matter. It is sealed against dirt and moisture.

f. EMERGENCY (SALVO) RELEASE.

(1) DESCRIPTION.- The bombs may be dropped in salvo to lighten the load of the airplane during an emergency. The salvo circuit is activated by either the pilot's, the bombardier's, or the salvo switch in the crew's quarters. Closing a salvo switch causes all of the bomb bay doors to open together and also partially closes the bomb release circuit. To prevent release of bombs before a door is completely open, a safety switch, contacted by the door at the full open position, completes the release circuit. The bombs will always drop with tail fuses safe.

(2) ELECTRICAL.- Closing a salvo switch closes a circuit to the indicator light relay. When energized, the indicator light relay allows current to flow into two systems. One system feeds energy to the salvo locking solenoid of the A-4 bomb-rack releases by way of the indicator light switch (in "OFF" position) and the indicator light circuit, bypassing the indicator lights. At the same time, the indicator light relay sends current as far as the bomb door safety switches. When the doors have opened completely, they contact the safety switches and complete the circuit to the salvo relays. Closing the salvo relays directs a flow of current from the salvo switches to the rotary release solenoids of the A-4 releases. The salvo locking solenoids are energized before the rotary release solenoids, thereby insuring that the plunger of the salvo locking solenoid will be extended and will prevent complete rotation of the releasing solenoids. The bombs will thus be released with the arming lever not tripped and the tail fuses unarmed.

(3) MAINTENANCE.- Replace any unit that fails to operate correctly.

(4) LUBRICATION.- No lubrication of the relays is necessary.

g. BOMB BAY #4 EMERGENCY SALVO. (See figure 9.)

(1) DESCRIPTION.- To facilitate the emergency exit of the crew through bomb bay #4, a switch located near the hatch between the crew nacelle and the bomb bay is used to open the bomb door and salvo the bombs. Operation of the release system for bomb bay #4 alone is similar to the normal salvo release from all of the bomb bays.

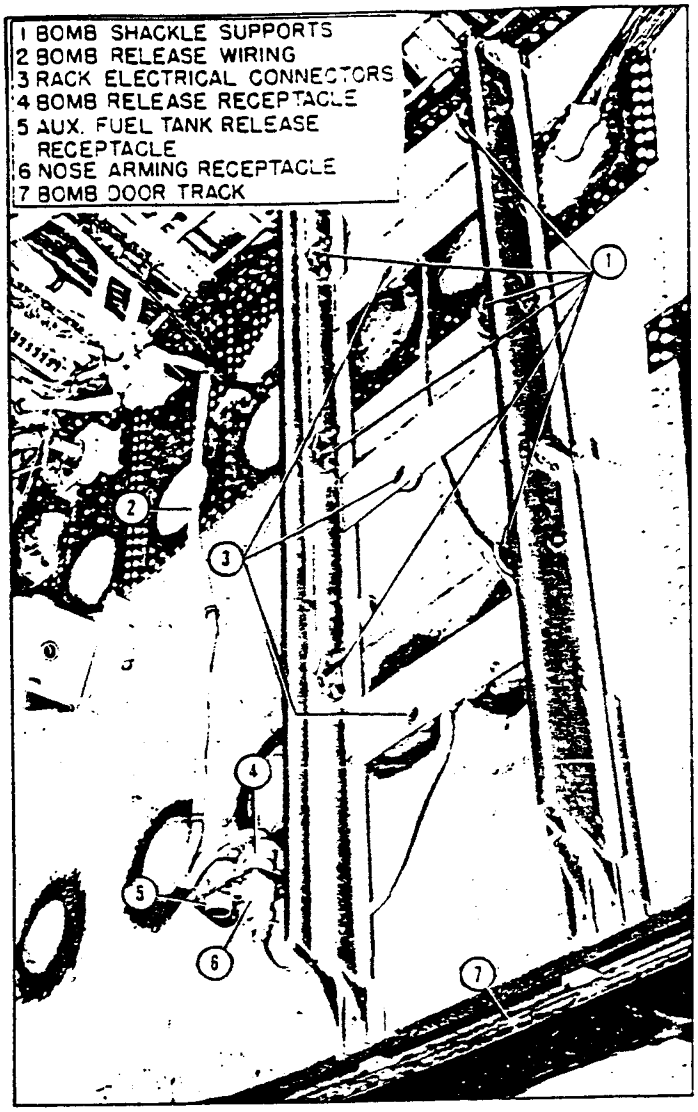


Figure 10. Bomb Rack Installation - Typical

(2) ELECTRICAL.- Closing the bomb bay #4 emergency release switch sends 28 volt d.c. through two circuits. To open the door, current from the switch passes through the normally closed side of a two-way safety switch to the door open relays of bomb bay #4. At the same time, current passes through the indicator light switch (in "OFF" position) through the indicator light system to operate the salvo locking solenoids of the A-4 bomb rack releases. As the door reaches the full open position, it contacts the safety switch and diverts the current from the door relays to the emergency salvo relay stopping the door motor and closing the emergency salvo relay. From the salvo relay, current goes directly to the rotary release solenoids of the A-4 releases allowing the bombs to be dropped. As the locking solenoids of the A-4 release are activated, simultaneously with the opening of the door, and the release does not take place until the doors are completely open, the delay between the two operations insures that the plunger of the locking solenoid will engage the rotary release solenoid and, by preventing complete rotation, allow the bombs to drop with tail fuses safe.

(3) MAINTENANCE.- Replace any unit that fails to operate correctly.

h. BOMB RACKS. (See figure 10.)

(1) DESCRIPTION.- XB-35 airplane (AAF 42-13603) is designed to carry ten 500 pound bombs in each of its eight bomb bays. As this is an experimental airplane, the inboard bomb bays will ordinarily be filled with special equipment making them of no use for carrying bombs. Since 500 pound bombs are the only type for which the airplane is designed, the bomb rails, brackets, etc., ordinarily removable from an airplane, are to be left installed and should not be removed except in case of damage. Attached to each side of each bomb bay are two pairs of bomb rails. The forward pairs support three bombs each and the aft pairs two. Each pair of rails is different from the others and, in case of removal, care should be taken that each pair is replaced in its proper position. Hooks on the rails fasten to the bomb shackles which are attached to the bombs prior to hoisting. The release panels mounted between the rails are used to support the bomb rack releases and contain the electrical receptacles for the releases.

(2) REMOVAL:

(a) Remove the screws holding the release panels in place between the bomb rails.

(b) Remove the panels complete with the release receptacles.

(c) To disconnect the receptacles from the panels, unfasten the four screws holding each in place.

(d) Remove the three bolts at the bottom of each rail.

(e) Remove the rail by moving down slightly so that the heads of the anchor bolts clear the anchor slots.

(3) INSTALLATION.

(a) Put each rail in place by engaging the anchor bolts in the anchor slots and pushing upward.

(b) Tighten the three bolts at the bottom of the rail.

(c) Install the release receptacles on the bomb rail panels with the four screws required.

(d) Install the panels between the rails and tighten the screws to hold them in place.

(4) BOMB SHACKLES.- Type B-7 bomb shackles are hung from hooks bolted to the bomb rails. When loading bombs, the shackle and bomb must be hoisted as a unit. The word "FRONT" appearing on all shackles denotes the position in

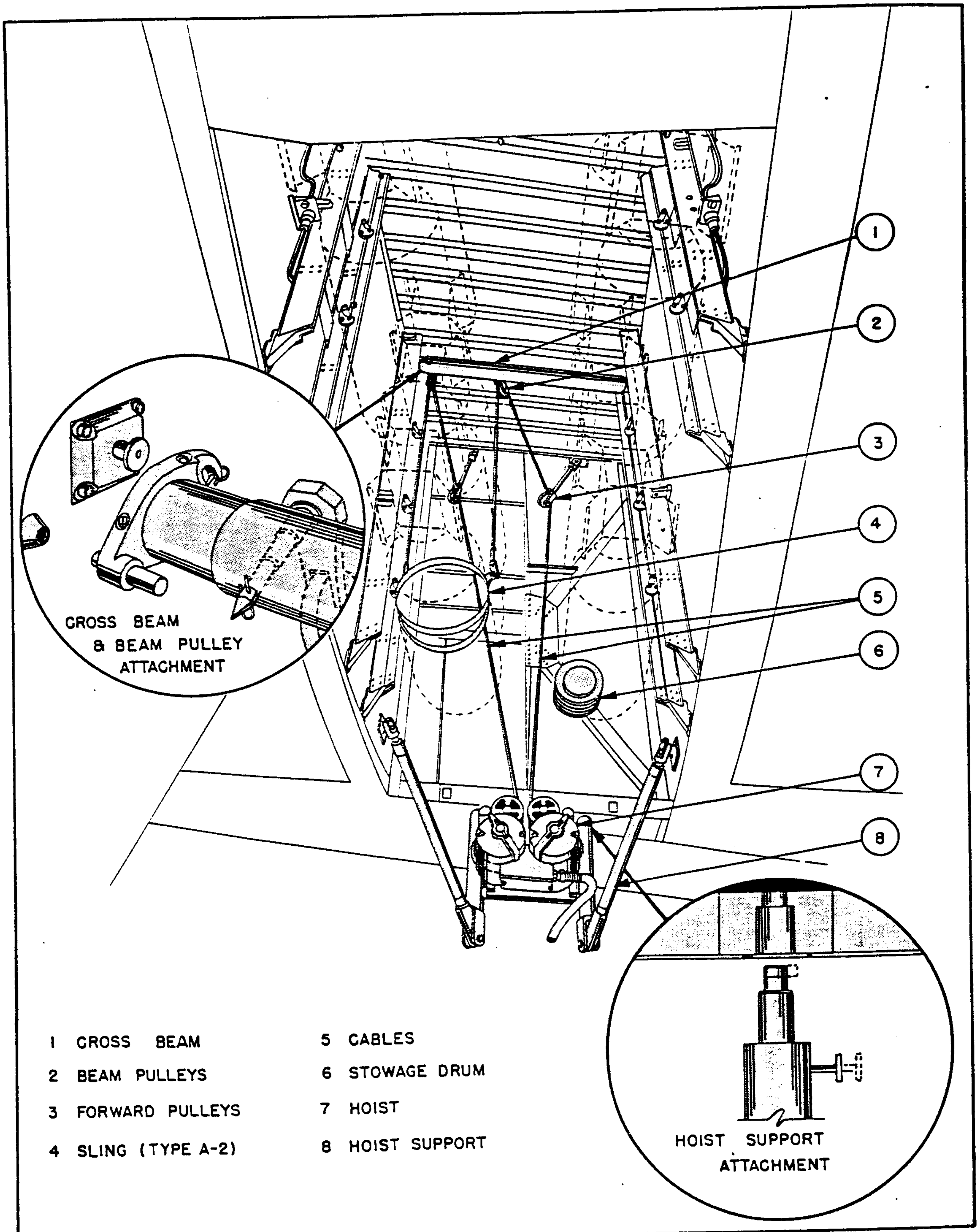


Figure 11. Bomb Hoisting Diagram

relation to the airplane. The two arms on the shackle engage the levers on the type A-4 bomb rack releases. One of the arms when tripped releases the bomb, and the other retains the arming wire so that the bomb will drop armed. If the bomb is salvoed, the arming lever will not be tripped, and the arming wire will drop with the bomb, making it safe.

i. BOMB HOISTING. (See figure 11.)- Two bomb hoist assemblies are furnished with the airplane. Each consists of a hoisting motor assembly, motor support, cross beam with pulleys, and a sling. Cables and pulleys in each bomb bay are used to complete the hoist mechanism.

(1) HOISTING MOTOR ASSEMBLY.

(a) DESCRIPTION.- The motor assembly is made up of a type C-6 bomb hoist and a mounting plate. The C-6 hoist contains two motors and cable drums, each of which controls the cable to one side of the bomb sling. Push-button controls for each motor allow the hoist control man to prevent rolling of the bomb during raising while permitting controlled rolling when hooking the shackle to the rail. Emergency cranks may be used when power is not available.

(b) MOUNTING.- The hoist is mounted after the hoist support has been installed on the airplane.

1. Place the bottom U channel of the mounting plate over the bottom rung of the hoist support.

2. Rotate the hoist about the lower rung until the upper U channel fits over the upper rung of the hoist support.

3. Insert the groove pin through the upper channel and rung.

4. Insert the groove pins through the lower channel and rung.

5. Connect the bomb hoist cables to the drums of the hoist motor.

(2) BOMB HOIST SUPPORT.

(a) DESCRIPTION.- The bomb hoist support, made of welded steel tubing, is connected to the outside of the wing just in front of and below the bomb bay. Two of the four connect points are inside the bomb bay on each side and the other two are recessed behind small access doors on the outside.

(b) MOUNTING.

1. Insert swivel pins in the mounting fittings on each side of bomb bay.

2. Rotate groove pins at least 90° to either side of slot. This locks the swivel pins in place.

3. Insert ends of main supports in the recessed connect points just forward of the bomb bay on the outside. It is necessary that the locking knobs be pulled out and held when the ends are pushed into place.

(3) SLINGS.- The type A-2 bomb hoist sling consists of a double-width chain and two attachment fittings. The automatic tightening feature of the fittings makes slippage of the bomb from the sling nearly impossible.

(4) BOMB HOIST CROSS BEAM.

(a) DESCRIPTION.- The cross beam is a telescopic tubular steel beam designed to support the hoist pulleys directly above the racks. Holes in the beam enable the pulleys to be positioned correctly. The telescopic feature is to aid installation.

(b) INSTALLATION.

1. Insert the pins at each end of the beam into the brackets above the racks.

2. Rotate the beam about the pins until the hooks on the beam catch on the anchor bolts.

3. Safety the beam by inserting the locking pins through the hook.

(5) MAINTENANCE.- The bomb hoist assemblies should be kept clean, dry, and lubricated in accordance with the following instructions:

(a) Before storing remove all dirt from the sling with kerosene Federal Specification VV-K-211.

(b) The cables should be cleaned with kerosene, Federal Specification No. VV-K-211.

(c) The metal parts of the hoist, hoist supports, and beam should be kept free from rust at all times.

(6) REPLACEMENTS.- The bomb hoist cable should be replaced when failure of one strand is noted or when kinking has caused a permanent bend in all strands.

23. INSTRUMENTS

23. INSTRUMENT SECTION.

a. GENERAL.

(1) DESCRIPTION.- The following instrument panels are provided in the airplane; the pilots' instrument panel, and pedestal panel, the navigator's instrument panel, and the engineer's instrument panels. All dial markings are fluorescent and are luminous at night. Oxygen instruments are installed at all crew stations. See Section IV, paragraph 19. For hydraulic instruments, see Section IV, paragraph 16.

(2) OPERATION.- With the exception of the clocks and magnetic compasses all instruments are actuated either by fluid or air pressure or electrical impulse.

(3) SERVICE AND MAINTENANCE.- The instruments are delicate mechanisms and they should be treated like a fine watch. The removal, installation and servicing should be accomplished only by competent personnel. Instruments requiring repair work or adjusting should be replaced. Instrument markings should be maintained legible by use of fluorescent radio active luminescent material.

b. INSTRUMENT INSTALLATIONS, CREW NACELLE.

(1) MAGNETIC COMPASS AN5733-2. (See figure 4.)- The magnetic compass is mounted on a bracket attached to the airplane structure just forward of the copilot.

(2) PILOTS' INSTRUMENT PANEL. (See figure 1.)

(a) GENERAL.- The pilots' instrument panel is cushion mounted just forward of the pilots' station. It is secured by five lockpins. When the lockpins are removed the panel can be moved sufficiently aft to disconnect the fittings from the instruments. With all of the fittings detached from the instruments, the panel can be removed.

(b) INSTRUMENTS INSTALLED ON THE PILOTS' INSTRUMENT PANEL. (See figure 1.)

1. BOMB RELEASE SIGNAL LIGHT.- This indicator light is installed in the upper left corner of the pilots' instrument panel. It is an amber light and lights when bombs are released. It is actuated by the bombardier's bomb release switch.

2. PILOT DIRECTOR.- This instrument (C-24863, Type C) is located below and to the left of the bomb release signal light.

NOTE

This instrument is not installed in airplane AAF 42-13603.

3. AIR SPEED INDICATOR (PILOT'S) 94-27335 Type F-2.- This instrument is installed near the top of the instrument panel just to the right of the bomb release signal light. This instrument is actuated by rammed air pressure from the pitot tubes.

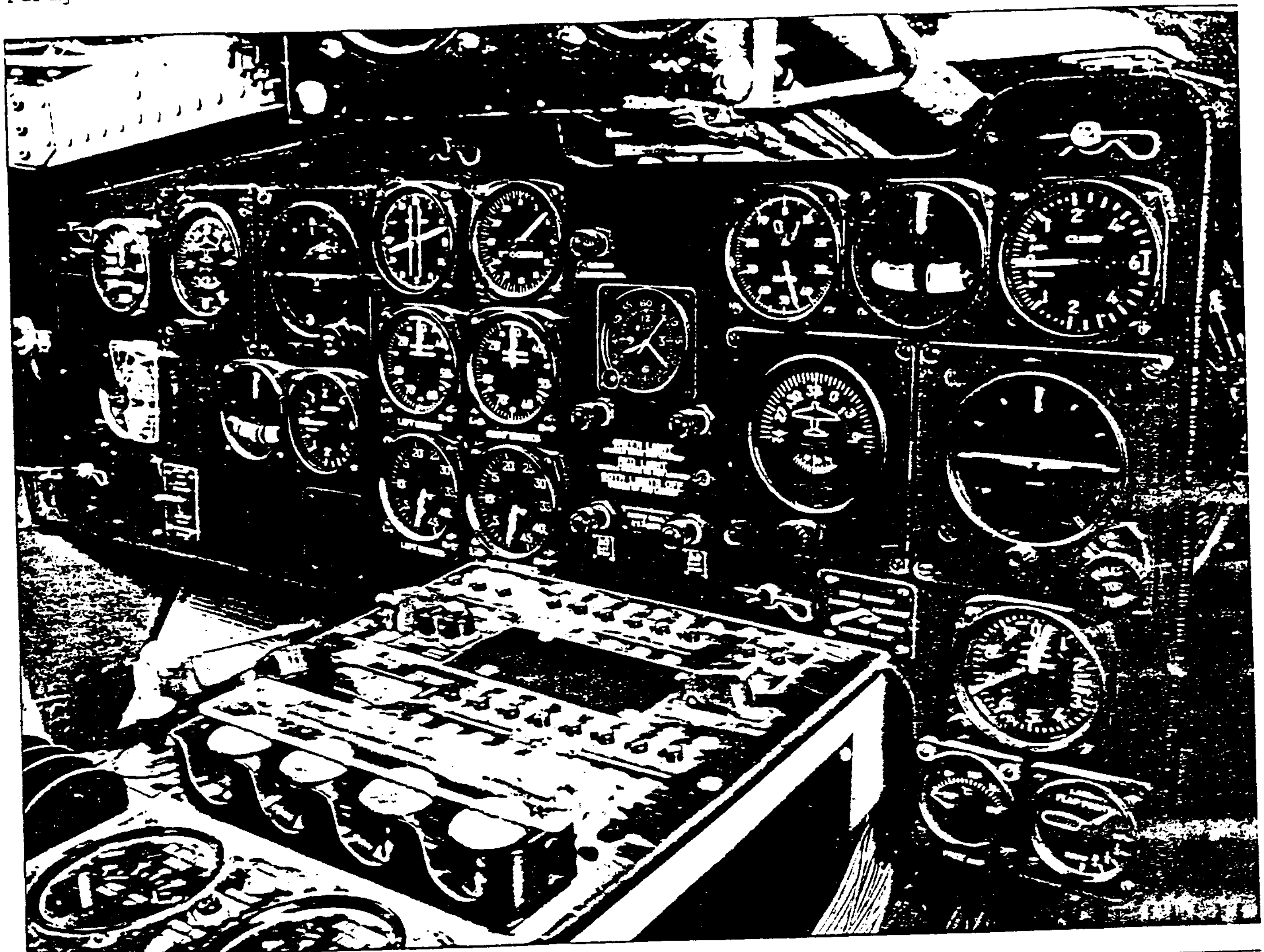
4. ALTIMETER (PILOTS') AN-GG-A-461 AN5760-2.- The pilot's instrument is installed just below the air speed indicator. An identical installation on the right side of the panel is for the copilot. These instruments are actuated by atmospheric pressure transmitted through the static lines of the pitot tubes or the static air pressure in bomb bay No. 5.

NOTE

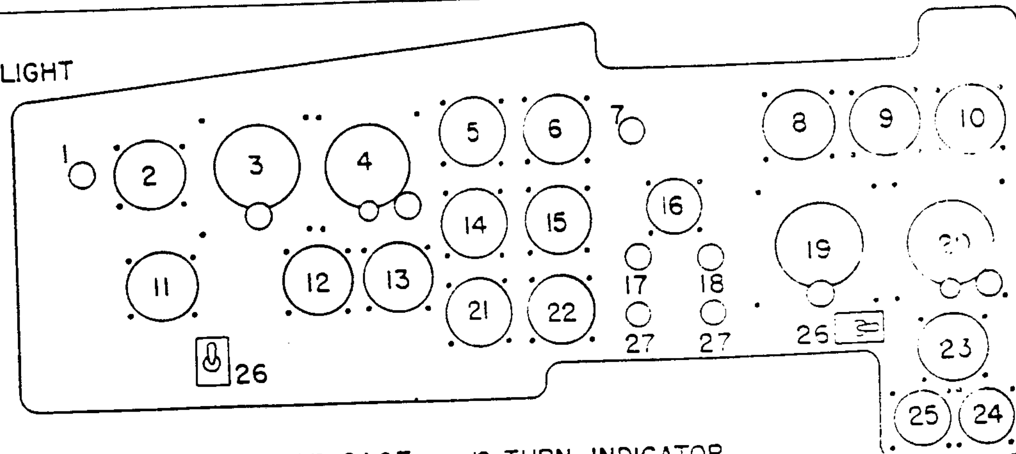
Two static-air-source selector valves are installed in the lower section of the instrument panel, one near the left edge for the pilot and one near the right edge for the copilot. These are two-way valves which offer a choice of either pitot tube or bomb bay static air pressure for the air pressure actuated instruments.

5. TURN INDICATOR (PILOT'S) 27393A Type C-1.- This instrument is installed to the right of the altimeter in the upper left section of the panel. This is a self-contained electrically driven gyroscope type instrument. Current is supplied from the 115 volt supply. It has a caging control and a cage indicator. An identical installation on the right side of the instrument panel is for the copilot.

6. FLIGHT INDICATOR (PILOT'S) 27394A Type E-1.- This instrument is installed to the right of the turn indicator. It is a self-contained electrically driven gyroscope type instrument. Current is supplied from the 115 volt a.c. supply. It is equipped with a caging control and a cage indicator. It indicates the extent of



1. BOMB RELEASE SIGNAL LIGHT
2. AIRSPEED INDICATOR
3. TURN INDICATOR
4. FLIGHT INDICATOR
5. REMOTE COMPASS INDICATOR
6. RADIO COMPASS INDICATOR
7. MARKER BEACON
8. AIRSPEED INDICATOR
9. BANK AND TURN INDICATOR
10. RATE OF CLIMB INDICATOR
11. ALTIMETER
12. BANK AND TURN INDICATOR
13. RATE OF CLIMB INDICATOR



14. MANIFOLD PRESSURE GAGE
15. MANIFOLD PRESSURE GAGE
16. CLOCK
17. GREEN LDG. GR. POSITION LOCKED DOWN
18. RED LDG. GR. POSITION RE-LEASED BUT NOT LOCKED
19. TURN INDICATOR
20. FLIGHT INDICATOR
21. TACHOMETER
22. TACHOMETER
23. ALTIMETER
24. FLAP POSITION INDICATOR
25. THERMOMETER
26. STATIC SELECTOR VALVE
27. SLOT DOOR INDICATOR LIGHTS

Figure 1. Pilots' Instrument Panel

the movement of the airplane relative to the lateral axis, and the fore and aft axis. There is an identical installation for the copilot on the right side of the instrument panel.

7. BANK AND TURN INDICATOR (PILOT'S) 94-27337 Type C-1.- This instrument is installed below the pilot's flight indicator. It is a self-contained electrically driven gyroscopic instrument supplied with 28 volt d.c. An identical installation for the copilot is on the right side of the instrument panel.

8. RATE OF CLIMB INDICATOR AN-GG-I-518 AN5825-3.- This instrument is installed just to the right of the bank and turn indicator. It is actuated by atmospheric pressure from the static tube. An identical installation for the copilot is on the right side of the instrument panel.

9. LOCALIZER.- Not installed in airplane number AAF 42-13603.

10. REMOTE GYRO COMPASS INDICATOR AN5730-6.- This instrument is installed at the top near the center of the instrument panel. The remote compass indicator is a repeater indicator actuated by the master gyro compass indicator installed on the navigator's instrument panel.

11. RADIO COMPASS INDICATOR AAF H41D7019.- This instrument is installed to the right of the gyro compass indicator. It is an autosyn driven instrument actuated by the autosyn transmitter in the radio compass loop assembly. See Section IV, paragraph 18.

12. MANIFOLD PRESSURE GAGES AN-G-9, AN5770-2A-34, AN5770-2A-12.- Two dual reading instruments are installed directly below the gyro and radio compass indicators on the pilots' instrument panel. The manifold pressure gages are of the absolute pressure type.

13. ENGINE TACHOMETER AN5530-2.- Two dual-indicating tachometers are installed directly below the two manifold pressure gages on the pilots' instrument panel. These instruments are actuated by tachometer generators, AN5531-1, installed on the engine accessory cases.

14. CLOCK AN-C-99, AN5743-1.- An eight-day spring-actuated clock is installed to the right of the manifold pressure gages.

15. MARKER BEACON RADIO SIGNAL LIGHT AAF 44A18454-4.- This light is installed just to the right of the radio compass dial. It is actuated by a relay in the marker beacon radio set. See Section IV, paragraph 18.

16. LANDING GEAR POSITION SIGNAL LIGHTS AAF 44A18454-2 and -3.- These lights are installed just below the clock. The red light is on the right and indicates the landing gear moving or not locked. The green light is on the left and indicates the landing gear is down and locked.

17. WING SLOT POSITION SIGNAL LIGHTS LH AND RH AAF 44A18454-4.- These indicator lights are near the bottom of the instrument panel directly below the landing gear position lights. The wing slot door position indicator lights are amber color and, when lighted, indicate the wing slot to be open. They are actuated by switches controlled by the wing slot mechanism.

18. AIR SPEED INDICATOR 27916-B Type F-1A (COPILOT).- This instrument is at th top of the instrument panel to the right of th marker beacon indicator light. It functions the same as the pilot's air speed indicator. (See Section IV, paragraph 3 preceding.

19. BANK AND TURN INDICATOR 94-27337 Type C-1 (COPILOT).- This instrument is installed to the right of the copilot's air speed indicator. It functions the same as the pilot's bank and turn indicator. (See Section IV, paragraph 7 preceding.)

20. RATE OF CLIMB INDICATOR AN-GG-I-518, AN5825-3 (COPILOT).- This instrument is installed to the right of the copilot' bank and turn indicator. It functions the same as the pilot's rate of climb indicator. (See Section IV, paragraph 8 preceding.)

21. TURN INDICATOR 27393 Type C-1 (COPILOT).- This instrument is installed just below the copilot's air speed indicator. It functions the same as the pilot's turn indicator. (See Section IV, paragraph 5 preceding.)

22. FLIGHT INDICATOR 27394-A Type E-1 (COPILOT).- This instrument is installed t the right of the copilot's turn indicator. It functions the same as the pilot's flight indicator. See Section IV, paragraph 6 preceding.

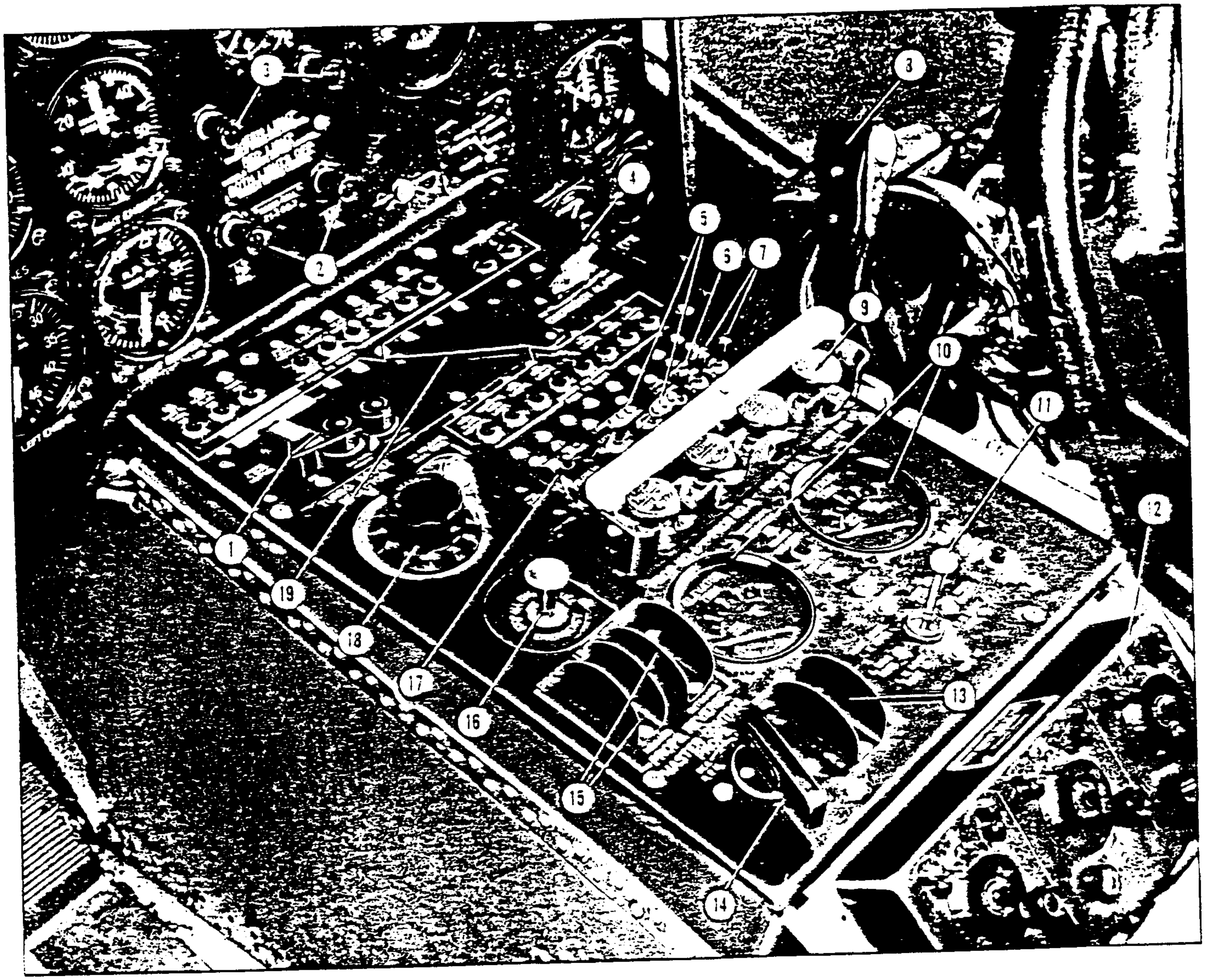
23. FLAP POSITION INDICATOR GE 8DJ11 PFC.- This instrument is installed at the extreme right and bottom of the instrument panel. It is actuated by a transmitter mechanically linked to the right hand flap, operated by 28 volt d.c.

24. THERMOMETER AN-GG-I-522, AN5790-6. This instrument is installed to the left of the flap position indicator. It is a free-air temperature indicator actuated by an electrical resistance bulb on the exterior wing surface.

c. REMOVAL AND INSTALLATION.

(1) INSTRUMENTS.- To remove any of the instruments from the pilots' instrument panel, remove the attaching screws securing the instrument to the panel. The screws are accessible from the rim of the instrument face. Lift the instrument out of the panel far enough to disconnect the fittings from the back of the instrument. Tag and cap all fittings and remove the instrument. After removal, protect the instrument from any possible damage. To install the instrument, reverse the removal procedure.

(2) INSTRUMENT PANEL.- To remove the instrument panel, remove the five lockpins



1. EMERGENCY ELEVON CONTROL SWITCH AND LIMIT LIGHTS
2. WING SLOT DOOR INDICATOR LIGHTS
3. LANDING GEAR INDICATOR LIGHTS
4. EMERGENCY ALARM BELL SWITCH
5. LANDING LIGHT CONTROL SWITCHES
6. FORMATION LIGHT SWITCH (not in use)
7. POSITION LIGHT SWITCHES
8. CO-PILOT'S CONTROL COLUMN
9. PROPELLER FEATHERING CONTROL BUTTONS
10. TRIM FLAP POSITION INDICATORS
11. TRIM FLAP CONTROL SWITCH
12. COMMAND RADIO RECEIVER CONTROLS
13. ENGINEER'S PROPELLER DISCONNECT SWITCH
14. PILOT'S MASTER PROPELLER CONTROL
15. PROPELLER REVERSING SWITCHES
16. EMERGENCY BATTERY AND IGNITION SHUT-OFF
17. WING SLOT DOOR CONTROL SWITCH
18. PILOT'S TURBO CONTROL
19. "PUSH" TYPE CIRCUIT BREAKERS

Figure 2. Pedestal Panel

securing the panel. (See figure 1.) Move the panel far enough aft to disconnect the fittings and wiring from the back of the panel. Tag all fittings as removed to facilitate reinstallation. Detach the grounding jumper. To install the panel reverse the removal procedure.

(3) PEDESTAL INSTRUMENT PANEL. (See figure 2.)

(a) GENERAL.- The pedestal panel is situated between the pilot and the copilot. It is necessary to raise the panel to remove the instruments.

(b) INSTRUMENTS AND LIGHTS.- Two trim flap position indicators and two emergency elevon load limit lights are installed on the pedestal panel.

1. AILERON TRIM FLAP POSITION INDICATOR 8DJ17ABL. (See figure 3.)- This instrument is installed near the aft end of the pedestal instrument panel just above the trim flap control switch. The instrument is actuated by a transmitter using 28 volt d.c. The transmitter is mechanically connected to the trim flap.

2. ELEVATOR TRIM FLAP POSITION INDICATOR 8DJ17ABM. (See figure 3.)- This instrument is installed to the left of the aileron trim flap position indicator and is similar in operation.

(4) NAVIGATOR'S INSTRUMENT PANEL (See figure 5.)

(a) GENERAL.- The navigator's instrument panel is installed on the crew nacelle wall just above the table. All instruments are installed from the face of the panel.

(b) INSTRUMENTS.

1. GYRO COMPASS MASTER INDICATOR AN5752-1.- The indicator operates on the 115 volt a.c. and is actuated by the gyro compass transmitter in the left wing. (See figure 6.) The gyro compass caging switch box is mounted on the bulkhead at table top level below the left lower corner of the instrument panel. The caging warning light and the caging toggle switch are mounted on this box. The warning light is red, and lights when the gyro is in the caged position. The caging motor is installed in the left wing approximately 65" inboard from the compass transmitter installation, which is installed at wing station 1015 just forward of the aft spar.

2. ALTIMETER AN5760-2.- This instrument is below and to the left of the gyro compass master indicator. The altimeter is actuated by the external air pressure in the pitot static tube.

3. AIR SPEED INDICATOR Type F-1 Specification 94-27916-A.- This instrument is installed to the right of the altimeter. It is actuated by the rammed air of the pitot tube.

4. FREE AIR THERMOMETER AN5790-6.- This instrument is just below the navigator's altimeter. It is actuated by an electrical resistance bulb operated by 28 volt d.c.

5. CLOCK AN5743-1.- An eight day clock is located to the right of the thermometer.

6. RADIO COMPASS INDICATOR. AAF H41D7020.- The radio compass indicator is installed in the lower right corner of the navigator's instrument panel. The indicator is an autosyn actuated instrument driven by the autosyn transmitter in the radio compass loop assembly. (See Section IV, paragraph 18.)

(c) REMOVAL AND INSTALLATION.

1. To remove any instrument from the navigator's instrument panel, remove

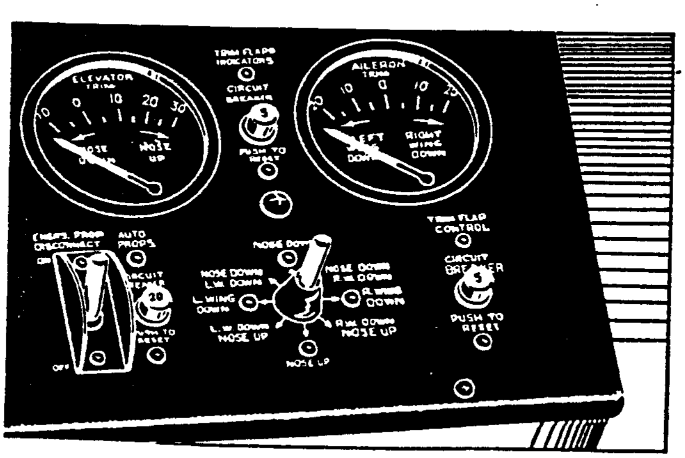


Figure 3. Trim Flap Controls

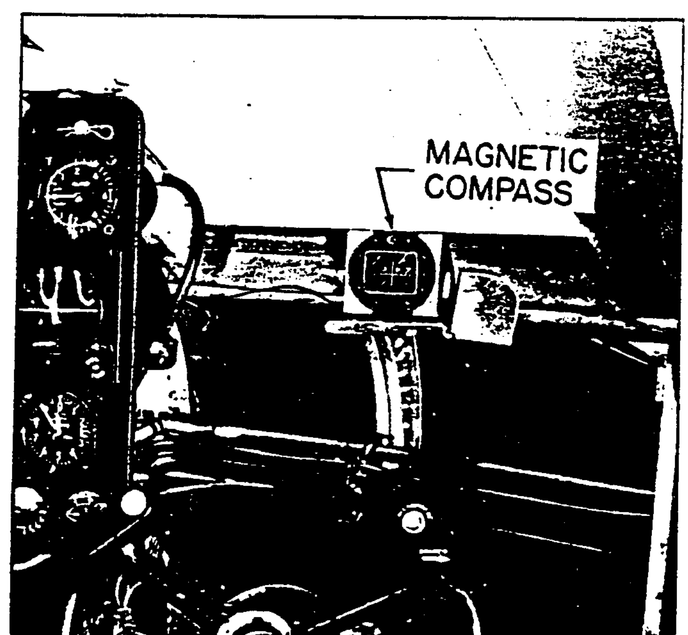


Figure 4. Magnetic Compass

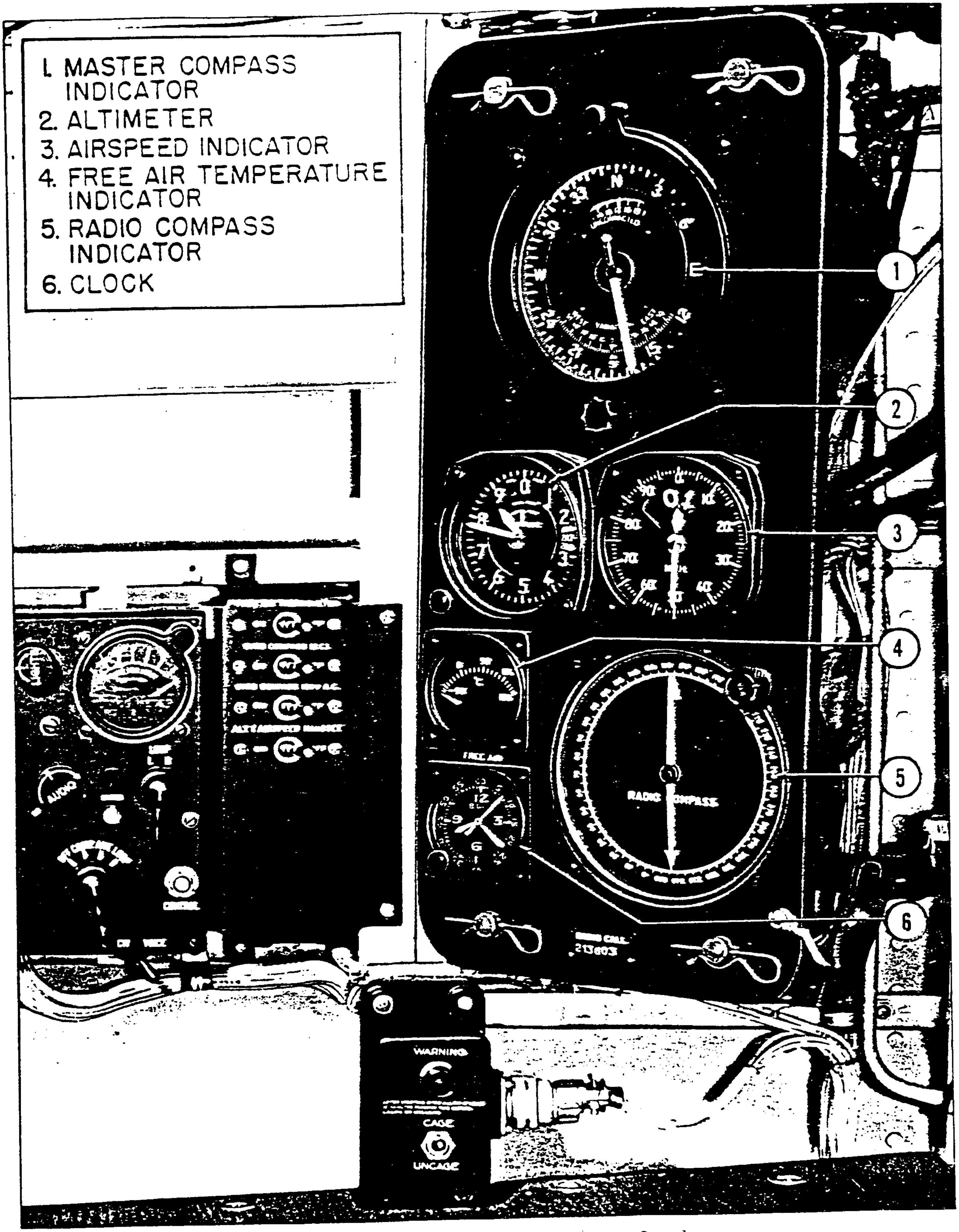
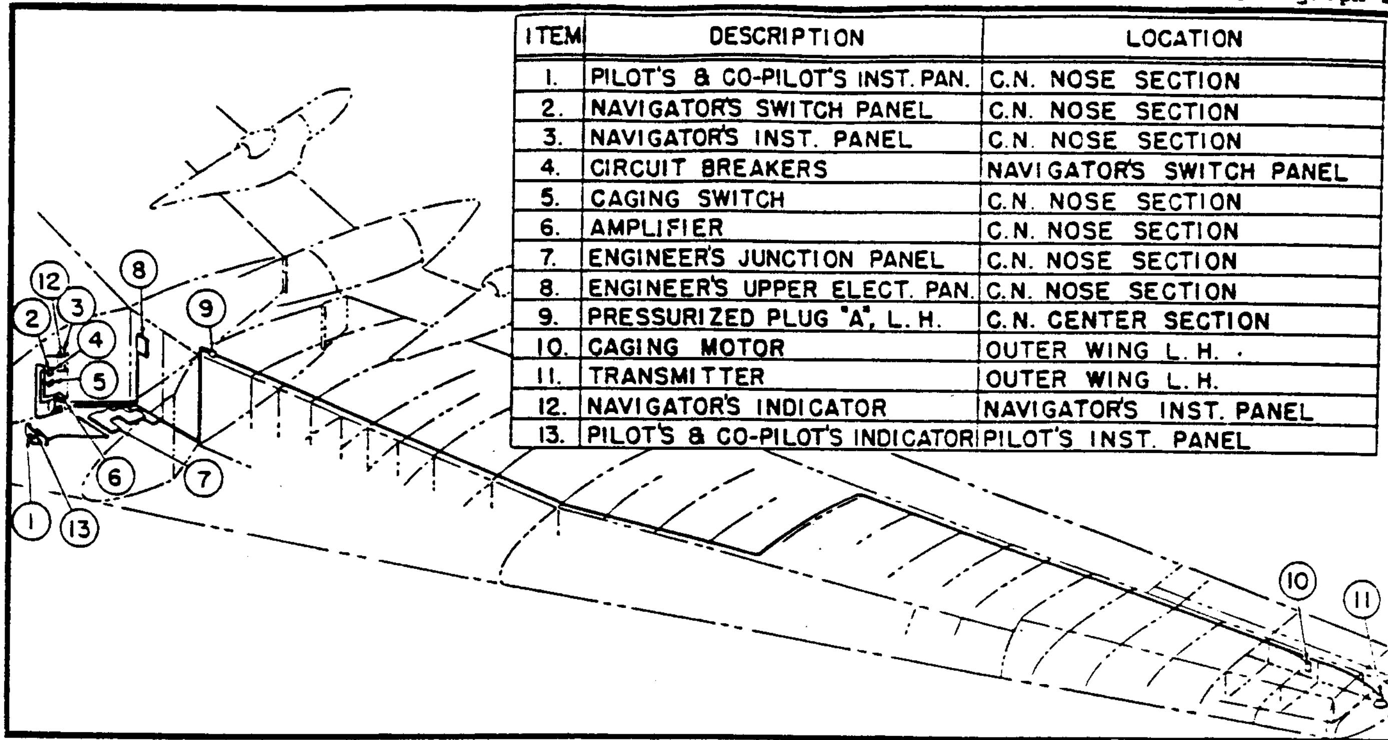


Figure 5. Navigator's Instrument Panel



ITEM	DESCRIPTION	LOCATION
1.	PILOT'S & CO-PILOT'S INST. PAN.	C.N. NOSE SECTION
2.	NAVIGATOR'S SWITCH PANEL	C.N. NOSE SECTION
3.	NAVIGATOR'S INST. PANEL	C.N. NOSE SECTION
4.	CIRCUIT BREAKERS	NAVIGATOR'S SWITCH PANEL
5.	CAGING SWITCH	C.N. NOSE SECTION
6.	AMPLIFIER	C.N. NOSE SECTION
7.	ENGINEER'S JUNCTION PANEL	C.N. NOSE SECTION
8.	ENGINEER'S UPPER ELECT. PAN.	C.N. NOSE SECTION
9.	PRESSURIZED PLUG "A", L. H.	C.N. CENTER SECTION
10.	CAGING MOTOR	OUTER WING L. H.
11.	TRANSMITTER	OUTER WING L. H.
12.	NAVIGATOR'S INDICATOR	NAVIGATOR'S INST. PANEL
13.	PILOT'S & CO-PILOT'S INDICATOR	PILOT'S INST. PANEL

Figure 6. Gyro Compass Electrical Circuit

the attaching screws securing the instrument to the panel face. Lift the instrument out of the panel far enough to disconnect the fittings from the back of the instrument and remove the instrument. Tag and cap all fittings removed. Protect the instrument against jarring or other damage To install the instrument reverse the removal procedure.

2. To remove the instrument panel, remove the four lockpins securing the panel to the mount. Move the panel out sufficiently to disconnect all fittings. Tag all fittings as removed. Detach grounding jumper.

(5) ENGINEER'S INSTRUMENT PANELS. (See figure 7.)

(a) AUXILIARY POWER SUPPLY PANEL 556593. (See figure 8.)

1. CYCLE METER K-1015947-23.- This instrument is in the lower left section of the auxiliary power plant panel. A switch near the center of the panel makes the frequency meter available for use with either power unit.

2. D.C. AMMETERS AN3201A300.- Two ammeters are installed near the top of the panel for the motor generators which supply 24 volt d.c.

3. TACHOMETER AN5530-2.- This instrument is close to the center of the panel. It is a dual type and gives the rpm of both power units. The instrument is activated by tachometer generators operated by the auxiliary units.

4. A.C. AMMETERS K-1015619-14.- An alternating current ampere meter is provided for each A.P.U. These meters are at the top of the panel on the right side.

5. WATTMETERS K-1015947-14.- A wattmeter for each auxiliary power unit is provided just below the ammeters.

6. A.C. VOLTMETER K-1015619-14. An alternating current voltmeter is installed in the lower right section of the panel. The same selector switch used for the cyclemeter makes the a.c. voltmeter available to either power unit.

(b) ENGINEER'S INSTRUMENT PANEL ASSEMBLY. (See figure 9.)

1. ALTIMETER AN5761-1.- The altimeter is the first instrument in the second row. It is actuated by exterior atmospheric pressure transmitted through the static lines.

2. RATE OF CLIMB INDICATOR AN5825-3.- This indicator is the first instrument in the third row. It is actuated by static air pressure. In conjunction with slowly neutralized back pressure.

3. FREE AIR THERMOMETER AN5790-6.- The thermometer is the first instrument in the fourth row. It is actuated by a electrical resistance thermometer bulb, AN5525-1, installed on the lower side of the wing surface.

4. OIL PRESSURE GAGE, RIGHT PROPELLER GEAR BOXES, AN5772-2A (2nd instrument in the 2nd row).- This is a dual instrument which indicates the oil pressure in the two right hand propeller gear boxes. It is actuated by pressure transmitters, AN5765-2, installed just above the gear boxes.

1. INSTRUMENT PANEL
2. A. P. U. CONTROL PANEL
3. INSTRUMENT LIGHTS
4. DOME LIGHT
5. UPPER ELECTRICAL CONTROL PANEL
6. EMERGENCY ALARM BELL
7. LOWER ELECTRICAL CONTROL PANEL
8. TURBO BOOST SELECTOR DIAL
9. INDIVIDUAL TURBO BOOST ADJUSTMENT KNOBS
10. SUIT HEATER CONTROL BOX
11. MIXTURE CONTROLS
12. THROTTLES
13. ENGINE SECTION FIRE EXTINGUISHER CONTROL PANEL
14. A. P. U. FIRE EXTINGUISHER CONTROL PANEL
15. GROUND CREW INTERPHONE SWITCH
16. HYDRAULIC PRESSURE GAGES
17. OXYGEN INSTRUMENTS
18. OXYGEN REGULATOR
19. RADIO JACK BOX

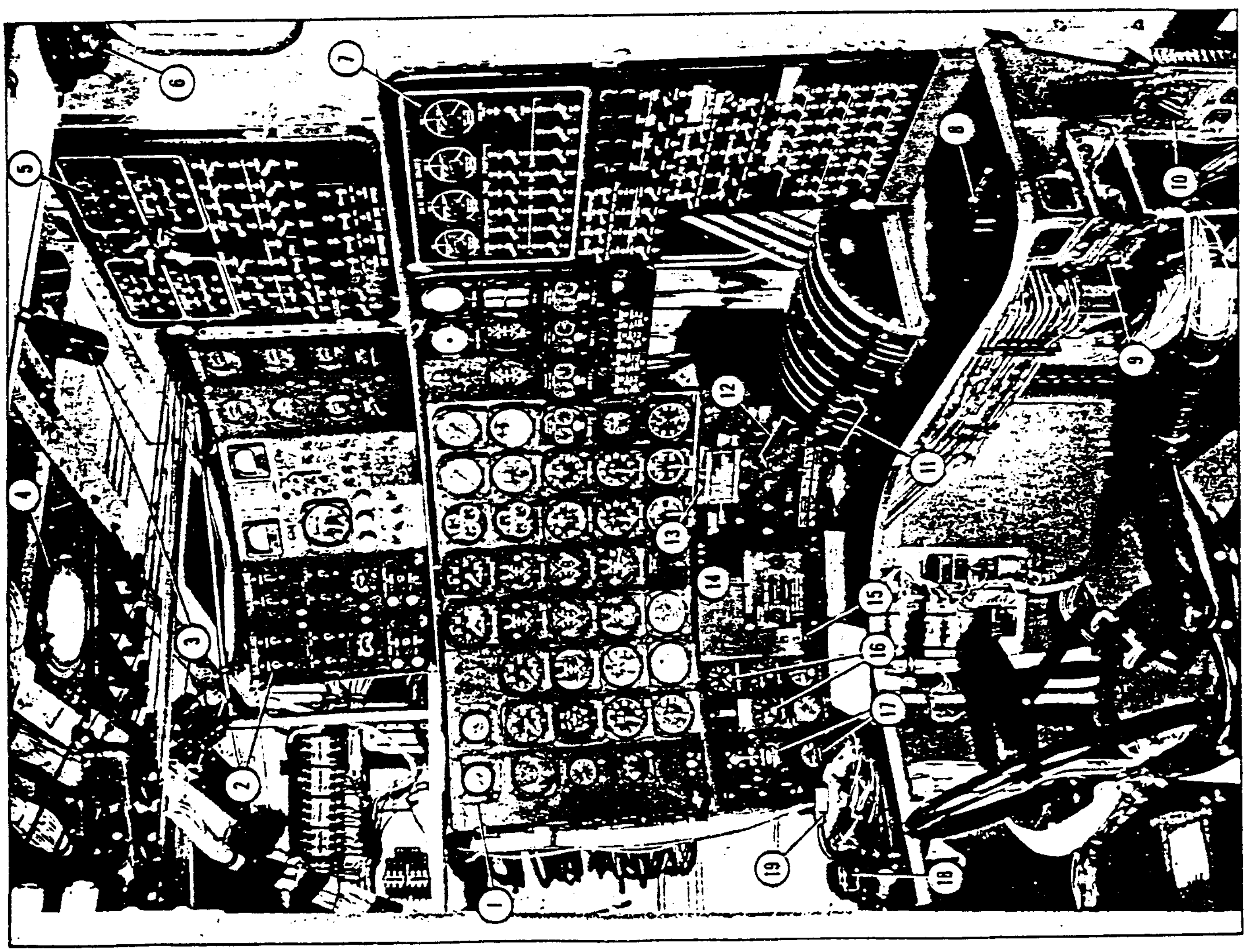


Figure 7. Engineer's Station

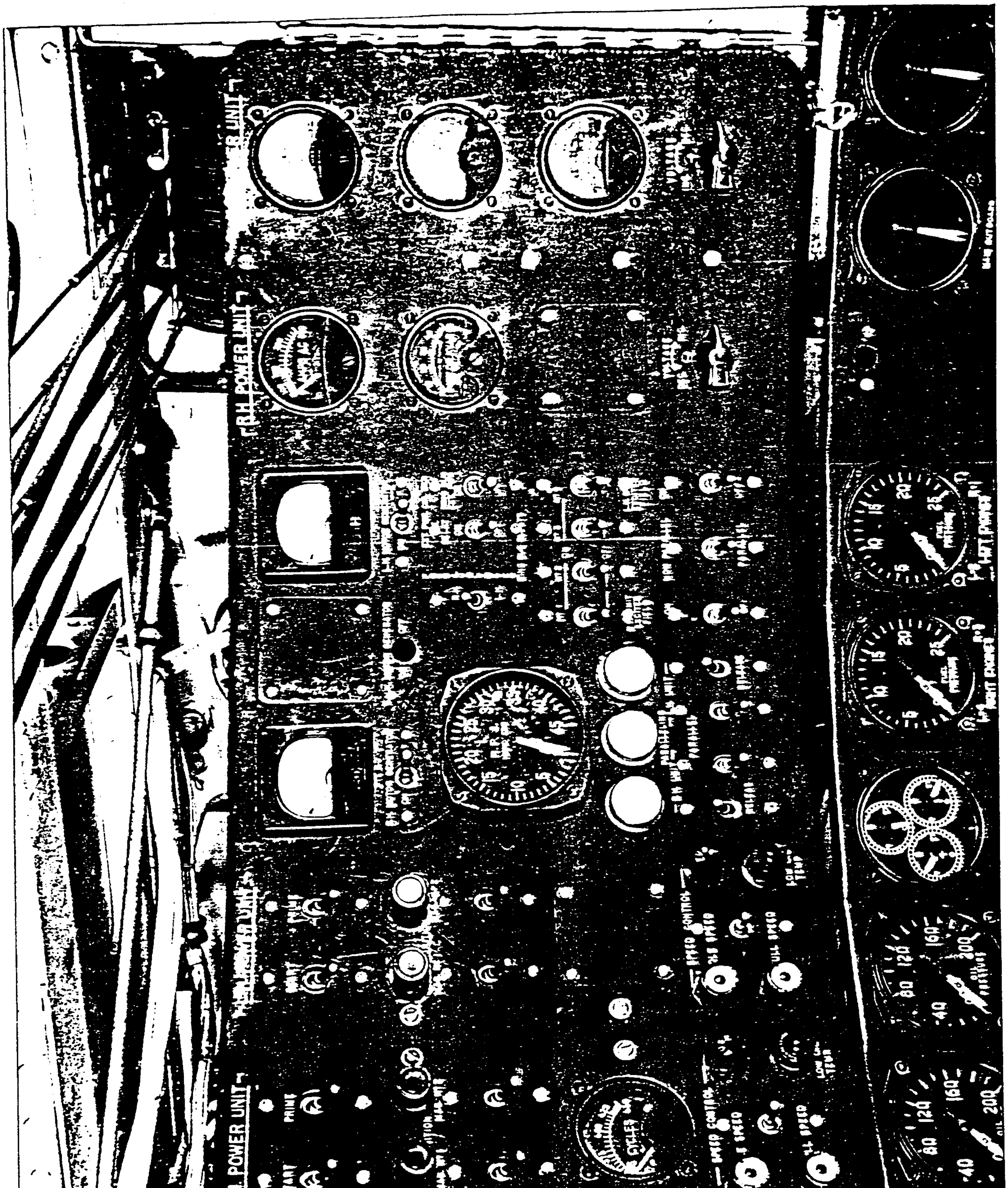


Figure 4. A.P.U. Control Panel

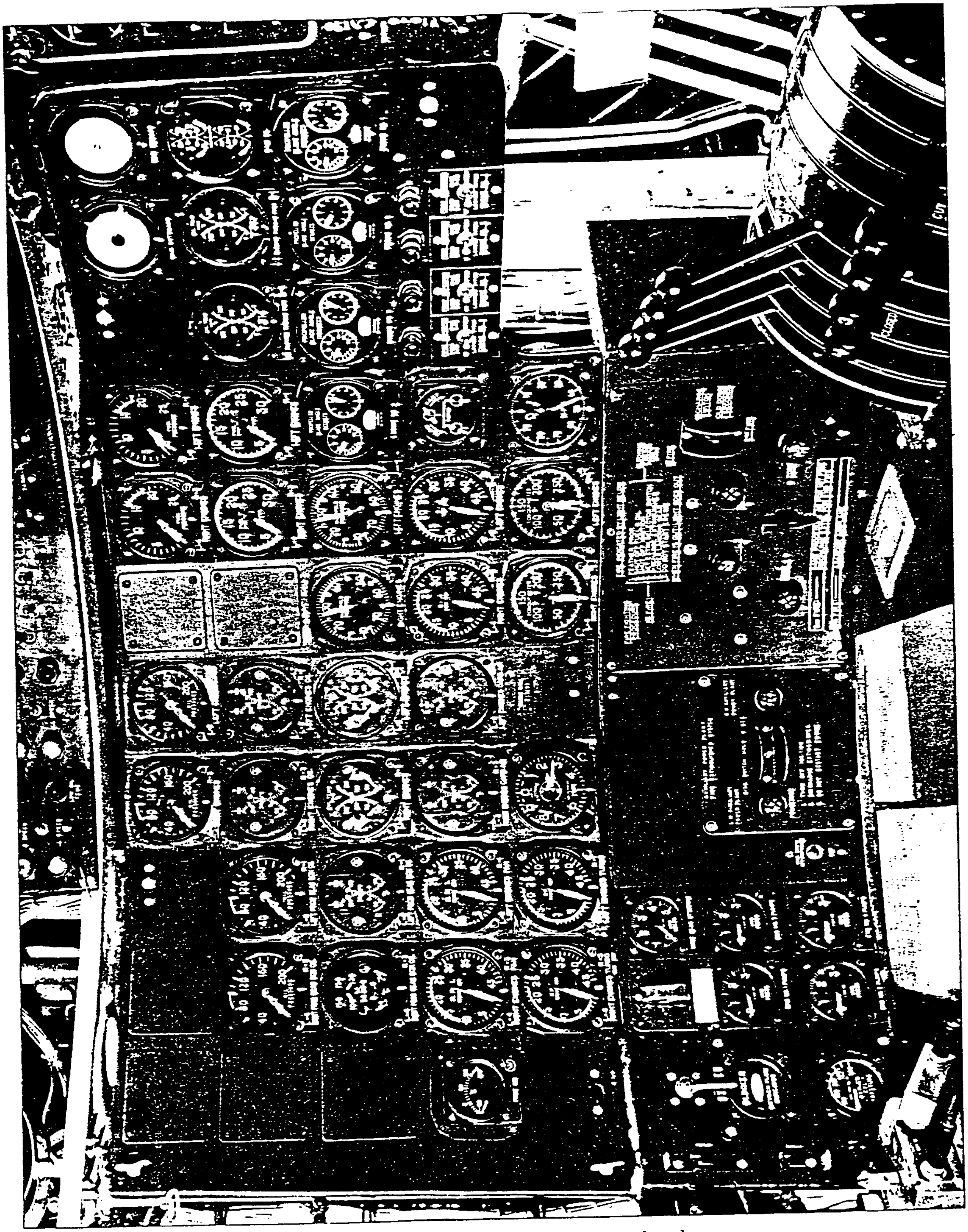


Figure 9. Engineer's Instrument Panel

5. THERMOMETER AN5795-6. (2nd instrument in the 3rd row).- This is a dual instrument indicating the oil temperatures in the two right hand propeller gear boxes. It is actuated by electrical resistance bulbs, AN5525-1, in the gear boxes.

6. TACHOMETER GE 8DJ-19-ABD (2nd instrument in 4th row).- This is a dual instrument indicating the rpm of the right engines fans. It is actuated by tachometer generators, AN5531-1, mounted on the engine fan shrouds.

7. OIL PRESSURE GAGE, LEFT PROPELLER GEAR BOXES (3rd instrument in 2nd row).- This is a dual instrument which indicates the oil pressure in the two left hand propeller gear boxes. It is actuated by pressure transmitters, AN5765-2, installed above the gear boxes.

8. THERMOMETER AN5795-6 (3rd instrument in 3rd row).- This is a dual instrument indicating the oil temperature in the two left-hand propeller gear boxes. It is actuated by electrical resistance bulbs, AN5525-1, in the gear boxes.

9. TACHOMETER 8DJ-19-ABC (3rd instrument in the 4th row).- This is a dual instrument indicating the rpm of the fans of the left engines. It is actuated by tachometer generators, AN5531-1, that are mounted on the engine fan shroud.

10. OIL PRESSURE GAGE, RIGHT ENGINES, AN5772-2A (4th space 1st row).- This is a dual instrument which indicates the oil pressure in the two right-hand engines. It is actuated by pressure transmitters, AN5765-2, that are installed in the engine bays above the carburetors.

11. THERMOMETER AN5795-6, RIGHT ENGINES OIL (4th space 2nd row).- This is a dual instrument indicating the oil temperatures in the two right engines. It is actuated by electrical resistance bulbs in the oil lines between the oil pumps and the oil filters.

12. THERMOCOUPLE INDICATOR AN5536-2 (4th space 3rd row).- This is a dual instrument which indicates the temperature of the C-1 cylinders of the right engines.

13. THERMOMETER AN5795-6 (4th space 4th row).- This is a dual instrument which indicates the carburetor air temperature. It is actuated by electrical resistance bulbs installed in the elbows of the intake ducts.

14. OIL PRESSURE GAGE, LEFT ENGINES AN5772-2A (5th space 1st row).- This is a dual instrument which indicates the oil pressure in the two left-hand engines. It is actuated by pressure transmitters, AN5764-2, that are installed in the engine bays above the carburetors.

15. THERMOMETER AN5795-6, LEFT-HAND ENGINES OIL TEMPERATURE (5th space 2nd row). This dual instrument indicates the temperature of the oil in the two left engines. It is actuated by electrical resistance bulbs installed in the oil lines between the oil pumps and the oil filters.

16. THERMOCOUPLE INDICATOR AN5536-2 (5th space 3rd row).- This dual instrument indicates the temperatures of the C-1 cylinders of the left engines. See Section IV, paragraph 7.

17. THERMOMETER AN5795-6 (5th space 4th row).- This dual instrument indicates the carburetor air temperatures. It is actuated by electrical resistance bulbs installed in the intake manifolds.

18. OIL LEVEL INDICATOR GE 8DJ20ACR, (6th space 1st row).- This four-element instrument indicates the amount of oil in each of the four oil tanks. It is actuated by selsyn 24 volt d.c. transmitters installed in the oil tanks.

19. MANIFOLD PRESSURE GAGE AN5770-2A34 (6th space 3rd row).- This dual instrument indicates the intake manifold pressures of the left engines. It is actuated by direct pressure from the intake manifolds.

20. TACHOMETER AN5530-2A-34 (6th space 4th row).- This dual instrument indicates the rpm of the right engines. It is electrically actuated by transmitter generators AN5531-1, installed on the engine cases.

21. TORQUE METER, MMM TYPE 6762-197 (6th space 5th row).- This dual instrument measures the torque of the right power plants. It is actuated by oil pressure from torque transmitters which are integral parts of the propeller reduction gear installations.

22. FUEL PRESSURE GAGE AN5772-1-34. RIGHT ENGINES (7th space 1st row).- This is a dual instrument which indicates the carburetor fuel pressure for the right engines.

23. FUEL FLOW INDICATOR, PIONEER #6007-63-A-14B PEX-102658-1 (7th space 2nd row).- This dual electrically operated instrument indicates the flow of fuel to the right engines. It is actuated electrically by autosyn transmitters installed in the fuel system piping.

24. MANIFOLD PRESSURE GAGE AN5770-2A-12 (7th space 3rd row).- This dual instrument is actuated by direct pressure from the intake manifolds of the left engines.

25. TACHOMETER AN5530-2A-12 (7th space 4th row).- This dual instrument indicates the rpm of the left engines. It is electrically actuated by transmitter generators, AN5531-1, installed on the engine cases.

26. TORQUEMETER MMM TYPE G 762-197 (7th space 5th row).- This dual instrument measures the torque of the left engines. It is actuated by oil from torque transmitters in the reduction gear cases. (See Section IV, paragraph 7) which are integral parts of the propeller reduction gear installations.

27. FUEL PRESSURE GAGE AN5772-1-12 LEFT ENGINES (8th space 1st row).- This dual instrument indicates the fuel pressure at the carburetor for the right engines. It is actuated by pressure transmitters installed in the engine bays above the carburetors.

28. FUEL FLOW INDICATOR, PIONEER 73-A-14B PEX-102658-1 (8th space 2nd row).- This electrically operated dual instrument indicates the flow of fuel to the left engines. It is actuated electrically by autosyn transmitters installed in the fuel system piping.

29. PROP PITCH INDICATOR, H.S.P. 59373-1 (8th space 3rd row). Engine No. 4.- This electrically operated instrument indicates in degrees the pitch of the propellers driven by engine No. 4. The transmitter is attached to the propeller control support assembly.

30. SYNCHROSCOPE AN5532-1 (8th space 4th row).- This instrument indicates which engines are running slower or faster than engine No. 1. The synchroscope operates from the tachometer electrical system of all four engines.

31. PROP PITCH INDICATOR, H.S.P. 59363-1 (9th space 3rd row). Engine No. 3.- This electrically operated instrument indicates in degrees the pitch of the propellers driven by engine No. 3. The transmitter is attached to the propeller control support assembly.

32. PROP PITCH INDICATOR, H.S.P. 59363-1 (10th space 3rd row). Engine No. 2.- This electrically operated instrument indicates in degrees the pitch of the No. 2 propeller. The transmitter is attached to the propeller control support assembly.

33. FUEL LEVEL INDICATOR GE 8DJ2 LBL (11th space 1st row).- Main inboard tanks. This is a dual instrument which indicates the amount of fuel in the inboard tanks. It is actuated by selsyn transmitters installed in the fuel tanks.

34. PROP PITCH INDICATOR, H.S.P. 59363-1 (11th space 3rd row). Engine No. 1.- This electrically operated instrument indicates in degrees the pitch of the No. 1 propeller. The transmitter is attached to the propeller control support assembly.

35. HYDRAULIC PRESSURE GAGES.- A hydraulic pressure gage for each pair of engine pumps, and a gage for the nose wheel steering and brake system are located below the engineer's instrument panel.

(c) INSTRUMENT REMOVAL AND INSTALLATION, ENGINEER'S INSTRUMENT PANEL.- Remove the two wing nuts on the left side of the instrument panel holding the panel to the hinge post. Remove the lockpins securing the panel to the mounts and push the bosses back, freeing the panel. Swing the panel out on the hinge post far enough to disconnect the fittings from the back of the instrument. Tag and cap all fittings removed. Remove the instrument attaching screws and lift the instrument out of the panel. To install the instrument reverse the removal procedure.

d. TRANSMITTERS, PRESSURE TYPE AN5765-2 (See figure 10.)

(1) REMOVAL.- Disconnect the lines from the transmitter. Remove safety wire. Remove the four attaching screws. Remove the transmitter. All lines and connections should be capped.

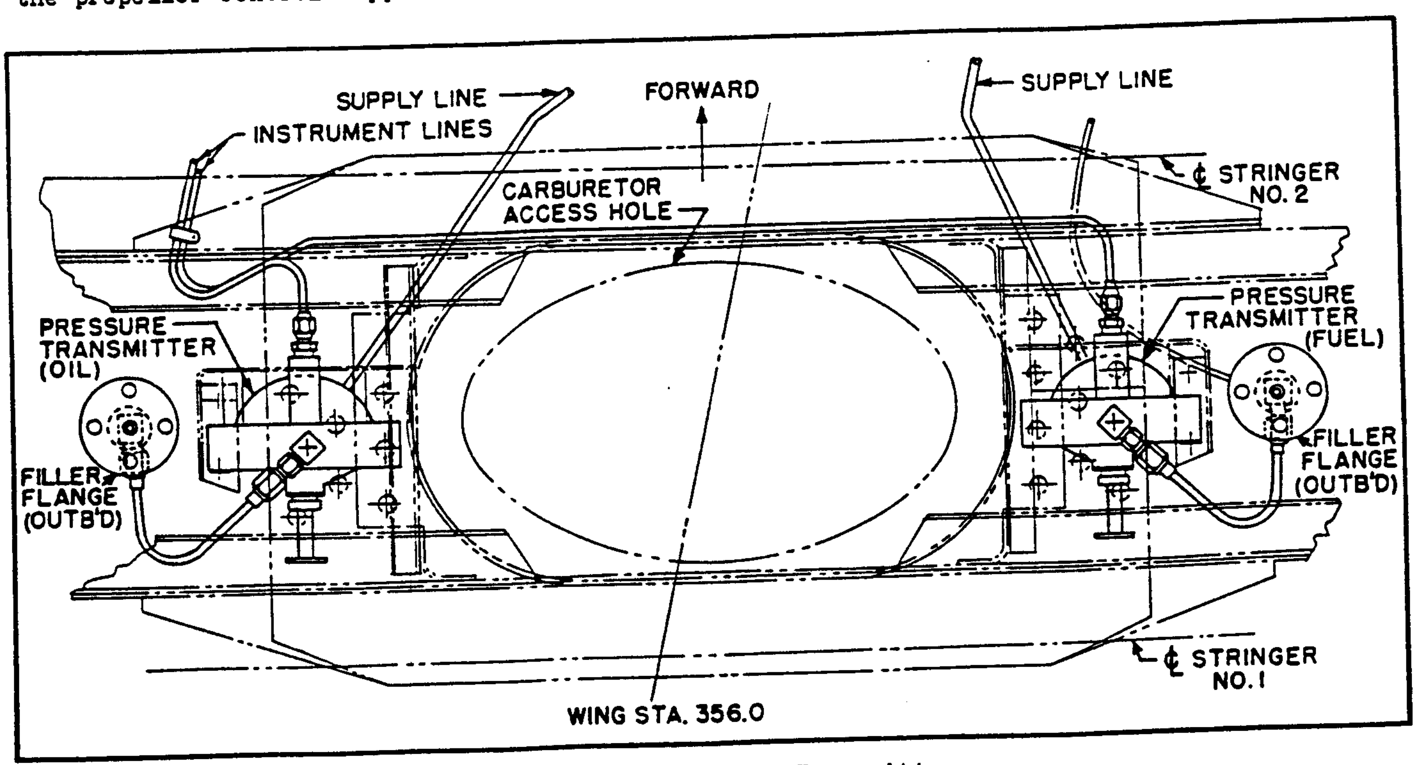


Figure 10. Pressure Transmitter

(2) INSTALLATION.- Place transmitter in position and secure with four attaching screws. Safety attaching screws. Remove caps and attach lines. Bleed lines to remove air pockets.

e. PITOT TUBES AN5816-2 and AN5814-2 (See figures 11 and 12).- These pitot tubes installed on the upper and lower wing surfaces, operate the pilots' air speed indicators, altimeters, and rate of climb indicators, and the navigator's altimeter and air speed indicator. They are electrically heated.

f. GYRO COMPASS TRANSMITTER AN5751-1. (See figure 6.)- This transmitter consists of a gyro with a ball type erection mechanism and a flux gate compass element all suspended in gimble rings, and a caging mechanism. It is operated by 110 volt 400 cycle current. The transmitter actuates the master compass indicator installed on the navigator's panel, which in turn actuates the pilots' compass indicator.

g. TACHOMETER GENERATORS, AN5531-1. (See figure 13.)- Are installed on the four engine cases and on the four fan shrouds. Tachometer generators GE Type CM5, are installed on both auxiliary power units.

(1) REMOVAL.- Disconnect the connector plugs. Remove the safety wire and remove the four flange attaching nuts, bolts and washers, and remove the generator.

(2) INSTALLATION.- Place the generator in position and engage the drive shaft. Replace the bolts, washers and nuts, and replace the safety wire. Connect the attaching plug and secure with the lock collar.

h. TRANSMITTERS, ELECTRICAL. (See figure 14.)

(1) The fuel-level transmitters are actuated by the rise and fall of the liquid level and transmit electrical impulses to the fuel level gages on the engineer's panel.

(a) REMOVAL.- Disconnect the electrical plug connectors and remove the screws securing the flange to the tank.

(b) INSTALLATION.- Reverse the removal procedure and replace safety wire.

(2) FLAP POSITION TRANSMITTER ELECTRICAL AN5785-1 (See figure 15.)- The transmitter is installed near the flap operating mechanism of the right wing and is mechanically linked to it.

(a) REMOVAL.- Disconnect the electrical plug connections and the link movement. Remove the four attaching screws and remove the transmitter.

(b) INSTALLATION.- Reverse the removal procedure.

i. FUEL FLOWMETER GENERATOR. (See Section IV, paragraph 7.)

j. GAGES OUTSIDE OF CREW NACELLE.

(1) A bungee pressure gage is installed in the upper forward section of each main landing gear wheel well.

(2) An air pressure gage is installed on the accumulator in the nose wheel well.

(3) An air pressure gage is installed on the emergency brake air bottle.

(4) Hydraulic pressure gages are installed on the nose landing gear bungee cylinder and on the nose gear doors bungee cylinder.

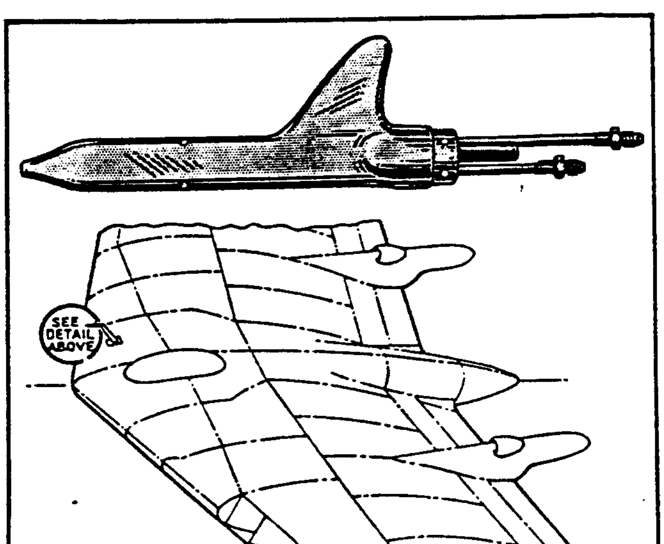


Figure 11. Upper Pitot Tube Installation

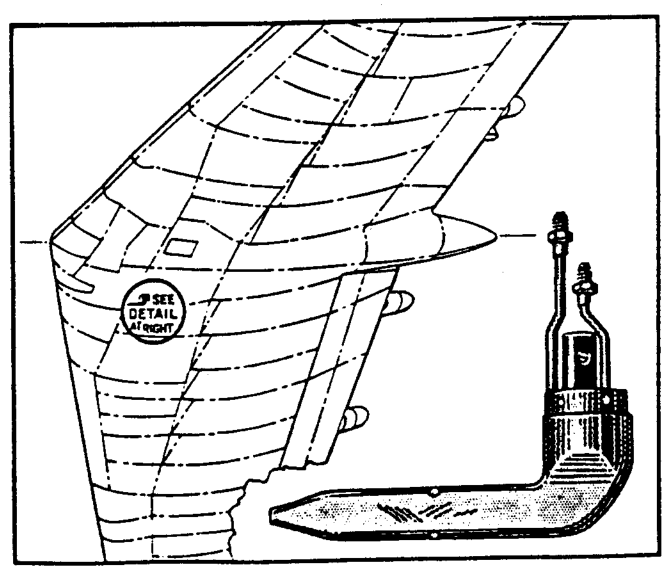
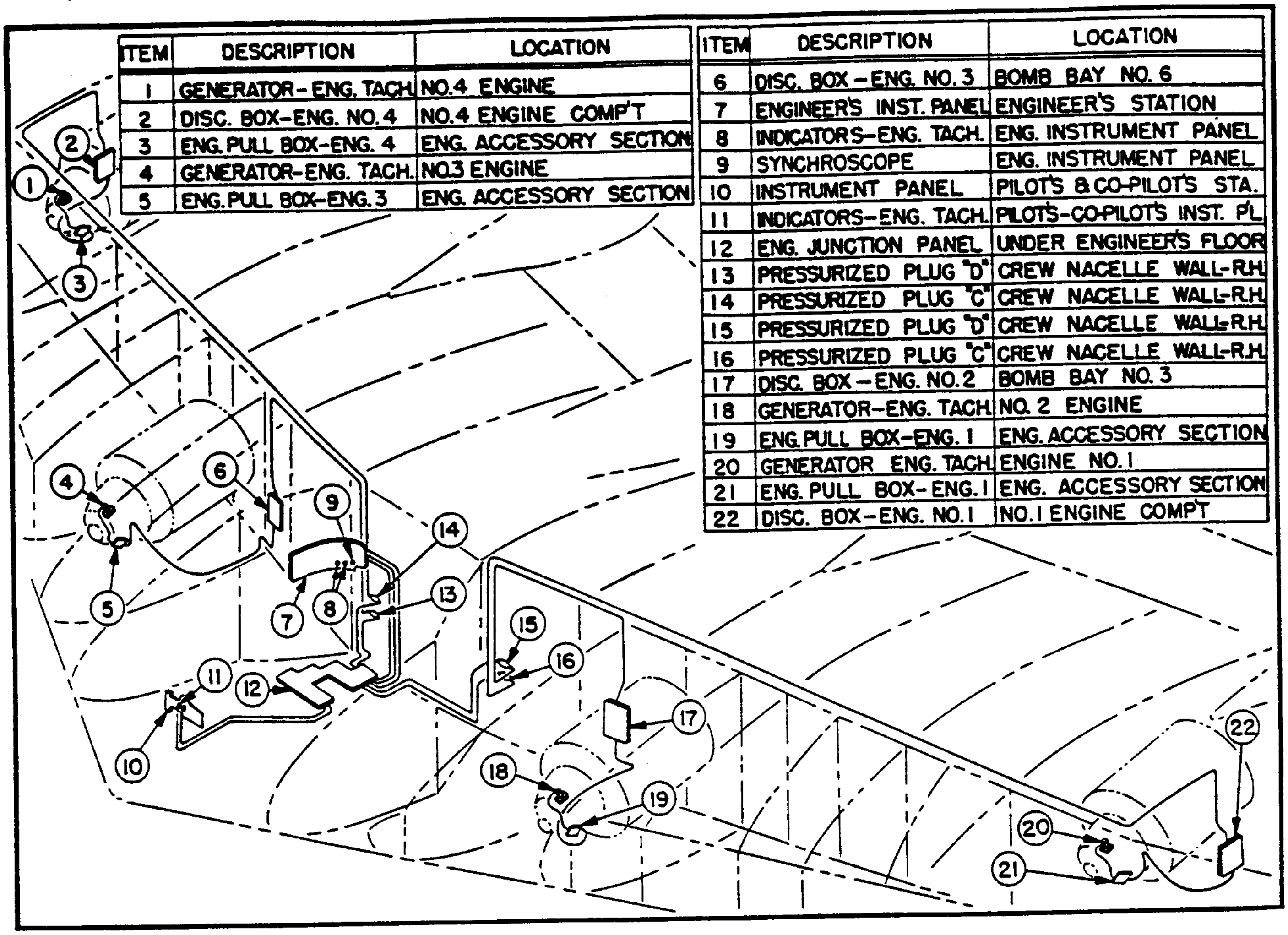


Figure 12. Lower Pitot Tube Installation



ITEM	DESCRIPTION	LOCATION
1	GENERATOR-ENG. TACH.	NO.4 ENGINE
2	DISC. BOX-ENG. NO. 4	NO.4 ENGINE COMP'T
3	ENG. PULL BOX-ENG. 4	ENG. ACCESSORY SECTION
4	GENERATOR-ENG. TACH.	NO.3 ENGINE
5	ENG. PULL BOX-ENG. 3	ENG. ACCESSORY SECTION
6	DISC. BOX-ENG. NO. 3	BOMB BAY NO. 6
7	ENGINEER'S INST. PANEL	ENGINEER'S STATION
8	INDICATORS-ENG. TACH.	ENG. INSTRUMENT PANEL
9	SYNCHROSCOPE	ENG. INSTRUMENT PANEL
10	INSTRUMENT PANEL	PILOT'S & CO-PILOT'S STA.
11	INDICATORS-ENG. TACH.	PILOT'S-CO-PILOT'S INST. PL
12	ENG. JUNCTION PANEL	UNDER ENGINEER'S FLOOR
13	PRESSURIZED PLUG "D"	CREW NACELLE WALL-R.H.
14	PRESSURIZED PLUG "C"	CREW NACELLE WALL-R.H.
15	PRESSURIZED PLUG "D"	CREW NACELLE WALL-R.H.
16	PRESSURIZED PLUG "C"	CREW NACELLE WALL-R.H.
17	DISC. BOX-ENG. NO. 2	BOMB BAY NO. 3
18	GENERATOR-ENG. TACH.	NO. 2 ENGINE
19	ENG. PULL BOX-ENG. 1	ENG. ACCESSORY SECTION
20	GENERATOR ENG. TACH.	ENGINE NO. 1
21	ENG. PULL BOX-ENG. 1	ENG. ACCESSORY SECTION
22	DISC. BOX-ENG. NO. 1	NO. 1 ENGINE COMP'T

Figure 13. Tachometer Generator Electrical Circuit

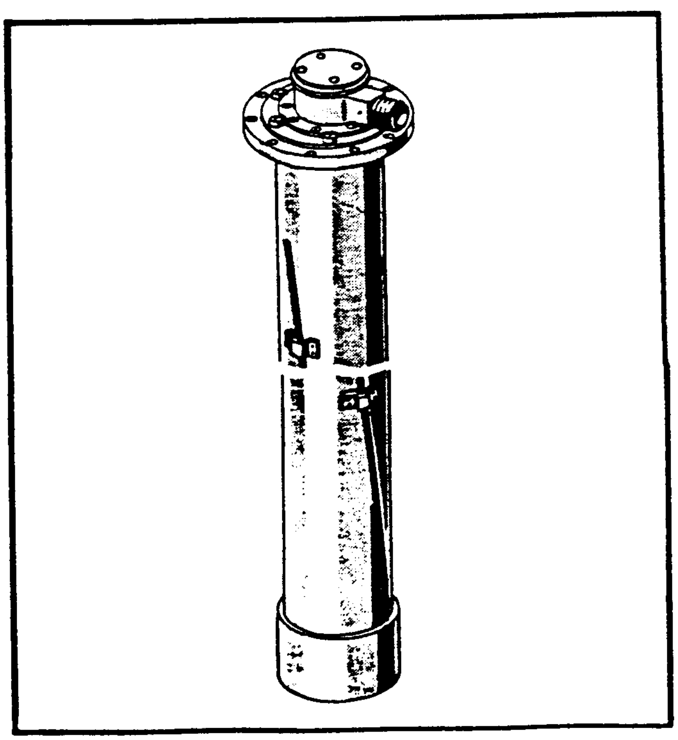


Figure 14. Fuel Level Transmitter

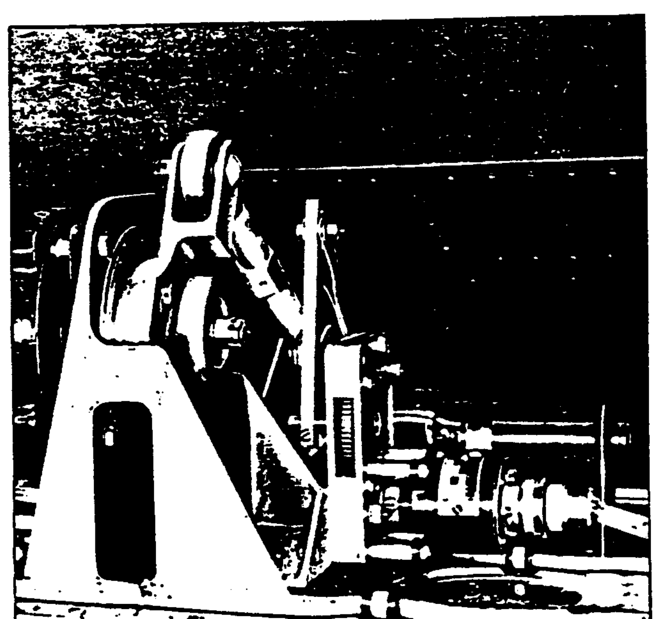


Figure 15. Flap Position Transmitter

24. PHOTOGRAPHIC EQUIPMENT

24. PHOTOGRAPHIC EQUIPMENT.- Photographic equipment has not been installed in this airplane.

25. FURNISHINGS AND EMERGENCY EQUIPMENT

25. FURNISHINGS AND EMERGENCY EQUIPMENT.

a. FURNISHINGS. (See figure 1.)

(1) SAFETY BELTS.- Each crew seat is provided with an adjustable lap-type safety belt (Type B-14). These belts are bolted to the sides of the seats, and have a quick-action buckle in the center.

(a) ADJUSTMENTS.

1. To shorten, pull either the left or right pull loop, at the ends of the center webbing, toward the center.

2. To lengthen, pull on either the left or right release tab, which will release the friction buckle, allowing the webbing to slip and thus lengthen the belt. A pull on the belt will then lock the friction buckle again.

3. The safety belts should not be shortened by stitching. Sufficient webbing adjustment is allowed for all installations.

(b) TEST.

1. All type B-14 safety belts will be removed and weight tested annually.

2. Prepare the belt for test by attaching one end to the testing lever, after adjusting to the largest possible size. Attach the other end to a weight of 800 pounds, using the anchorage bolts for attachment.

3. The belt is tested by gently raising the prescribed weight from the floor (avoid impact loading), and lowering it immediately to avoid placing unnecessary stresses on the belt.

4. Do not attempt to test the belt by tearing the webbing or stitching by hand, as such stresses cannot be uniformly applied or measured, and have no practical value. Even if the belt is not visibly torn by such practice, undetected damage may result in premature failure.

(2) TOWING AND STEERING BAR.- A towing and steering bar is stowed in No. 2 Bomb Bay. (See figure 2.)

(3) MISCELLANEOUS KITS AND PARTS.- (See figure 1.) The following kits and parts are stowed together in the aft crew compartment.

NAME	PART NO.	QUANTITY
Armorer Mechanic's Kit	AER#45-7560	1
Crew Chief's Kit	AER#45-7565	1
Radio Operator's Kit	AER#45-7670	1
Type EZ Emergency Sustenance Kit	AER#45-7700 (41K6996)	1
Electrical Wiring Diagram Book	154973	1
Wiring Diagram Book Cover	558841	1
Radio Transmitter (Spare)	SCR-274-N (H41G5076)	1
Radio Transmitter Cover	458928	1
Miscellaneous Parts Stowage Bag	458927	1
Containing the following parts:		
Jack Pad	481367	1
Jack Pad	495696	6
Hyd. Reservoir Filler	256344	1
Bolt	AN28-18	4
Bolt	AN4-56	1
Bolt	AN6-20A	8
Bolt	AN6-16A	8
Bolt	AN6-15A	8
Bolt	AN6-14A	6
Eyebolt	AN44-4A	3
Washer	AN960-C416	6
Washer	AN960-C616	24

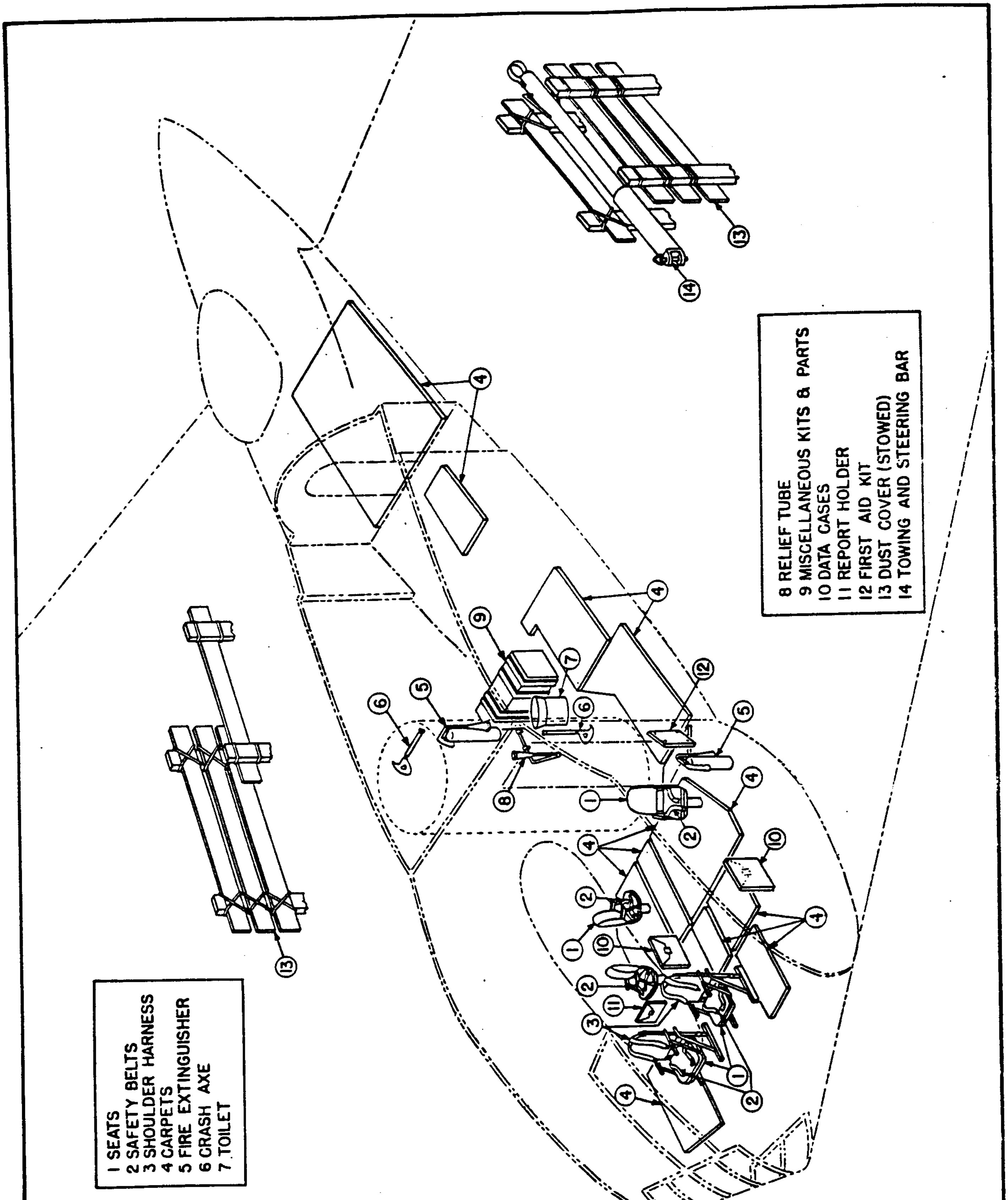


Figure 1. Furnishings

(4) DUST COVERS. (See figures 1 and 2.)

(a) The following dust covers are stowed together in the aft crew compartment:

NAME	PART NO.	QUANTITY
C.N. Nose section Enclosure Cover	555895	1
Turbo Flight Hood Cover	556007	8
Turbo Wastepipe Cover	556008	8
Tire Cover	558741	5

(b) The following dust covers are stowed together in the #2 Bomb Bay:

NAME	PART NO.	QUANTITY
Outboard Leading Edge Duct Cover	557028-2	1
Outboard Leading Edge Duct Cover	557028-4	1
Inboard Leading Edge Duct Cover	557027-2	1
Inboard Leading Edge Duct Cover	557027-4	1

(c) The following dust covers are stowed together in the #7 Bomb Bay:

NAME	PART NO.	QUANTITY
Outboard Leading Edge Duct Cover	557028-3	1
Outboard Leading Edge Duct Cover	557028-5	1
Inboard Leading Edge Duct Cover	557027-3	1
Inboard Leading Edge Duct Cover	557027-5	1

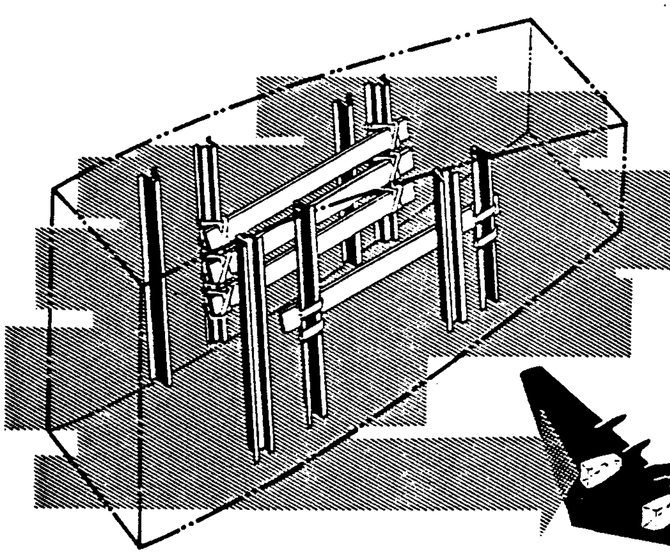
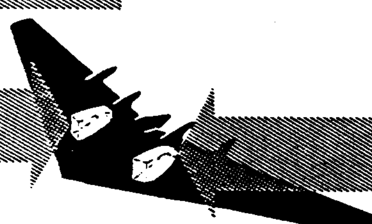
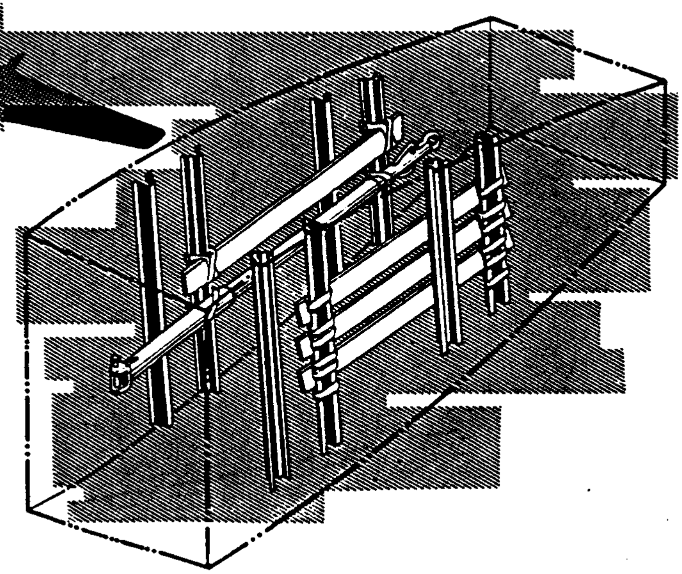




Figure 2. Stowed Equipment

(5) ENTRANCE LADDER.- A ladder is provided for use at the main entrance hatch. During flight, the ladder is telescoped and strapped to brackets on the left side of the forward turret well.

(6) SHOULDER HARNESS.- The pilot and copilot are provided with safety shoulder harness (Type B-15). The harness is attached to the inertia lock at the back of each seat and may be adjusted by shortening or lengthening it at the D-Ring.

(7) CARPETS.- Eleven green carpets are located throughout the cabin to lessen wear on the floor surfaces. They are held in place by snap fasteners attached around their edges. (See figure 3.)

(8) DATA CASES.- A data case is attached to the frame to the left of the pilot's seat near the floor. Another is attached to the central framework opposite the navigator's seat.

(9) FLIGHT REPORT HOLDER.- A plywood flight report holder is provided. It is attached to the framework between the pilot's and copilot's seats.

(10) RELIEF TUBE.- A relief tube is clipped to the aft side of the crew nacelle truss. It may be cleaned by flushing it out with water.

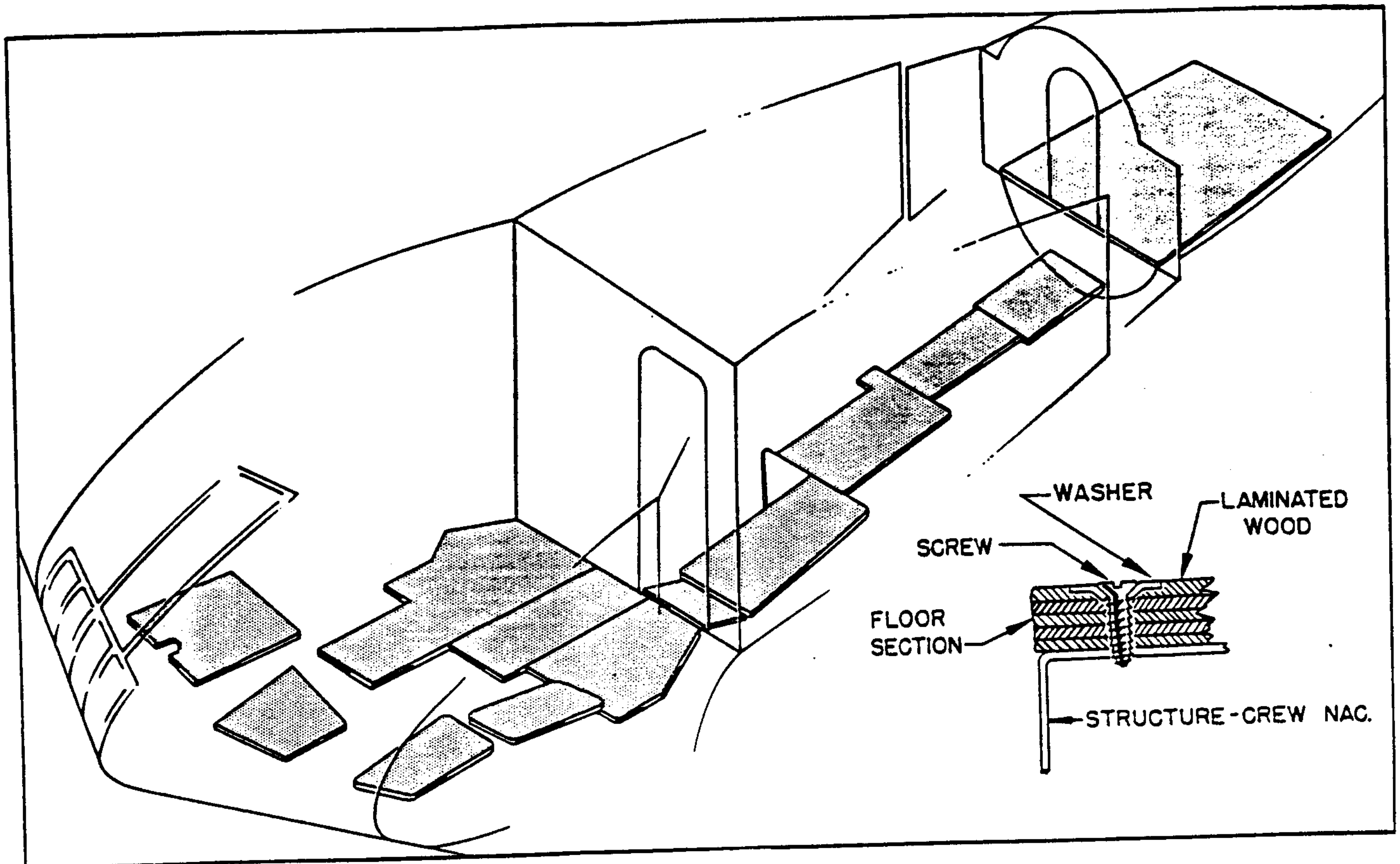


Figure 3. Carpets

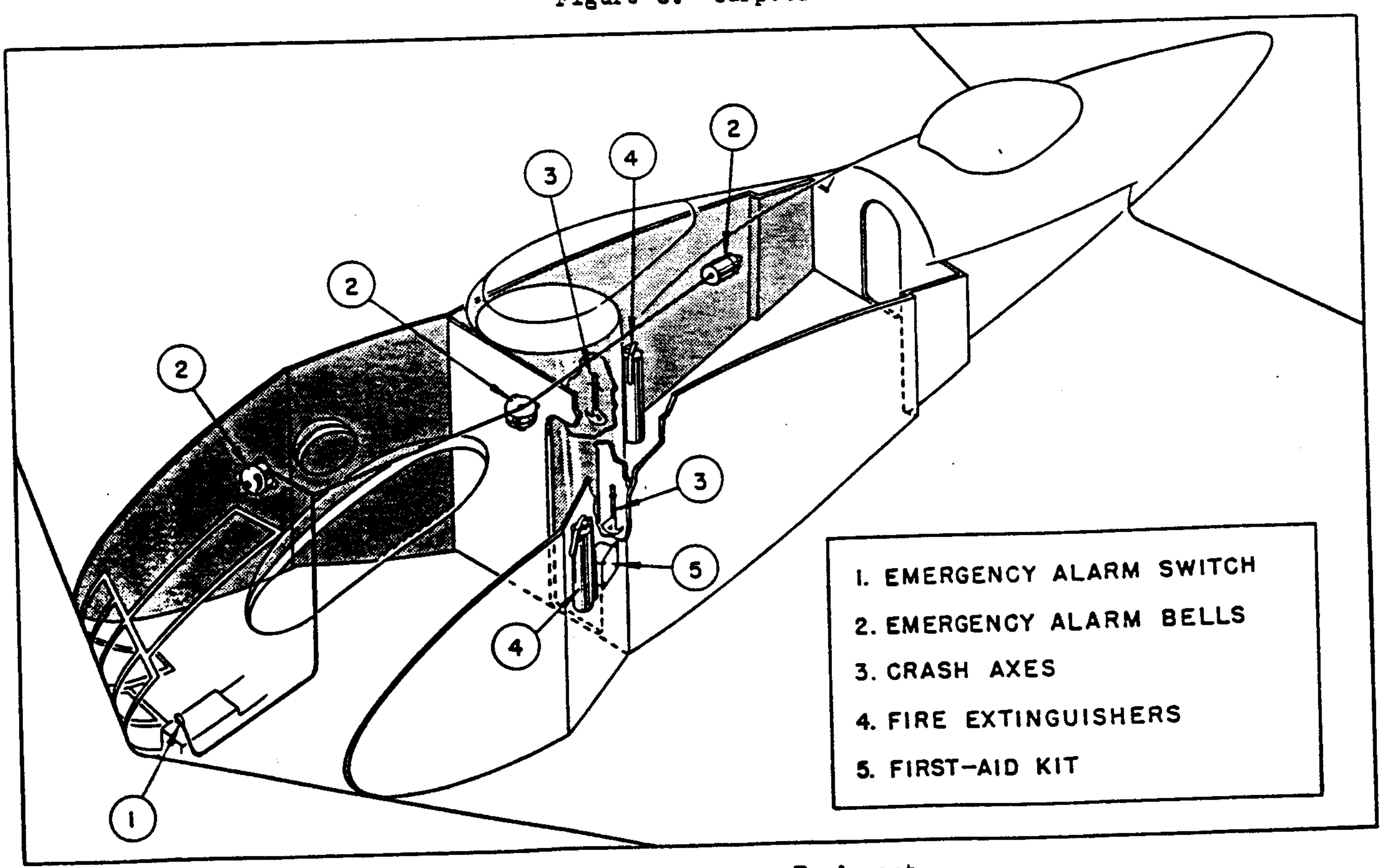


Figure 4. Emergency Equipment

(11) SEATS.

(a) PILOT'S SEAT.

1. DESCRIPTION.- The pilot's seat is a Warren-McArthur Model 259-ASI with an inertia locking harness reel. A lever at the front left of the seat allows positive locking of the safety harness at 1/2 inch increments over a total distance of 18 inches. When the lever is locked in the aft position it allows movement of the harness over the 18 inches against the pull of the spring in the inertia lock. The adjusting lever on the right side releases the locking pins and allows the seat to be raised by an elastic shock cord. The seat is lowered by the weight of the pilot when the locking pins are released. The aft left lever in its forward position controls the turning of the seat. In its aft position the lever releases the locking pins and allows fore and aft movement of the seat in 1 inch increments. The seat is supported on rollers riding on tracks bolted to the floor.

2. REMOVAL.

a. Unbolt section of floor supporting seat.

b. Lower seat complete with tracks and floor through forward lower escape hatch. Seat, tracks, and floor weigh approximately 50 pounds.

c. To remove seat from floor unbolt either fore or aft retainer blocks and slide off.

d. Release locking pins with control lever and slide seat off tracks.

3. INSTALLATION.

a. Make sure seat is on tracks and retainer blocks are tight.

b. Return seat and floor assembly to airplane through lower forward escape hatch.

c. Bolt floor in place.

(b) COPILOT'S SEAT.

1. DESCRIPTION.- The copilot's seat is a Warren-McArthur Model 258-ASI with an inertia locking harness reel. A lever at the front left of the seat when in the forward position locks the safety harness at 1/2 inch increments over a total distance of 18 inches. When the lever is locked in the aft position it allows movement of the harness over the 18 inches against the pull of the spring in the inertia lock. The adjusting lever on the right side releases the locking pins and permits the seat to be raised by an elastic shock cord. The seat is lowered by the weight of the pilot when the locking pins are released. The aft lever controls the fore and aft movement of the seat in one inch increments. The seat is supported on rollers riding on tracks bolted to the floor.

2. REMOVAL.

a. Unbolt the tracks from the floor.

b. Lower complete assembly through the lower escape hatch. (Approximate weight 35 lbs.)

c. Remove retainer blocks from track.

d. Slide seat off the tracks.

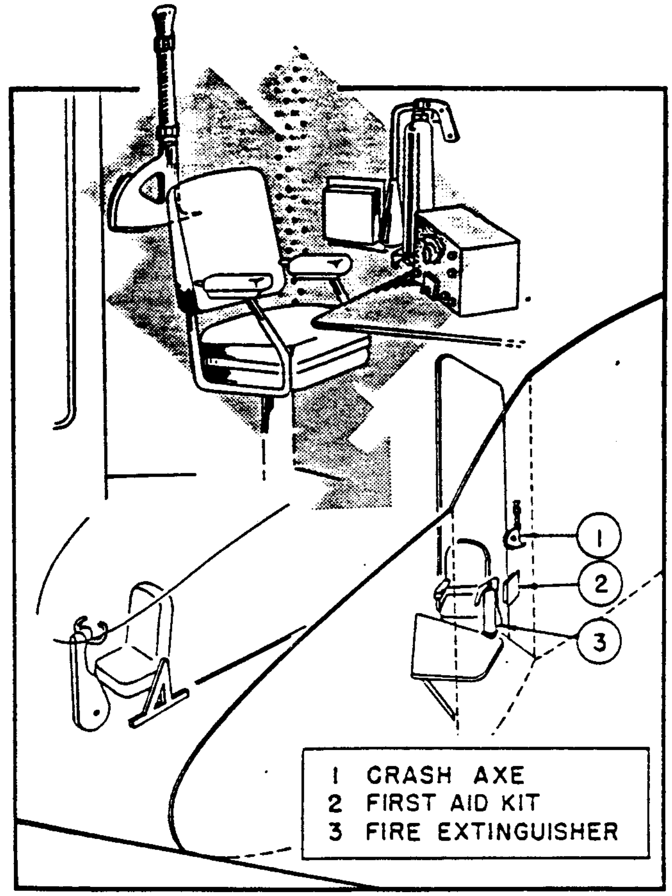


Figure 5. Emergency Equipment - Radio Operator's

3. INSTALLATION.- Reverse the removal procedure.

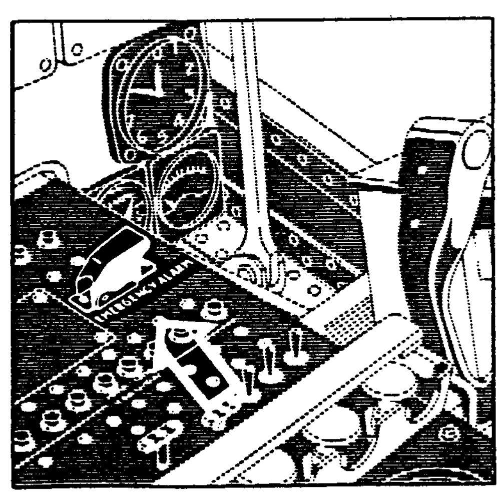


Figure 6. Emergency Alarm Switch

(c) NAVIGATOR'S, FLIGHT ENGINEER'S AND RADIO OPERATOR'S SEAT.

1. DESCRIPTION.- The navigator's and radio operator's seats are Warren McArthur Model 246-1. The flight engineer's seat is a Model 246, modified. These seats are bolted to pedestals which are riveted to the floor structure. A lever on the right side controls the rotation of the seats. They may be locked in any one of eight positions 90 degrees apart, but have no vertical or fore-and-aft adjustment.

2. REMOVAL.

a. Remove cotter key, nut and washer from center bolt between seat and pedestal.

b. Pull rotation lever and lift seat off pedestal.

c. Lower seat through forward escape hatch. Each seat weighs approximately 15 pounds.

3. INSTALLATION.

a. Return seat to crew nacelle through forward escape hatch.

b. Place seat on pedestal over the center bolt. Tighten washer and nut on bolt and install cotter key.

b. EMERGENCY EQUIPMENT. (See figures 4 and 5.)

(1) FIRST AID KIT.- A Type 42D7411 first aid kit is attached to the frame to the left of the radio operator.

(2) CRASH AXES.- Two Type 42D8331 crash axes are carried in the airplane. One is located in a bracket attached to the frame to the left of the radio operator. The other is located in a bracket attached to the aft side of the turret support structure in the aft cabin.

(3) HAND OPERATED FIRE EXTINGUISHERS.- Two carbon dioxide, hand operated fire extinguishers, Kidde Type 4TB, are located in the crew nacelle. One is attached to the frame to the left of the radio operator. The other is attached to the aft side of the turret support structure in the aft cabin.

(4) EMERGENCY ALARM.

(a) DESCRIPTION.- An emergency alarm bell system is provided. It is a 24 volt, grounded d-c circuit. The system is independent and can be operated at any time as it is connected directly to the battery. An emergency toggle switch on the pilot's pedestal operates individual emergency bells at the engineer's, navigator's and tail gunner's positions, and one in the crew's quarters, simultaneously. (See figure 6.)

(b) WIRING.- The battery is connected to a bus bar in the nose wheel relay panel. Current for the circuit is tapped from this bus bar and connected to the pilot's switch. When the switch is thrown, current is fed to the engineer's junction panel, and from there is directed to the individual alarm bells. The lead for the tail gunner is routed to the landing flap relay panel and from there to the alarm bell. (See figure 7.)

ITEM	DESCRIPTON	LOCATION
1	NAVIGATORS ALARM BELL	CREW NACELLE-NOSE SEC.
2	PILOT'S PEDESTAL SW. PANEL	CREW NACELLE-NOSE SEC.
3	CONTROL SWITCH	PILOT'S PEDESTAL-C.N.
4	ENGINEER'S JUNC. PANEL	CREW NACELLE-NOSE SEC.
5	PRESSURIZED PLUG	CREW NACELLE-NOSE SEC.
6	NOSE WHEEL RELAY PANEL	NOSE WHEEL WELL
7	ENGINEER'S ALARM BELL	CREW NACELLE-NOSE SEC.
8	CREW'S QUARTERS ALARM BELL	CREW NACELLE CENTER SEC.

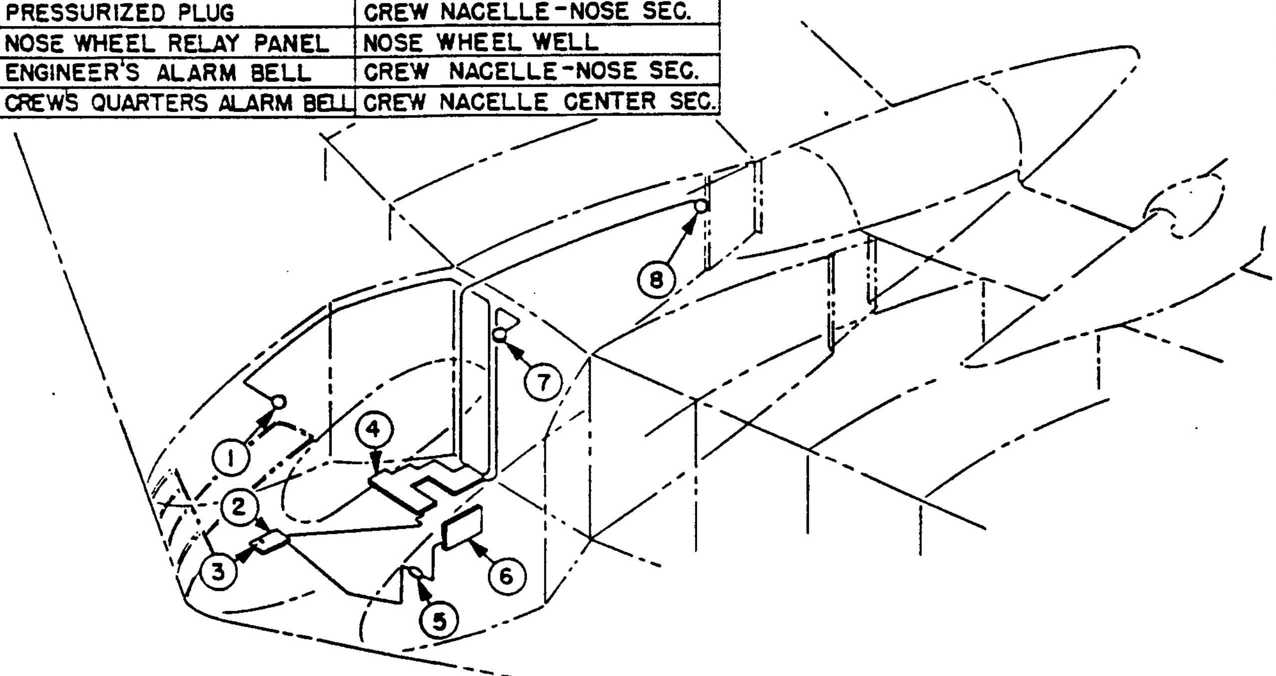


Figure 7. Emergency Alarm Switch Circuit

SECTION V
SERVICE INSPECTIONS

V. SERVICE INSPECTIONS.-

All aircraft in Army and Navy Service are inspected periodically. Inspection periods established for the Army Air Forces and the Navy Service are not identical, and for that reason, inspection periods specified in this section in terms of hours consist of two figures i.e., "25-30 hour inspection," the first figure of which indicates the Army Air Forces period, and the second figure of which indicates the comparable Navy period. Pre-Flight and Daily Inspections are identical in both services.

All periodical service inspections are cumulative in effect, and the latest inspection will include all operations performed during previous inspections.

CLASSIFICATION.- The periodic inspections on all aircraft are: Pre-flight; Daily; 25-30 Hour; Engine Change; and Special.

PRE-FLIGHT.- The pre-flight inspection is a check of the airplane to determine that the instruments, controls, auxiliary systems, power plants, etc., are functioning properly; that all cowling, fuel and oil tank caps, etc., are in place and properly fastened or secured; and that the airplane is properly serviced and ready for flight. The pre-flight inspection is required on the following occasions: for all airplanes which are in commission, prior to the first flight each day and at least once every day. This does not include airplanes in "in storage" status; undergoing engine change; or in the engineering shops and not being used for flight. Pre-flight inspection should be done on all transient airplanes prior to departure from any station, whether or not a pre-flight inspection has been accomplished the same day at another station.

DAILY.- The daily inspection is an inspection to determine the general condition of the airplane and engine. It is designed to detect aggravated conditions, maladjustments, breaks, etc., but is not designed to be sufficiently thorough and reaching to detect slight wear and early stages of deterioration. If practicable, the daily inspection should be accomplished during a period definitely set aside for that purpose, either after the day's flying is over, or before the start of flying the following day.

25-30 HOUR.- The 25-30 hour inspection includes the daily inspection, and is designed to be sufficiently thorough and searching to allow detection of slight wear and other early stages of deterioration. No airplane should be allowed to remain more than one month without a 25-30 hour inspection, irrespective of flying time, except airplanes in depots undergoing overhaul and airplanes in "in storage" status.

50-60 HOUR.- The 50-60 hour inspection includes the daily and 25-30 hour inspection, and is designed to be a complete, thorough, and searching inspection of the entire airplane as far as it is within the scope of the visual inspection system.

ENGINE CHANGE.- Engines will normally be removed for overhaul at the expiration of the period listed in Section X of Technical Manual No. TM-1-514 (the desirable maximum number of flying hours between overhauls), except that additional flying time (not to exceed 20 per cent of the number of hours listed) may be authorized when the condition of the engine warrants.

SPECIAL.- The 100-120, 200-240, and 300-360 hour inspections which are normally added, are accomplished along with the regular 50-60 hour inspections as they come due. The 25-30 hour inspection after engine change is performed between the twentieth and thirtieth flying hours following an engine change. This is an engine "shake-down inspection" period, at which time all special inspections incident to an engine change are performed.

The inspections outlined in this section are arranged to correspond with the columns on the Army Air Forces Form 41B. The following index is provided for convenience in locating the inspections specified for the various components of the XB-35 airplane.

- Bombing
- Communication
- Navigation
- Engine Controls
- Engine Instruments
- Ignition and Electrical
- Fuel System
- Oil System
- Cooling
- Engine Valves
- Manifold and Superchargers
- Propellers and Accessories
- Power Plant - General
- Cockpit and Cabins
- Flight Control Mechanism
- Movable Surfaces
- Fuel Tanks
- Landing Gear
- Wheels, Tires, and Brakes
- Hydraulic System
- Oxygen Equipment
- Airplane - General
- Fire Extinguisher System
- Navigation Instruments
- Battery

BOMBING EQUIPMENT

PRE-FLIGHT INSPECTION

BOMB BAY DOORS.- Check the bomb bay doors, rollers and roller tracks for general condition.

Inspect the bomb bay door actuators and drums for security of mounting. Inspect the cables, pulleys and pulley brackets for possible damage.

BOMB RELEASE INDICATOR LIGHTS.- Test the operation of the indicator lights by placing the switch marked "INDICATOR LIGHTS," located on the bombardier's control panel, in the "TEST POSITION." Press all indicator lights with a finger and check that each light illuminates.

BOMBING MECHANISM SALVO TEST.- Install and cock all bomb releases and release shackles in all bomb bays and close all bay doors. With the master switch "ON," throw the switch marked "SALVO OR EMERGENCY RELEASE," located on the bombardier's control panel upward. All bomb bay doors should start to open and the salvo indicator lights at the pilots' and bombardier's stations, and at the crew's quarters should illuminate. With all the doors completely open, all door indicator lights should illuminate, the release arms on all shackles in all bays should trip in the pre-determined sequence. No arming levers on any shackles should actuate. Verify that all releases have operated by placing the bomb indicator light switch in the "ON" position. Only those indicator lights corresponding to inoperative releases should illuminate.

NOTE

When opening or closing bomb bay doors either independently or simultaneously by means of the door selector switch, always throw the individual door switches prior to operating the door master switch.

BOMB MECHANISM "SELECTIVE" TEST.- Cock two releases in the No. 1 bomb bay and one release in each of the other bays. Set the intervalcontrol "TRAIN SELECTIVE" switch to "SELECT." The pilot light will be on. Press the bombardier's release switch for each of the bomb release mechanisms. Check to see that only one bomb rack release mechanism is tripped with each contact of the release switch. Check the sequence of the bomb bay release. The sequence should be as follows: 1-8, 2-7, 3-6, 4-5.

BOMB MECHANISM "TRAIN" TEST.- Set the "TRAIN SELECTOR" switch to "TRAIN." Cock 50 bomb shackle releases. Set the "COUNTER" switch to correspond with number of cocked bomb rack release mechanisms installed. Depress the bomb release switch. Check to see that all rack release mechanisms have actuated.

NOTE

In both "SELECTIVE" and "TRAIN" tests, all shackle arming and release levers should trip.

NOTE

The pilot light should glow until the "COUNTER" switch returns to the "O" mark.

BOMB BAY NO. 4 EMERGENCY RELEASE TEST.- Cock all releases in bomb bay No. 4 and close the bomb bay door. Trip the bomb bay No. 4 "EMERGENCY" switch. The door should open and when completely open all releases should actuate. No release arming lever should actuate.

BOMB RELEASE SHACKLES.- Check the ease of operation and retention of the arming wires during the bomb release test.

With the bombardier's power supply switch "ON" and the nose fuse arming switch in the "ARMED" position, the arming wire should withstand a pull of 50 pounds. With the nose fuse arming switch in the "SAFE" position, the arming wire must release by a pull of less than 4 pounds.

50-60 HOUR INSPECTION

INTERVALCONTROL (MINIMUM SPACING TEST).- Set the "TRAIN SELECTOR" switch in the "TRAIN" position and the "COUNTER" switch to the "50" calibrated mark. Set the "INTERVAL SELECTOR" dial at the minimum interval in feet between bombs. Wait one minute and then depress the bomb release switch. With a stop watch check the time required for the "COUNTER" switch to move from the "50" mark to the "O" mark. If the time lapse is less than 2.1 seconds or more than 2.9 seconds replace the intervalcontrol.

INTERVALCONTROL (MAXIMUM SPACING TEST).- Set the "TRAIN SELECTOR" switch to the "TRAIN" position and the "COUNTER" switch to the "50" calibrated mark. Set the "INTERVAL SELECTOR" dial at the maximum interval in feet between bombs. Wait one minute and then depress the bomb release switch. With a stop watch check the time required for the "COUNTER" switch to move from the "50" mark to the "O" mark. Replace the intervalcontrol if the time lapse is less than 41 seconds or more than 50 seconds.

100-120 HOUR INSPECTION

BOMB RACK SELECTOR.- Inspect the bomb rack release mechanism for mechanical looseness. Tighten all external screws and nuts. Check all external and internal wiring and connections for frayed insulation and broken wires.

COMMUNICATIONS

PRE-FLIGHT INSPECTION

Check the phone and microphone cords, particularly at the jack plugs, to see that cords have not pulled out.

Check all wiring for damage or potential damage and see that all connections in the junction and jack boxes are tight.

Check the interphone operation at all stations.

Check the operation of all radios.

RC-193 MARKER BEACON.- Inspect all mechanical and electrical connections on the antenna assembly for looseness or breaks. Check the connection of the lead-in wire to terminal TM-201 and the connection of radio frequency cable RG-8/U to the receiver.

See that all connectors are firmly inserted in their respective sockets. Inspect for evidence of excessive moisture.

Moisture may cause binding between the core and the shell of plug PL-108. To remove the plug when such a condition exists, remove the chassis of the receiver from the case and remove the screws fastening the socket assembly. Withdraw the terminal pin block and disengage the pins from the socket. Unscrew the plug. Assemble the socket but do not tighten the screws until an assembled plug is installed to properly align the pins with the shell. Tighten the screws carefully to avoid damaging the terminal block.

SCR-274-N COMMAND RADIO.- Check to see that the proper receiving and transmitting units are installed for operation on the scheduled frequencies. Check the operation of all receiver controls and make certain that the receivers are operating. An aural check on the operation of each receiver should be made by listening to the signals on CW at maximum gain while tuning through the entire band. All receivers, except the unit being tested, must be turned off.

Check the input alignment of each receiver by adjusting knob "E-9" for maximum receiver output while listening to a weak signal. Advance each "INCREASE OUTPUT" control to its maximum position and listen for the electrical noise produced by each receiver dynamotor. The noise should be negligible.

With the airplane engines operating, listen for interference noises produced by the ignition system, generator or voltage regulator. Check each stations's headset cord and plug for open or intermittent contacts. Check the operation of all transmitting controls and note that the antenna currents on "MCW" and "VOICE" are approximately equal. A sidetone signal of approximately 1000 cycle intensity should be heard when operating on MCW of CW. With the "S-50" switch in the "VOICE" position, speech should be audible when the lips are pressed against the microphone.

CAUTION

> Do not operate the equipment on the ground longer than is necessary to complete the operation check. Upon leaving the airplane always set the "TRANS-POWER" and "CW-OFF-MCW" switch in the "OFF" position.

AN/AIC-2 INTERPHONE.- Operate the Radio Compass, the Marker Beacon and the Command radios and check the operation of all radios through the interphone jack boxes and remote gain control units.

Inspect all components of the interphone for security of attachment. Disconnect all plugs and jacks and look for evidence of damage caused by vibration. Inspect them for the appearance of corrosion. Inspect all interphone cables and wiring for breaks in the insulation.

AN/ARN-7 RADIO COMPASS.- This inspection of Radio Compass AN/ARN-7 should be a rapidly performed visual and operating inspection to determine whether the equipment is in working order. Check the sense antenna for proper security and tension. Check condition of insulators, cleaning if dirty and replacing if cracked. Make a visual check for satisfactory security of all components.

Observe mechanical ease of operation and absence of mechanical looseness of controls on all equipment during the operational check which follows.

Place function switch on "COMP."

If control lamp does not light, press the "CONTROL" button until the lamp illuminates. This indicates the transfer relay is working properly when activated from this control box. Notice operation of the dial and meter lights. Turn the "LIGHTS"rheostat and observe the operation of the lamps. Replace burned out lamps and check for the presence of serviceable spares.

Tune through each band and observe the action of the tuning meter, "AUDIO" control, signal strength, accuracy of frequency dial calibration, and indicated bearing of stations of known location. Switch to "LOOP." Operate "LOOP L-R" switch and observe the action of the indicator needle.

Turn the function switch "OFF."

DAILY INSPECTION

This inspection should be a thorough visual and operating inspection to determine whether the equipment is in working order. In addition, check the spare fuse holder for the presence of the spare fuses and the loop antenna housing and mounting for the proper security and condition of the sealing unit. If the housing or mounting are cracked, replace the defective part.

Inspect the dehydrator desiccant for an indication of excessive moisture in the loop dehydrator unit. If the desiccant has a dark blue color, its condition is satisfactory if light blue or pink in color, it must be reactivated as follows:

Detach the rubber or vinylite tube from the cartridge, and remove the safety wire from the mounting clips. Remove the cartridge from the clips. Remove the vented end-cap and screen from the dehydrator assembly, and refill with dark blue desiccant. If no desiccant is available other than that removed, heat the particles in a flat pan, stirring them occasionally, to a temperature of 177°C (350°F), until they resume a dark blue color.

CAUTION

> Do not exceed a temperature of 204°C (400°F) or the activity of the desiccant may be permanently impaired. After reactivation, cool the desiccant, immediately pour it back into the transparent tube and reassemble and remount the dehydrator.

NOTE

> If the dehydrator is not to be placed in service immediately, plug or tape the vent and the opening in the hose connector while it is in storage.

Reinstall the cartridge, replace the safety wire, remove the tape or plug and reconnect the hose.

Check all unit controls for mechanical condition and ease of operation during the check which follows:

Place function switch on "ANT."

If the control lamp does not light, press the "CONTROL" button switch until the lamp illuminates. This indicates that the transfer relay is working properly when activated from this control box.

Notice the operation of the dial and meter lights. Turn the "LIGHTS" rheostat to see that the tuning dial and meter lamps can be dimmed. Replace burned out lamps, and check for the presence of serviceable spares. Tune through each band and observe action of the tuning meter, "AUDIO" control, signal strength, and accuracy of frequency dial calibration.

Switch to "LOOP." Operate the "LOOP L-R" switch and observe the indicator for directional indication. Check the rotation of the indicator needle at both high and low speeds. Observe the smoothness of rotation taking into consideration the fact that the indicator needle varies its speed during a 360-degree rotation due to the compensator quadrantal error correction unit. Tune in a station and check to see if, during 360-degree rotation of the loop, two null signals are indicated. These null signals may be observed by the variation of volume of the audible signal and a decrease in tuning meter deflection.

Turn the "CW-VOICE" switch to "CW" and note the null signal is sharp enough to be used for obtaining a bearing. The 800-cycle note should be heard clearly except when the loop is exactly in the null position.

Tune to a station and switch to "COMP." Observe the indicator reading. Switch to "LOOP." Operate the "LOOP L-R" switch until the indicator pointer is 175 degrees clockwise from station bearing position. Switch back to "COMP" and observe the time it takes for the needle to return to the station bearing. It should take approximately six seconds on a moderately strong signal. Repeat this check by rotating the indicator pointer to a position 175 degrees counterclockwise from the station bearing.

Repeat the preceding check on each band by using a station whose direction is known. The indicator should indicate the correct position of the stations with respect to the fore-and-aft line of the airplane.

Check for intermittent receiver operation, while subjecting control box, receiver, connecting plugs and cordage to jarring.

Turn the function switch "OFF."

25-30 HOUR INSPECTION

SCR-274-N COMMAND RADIO.- Check all tubes with a tube tester and replace those tubes which are indicated as being defective or weak.

100-120 HOUR INSPECTION

AN/RC-193 MARKER BEACON RECEIVER.- Inspect the receiver for deterioration caused by vibration or moisture.

Check the receiver tubes.

CAUTION

> Turn the power switch off before removing any tube from its socket.

Replace those tubes which show a discolored area on the glass immediately above the filament wire.

AN/AIC-2 INTERPHONE.- Remove the covers from the amplifier. Examine each part of the amplifier for evidence of overheating, corrosion and other damage.

Remove the tubes and examine the filaments and contacts. Replace defective tubes.

Replace any defective part found in the amplifier.

Remove the dynamotor dust caps and remove the dust and copper particles with compressed air. Check the dynamotor commutator and brushes for signs of excessive wear or visible damage.

BC-1366 JACK BOXES.- Remove the cover from each jack box and inspect the interior for damage caused by corrosion and vibration. Replace defective jack boxes.

AN/ARN-7 RADIO COMPASS RECEIVER.- Detach the two plugs, tuning shafts, ground and antenna wires from the face of the receiver. Loosen the two fasteners at the lower front corners of the cabinet and remove the receiver. Take the receiver unit to a test bench.

Loosen the knurled nut in the lower center face of the receiver unit. Slide the receiver chassis out of the case.

Test all tubes on a tube checker.

Inspect the radio for loose or dirty tube and plug socket contacts, broken or corroded connections, deterioration of any parts, and dirty chassis.

Replace all tubes found defective and install the serviceable tubes to the identical sockets from which they were removed. Make sure that the tubes are firmly seated in their respective sockets and that all grid caps are tight and are not shorting.

Install the chassis in the case and tighten the knurled nut.

Install receiver unit on mounting.

Check the mounting base screws and the fasteners which hold the radio compass unit to the mounting. Be sure the ground strap is securely clamped to the ground post. See that the loop antenna lead-in is secured and that the braid at each end of the cord is firmly attached to the structure of the airplane.

Attach the two plugs, the tuning shafts, ground, antenna wire and "CW-VOICE" switch-lead to the face of the receiver.

Turn the tuning crank on the radio operator's control box against the stop at the low end of the 850-1750 kc band. Check to see that "ALIGN" mark on each radio-control-box dial is beneath the respective reference line. Hand tighten tuning shafts.

CONTROL BOXES.- Inspect the control boxes for loose plugs, broken or corroded connections, missing and unserviceable lamps, binding tuning drives or controls.

NOTE

> In removing the compass control box, the plug-release screw (at the lower left corner near the tuning crank) must not be loosened until the captive mounting screws have been fully disengaged. To install, tighten the plug release screw first.

RECEIVER ADJUSTMENTS.- Use the function switch to turn the complete equipment on and off, and note whether or not the magnetic compass is affected. Determine the extent of any radio interference in other radio equipment caused by the compass.

AUTOMATIC SENSITIVITY ADJUSTMENT.- The indicator pointer hunting may be controlled by means of the screw driver adjustment marked "AUTO. SENS," located on the radio compass unit panel. Perform the following sensitivity check. Switch to the "COMP" position and tune to a radio transmitting station from 10 to 50 miles distance. Allow time for the loop to reach a null.

Note the bearing indicator pointer azimuth reading.

Switch to "LOOP" and rotate the loop so that indicator pointer is one degree from the reading taken from the "COMP" position.

Switch to "COMP" and again note the reading. This reading should be within 0.5 degree of the initial reading obtained on "COMP" position for proper setting of "AUTO. SENS."

If the sensitivity does not meet the requirements of this check, open the cover plate over the "AUTO. SENS." control and insert a screw driver. Adjust to obtain the desired amount of hunting but maintain a sufficient amount of sensitivity as indicated in preceding steps.

With the function switch in the "ANT" position and the "AUDIO" control in the fully clockwise position, tune through each band with the engines stopped, and note the noise level. Repeat this test with the engines running at various speeds. If any appreciable increase in noise is noted, the aircraft shielding and bonding or the battery circuit filtering must be improved. (Supply voltage should be constant before and during engine run up.)

GENERAL

APPLICABLE TO ALL PARTS.

Inspect all nuts, bolts, and screws for looseness. Do not tighten or loosen glyptalled screws or nuts unless they are loose. If they are loose, remove screws or nuts, apply glyptal replace and tighten them.

Remove all loose solder, dirt, and metallic chips.

Clean the equipment thoroughly.

Remove all traces of corrosion.

Inspect all soldered joints.

Inspect wiring. If wires seem to be breaking from vibration, clamp a soldering lug to the lead and resolder.

Inspect all plug connectors and clean, if necessary.

RADIO COMPASS UNIT.

NOTE

> Do not disturb alignment adjustments. Do not disturb wiring, unless necessary.

Check all tubes, with the exception of loop control tube. If the plate current is less than 80 percent of normal plate current, with 6.3 volts on the heater, replace the tubes. Replace all tubes used over 500 hours.

The loop control tubes JAN-2051 are gas tetrodes, and cannot be checked as simply as high vacuum tubes. It is recommended that they be tested in the following manner: With a 6.3 volts heater potential, apply 250 volts rms through 3000 ohms resistance to the plate. Connect pin 4 to pin 8 at the socket and connect the screen grid to the cathode. With the control grid connected to a variable d.c. bias supply through 100,000 ohms, conduction shall occur at a grid potential of not more than -3.3 volts nor less than -2.1 volts.

Check the d.c. voltage of the control system from resistor R74A to ground. Check this voltage from the terminal to which two wires are connected. During the starting surge load, as the band switch mechanism is operated, this voltage shall not fall below 25 volts, with a 115-volt, 400 cycle power supply.

Inspect the capacitor and drive assembly 189 and remove all dirt and old grease. Lubricate the gears and tuning shaft coupling.

Inspect the tuning capacitors C2 and inspect for dirt between plates. Carefully clean with a pipe cleaner. Do not bend the plates and do not lubricate. Do not blow out with compressed air.

RADIO CONTROL BOX C-4/ARN-7.- Inspect, clean and lubricate the dial drive mechanism and the tuning-shaft coupling.

Inspect the tuning meter I-70-(). Do not open the case. If it is unserviceable, replace the meter.

LOOP ANTENNA.- Clean off all grease and dirt. Inspect the sockets 430, 446, 448, and 449 for corrosion, and clean them if necessary. Inspect the fit of the loop mounting and tighten it if necessary. Remove the loop housing 454 and, with drive mechanism operating, slightly retard the motion of the loop 455, by hand, to determine whether the drive system is operating satisfactorily. Inspect the loop housing for damage and replace it if necessary. The entire loop assembly must be kept well sealed for efficient operation of the dehydrator. Reseal loop housing.

LOOP AND DEHYDRATOR CHECK.- When slowly rotating the loop, with "LOOP L-R" switch, the indicators should operate smoothly. If they do not, check the autosyn-transmitter and compensator mechanism to determine the cause of the trouble. If an attempt has been made to apply more than a 20-degree radio compass deviation correction, the cam strip 456 may be bent, causing jumpy pointer action. If this is the case, return all adjusting screws toward their zero correction position, and proceed carefully in a manner which reduces the stress at all positions. If, with no correction applied, the cam strip is still kinked or uneven, it will be necessary to install a new compensator unit.

INDICATOR.- Inspect the indicator. Rotate the loop at slow speed to see if the pointer follows the loop rotation without sticking, jerking, or fluttering.

INDICATOR (NAVIGATOR'S).- Inspect the indicator. Rotate the loop at slow speed, to see if the pointer follows the loop rotation without sticking, jerking, or fluttering. Before concluding that the indicator itself is responsible for erratic pointer action, decide whether the compensator is causing the trouble. Use the "VAR." knob to rotate the graduated scale; it should rotate without binding and yet have sufficient friction to prevent it from vibrating from the position to which it was originally set.

RELAY.- Inspect and clean all contacts, including relay RE8, with carbon tetrachloride. Dress the leads, if necessary. Make sure that the armature pigtails of the ON-OFF relay RE8 will not touch the side of the case when installed. If it is apparent that the relay is operating satisfactorily, nothing further should be done.

Check all short switch clips for correct switch operation. As each blade passes through a clip, the clip should move indicating that good contact is being made.

The small spring operated detent at the ratchet side of the motor should operate once per step to prevent reverse stepping.

PERFORMANCE TEST.- Assemble the equipment, and measure its performance. Vibrate the equipment; there should not be any clicks or increase in noise, with and without r.f. input. If the equipment is noisy or fails to meet the performance requirements, re-examine it until the trouble is discovered and eliminated.

WIRING AND MISCELLANEOUS UNITS.- Inspect wiring at mounting FT-224-A and socket 224 of the radio control box for abrasion or possible shorts. Inspect aircraft bonding. Assemble the equipment, and secure with safety wire. Inspect the antenna lead-in, and replace it if necessary.

IGNITION AND ELECTRICAL

PRE-FLIGHT AND DAILY INSPECTION

IGNITION SYSTEM.- Check all switches and controls located on the pilots' and engineer's panels for security of mounting.

Replace all obliterated name plates and decals.

Inspect the engine ignition units for security of mounting.

See that all ignition system wiring connectors are tight and safetied and that their joints are properly soldered.

The ignition system may be checked by operating each engine at one-third throttle and turning the ignition switch to the "OFF" position. The engine should stop firing immediately. If the engine does not stop firing immediately, turn the fuel supply to the "OFF" position, and check the electrical system for defective ground connections.

WARNING

Do not touch the propellers until the engine becomes cold or the defect is located and corrected.

NOTE

Freedom from engine vibration is a good indication of proper functioning, particularly of the ignition system.

LIGHTS.- Check all lights both interior and exterior to see that they are functioning properly. Visually inspect the electrical wiring and see that all connections are secure and all insulation covering intact. Check for stowage of extra bulbs and extra fuses.

ALTERNATOR.- Check the alternator output by operating the auxiliary power units at approximately 2160 rpm. Hold the frequency and voltmeter switch to operate first the left-hand unit and then the right-hand unit and check the voltmeter for the required indication of approximately 208 volts at 400 cycles. The two voltage regulator switches should be tested at this time with the voltmeter on to check for operational controls.

GENERATORS.- Check the generator output by placing the generator switch in the "ON" position with some load, such as lights, on the system. The ammeter should indicate a reading.

Check the generator mounting bolts for security. Check for defective mounting studs, loose nuts, and loose or broken safety wires or cotter pins. Check for cracks in the mounting flange. If cracks are found, replace the generator.

After each flight of one hour or more above 25,000 feet, check the brush springs and brushes. Check for discolored, misshapen springs, and springs having abnormally high or low pressure in comparison to the majority of the springs. Check for sticky brushes. If the brushes (and commutator) are greasy, oily, or dirty, or if the commutator has high bars, the generator requires overhaul.

Check for excessive wear of the brushes. Brushes worn down to 11/16-inch must be replaced. Replace defective springs or brushes.

CAUTION

When the main gear wheel wells are to be cleaned, cover the generators to protect them from the cleaning fluid.

Check the landing lights for proper operation and extension.

25-30 HOUR INSPECTION

ELECTRICAL SYSTEM.- Visually check all wiring for damage. Look particularly for chafed insulation.

Check all rheostats for damage, loose mountings, and missing decals or obliterated stencils.

Check for loose connections and security of access plates at all junction boxes.

GENERATORS.- Inspect all generators to see if their terminal connections are properly soldered and provide proper contact.

Check the condition of the generator terminals.

Inspect the generator and power control panels for security of mounting and proper wiring connections.

Check the generator for security of attachment and proper safetying.

SWITCHES.- Inspect all electrical switches for security of connections, correct operation, and general condition. Where it is practicable inspect the condition of the switch contacts.

Check all connector plugs for proper insulation. See that electrical tape is wrapped four times clockwise around the connector nut with the wrappings continuing to the connector plug body. Shellac the entire wrappings. Check all conduits for breaks or wearing and for security of attachment. Check all cable plugs for clearance.

IGNITION SYSTEM.- Remove all spark plugs. Clean, check the gap, and bomb test, before replacement.

Check all high tension lead insulators and springs before replacing the plugs. Replace any burned insulators and bent or weak springs. Tighten the ignition shielding nuts.

Check for adequate spark plug connections. Check the condition of the high tension leads flex cable. If breaks are found, repair or replace as necessary.

Check for damaged spark plug elbows. Even slight dents or defects are reason for replacement.

Install the spark plugs and tighten them to a torque of not less than 300 foot-pounds or more than 360 foot-pounds.

Check the elbow terminals and shielding nuts for security. When tightening the elbow assembly of the shielded plugs the barrel must not be loosened. Exercise care to see that the barrel is not rotated within the shell.

MAGNETOS.- Remove the magneto breaker cover and inspect the cam and breaker assembly.

Check for damaged breaker felts, breaker arm spring and see that the stop-clearance is properly adjusted. Inspect the magneto for loose arm bushings and excessive arm axial play.

Lubricate and adjust the breaker points. Remove excessive lubrication with gasoline. Dry the assembly with compressed air and then apply 3 or 4 drops of engine oil grade 98, Specification No. AN-VV-O-466.

50-60 HOUR INSPECTION

MOTOR GENERATOR.- Inspect the generator for security of mounting. Check that it is clean and that no excessive amount of lubrication is evident.

Check the generator brushes to see that they are not shorter than 1/4 inch below the edge of rivets. Check the brush spring tension for the required 24 ounce pull.

Check the generator for possible loose rocker rings in the mounting bracket. If they are loose replace them and their attaching screws. Check the commutator for smoothness of action and freedom from surface pitting.

See that the brush band felt lining is cemented to the inside of the brush opening to insure a tight fit. Inspect, clean with compressed air and lubricate the field ring assembly. Clean the generator housing with gasoline or kerosene, and dry it thoroughly with compressed air.

Check the terminal nuts for tightness.

REVERSE CURRENT RELAY.

CAUTION

Make certain that all electrical current is off when checking the reverse current relay.

Check the operation of the relay by applying approximately 30 volt d.c. between the "NEG." and "GEN." See if the relay contacts close. Check the operation of the contactor by closing the relay contacts manually, and apply 20 volt d.c. between the "SW" and "NEG," to insure that the contactor is in operating condition. If the contactor should close, the contactor is in operating condition but the reverse current relay is inoperative. If the contactor does not close, it is either out of adjustment, the coil is open circuited, or the relay holding coil may be open circuited.

Blow out dust and dirt with compressed air.

Inspect for magnetic chips in the relay and remove them if found.

Check for burned or pitted contacts.

Check the terminal connections for tightness.

ALTERNATOR.- Remove the alternator cover and brush holder located at the forward end of the alternator below the armature junction box. Inspect the slip ring and if it is dirty or discolored, clean it by holding a piece of No. 000 sandpaper against it while slowly turning the rotator. If the slip ring is rough or worn remove the rotor and replace it.

Inspect the alternator brushes and brush holders. The brushes should slide freely in their holders and should be free from any evidence of oil. Replace brushes worn to 1/2-inch in length. Replace cracked brush holders.

STARTER EXCITER.- Remove the cover at the rear end of the starter exciter, loosen the self-locking nuts on the outer pair of terminal nuts. Remove the brush holder plate and withdraw the brush holder assembly. Inspect the commutator. If it needs resurfacing, replace the entire starter exciter unit. Inspect the brushes, and check the brush holder for freedom of movement on the pivot. Replace brushes worn to 1/4-inch in length.

BATTERY CURRENT RELAY.- Inspect the battery circuit relay for security of mounting and condition of wiring.

ELECTRICAL.- Inspect the generator for cleanness, excessive arcing, sticky brushes, and worn commutators.

Inspect the generator terminal cables for proper covering with friction tape.

Check all solenoid switches for proper operation.

Inspect all wiring for security of attachment.

Check all conduit connector nuts for tightness.

Check the bonding braid terminals for security and possible damage.

IGNITION SYSTEM.

IGNITION SHIELDING.- Check the ignition shielding for proper attachment.

Check the voltage regulator contact points for condition.

GENERATOR.- Disconnect the ventilation tube and visually check for any defects.

Remove the air blast cover and check for dents, grease, oil, or dirt. If dents are present, gently tap them out. Wipe out the inside of the air blast cover with carbon tetrachloride, Army Specification No. 4-503-110B.

Check for loose or broken safety wires, loose or broken screws, and cracks in the end shield. Replace the generator if cracks are found.

Check for broken safety wires, loose or broken screws, loose brush holder yokes, or loose brush terminal screws, burned or otherwise defective inside cross connector, loose or broken outside cross connector, loose brush holder.

Check for dust, dirt, grease, or oil on the commutator.

Check for loose or unsoldered connections between the armature coil terminals and the commutator riser.

Check the commutator surface for scoring or uneven wearing, high or low bars, dull-black patches along the edges, or dull-black brush tracks.

Check for dust and dirt in the receptacle and plug, loose or broken safety wires, loose screws, or a loose terminal box cover; misshapen, burned, or discolored terminals, loose terminal box, or cracks in the terminal box and cover. If there is dust or dirt in the receptacle or plug, blow it out with dry compressed air. If there are loose or broken safety wires or screws, tighten or replace them as necessary. If there are other defects, replace the generator.

NOTE

> If the terminals are defective, the connector plug may also be defective. If so, remove it and install a serviceable one.

Make a visual inspection of all internal and external wiring for possible grounded, shorted, or broken leads, and for burned, cracked, or unserviceable insulation. Examine all terminal connections for corrosion, and make sure they are tight. Polish corroded terminals with a fine abrasive. If the internal wiring is damaged, replace the starter.

Check all mounting nuts for security and see that all safety wire is in place.

100-120 HOUR INSPECTION

IGNITION SYSTEM.- Remove the cover from each magneto. Clean the inside of the electrode shield and distributor rotor with a clean cloth.

Check the magneto for cracks. If cracks are found in the magneto case replace the magneto.

Remove oil from the breaker plate or points with a chamois moistened in acetone, Federal Specification No. O-A-51A. DO NOT USE CARBON TETRACHLORIDE and do not leave any foreign substance between the points.

CAUTION

> Do not use a file, emery paper, or any other abrasive on the points.

Lubricate the cam oiler with oil Specification No. AN-O-6. Check to see that the oil wick rubs against the cam.

Check the coil contact for burns or dirt. If it is dirty, clean it with No. 0000 sandpaper.

Check to see that the ground terminal is secure.

Check the breaker-open interval.

Replace the spark plugs.

Check to see that all nuts on the detachable leads and spark-plug elbows are tight.

Check to see that the lead clips are tight.

Check the performance of the entire ignition system with the engine running.

STARTERS.- Visually inspect the starters for housing failures or cracks, especially at the mounting flange. If any cracks or other damage are noted, replace the starter.

Remove the window strap from the motor housing and carefully examine the underside for the presence of oil and particles of copper, solder, carbon, insulation, or other foreign matter. If such is found replace the starter.

Check the tension on the brush springs with the springs raised 7/16-inch above the top of the brush box. The tension must be the same on each spring. If one or more springs are weak, replace the brush springs.

Brushes should fit freely in the brush boxes. Binding brushes and brush boxes must be wiped clean with a cloth moistened in dry cleaning solvent, Federal Specification No. P-S-661. Replace brushes worn down to 3/8-inch.

Inspect the contact surface of the commutator for roughness and color. An even highly burnished copper color indicates satisfactory operation. If the commutator is dirty, clean it with unleaded gasoline, Specification No. AN-F-22. DO NOT USE CARBON TETRACHLORIDE on an abrasive. If the commutator is badly scored or pitted, replace the starter.

200-240 HOUR INSPECTION

REVERSE CURRENT RELAY.- Check the reverse current relay for corroded connections, loose mountings, adequate contact pressure and damaged parts.

SPECIAL 300-360 HOUR INSPECTION

Inspect the landing lamp plunger and stud assembly. If the stud at the end of the plunger measures less than 1/16-inch replace the assembly.

500-600 HOUR INSPECTION ENGINE CHANGE

INDUCTION VIBRATOR.- Change the induction vibrator elements.

STARTER.- At the time of engine overhaul, replace the starter.

LANDING LIGHTS.- Remove the retractable landing light assemblies and replace them with new or reconditioned ones.

MOTOR GENERATOR.- After 500 hours of operation remove the generator and replace it. Send the removed generator to a repair depot for a general inspection and overhaul.

ENGINE CHANGE

REVERSE CURRENT RELAY.- Remove the reverse current relay and replace it. Send the replaced relay to an overhaul depot for repairs.

ENGINE CONTROLS

PRE-FLIGHT INSPECTION

CONTROL CABLES.- Inspect all engine control cables for broken wires. Replace cables with three broken wires in any one-inch length of cable.

Check all cable pulleys for ease of operation and possible damage. Inspect pulley brackets for firm attachment to the airplane structure.

CONTROL LINKAGE.- Test all cables, push-pull rods, and bell cranks for freedom of movement and for possible excessive play in the linkage.

Remove any accumulated grease or dirt from the cables or rod tipped bearings, with a water dampened cloth.

Check the synchronization between the movement of the engineer's and pilots' engine control pedestals.

25-30 HOUR INSPECTION

CONTROL CABLES.- Check the throttle and mixture control cables for the required tension. See Section IV, paragraph 9. Check along the entire length of the engine control system and test the controls for the proper freedom of movement, for clearance and for possible obstruction.

Check the control system for evidence of excessive play in the linkage.

Check all engine control cables for clearance and damage.

Test the engineer's and pilots' engine controls for the proper synchronization of movement and freedom of action.

Test the operation of the engineer's throttle brake.

FUEL SYSTEM

PRE-FLIGHT AND DAILY INSPECTION

Drain all booster pumps, fuel tank sumps, and cross-feed valve drains, and safety.

Check all vent, drain, and overflow lines for security of attachment and freedom from obstruction.

Check all fuel lines for evidence of leakage and security of attachment prior to the engine ground check.

Check the surface immediately beneath the fuel tanks for evidence of fuel leakage.

If leakage exists, remove the fuel tank doors and make adequate repairs.

Check for fuel leaks at the tank filler neck and at fuel line connections.

Check all fuel lines and vents for evidence of deterioration, chafing, and security of attachment and freedom from obstruction.

Check the accuracy of the liquidometers by comparing the readings with the known quantity of fuel in the tanks.

After the engine ground check, carefully inspect for fuel leaks.

Check that all fuel tanks are filled to capacity and that fuel liquidometers indicate corresponding figures.

Check wiring at the bottom of the fuel pumps.

Check the wiring connectors at the fuel valves for possible twisting of wires. Check that the liquidometer plugs are tight.

Operate the selector switches and test the fuel valves and fuel pumps for correct operation.

Operate the selector switches and see if the selector valves operate properly.

EMERGENCY FUEL SHUT-OFF VALVES.- Inspect the emergency fuel shut-off valve control cables, pulleys and pulley brackets for security of attachment and possible damage.

During the engine warm-up check the emergency fuel shut-off valve operation.

25-30 HOUR INSPECTION

Check the cross-feed and selector valves for security of mounting, leaks, and proper operation.

Remove the carburetor fuel strainer and clean it with kerosene, Federal Specification No. VV-K-211; replace and safety.

Turn the booster pumps on; operate the fuel tank selector valves and see if the booster pumps turn on when their tanks are selected.

Lubricate the carburetor control linkage with oil, Specification No. AN-O-6.

FUEL PUMPS.- Inspect the fuel pumps and drain valves for leaks, security of attachment and tightness of connections.

CARBURETORS.- Check the carburetors for general condition, security of attachment and security of control linkage.

FUEL STRAINERS.- Remove, clean and inspect all fuel strainer screens. Replace damaged screens.

FUEL LINES.- Check all fuel lines for leaks, tightness of fittings and connections. See that all fuel hose sections are in good condition and that fuel clamps are secure.

EMERGENCY FUEL SHUT-OFF VALVES.- Check the emergency fuel shut-off valve control cables for the proper tension. Inspect the entire cable system for clearance.

Check the fuel valve control for binding and security of linkage.

Check the condition of the fuel valve control cables. Replace any cable in which more than three broken strands appear in any one-inch length of cable.

LIQUIDOMETER.- Check the fuel liquidometer transmitters for security of attachment to the fuel tanks. Check the fuel lines to the fuel pressure transmitters for leaks, chafing and tightness of fittings.

Check the liquidometer connector plugs for tightness.

DRAINS.- Inspect the overflow drain and vent lines for chafing and security of attachment. Inspect all fuel drains for proper safetying.

FUEL BOOSTER PUMPS.- Inspect the fuel booster pumps for leaks at the mounting and at the pump drain. Check the pump drain safety wiring.

Check the wiring connected to the bottom of the booster pump for damage to the wiring or wiring insulation.

Remove the fuel-pump valve relay cover plug and clear the vent hole of obstruction.

50-60 HOUR INSPECTION

Check the throttle-mixture controls for secure linkage.

Lubricate the throttle shaft with oil, Specification No. AN-O-6.

Inspect the fuel-pump coupling for wear.

Inspect the electrical connections to the fuel booster pumps for security of attachment and evidence of deterioration.

Check the fuel pump pressure line to the relief and check valve assembly for security and condition.

200-240 HOUR INSPECTION

Remove the carburetor. Flush the carburetor with solvent, Federal Specification No. P-S-661, and reinstall.

SPECIAL 300 HOUR INSPECTION

Remove the booster pumps, clean the screens with solvent, Federal Specification No. P-S-661 and inspect for defects.

SPECIAL 2000 HOUR INSPECTION

Replace the booster pumps.

OIL SYSTEM

PRE-FLIGHT INSPECTION

See that all oil supply tanks have been filled to the limit of their capacity.

Check along the length of all oil lines for evidence of leaks particularly at connections and fittings. If leaks are found, tighten the fittings and connections, and if this does not eliminate the leakage, replace the fittings.

Check the oil lines to the oil pressure transmitter for security of attachment.

Check all oil system lines, pumps and valves for possible leaks and security of attachment.

Check the oil system overflow lines for freedom of obstruction.

When operating in cold weather, open the drain cocks at the bottom of each oil tank sump and remove the water and sediment. Replace and safety the plug.

Remove the drain at the bottom of each oil cooler and remove the water and sediment. Replace and safety the drain.

DAILY INSPECTION

Disconnect the oil inlet line at the pump and drain sufficient oil to determine that no obstructions exist in the line. Reconnect the oil line.

Check the flow from the oil drain. Clean the filter with solvent, Federal Specification No. P-S-661; replace and safety the plug.

Fill each oil tank.

Check the oil cooler and oil cooler inlet and outlet lines for security of attachment and connections.

Check the oil dilution valve for satisfactory operation.

25-30 HOUR INSPECTION

Check the oil level indicators and see if their reading corresponds to the known level of oil in the tanks. Test the transfer pumps for proper operation. Test the oil dilution and diversion system for proper operation.

Check the oil tanks for damage.

Check all oil lines for security of attachment, and damage.

Check the hose connections and the attaching clamps for general condition and security.

Clean all removable oil system screens with kerosene, Federal Specification No. VV-K-211.

Inspect the oil cooler shutters for proper operation and general condition.

Inspect the oil cooler by-pass valve for security of attachment.

50-60 HOUR INSPECTION

Inspect the oil tank vent lines and oil coolers for security of mounting, general condition and clogging.

Inspect the area around each oil tank for signs of leakage and for proper anchorage of lines leading from the tanks.

Inspect the oil dilution valve by disconnecting the dilution line from the oil line and, with fuel pressure maintained by the booster pump, operate the oil dilution switches on the instrument panel. With the switches open, there should be no leakage through the solenoid valve.

Remove the engine oil sump plug and drain the sump. Replace and safety the plug.

100-120 HOUR INSPECTION

Thoroughly check the entire oil system lines, connections and fittings, tanks, and cooler for damage or any signs of leakage.

Open all drains, remove all screens, and clean with kerosene, Federal Specification No. VV-K-211. Safety the plugs when they are reinstalled.

ENGINE CHANGE

Replace the oil coolers at the same time that the engines are overhauled or changed. Remove and replace the oil pump. If no replacement is available, the original pump may be reinstalled after being dismantled and checked. Replace the gaskets.

Flush the oil system with kerosene, Federal Specification No. VV-K-211.

CAUTION

> When using kerosene for cleaning, take regular precautions against fire.

<u>ENGINE VALVES</u>

ENGINE CHANGE

Under normal conditions, the valve mechanism will require no adjustment between major overhauls of the engine.

<u>COOLING SYSTEM</u>

PRE-FLIGHT INSPECTION

CABIN AIR VALVES.- Test these valves during engine run-up in the following manner: Move the "RH" and "LH" switches (Engineer's Upper Switch Panel) to the "Open" positions. Move the "Supercharged-Unsupercharged" switch to the "Supercharged" position. Check for air-flow into the crew nacelle. After checking, return the switches to the "Close" and "Unsupercharged" positions.

CAUTION

> When checking the operation of the selector valves do not operate the valve actuator drive motors for more than one minute of continuous operation. For each minute of operation the drive motor must be allowed nine minutes for cooling.

25-30 HOUR INSPECTION

RAMMED AIR FILTERS.- Remove and clean the carburetor rammed air filters. Re-oil the filters.

RAMMED AIR VALVE LINKAGE.- Check the rammed air valve linkage for lost motion, clearance and synchronization, during the operation.

COOLING AIR DOORS.- Check the degree the cooling door opens at the time the microswitch is energized.

TURBO CRUISE VALVE LINKAGE.- Check the turbo cruise valve linkage for lost motion and clearance.

Check the turbo cruise valve actuator for security of mounting and its proper electrical connection.

100-120 HOUR INSPECTION

CABIN AIR CHECK VALVES.- Remove the lid from each subassembly switch box and check the wiring for burns and the insulation for abrasions. Check to see that all screws and bolts of the valve assembly units are secure.

AIR FLOW SELECTOR VALVES.- Inspect the valves for loose bolts and screws and tighten as necessary.

Remove the cover from the control box of each actuator subassembly and inspect the wiring for burns and abrasions.

<u>MANIFOLDS AND SUPERCHARGERS</u>

25-30 HOUR INSPECTION

MANIFOLDS.- Check the engine intake and exhaust manifolds for general condition and security of attachment. See that there are no leaks around the manifold gaskets. Replace those gaskets which are worn.

EXHAUST SYSTEM.- Check all exhaust castings for burned areas or cracks caused by intense heat.

Check the attachment of the exhaust castings to the cylinder exhaust outlets.

EXHAUST SHROUDS.- Check the exhaust system for hot spots appearing on the shrouds, which indicate damaged exhaust stacks. Check that the shrouds are securely buttoned and fastened. Check that the exhaust system shroud blankets are free from evidence of any oil. Inspect the exhaust system heat exchanger box for security of attachment.

Check the heat exchanger box and nozzle box duct for leaks around the attaching flanges.

Remove any accumulation of exhaust scale formation from the exhaust manifold by tapping them with a mallet and brushing them clean with a wire brush.

WIRING.- Check the wiring between the engine and the main turbosupercharger boxes for loose connections.

Check the connectors at the amplifiers, motors, and governors for solder joints and wire safety.

CAUTION

Do not disconnect connectors with the current on.

Check the operation of the wastegate motor linkage and boost selector by disconnecting the pressuretrol plug and connecting a test potentiometer in place thereof or by disconnecting the carburetor deck pressure line at the pressuretrol and connect the hose to the inlet at the pressuretrol. Then blow or suck at hose to simulate carburetor pressure.

Check the amplifier tubes to see that they are not loose in the sockets. Remove the amplifier installed, test the spare amplifier and then replace the original. Check the pressuretrol wiper for cleanness. Tighten the pressuretrol wiper shaft.

Check the nozzlebox and cooling-cap bolts for looseness or broken safety wire.

Check the turbosupercharger oil lines for leakage.

SUPERCHARGER.- Check the nozzle box and bucket wheel for the proper clearance.

Check the gap between the cooling cap and the bucket wheel for the proper clearance. Inspect the nozzle box for cracks. Check the air induction system, ducts, joints, and gaskets for proper attachment.

Check the turbosupercharger for security of mounting. Check all electrical wiring connections to the turbosupercharger regulator. Inspect the turbosupercharger boost control linkage for proper operation and freedom of movement.

50-60 HOUR INSPECTION

TURBOSUPERCHARGER REGULATOR.- Check all the mounting bolts on the turbosupercharger regulator control box for tightness.

Check all electrical wiring for proper connection to the turbosupercharger regulator control box. Check that the linkage control is properly adjusted.

Check all pressure connections between the regulator control box and the points where the pressure-sensing line connects to the turbosupercharger compressor. Tighten any loose connections. Check the mechanical linkage between the turbo regulator control box and the wastegate, and see that it is adjusted properly.

Inspect the electric wiring, from the airplane power supply to the regulator control box and from the regulator to the overspeed generator, for damage to the insulation.

Inspect the three-prong electric connector on the overspeed generator for loose wires and for tightness. Fasten any loose wires with tape, and tighten the connector if it is loose.

Inspect the flexible cable running from the turbo oil pump to the overspeed generator for tight connections or damage. Tighten any loose connections, and replace the cable if it is damaged.

Open the drain cock in the pressure-sensing line to drain any accumulated moisture.

CAUTION

Close and safety the drain cock.

100-120 HOUR INSPECTION

TURBOSUPERCHARGER.- Check the total side (radial) and end (axial) play of the rotor.

Check the turbosupercharger mounts and brackets for security of attachment. Test the turbosupercharger bucket wheel for freedom of rotor rotation, mechanical damage, cracks, "mushrooming," nicks, stretching, broken buckets and similar damage.

Check the bucket wheel runout. Carefully check the turbosupercharger lubrication system for leaks, especially at the line fittings If leaks exist, tighten or replace fittings or damaged lines.

DUCTS.- Check all ducting of the exhaust system for damage and security of attachment.

Clean all ducts with solvent, Federal Specification No. P-S-661.

Remove air filters and clean with solvent, Federal Specification No. P-S-661. Blow the filters dry with compressed air, dip them in hydraulic oil, Specification No. AN-VV-O-366, and reinstall.

PROPELLERS AND ACCESSORIES

PRE-FLIGHT AND DAILY INSPECTION

OPERATION CHECK.- With the engines running at reduced throttle, set the control switches for constant speed and operate the propeller control several times through its entire range Check the pitch change by means of the pitch indicator, or by changes of rpm and manifold pressure.

Place the control switches for lock-pitch at an intermediate blade angle position. Increase and decrease the governor controlled setting. There should be no change in the blade angle setting and the rpm should remain constant.

With the propeller set for constant speed operation at 2000 rpm, move the throttle back until the speed drops to 1900 rpm. Push the throttle rapidly from the 1900 rpm position to full open. Engine speed should not exceed 2300 rpm and should return to 2000 rpm within 5 seconds.

NOTE

The time limit given for each of these operations is the maximum allowable. If the operation requires any longer to perform, it is an indication that the propeller is malfunctioning. Stop the propellers and check for the trouble immediately.

Move the control switches into the reverse position with the throttles set for 30 inches Hg. at 2000 rpm. The blade should attain the reverse position within 2 seconds. Place the switches into the unreversed position. The blades should move into the governor position within 2 seconds.

With the engines operating at 2000 rpm at 30 inches Hg, check propeller feathering.

With the engine operation at approximately 30 inches Hg manifold pressure, place the propeller control switches into positions of increase pitch and decrease pitch and check that the tachometer responds correctly at each propeller position.

PROPELLER BLADES.- Inspect all blades for bends, nicks, cracks, and raised edges, and repair those damages before the next flight.

Wash the propeller blades with thoroughly clean fresh water, dry completely and then apply a thin film of clean engine oil. If propeller roughness has been reported check all blade angle settings with a bubble protractor at each blade reference station. Oil leakage from the blade tip vent hole shall be cause for immediate investigation.

HUB.- Check all external cotter pins, bolts and safety wire for proper fastenings.

Check for oil leakage at the pump attaching bolts, pump hub seal, pump seal cover plate and rotating seals. If by tightening the securing nuts small leaks cannot be stopped, replace the unit.

Check the hub oil level with sump plug at its highest point. If necessary, add Pennsylvania Crude SAE No. 10 oil.

SPINNER.- Before installing the spinner on the propeller hub, check the shell for visual evidence of damage. Install the spinner shell on the propeller hub and tighten the screws securely.

PROPELLER CONTROLS.- Inspect the propeller control hydraulic unit for leakage of oil between the parting surfaces. If after tightening the nuts the leakage continues, replace the unit.

PROPELLER GEAR BOX.- Inspect the propeller gear box assembly each day for oil leaks, broken or damaged safety wires or loose nuts.

25-30 HOUR INSPECTION

BLADES.- Replace those propeller blade markings that have become indistinct.

SPINNER.- Check the spinner attaching screws for tightness and the spinner shell screw holes for elongation or distortion. Inspect the spinner for dents, nicks, pulled rivets, or similar damage.

50-60 HOUR INSPECTION

PROPELLER GEAR BOX.- Remove and clean the gear box oil screen with solvent, Federal Specification No. P-S-661. Replace the screen in the gear box.

100-120 HOUR INSPECTION

Remove the hub and blade assemblies from the propeller shafts. If oil leakage is apparent at the rotating seal, remove the thrust ring assembly from the pump and the rotating seal assembly from the translating control and repair if possible or replace if necessary.

Remove the distributor valve cap, the valve assembly, and the cam. Examine the valve sleeve for roughness and smooth with crocus cloth if necessary. If the roughness is excessive, replace the sleeve. Check the distributor valve for freedom of movement after cleaning the assembly with solvent, Specification No. P-S-661. Dry the assembly thoroughly with compressed air. If the valve sticks, disassemble from the sleeve and repair or replace as necessary. Remove and clean the strainer bolt. Install the bolt and tighten to a torque of 50-55 pound-feet.

Inspect the rear cone and rear cone seat of both the 60 and 80 components for roughness and for metal particles.

Check the pump for freedom of movement by rotating the eccentric.

Examine the control idler gears for freedom of movement and evidence of wear. Remove the hydraulic unit and the auxiliary motor-wiring harness unit in preparation for installation of the hub and blade assembly. Install the hub and blade assemblies and check the distributor valve setting. Attach the hydraulic units and the auxiliary motor-wiring harness.

200-240 HOUR INSPECTION

Remove the hub and blade assembly and the control assembly.

Disassemble and completely overhaul both assemblies.

SPECIAL INSPECTION

When an object strikes the propeller blade, stop the propeller as soon as possible and make a complete examination of the blade.

Magnetically inspect all stressed steel parts of the propeller.

POWER PLANT - GENERAL

NOTE

Since a visual inspection of the power plant and its accessories is no guarantee of satisfactory operation, a pilot's check list is provided in which is set forth all operations relevant to the engine and accessory ground check. Items appearing on the list which have no apparent connection to the engine and accessory check, are necessary as safety measures prior to starting the engine. All procedures outlined in the list must be carried out before the airplane is certified to flight.

25-30 HOUR INSPECTION

Check the cylinders for damaged or broken cooling fins and baffles.

Check the neoprene dust connections for leaks, cracks, abrasions, and loose clamps.

Check the ignition shielding assembly for security of attachment and tightness of union nuts.

Visually check the entire engine and mountings.

Look particularly for evidence of corrosion; loose or missing bolts and nuts; broken or missing safety wire; cracked or broken mounting flanges of cylinders and engine accessories; fuel, oil, or water leakage; damage to or chafing of plumbing and electrical leaks in the accessory section.

Check to see that all hose clamps are in place and properly safetied.

Visually check to see that all control cables and rods are connected and in satisfactory operating condition.

Check the rocker box covers for leaks and replace gaskets as necessary.

See that the rocker box cover gaskets are in good condition before replacing the covers.

Check the carburetor, its lines, and accessories for security of attachment and evidence of leakage.

50-60 HOUR INSPECTION

Inspect the cylinders for general condition.

Inspect the deflectors for security of attachment. See that they do not rub the fins.

Check the cadmium plating on the engine mounts and steel fittings for abrasions. If any part of the plating has been removed, clean the damaged area, and coat it with zinc chromate primer and aluminized lacquer.

Check the tightness of the rocker-box-cover stud nuts; oil sump attaching nuts; intake pipes; push rods; and all engine accessories.

ENGINE CHANGE - "SHAKE-DOWN" INSPECTION

Check the intake pipe packing-nuts for tightness.

Check the valve clearances. Check for broken valve springs.

CREW NACELLE

PRE-FLIGHT INSPECTION

Check the electrical terminal panels located under the cockpit floor, for possible wire damage, loose connections, and for the presence of loose nuts, screws, rivets, washers, or metal chips, which might cause short circuits.

Check all wiring throughout the cockpit area for loose connections and damage, particularly where the wiring clamps attach to the floor stringers. Inspect the wiring at the left of the copilot's position where it passes close to control cables and other movable units.

Check all cockpit lights for proper illumination.

Check the pilots' seats for security of mounting and proper operation, and check the belts for general condition.

Check the inside of the crew nacelle and secure or remove all loose equipment.

Check the door hinges for safeties. Check the emergency exit door seals.

Check the lavatory for cleanliness, and see that all soap and paper are in the racks.

Clean the windows and canopy; check for loose glass and for security of the canopy and astrodome.

Check the hand fire extinguishers for seals and for security of mounting.

Check the cabin lights, instrument panel light. navigation lights, and landing lights.

Inspect the pilots' rudder pedal assemblies for proper functioning of all parts, lost motion, or binding. Check for proper neutral position of the rudder pedals when the rudders are in neutral position.

Inspect the rudder-pedal-assembly attaching brackets for security of mounting, cracks, or other defects.

Inspect the pilots' control columns and wheels for general condition, and proper functioning of the parts; noting especially any binding in the action of the control wheels.

Inspect the outer skin surfaces for visible signs of corrosion.

Inspect the entire structure for pulled rivets; buckled or rumpled skin; bent and distorted longerons, stringers, or bulkheads.

Check visible bolts, nuts, pins, and brackets for tightness and firm attachment.

Check all doors to see if they are fastened securely, fit properly, and provide smooth fairing with the adjoining structure.

Inspect the emergency release mechanisms for proper operation.

Check the crew nacelle enclosures for cracks, holes, or blurred areas. Repair or replace damaged enclosures.

25-30 HOUR INSPECTION

Inspect all accessible parts of the interior and exterior of the airplane for bent structural members and braces; cracks, particularly at sharp bends; loose bolts or rivets; proper attachment and condition of inspection doors, covers, fairings, condition of windows, and enclosures.

Inspect the pressure sealing strips.

50-60 HOUR INSPECTION

Check the airplane for internal structural damage as evidenced by distorted or rumpled skin.

Inspect for elongated bolt holes and tightness of bolts.

Inspect for corrosion.

Inspect the security of attaching bolts around the crew nacelle plexiglas canopies.

Inspect the security and condition of loose equipment tie-down straps.

When the inspection plates are removed, examine the condition of all the fibre stop nuts.

FLIGHT CONTROL MECHANISM

PRE-FLIGHT AND DAILY INSPECTION

Operate the pilots' rudder pedals, control columns, control wheels, and landing flap control handles to check for freedom of movement and proper relation of the control surfaces to the movements of the manual controls.

25-30 HOUR INSPECTION

Check the tension of all control cables and make adjustments if necessary.

Check all turnbuckles for safetying.

Inspect all cables for frayed wires.

Replace 7 x 19 cables in which six or more broken wires are found in any one inch length of cable.

Inspect for broken, loose, or misaligned pulleys and fairleads.

AUTOMATIC FLIGHT CONTROLS

There is no automatic pilot installation in this airplane.

MOVABLE SURFACES

PRE-FLIGHT AND DAILY INSPECTION

CONTROLS.- Check the elevons, rudders, landing flaps, and trim flaps for satisfactory operation, adequate clearance, and possible damage.

FABRIC ELEMENTS.- Check the attachment of all fabric surfaces.

Check the frame work of the fabric-covered control-surfaces for possible distortion.

Check the operation of the landing flaps and see that the landing flap indicator registers the relative flap positions.

Check the landing flap control system wiring for loose connections or damage at the actuator, relay panel, pilot's controls and position transmitter.

Check the operation of the trim flaps and see that the trim flap indicators correctly indicate the relative position of the flaps.

Check the trim flap control system wiring for loose connections or damage at actuators, relay panels, pilot's controls and position transmitters.

Check the operation of the elevon emergency system.

Check the elevon emergency operation system wiring at the column and panel switches, relay panels, actuator and actuator switches for secure mounting.

Check the operation of wing slots and inspect the wing slot actuator switches and wiring.

25-30 HOUR INSPECTION

Inspect the elevons, rudders, and flaps for free and full movement, warping, condition of covering, condition of hinges, and security of attachment. If any vibration develops, the hinge bolts should be checked for tightness. Access doors must be removed to check these bolts.

50-60 HOUR INSPECTION

Inspect the elevons, rudders, and flaps for free and full movement, warping, condition of hinges, and security of attachment.

Remove all inspection plates and inspect the internal structure for damage or distorted units.

FUEL TANKS

PRE-FLIGHT INSPECTION

MAIN TANKS.- Inspect the wing area underneath the fuel tank compartments for signs of fuel leakage. Service the fuel tanks and check the fuel tank filler necks and drains for secure fastening and proper safetying.

25-30 HOUR INSPECTION

Check the fuel tanks for leakage.

Remove tank compartment covers and make visual inspection of the fuel tank's exterior surface for chafing marks. If found, eliminate the cause.

Inspect the tank fittings for secure attachment to the tanks.

50-60 HOUR INSPECTION.

Inspect the fuel tanks for security of anchorage. Check the tanks for leakage (particularly at the seams).

Check the condition and position of the padding and proper tension of the supporting straps.

Check for external damage and leaks near the tank fitting connections.

Check the filler neck and drain fitting for security of attachment.

Inspect the tank fuel line connection for firm attachment.

100-120 HOUR INSPECTION

Drain the tanks completely and compare the quantity of the fuel needed to refill the tank with the original rated capacity. If the capacity is reduced by five per cent or more, replace the tank.

200-240 HOUR INSPECTION

Remove the fuel tanks and inspect for condition of the drain cock and filler neck attachment to the tank.

Check the tank for external leaks, deterioration or damage.

Inspect the fuel tanks for deterioration.

NOSE GEAR

PRE-FLIGHT INSPECTION

See that the switch mounting and wiring connections are secure.

Check the nose gear door, limit switches, limit panel and pressure plug for loose connections.

MAIN LANDING GEAR

PRE-FLIGHT INSPECTION

Check the wing slot, door and gear limit switches for secure mounting.

Check wiring connections and routing of wiring cables for clearance of the wheels, doors, cables and all other moving parts.

Check the operation of the warning horns, reset switch, and landing gear indicators. Check the operation of the landing gear safety switch and lock solenoid.

Check the main gear strut for evidence of hydraulic fluid leakage.

Check the landing gear strut for the proper degree of air inflation.

See that all landing gear linkage is secure and undamaged.

WHEELS, TIRES, AND BRAKES

PRE-FLIGHT AND DAILY INSPECTION

BRAKES.- Check the brakes for proper operation.

Check the parking brakes for proper operation. The brakes should hold the airplane steady during engine warm-up at full throttle.

CAUTION

Do not test the emergency brake system.

Inflate the emergency brake air bottle.

TIRES.- Inspect the tires for visible signs of damage both to the treads and walls.

Check the tires for scuff marks large enough to unbalance the tires.

Inspect the tires for slippage on the wheel rims.

Inflate each tire to the deflection marker.

Check the wiring of pilots' control columns, parking brake switches and solenoids.

Check the operation of the brake pump motors and wiring for possible damage or loose connections.

25-30 HOUR INSPECTION

BRAKES.- Make a general check of the complete brake system.

Check the emergency air brake system.

Apply the brakes and check for proper operation. Bleed the brake lines if necessary.

Inspect the parking brake control for operation and general condition.

Inspect the wheel bearings for scores, cracks, or other damage.

Inflate the emergency air bottle and lines. Check for leaks and firm attachment.

WHEELS.- Inspect the wheel rims for evidence of excessive corrosion or damage.

Inspect the wheels for excessive wear between the wheel bushing and axle. Adjust the wheel-bearing nut to eliminate any wheel side play.

Check the wheels for correct alignment.

50-60 HOUR INSPECTION

BRAKES.- Remove the wheels and inspect the brake assemblies for security of nuts and bolts. Inspect for cracks; broken, loose, or worn parts, or hydraulic leaks.

WHEELS.- Inspect the wheel bearings for damage or evidence of deterioration, and lubricate.

Inspect the felt grease retainers. If they are grease soaked, replace.

Inspect the wheels for corrosion on the visible portion of the wheel rim. If any damage to the wheel rim edges is found remove the casing and inspect further.

Inspect the entire wheel assembly for cracks in the wheel castings, corrosion, condition of protective coating, dents in rims or discs, and snugness of fit of valve stem washers.

TIRES.- Remove the tires and inspect the casing for damage to the fabric sidewalls. Inspect the tires and tubes for damage and replace if necessary.

Inspect the valve stems for a snug fit when the tire is installed on the wheel. Inflate the tire to the deflection marker.

300-360 HOUR INSPECTION

BRAKES.- Remove the wheels and completely disassemble the brake units for inspection.

Clean the brake assemblies and inspect for excessive wear and damage.

WHEELS.- Inspect the wheels for damage.

HYDRAULIC SYSTEM

PRE-FLIGHT AND DAILY INSPECTION

Check the reservoirs for proper fluid level. Fill if necessary.

Check the accumulator air pressure gage; should read 600 psi.

Check emergency air brake bottle pressure gage; should read 1500 psi.

Break the electrical circuit (for operating the main hydraulic pump) at the micro switch on each main gear door, and check the emergency override switch for operating the main pump.

With the engine running, check the power boost system hydraulic pressure gages (should be 2000 ± 50 psi); and the nose wheel brake and steering system hydraulic pressure gage (should be 3000 ± 50 psi). Also check gages for excessive oscillation of the indicator.

Check operation of rudders, elevons, and wing slot doors.

25-30 HOUR INSPECTION

Check spring tension setting of pressure switches.

Check solenoid valves and pressure switches for security of electrical connection, mounting and hydraulic connections.

Check all valves in the system for evidence of leakage, proper operation and mounting.

Check hydraulic pumps for leakage at the connections of the intake, discharge, and return ports; and for security of mounting.

Check the power boost system hydraulic pump VEE belts for slippage, wear, and fraying. Check pump bracket tension adjustment for proper tension.

Check nose gear steering and brake system hydraulic pumps at the lower drain port in the pump housing for excessive leaking at the pump seal. If leakage exceeds 5 cc per hour while pump is operating, the condition must be corrected.

Check general condition of all actuating cylinders for evidence of leakage at piston rod packing nut and cylinder head joints. All external parts, including attaching parts, should be inspected for general condition.

Check filters and check valves for leakage and operation.

Investigate any polished areas and worn spots to determine whether hydraulic lines have shifted or whether the lines have been fouled by moving parts of the airplane.

All lines that are dented, deformed, or kinked should be replaced with new lines.

Check the flexible hoses to determine if the hoses are held clear during the operation of the related mechanisms. At places where damage is suspected, squeeze flexible hoses between thumb and forefinger to detect soft spots and deterioration. Check for ballooning and cracking of flexible hoses.

Note the location and security of hose clamps. Keep hoses free from oil and grease.

Trace all leaks to their source. If a tube leaks, install a new tube. If a leak occurs at a connection, tighten the connection moderately. If tightening does not stop the leak, break the connection and inspect the tube for cracks.

Inspect all fittings for defects, and install new parts if necessary. Connections should be tightened snugly but not forced.

50-60 HOUR INSPECTION

Thoroughly check hydraulic pumps of both systems for leakage and security of mounting.

100-120 HOUR INSPECTION

Operate all units in the hydraulic system as outlined in Section IV, paragraph 16, under operational test.

Remove slot door filters, disassemble and inspect filter elements. Replace elements if necessary.

300-360 HOUR INSPECTION

Drain the hydraulic reservoirs and clean the filters. Replace gaskets, and test in accordance with Section IV, paragraph 16, under hydraulic reservoirs.

Test, and if necessary, adjust the system relief valves and pressure regulator.

Remove, disassemble, and inspect all filters and check valves.

500-600 HOUR INSPECTION

Remove solenoid valves, disassemble and inspect.

Check relief valves and pressure regulator in the hydraulic system for proper operating pressures. Adjust if necessary.

Remove all hydraulic pumps for overhaul.

NAVIGATION INSTRUMENTS

PRE-FLIGHT INSPECTION

Wind the clock and set it to the operations office time.

Inspect the pitot heads for dirt or obstructions and alignment. Turn on the pitot heater switch and check heater operation.

Check the glasses and cases of the compasses for signs of leakage. Check for excessive plate oscillation or lack of freedom of rotation.

Check for excessive oscillation in the pointers of the air speed indicator, altimeter, and rate-of-climb indicator.

Set the pointer of the sensitive altimeter to the surveyed elevation of the field from which the take-off is to be made.

DAILY INSPECTION

Check the clock cover glass for looseness and cracks.

Check the compass fluid for bubbles or discoloration.

Check the thermometer for a reading consistent with atmospheric or hangar temperature; and the cover glass for looseness or cracks.

Check the cover glass of the rate-of-climb indicator, and the sensitive altimeter for looseness or cracks.

Test the setting knob of the altimeter for freedom of movement and see that all pointers and reference markers move when it is turned.

50-60 HOUR INSPECTION

Check for security of mounting of the clock, thermometer, compasses, air speed indicator, altimeter, and rate-of-climb indicator.

Check the lines from the air speed indicator, and altimeter for leaks.

100-120 HOUR INSPECTION

Swing the compass every 100 hours or every 30 days if the airplane is flown less than 100 hours. Swing the compass every time a major change of equipment likely to affect the compass is made.

Drain the connecting lines from the pitot head to the air speed indicator, and check all connections for leaks and looseness.

Remove the drain plug of the bank-and-turn indicator to drain condensate and excess oil. Clean the screen and check the suction.

BATTERY

DAILY INSPECTION

SPECIFIC GRAVITY.- Check the battery with a temperature-corrected hydrometer. Return the electrolyte in the hydrometer to the same cell from which it was taken. Replace the battery if the specific gravity is below 1.240 or above 1.310, or if the specific gravity of any two cells varies by more than 20 points.

ADDITION OF WATER.- Add distilled water to the battery if the electrolyte cannot be seen or the hydrometer reading not taken. Do not cover the plate protector with more than 3/8-inch of water.

ADDITION OF WATER IN COLD WEATHER.- When operating the battery in cold weather temperatures do not add water to the cells unless the battery is to be charged immediately after. The water will remain at the top of the cells and freeze unless it is thoroughly mixed with the electrolyte.

VENT BOTTLE AND TUBE.- Check that the vent tube is unobstructed. Saturate the vent bottle and pad with a soda and water solution. Secure the vent tube within the vent jar.

BATTERY TERMINALS.- Check to see that all battery terminals are secure and clean.

25-30 HOUR INSPECTION

BATTERY LEADS AND TERMINALS.- Inspect the battery leads for condition of the insulation. Check to see that the battery terminals are tightly fastened and remove all corrosive collections from them by brushing with a stiff bristle brush. Wash the terminal connections with a water and soda solution. Rinse the terminals with water, and when dry, coat them with vaseline.

place worn terminals, washers and wing nuts.

BATTERY MOUNTING.- Check the battery mounting bolts and see that they are sufficiently tight to hold the battery securely in place.

BATTERY VENT BOTTLE AND VENT TUBE.- Inspect the felt pad in the vent bottle and if it is dry saturate it with a concentrated solution of soda and water. Remove any excess liquid from the bottle.

CAUTION

> See that the battery switch is "OFF" before removing or replacing battery terminals.

BATTERY.- When the aircraft is to be idle more than one week, remove the battery from the airplane and store it in a battery room, where it will be kept fully charged and ready for immediate use.

200-240 HOUR INSPECTION

BATTERY.- Remove the battery from the airplane and test its capacity. Charge the battery fully and then overcharge it for 2 hours at the normal rate. Check the specific gravity of each cell. Allow the battery to stand for 12 hours and then conduct a capacity test with a 5-minute battery capacity tester. If the battery passes the test, recharge it for 5 hours at the normal rate.

AIRPLANE - GENERAL

PRE-FLIGHT INSPECTION

Check to see that the following equipment has been installed in the airplane and is in serviceable condition: Engine Service Instructions; Radio Equipment Handbooks; airplane check list and holder; data case; shoulder harnesses and safety belts; covers for the pitot heads; the cockpit enclosure; and air-duct covers; parts necessary for hoisting and jacking operations; flight report and map holder; bomb loading charts; bomb hoisting equipment.

EMERGENCY EQUIPMENT

See that the following equipment is installed and be sure that it is serviceable: one first aid kit, two crash axes, and two fire extinguishers.

NOTE

> See that these fire extinguishers are sealed and have inspection tags on them.

25-30 HOUR INSPECTION

Inspect the interior of wheel wells, bomb bays, and engine bays for general condition and loose or missing bolts, nuts, screws, rivets, or cotter pins.

Inspect the wheel well, bomb bay, and engine bay doors and door locks for proper closing.

FIRE EXTINGUISHER SYSTEM

PRE-FLIGHT INSPECTION

INDICATOR LIGHTS.- Test the operation of the fire extinguisher indicator light bulbs by pressing each bulb firmly with the fingers. The bulb should illuminate.

FIRE EXTINGUISHER SYSTEM DISCHARGE INDICATOR DISCS.- Inspect the red celluloid discs located in the outboard discharge indicators and make certain that they are intact. If a disc is ruptured, one or more of the fire extinguisher cylinders has been prematurely discharged due to expansion of the gas caused by high temperatures. Remove and weigh each cylinder of the particular group. Replace empty or ineffective cylinders with ones that are completely charged.

CYLINDERS.- Each CO_2 cylinder will be inspected prior to flight for condition of the fittings and the firmness of the cylinder mount attachment to the airplane structure.

50-60 HOUR INSPECTION

Remove all fire extinguisher cylinders and weigh them to detect the loss of any gas. Replace those cylinders showing an excessive loss of gas.

500-600 HOUR INSPECTION

This inspection and test will be made at the expiration of the 500-600 hour inspection period or 6 months from the date of the last inspection whichever comes first.

FIRE EXTINGUISHER SYSTEM TEST.- Operate the fire extinguisher system switches and discharge all cylinders of the system.

Test both the "FIRST FIRE" and "SECOND FIRE" systems on different engines and keep a permanent record as to which engine fire extinguisher systems are tested. When testing the fire extinguisher system, connect a 28 Volt d.c. external power source to the airplane.

When operating the fire extinguisher system, one man should be stationed to observe discharge of the cylinders and to check that the distribution of the CO_2 gas about the engine is complete. The cylinder discharge nozzles will usually be coated with frost. Those discharged nozzles without the appearance of frost should be checked for possible malfunctioning. With the test completed, remove the discharged cylinders from the airplane and replace them with cylinders which are completely charged with CO_2 gas.

ANNUAL INSPECTION

TYPE B-14 SAFETY BELTS.- Remove the safety belts from the airplane.

Adjust the belt to the largest possible size and attach one end of it to the testing lever. Use the anchor bolts to attach 800 pounds of lead to the other end of the belt.

Smoothly and gently raise the attached weight from the floor. Lower the weight immediately to avoid placing unnecessary stress on the belt.

CAUTION

When raising the attached weight from the floor do it slowly and smoothly to avoid any chance of impact loading.

CAUTION

Do not attempt to test the strength of the belt by tearing the webbing or stitching by hand. Such a test is of no value.

NIGHT FLYING EQUIPMENT

PRE-FLIGHT INSPECTION

Check all exterior lights.

Check the indicator lights.

Check for damaged or dirty lenses or damaged gaskets.

OXYGEN EQUIPMENT

PRE-FLIGHT INSPECTION

Check the oxygen filler valve for leakage.

Check the oxygen system pressure and enter the reading on the flight replenishment form.

DAILY INSPECTION

Fill the oxygen system cylinders to 425 psi pressure.

Check operation of the oxygen regulator and flow indicators.

WARNING

Never permit oil or grease of any type to come in contact with the oxygen system.

Inspect the male quick-disconnect fittings for tight fit. (A 12-pound pull should be required to separate them.)

Check the gasket installation and the knurled-attachment nut for security.

Operate the valve assemblies and check for freedom of action.

Check the tightness of the body caps and adjust the regulating screws.

Test each mask for satisfactory oxygen flow; after each inspection, sterilize each mask.

Check to see that the portable emergency oxygen cylinders are fully charged and installed in the proper locations.

25-30 HOUR INSPECTION

Inspect the oxygen lines and valves for leaks. If leaks exist, replace connections, lines, or fittings, and seal all threads with anti-seize compound, Specification No. AN-C-86.

Wash the oxygen masks in soap and water and dry thoroughly.

50-60 HOUR INSPECTION

Make a complete operational check of the oxygen system.