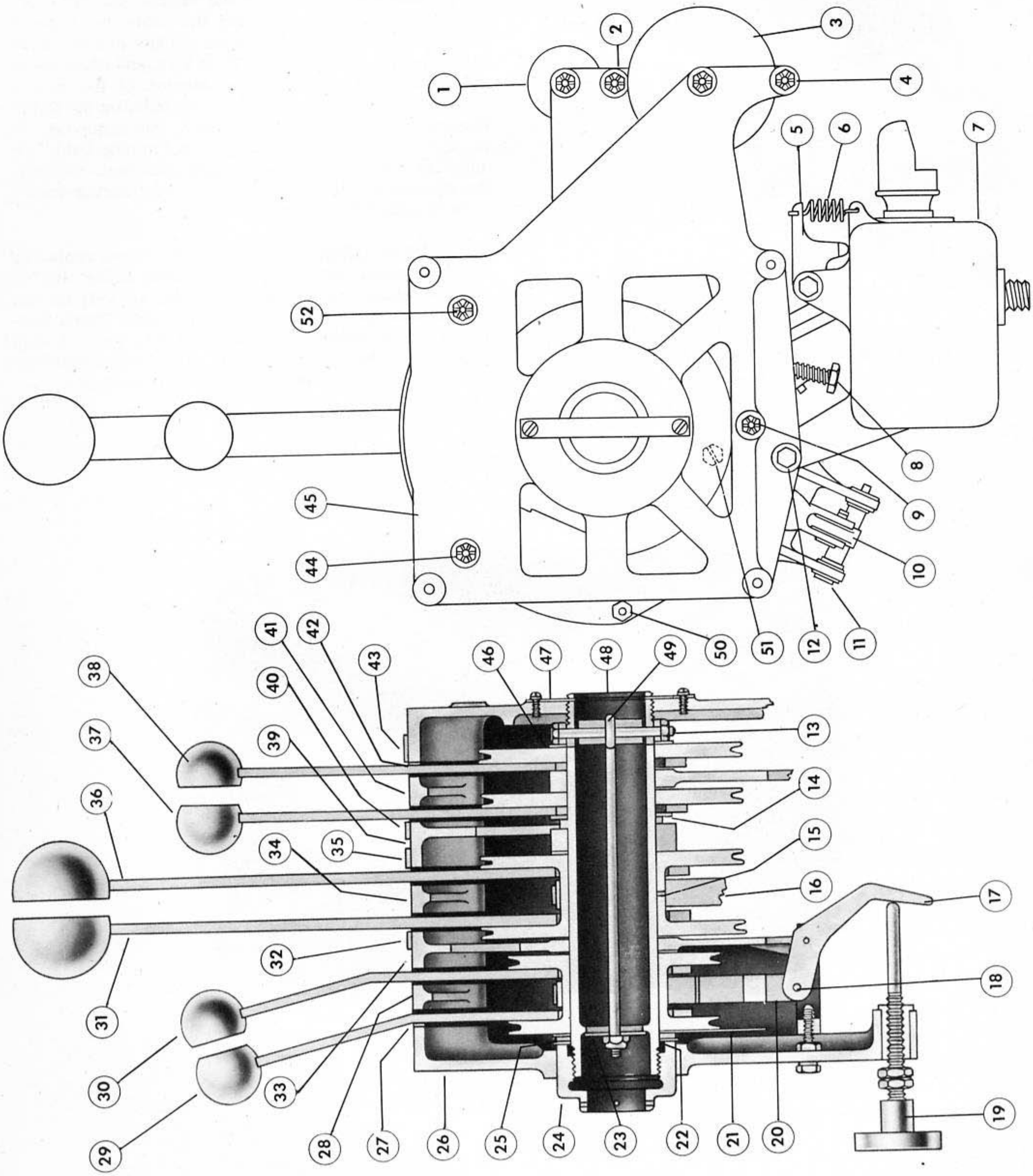


Figure 110 - PILOT'S ENGINE CONTROLS

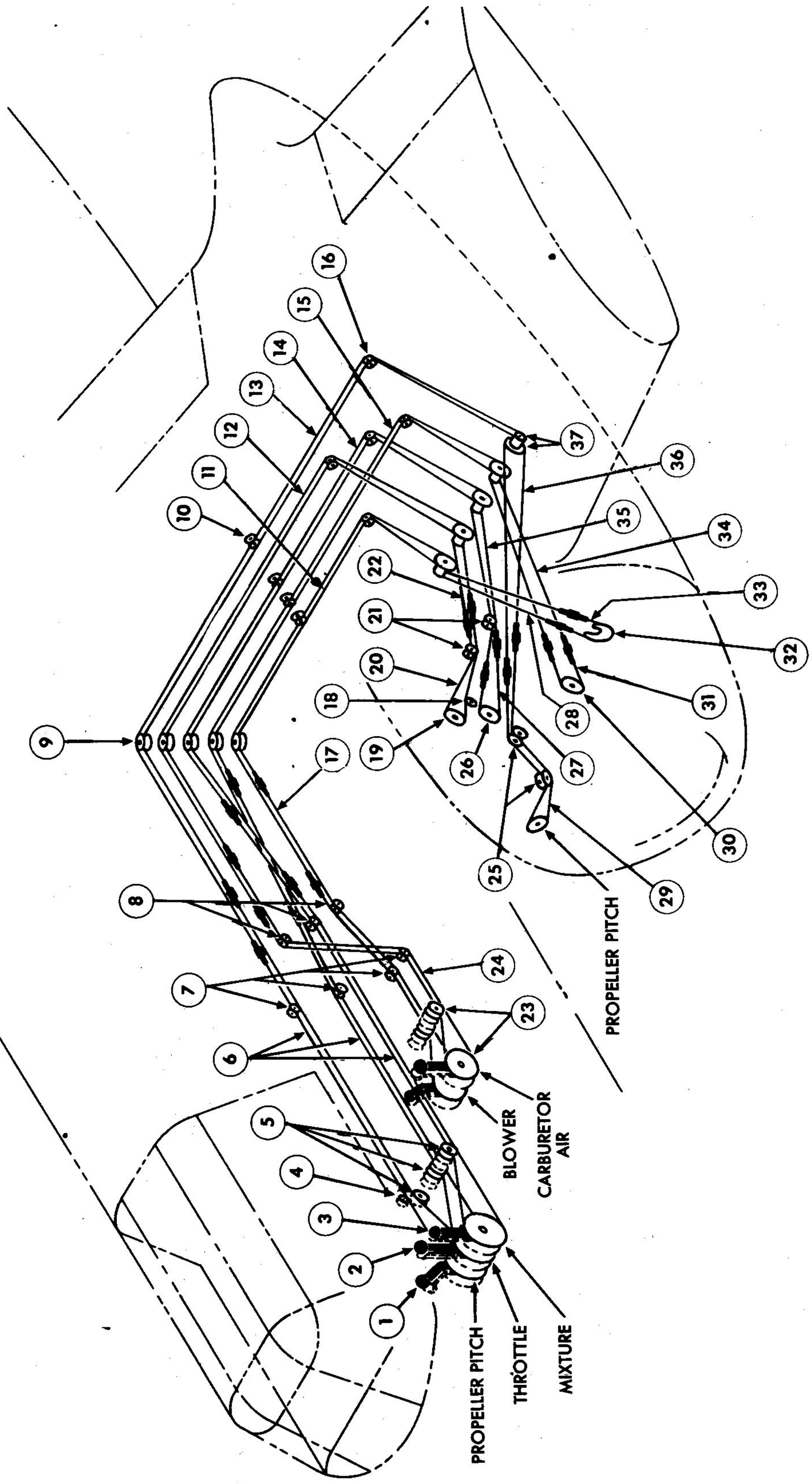


Figure 111 - LEFT-HAND ENGINE AND PROPELLER CONTROLS

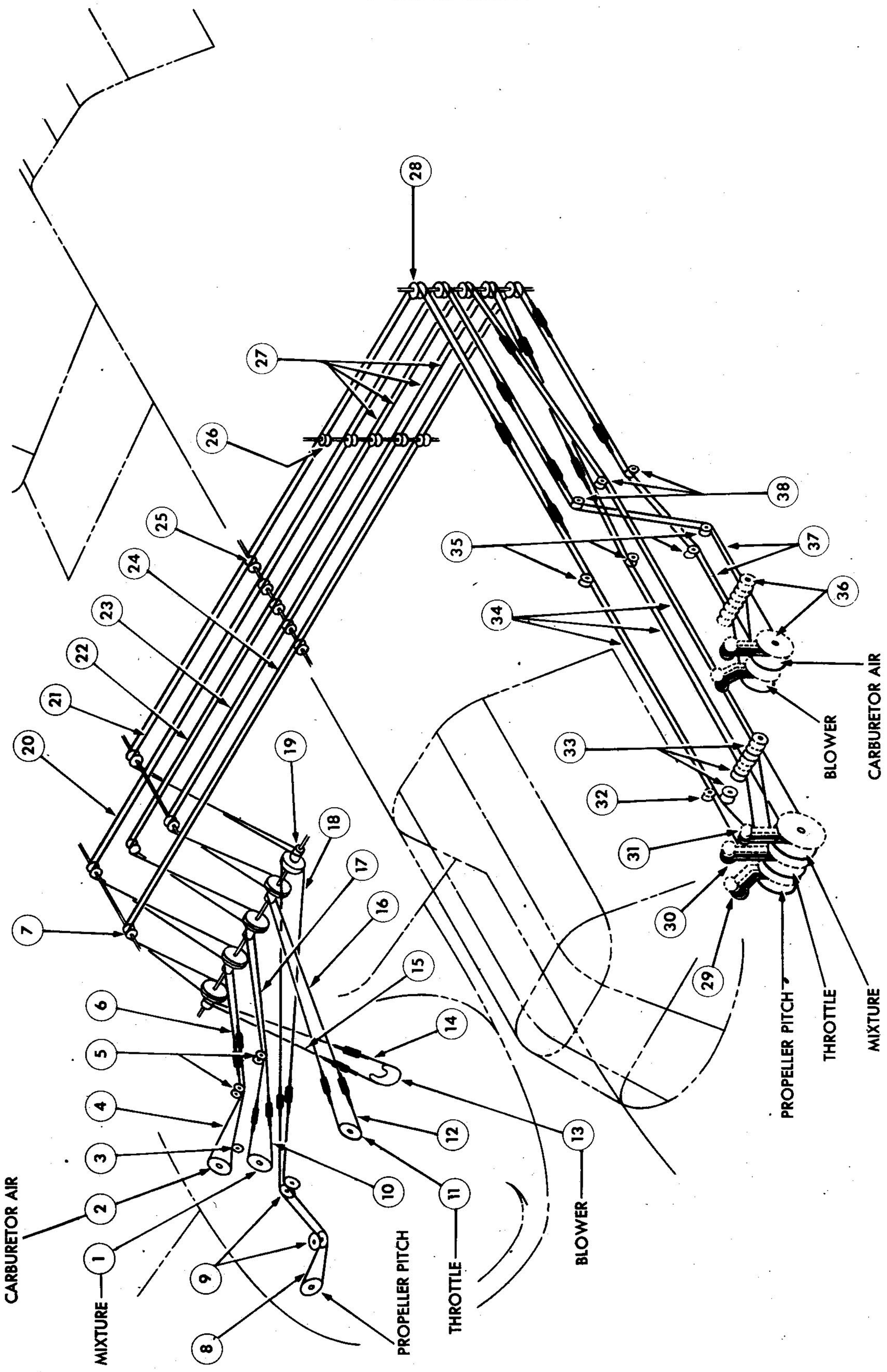


Figure 112 - RIGHT-HAND ENGINE AND PROPELLER CONTROLS

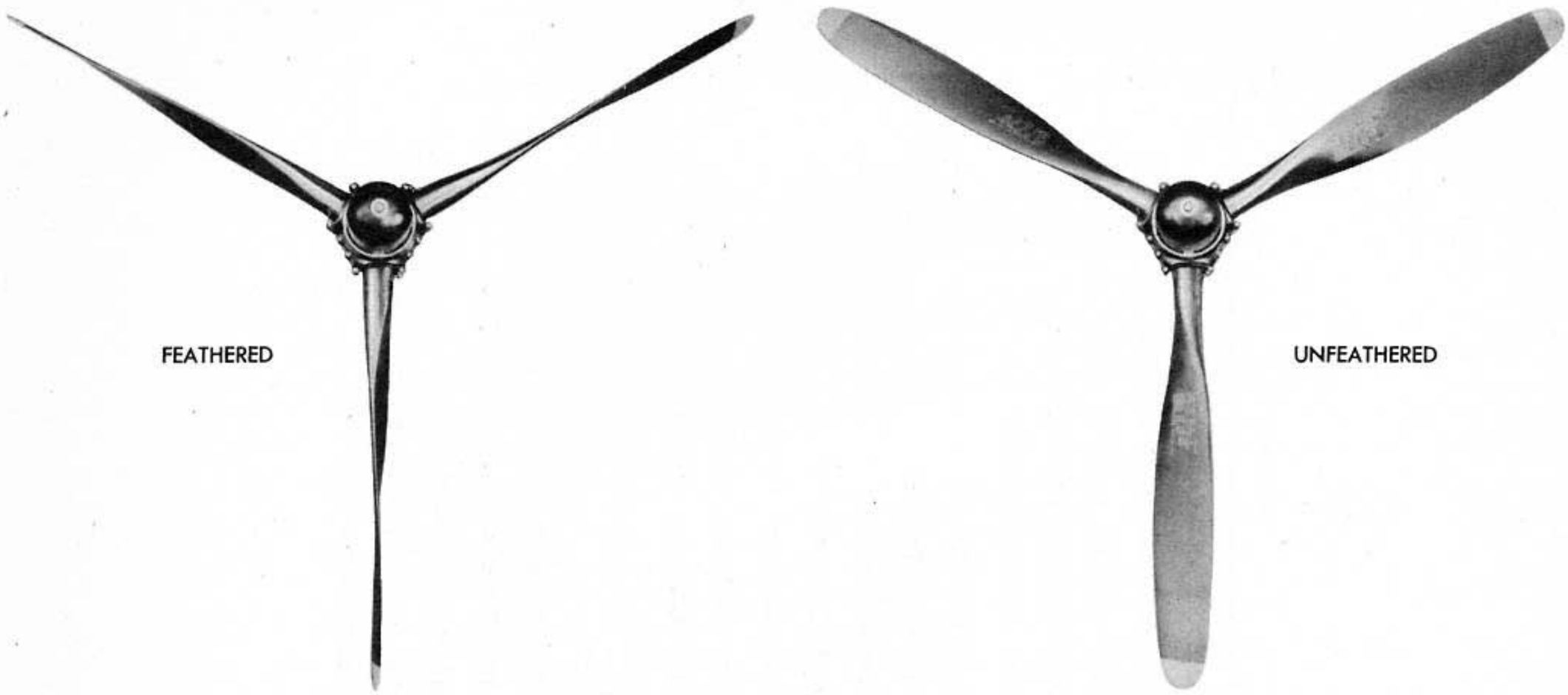


Figure 113 - PROPELLERS FEATHERED AND UNFEATHERED

10. PROPELLERS.

a. DESCRIPTION.

(1) GENERAL. (See figure 113.) - Each engine is equipped with a Hamilton Standard, hydromatic, full-feathering propeller. The nominal diameter of each propeller is 11 feet 4 inches. Each propeller consists of a 23E50 hub and three 6353A-21 blades. A propeller anti-icer system is provided.

(2) FEATHERING SYSTEM. (See figure 121.) - Fluid for operating the propeller feathering system in each nacelle is provided by the engine oil container in each inner wing panel. A sump at the bottom of the oil container provides a one-gallon oil supply which is available to the propeller feathering system only. From this sump the oil is directed to an electrically operated pump which forces the oil under pressure to a cable controlled propeller governor mounted on the front section of the engine. The pressure of the oil between the pump and the governor may range up to 500 pounds per square inch for feathering and to 600 pounds per square inch for unfeathering the propeller. A switch is provided for each propeller. After pushing the respective switch for the propeller to be feathered, the switch will automatically release when the propeller blades reach their full feathered position. To unfeather the propeller, push in the switch and hold until the engine windmills at 600 to 800 rpm. Then release the switch.

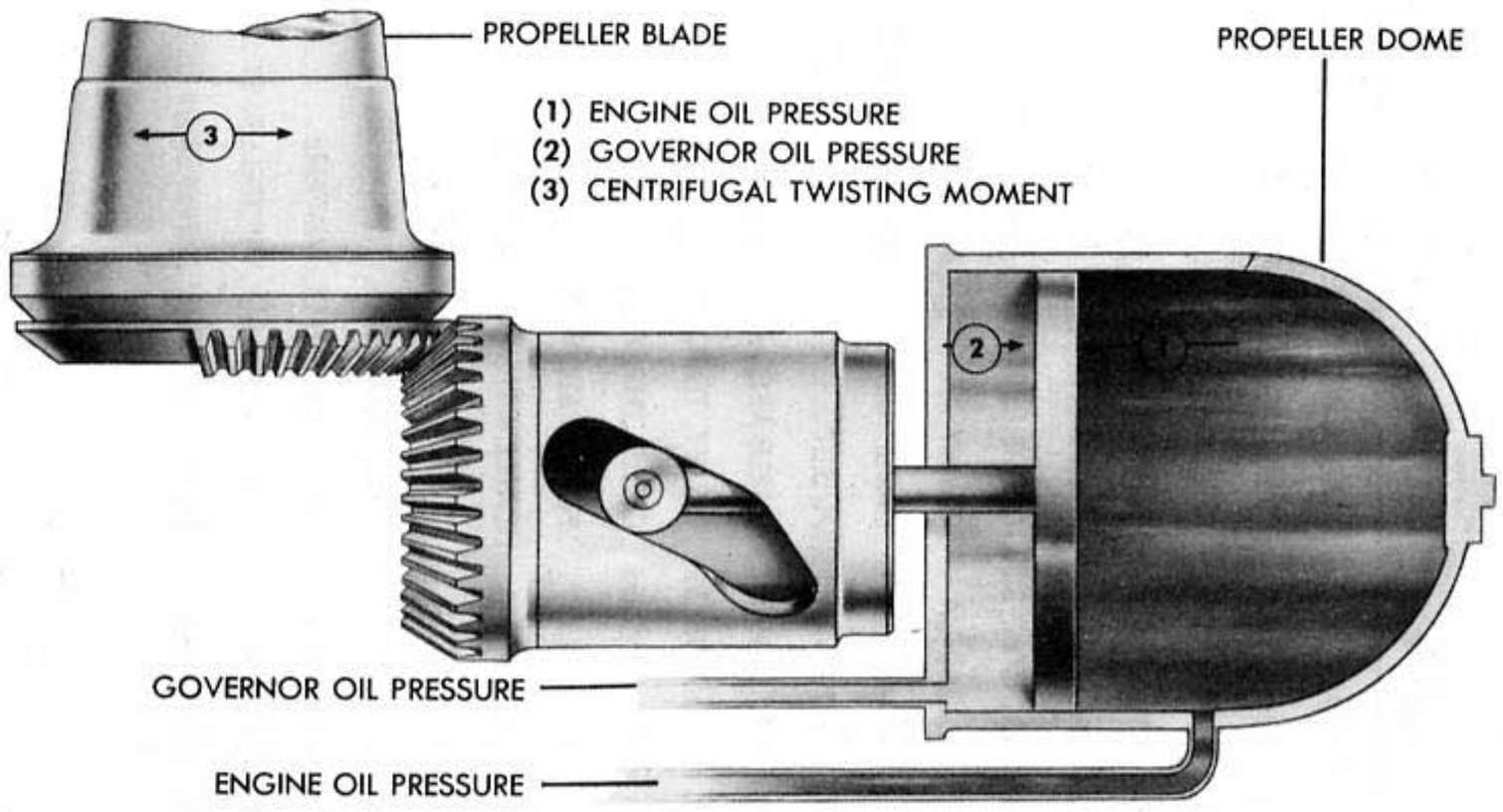


Figure 114 - PROPELLER CONTROL FORCES

SYMPTOM	CAUSE	REMEDY
	Improper governor gasket.	Replace gasket.
	Propeller feathering pump inoperative.	Test operation of pump with 24-volt current. If pump remains inoperative, replace the unit. If pump operates in test, trace the circuit with a trouble lamp. Replace defective part.
Slow increase in rpm during flight.	Oil supply low.	Stop engine immediately. Feather propeller. Replenish oil supply before again starting engine.

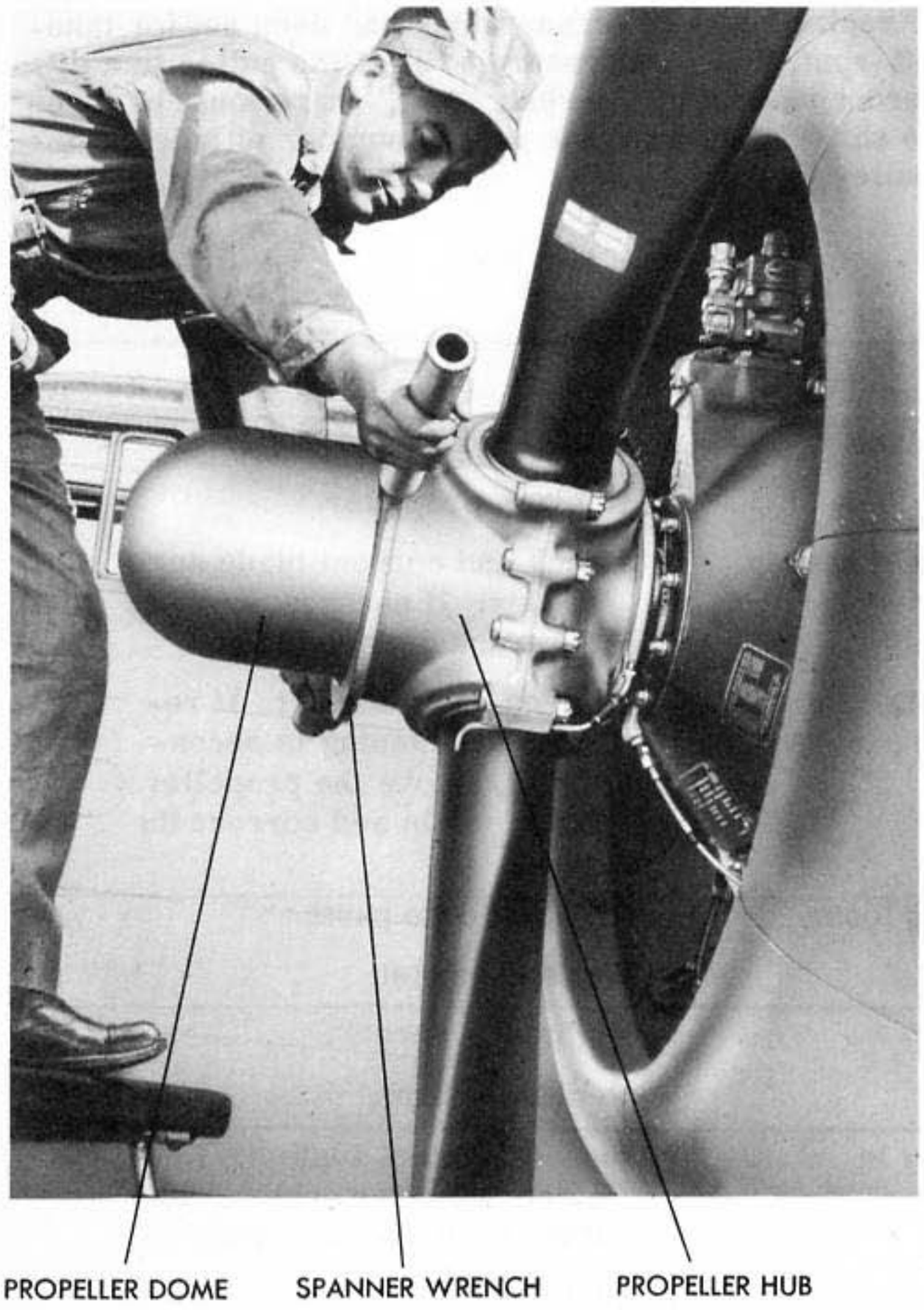


Figure 115 - REMOVING PROPELLER

c. REMOVAL AND DISASSEMBLY.

(1) REMOVAL OF PROPELLER. (See figure 115.)

(a) Remove the propeller dome plug from the front of the propeller dome.

(b) Remove the propeller dome with a spanner wrench.

NOTE

Use heavy duty installation and removal tools if available. If not, use the composite propeller wrench in the airplane tool kit.

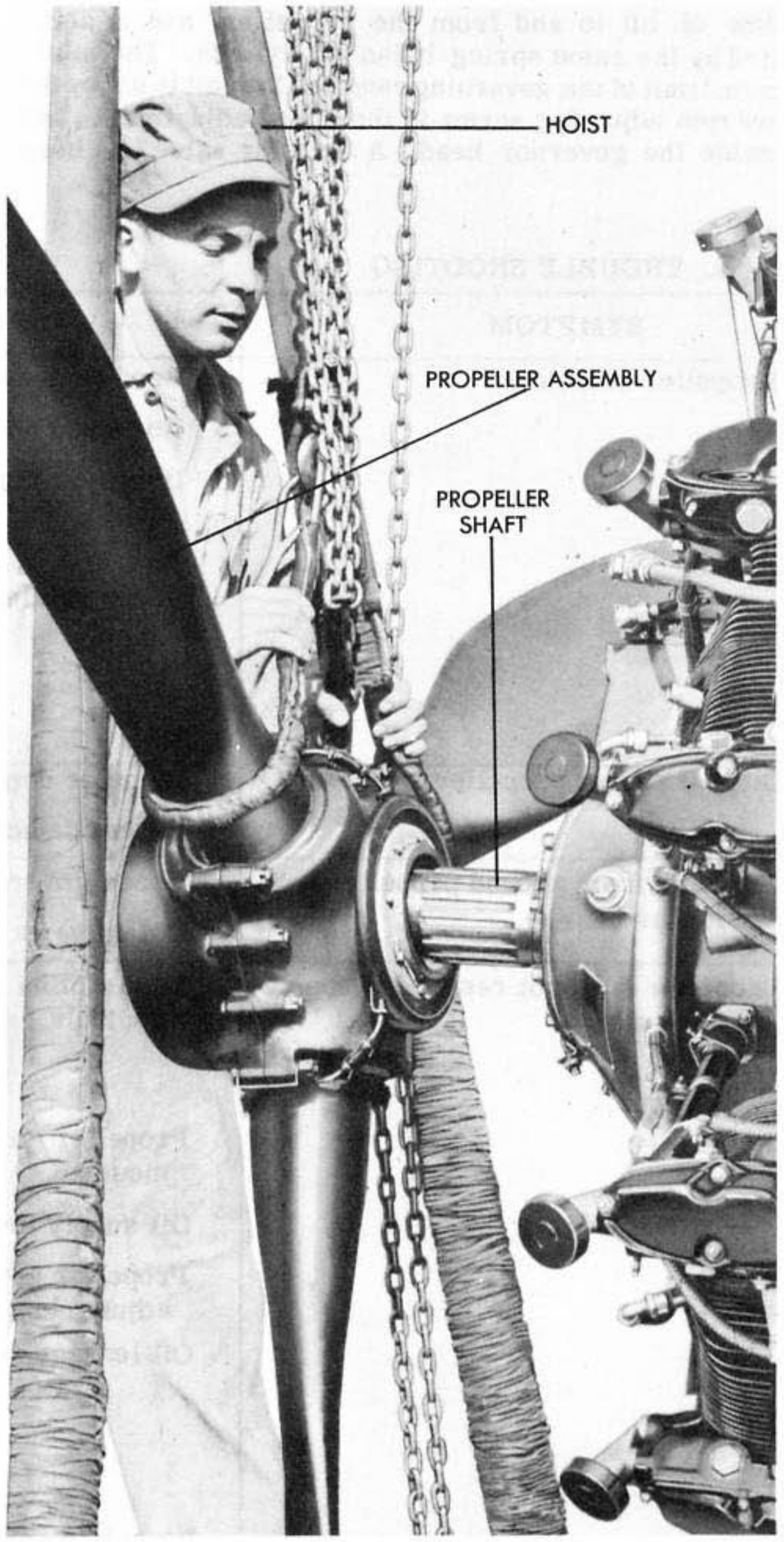


Figure 116 - LIFTING PROPELLER FROM SHAFT

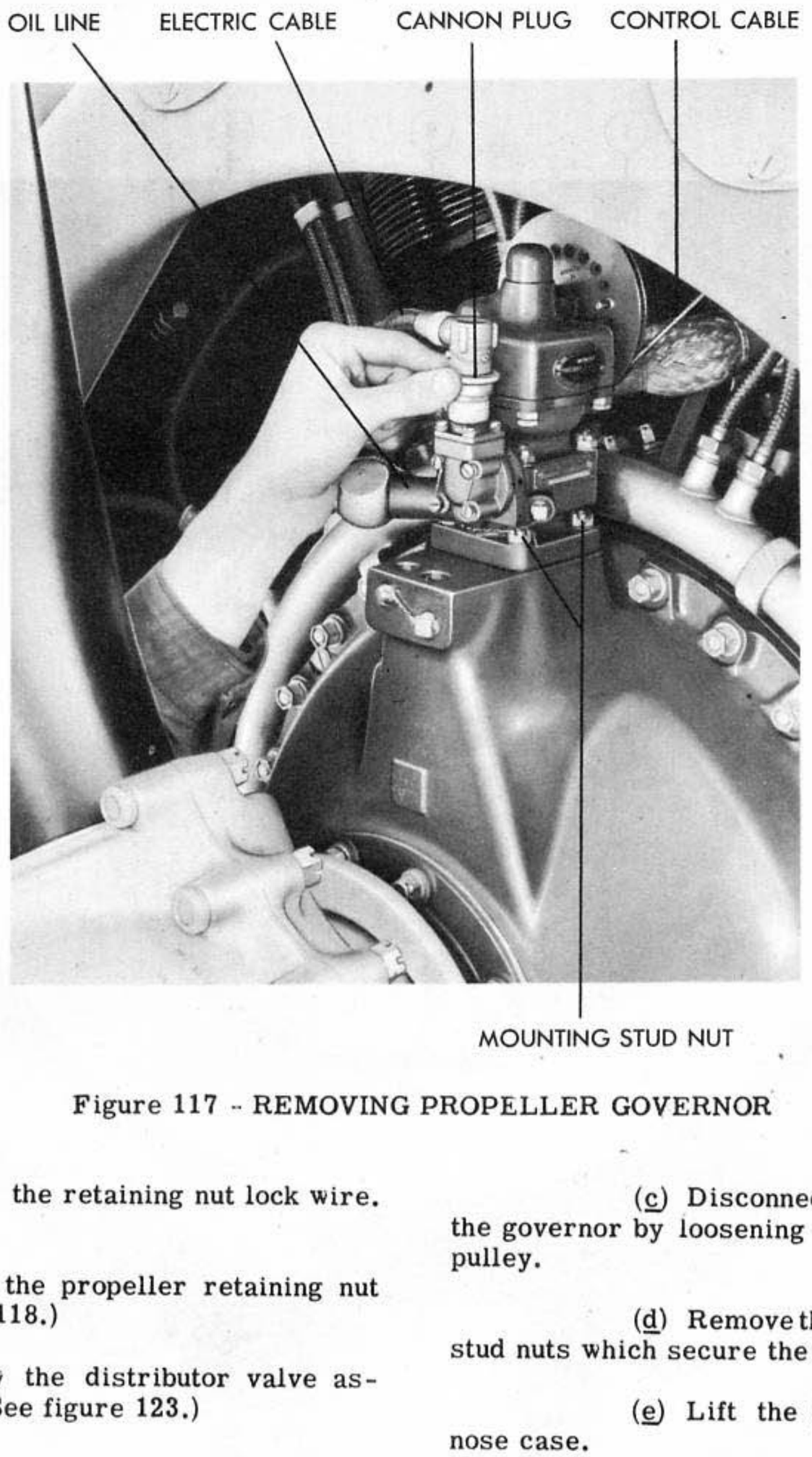


Figure 117 - REMOVING PROPELLER GOVERNOR

(c) Remove the retaining nut lock wire. (See figure 118.)

(d) Loosen the propeller retaining nut on the shaft. (See figure 118.)

(e) Unscrew the distributor valve assembly from the shaft. (See figure 123.)

CAUTION

Be sure retaining nut lock wire has been removed before turning distributor valve, as otherwise the locking splines in the valve housing will be mutilated.

(f) Unscrew retaining nut completely.

(g) Remove the propeller from the shaft, protecting the threads from damage. (See figure 116.)

(2) REMOVAL OF PROPELLER GOVERNOR. (See figure 117.)

(a) Disconnect the electric cable from the governor at the Cannon plug on the cut-out switch.

(b) Disconnect the feathering oil line from the governor.

(c) Disconnect the control cable from the governor by loosening the cable and removing the pulley.

(d) Remove the four castellated mounting stud nuts which secure the governor to the engine.

(e) Lift the governor from the engine nose case.

d. MAINTENANCE REPAIRS.

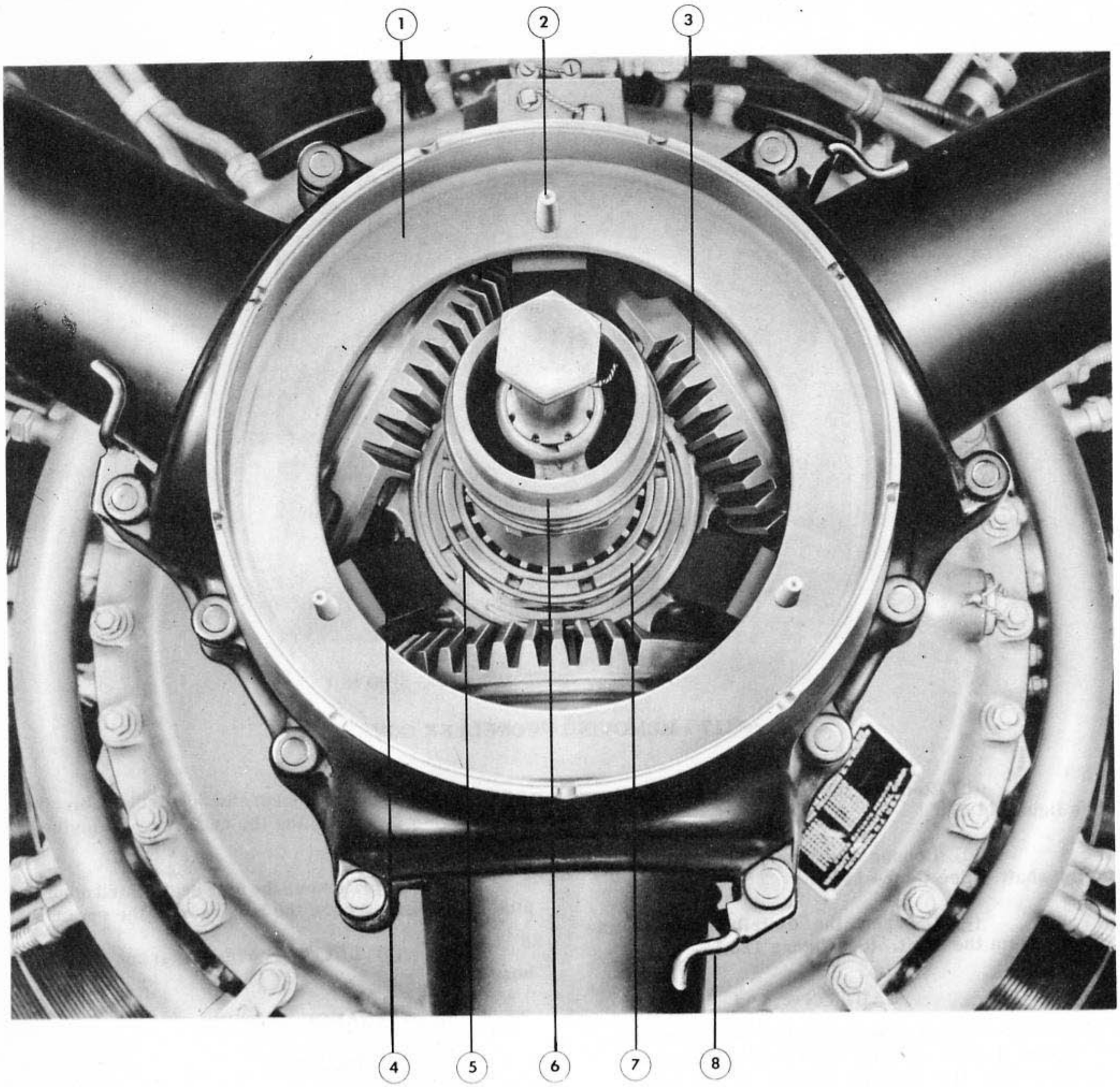
(1) PROPELLERS.

(a) COATING WITH OIL. - Coat all unprotected surfaces of the blades and hub with clean engine oil after the last flight of the day.

(b) CLEANING BLADES. - Clean propeller blades with gasoline.

(c) CLEANING PROPELLER HUB. - Clean steel hubs with gasoline or kerosene, and suitable cloth or brushes.

(d) USE OF CAUSTIC MATERIAL. - Except for etching, caustic materials must not be used. Use solvents such as approved paint and varnish removers to remove paint and varnish.



1. OUTBOARD BARREL HALF
2. FIXED CAM LOCATING DOWEL
3. BLADE GEAR SEGMENT
4. BARREL SUPPORT
5. RETAINING NUT LOCK WIRE
6. DISTRIBUTOR VALVE ASSEMBLY
7. PROPELLER RETAINING NUT
8. ANTI-ICER NOZZLE

Figure 118 - PROPELLER - DOME REMOVED

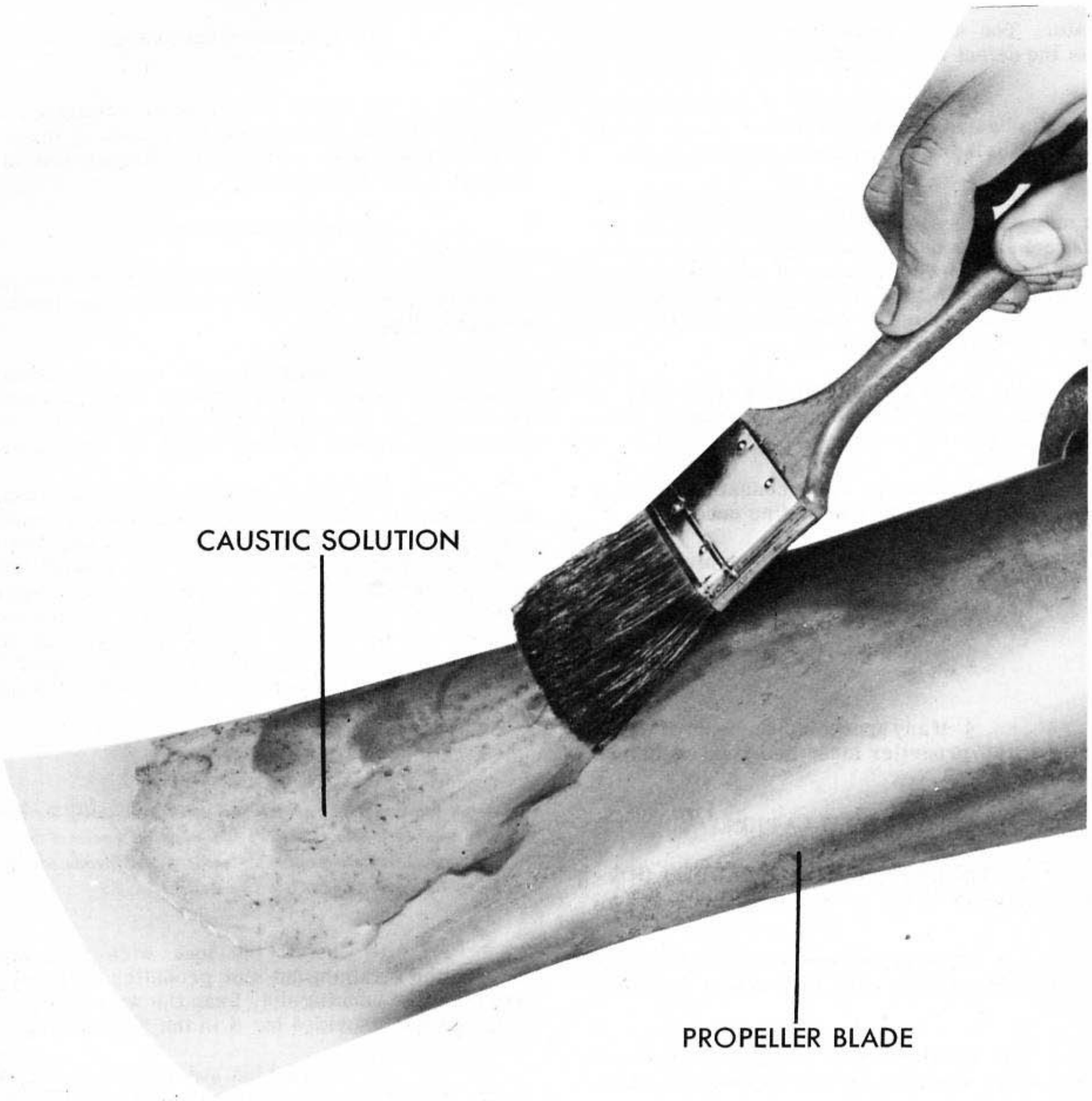


Figure 119 - ETCHING PROPELLER

(e) REMOVAL OF CLEANING SUBSTANCES. - All cleaning substances must be entirely removed after use. Dry all surfaces and coat with oil.

(f) REMOVAL OF SALT. - As soon as possible after being subjected to salt water, flush off all traces of salt from the propeller, and coat with oil.

(g) LOCAL ETCHING. (See figure 124.)

1 PURPOSE. - Local etching is employed for the following purposes:

a. To determine whether visible lines are cracks or merely scratches.

b. To determine, with a minimum removal of metal, when shallow cracks and doubled-back edges of metal have been fully removed.

c. To provide a simple means of accomplishing this work without removing or disassembling the propeller.

2 PREPARATION OF CAUSTIC. - Caustic solution is prepared locally by adding to one gallon of water one pound of commercial caustic soda.

3 PROCEDURE.

a. Clean the area to be etched with emery cloth. Apply caustic solution with a brush or swab.

b. After the area is well darkened, wipe it off with a clean cloth dampened with

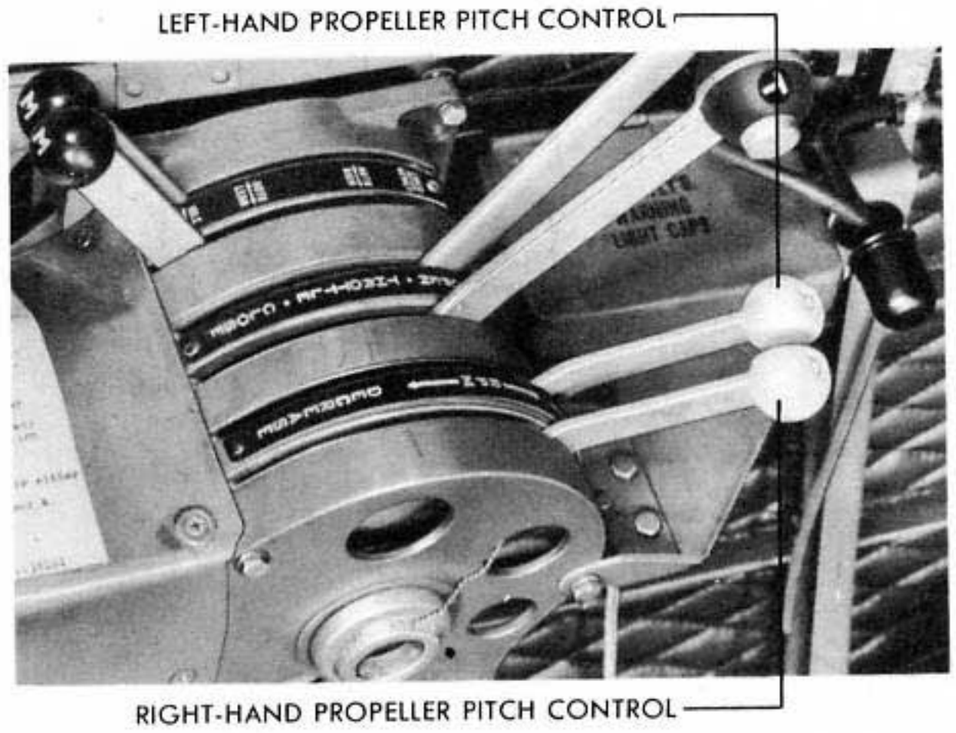


Figure 120 - PROPELLER PITCH CONTROLS

f. FINAL TEST AND ADJUSTMENT AFTER INSTALLATION.

NOTE

Governors will be set for take-off rpm on a governor test stand if available before installation. If it is necessary to make adjustments on the airplane, the following procedure will be used:

(1) TRIAL SETTING OF PROPELLER GOVERNOR. For the trial setting, place the cockpit lever approximately 1/8 inch from the forward end of its full travel. Turn the pulley attached to the governor control shaft in a clockwise direction until the rack bottoms in the cover. Rotate the control shaft counterclockwise approximately 90 degrees. With the control shaft held in this position, connect the linkage between the cockpit control lever and the governor. This setting should give approximately the take-off rpm and permit sufficient movement of the cockpit control lever to obtain minimum rpm.

(2) GROUND-TEST OF PROPELLER GOVERNOR.

(a) If, with the cockpit control full forward, more than take-off rpm is obtained at run-up, the propeller is in full low pitch and the constant-speed control is set to govern at higher than take-off rpm. To correctly adjust the linkage system between the cockpit lever and the constant-speed unit, follow the procedure outlined below:

1 Pull the cockpit lever slowly back until the tachometer indicates a drop in rpm. At this point, the governor is set to govern at the indicated rpm. Move the cockpit lever so the tachometer reads take-off rpm and shut down the engine. Without disturbing the cockpit lever, regulate the adjustable stop at the constant speed unit to limit the rotation of the control shaft to this exact angular position, shifting the stop in the pulley holes, if necessary.

2 Readjust the linkage system so that the cockpit lever is approximately 1/8 inch of its full forward position when the governor pulley is held against the adjustable stop.

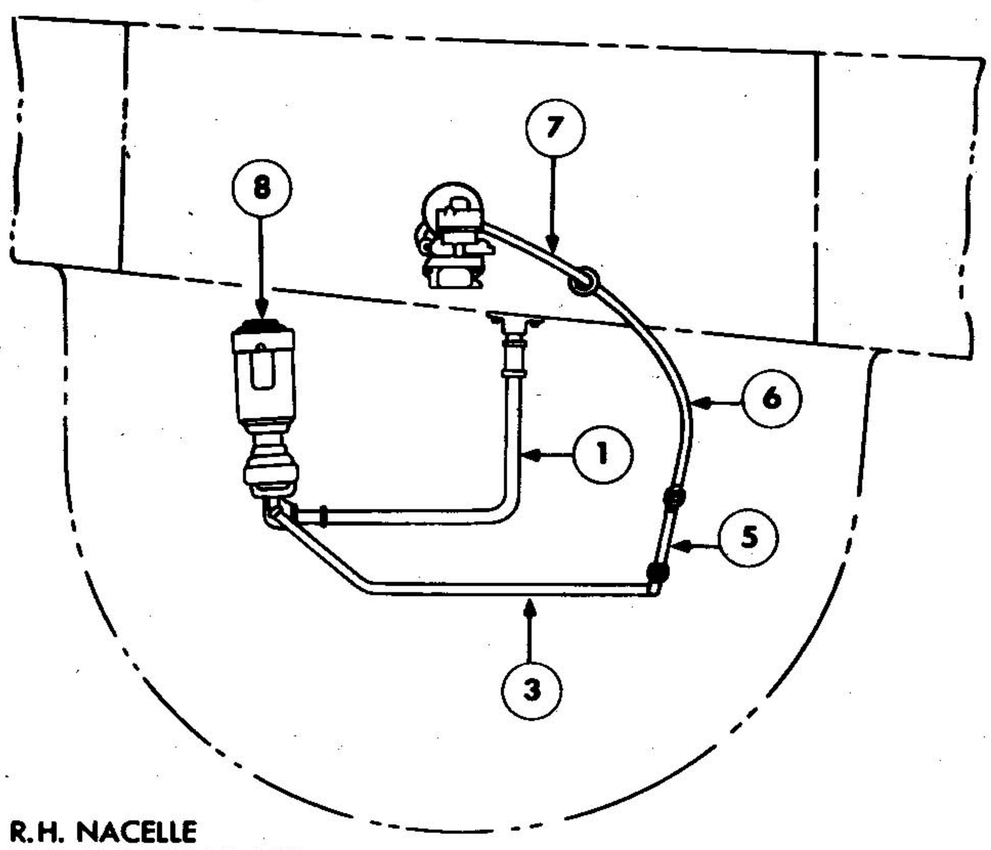
(b) If, with the cockpit control full forward (see figure 120), the take-off rpm is not obtained at run-up, vary the manifold pressure slightly.

1 If the rpm remains constant, the governor setting is too low. The stop on the governor, the control linkage on both, must be readjusted to permit the pulley to rotate further in a counterclockwise direction until take-off rpm is obtained. Adjust as required until at take-off rpm the pin in the governor pulley is against the stop screw and the cockpit control is approximately 1/8 inch from the full forward position.

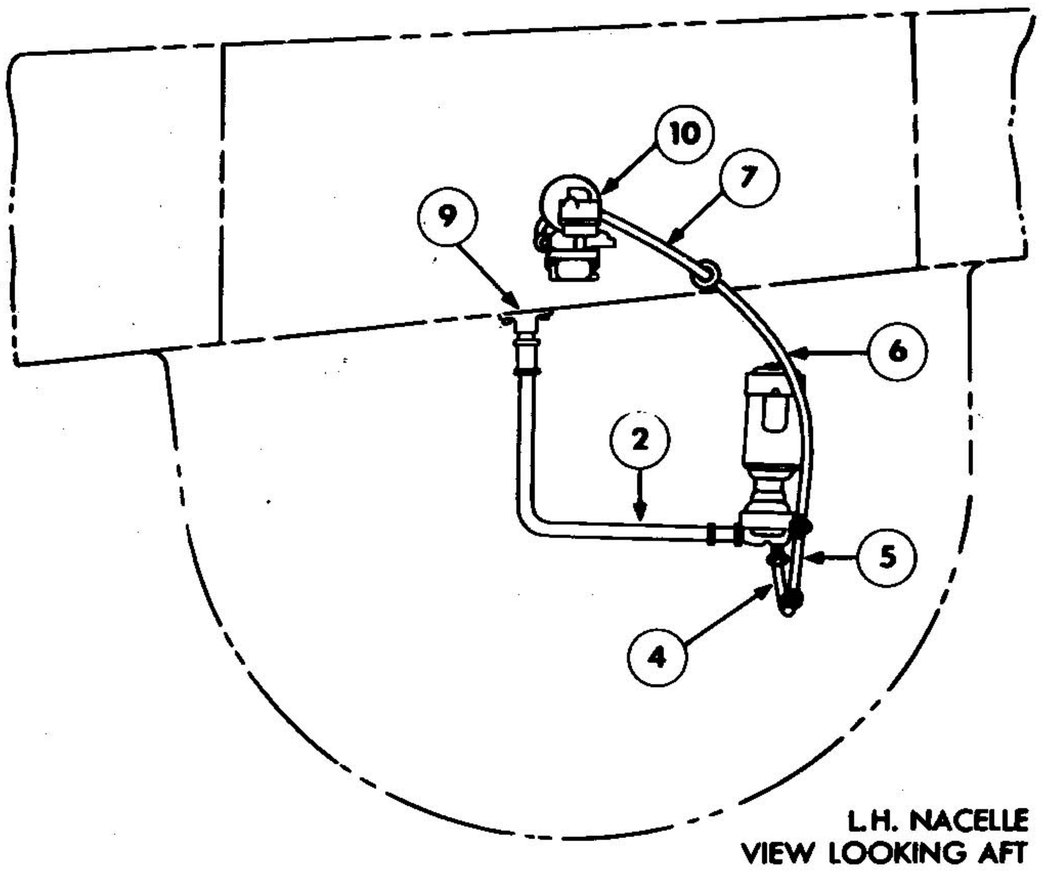
2 If the rpm varies as the manifold pressure is changed, the blades are against the low pitch stop and are not being controlled by the governor. Check the low angle setting of the blades. Loss of engine power can also cause this condition.

CAUTION

No attempt will be made to correct this condition by readjusting the governor as this may lead to overspeeding in flight.



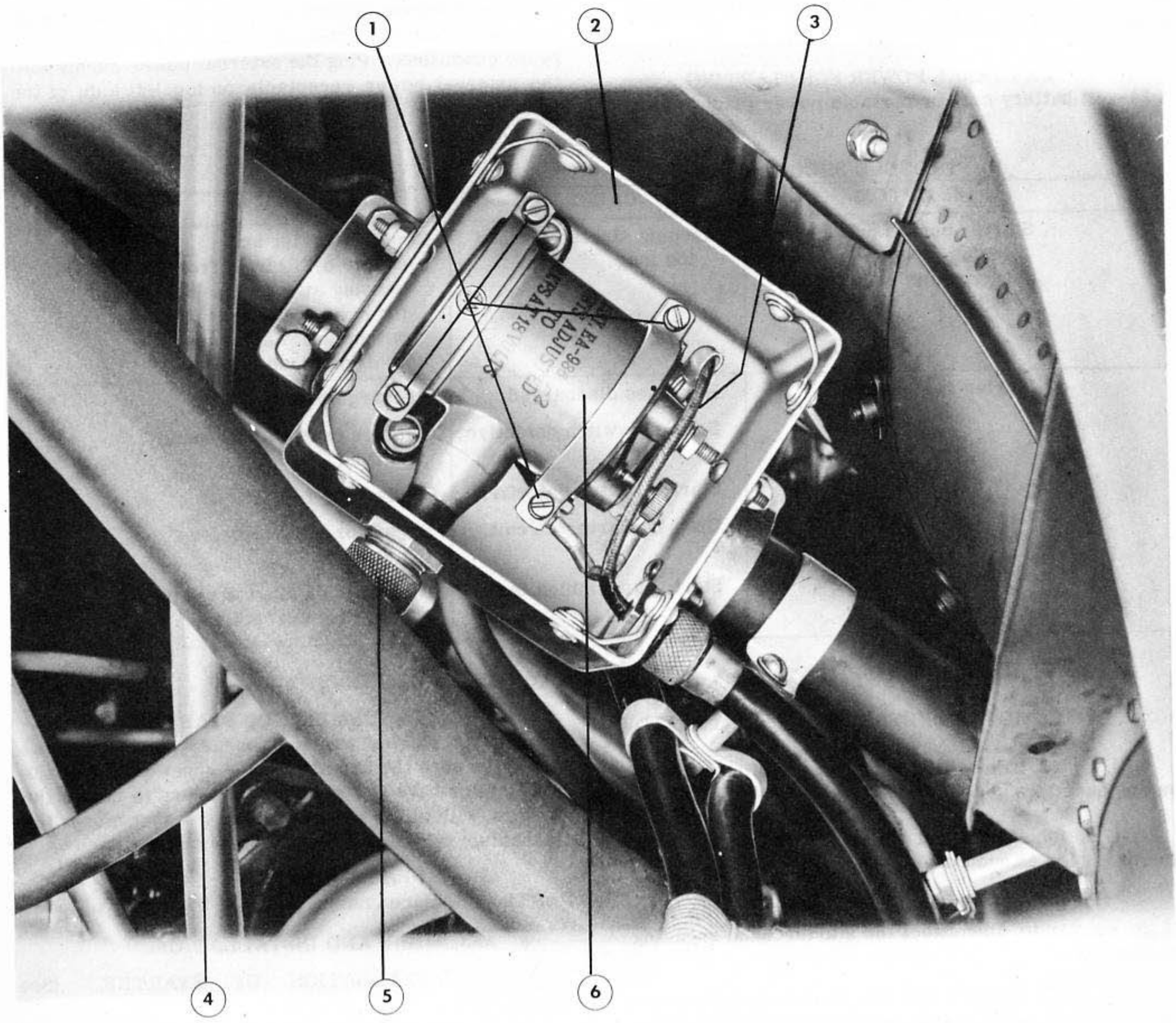
R.H. NACELLE
VIEW LOOKING AFT



L.H. NACELLE
VIEW LOOKING AFT

ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
		FLUID SUPPLY LINES	
1.	4092464-10	OIL TANK HOPPER OUTLET SUMP ASSEMBLY TO PROPELLER FEATHERING SYSTEM OIL PUMP—R.H.	1
	AAF-835-16	NIPPLE, HOSE	2
	AAF-895-5	ELBOW, STREET	1
	14 WITTEK G.T.	CLAMP	4
	AAF-895-B74	PLUG	1
2.	4092464-9	OIL TANK HOPPER OUTLET SUMP ASSEMBLY TO PROPELLER FEATHERING SYSTEM OIL PUMP—L.H.	1
	AAF-835-16	NIPPLE, HOSE	1
	AAF-850-16-90°	ELBOW, HOSE	1
	AAF-884-16-11	HOSE	2
	42A11615	CLAMP	4
	AAF-895-B74	PLUG	1
		PRESSURE LINES	
3.	4092464-3	PROPELLER FEATHERING SYSTEM OIL PUMP TO PROPELLER FEATHERING SYSTEM HOSE—R.H.	1
	AAF-895-86	BUSHING	1
	AAF-811-CT45°-10NS	ELBOW	1
4.	4092464-4	PROPELLER FEATHERING SYSTEM OIL PUMP TO PROPELLER FEATHERING SYSTEM HOSE—L.H.	1
	AAF-895-86	BUSHING	1
	AAF-811-CT45°-10NS	ELBOW	1
5.	2086069-4	HOSE, PROPELLER FEATHERING SYSTEM	1
	275765	NUT, CHECK	1
	1106195	BRACKET	1
	AN960-1416	WASHER	1
	AN3-10A	BOLT	2
	AAF-365-1032	NUT	2
	AN960-10	WASHER	4
6.	4092464-8	PROPELLER FEATHERING SYSTEM HOSE TO FIRE SEAL	1
	2031701-10-18SS	CONNECTOR	1
	1031662-10SS	NUT	1
	AN960-1416	WASHER	1
	755-10-2-8	CLIP, ADEL	1
	AN520-10-10	SCREW	1
	AAF-365-1032	NUT	1
	143908-028S104-063	WASHER	1
	AN960D-10	WASHER	1
	AN960-10	WASHER	1
7.	4092464-12	FIRE SEAL TO PROPELLER FEATHERING SYSTEM GOVERNOR	1
	AAF-811-CT45-10NS	ELBOW	1
	1044085	CLIP	1
	2109287	BRACKET	1
	AN520-10-10	SCREW	1
	AAF-365-1032	NUT	1
	AN960-10	WASHER	2
8.	280BH	PUMP, PROPELLER FEATHERING SYSTEM OIL	1
	2064935	CLAMP, PUMP	1
	1066114	BASE, PUMP CLAMP	1
	1687510-10-16	SCREW	2
	AAF-365-1032	NUT	2
	AN76-17A	BOLT	4
	AN960-10	WASHER	2
9.	5171315	SUMP ASSEMBLY, OIL TANK HOPPER OUTLET—L.H.	1
	5171315-1	SUMP ASSEMBLY, OIL TANK HOPPER OUTLET—R.H.	1
	2067251	GASKET	1
	AC365-428	NUT	16
	4106687	FITTING, OIL TANK OUTLET ADAPTER	1
	1066875	GASKET	1
	AC365-428	NUT	6
	1066943	BAR	1
	AN43-7	EYEBOLT	2
	AN393-25	PIN	2
	AN960-10	WASHER	2
	AN310-4	NUT	2
	AN-960-416	WASHER	2
	2106959	RING, TANK RETAINER	1
	AN505-10-26	SCREW	16
	2067263	COVER, OIL TANK SUMP	1
	1066876	GASKET	1
	AN770-1	COCK, DRAIN	1
10.	4G8-15D	GOVERNOR, HAMILTON STANDARD PROPELLER FEATHERING SYSTEM	1

Figure 121 - PROPELLER FEATHERING SYSTEM



1. BOOSTER COIL MOUNTING SCREWS
2. JUNCTION BOX
3. PRIMARY CIRCUIT WIRE
4. HIGH TENSION CABLE
5. HIGH TENSION CABLE LOCK NUT
6. BOOSTER COIL

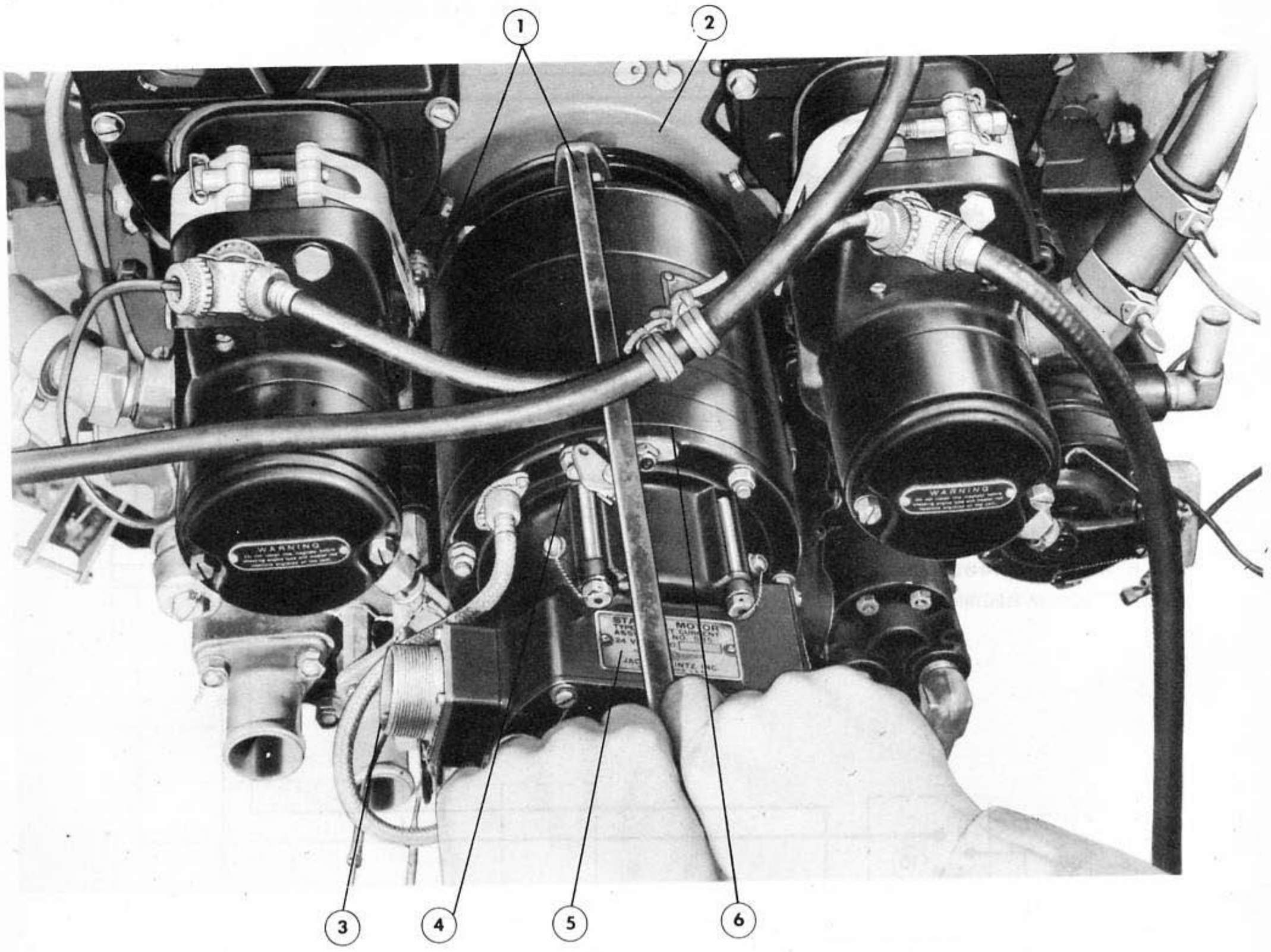
Figure 122 - BOOSTER COIL

11. STARTING SYSTEM.

a. DESCRIPTION.

(1) STARTERS. (See figure 123.) - Each engine is equipped with a type JH-5AD combination electric inertia and direct cranking starter. The starters are mounted on the center of the accessory sections of the engines. Energizing and meshing switches in the pilot's electrical panel operate the starters. A crank is furnished for manual operation.

(2) BOOSTER COILS. (See figure 122.) - Each engine is equipped with a booster coil mounted in a shielded case. Flexible conduit is provided to shield the leads from the case to one of the magnetos. The coils are controlled through the engine starter meshing



1. STARTER FLANGE TO ACCESSORY CASE STUD NUT
2. ACCESSORY CASE
3. CANNON PLUG SOCKET
4. STARTER HAND ENGAGING MECHANISM
5. STARTER WRENCH —S65-14853-2GTX
6. STARTER

Figure 123 - REMOVING STARTER

(2) INSTALLATION OF BOOSTER COIL. (See figure 122.)

(a) Connect primary circuit coil wire to the terminal on the booster coil.

(b) Place the booster coil in the junction box so the receptacle for the high tension cable is alined with the opening for the high tension cable in the junction box.

(c) Install the four booster coil mounting screws.

(d) Insert the high tension cable into its receptacle in the booster coil and screw the high tension cable locking nut onto the boss in the junction box.

1. FILLER CAP OVERFLOW
2. TANK TOP VENT
3. FILLER CAP
4. HOPPER
5. SUPPLY TANK
6. VENT
7. DIVIDED CHANNEL STANDPIPE
8. SUMP ADAPTER
9. OIL SEPARATOR
10. LINE TO ATMOSPHERE
11. VACUUM PUMP
12. SUCTION RELIEF VALVE
13. FLAPPER VALVE
14. TURN AND BANK RELIEF VALVE
15. SUCTION GAUGE
16. OIL PRESSURE GAUGE
17. OIL TEMPERATURE GAUGE
18. PROP FEATHERING GOVERNOR
19. GYRO-COMPASS
20. TURN AND BANK INDICATOR
21. ARTIFICIAL HORIZON
22. MASTER RELIEF VALVE
23. FILLER CAP OVERFLOW
24. ELECTRIC MOTOR PROP FEATHERING PUMP
25. "Y" DRAIN
26. OIL TEMPERATURE BULB
27. OIL DILUTION SOLENOID VALVE
28. LINE FROM CARBURETOR
29. OIL PRESSURE LINE
30. OVERFLOW TO ENGINE SUMP
31. VISCOSITY VALVE REGULATING SCREW
32. VISCOSITY VALVE
33. SHUTTER
34. OIL COOLER
35. SUMP PLUG
36. COOLING TUBES
37. PRESSURE REGULATING SCREW
38. ENGINE OIL PUMP
39. SCAVENGER LINE TO ENGINE SUMP

NOTE:
PART NUMBERS ARE GIVEN IN THE LEGEND FOR FIGURE 137

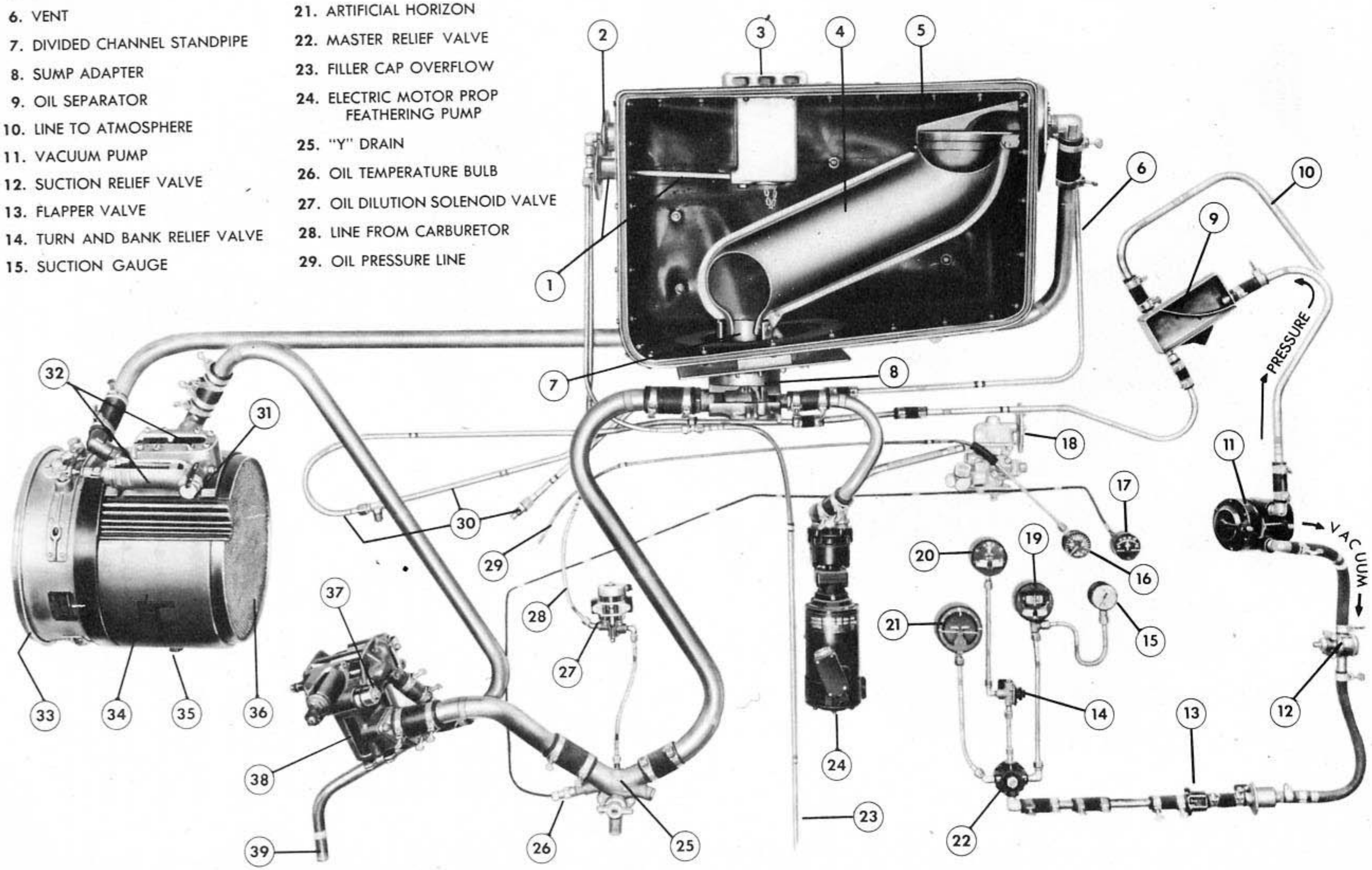
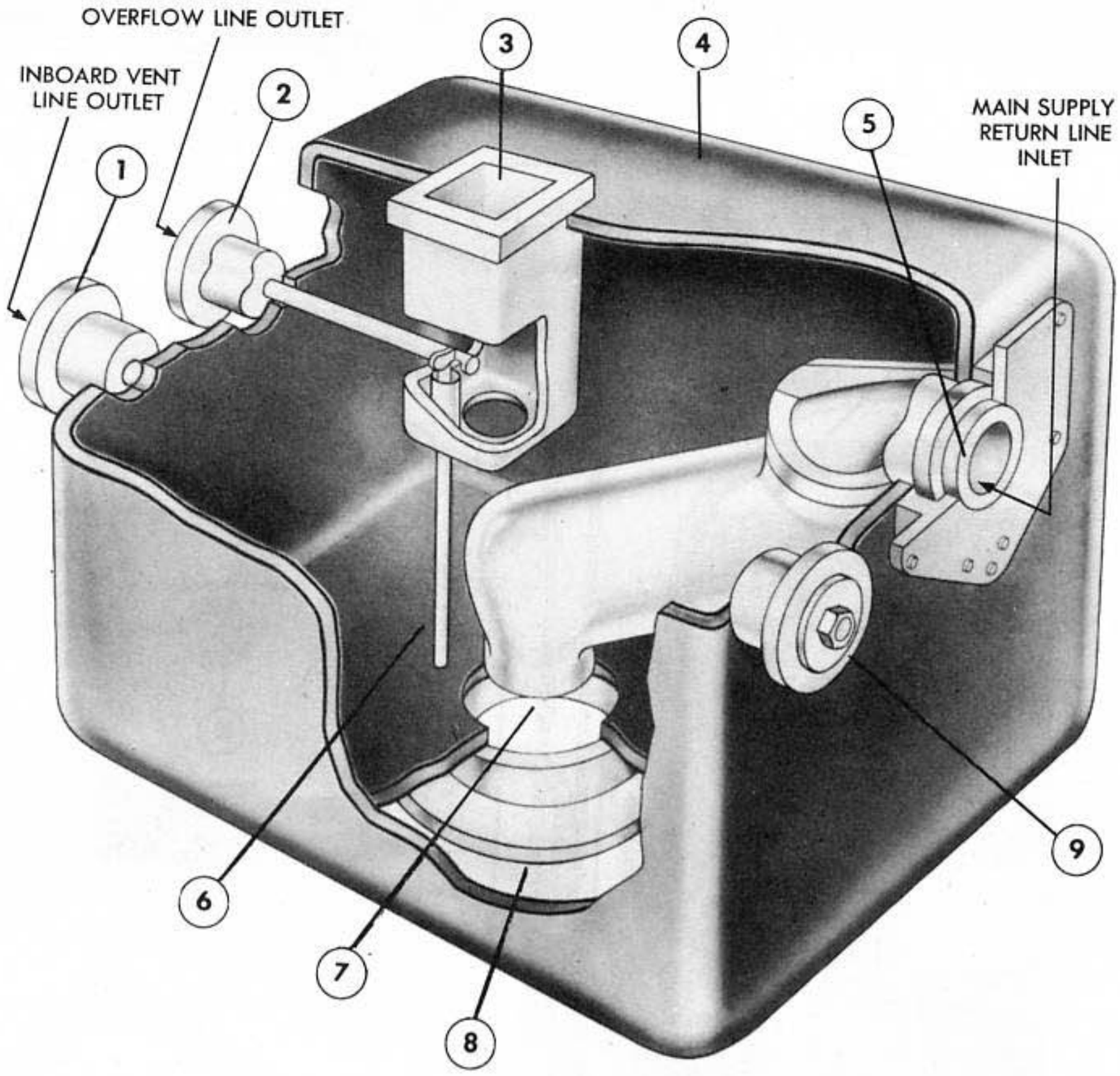


Figure 125 - OIL SYSTEM MOCK-UP



ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	2106957	OUTLET, OIL TANK VENT STATION 59.72—L.H. & R.H.	1
	1106953	GASKET, OIL TANK VENT—L.H. & R.H.	1
2.	2109523-6	TUBE ASSEMBLY, FILLER CAP OVERFLOW—L.H. & R.H.	1
	AC811T6D	SLEEVE—L.H. & R.H.	1
	AC811ET6D	ELBOW—L.H. & R.H.	1
3.	5106684	FILLER ASSEMBLY, OIL TANK—L.H.	1
	5106684-1	FILLER ASSEMBLY, OIL TANK—R.H.	1
	AN505-10-24	SCREW—L.H. & R.H.	12
	42B3581	CAP ASSEMBLY, FILLER—L.H. & R.H.	1
4.	5174352	CONTAINER ASSEMBLY, OIL—L.H.	1
	51174352-1	CONTAINER ASSEMBLY, OIL—R.H.	1
5.	5106685	SUPPORT RETURN NECK AND HOPPER—L.H. & R.H.	1
	1106952	GASKET, OIL TANK INLET FITTING—L.H. & R.H.	1
	AC365-428	NUT—L.H. & R.H.	8
6.	2109298	STICK ASSEMBLY, OIL GAUGE MEASURING—L. H. & R.H.	1
	2109299	TUBE ASSEMBLY, OIL GAUGE—L.H. & R.H.	1
7.	5109133	HOPPER ASSEMBLY, OIL TANK—L.H. & R.H.	1
	2135563	SUPPORT, HOPPER OIL TANK HINGE—L.H. & R.H.	1
	2135563-1	SUPPORT, HOPPER OIL TANK HINGE—L.H. & R.H.	1
	2133073	HINGE ASSEMBLY, OIL TANK HOPPER SUPPORT—L.H. & R.H.	1
	1029679P8-10	SCREW—L.H. & R.H.	2
	1029679P8-9	SCREW—L.H. & R.H.	2
	AC365-832	NUT—L.H. & R.H.	4
	AN960-A8	WASHER—L.H. & R.H.	4
	AN3-5A	BOLT—L.H. & R.H.	1
	AC365-1032	NUT—L.H. & R.H.	1
	AN960-D10	WASHER—L.H. & R.H.	1
8.	5171315	SUMP ASSEMBLY, OIL TANK HOPPER OUTLET—L.H.	1
	5171315-1	SUMP ASSEMBLY, OIL TANK HOPPER OUTLET—R.H.	1
	2067251	GASKET, OIL TANK SUMP—L.H. & R.H.	1
	AC365-428	NUT—L.H. & R.H.	16
	4106687	FITTING, OIL TANK OUTLET ADAPTER—L.H. & R.H.	1
	1066875	GASKET, OIL TANK OUTLET ADAPTER—L.H. & R.H.	1
	AC365-428	NUT—L.H. & R.H.	6
	1066943	CLAMP, OIL TANK SUMP COVER—L.H. & R.H.	1
	AN43-7	EYEBOLT—L.H. & R.H.	2
	AN393-25	PIN—L.H. & R.H.	2
	AN960-10	WASHER—L.H. & R.H.	2
	AN310-4	NUT—L.H. & R.H.	2
	AN960-416	WASHER—L.H. & R.H.	2
	2067263	COVER, OIL TANK SUMP—L.H. & R.H.	1
	1066876	GASKET, OIL TANK SUMP COVER—L.H. & R.H.	1
	AN770-1	COCK, DRAIN—L.H. & R.H.	1
9.	2106958	OUTLET, OIL TANK VENT STATION 89.80—L.H. & R.H.	1
	1106953	GASKET, OIL TANK VENT—L.H. & R.H.	1

Figure 126 - OIL SUPPLY CONTAINER

12. OIL SYSTEM.

a. DESCRIPTION.

(1) GENERAL. (See figures 125 and 137.) - Each engine and its propeller has an independent pressure feed oil system. Two oil supply containers are located in the inner wings forward of the main spar on the center line of the nacelle. Filling, removal, and installation of the oil supply containers are accomplished through access doors and cover plates on the upper wing surface. Supply lines to the engine pump and to the propeller feathering pump lead from a sump adapter which is attached to the bottom of the oil supply container. The sump adapter protrudes beneath the wing and is accessible forward of the fire wall. The oil container filler cap is so constructed that it regulates the ratio of oil supply to air space. A baffled hopper reduces oil foaming and minimizes the turbulence of flow. The hopper also vents air in oil returning from the engine. Pressures set up in the oil container by the foaming of return oil, or by volatilized gases due to oil dilution or burned oil are released by vent lines. Vents lead from both the inboard and outboard upper walls of the supply container to the engine, and assure venting while the oil container is inclined. Excess of oil in the filler neck overflows by line to atmosphere. An engine pump supplies oil under pressure to each engine, and filters and returns the oil through the cooler to the supply container. An oil temperature regulator, referred to as the oil cooler, is mounted in each nacelle, inboard. An electrically driven pump supplies oil at proper pressures directly from the supply container to a propeller feathering governor. For cold starts a solenoid operated valve controls injection of gasoline into the oil at the "Y" drain leading to the engine supply.

(2) OIL CONTAINERS. (See figure 126.) -Containers are of the self-sealing type. Each is attached to the inner wing structure at six points and has a capacity of 23 U.S. gallons (19 Imperial gallons) oil supply and about three gallons foaming space. Use only AAF Specification AN-VV-O-446a, grade 1120, oil. Access to the filler cap for filling and checking oil is made through hinged access door (E) (figure 19), which is a part of fairing plate (D) (figure 19), located on the upper wing surface. A bayonet type oil gage rests in a tube leading from the filler cap downward into supply container and is removable for inspection through the filler neck. A filler neck overflow line (figures 125 and 126) leads from filler neck through oil container wall and to atmosphere, where it may be identified on the inboard side of the nacelle at frame Station 43 (figure 7). As this line leads horizontally from the lower portion of the filler cap, which itself extends well down into the container, filling of containers above this level is rendered impossible. Therefore, provision is made for air and foaming space and for the release through vents of the gases mixed with oil returning from engine. Oil pressures formed in the engine by burned gases or by oil dilution are relieved by vents from the rear engine case. The vents empty at a point near the trailing edge of the upper cowl flaps. Foaming oil carried over in the vent lines with the gases from the supply container to the engine sump is scavenged and returned to supply by the scavenge side of the engine pump. A hopper (figures 125 and 126) within the container and through which the return oil feeds as it enters oil container, is provided with four baffles which quiet the flow of oil. The hopper also incorporates three vents at its head to release into the air space at top of oil container any gases mixed with the return oil. The head of the hopper is designed so that oil enters the hopper in a manner to avoid foaming. Oil returning from the engine through the cooler unit enters the upper wall of the container directly into the hopper. It flows downward through the baffles and is released into the container supply from an opening in the bottom of the hopper. A standpipe (figure 126) extending upward into the container above the sump, supplies at all times approximately a gallon of oil to the propeller feathering pump. This assures a means of feathering the propeller even in an emergency such as severance of the main oil line leading from oil container supply to the "Y" drain and engine. The oil container may be drained by means of a drain cock at the bottom of the "Y" drain. Before opening cock, attach suitable length of clean hose to catch oil.

(3) SUMP ADAPTER. (See figures 125 and 127.) - A sump casting is assembled to the bottom of the oil container and a sump adapter is attached by six bolts to the casting. The sump adapter will catch and

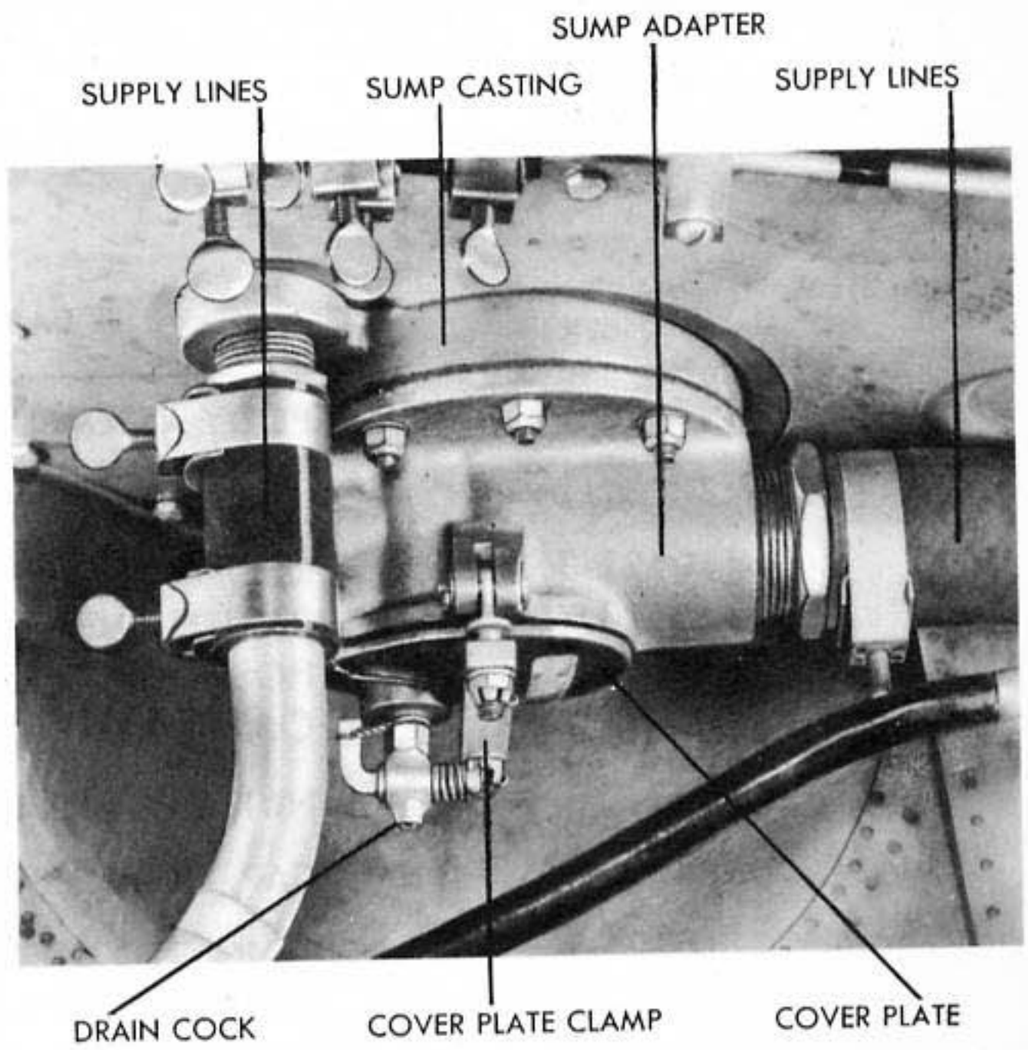
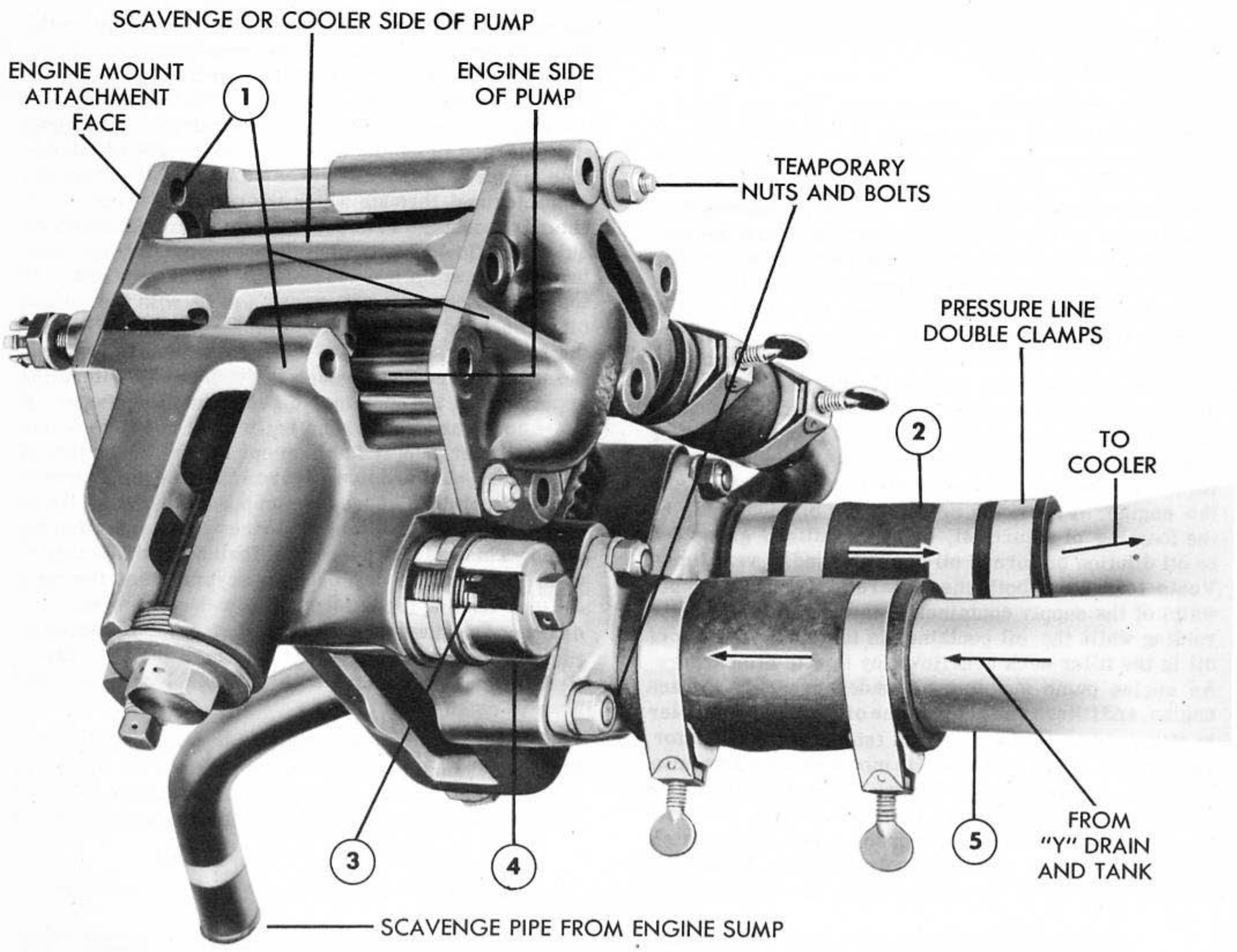
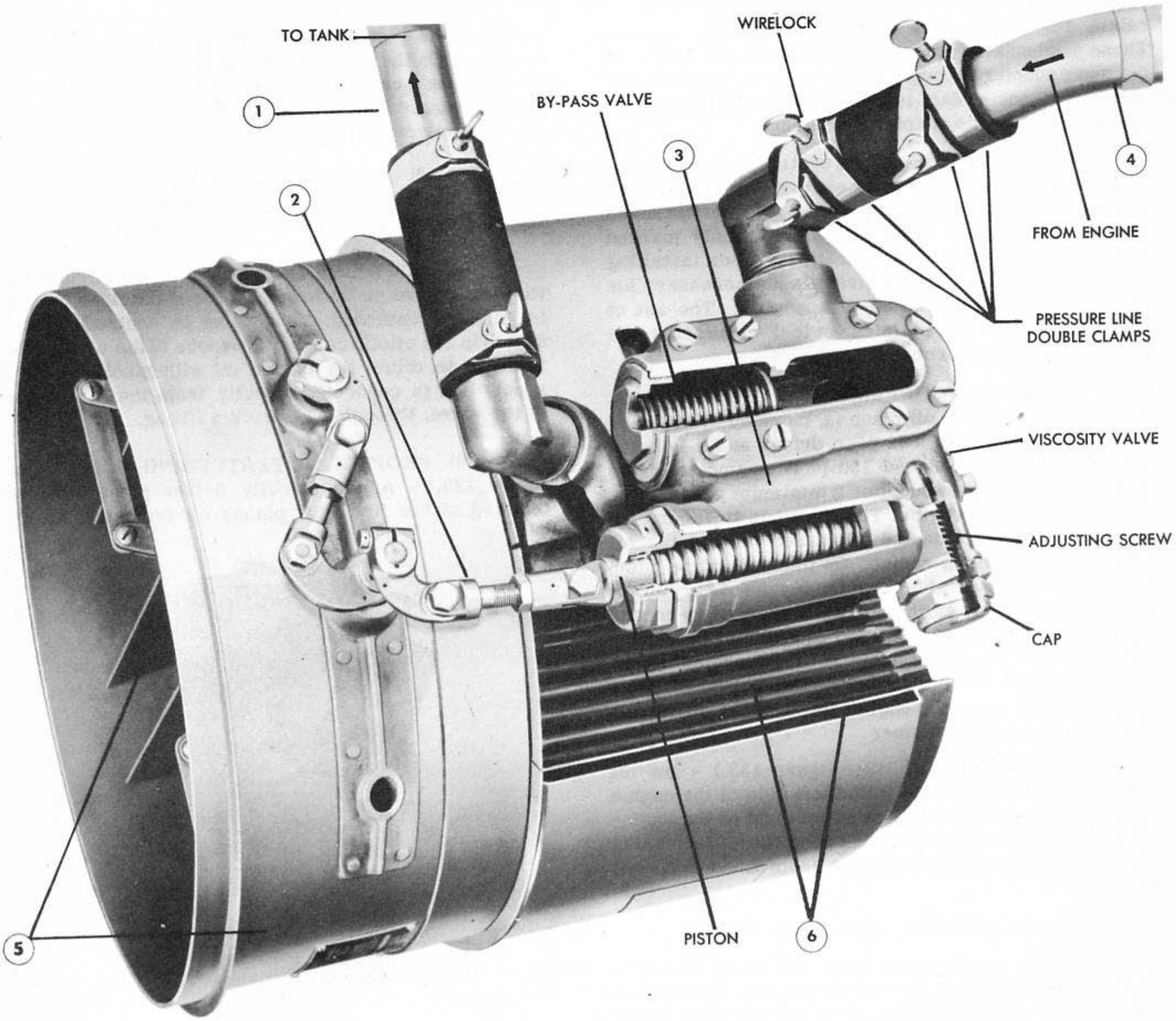


Figure 127 - INSTALLED OIL CONTAINER SUMP ADAPTER



ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	414689	BODY ASSEMBLY, OIL PUMP (Includes body, end plate, cover, bushings and studs. Body, end plate and cover not replaceable separately.)	1
2.	5110121-3	RETURN LINE, ENGINE TO FIRE WALL—L.H.	1
	5110121-4	RETURN LINE, ENGINE TO FIRE WALL—R.H.	1
	AC882-20-16	HOSE—L.H. & R.H.	2
	42A 11615	CLAMP, HOSE—L.H. & R.H.	8
3.	65853	NUT, OIL PRESSURE RELIEF VALVE ADJUSTING	1
4.	65852	CAP, OIL PRESSURE RELIEF VALVE	1
5.	5110121-1	MAIN FEED LINES, Y DRAIN TO ENGINE—L.H. & R.H.	1
	AC882-24-14	HOSE—L.H. & R.H.	2
	42A 11615	CLAMP, HOSE—L.H. & R.H.	4

Figure 128 - ENGINE OIL PUMP — CUTAWAY VIEW



ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	5109969-17	RETURN LINE, COOLER TO HOSE—L.H.	1
	5109970-17	RETURN LINE, COOLER TO HOSE—R.H.	1
	AC882-20-18	HOSE—L.H. & R.H.	2 L.H. 1 R.H.
	42A 11615	CLAMP, HOSE—L.H. & R.H.	8 L.H. 4 R.H.
	A755-20-2-10	CLIP, ADEL—L.H. & R.H.	2
	AN520-10-10	SCREW—L.H.	1
	AC365-1032	NUT—L.H. & R.H.	1
	117425-30-016	SPACER—L.H.	1
	42A 11615	CLAMP, HOSE—R.H.	1
	AN520-10-8	SCREW—R.H.	1
2.	3A-220	CLEVIS	1
	3A-259-1	BOLT, CLEVIS	1
	AN316-6R	NUT, CHECK	1
3.	IC-179	VALVE ASSEMBLY	1
4.	5109969-16	RETURN LINE, FIRE WALL TO COOLER—L.H.	1
	5109970-16	RETURN LINE, FIRE WALL TO COOLER—R.H.	1
	AC853-20	ELBOW, 45° HOSE—L.H.	1
	AC882-20-18	HOSE—L.H. & R.H.	2
	42A 11615	CLAMP, HOSE—L.H. & R.H.	8
	A755-20-2-10	CLIP, ADEL—L.H. & R.H.	1
	117425-30-020	SPACER—L.H.	1
	AN520-10-26	SCREW—L.H.	1
	AN520-10-8	SCREW—R.H.	1
	AC365-1032	NUT—R.H.	1
5.	1E315	SHUTTER ASSEMBLY	1
6.	1E171	OIL COOLER	1

Figure 129 - OIL COOLER – CUTAWAY VIEW

retain any condensates flowing through the system. These condensates can be removed from the bottom of the sump adapter through a drain cock provided for the purpose. A cover plate is held in place over the opening in the bottom of the adapter by clamps.

(4) OIL LINES. - All oil system lines are made from aluminum alloy, except oil pressure gage lines which are made of copper. All have an outer diameter of 1/4 inch to 1-1/2 inch. Lines are plainly marked with a yellow band for identification. When installing new oil lines or making repairs it is not necessary for the lines to be heat-treated or annealed. The use of corrosion-resistant stainless steel eliminates the necessity of either process.

(5) ENGINE OIL PUMP. (See figure 128.) - A double-acting engine oil pump is mounted at the rear of each engine where it is gear driven as an integral unit. (See figures 128 and 132.) The pump is of the meshed gear type and supplies a minimum pressure of 70-75 pounds to the engine. The pump has two actuating sides. On the left side the oil passes through the oil filter, and then to the engine. On this side of the pump a spring regulating valve provides means of varying oil pressure. Tension on the spring is changed by means of an adjusting screw. On the right side of the engine oil pump the scavenge pump is incorporated as an integral part of the entire unit. The scavenge pump forces the oil from the engine through the oil cooler and back to the oil container.

(6) OIL FILTER. (See figure 133.) - An oil filter is attached by bolts to the left side of the engine accessory section and is located forward of the engine oil pump. Engine oil passes between the self-cleaning oil filter disks under pressure from the engine oil pump.

(7) OIL COOLER. (See figure 129.)

(a) Each engine is served by an oil cooler located on the inboard side of the nacelle. Two straps around the cooler and bolts along the forward flange ring attach the unit to the nacelle structure. The oil cooler is composed of three major assemblies, oil cooler, assembly valve, and the shutters.

(b) Of honeycomb tube construction, the cooler serves to dissipate heat from oil flowing through it. A sleeve or muff encloses the radiator assembly. Air flow is provided by a scoop in the nacelle forward of the cooler. On the bottom of the unit is a drain plug. This permits removal of condensates if the cooler becomes clogged.

(c) The combination valve serves two purposes: One side of the valve directs oil flow through the cooler or bypasses it around the outer muff directly to the oil tank. The other side houses a piston which actuates the shutters. Cold oil, too thick to pass through the cooler tubes, applies a back pressure which operates the piston, opens the valve, and closes the shutters. On the inboard side of the viscosity valve is an adjusting screw which controls the tension of the valve spring. It is pre-set at the factory and should not be tampered with.

(d) A flap, located to the rear of the oil cooler, acts as a rear door to the air scoop. It is actuated by cable from the lower cowl flaps.

(8) OIL DILUTION VALVE. - An oil dilution valve is located on the forward side of the fire wall and is solenoid operated. The valve is controlled by a switch in the pilot's cockpit. Purpose of the oil dilution valve is to dilute the engine oil with gasoline. Fuel supply line is connected directly from the carburetor to the valve, through a restricted fitting.

(9) PROPELLER FEATHERING PUMP. (See figure 130.) - An electrically driven pump mounted forward of the fire wall pumps oil from the supply

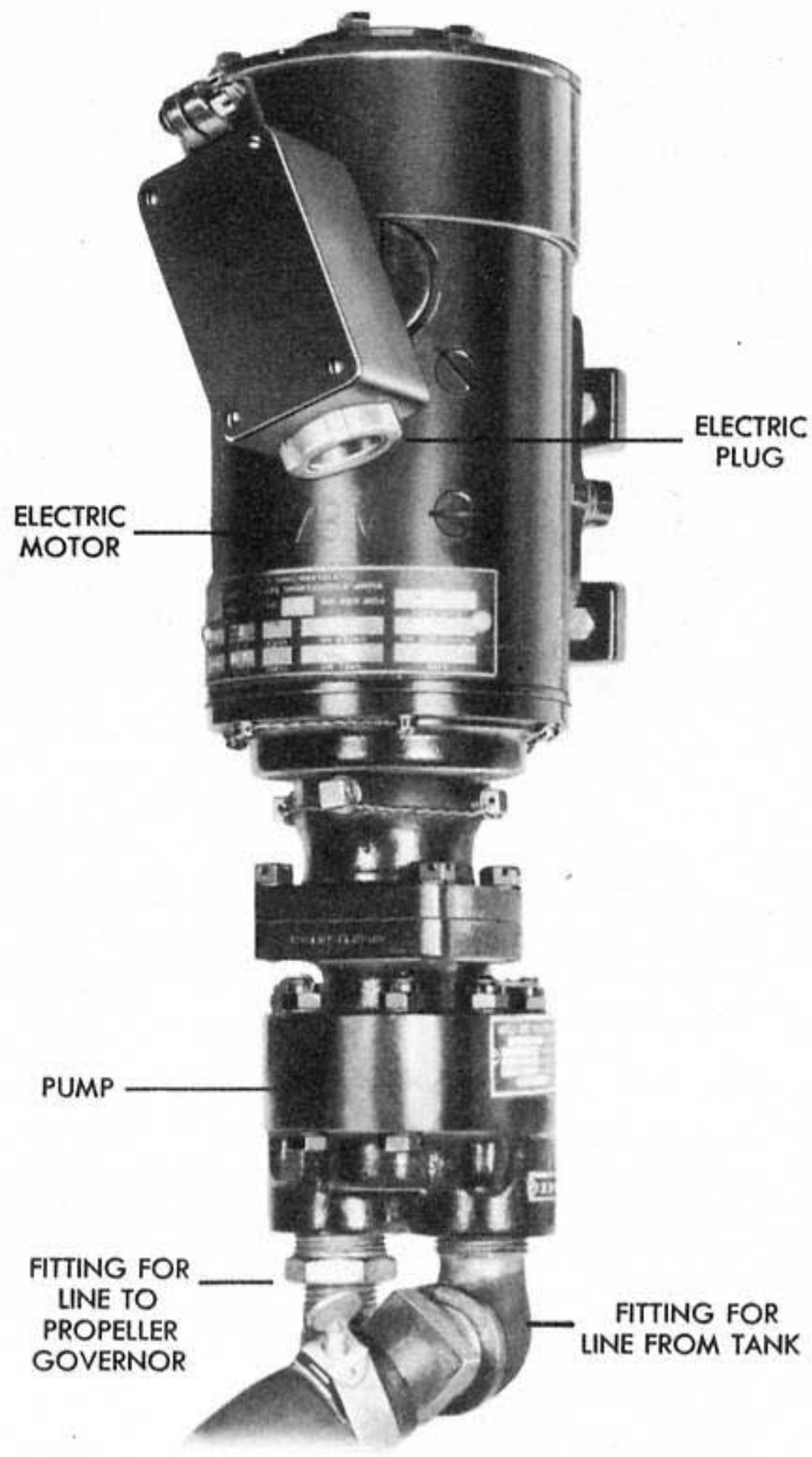


Figure 130 - PROPELLER FEATHERING PUMP

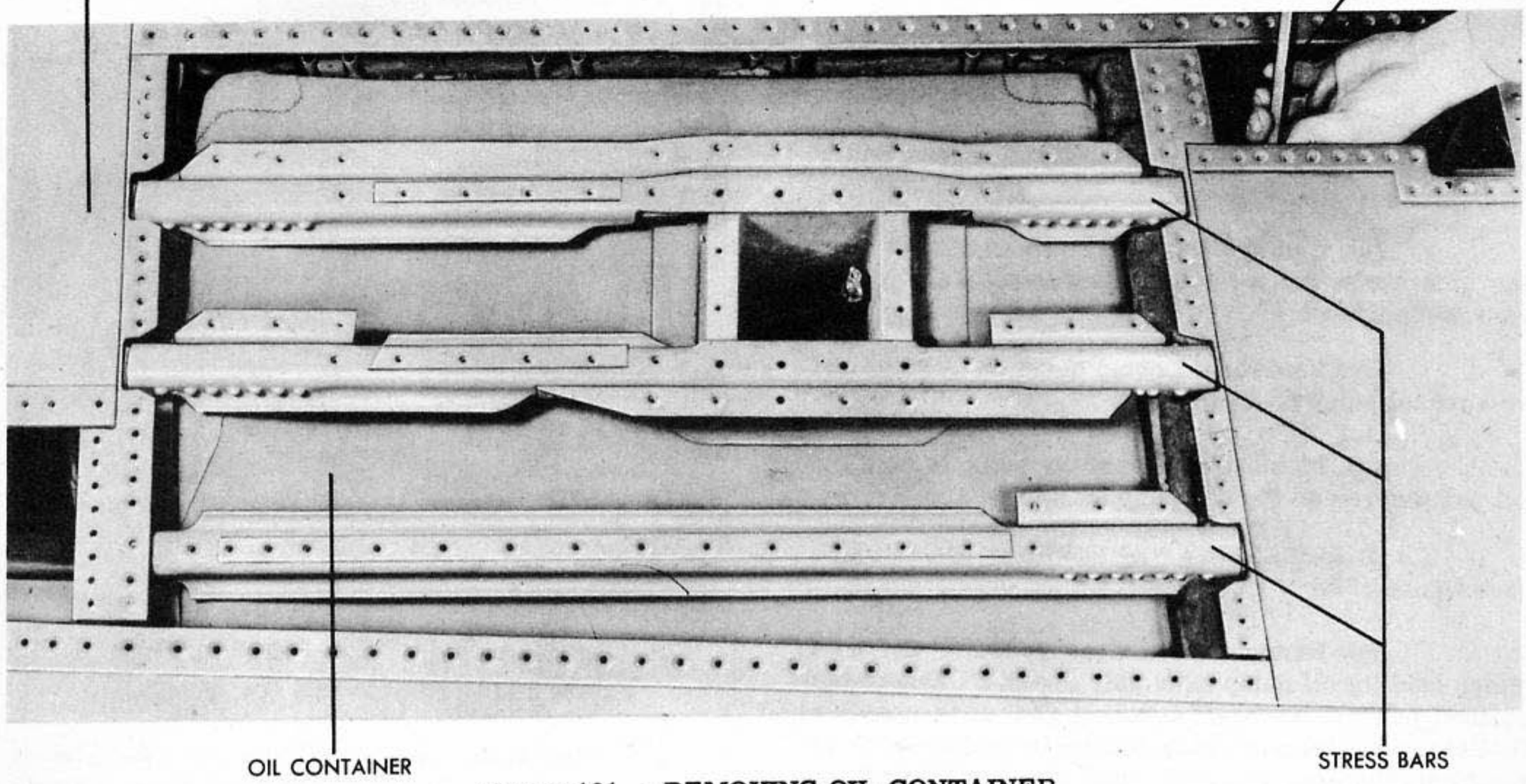
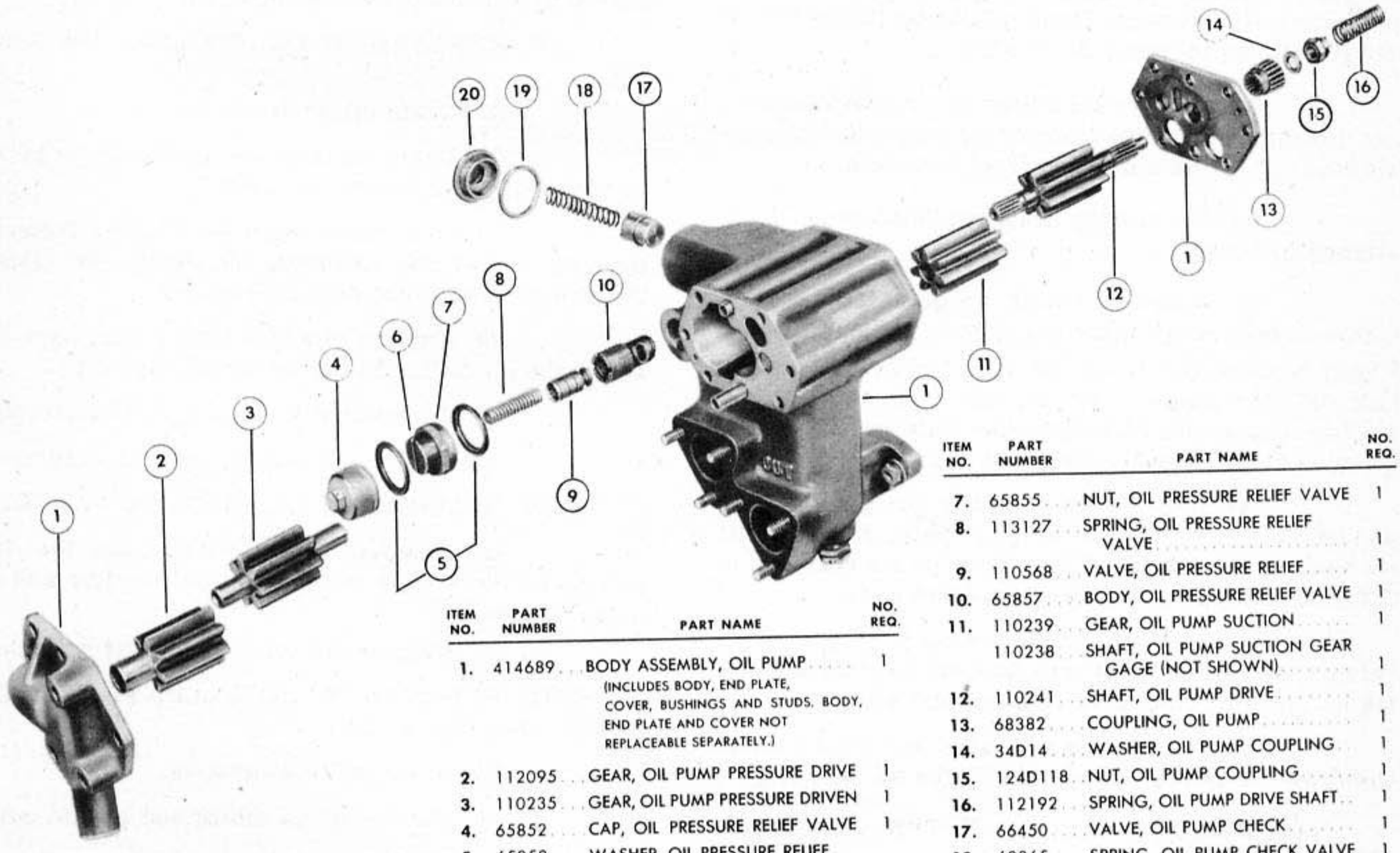


Figure 131 - REMOVING OIL CONTAINER



ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	414689	BODY ASSEMBLY, OIL PUMP (INCLUDES BODY, END PLATE, COVER, BUSHINGS AND STUDS. BODY, END PLATE AND COVER NOT REPLACEABLE SEPARATELY.)	1
2.	112095	GEAR, OIL PUMP PRESSURE DRIVE	1
3.	110235	GEAR, OIL PUMP PRESSURE DRIVEN	1
4.	65852	CAP, OIL PRESSURE RELIEF VALVE	1
5.	65858	WASHER, OIL PRESSURE RELIEF VALVE	2
6.	65853	NUT, OIL PRESSURE RELIEF VALVE ADJUSTING	1
7.	65855	NUT, OIL PRESSURE RELIEF VALVE	1
8.	113127	SPRING, OIL PRESSURE RELIEF VALVE	1
9.	110568	VALVE, OIL PRESSURE RELIEF	1
10.	65857	BODY, OIL PRESSURE RELIEF VALVE	1
11.	110239	GEAR, OIL PUMP SUCTION	1
	110238	SHAFT, OIL PUMP SUCTION GEAR GAGE (NOT SHOWN)	1
12.	110241	SHAFT, OIL PUMP DRIVE	1
13.	68382	COUPLING, OIL PUMP	1
14.	34D14	WASHER, OIL PUMP COUPLING	1
15.	124D118	NUT, OIL PUMP COUPLING	1
16.	112192	SPRING, OIL PUMP DRIVE SHAFT	1
17.	66450	VALVE, OIL PUMP CHECK	1
18.	68865	SPRING, OIL PUMP CHECK VALVE	1
19.	66453	RING, OIL PUMP CHECK VALVE	1
20.	66451	RETAINER, OIL PUMP CHECK VALVE	1

Figure 132 - EXPLODED VIEW OF ENGINE OIL PUMP

(4) REMOVAL OF ENGINE OIL PUMP. (See figure 128.)

(a) Drain oil from system.

(b) Disconnect all tubing and hose connections from the pump. Cap the tubing to prevent entry of dirt.

(c) Remove the safety wire and nuts from the nine studs which secure the pump to the engine accessory mount.

(d) Hold the oil pump cover on by hand and remove oil pump from engine.

(e) Install two temporary bolts to hold the oil pump cover on the oil pump until disassembly.

(5) DISASSEMBLY OF ENGINE OIL PUMP. (See figure 132.)

(a) Remove the temporary bolts and nuts which hold the oil pump assembly together. Due to the splined pump drive shaft coupling gear it is possible to slide off the oil pump body leaving the oil pump drive shaft coupling gear and drive shaft attached to the front end plate. During this disassembly care must be taken not to drop the scavenge pump idler gear if this is removed with the oil pump drive shaft.

(b) Remove the cotter pin, castellated nut, and washer from the oil pump drive shaft and separate the coupling, drive shaft, and front end plate.

(c) Remove the scavenge pump gears if not already removed.

(d) Remove the rear end plate from the two hollow dowels which aline the plate to the pump body. It may be necessary to tap the plate lightly with a rawhide or fiber mallet. Do not use a screwdriver or similar implement to loosen the plate as the use of these tools may damage the plate and body.

(e) Remove the pressure pump drive gear and its mating pressure pump idler gear. Note that the oil pump drive gear shaft is splined on its rear end to accommodate the pressure pump drive gear.

(f) To disassemble the oil pressure relief valve, remove the cap, bronze washer, lock nut, adjusting nut, spring, piston, valve body, and washer.

(g) Remove the oil check valve cap nut and withdraw the spring and valve with the oil seal ring.

(6) REMOVAL OF OIL FILTER. (See figure 138.)

(a) Remove safety wire from the three stud nuts that attach the oil filter to the engine accessory section. Remove nuts.

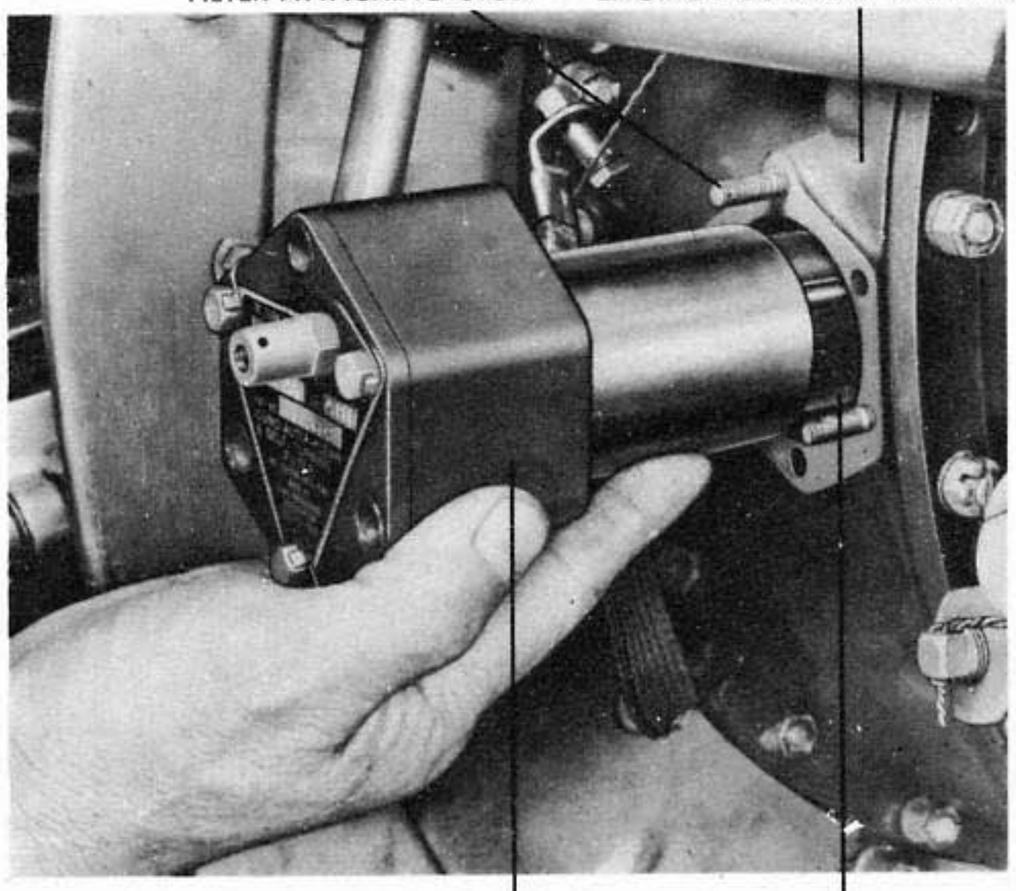


Figure 133 - REMOVING OIL FILTER

(b) Slide oil filter from its case, being careful to protect the disk assembly from damage caused by rubbing the accessory case.

(7) REMOVAL OF OIL COOLER. (See figure 134.)

(a) Drain oil from system.

(b) Drain oil from oil cooler jacket by removing plug from bottom of cooler.

(c) Disconnect the hose clamps from the main oil supply line and from the supply line leading to the engine oil pump at the oil cooler.

(d) Remove the nine flange ring bolts that attach the oil cooler to the forward flange ring.

(e) Remove the four strap bolts and straps.

(f) Remove oil cooler from its cradle.

(8) REMOVAL OF OIL DILUTION VALVE.

(a) Remove safety wire from the four screws on the bottom of the oil dilution valve and remove screws.

(b) Remove the valve piston and valve seat.

(9) REMOVAL OF PROPELLER FEATHERING PUMP. (See figure 135.)

(a) Drain oil from system.

(b) Disconnect all tubing and hose at pump.

(c) Disconnect electrical connection at junction box attached to pump motor.

(d) Remove four stud nuts that attach propeller feathering pump to the fire wall. Remove pump.

d. MAINTENANCE REPAIRS.

(1) INSPECTION AND REPAIR OF OIL CONTAINERS.

(a) Inspect exterior of container for cuts or breaks. Replace if cut or damaged.

(b) Inspect six flange connections 1, 2, 3, 5, 8 and 9 (figure 126) for security of attachment to the container.

(c) Clean inside of oil container through the sump opening at the bottom of the container.

(2) INSPECTION AND REPAIR OF OIL COOLER.

(a) Remove the valve from the cooler.

(b) Clean the outside of the oil cooler and the outside and inside of the valve by immersing in separate tanks and rotating the parts by hand.

(c) Remove oil cooler and valve from the cleaning tanks and drain. Dry with compressed air.

(d) Test the oil cooler for leaks at 100 pounds per square inch air pressure by submerging the cooler in warm water. Repair any leaks found.

e. REPLACEMENTS.

(1) INSPECTION AND REPLACEMENT OF SUMP ADAPTER PARTS.

(a) Clean sump adapter carefully with solvent.

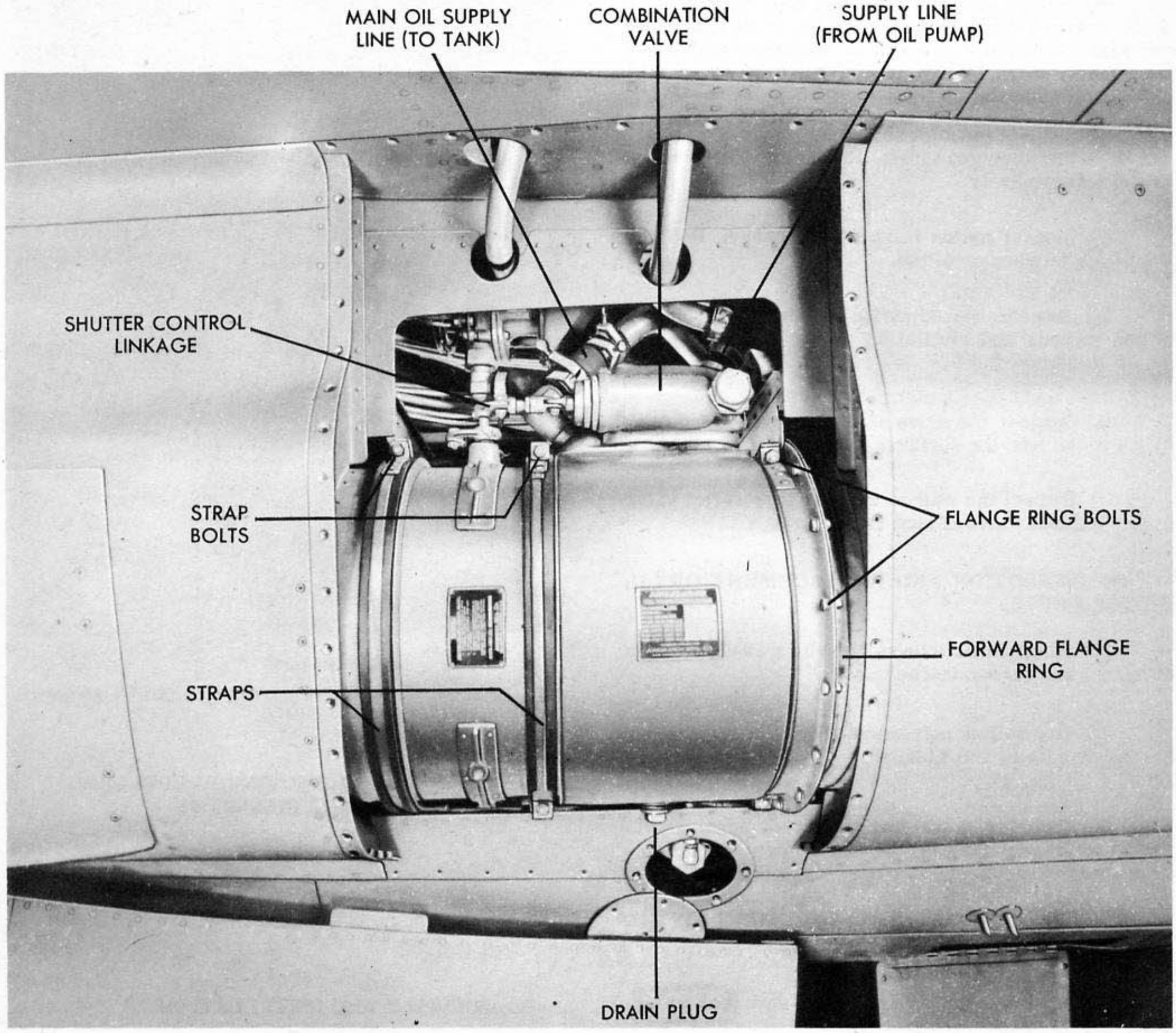


Figure 134 - INSTALLED OIL COOLER

(b) Inspect for any cracks or defects in the metal. Replace defective parts.

(c) Install new gasket.

(2) INSPECTION AND REPLACEMENT OF ENGINE OIL PUMP PARTS.

(a) Clean all finished surfaces of the oil pump with crocus cloth and gasoline.

(b) Inspect the oil pump body for cracks and condition of the finished surfaces. Replace if cracked.

(c) Inspect the threads in the tapped holes for nicks or burs. Remove all burs and nicks by retapping.

(d) Inspect the end plate for cracks, condition of the finished surfaces and check the drive shaft hole for wear. Replace if cracked or if drive shaft hole is excessively worn. (Shaft should not have more than 0.015-inch clearance.)

(e) Inspect the idler shaft gear for cracks, wear, and fit on the idler gear shaft. Replace gear if cracked or worn excessively.

(f) Inspect piston for pitting or wear. Replace if surface is worn or pitted.

(g) Inspect the adjusting screw for condition of the threads and mutilation of the slots. Replace screw if damaged.

(h) Inspect the drive shaft for cracks and condition of the bearing surfaces. Replace if cracked.

(i) Inspect the seat in the pressure relief valve body. Replace valve if seat is damaged.

(3) INSPECTION AND REPLACEMENT OF OIL FILTER PARTS.

(a) Clean filter thoroughly with a 50-50 solution of benzol and carbon tetrachloride.

(b) Dry with compressed air and check for any breaks or cuts in the cleaner body. Replace if damaged.

(c) Examine disks for burring or bending sufficient to prevent rotation of disks. Replace if damaged.

(4) INSPECTION AND REPLACEMENT OF OIL DILUTION VALVE PARTS.

(a) Clean valve piston and valve seat thoroughly.

(b) Inspect piston and valve seat for wear. Replace if worn.

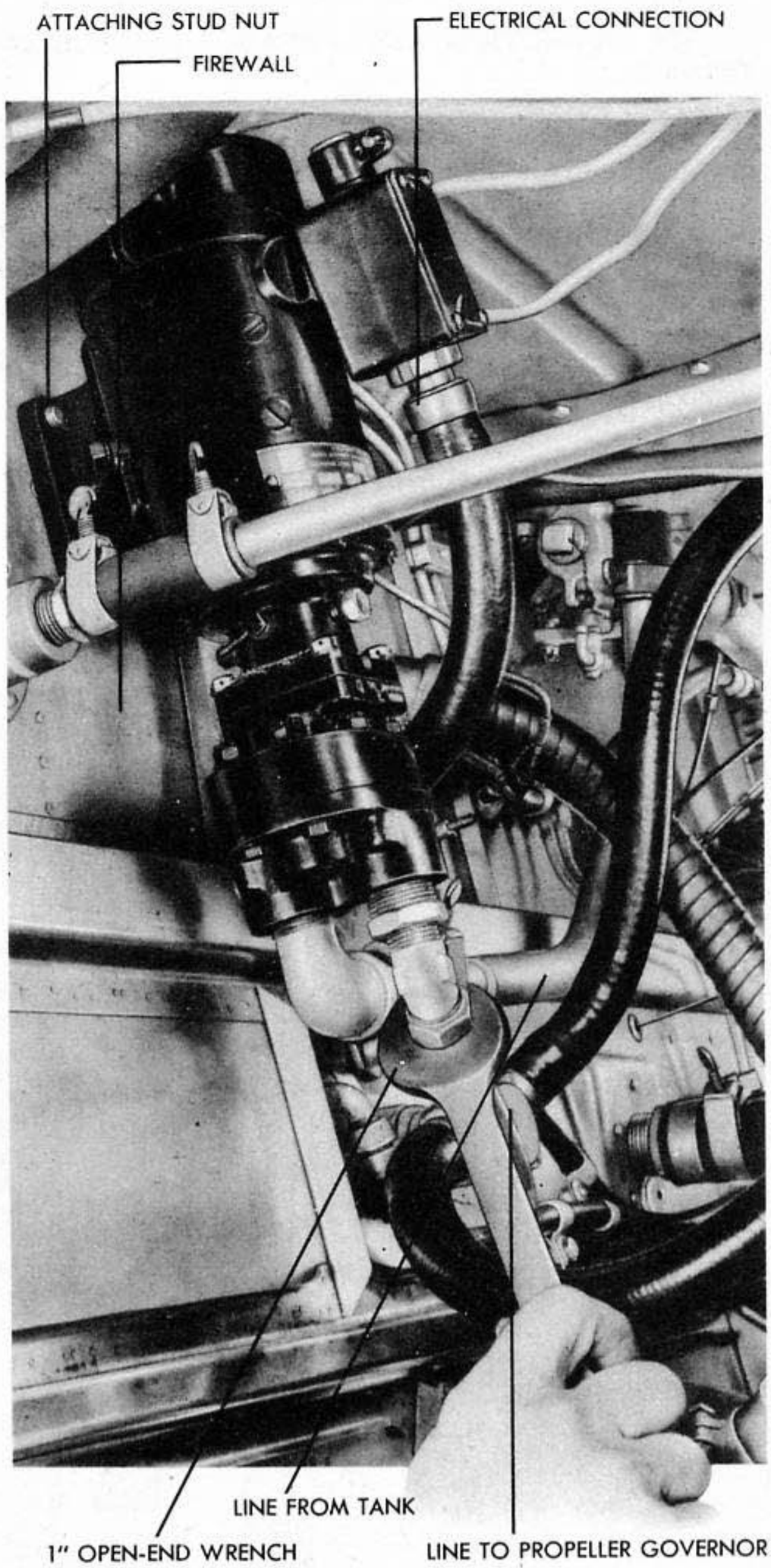


Figure 135 - REMOVING PROPELLER FEATHERING PUMP

f. ASSEMBLY AND INSTALLATION.

(1) INSTALLATION OF THE PROPELLER FEATHERING PUMP. (See figure 135.)

(7) INSTALLATION OF OIL LINES. - When installing oil lines use the proper size wrench to prevent damaging the connections. When replacing lines, be sure they do not make contact with other lines, control cables, brackets, or structural members. Breaks are sometimes caused by rubbing and wear due to vibration if the lines lack clearance. When connecting the main feed lines to the "Y" drain and from the pump to the cooler be sure the former is 1-1/2-inch tubing and the latter is 1-1/4-inch tubing. Tighten tubing connections securely. Check for leaks after installation.

(8) ASSEMBLY AND INSTALLATION OF SUMP ADAPTER. (See figure 127.)

(a) Assemble the drain cock and clamp bolts to the adapter. Do not tighten excessively. There is danger of bending the plate and causing a leak.

(b) Place the gasket in position on the sump adapter and install the adapter. Tighten the six nuts that secure the adapter to the casting.

(c) Connect the hose connections of the engine pump line and the propeller pump line at the sump adapter.

(d) Fill the oil container.

(9) INSTALLATION OF OIL CONTAINERS. (See figure 131.)

(a) Install hopper in oil container through the sump opening at the bottom of the container.

(b) Apply a light coating of cement, Specification AAF 26544-A, to all surfaces which come in contact with attaching fittings 1, 2, 3, 5, 8, and 9. (See figure 126.)

(c) Place oil container in position in inner wing.

(d) Connect and tighten the six flange connections 1, 2, 3, 5, 8, and 9. (See figure 126.)

(e) Attach the three stress bars and cover plates (C), (J), and (H) and fairing plate (D) to the upper wing surface. (See figure 19.)

g. FINAL TEST AFTER ASSEMBLY

(1) TEST OF OIL DILUTION VALVE AFTER INSTALLATION. - Turn ON fuel container to engine mixture control idle cut-off. Remove line fitting at valve on "Y" drain side. Plug "Y" drain line. Turn ON main battery switch and master switch. Depress dilution valve switch for one minute, noting number of drops at valve fitting. Ten drops per minute is permitted.

(2) TEST OF OIL COOLER AFTER INSTALLATION.

(a) Fill the oil container with oil, Specification AN-VV-O-446a, grade 1120.

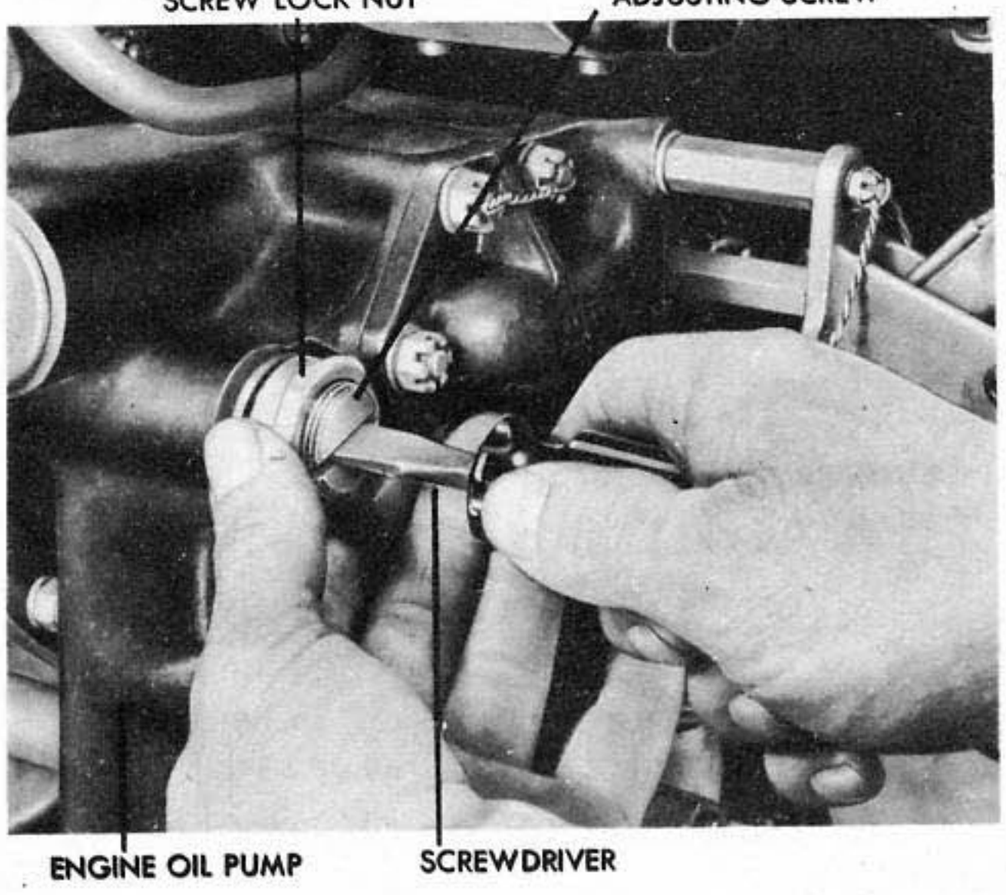


Figure 136 - ADJUSTING OIL PRESSURE RELIEF VALVE

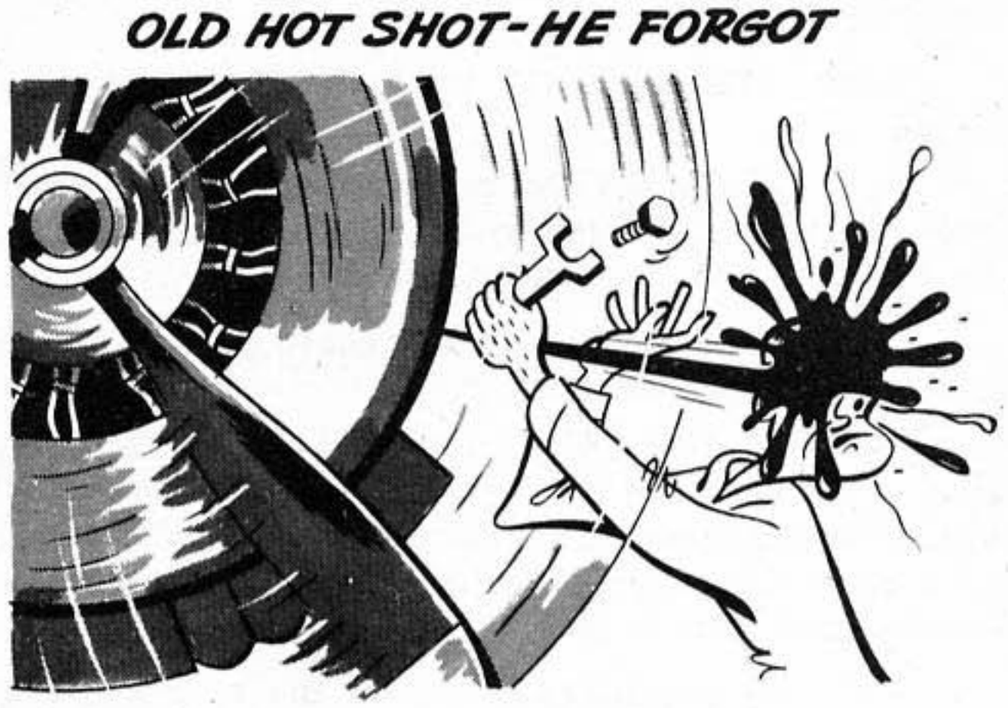
(b) Start engine and visually check cooler and adjacent tubing for oil leaks.

(c) For temperature check, head ship into wind with cowling on before changing adjustments.

(3) TEST AND ADJUSTMENT OF ENGINE OIL PUMP AFTER INSTALLATION. (See figure 136.)

(a) Fill system with oil.

(b) Start engine and check all attaching points for leaks. Tighten connections if leaking.



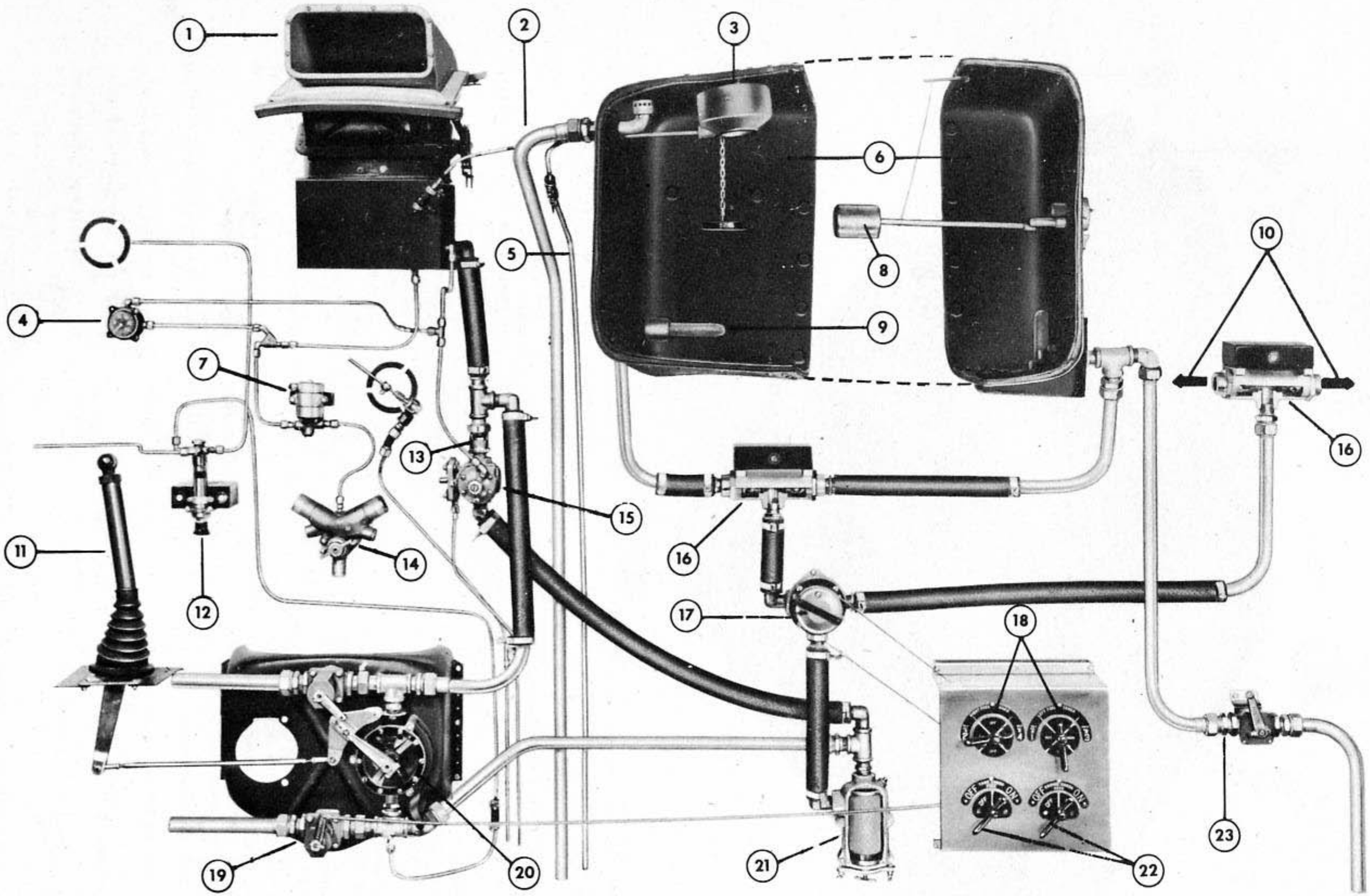
(c) With engine running at 2,000 rpm, and 60 degrees C (140 degrees F) oil inlet temperature, check oil pressure gage, which should read 85, + 15, -5 per square inch. It may be necessary to loosen lock nut and adjust pressure adjusting screw until gage registers 85 pounds. (See figure 136.) One revolution of the screw approximates 12 pounds pressure. Turning screw clockwise increases pressure. Tighten lock nut and install safety after adjustment.

(4) TEST OF SUMP ADAPTER AFTER INSTALLATION.

(a) Check hose connections for leaks. Tighten clamps if leak is noticed. Do not exceed 25 inch pounds torque when tightening clamps.

(b) Check for leaks around sump casting. Tighten all nuts if connection leaks. If leaking continues, remove sump adapter and install new gasket.

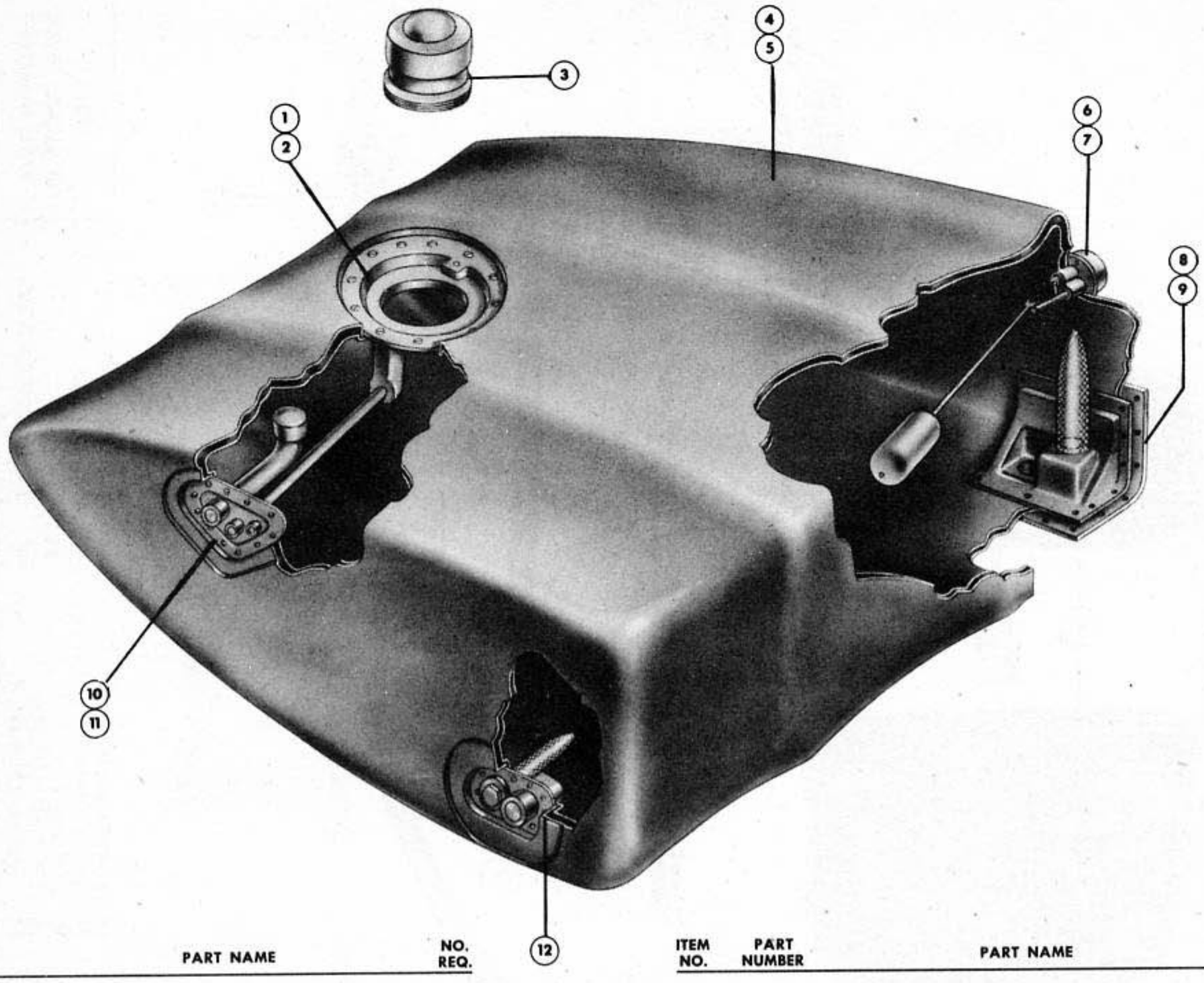
(5) TEST OF OIL CONTAINERS AFTER INSTALLATION. - Fill oil containers with oil and check all attaching points for leaks. Tighten connections if oil seepage is noticed.



1. CARBURETOR AIR SCOOP
2. FUEL TANK OVERFLOW
3. FILLER CAP
4. FUEL PRESSURE GAUGE
5. FILLER CAP OVERFLOW
6. R.H. INBOARD FUEL TANK
7. SOLENOID OIL DILUTION VALVE
8. LIQUIDOMETER TANK UNIT
9. STRAINER
10. TO R.H. OUTBOARD FUEL TANK
11. WOBBLE PUMP HANDLE
12. PRIMER PUMP
13. FLAPPER VALVE
14. OIL "Y" DRAIN
15. FUEL PUMP
16. BALL CHECK VALVES
17. TANK SELECTOR VALVE
18. SELECTOR VALVE CONTROLS
19. CROSS FEED VALVE
20. WOBBLE PUMP
21. STRAINER
22. CROSS FEED CONTROLS
23. DUMP VALVE

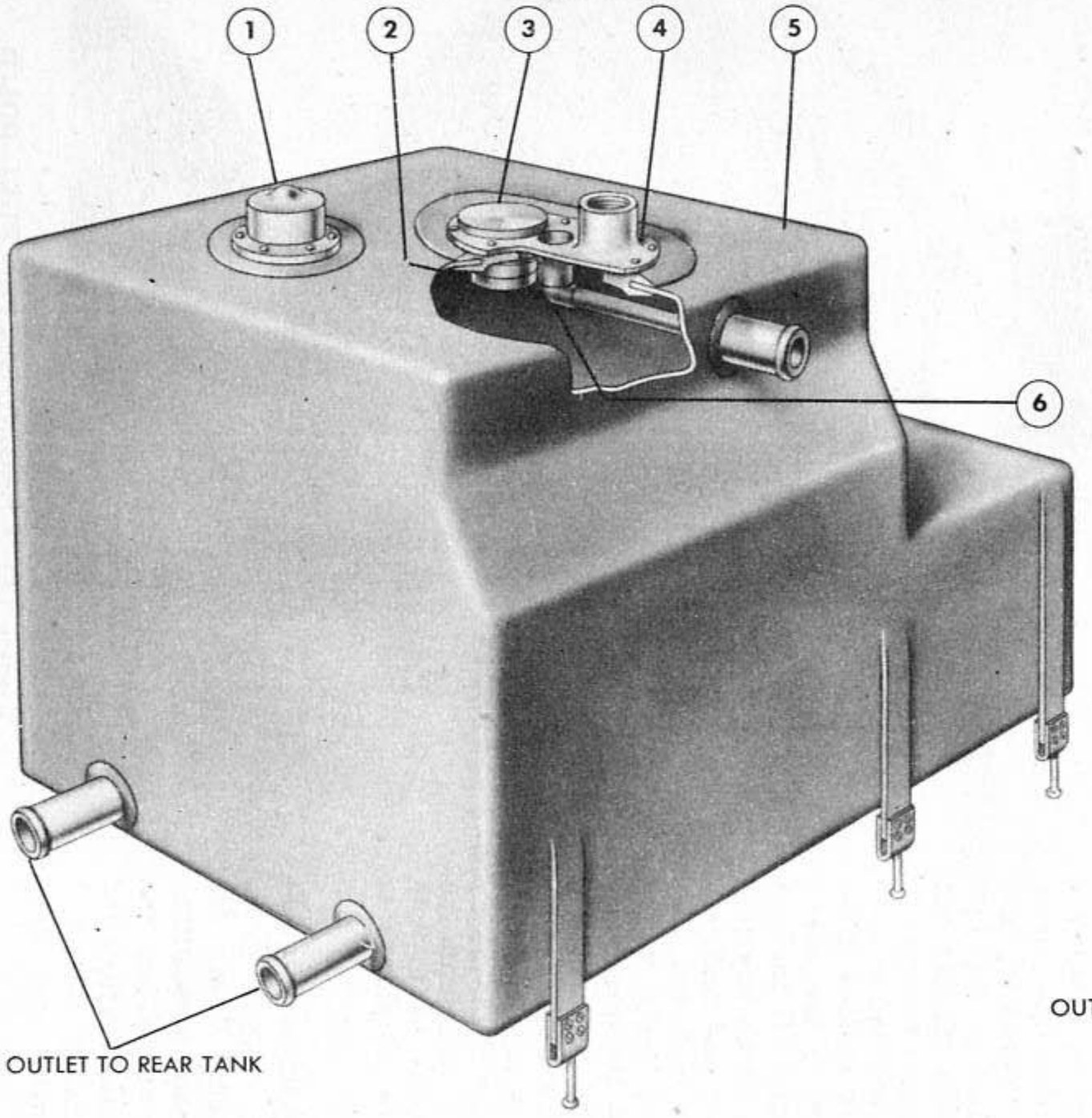
NOTE:
SEE FIGURE 158 FOR PARTS NUMBERS

Figure 138 - FUEL SYSTEM MOCK-UP



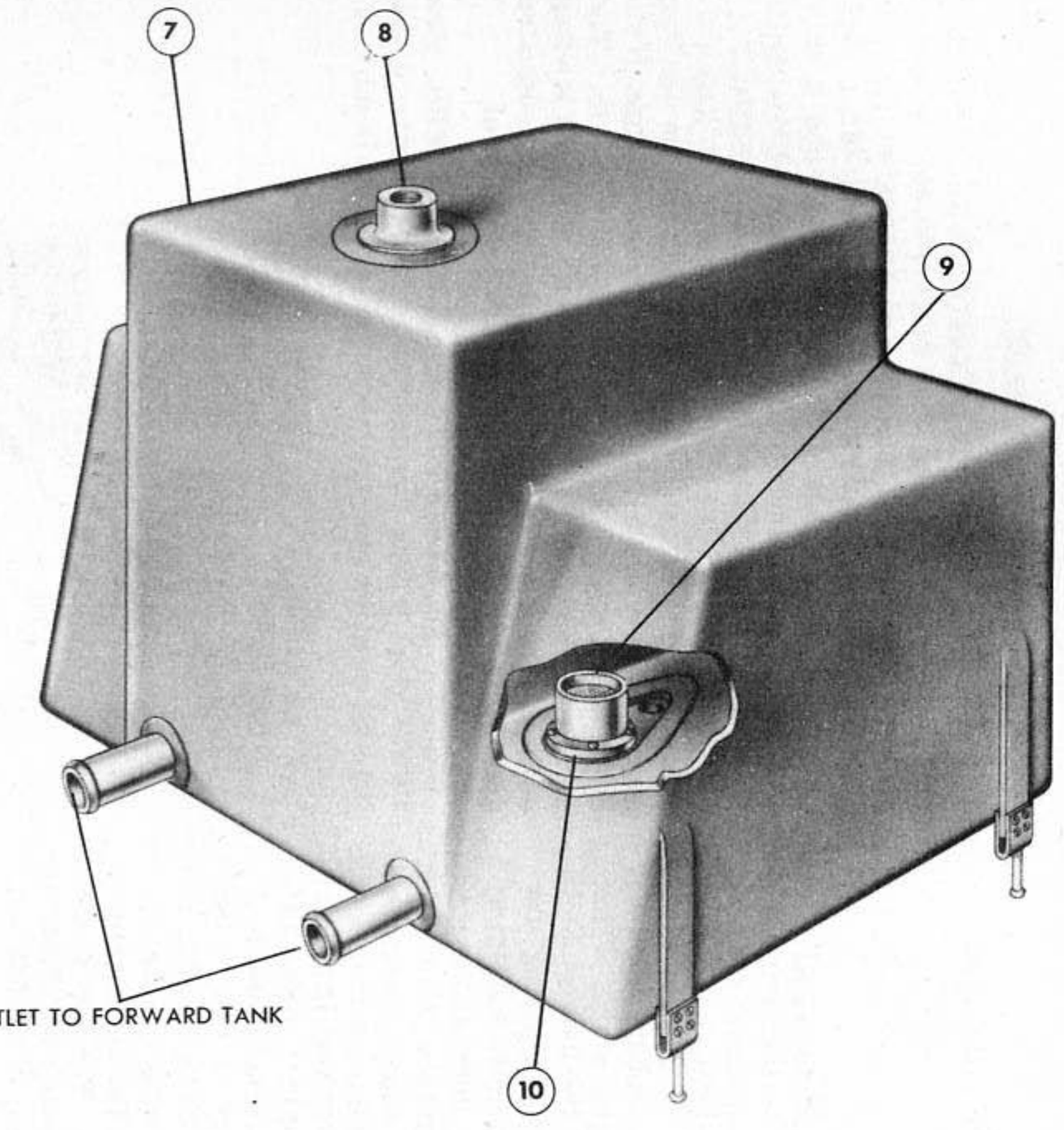
ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	4137686-3	FILLER ASSEMBLY, INBOARD FUEL TANK	1
	2110035	GASKET, INBOARD FUEL TANK FILLER	1
	AN73A6	BOLT	12
2.	4137687-500	FILLER ASSEMBLY, OUTBOARD FUEL TANK—L.H.	1
	4137687-501	FILLER ASSEMBLY, OUTBOARD FUEL TANK—R.H.	1
	2107962	GASKET, OUTBOARD FUEL TANK FILLER	1
	AN73A6	BOLT	8
3.	1137783	CAP, FUEL FILLER	1
4.	5108314	CONTAINER ASSEMBLY, INBOARD FUEL—L.H.	1
	5108314-1	CONTAINER ASSEMBLY, INBOARD FUEL—R.H.	1
5.	5108315	CONTAINER ASSEMBLY, OUTBOARD FUEL—L.H.	1
	5108315-1	CONTAINER ASSEMBLY, OUTBOARD FUEL—R.H.	1
6.	4062365	UNIT, INBOARD FUEL TANK GAUGE	1
	AC500-10-10	SCREW	8
	1105393	GASKET, FUEL TANK LIQUIDOMETER UNIT	1
7.	4062359	UNIT, OUTBOARD FUEL TANK GAUGE	1
	AC500-10-10	SCREW	8
	1105393	GASKET, FUEL TANK LIQUIDOMETER UNIT	1
8.	5074489	FITTING, INBOARD FUEL TANK OUTLET, STATION "O" REMOVABLE—L.H.	1
	5074489-1	FITTING, INBOARD FUEL TANK OUTLET, STATION "O" REMOVABLE—R.H.	1
	2108420	GASKET, FUEL TANK REMOVABLE FITTING	1
	AN74A6	BOLT	8
	2064912	STRAINER ASSEMBLY, RESERVE FUEL FINGER	1
	AN900-20	GASKET	1
	AC895-B70	PLUG	1
	4215-¾-45°	ELBOW, PARKER STREET	1
	AN771-2	COCK, DRAIN	1
9.	4106682	FITTING, OUTBOARD FUEL TANK OUTLET, STATION 110 REMOVABLE—L.H.	1
	4106682-1	FITTING, OUTBOARD FUEL TANK OUTLET, STATION 110 REMOVABLE—R.H.	1
	1106879	GASKET, OUTBOARD FUEL TANK REMOVABLE FITTING	1
	AN74A6	BOLT	10
	2064912	STRAINER ASSEMBLY, RESERVE FUEL FINGER	1
	AN900-20	GASKET	1
	AN771-2	COCK, DRAIN	1
10.	4131373	FITTING ASSEMBLY, INBOARD FUEL TANK, OVERFLOW—L.H.	1
	4131373-1	FITTING ASSEMBLY, INBOARD FUEL TANK, OVERFLOW—R.H.	1
	2109640	GASKET, INBOARD FUEL TANK FITTING	1
	AN73A6	BOLT	11
	2109523-2	TUBE ASSEMBLY, INBOARD FILLER CAP OVERFLOW	1
11.	4131374	FITTING ASSEMBLY, OUTBOARD FUEL TANK, OVERFLOW—L.H.	1
	4131374-1	FITTING ASSEMBLY, OUTBOARD FUEL TANK, OVERFLOW—R.H.	1
	1107965	GASKET, MULTIPLE FITTING	1
	AN73A6	BOLT	7
	1118833	TUBE ASSEMBLY, OUTBOARD FILLER CAP OVERFLOW	1
12.	4105741	FITTING, FUEL OUTLET, STATION 48.45 REMOVABLE	1
	1106972	GASKET, FUEL TANK REMOVABLE FITTING	1
	AN73A6	BOLT	7
	2107546	STRAINER ASSEMBLY, FUEL FINGER, STATION 48.45	1
	AN900-20	GASKET	1

Figure 139 - WING FUEL CONTAINER



FORWARD BOMB BAY FUEL CONTAINER

ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	4147504-1	GAGE ASSEMBLY, TOP MOUNT FLOAT TYPE LIQUID	1
	AC500A10-10	SCREW	8
2.	2147973-4	ADAPTER ASSEMBLY, FUEL TANK FILLER	1
3.	AC39B5435	CAP	1
4.	4148672	FITTING, FORWARD BOMB BAY TANK FILLER AND OUTLET	1
	AN73-A5	BOLT	17
5.	5147501	TANK ASSEMBLY, BOMB BAY FUEL, FORWARD	1
6.	2146801-4	FITTING ASSEMBLY, NACELLE FUEL FILLER OVERFLOW	1
	1109909-8	GASKET, ANNULAR ALUMINUM ASBESTOS	1



AFT BOMB BAY FUEL CONTAINER

ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
	1146857	NUT, NACELLE FUEL FILLER OVERFLOW FITTING	1
7.	5147502	TANK ASSEMBLY, BOMB BAY FUEL, AFT	1
8.	2147680	FITTING, BOMB BAY FUEL TANK VENT	1
	AC500A10-10	SCREW	8
9.	2138501	SCREEN ASSEMBLY, FUEL BOOSTER PUMP	1
	AC500A10-7	SCREW	4
10.	4148868	ADAPTER ASSEMBLY, FUEL BOOSTER PUMP	1
	AN73-5A	BOLT	12
	AN960-10L	WASHER	12

Figure 140 - BOMB BAY FUEL CONTAINERS

NOTE

(This information applies only to airplanes AF42-53535 through AF42-54284.)

13. FUEL SYSTEM.

a. DESCRIPTION.

(1) GENERAL. (See figures 138 and 158.) - A pressure fuel system is incorporated in the airplane. It consists of the following: Two fuel containers in each inner wing, two fuel containers in the bomb bay, feed lines, cross-feed lines and controls, strainers, tank selectors, fuel pumps, primer pump, wobble pumps, dump valves, blower drains, and carburetors. The wing fuel system normally functions as two independent units with the left-hand fuel containers supplying the left engines and the right-hand fuel containers supplying the right engines. Main supply lines connect at the inboard and outboard ends of each container joint to a common outlet through a ball valve as shown on figure 138, thus permitting fuel to be supplied from either end of the container. When the airplane is banking in either direction, the fuel is always drawn from the lower end of the containers by means of the action of the ball valve, thus assuring a constant supply of fuel to the engine. A single line extends from the ball valve to the tank selector located within the wing on the inboard side of each nacelle which directs the fuel through the strainer to the engine driven pump. The fuel pump maintains a minimum pressure of 12 pounds per square inch (14 pounds per square inch desired, 16 pounds per square inch maximum) at the carburetor. Two vent lines are attached to each carburetor. One line allows the carburetor to vent directly back to each inboard fuel container, and the other vents back to the fuel pump. A line from each pump extends through the engine section cowling, allowing each pump to drain to the atmosphere. An overflow line is connected to each tank filler neck and extends to the lower surface of the inboard wing. Vent lines are attached to the upper position of each fuel container and extend aft through the nacelle to the atmosphere. Two bomb bay fuel containers function as one independent unit and are used when the left-hand, right-hand, or both wing fuel container systems are inoperative. A main supply line connected to an electric driven booster pump located on the aft face of the bulkhead at Station 70 leads fuel from the fuel container to the suction cross-feed line and directly to either engine. A fuselage tank selector control is located on the left side of the pilot's compartment and permits selection of fuel from the bomb bay fuel container to either engine or to both engines. Total capacity of the six fuel containers is 540 U.S gallons (449 Imperial gallons).

(2) FUEL LINES. - There are three different types of lines used in the fuel system: copper lines, dural tubing lines, and bulletproof rubber lines. All fuel lines are plainly marked by a red band to facilitate identification. Sizes of fuel lines are main system and cross-feed lines, 1-inch O.D.; filler neck overflow and blower chain lines, 3/8-inch O.D.; primer line, fuel pressure line, oil dilution line and static vent line, 1/4-inch O.D.

(3) FUEL CONTAINERS.

(a) WING FUEL CONTAINERS. (See figure 139.) - Four self-sealing wing fuel containers are provided to carry a total fuel load of approximately 400 U.S. gallons (333 Imperial gallons). Each inner wing incorporates an inboard container which has a fluid capacity of approximately 136 U.S. gallons (113 Imperial gallons) and an outboard container with a capacity of approximately 64 U.S. gallons (53 Imperial gallons). The inboard container is located between the leading edge of the wing and the main spar and extends from the inboard side of the nacelle to the root rib. The outboard container is located between the wing leading edge and the main spar and extends from the outboard side of the nacelle to the outer wing panel joint.

(b) BOMB BAY FUEL CONTAINERS. (See figure 140.) - The two bomb bay fuel containers are the self-sealing type and are installed in the bomb bay.

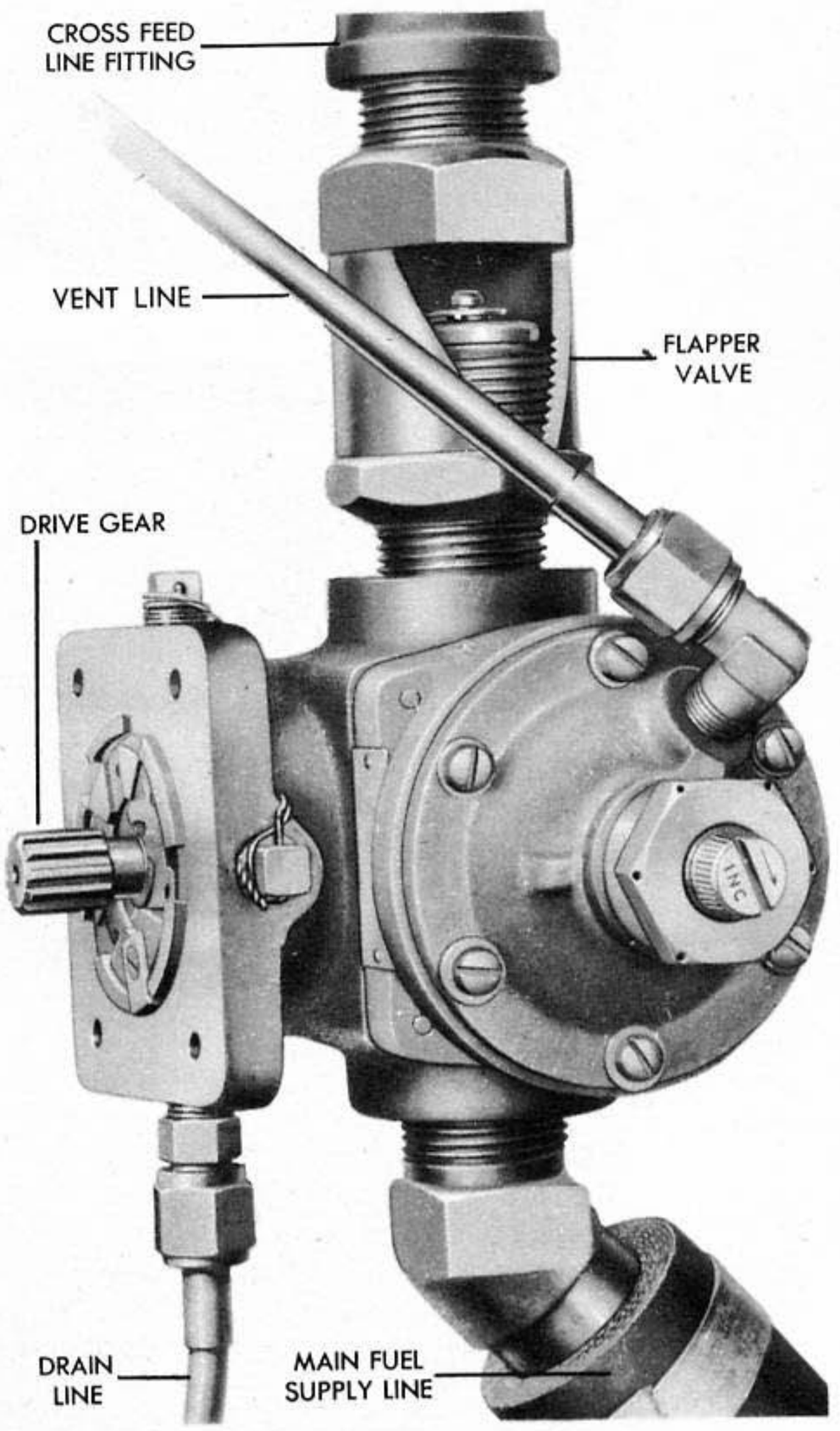


Figure 141 - ENGINE DRIVEN FUEL PUMP

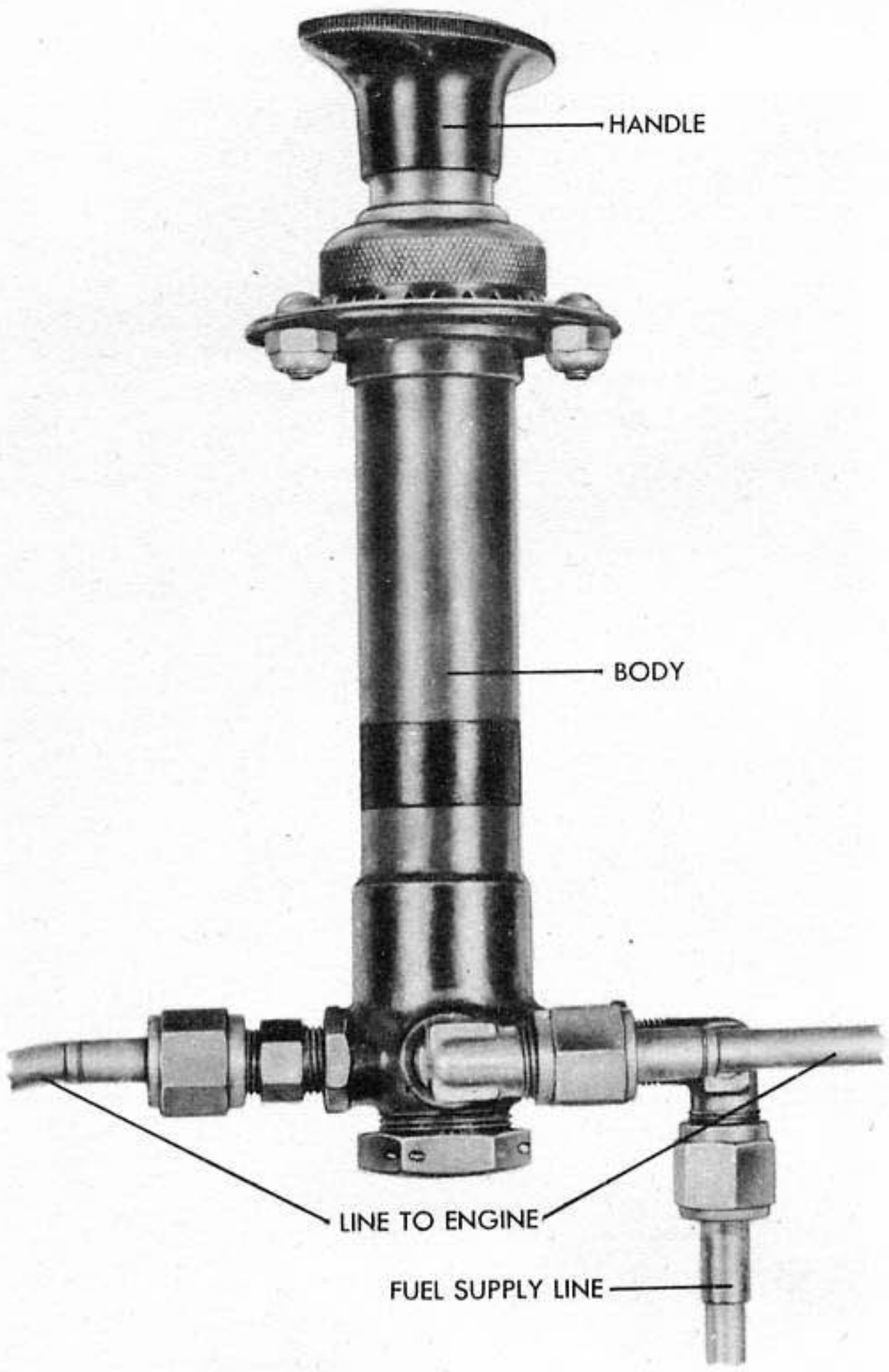


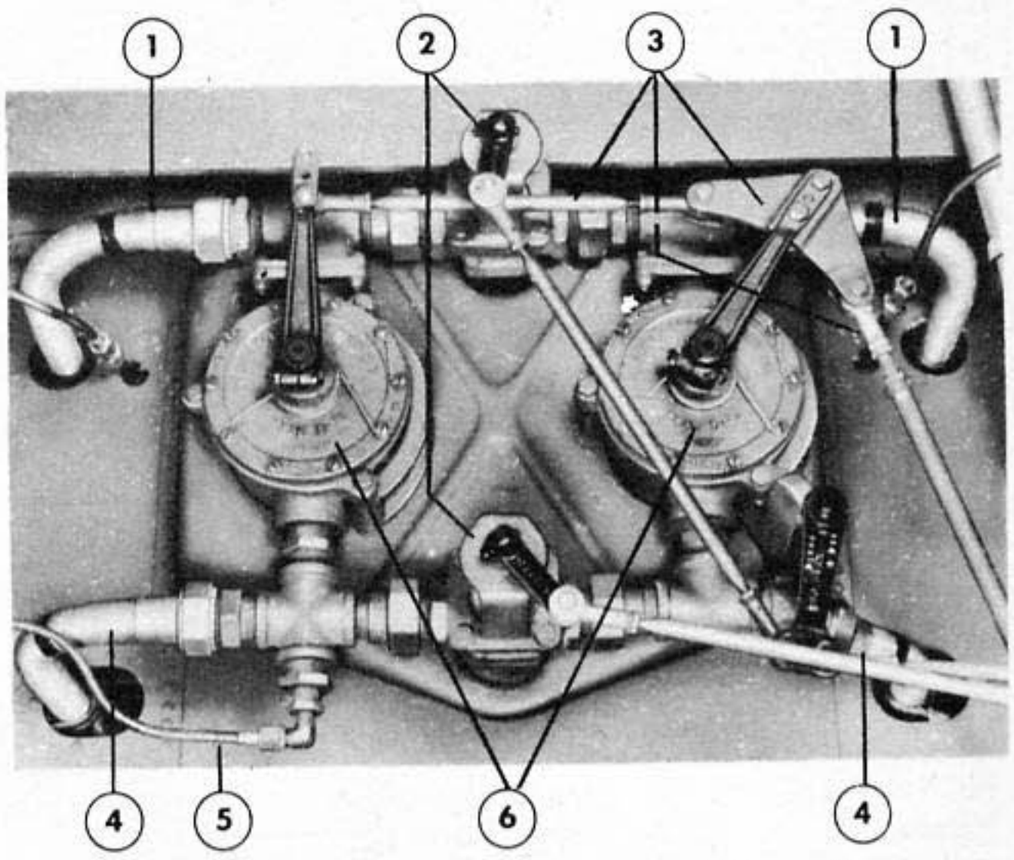
Figure 142 - PRIMER PUMP

one on each side of the bulkhead at Station 156. (See figure 7.) Fuel is supplied to the main system by an electrically driven booster pump at the bottom of the rear fuel container, through the tank selector valve in the left-hand inner wing. Bomb bay fuel containers have a total capacity of 140 U.S. gallons (117 Imperial gallons). Fuel level is maintained by two hoses which interconnect the fuel containers. A quantity gage float unit is mounted in the forward fuel container and indicates the quantity of fuel on position No. 5 of the quantity gage at the right side of the pilot's instrument panel. The filler neck, located at the top side of the forward fuel container, is provided with an overflow line which empties through the bottom of the fuselage. A vent line interconnecting both fuel containers is routed overboard through the bottom of the fuselage. A drain line from the booster pump and a tank drain line empty through the bottom of the fuselage to the atmosphere.

(4) ENGINE DRIVEN FUEL PUMPS. (See figure 141.) - Each engine drives a fuel pump of the rotary-vane, positive displacement type which maintains a pressure of 15 pounds per square inch at the carburetor. The pump consists essentially of a body containing a liner having a noncircular bore in which a rotor with three pairs of sliding blades is driven by a self-alining coupling. The special contour of the liner bore in combination with the number of blades and spacing of the ports produces a pulsationless flow. A metallic fuel seal prevents leakage around the rotor shaft.

(5) PRIMER PUMP. (See figure 142.) - A primer pump is located at the upper end of the fixed gun charging control panel on the right side of the pilot's cockpit, and is manually operated. Fuel supply for the primer is taken from the bottom of the left-hand wobble pump. Two lines extend from the primer. One line runs down each side of the fuselage, into the adjacent inner wing and thence through the nacelle and fire wall to the engine. (See figure 158.)

(6) WOBBLE PUMPS. (See figure 143.) - The two wobble pumps are manually operated auxiliary fuel pumps located on a bulkhead forward of Station 156. Both pumps are operated simultaneously by a handle which extends upward from the floor at the left side of the pilot's seat. (See figure 156.) Push-pull rods connect the pilot's control handle to the actuating linkage at Station 156. The tie rods to the pump cranks hold the right-hand wobble pump crank (looking forward) in an upright position and the left-hand pump crank at 45 degrees to the left of vertical when the pilot's operating handle is midway of its stroke (figure 159) or vertical. On airplanes No. 42-53535 to 42-54284 another control



1. ENGINE CROSS-FEED LINES
2. CROSS-FEED VALVES
3. OPERATING LINKAGE
4. FUEL CONTAINER CROSS-FEED LINES
5. PRIMER LINE
6. WOBBLE PUMPS

Figure 143 - INSTALLED WOBBLE PUMPS

handle for the wobble pumps is located in the gunners' cockpit.

(7) CROSS-FEED CONTROL SYSTEM.

(a) GENERAL. (See figure 158.) - Cross-feed fuel control, operating both by pressure and suction, and in conjunction with the tank selector valve, allows fuel to be drawn from any fuel container for either or both engines. The pressure cross-feed lines tee into the main supply line on the pressure side of each fuel pump. From this tee they pass through the fire wall, through each nacelle and inner wing to the bulkhead at fuselage Station 156, where they attach to a cross-feed valve. (See figure 121.) The suction cross-feed lines tee into each main fuel supply line between the fire wall and the strainer. The lines extend through the inner wing to the fuselage and connect to a cross-feed valve. A check valve is located at each side of the control valve in the pressure cross-feed system. A tee and cross are located at each side of the control valve in the suction cross-feed system. These fittings interconnect the two systems through the wobble pumps for manual operation of cross-feeding. (See figure 159.)

(b) CABLE CONTROLS. (See figure 159.) - Two cross-feed cable controls, leading to the cross-feed valves, are located on the fuel valve control panel installed on the left side of the pilot's cockpit. The engine cross-feed control operates the pressure cross-feed system and the tank cross-feed operates the

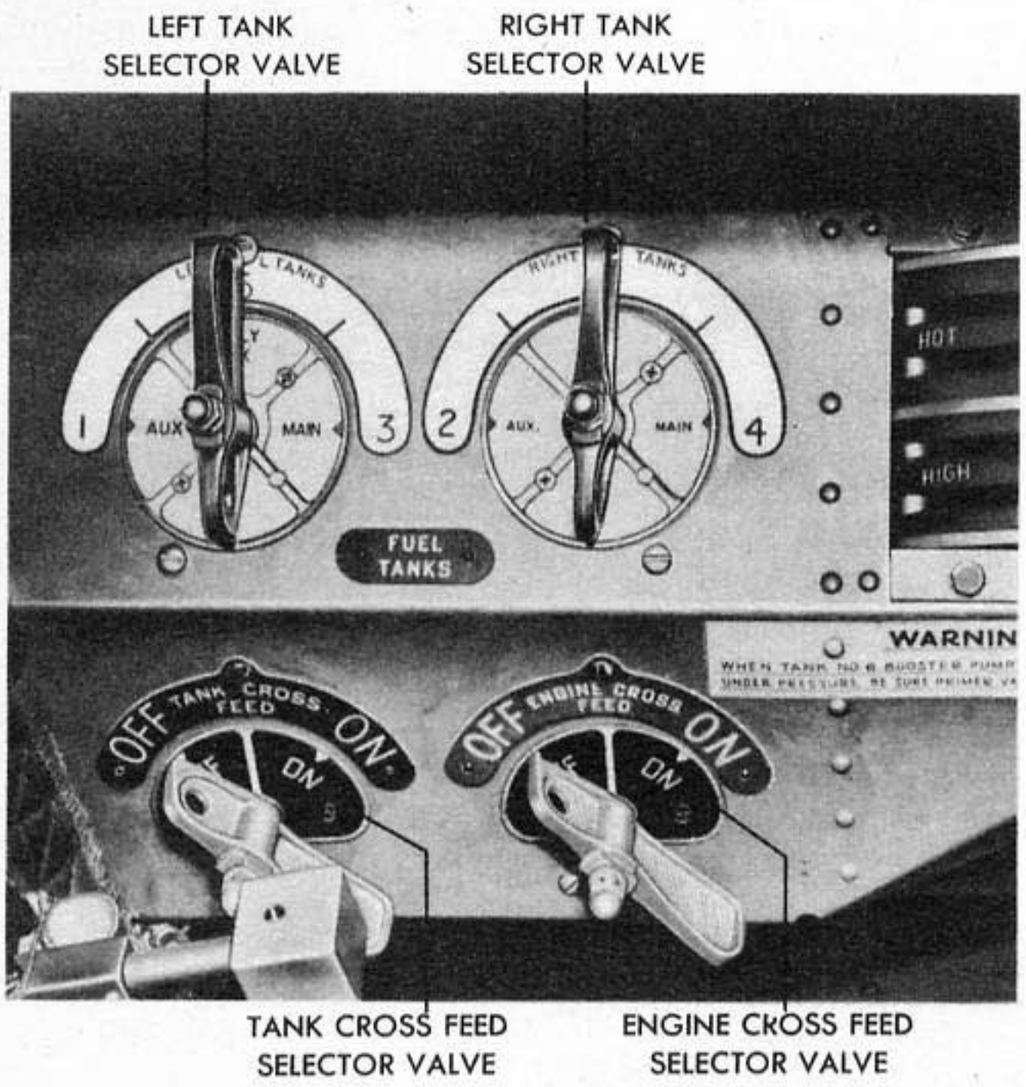


Figure 144 - FUEL SYSTEM SELECTOR VALVE AND CROSS-FEED CONTROLS

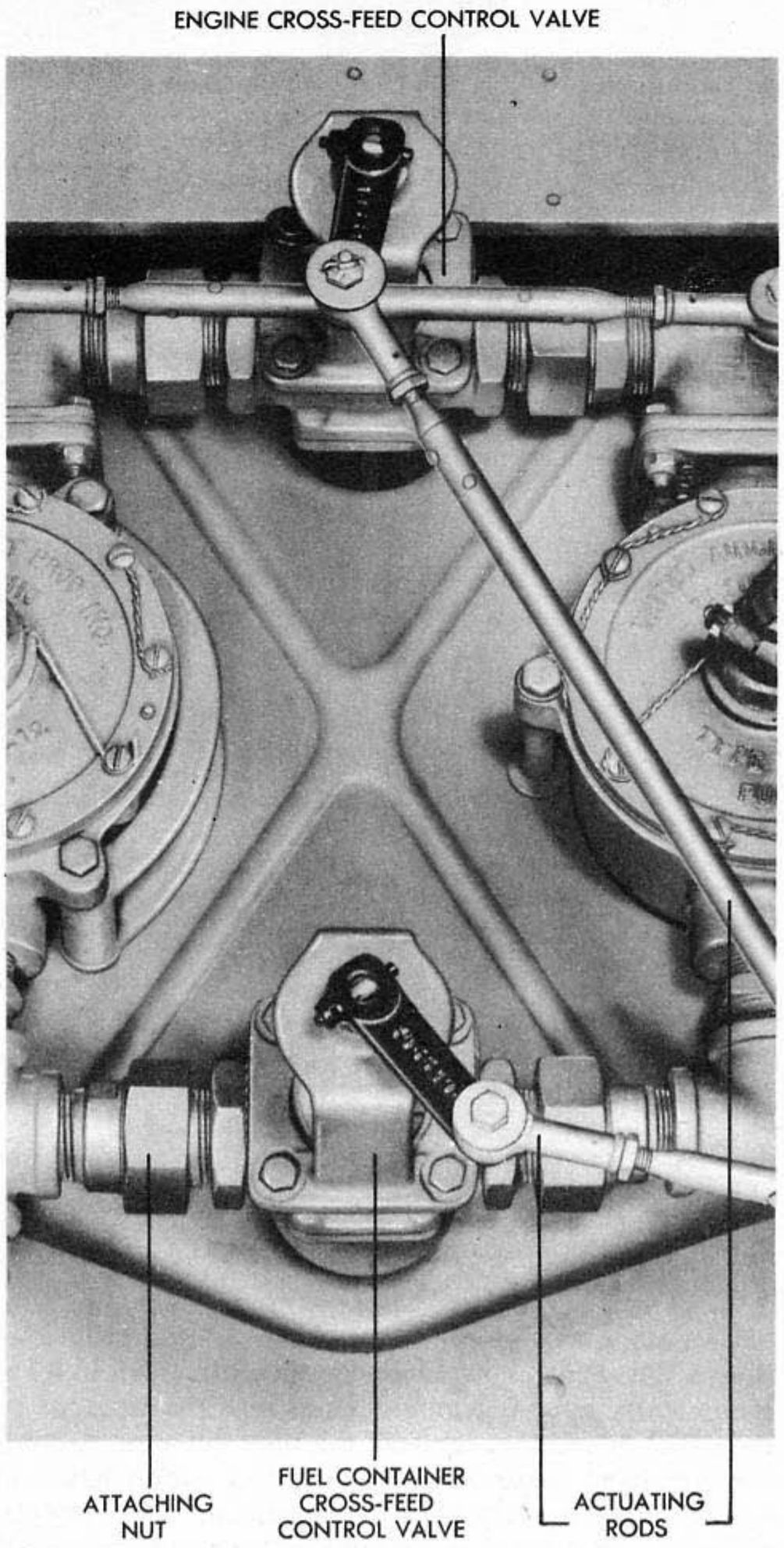


Figure 145 - INSTALLED CROSS-FEED CONTROL VALVES

suction cross-feed system. Push-pull rods and 3/32-inch cables connect the actuating handles in the pilot's cockpit to the valves mounted on the bulkheads at Station 156. The clevis arrangement incorporated in the shaft assembly of each valve can be used to determine the position of the valves for coordination with the control handle positions. When the slot of the clevis is horizontal, the valve is OFF; and when the slot is vertical, the valve is ON. Valve movements can be checked by observing that the control handle "clicks" into each designated position.

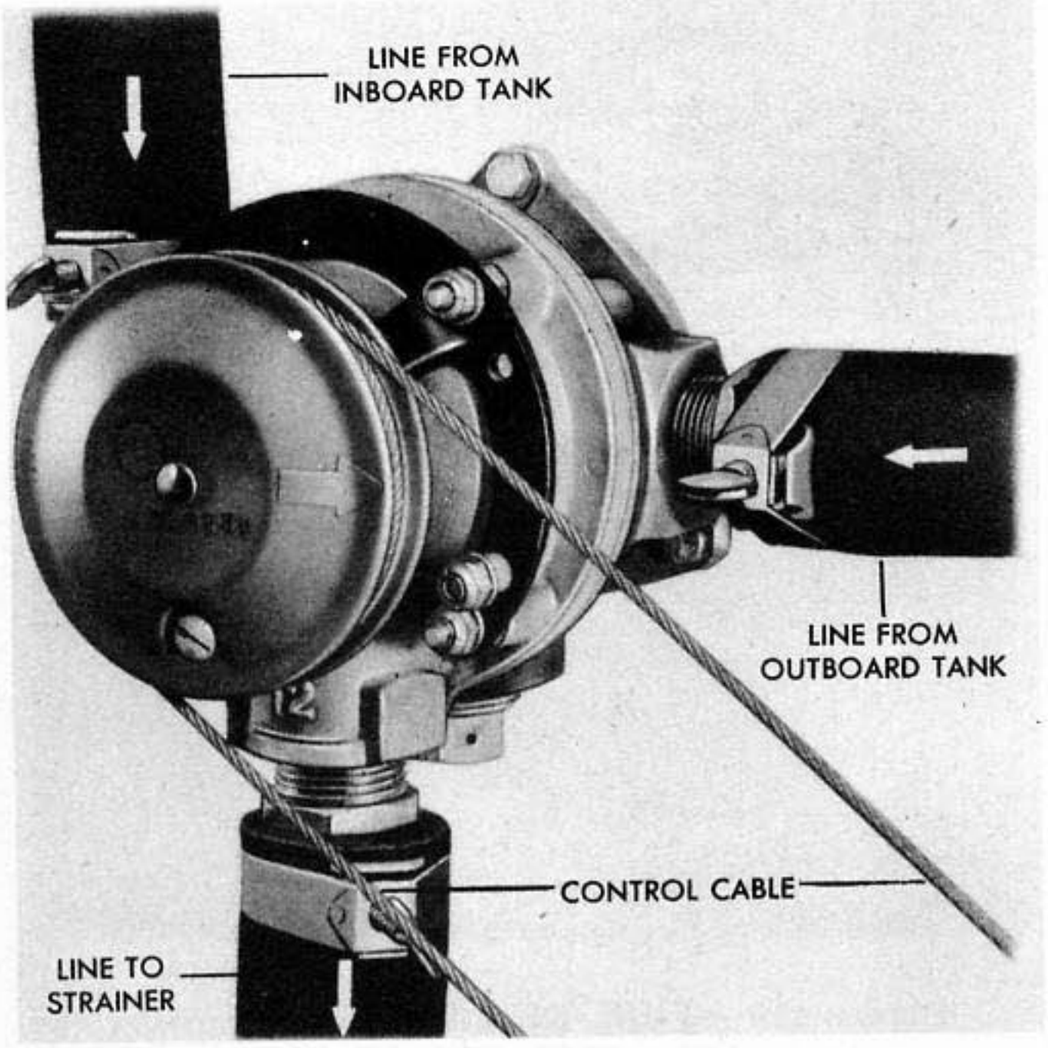
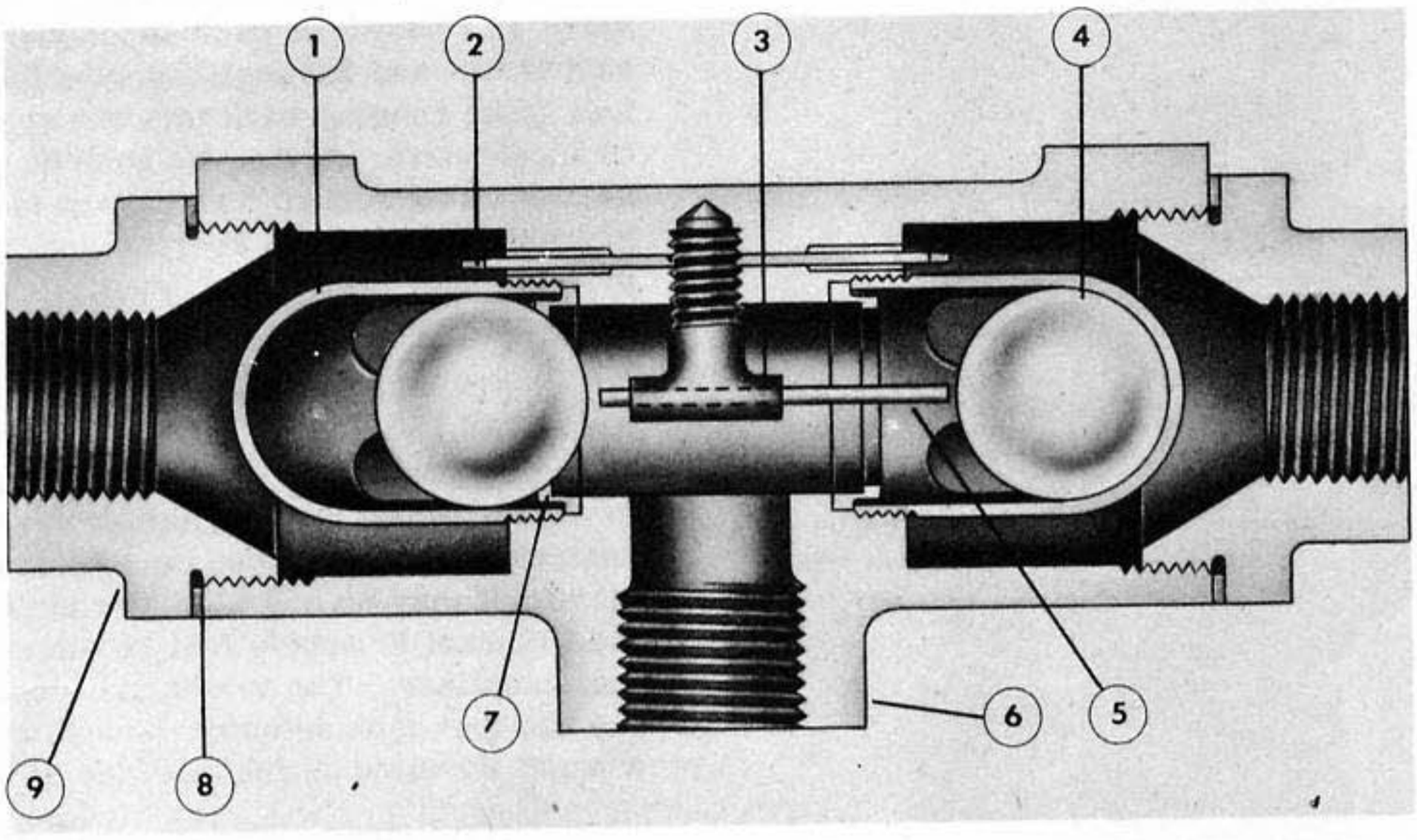


Figure 146 - FUEL TANK SELECTOR VALVE

NOTE

All replacement cables should be proof-loaded to 552 pounds before installation.

(c) OPERATION OF CROSS-FEED CONTROL SYSTEM. (See figure 144.) - During normal operation both the pressure and suction cross-feed valve control handles in the pilot's cockpit are in the OFF position. The tank selector valve control handles may be at either the AUX. or MAIN position. This allows each engine to be supplied with the fuel from either fuel container in its respective wing. If fuel supply to the left-hand engine from a left-hand wing fuel container is cut off due to pump failure, turn the tank selector valve control handle for the left-hand fuel containers to the OFF position. Turn the tank selector valve control handle for the right-hand fuel container to the desired fuel container. Turn the pressure cross-feed control handle to the ON position. The fuel flows from the tee on the pressure side of the right-hand fuel pump, through the pressure cross-feed valve and enters the supply line for the left-hand engine at the tee on the left-hand fuel pump. To supply fuel to the right-hand engine from the left-hand fuel container in case of



ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	295013	GUIDE, BALL	2
2.	294008	PIN, LOCK	1
3.	295016	GUIDE, SPACER	1
4.	294001	BALL	2
5.	294003	PIN, SPACER	1
6.	295011	BODY	1
7.	288290	SEAT, BALL	2
8.	294002	GASKET	2
9.	295012	CAP	2

Figure 147 - FUEL BALL CHECK VALVE - CROSS SECTION

failure of the right-hand fuel pump, reverse the settings of the tank selector valves. If it becomes necessary to feed both engines from fuel containers in one wing due to a cause other than pump failure, the gravity (suction) cross-feed may be used.

(8) CROSS-FEED CONTROL VALVES. (See figure 145.) - Two manually operated cylindrical cross-feed control valves are mounted near the wobble pumps on the aft bomb bay bulkhead at Station 156. One valve is installed in the engine (pressure) cross-feed line and the other is installed in the tank (suction) cross-feed line. These valves are interchangeable. The valves are controlled through a system of cables and rods from a dial and handle assembly mounted with the fuel tank selector valve controls on the panel on the left side of the pilot's cockpit.

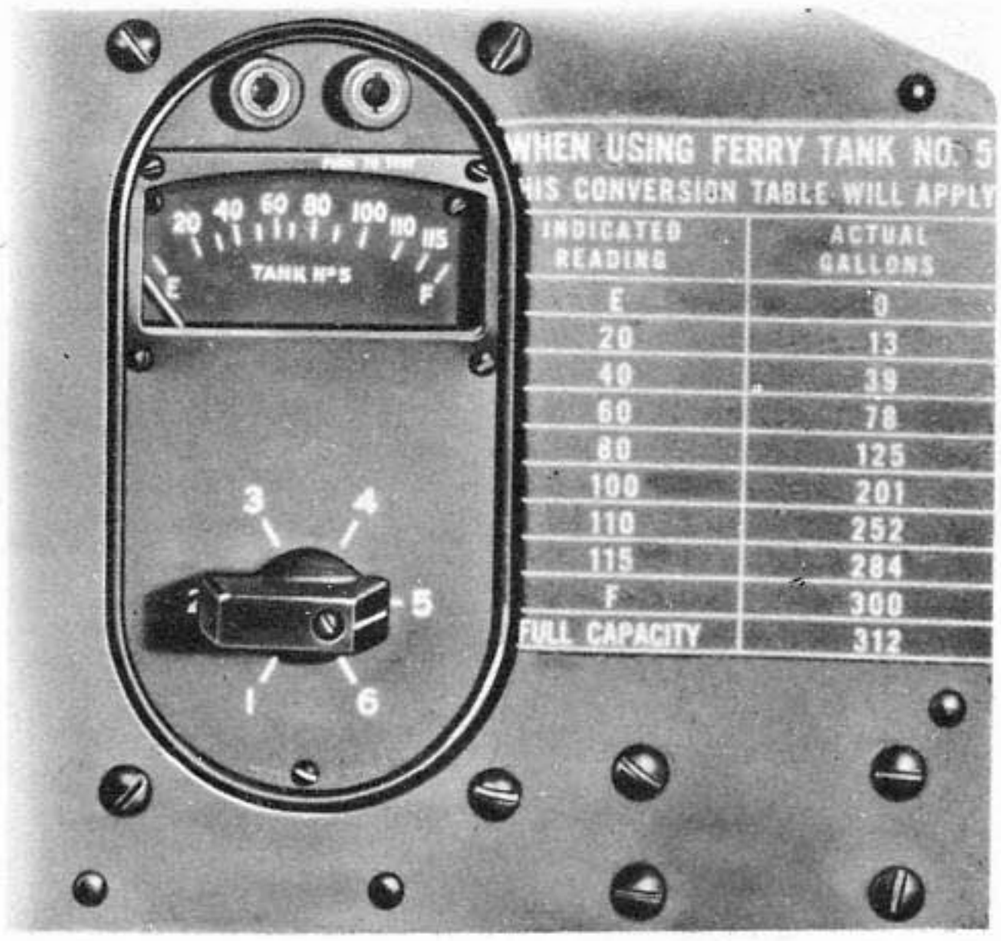


Figure 149 - FUEL QUANTITY GAGE AND SELECTOR SWITCH

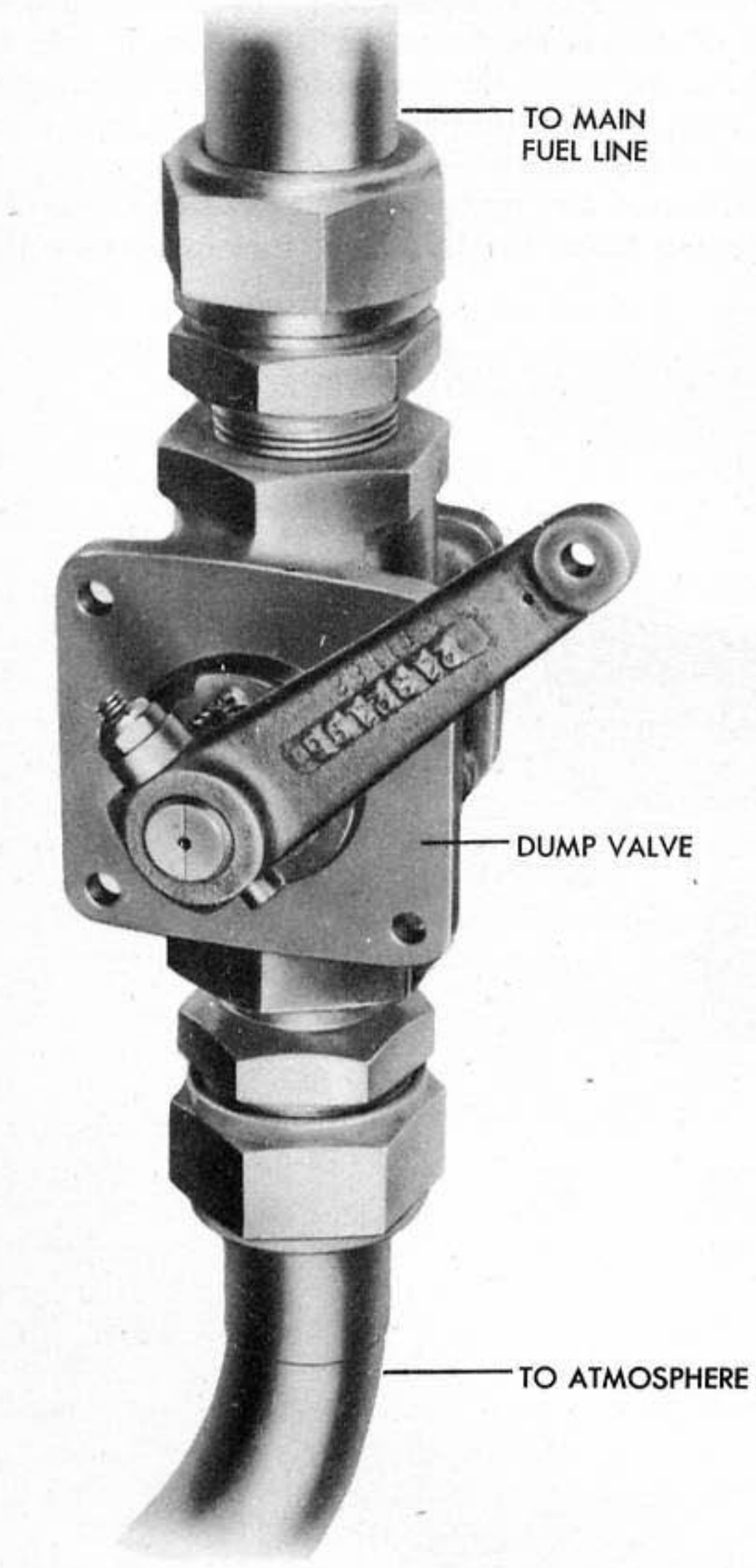


Figure 148 - FUEL DUMP VALVE

(9) CHECK VALVES. - A flapper type check valve is located in each main fuel line between the carburetor and the engine driven fuel pump to prevent fuel from running back into the system when a pump is inoperative. A No. 60 hole is provided inside of seat to allow enough fuel to flow to the pump below to prevent vanes from scoring and overheating during priming operations, and to eliminate vapor troubles while operating on pressure cross-feed.

(10) FUEL TANK SELECTOR VALVES. (See figure 146.) - A tank selector valve is located within the wing on the inboard side of each nacelle. It is used to select either fuel container for fuel supply to the engine-driven fuel pump on the same side of the airplane. It may be operated in conjunction with cross-feed control to supply fuel to either engine from any fuel container. The valves are connected by cable to the two fuel tank selector manual controls located on a panel installed on the left side of the pilot's cockpit.

(11) FUEL BALL CHECK VALVES. (See figure 147.) - A ball check valve connects both main fuel supply lines from each self-sealing fuel container to a common outlet. A ball and pin arrangement in the valve operates automatically so that one side of the valve is opened while the other side is closed. Therefore, when the airplane is banking in either direction, the fuel is always drawn from the lower end of the fuel container due to the action of the ball valve. This assures a smooth uninterrupted flow of fuel to the engines. There are four fuel ball check valves on the airplane located in the main line - one below each wing fuel container. These valves, part No. 295010, are

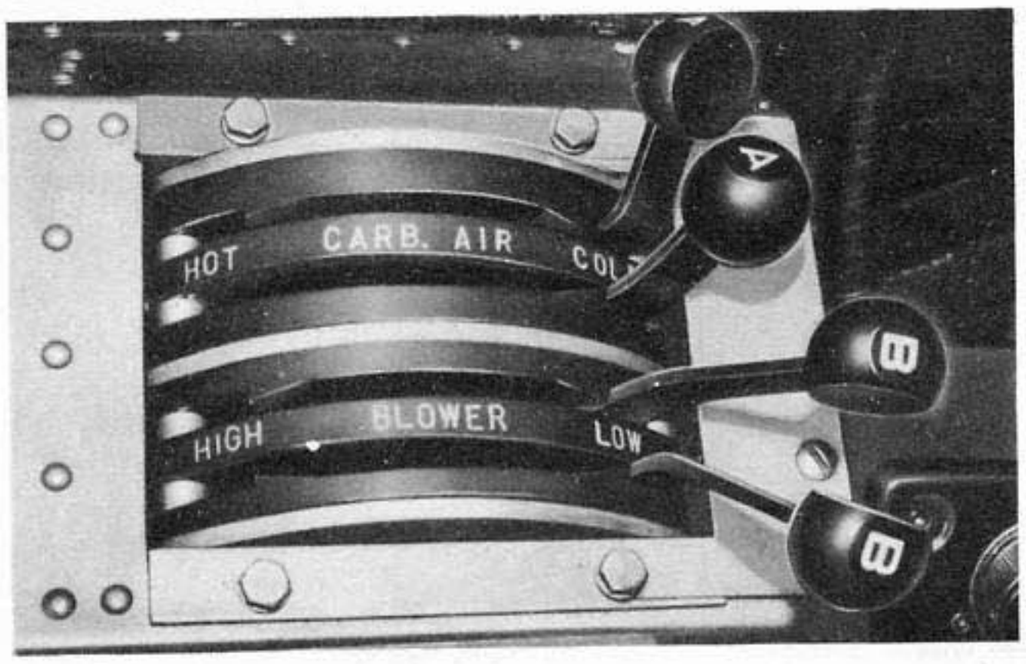


Figure 150 - CARBURETOR AND BLOWER CONTROLS

interchangeable. The inboard side fittings, however, are different from the outboard because of the positions in which the valves are installed in the wing spars.

(12) FUEL DUMP VALVE SYSTEM.

(a) GENERAL. (See figure 148.) - The fuel dump system is provided for emergency destruction of the airplane on the ground as well as emergency dumping of the fuel in flight. The system consists of a gate-type dump valve installed in the main fuel line leading from each inboard fuel container. These valves are located on the aft face of the bulkhead at Station 156 1/2, and have an outlet on each side of the fuselage just aft of that Station. The valves are linked together and must be safetied down at all times by a 24-gage copper wire.

(b) OPERATION OF FUEL DUMP VALVES. - The dump valves are controlled by a single ball type handle on the right side of the cockpit floor. This handle is painted red and marked "DESTRUCTION VALVE." When the control handle is pulled both valves are opened. The pilot has no way of closing them again.

(13) FUEL QUANTITY GAGE.

(a) SELECTOR SWITCH. (See figure 149.) The selector switch is mounted on the pilot's instrument panel and is an integral part of the indicator. The indicator hand on the dial always shows the quantity of fuel in the fuel container for which the selector switch is set. The selector switch connects the indicating mechanism with the liquidometer unit in the tank chosen. The selector switch points are:

No. 1 - Left auxiliary (outboard) fuel container.

No. 2 - Right auxiliary (outboard) fuel container.

No. 3 - Left main (inboard) fuel container.

No. 4 - Right main (inboard) fuel container.

No. 5 - Bomb bay (fuselage) fuel containers.

(b) LIQUIDOMETER TANK UNITS. (See figure 139.) - The EA-15 tank unit consists of a circular housing with AC-35A4269 socket. To the housing is attached a supporting member on which a float arm pivots. Within the housing are a resistance strip (with provision for adjusting stroke and end position) and a movable contact arm connected by leverage to the float arm. A metal bellows mounted on the housing prevents fuel leakage. The tank unit operates automatically by means of a float which is governed by the amount of liquid in the fuel container. The position of the float is transferred by a linkage system to a contact arm on a very low resistance in the housing. The fuel is sealed from electrical parts by the metal bellows. A tank unit of the same type (EA-15W) is installed in each wing tank and adjusted to each particular fuel container. Whenever a tank unit is installed, it must be adjusted to the fuel container.

(14) FUEL STRAINERS. - A type C-4 strainer is located in each main fuel line between the fuel pump and the selector valve. The interior of the strainer is constructed in the shape of a cone. The strainer is the lowest point in the fuel system.

(15) BLOWER DRAIN. - The blower drain is a 3/8-inch dural line running from the bottom of the blower case to the trailing edge of the lower cowl flaps. The exposed end has a pressure cut. Where the line joins the case there is a metal disk that opens and closes a vent, thereby acting as a valve. It is closed when the engine is running. When the engine is being stopped, the vent opens to allow any liquid to drain from the carburetor. If this disk type valve fails to open when the carburetor is bled, fuel will run into the lower intake tubes, and structural failure or serious damage to the engine may result when the engine is started. In normal operation, failure of the valve could be caused only by presence of oil or another sticky substance in the fuel.

(16) CARBURETORS. (See figures 155 and 156.) - Each engine is equipped with a single Stromberg injection type carburetor. A vapor vent line is connected from the carburetor screen chamber to the inboard fuel tank. A balance vent line is connected from the top deck of the carburetor to the siphon chamber of the fuel pump. This line is also connected to the air vent fitting on the fuel pressure gage. Two pressure gages are mounted on the pilot's instrument panel and are connected so that the readings are taken at the point where the fuel enters the carburetors.

SYMPTOM	CAUSE	REMEDY
	Vapor lock in system.	Turn ON engine cross-feed valve. Let engine resume normal running. Then slowly turn cross-feed OFF until eight pounds per square inch pressure is obtained. Vapor locked pump will gradually pump out the gas vapor. Shut engine cross-feed OFF when 15 pounds per square inch pressure is resumed.
Fuel container collapses as fuel is consumed.	Dirt in vent line filter.	Replace fuel container. Clean the filter in the vent line every 25 hours.
Fuel siphons from fuel container during flight.	Crack in connection of 3/8-inch overflow line to filler cap at top of fuel container.	Replace or repair defective parts. Inspect sweat fit of line to cap when fueling airplane to prevent recurrence of fuel loss.
	Filler cap lost.	Replace filler cap. Be sure filler caps are installed properly after fueling airplane.
Primer pump fails to function.	Air in primer pump.	Turn ON tank cross-feed valves. Operate wobble pump. Air will be forced from primer pump.

c. REMOVAL AND DISASSEMBLY.

(1) REMOVAL OF INBOARD FUEL CONTAINER. (See figure 139.)

(a) Drain inboard fuel container through access door (A). (See figure 19.)

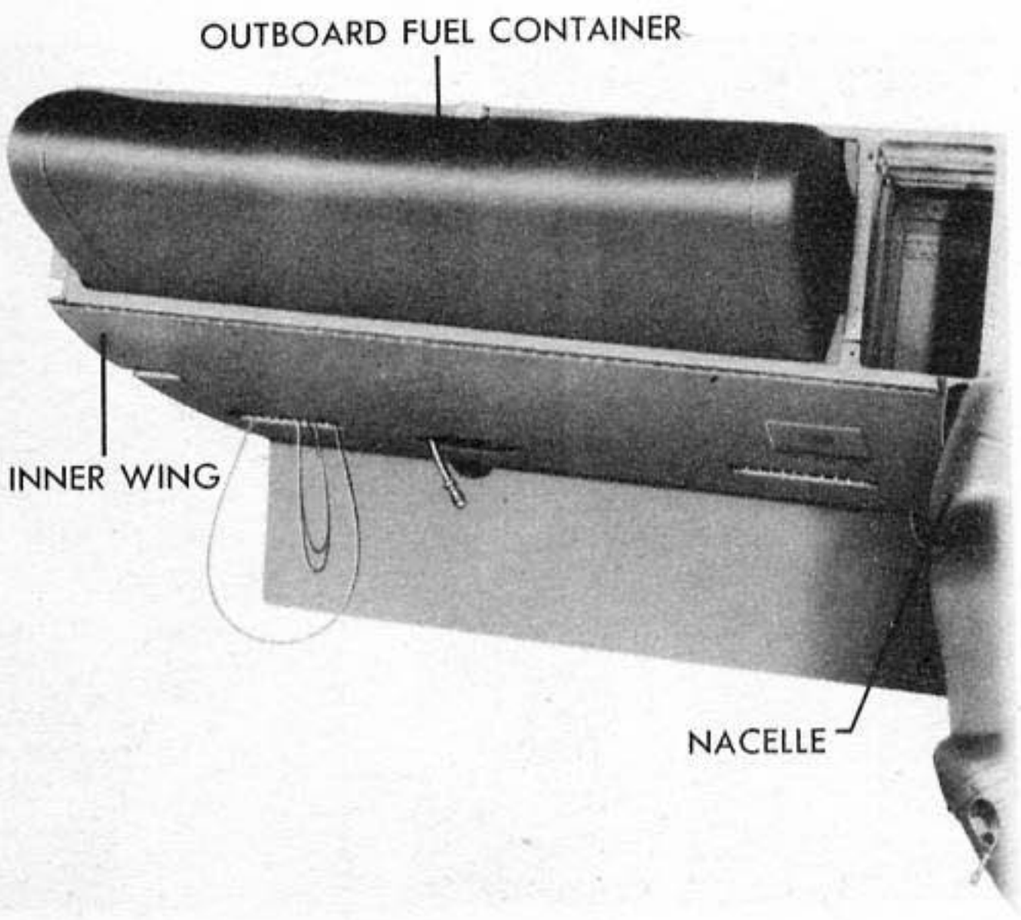


Figure 151 - REMOVING OUTBOARD FUEL CONTAINER

(b) Remove inner wing panel to fuselage fairing.

(c) Remove nacelle to wing fillet

(d) Remove leading edge of inner wing.

(e) Remove screws from the outlet, vent, and overflow fittings.

(f) Remove screws from the liquidometer mounting ring.

(g) Remove fuel container fittings. Loosen all zinc chromate glue around them.

(h) Remove screws which secure anti-collapsing tabs from the exposed split of the wing structure.

(i) Remove fuel container, being careful not to collapse or tear it.

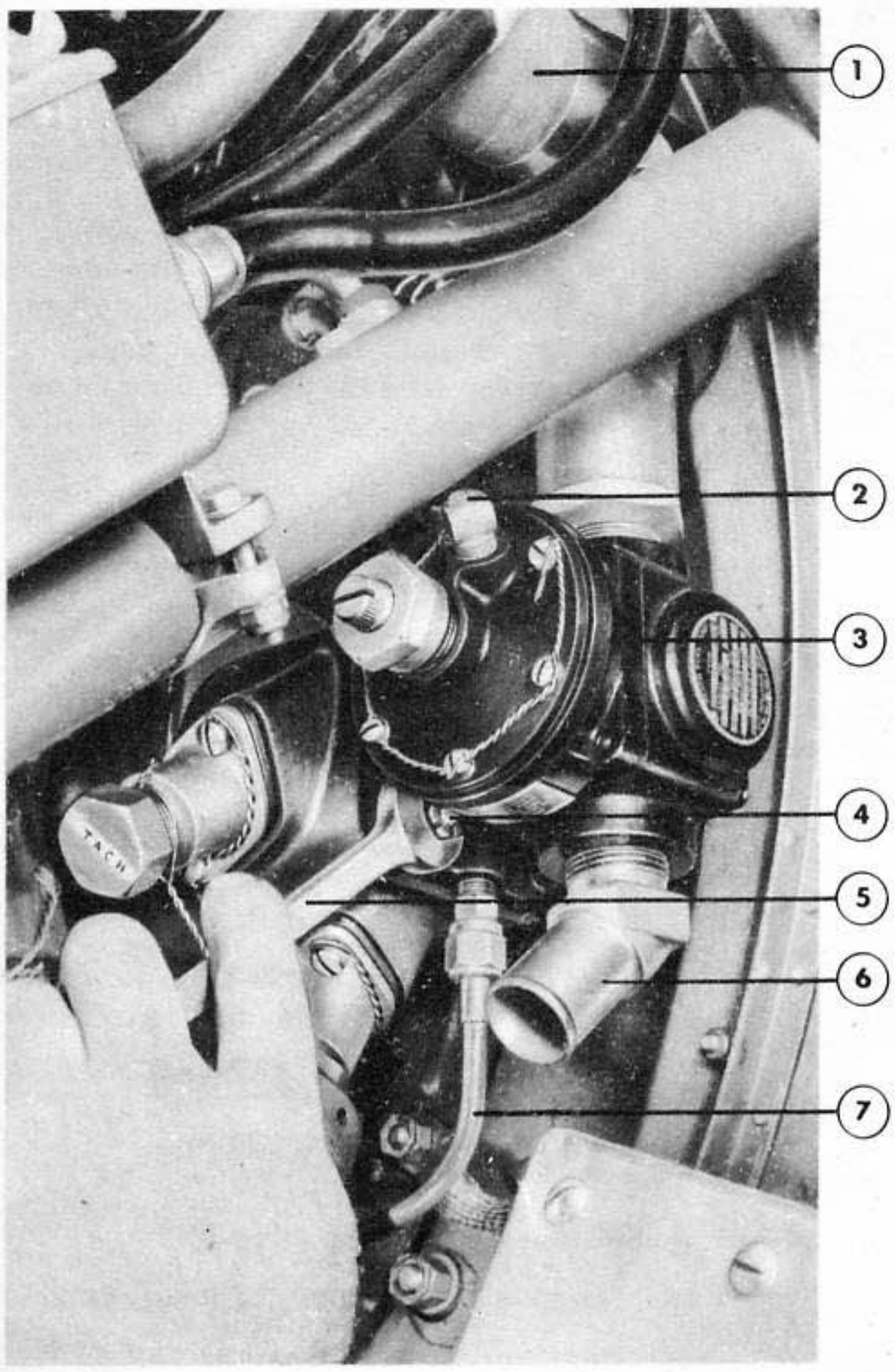
(2) REMOVAL OF OUTBOARD FUEL CONTAINER. (See figure 151.)

(a) Drain the outboard fuel container through access door (K). (See figure 19.)

(b) Remove the outer wing.

(c) Remove the leading edge of the inner wing outboard of the nacelle.

(d) Remove screws that secure the anti-collapsing tabs to the wing.



1. CROSS-FEED LINE
2. SUPERCHARGER CONNECTION
3. FUEL PUMP
4. PUMP ATTACHING NUT
5. ½-IN. OPEN-END WRENCH
6. MAIN FUEL SUPPLY LINE FITTING
7. DRAIN LINE

Figure 152 - REMOVING ENGINE DRIVEN FUEL PUMP

(e) Disconnect all fittings from the fuel container.

(f) Remove six screws that attach fuel container to outboard edge of wing.

(g) Carefully pry the fuel container loose from the structural part of the wing.

(3) REMOVAL OF BOMB BAY FUEL CONTAINER. (See figure 140.)

NOTE

Fuel containers and supports are removed through the bottom of the fuselage. The forward fuel container and support weigh approximately 134 pounds and the rear fuel container and support weigh approximately 122 pounds.

(a) Drain fuel by opening drain cock at bottom of rear fuel container.

(b) Disconnect vent line and overflow lines at the fuel container.

(c) Disconnect main fuel line, pump drain line and tank drain line at the booster pump and adapter. Remove booster pump and adapter from fuel container after disconnecting pump wiring.

(d) Disconnect electrical conduit at the top of the forward fuel container. Disconnect fuel container from floor at the strap hold-downs.

(e) Remove support attaching bolts at fuselage. Raise fuel container, remove floor panel. Remove fuel container.

(4) REMOVAL OF FUEL PUMP. (See figure 152.)

(a) Remove the accessory cowling on the right side of the nacelle.

(b) Disconnect the main supply line from the bottom of the pump and the cross-feed line from the top of the pump.

(c) Disconnect fuel pump drain line.

(d) Disconnect sylphon vent line at pump.

(e) Remove castellated nuts at pump base.

(f) Remove pump.

(5) REMOVAL OF PRIMER PUMP. (See figure 153.)

(a) Disconnect the three fuel lines from the under side of the primer.

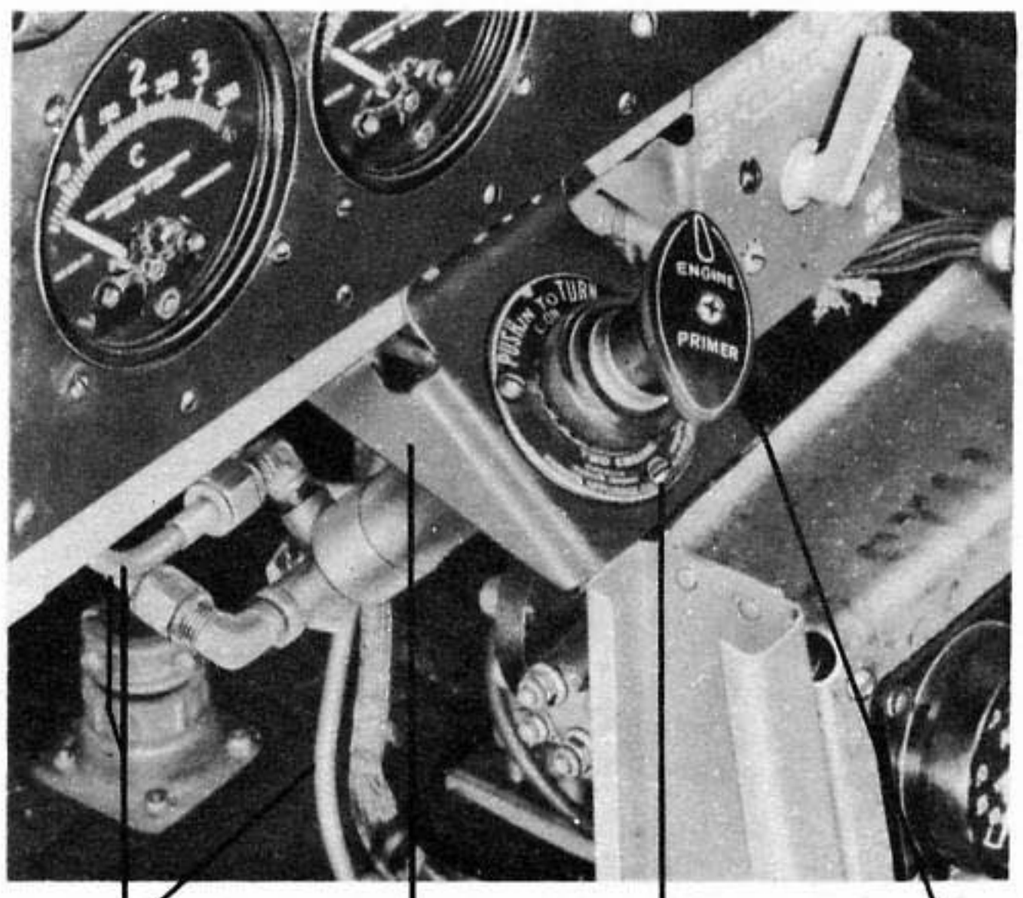


Figure 153 - INSTALLED PRIMER PUMP

(b) Remove primer handle.

(c) Remove the three screws that hold the primer to the lower panel in the cockpit.

(d) Lower the primer down through the panel.

(6) DISASSEMBLY OF PRIMER PUMP. - Remove primer cover and plunger.

(7) REMOVAL OF WOBBLE PUMP. (See figure 143.)

(a) Set all control valves in OFF position.

(b) Disconnect operating linkage rods at wobble pumps.

(c) Disconnect fuel tank cross-feed, engine cross-feed, and primer lines at the pumps.

(d) Disconnect linkage to cross-feed valves.

(e) Remove pump support screws on each side. Lift pumps out.

(f) Remove all fuel fittings.

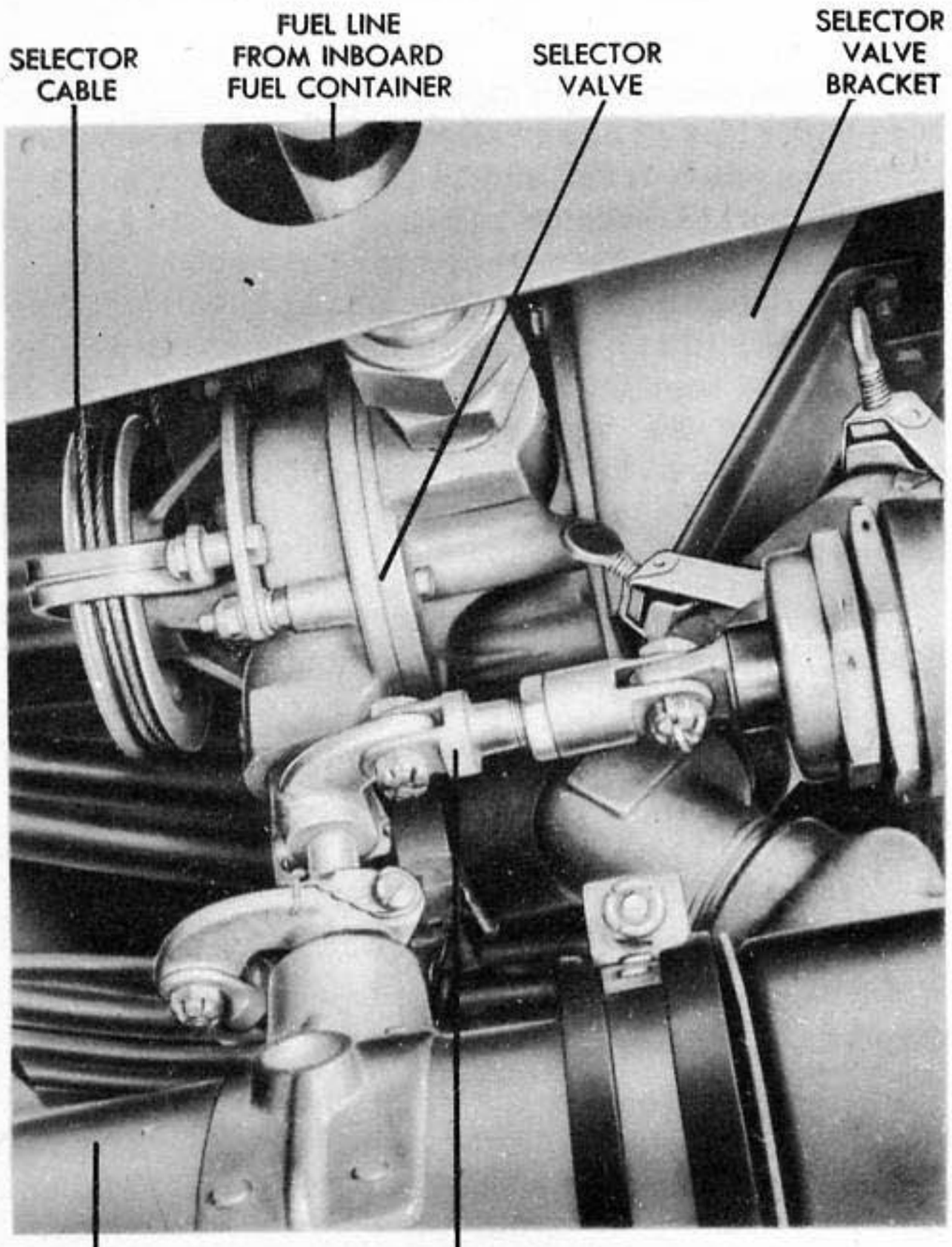


Figure 154 - INSTALLED FUEL TANK SELECTOR VALVE

(8) DISASSEMBLY OF WOBBLE PUMP.

(a) Remove screws from top cap and remove cap.

(b) Remove cap gasket.

(c) Remove steel disk.

(d) Remove inner pump wing.

(e) Remove intake and discharge valve.

(f) Loosen safety nut and remove adjusting screw and spring.

(g) Remove sylphon.

(9) REMOVAL OF CROSS-FEED CONTROL VALVE. (See figure 145.)

(a) Loosen the two nuts which attach the valve to the cross-feed line.

(b) Disconnect the actuating rod leading to the valve and remove the valve from the dural line.

(10) REMOVAL OF CHECK VALVE. - Disconnect fuel lines and unscrew the valve assembly.

(11) DISASSEMBLY OF CHECK VALVE. - Unscrew the valve cap and remove the Neoprene seal.

(12) REMOVAL OF FUEL TANK SELECTOR VALVE. (See figure 154.)

(a) Drain fuel containers which supply fuel to valve being removed.

(b) Remove oil cooler fairing on the inboard side of engine nacelle. (See figure 19, item 0.)

(c) Loosen selector cable in bomb bay.

(d) Wrap cable on drum to prevent unwinding. Remove the drum.

(e) Disconnect drain and cap all fuel lines at the selector valve.

(f) Remove the bolts that secure the selector valve to the bracket.

(g) Remove oil cooler shutter actuating linkage.

(h) Lift the selector valve out over top of the oil cooler.

(13) DISASSEMBLY OF FUEL TANK SELECTOR VALVE.

(a) Remove mounting case.

(b) Remove pulley retainer and remove pulley.

(c) Remove valve housing.

(d) Remove drive shaft pin.

(e) Remove four body bolts for final disassembly of valve.

(14) REMOVAL OF FUEL BALL CHECK VALVE.

(a) With cross-feed valves in OFF position drain the fuel container which supplies fuel to the valve to be removed.

(b) Disconnect lines from the valve and remove it by taking out the attachment bolts.

(15) DISASSEMBLY OF FUEL BALL CHECK VALVE. (See figures 147 and 157.)

(a) Unscrew and remove set screw, plug, and lock screw.

(b) Unscrew and remove end caps and gaskets.

(c) Unscrew and remove ball guides, steel balls, ball seats, and Neoprene washers.

(d) Remove spacer pin from spacer guide.

(e) Drive out spacer pin locking spacer guide to body.

(f) Unscrew and remove spacer guide.

(16) REMOVAL OF LIQUIDOMETER TANK UNIT. (See figure 139.) - Disconnect the electrical conduit at the unit and remove the bolts which mount the unit in the fuel container.

(17) REMOVAL OF FUEL STRAINER. - Loosen the butterfly nut on the bottom of the strainer housing, and the hinged support will fall away allowing the strainer and the strainer cap to fall out.

CAUTION

Always observe the blower drain when the carburetor is bled and be sure that fuel is running out the drain.

(18) REMOVAL OF BLOWER DRAIN.

(a) Remove the 3/8-inch dural line.

(b) Unscrew the valve assembly from the blower case.

(19) DISASSEMBLY OF BLOWER DRAIN - Remove the cap screw and the small parts will automatically become separated. Slush in gasoline or an approved solvent.

(20) REMOVAL OF CARBURETOR. (See figure 155.)

(a) Turn selector valve in pilot's cockpit to OFF position.

(b) Remove the antidrag ring cowl.

(c) Remove the carburetor air scoop fairing as follows: Remove cover plates both sides of

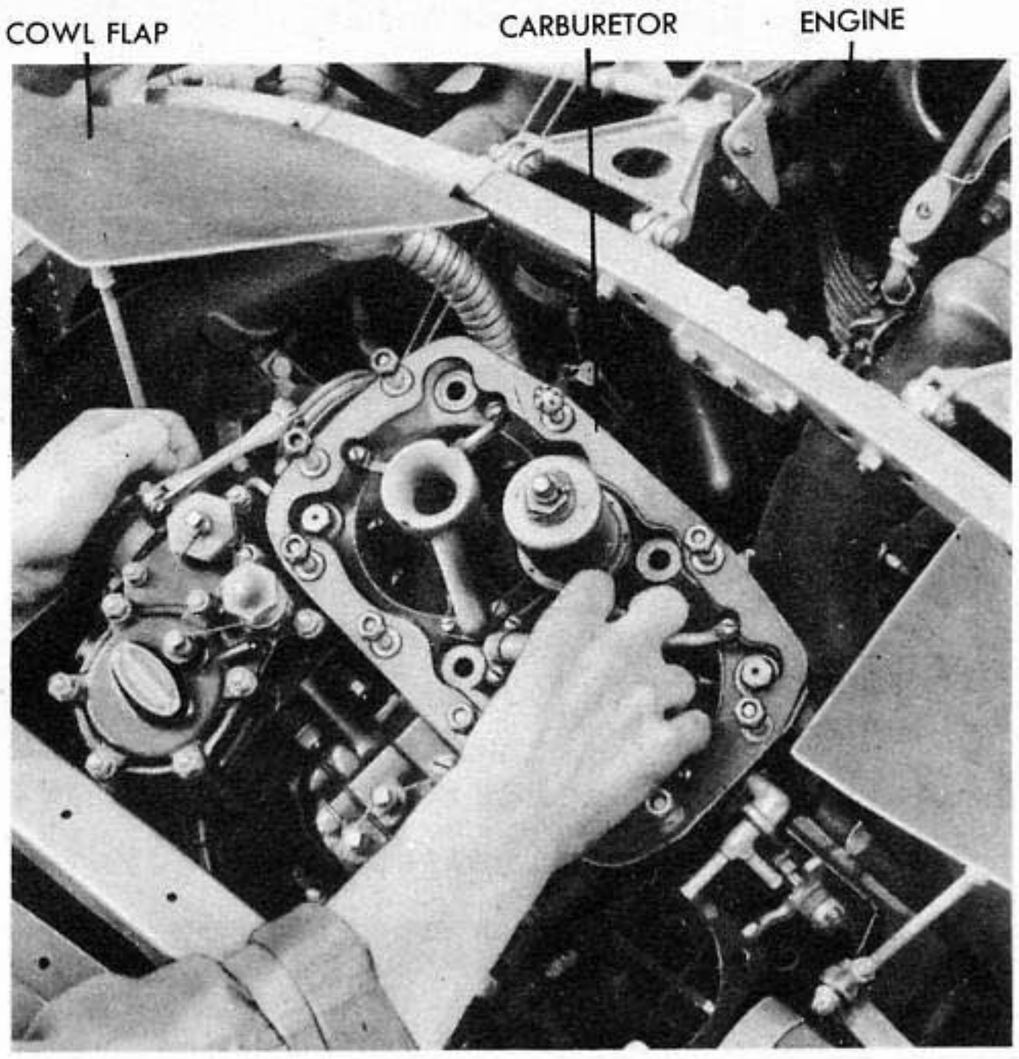


Figure 155 - REMOVING CARBURETOR

scoop. Remove exit fairings for upper cowl flaps from wing both sides of scoop. Disconnect air temperature bulb connection from middle of back of scoop. Disconnect four carburetor anti-icer lines from back of scoop. Remove cover from top of air scoop fairing. Remove five cap screws under air scoop fairing. Remove six Phillips head screws from air scoop fairing. Remove ten remaining cap screws that hold sides of air scoop to the venturi ring. Disconnect control cables. Loosen the lower clamp on the Neoprene collar that connects the scoop to the carburetor. Lift off the air scoop.

(d) Disconnect the carburetor control cables from the carburetor. Tag them to aid assembly.

(e) Cut safety wire on the seven body bolts which secure the carburetor to the carburetor adapter. Remove nuts.

(f) Remove discharge nozzle line which runs from the carburetor body to carburetor adapter.

(g) Lift carburetor from the carburetor adapter.

(h) Remove the eight carburetor adapter hold-down stud nuts. Lift the carburetor adapter from the rear supercharger housing.

CAUTION

Do not drop bolts, washers, or tools into rear supercharger housing.

(c) Inspect pump shaft. Replace if scored.

(3) INSPECTION AND REPLACEMENT OF FUEL TANK SELECTOR VALVE PARTS.

(a) Inspect drive shaft for wear or pitting or scored surfaces. Replace drive shaft if any of these defects is noticed.

(b) Inspect all threaded parts for burs or roughness of the threads. Rethread or retap if necessary.

(c) Inspect valve body for cracks or defects in the metal. Replace body if defective.

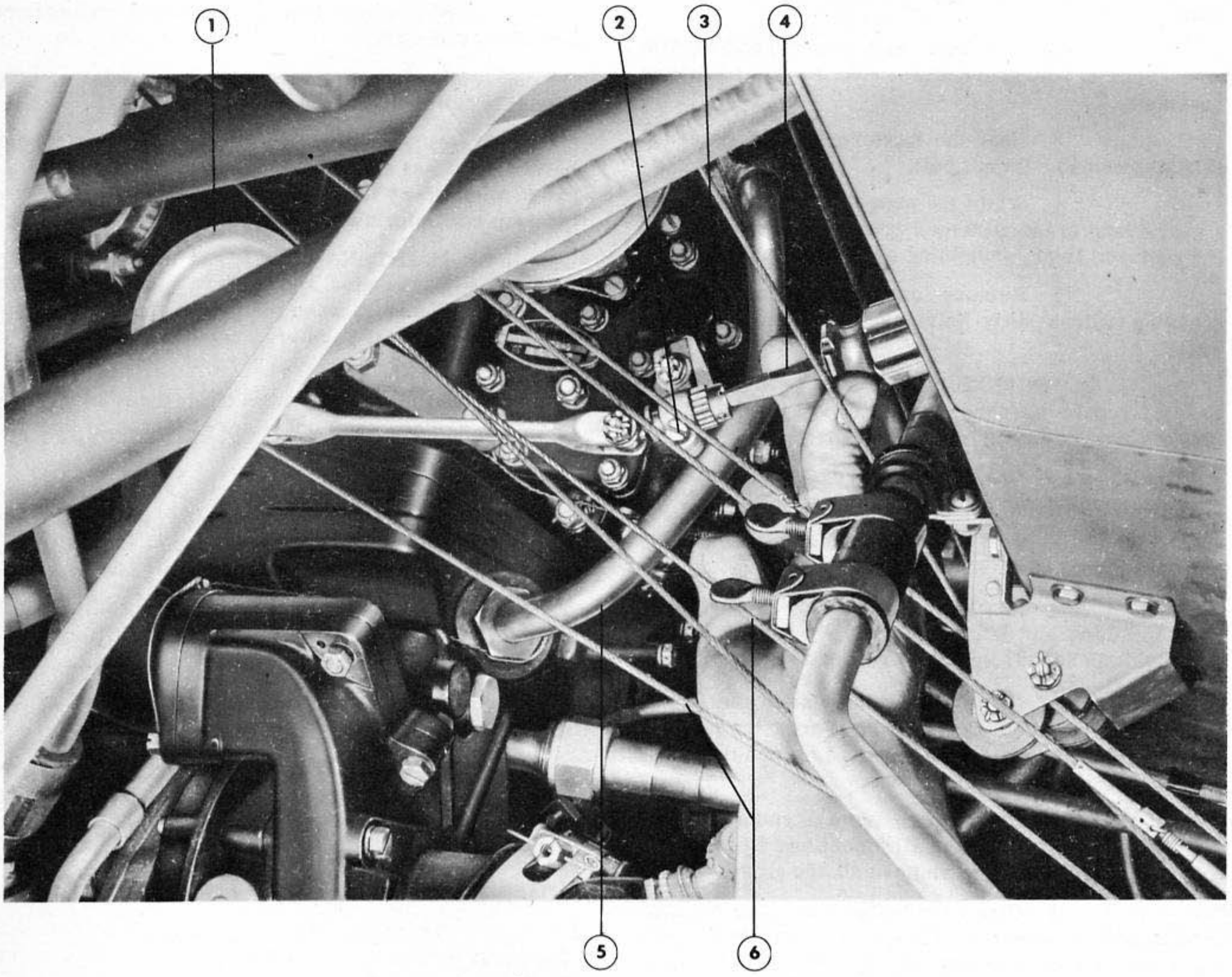
(4) INSPECTION AND REPLACEMENT OF FUEL BALL CHECK VALVE PARTS. - In normal operation the Neoprene washers are the only parts of the fuel ball check valves subject to deterioration or excessive wear. When these washers are worn, the valve will leak and the washers must be replaced.

f. ADJUSTMENTS.

(1) ADJUSTMENT OF CARBURETOR.

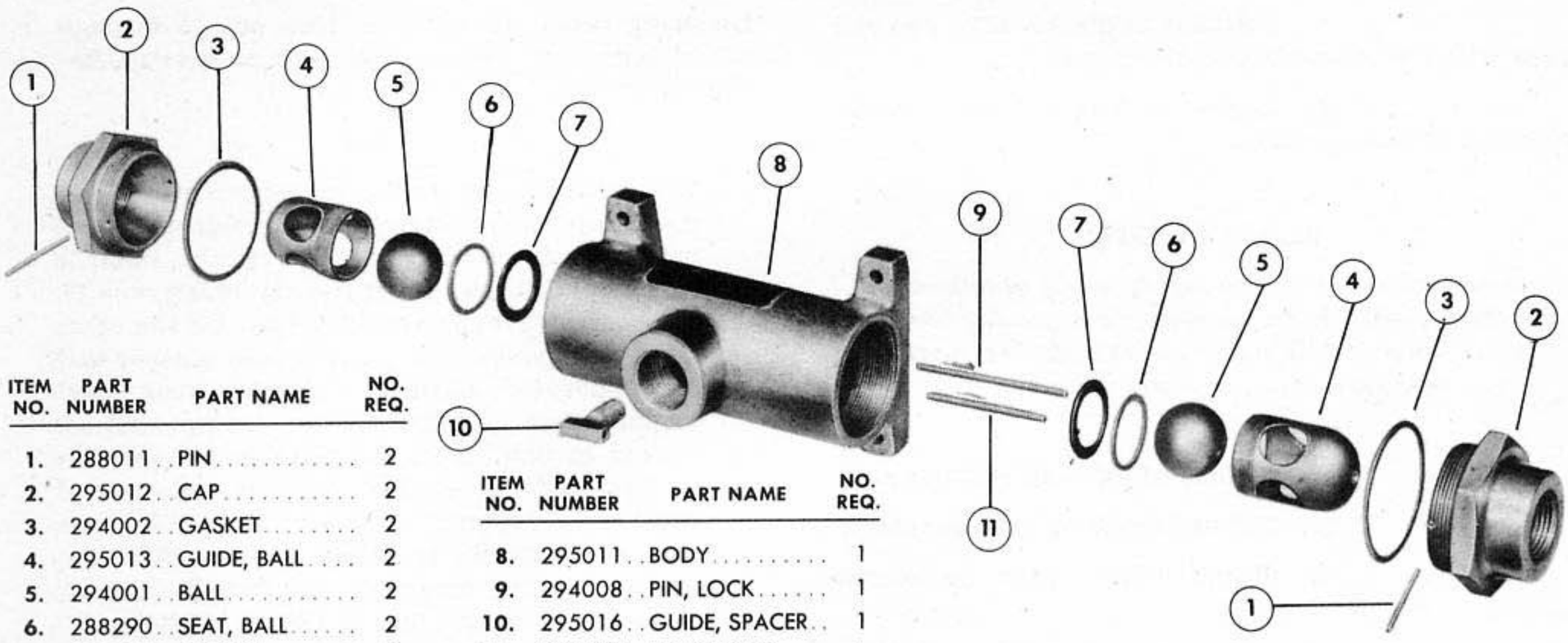
(a) First determine whether the mixture is too rich or too lean as follows:

1 Indications of too lean mixture:



1. CARBURETOR THROTTLE CONTROL PULLEY
2. IDLE ADJUSTING KNOB SET SCREW
3. IDLE ADJUSTING KNOB
4. SCREWDRIVER
5. DISCHARGE NOZZLE LINE
6. CARBURETOR CONTROL CABLES

Figure 156 - ADJUSTING IDLE MIXTURE OF CARBURETOR



ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	288011	PIN	2
2.	295012	CAP	2
3.	294002	GASKET	2
4.	295013	GUIDE, BALL	2
5.	294001	BALL	2
6.	288290	SEAT, BALL	2
7.	294004	GASKET	2
8.	295011	BODY	1
9.	294008	PIN, LOCK	1
10.	295016	GUIDE, SPACER	1
11.	294003	PIN, SPACER	1

Figure 157 - FUEL BALL CHECK VALVE - EXPLODED VIEW

(b) Install the four nuts, washers, and palnuts on the outside adapter hold-down studs. Install the four castellated nuts, washers, and safety wire on the inside adapter hold-down studs.

(c) Using a new gasket, place the carburetor in position on the carburetor adapter. Install the seven body bolts which secure the carburetor to the adapter. Safety-wire the nuts.

(d) Install discharge nozzle line which runs from carburetor body to the carburetor adapter.

(e) Connect main fuel line to the carburetor.

(f) Connect carburetor control cables to the carburetor.

(g) Install carburetor air scoop fairing as follows: Safety hot air door in the "cold" position and tape the cable to hold it on the pulley. See that the Neoprene collar is clamped securely to the air scoop; place the other clamp around the Neoprene collar and roll the Neoprene collar back (like a cuff) over both clamps. Lower air scoop into position. Unroll Neoprene collar. It will thereby fit itself to the carburetor air scoop adapter. Push the loose clamp down until it fits around the bottom of the Neoprene collar. If the clamp will not go down in front, remove the inspection plates at the sides of the air scoop. Tighten the lower clamp, using a flat screwdriver. Install ten cap screws along the sides of the air scoop into the venturi ring. Be careful not to force any of the cap screws. If screws will not start easily, drill sheet metal out to 1/4-inch diameter. Install five cap screws under air scoop fairing. Replace cover on air scoop fairing. Install six Phillips head screws in air scoop fairing. Connect four anti-icer lines to back of air scoop. Connect electric plug to air temperature bulb on back of air scoop. Install exit fairings for upper cowl flaps. Install cover plates on wing. Hook up control cables, removing tape and safety wire.

(h) Install antidrag ring cowl.

(2) ASSEMBLY OF BLOWER DRAIN. - Insert the small parts and install the cap screw.

(3) INSTALLATION OF BLOWER DRAIN.

(a) Install the valve assembly in the blower case.

(b) Install the 3/8-inch dural line leading from blower drain to trailing edge of the cowl flaps.

(4) INSTALLATION OF FUEL STRAINER.

(a) Insert the screen assembly and the cap into the housing with the tip of the cone pointing up. Secure them in place with the hinged support and tighten the butterfly nut.

(b) Before starting engine, expel air trapped in lines to the fuel pump, the selector valve, and the tank cross-feed valve as follows: Remove the 1/4-inch plug on top of the strainer. Turn on the selector valves. As soon as the lines are full, fuel will run out of the 1/4-inch hole in the strainer. Then replace the plug. Air also becomes trapped in the line underneath the pump. Therefore, remove the line from the fitting on the bottom of the pump and turn on the selector valve. While fuel is running from this line, replace the line back into the pump fitting.

(5) INSTALLATION OF LIQUIDOMETER TANK UNIT. (See figure 139.)

(c) Install accessory cowling on right side of engine nacelle.

NOTE

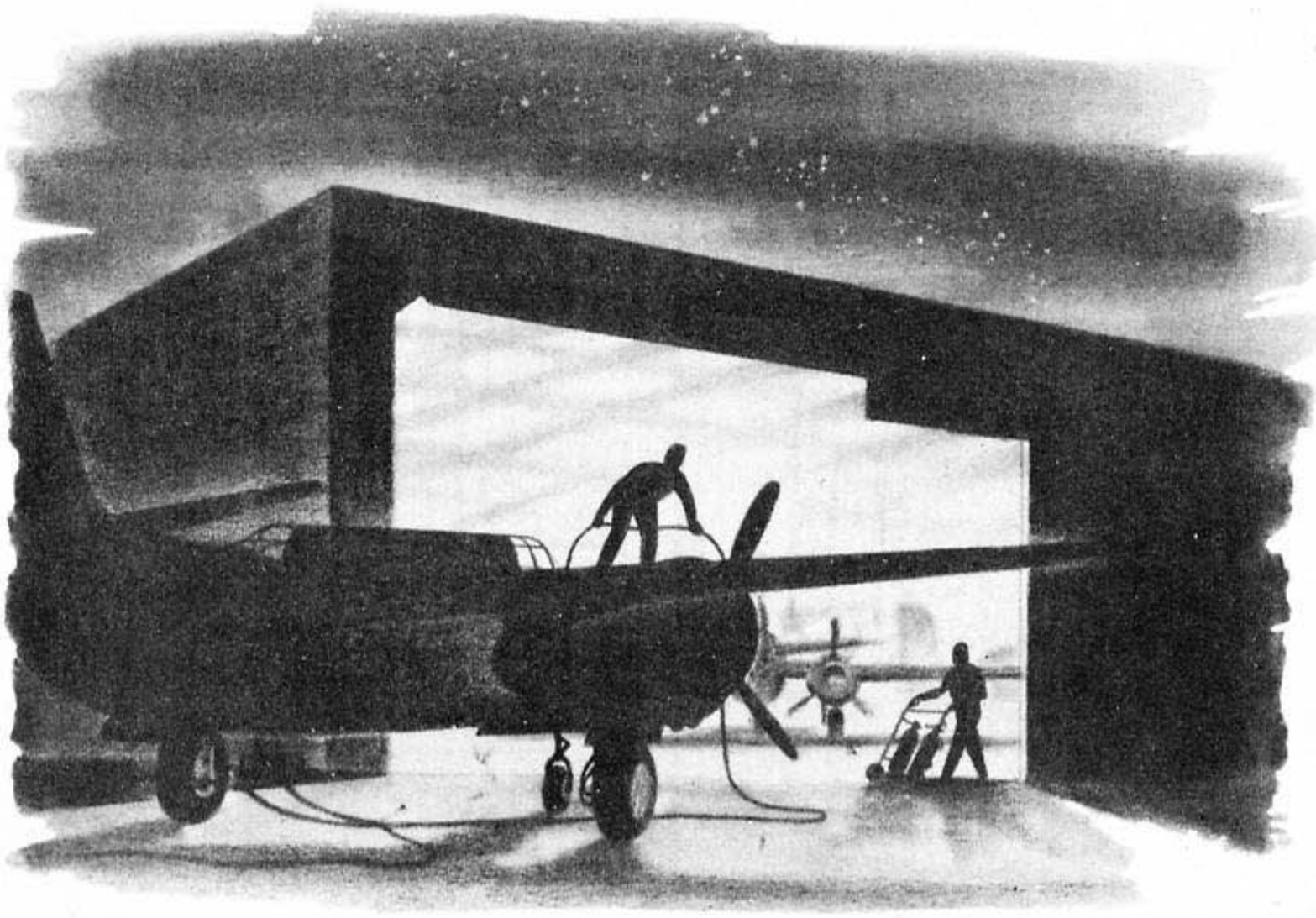
If there is an air leak in sylphon vent line, it will cause high fuel pressure gage reading and low-pressure output at pump.

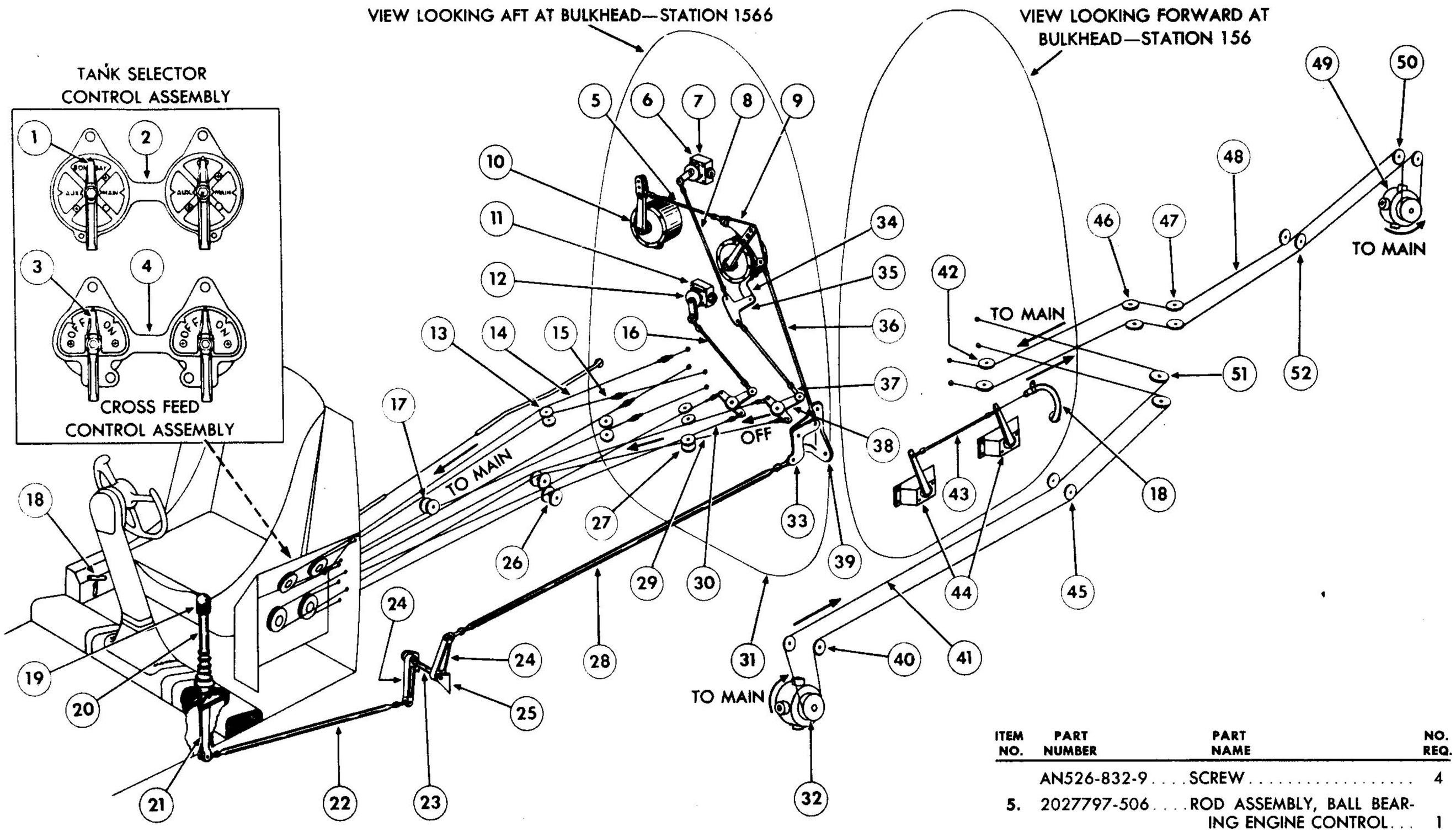
(3) TEST OF WOBBLE PUMP AFTER INSTALLATION. - Operate the wobble pump. Adjust the pressure to 14 pounds per square inch by turning the adjusting valve on the back of each pump. Pressure adjustment on the pump is reached through a hole in the bulkhead aft of Station 156 in the rear bomb bay.

(4) TEST OF FUEL TANK SELECTOR VALVE AFTER INSTALLATION. - With tank selector OFF and mixture control AUTO. RICH, operate the wobble pumps. A small amount of gasoline will probably come from the blower drain, but if the fuel continues to flow through the blower drain the selector valve is leaking.

(5) TEST OF FUEL BALL CHECK VALVE AFTER INSTALLATION. - Place approximately five gallons of fuel in the fuel container for which the check valve functions. Tilt the airplane and run the engine from that container.

(6) TEST OF LIQUIDOMETER TANK UNIT AFTER INSTALLATION. - Check gage reading when tank is empty, then put a given amount of fuel in each fuel container. Turn the selector switches ON to the various fuel containers and note the amount of fuel in each container. Finally, check for full tank capacity. If these amounts correspond to the known fuel supply in each container, the liquidometer tank unit is operating correctly.





ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	5166752-A-55-210	DIAL AND HANDLE ASSEMBLY	2
	1087510-6-10	SCREW	4
2.	4063990	SUPPORT ASSEMBLY, FUEL TANK SELECTOR VALVE CONTROL	1
	AN526-832-8	SCREW	4
3.	5166752-A-2-103	DIAL AND HANDLE ASSEMBLY	2
	1087510-6-10	SCREW	4

ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
	2059207	PULLEY, FUEL CROSS FEED VALVES	2
	124604-30-9	PIN, THREADED TAPER	2
	AC365-440	NUT	2
	AC960-4	WASHER	2
	1058277	SHAFT, FUEL CROSS FEED VALVES	2
	AN435-4-12	PIN, SHAFT	2
4.	4058341	SUPPORT ASSEMBLY, FUEL CROSS FEED VALVES	1

ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
	AN526-832-9	SCREW	4
5.	2027797-506	ROD ASSEMBLY, BALL BEARING ENGINE CONTROL	1
	AN970-3	WASHER	1
	148535	BOLT, ¼" SHOULDER	1
	AN3-11	BOLT	1
	AN310-3	NUT	2
	AN316-4R	NUT	2
6.	2064917	DRIVE ASSEMBLY, ENGINE FUEL CROSS FEED VALVE	1
	AN3-6A	BOLT	4
	AC365-1032	NUT	4
7.	2175092	VALVE ASSEMBLY, FUEL CROSS FEED (ENGINE)	1
8.	2027797-812	ROD ASSEMBLY, BALL BEARING ENGINE CONTROL	1
	AN970-3	WASHER	1

Figure 159 - FUEL SYSTEM CONTROLS

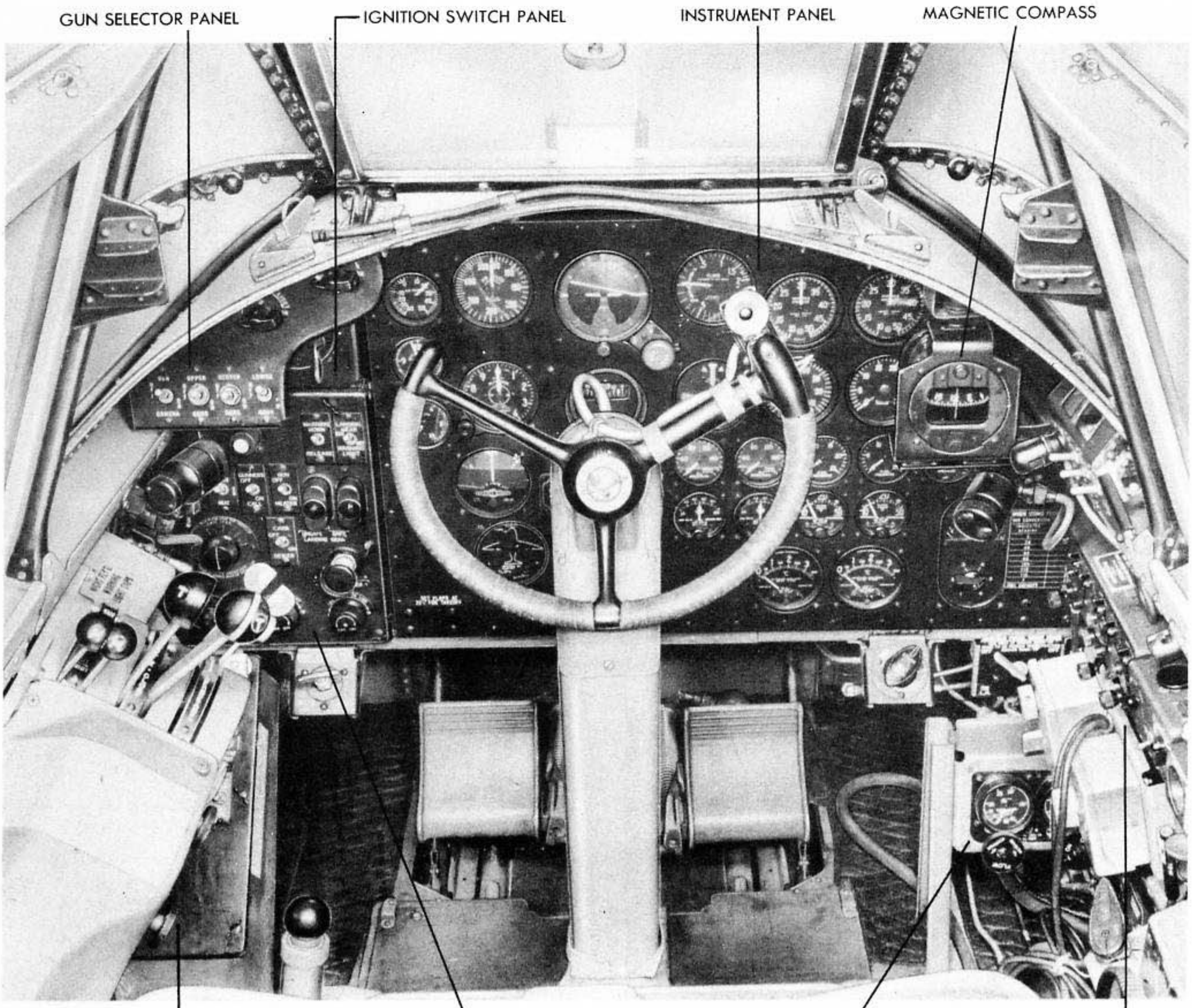


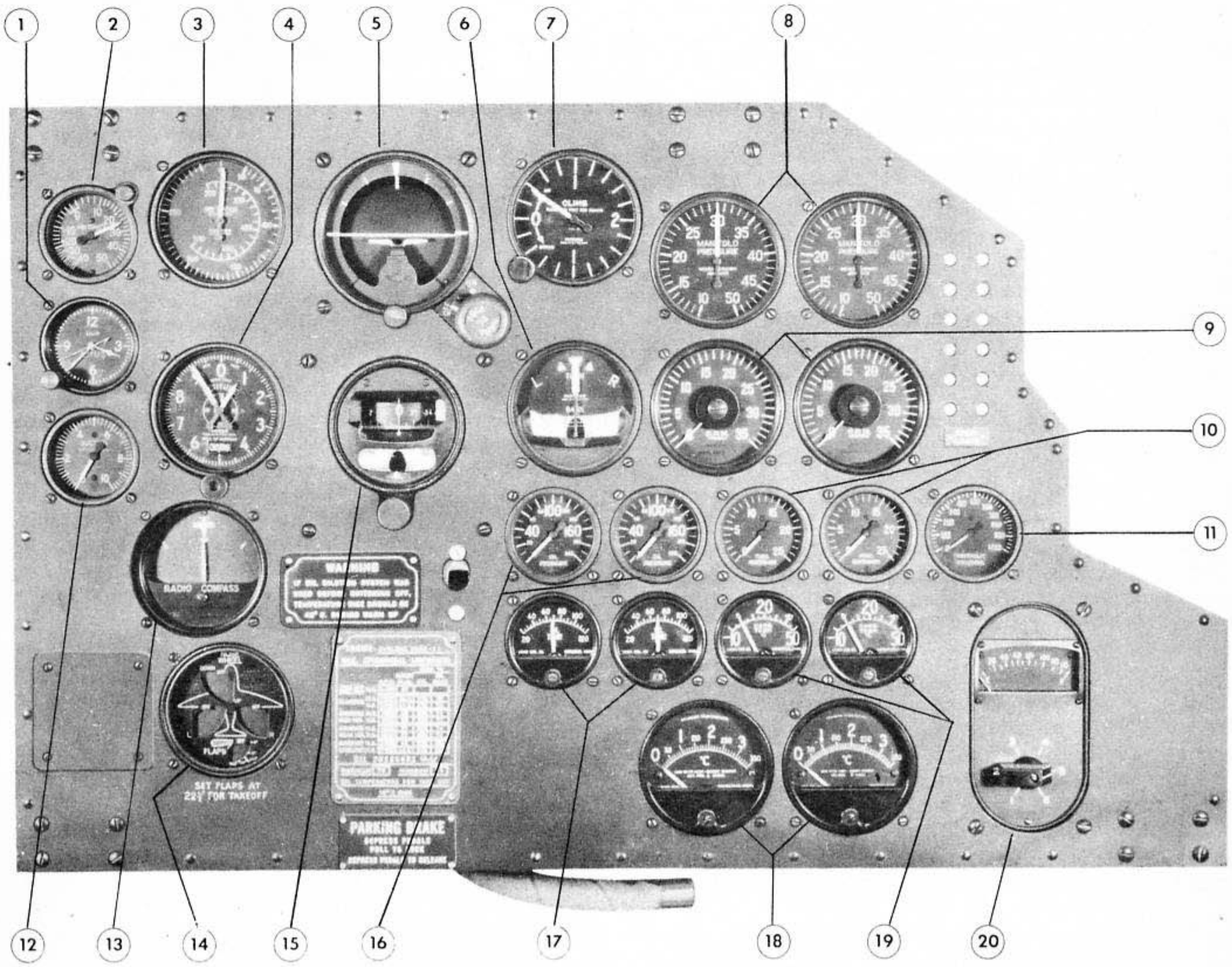
Figure 160 - PILOT'S COMPARTMENT

14. INSTRUMENTS.

a. DESCRIPTION.

(1) GENERAL. - All instruments are fluorescent lighted. The following are mounted on a shockproof instrument panel located in the pilot's compartment. (See figures 160 and 161.)

Air-speed indicator	Pioneer, 1426-4T
Altimeter	Pioneer, 1582-2M
Carburetor mixture temperature indicators (two)	Lewis, 47ACX
Clock	AAF Specification 94-27970, type A-11
Compass	IN-4A
Engine temperature indicators (two)	Lewis, 17AT7K
Flight indicator	AN-5736-2 (Sperry 647900)
Fuel pressure gages (two)	AAF Specifications 94-27919 type C-13
Fuel quantity indicator	EA47W-6
Hydraulic pressure gage	AAF Specification 94-27922, type E-4
Indicator unit for landing wheels and flaps	G.E., 8DJ4PBX



ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	AAF SPEC. 94-27970 TYPE A-11	CLOCK	1
2.	U. S. GAUGE AW-1⅞-20CG	THERMOMETER, OUTSIDE AIR	1
3.	PIONEER 1426-4T	INDICATOR, AIR-SPEED	1
4.	PIONEER 1555-2L	ALTIMETER	1
5.	AN-5736-2 (SPERRY 647900)	INDICATOR, FLIGHT	1
6.	AAF SPEC. 27348 TYPE A-11	INDICATOR, TURN AND BANK	1
7.	PIONEER 1634-1M	INDICATOR, RATE OF CLIMB	1
8.	U. S. GAUGE AW-2¾-14F	GAUGE, MANIFOLD PRESSURE	2
9.	WESTON MODEL 545 TYPE 56L	TACHOMETER	2
10.	AAF SPEC. 94-27917 TYPE B-8A	GAUGE, FUEL PRESSURE	2
11.	AAF SPEC. 94-27922 TYPE E-4	GAUGE, HYDRAULIC PRESSURE	1
12.	AAF SPEC. 94-27336 TYPE E-4	GAUGE, SUCTION	1
13.	IN-4A	COMPASS, RADIO	1
14.	GE8DJ4PBX	INDICATOR, LANDING GEAR AND FLAP POSITION	1
15.	AN5735-2 (SPERRY 647910)	INDICATOR, TURN	1
16.	AAF SPEC. 94-27917 TYPE B-8	GAUGE, OIL PRESSURE	2
17.	LEWIS 47AC2J	INDICATOR, OIL TEMPERATURE	2
18.	LEWIS 17AT7K	INDICATOR, ENGINE TEMPERATURE	2
19.	LEWIS 47ACX	INDICATOR, CARBURETOR MIXTURE TEMPERATURE	2
20.	EA47W-6	INDICATOR, FUEL QUANTITY	1

Figure 161 - INSTRUMENT PANEL

Manifold pressure gages (two) . . . . . U.S. Gage, AW-2 3/4-14F
Oil pressure gages (two) . . . . . AAF Specification 94-27917, type B-8A
Oil temperature indicators (two) . . . . . Lewis, 47AC2J
Outside air thermometer . . . . . U.S. Gage, AW-1 7/8-20-CG
Rate of climb indicator . . . . . Pioneer, 1634-1M
Suction gage . . . . . AAF Specification 94-27336, type F-4
Tachometers (two) . . . . . Weston model, 545, type 56P
Turn and bank indicator . . . . . AAF Specification 27348, type A-11
Turn indicator . . . . . AN-5735-2 (Sperry 647910)

(2) INSTRUMENT PANEL. (See figure 161.) - A shockproof instrument panel is mounted in the pilot's compartment and held in place by four bolts that are inserted through rubber shock mountings.

(3) PITOT AND VACUUM SYSTEMS. (See figure 169.)

(a) A pitot static and a pitot pressure line extend from a pitot head at the top of the vertical stabilizer along the left side of the fuselage to tees behind the pilot's instrument panel. A line from each tee connects to the air-speed indicator and altimeter on the panel. A drain tee is installed in each line aft of Station 75.

(b) The vacuum system consists of lines which extend from vacuum pumps on each engine through the nacelle and inner wing to a "Y" fitting at the right side of the fuselage. From this point they continue forward along the right side of the fuselage to the suction regulator behind the instrument panel. Three lines extend from the regulator to the throttle valve, flight indicator and turn indicator, respectively. The bank and turn indicator and suction gage obtain vacuum from the throttle valve and flight indicator, respectively.

(4) COMPASSES. - There are two compasses in the pilot's compartment. One is the magnetic type and the other is a radio compass. See paragraph 22, this section, for information on the radio compass.

(5) TACHOMETER GENERATOR (See figure 164.) - A small generator mounted on the fuel pump accessory drive on the rear of the engine supplies the necessary electrical current to actuate the tachometer.

(6) VACUUM PUMP. (See figure 162.) - To supply vacuum for the operation of gyroscopically actuated instruments, a vane-type vacuum pump operates in the oil system. The vacuum pump takes its small oil requirements from the engine accessory section on which it is mounted by four stud bolts. The pump is gear driven as an engine accessory. Incorporated in the vacuum line to the instruments are four valves. A suction relief valve is located at the engine accessory section forward of the fire wall on the inside of the nacelle. It controls flow in one direction in the event of backfire of the engine. A master relief valve

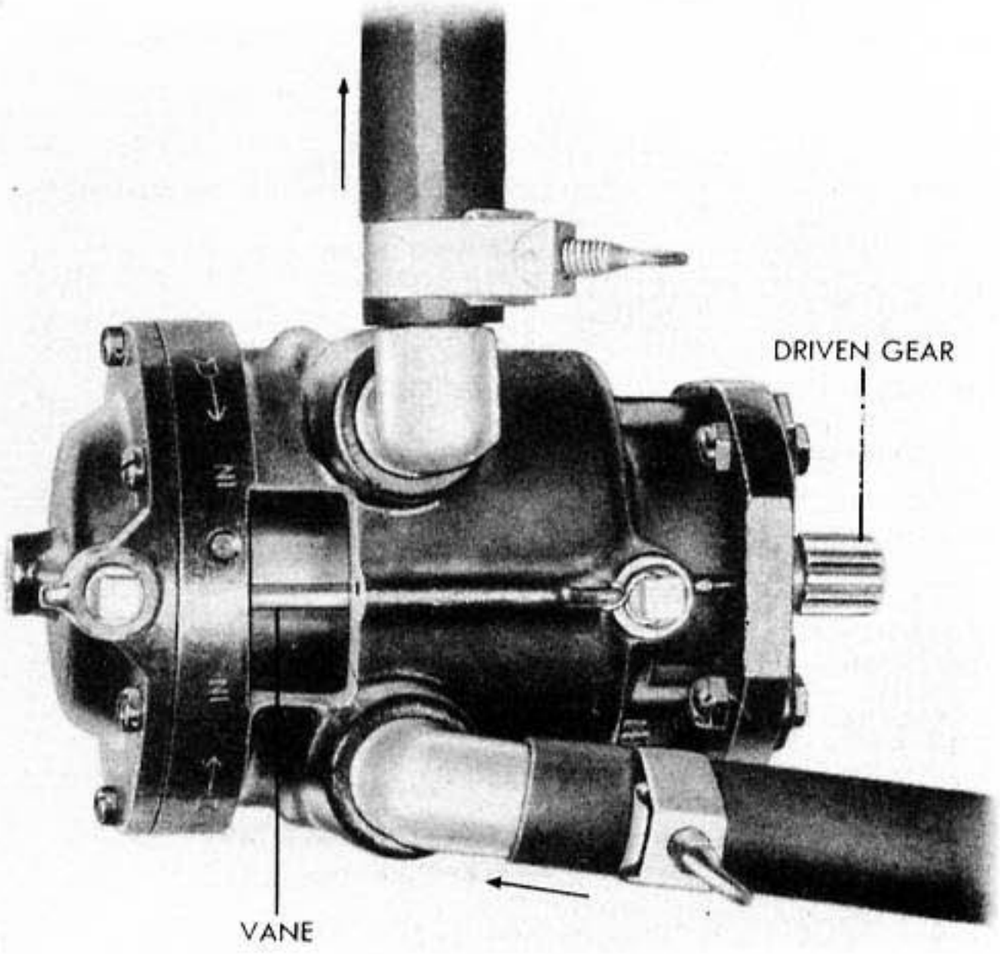


Figure 162 - VACUUM PUMP - CUTAWAY VIEW

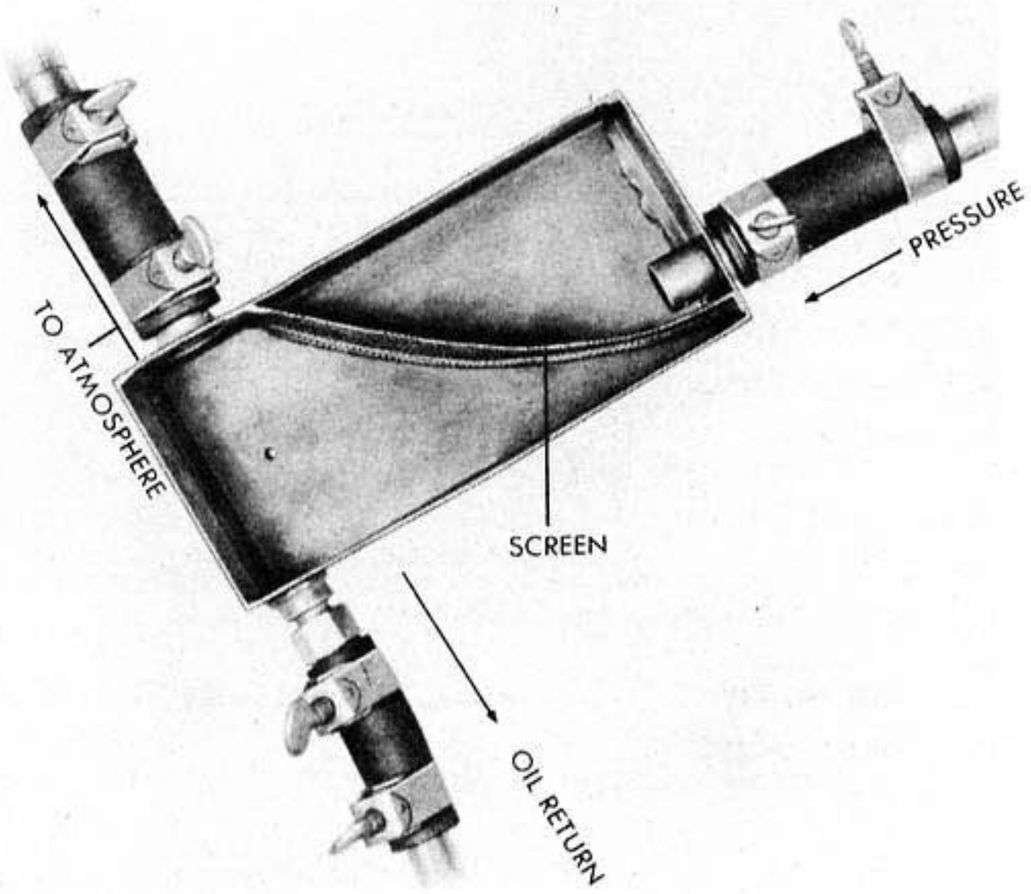


Figure 163 - OIL SEPARATOR - CUTAWAY VIEW

(d) Remove mounting screws and lift the instrument from the panel.

(2) REMOVAL OF INSTRUMENT PANEL.

(a) Remove access doors located between stations 0 and 14 from top of fuselage.

(b) Disconnect all attaching wires and lines. Tag the wires and lines as they are disconnected to facilitate assembly. Cap tubing to prevent entry of dirt.

(c) Remove the center bolts of the shock mountings.

(d) Remove the panel from the cockpit.

(3) REMOVAL OF TACHOMETER GENERATOR. (See figure 164.)

(a) Disconnect the electrical wiring at the Cannon plug on lower end of the generator.

(b) Cut the safety wire on the large union nut.

(c) Remove union nut and release generator from the accessory drive.

(4) REMOVAL OF VACUUM PUMP. (See figure 162.)

(a) Disconnect hose leading from fire wall to pump at pump.

(b) Disconnect hose leading from oil separator to vacuum pump at pump.

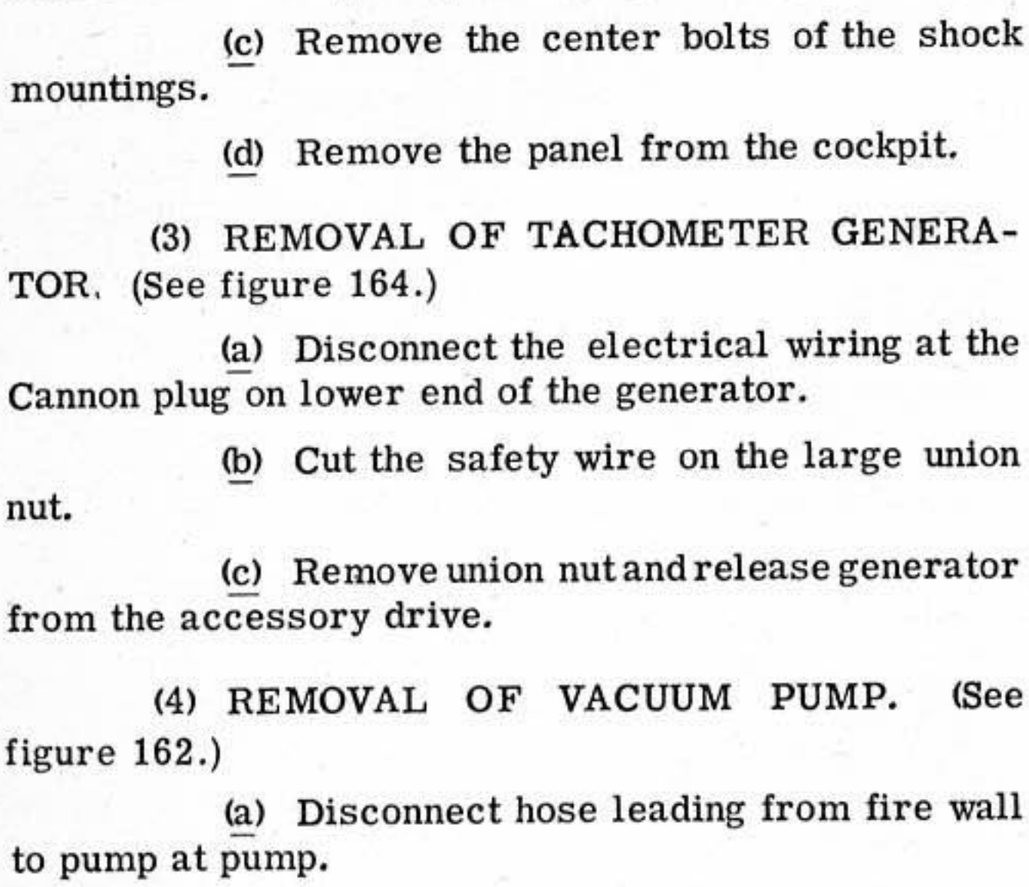


Figure 164 - REMOVING TACHOMETER GENERATOR

(c) Remove four bolts that attach vacuum pump to crankcase.

(5) REMOVAL OF OIL SEPARATOR. (See figure 163.)

(a) Disconnect line leading from vacuum pump to oil separator at oil separator.

(b) Disconnect line leading from crankcase to oil separator at oil separator.

(c) Disconnect hose leading from fire wall to oil separator at oil separator.

(d) Remove two cotter pins, castellated nuts and bolts that attach oil separator to its bracket.

d. MAINTENANCE REPAIRS.

(1) MARKING INSTRUMENTS. - When installing any aircraft instrument, always be sure the instrument is marked. If not marked, mark each instrument to identify its purpose either by plate, name data, or drawing number. Make all markings neat and not over 1/16 inch wide. Use aircraft enamel, Specification AN-E-3, or lacquer, Specification AN-TT-L-51. Apply enamel with a finely pointed brush and lacquer with a drafting pin. Use a compass to make arc-shaped marks on instrument glasses and apply masking tape in the center of the glass to prevent slippage of compass points. Use colors as follows:

(a) Insignia red line to indicate MAXIMUM PERMISSIBLE.

(b) Willow green arc to indicate OPERATING RANGE.

(c) White line for reference line. Apply to both edges of instrument case and cover glass so that alinement of marks indicates the glass is properly positioned.

(2) INSPECTION AND REPAIR OF VACUUM PUMP.

(a) Clean pump thoroughly in solvent.

(b) Inspect pump to see if any of the vanes have broken away. If this condition is found, clean all parts thoroughly and examine the line to the separator for particles of broken metal. Clean the line well.

e. REPLACEMENTS.

(1) INSPECTION AND REPLACEMENT OF INSTRUMENT PARTS.

(a) Inspect instrument for broken or loose cover glass. Replace glass if broken.

(b) Inspect instrument for discolored or chipped luminous markings. Replace instrument if chipped or discolored.

(c) Inspect threads of instrument for burs or stripping. Rethread if damaged.

(d) Check case of instrument for cracks or points of leakage. Replace if damaged.

(2) INSPECTION AND REPLACEMENT OF INSTRUMENT PANEL PARTS.

(a) Inspect all instruments for security of mounting. Tighten if loose.

(b) Inspect the four shock absorber units on the panel and replace if damaged.

(c) Inspect panel for any cracks or breaks in its surface. Replace if cracked or broken.

(3) INSPECTION AND REPLACEMENT OF OIL SEPARATOR.

(a) Clean oil separator thoroughly in gasoline.

(b) Inspect oil separator for any external defects. Replace if damaged.

f. ADJUSTMENTS.

(1) CHECKING ZERO ADJUSTMENT OF ALTIMETER: (See figure 165.)

(a) Take a portable altimeter, part No. 37D3341, to the control tower and set pointers to read the surveyed elevation of the station altimeter above sea level. Vibrate the instrument before taking the reading. The pressure scale of the portable altimeter should read the existing "altimeter setting." If it does not, loosen the zero setting adjustment screw just to the left of the setting knob and displace it to the left. Do not remove screw. Then with the pointers still reading the elevation, read the existing altimeter setting. Check the reading carefully and vibrate the instrument. The portable altimeter now reads correctly for the existing altimeter setting and the scale correction is zero for this pressure.

(b) Carry the portable altimeter to the altimeter in the airplane. Be sure to leave the pressure scale on the portable altimeter set to the existing altimeter setting. Set the reference markers on the airplane altimeter to zero, read the pointer indication and determine the scale correction for this pressure altitude. Now vibrate and read the portable altimeter and subtract the correction, which has just been determined for the airplane altimeter, from this reading. Next set the pointers of the airplane altimeter to read this value, tapping the instrument sufficiently to remove all friction. The pressure scale of the airplane altimeter should read the existing altimeter setting as set on the pressure scale of the portable altimeter.

(c) If, after this procedure, the airplane altimeter does not indicate the existing altimeter setting, loosen the adjusting screw to the left of the knob (do not remove screw), and displace it to the left. Then pull out on the knob and turn until the pressure scale does read the existing altimeter setting, keeping the

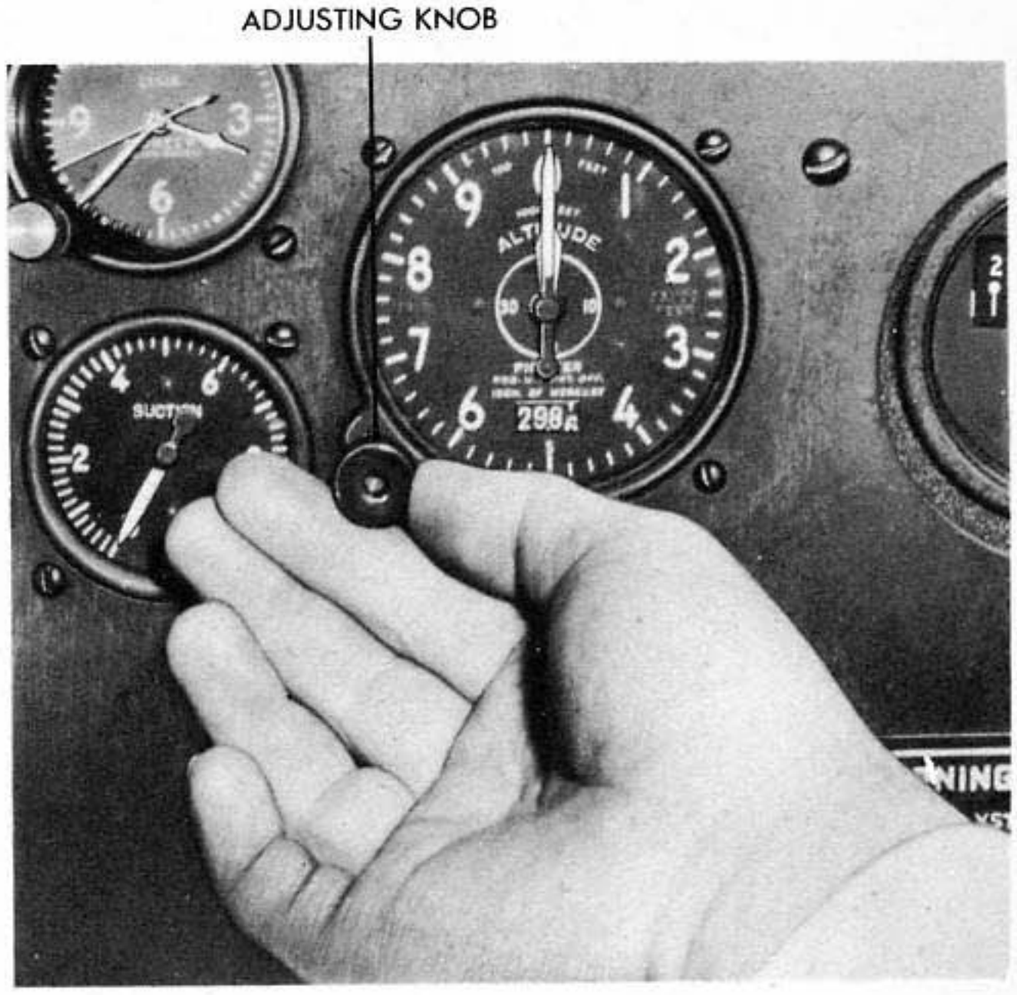


Figure 165 - ADJUSTING ALTIMETER

pointers on the corrected reading determined in the preceding paragraph. Tap the altimeter during this procedure to remove the friction. If the pointers read properly and the pressure scale reads the existing altimeter setting, move the screw back to the right and tighten. The airplane altimeter is now set to the proper correction on its scale correction card, and all the other corrections appearing thereon should be applicable for other altitudes.

NOTE

This check should not be made until at least 12 hours after the airplane has been flown.

(2) SWINGING COMPASS. - If the compass is suspected of being in error it should be checked and compensated if necessary. The procedure to compensate or swing the compass is as follows:

(a) Remove compensating drawer or assembly, or set compensator assembly for zero effect by matching the dots on the compensator screws with those on the instrument case.

(b) Head the airplane to Magnetic North (see figure 166), Magnetic East, Magnetic South, and Magnetic West and read the airplane's compass on the four headings.

(c) Enter the magnetic headings and compass readings in their appropriate spaces under "Compensating Swing," on AAF Form No. 57. Subtract the compass readings from the corresponding magnetic headings to obtain the deviations and enter the deviations and their signs in the next column.

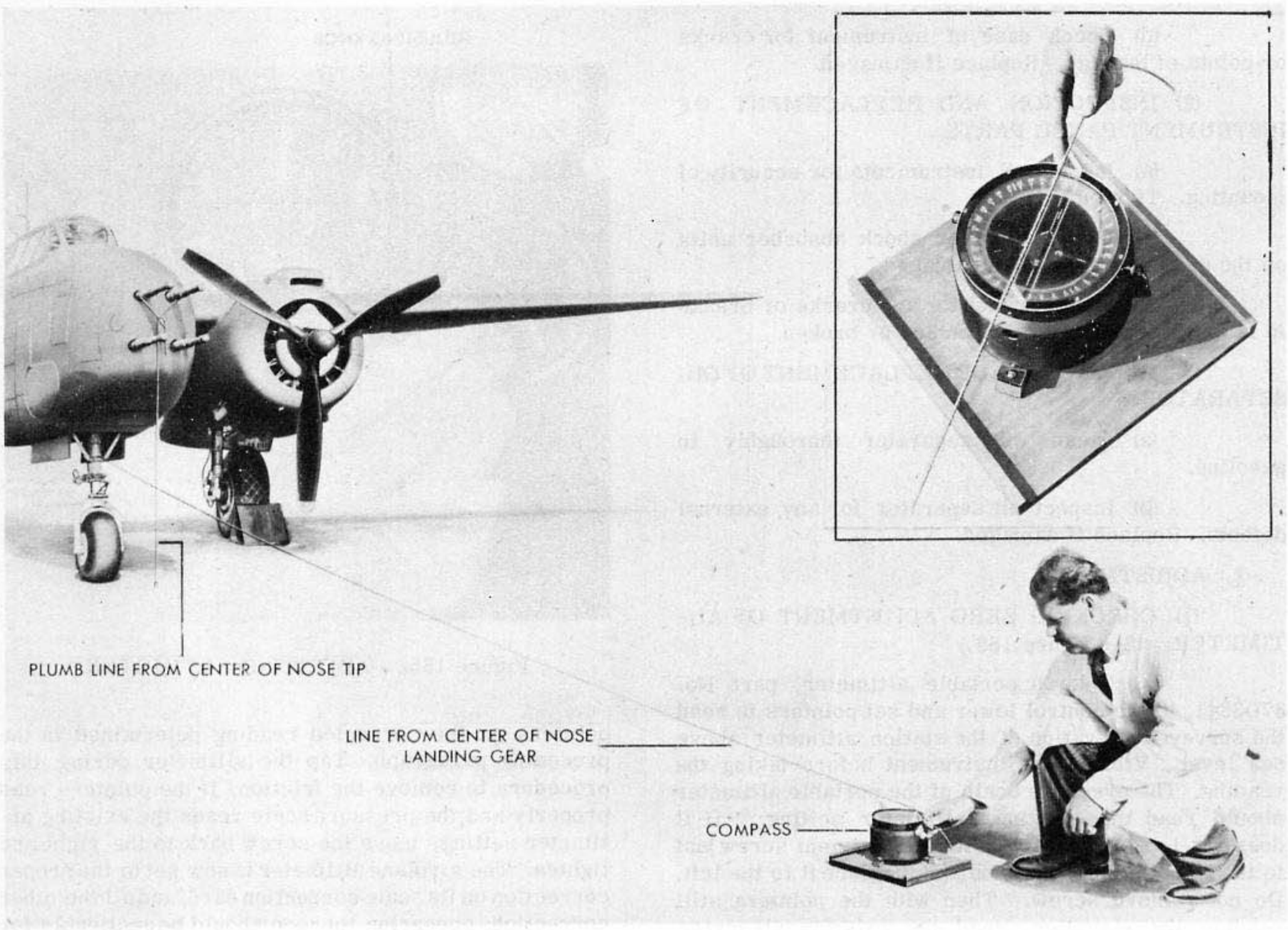


Figure 166 - HEADING AIRPLANE NORTH FOR COMPASS ADJUSTMENT

(d) Using the recorded deviations, calculate the coefficients A, B, and C, according to the formulae, on the lower part of the form.

NOTE

All calculations are algebraic, that is,

Multiplication	Addition	Subtraction	Division
+ (+) = +	+ (+) + = +	+ (-) - = +	+ ÷ + = +
+ (-) = -	- (+) - = -	+ (-) + = ±	- ÷ - = -
- (+) = -	+ (+) - = ±	- (-) + = -	+ ÷ - = -
- (-) = +		- (-) - = ±	- ÷ + = -

(e) With the airplane's head on Magnetic North, add coefficient C algebraically to the compass reading on that heading to determine what the instrument should indicate when compensated. Replace the compensator and make the compass indicate the compensated value by adjusting the N-S (see figure 167) compensating screw (use nonmagnetic screwdriver) or by inserting magnets in that chamber of the compensating drawer at right angles to the compass needle (the lateral chamber).

(f) With the airplane's head on Magnetic East, add coefficient B algebraically to the compass reading on that heading to determine what the instrument should indicate when compensated. Make the compass indicate the compensated value by adjusting (see figure 167) the E-W compensating screw (use nonmagnetic screwdriver) or by inserting magnets in that chamber of the compensating drawer at right angles in the compass needle (the longitudinal chamber).

NOTE

If the compensation on North is inadvertently altered when the airplane's head is Magnetic East, step 5 must be redone. Before repeating step 5, reset the N-S compensator for zero effect.

(g) With the airplane on any heading, add coefficient A algebraically to the reading of the compass reading on that heading to determine what the

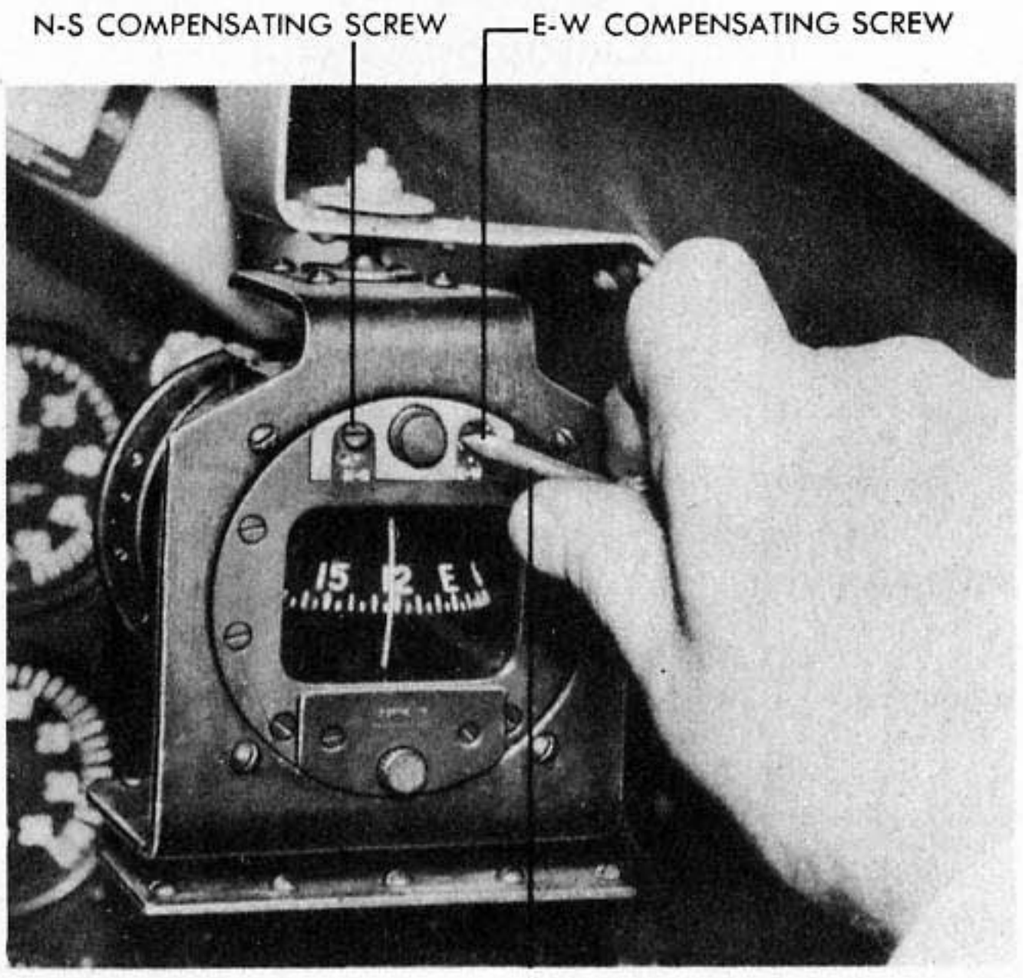


Figure 167 - ADJUSTING COMPASS

instrument should read when compensated. Make the compass indicate the compensated value by rotating it bodily, clockwise if coefficient A is positive, or counter-clockwise if coefficient A is negative. Secure the compass. This completes the actual compensation of the compass.

(h) Place the airplane's head on the cardinal and quadrantal magnetic headings (East, Southeast, South, Southwest, West, Northwest, North, and Northeast) and enter the magnetic headings and the corresponding compass readings in their proper spaces on AAF Form No. 57 under "Residual Swing."

(i) Complete AAF Form No. 57, according to the subtractions indicated at the bottom of the last two blank columns, and tear off the compass card and place it in the compass card holder in the airplane. File the remainder of the card as a permanent record.

g. INSTALLATION.

(1) INSTALLATION OF OIL SEPARATOR. (See figure 163.)

(a) Place oil separator in position on its bracket and install two bolts, castellated nuts, and cotter pins.

(b) Connect line leading from fire wall to oil separator.

(c) Connect line leading from vacuum pump to oil separator at oil separator.

(d) Connect line leading from engine crankcase to oil separator at oil separator.

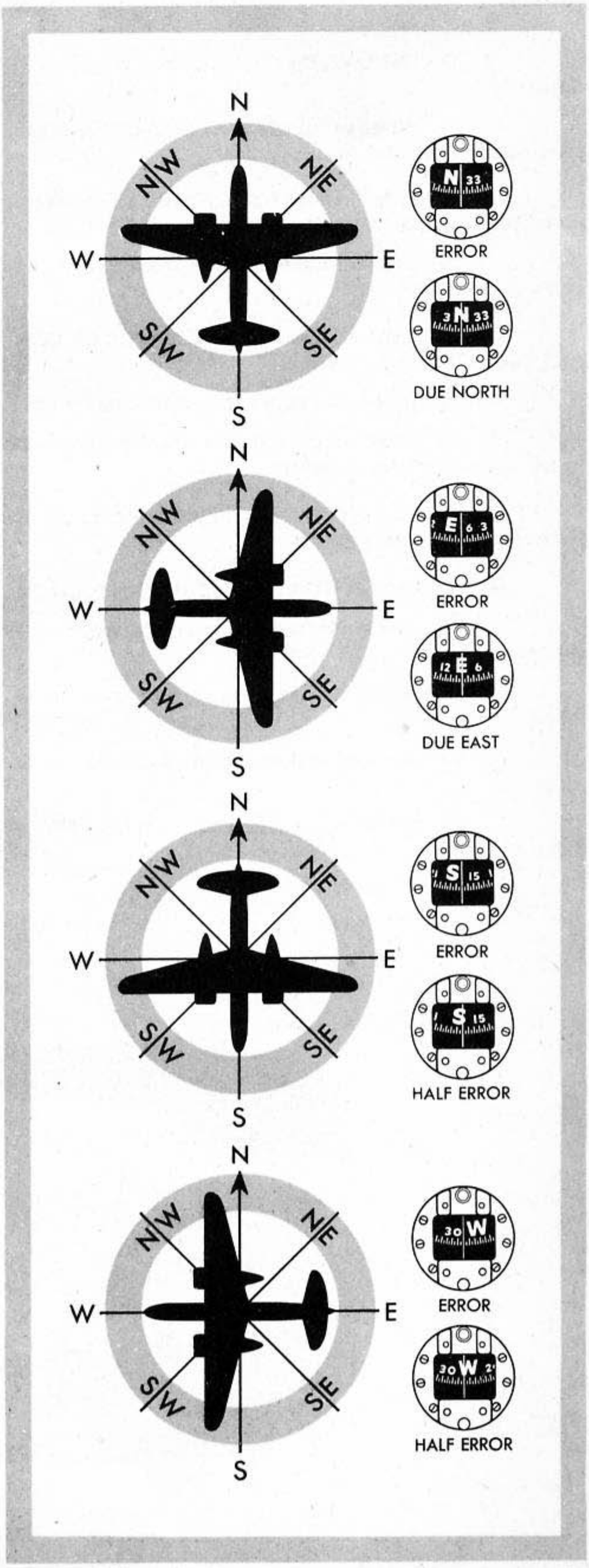
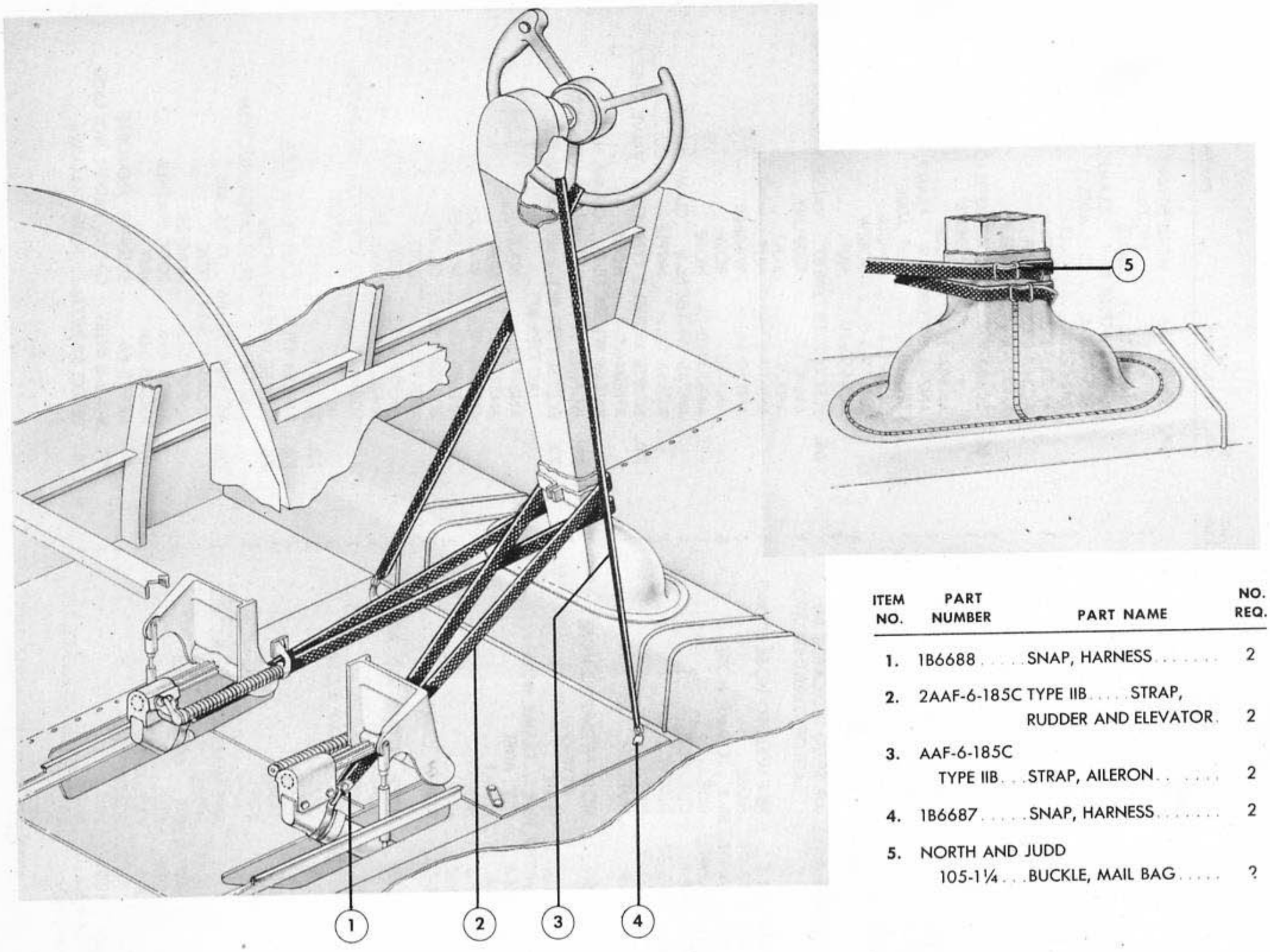


Figure 168 COMPASS COMPENSATION



ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	1B6688	SNAP, HARNESS	2
2.	2AAF-6-185C TYPE IIB	STRAP, RUDDER AND ELEVATOR	2
3.	AAF-6-185C TYPE IIB	STRAP, AILERON	2
4.	1B6687	SNAP, HARNESS	2
5.	NORTH AND JUDD 105-1¼	BUCKLE, MAIL BAG	?

Figure 170 - SURFACE CONTROL LOCKS

15, SURFACE CONTROLS.

a. DESCRIPTION.

(1) GENERAL. - The rudder, elevators, and ailerons are operated by cables and controlled from the pilot's position by a control column and wheel, and rudder pedals. The tab for each control surface, also cable-operated, is controlled from the tab control unit mounted on the right side of the pilot's cockpit. All main control cables are 3/16-inch, 7 by 19, extra flexible, preformed steel. All tab cables are 3/32-inch, 7 by 7, flexible preformed steel. The cables are routed by a series of fair-leads and pulleys. The pulleys are the lubricated type sealed at the factory. Turnbuckles are provided at intervals to facilitate removal, installation, and adjustment of the control system. The wing flaps are operated hydraulically and controlled by a unit in the instrument panel.

(2) SURFACE CONTROL LOCKS. (See figure 170.) - A locking arrangement consisting of four heavy cotton straps is provided to lock the surface controls when the airplane is parked. Two strap assemblies, looped around the bottom of the control column and clipped to the rudder pedals, prevent movement of the rudder. Elevator and aileron movement is locked by two straps looped through the control wheel and clipped to armor plate bolts on the left and right sides of the cockpit floor. When not in use, the straps may be stowed under the pilot's seat cushion.

(3) CONTROL COLUMN AND WHEEL. (See figure 171.) - The control column in the pilot's cockpit and the control wheel at the top of the column provide for longitudinal and lateral control of the airplane. Forward and aft movement of the column lowers and raises the nose. Conventional movement of the wheel provides lateral balance.

(4) ELEVATOR CONTROLS. (See figure 176.) - The elevator control cables attach to the control column torque tube horns, and run forward around pulleys, then aft, following the same route as the rudder cables. Elevator travel is limited by the elevator

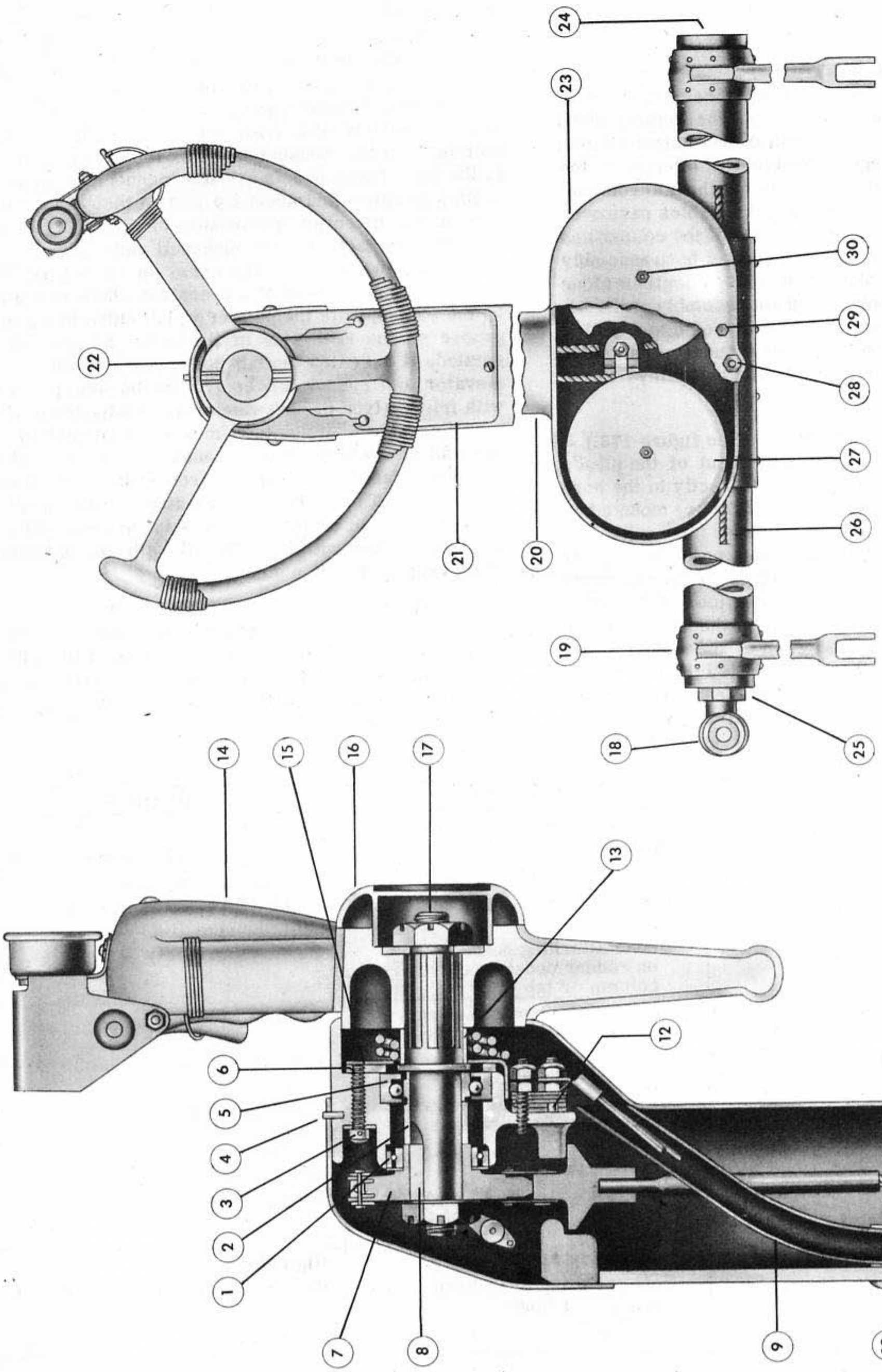


Figure 171 - CONTROL COLUMN

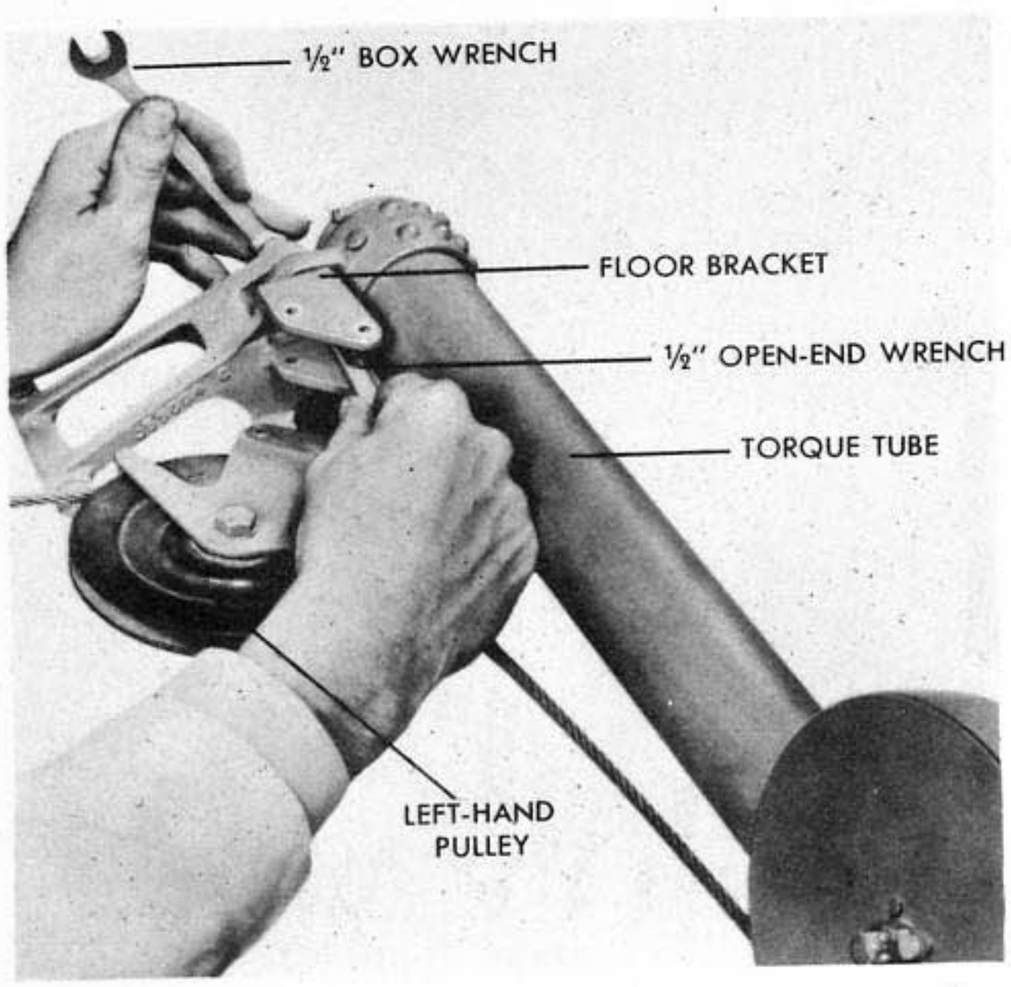


Figure 172 - REMOVING CONTROL COLUMN

c. REMOVAL AND DISASSEMBLY.

(1) REMOVAL OF CONTROL COLUMN. (See figure 172.)

(a) Break the rigging on the four elevator cables at the turnbuckles.

(b) Remove two bolts attaching the cable counterweights and remove the right-hand and left-hand weights from the nose wheel well.

(c) In the forward bomb bay break down the two aileron control cables and remove them from the pulleys alongside of the battery cases.

(d) Enter the cockpit and remove the two covers from the torque tube assembly.

(e) Remove the two pulleys on the ends of the torque tube (one right-hand; one left-hand).

(f) Remove the two hinging bolts attaching the torque tube to the floor bracket.

(g) Remove electrical connections that control guns and bomb release.

1. Remove the cover plate (facing aft) on the control column under the wheel. (See figure 173.) Remove the two electrical wires from the terminals. At the left side of the torque tube unscrew the breeze fitting and pull out the wires.

2. On the forward face of the control column are the wires that control releasing the bombs. Disconnect the wires inside the bomb control panel and pull them out.

(h) Lift out control column.

(2) DISASSEMBLY OF CONTROL COLUMN.

(a) Remove three nuts from the lower column cover plate (facing aft) and pry off the plate.

(b) Push out the bolts and remove the two pulleys in the bottom of the column.

(c) Remove the two bolts attaching cables to linkage at top of the column and remove the cables from the column.

(d) Remove the cover plate (facing forward) at the top of the column. (See figure 173.)

(e) Lift chain off sprocket and pull it out through the cover plate opening under the wheel.

(f) Pry off the name plate from the wheel.

(g) Unsafety and remove bolt and washers and pull the wheel off the splined shaft.

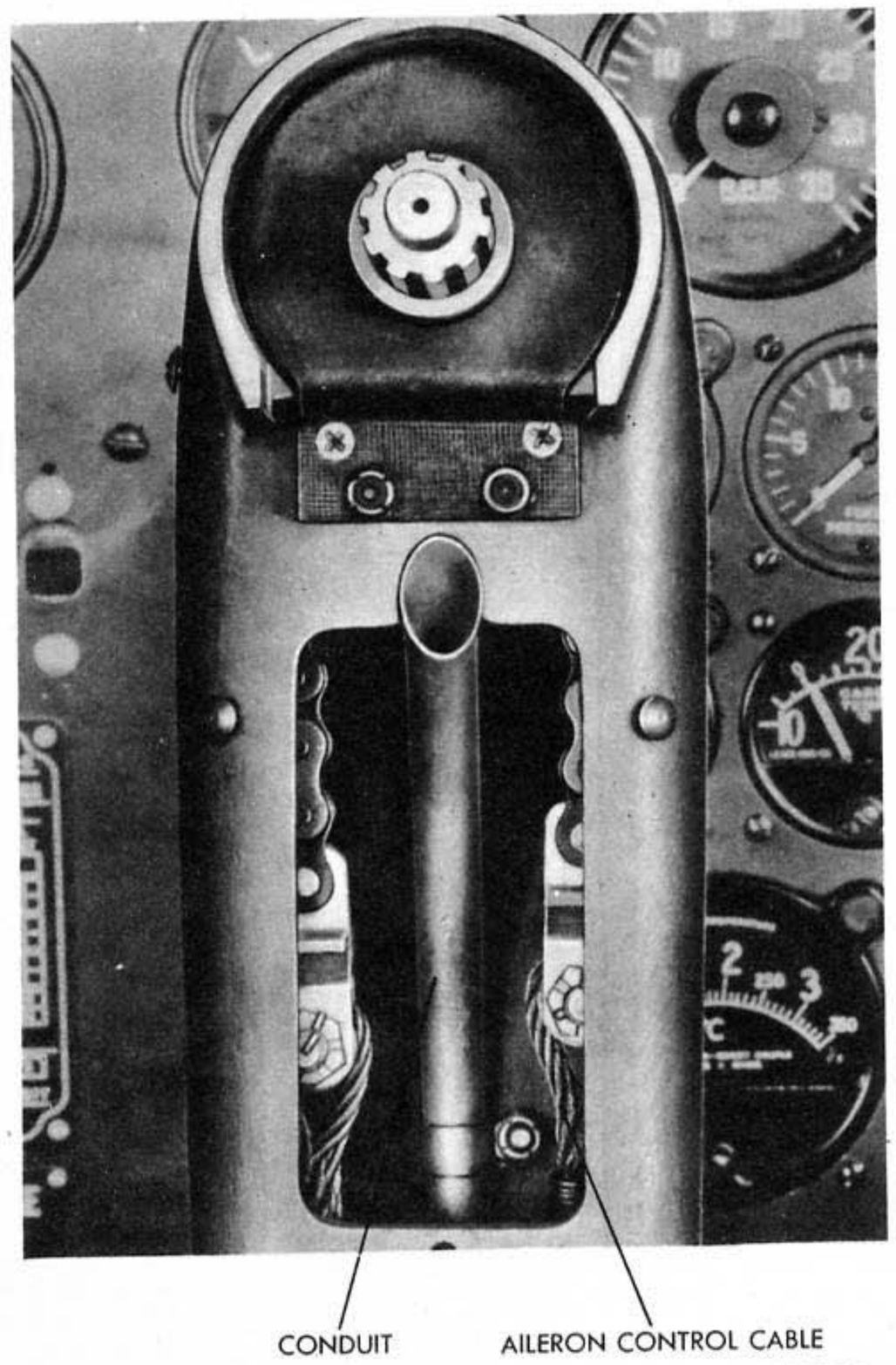


Figure 173 - CONTROL COLUMN - TOP COVER PLATE AND WHEEL REMOVED

(d) Check and adjust the UP throw: Check the UP throw for 9-7/16 inches. If not correct, lock the wheel in neutral again and adjust the turnbuckles in the wings to raise the aileron approximately two degrees above neutral. Bring the aileron back to neutral by means of the push-pull rod. Measure the throw again. Make this adjustment until the correct throw is obtained. When the up throw is properly adjusted, the DOWN throw (6-1/2 inches) automatically will be set.

(3) TOE PEDAL ADJUSTMENT OF RUDDER CONTROLS.

(a) Rotate the latch levers located on the inboard side of each rudder pedal toward the center line of the airplane in order to release the pedals for adjustment.

(b) Move the pedal to the desired position.

(c) Re-engage the latch lever in the holes of the splined shaft.

(4) RIGGING RUDDER CONTROLS.

(a) Lock the pedals in neutral position. Wooden blocks placed in front and behind the pedals and held by means of a clamp will hold the pedals in neutral position.

(b) Bring the cables to proper tension: The rudder has only two cables, one on each side of the fuselage. Each cable has one turnbuckle. Bring both cables to tension by turning each turnbuckle up the same amount (125 pounds at 21 degrees C or 70 degrees F).

(c) Adjust the rudder to neutral: With the pedals locked in neutral the rudder should be in neutral. The rudder is adjusted to neutral with the turnbuckles in the bomb bay. Let off a number of turns on the right turnbuckle and take up the same number of turns on the left one to move the rudder to the right. Let off a number of turns on the left turnbuckle and take up the same number of turns on the right one to move the rudder to the left. Repeat until the rudder lines up with the vertical stabilizer (neutral).

(d) Adjust the rudder throw: Adjust the correct throw of the rudder by means of the stops located one on each side of the nose section directly in back and above the machine guns. Turn the stops in for more throw and out for less throw. Correct throw is 19-1/2 inches right and left.

(5) REWINDING TAB DRUMS. (See figure 174.)

(a) Do not attempt to rewind the drum while it is installed. Remove the drum by removing the Zerk fitting from the end of the actuating rod, loosening the thrust nut, separating the adjusting wheel from the drum and revolving the adjusting wheel until the rod comes out. Then lift out the drum.

(b) Begin wrapping one strand of cable on the drum in the direction in which it naturally falls until half of the drum is wrapped.

(c) Wrap other strand of cable in the opposite direction. When finished, there should be the same number of turns on each side.

(d) Tape drum and cable to prevent unwinding.

(e) Install drum and bring cables to tension.

(f) Remove the tape.

NOTE

When rewinding the elevator tab drums, follow the procedure outlined above, with the following exception: There should be 3-1/2 turns on the aft side of the drum and 4-1/2 turns on the forward side of the drum.

(6) ADJUSTING TABS TO NEUTRAL. - Set the indicator in the cockpit on neutral, or zero. Loosen the two nuts on the end of the casting (the actuating drum at the surface) and turn outward. Pry the adjusting wheel away from the drum and turn in one direction or the other depending upon whether the tab is to be raised or lowered. After neutral is obtained, tighten the nuts again just enough to prevent end play in the drum. Before breaking down any of the tab cables be sure to clamp the cables in the forward bomb bay at the pulleys to prevent cables from coming off the drums in the cockpit.

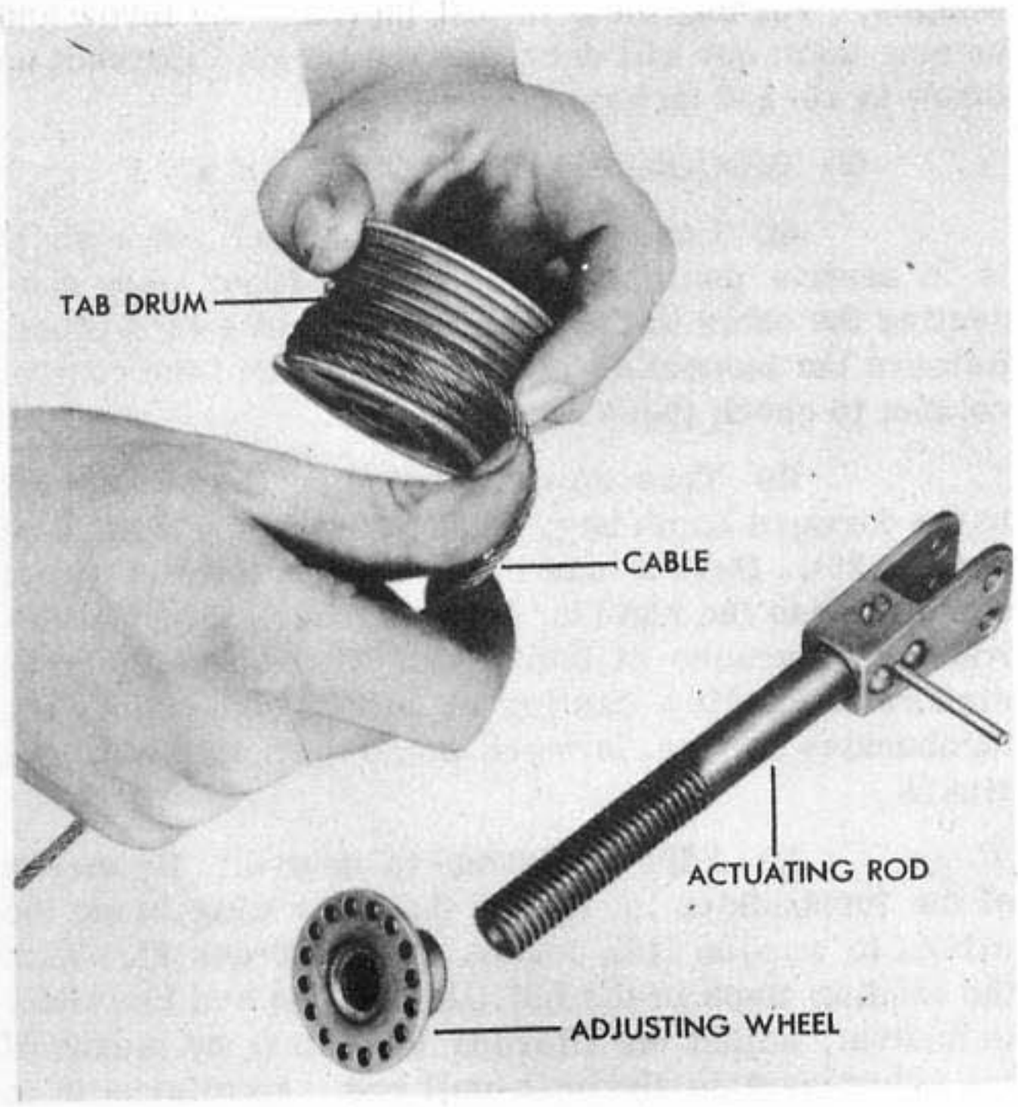


Figure 174 - REWINDING TAB DRUM

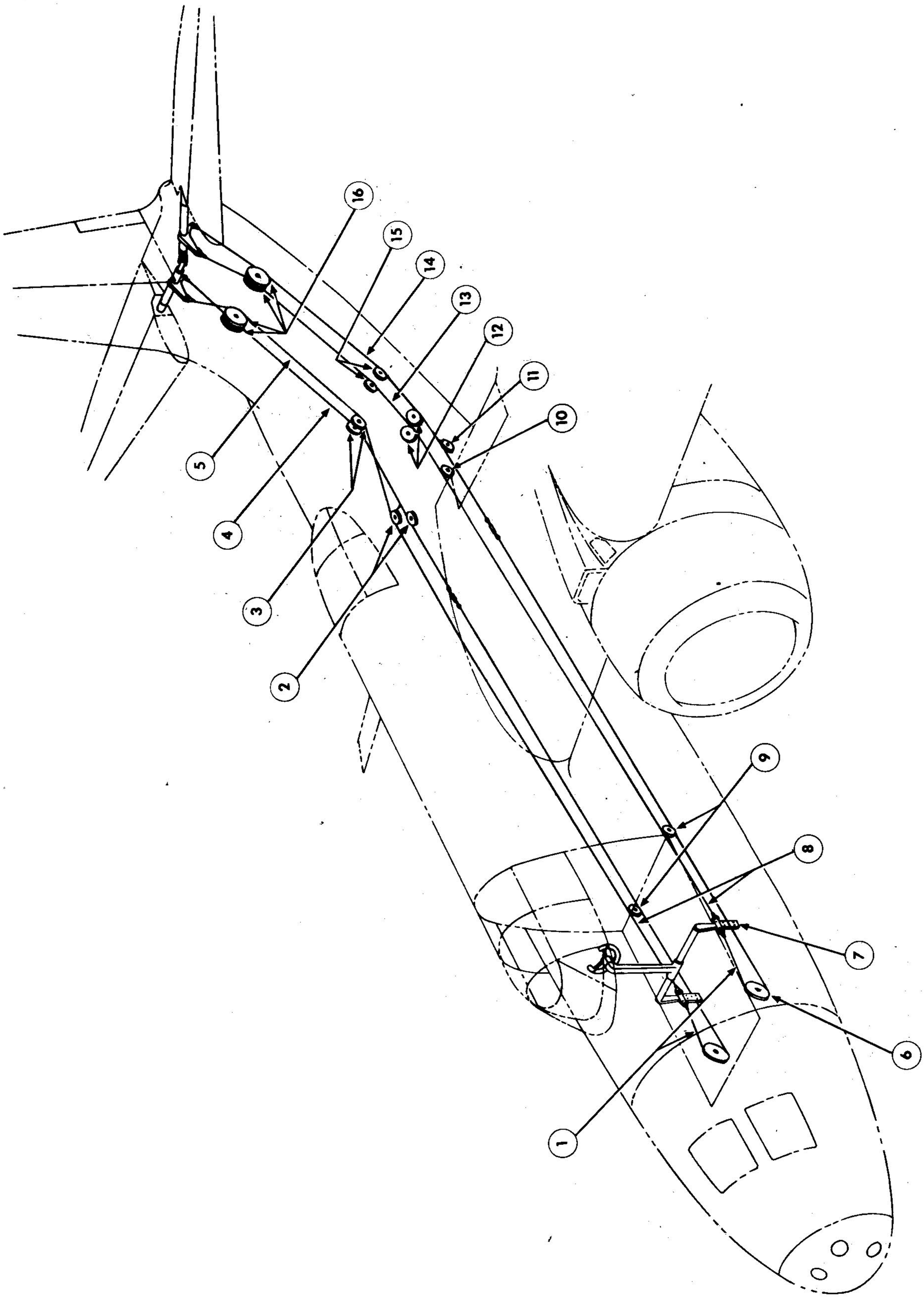
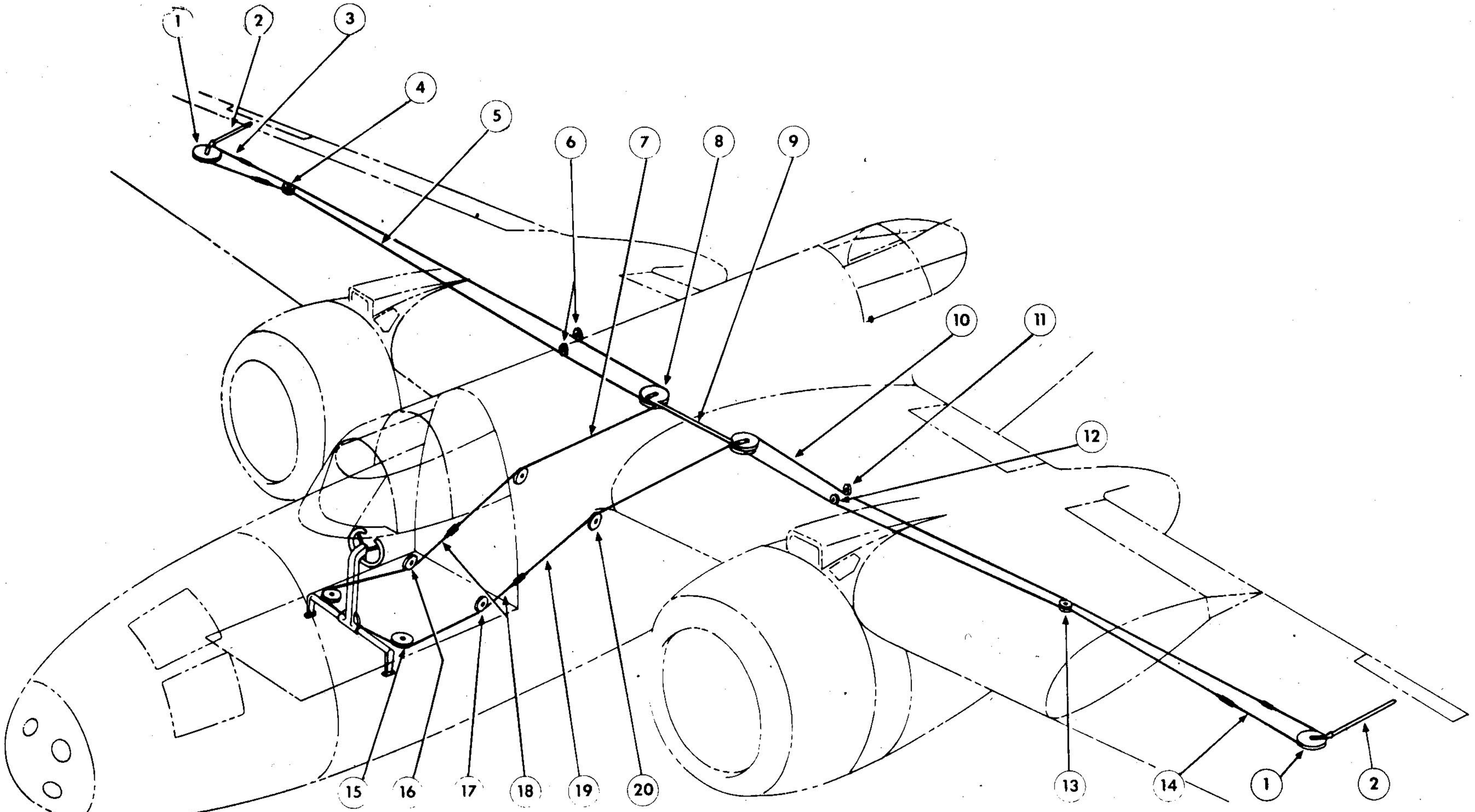


Figure 175 - ELEVATOR CONTROLS



ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	4066431	PULLEY ASSEMBLY, AILERON DIFFERENTIAL COMPLETE	2
	1060409	SPACER, AILERON PULLEY ASSEMBLY	2
	D-5	BEARING	2
	AN5-34	BOLT	2
	AN960-D516	WASHER	2
	AN310-5	NUT	2
	143358-019	PIN, PULLEY GUARD	4
	143358-213	PIN, PULLEY GUARD	4
2.	2058632	LINK ASSEMBLY, AILERON CONTROL	2
	AN4-17	BOLT	2
	AN960-416	WASHER	2
	AN310-4	NUT	2
	1060325	END ASSEMBLY, AILERON CONTROL TUBE ADJUSTING	2
	AN316-6R	NUT	2
	AN24-38	BOLT	2
	AN960-416	WASHER	2
	AN320-4	NUT	2
3.	2064977-18	CABLE ASSEMBLY, " BUSHING END	2
	AN25-14	BOLT, CLEVIS	2
	AN960-D516	WASHER	2
	AN320-5	NUT, SHEAR	2
	124682-5S14-065	WASHER	2
	AC150-46L	TURNBUCKLE ASSEMBLY	2
	AN25-14	BOLT	4
	AN960-D516	WASHER	4

Figure 176 - AILERON CONTROLS

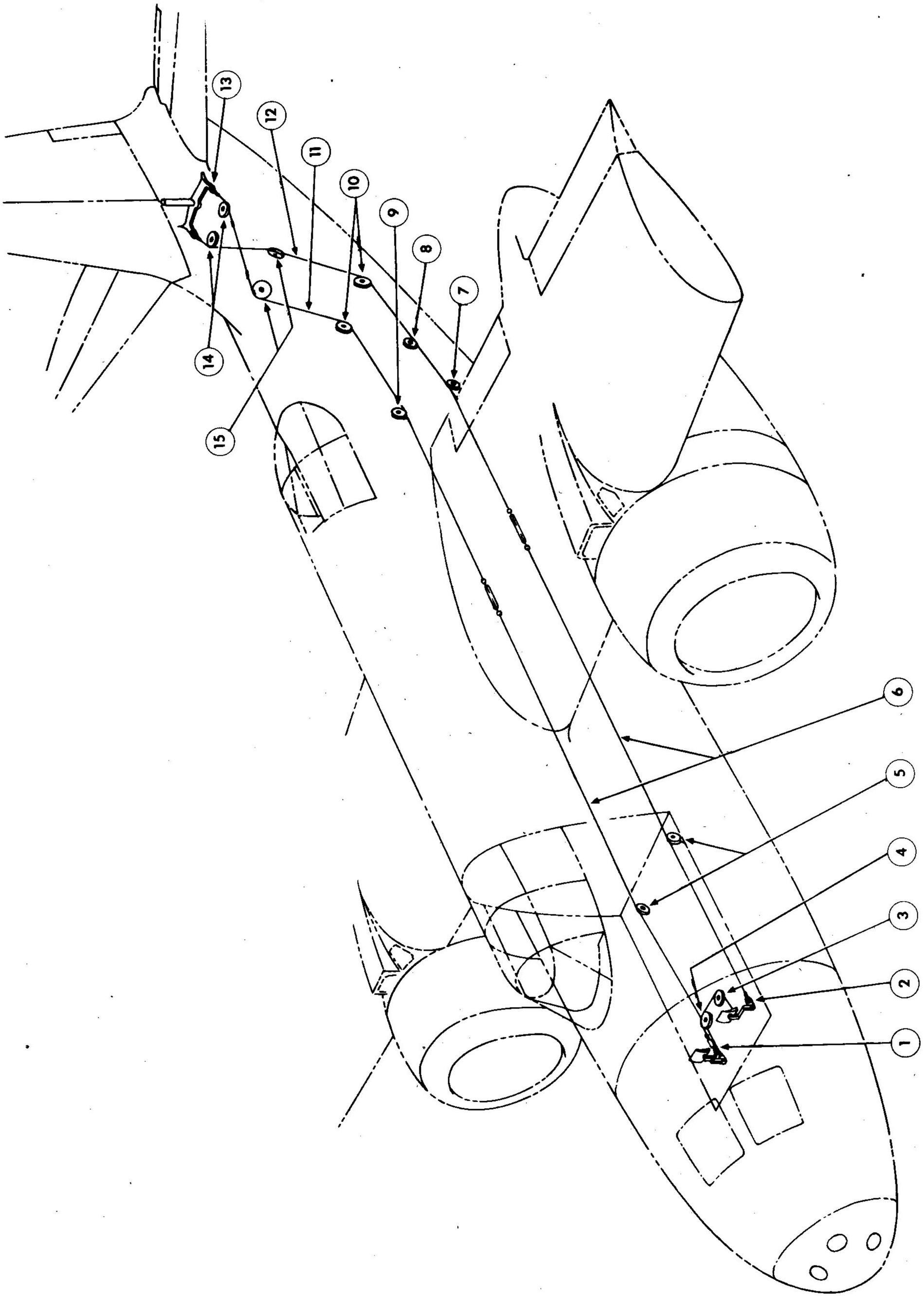


Figure 178 - RUDDER CONTROLS

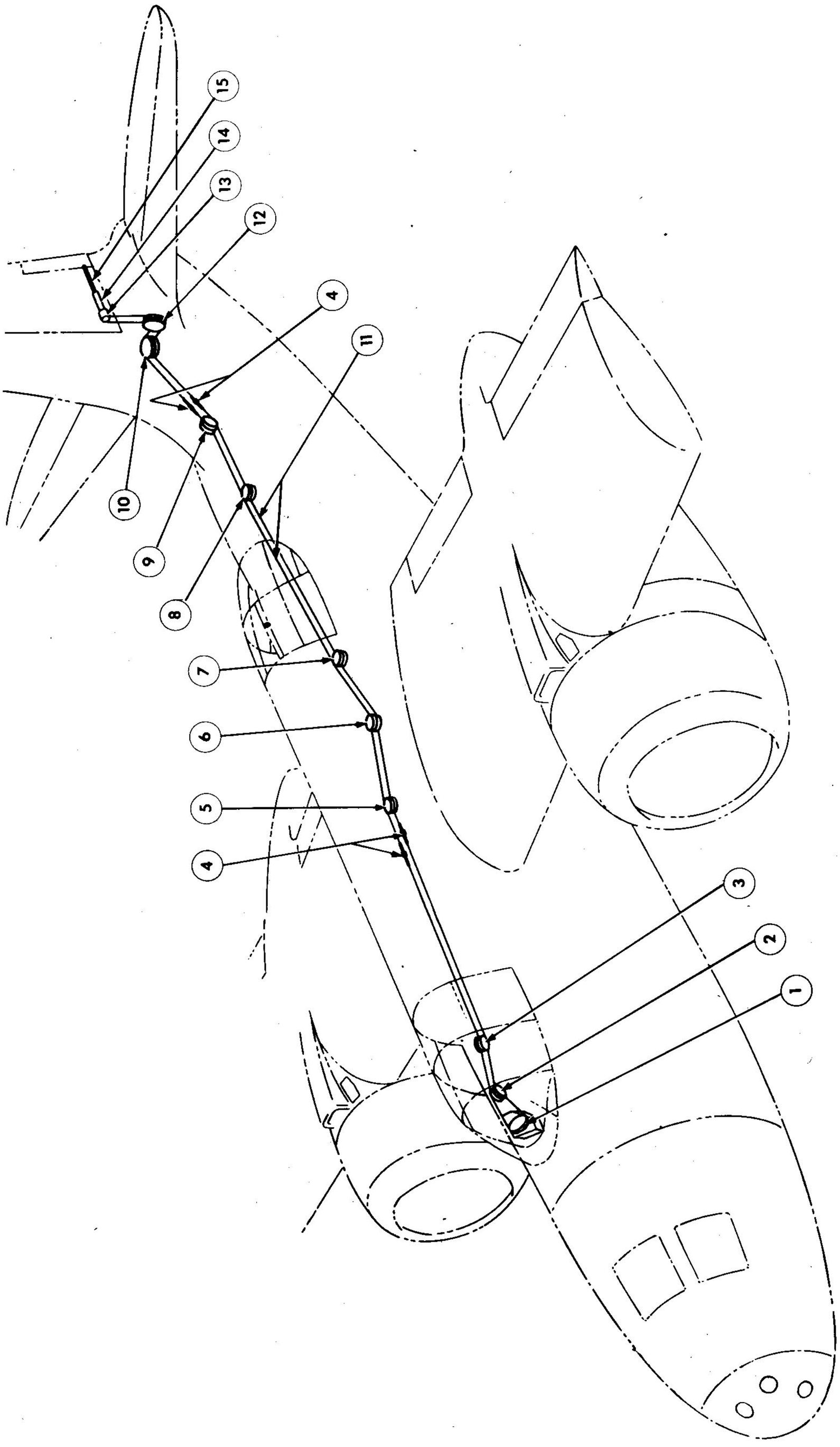


Figure 179 - RUDDER TAB CONTROLS

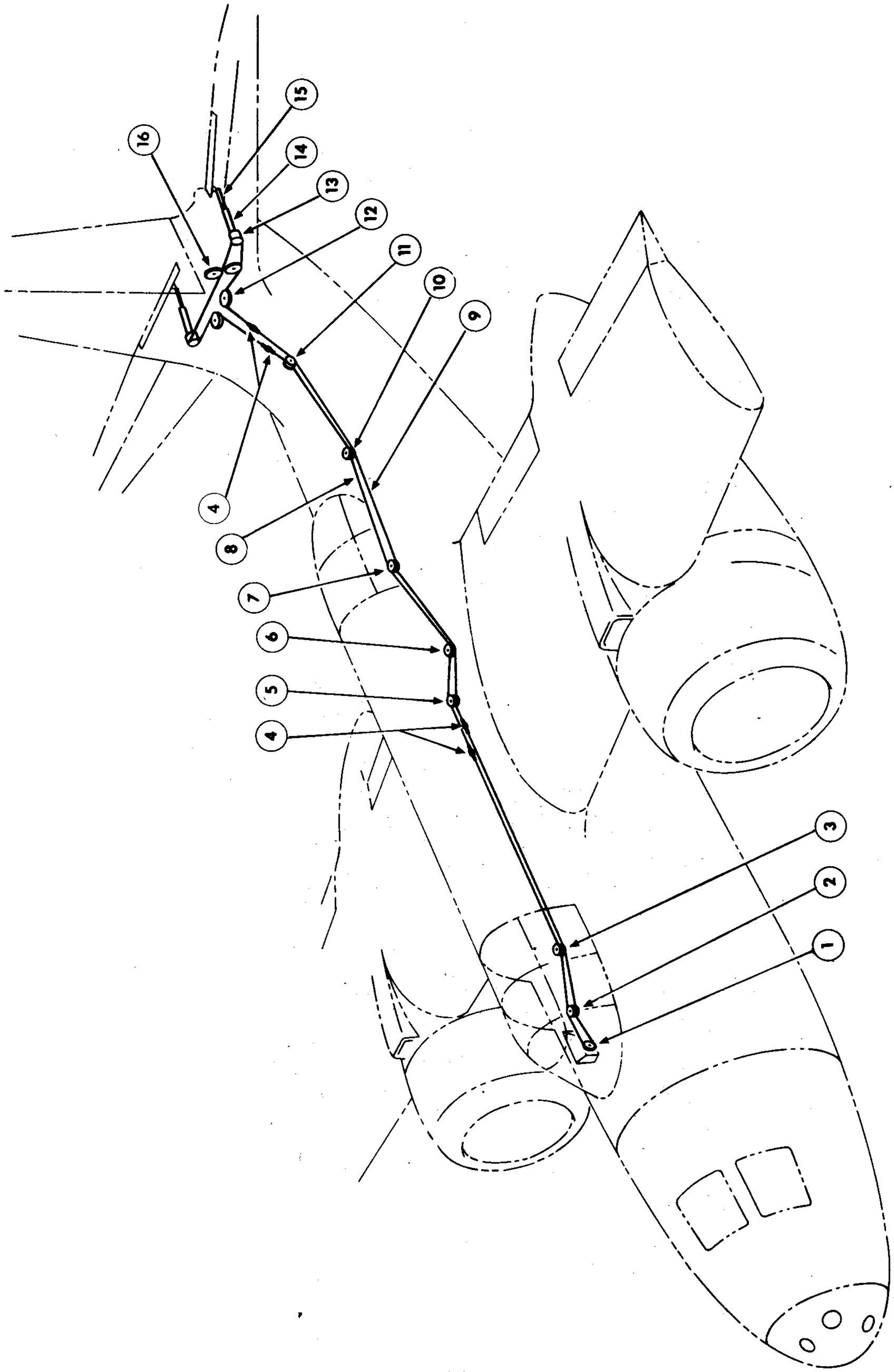


Figure 180 - ELEVATOR TAB CONTROLS

ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	2055476-10	DRUM ASSEMBLY, TRIM TAB CONTROL UNIT	1
	AN155-8S	BARREL, TURNBUCKLE	2
	AN160-8S	FORK, TURNBUCKLE	2
2.	AN210-1A	PULLEY	2
	AN3-10	BOLT	2
	AN960-D10	WASHER	2
	AN310-3	NUT	2
	175332	BRACKET	2
	AN4-14A	BOLT	2
	AN960-D416	WASHER	2
	AC365-428	NUT	2
	4067880	BRACKET, FUSELAGE STATION 53 TRIM TAB CABLE PULLEY	1
	AN3-5A4	BOLT	1
	AN960-D10	WASHER	1
	AC365-1032	NUT	1
	1069940	CLIP	1
3.	AN210-1A	PULLEY	2
	117425-3D-027	SPACER, BOLT	1
	AN3-25	BOLT	1
	AN310-3	NUT	1
	143358-204	PIN, PULLEY GUARD	1
	5068177	BRACKET, FUSELAGE STATION 75 TRIM TAB CABLE PULLEY	1
	AN3-6A	BOLT	7

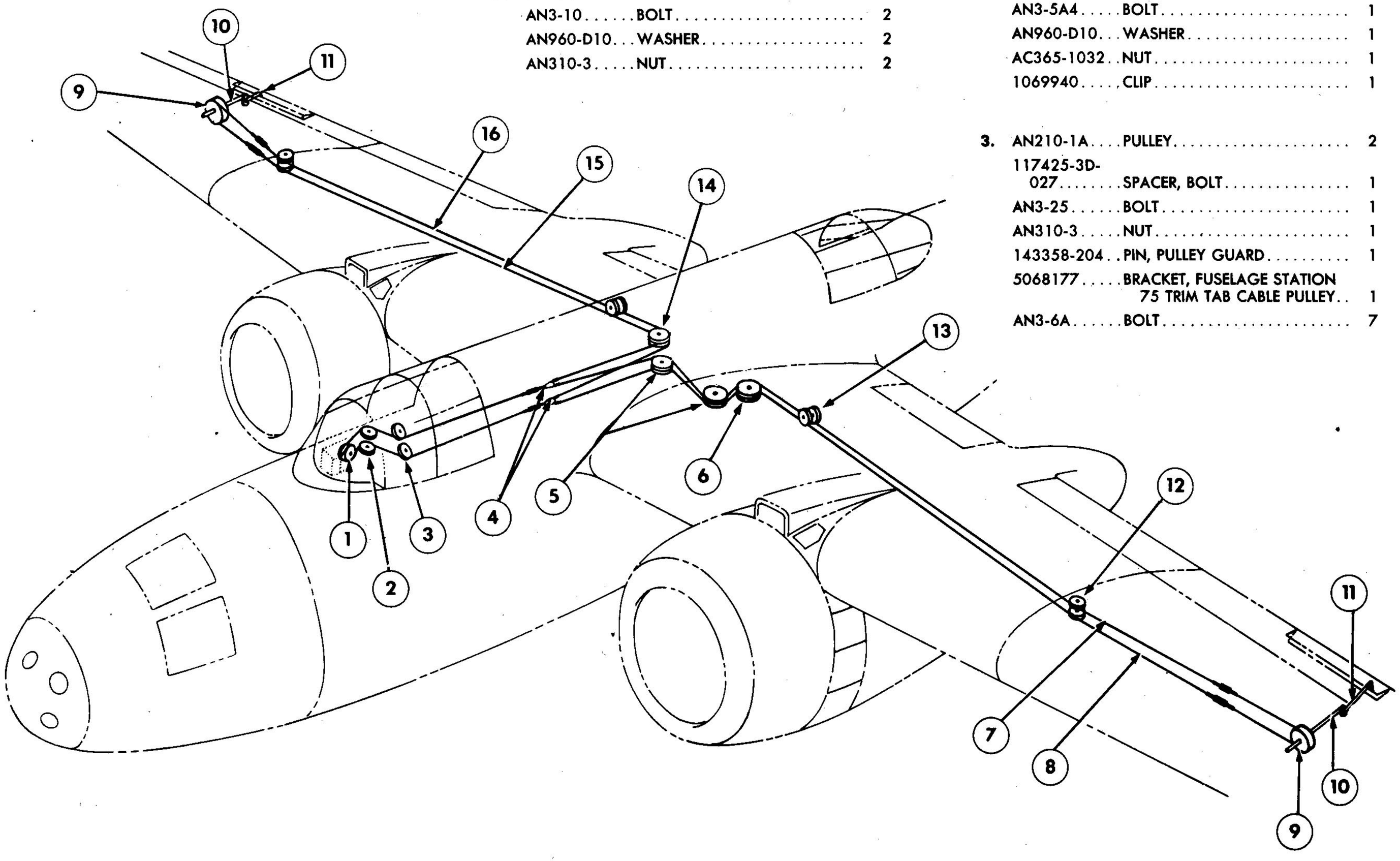


Figure 181 - AILERON TAB CONTROLS

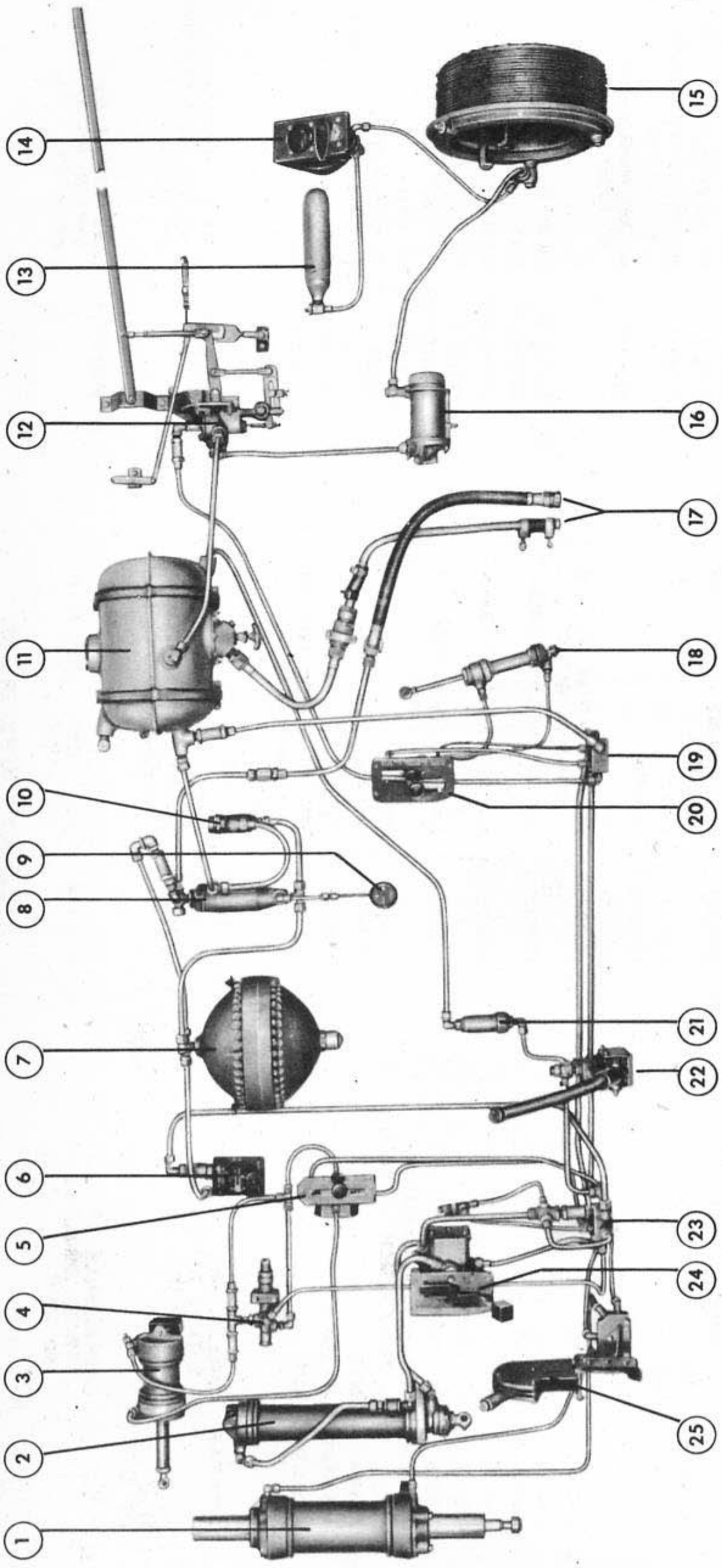


Figure 182 - HYDRAULIC SYSTEM MOCK-UP

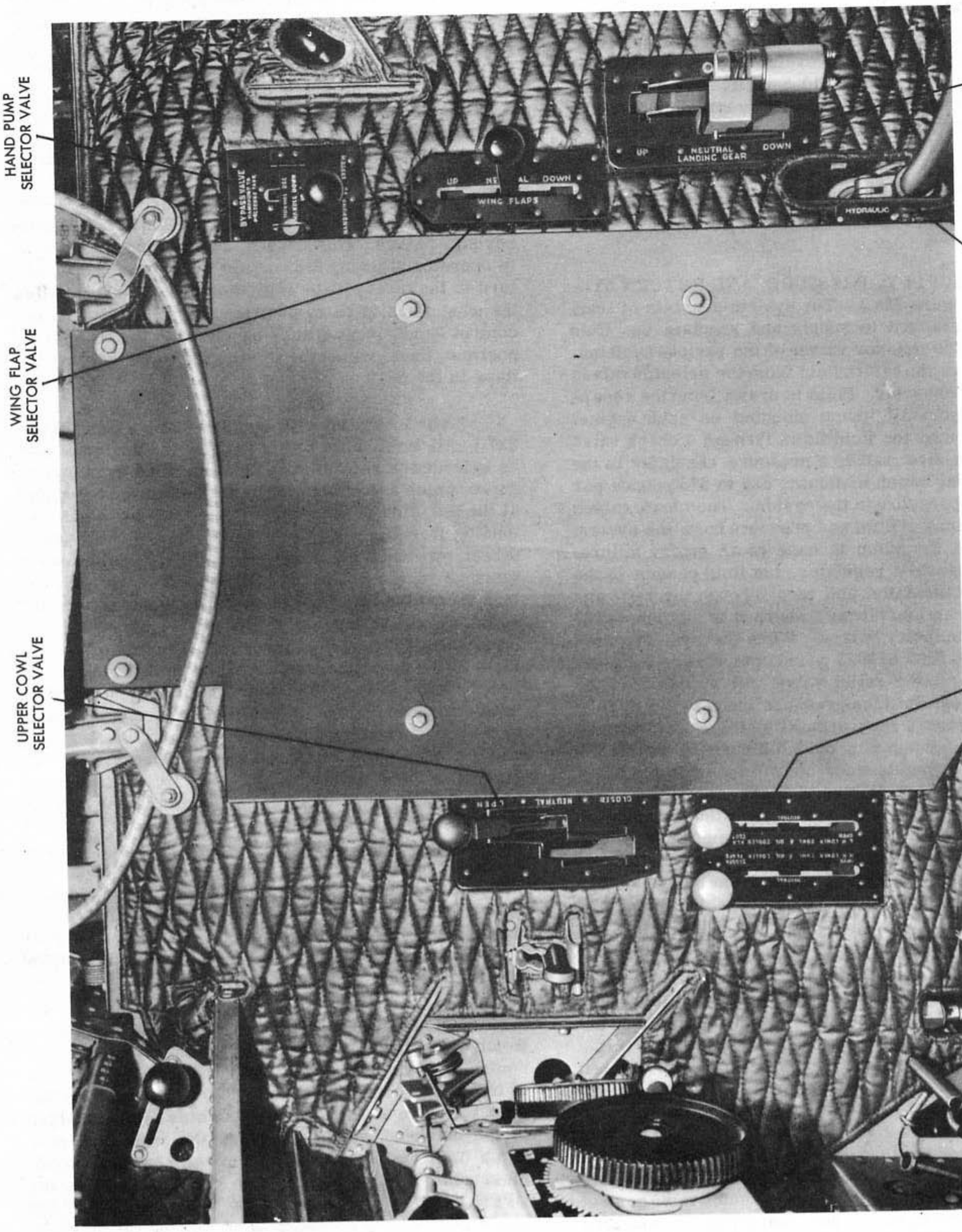


Figure 183 - HYDRAULIC SYSTEM CONTROL VALVES

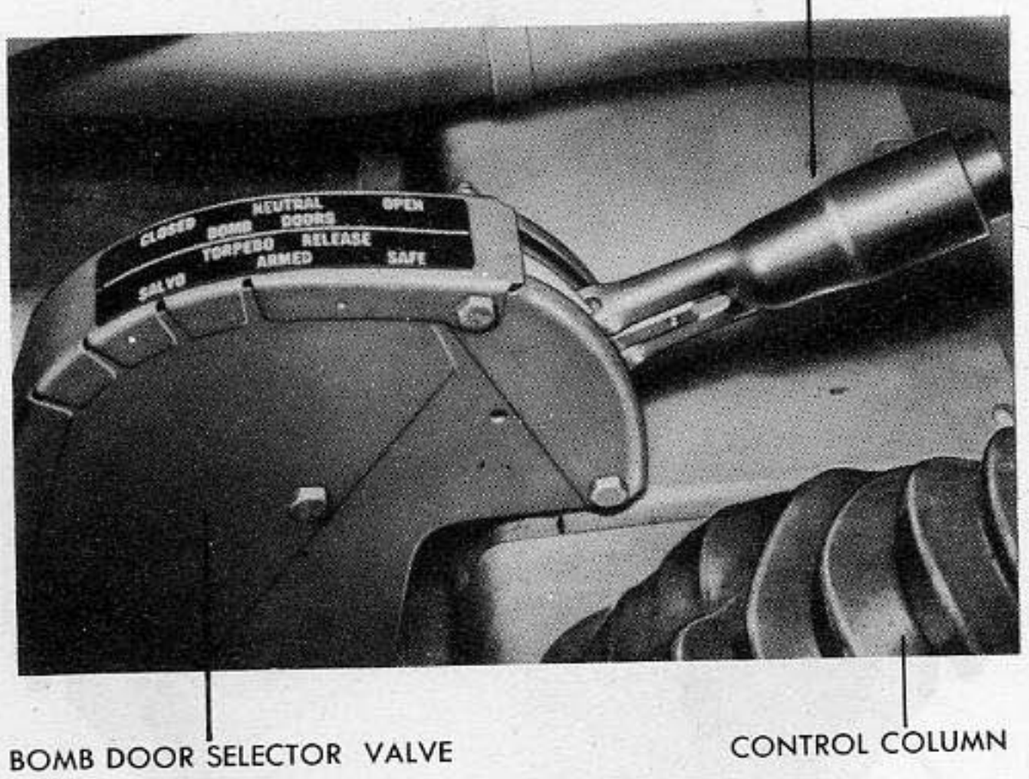


Figure 184 - BOMB DOOR SELECTOR VALVE

strut and back to the reservoir through the selector valve. When the selector valve control handle is moved to the CLOSE position, the action of the fluid is opposite to that described above. In all cases the selector valve should be moved to NEUTRAL after the desired operation is completed.

(6) COWL FLAP SYSTEM. (See figure 228.) - Upper cowl flaps of each engine section are operated simultaneously by a single selector valve while each of the lower cowl and oil cooler flaps is operated independently by a separate selector valve. (See figure 183.)

NOTE

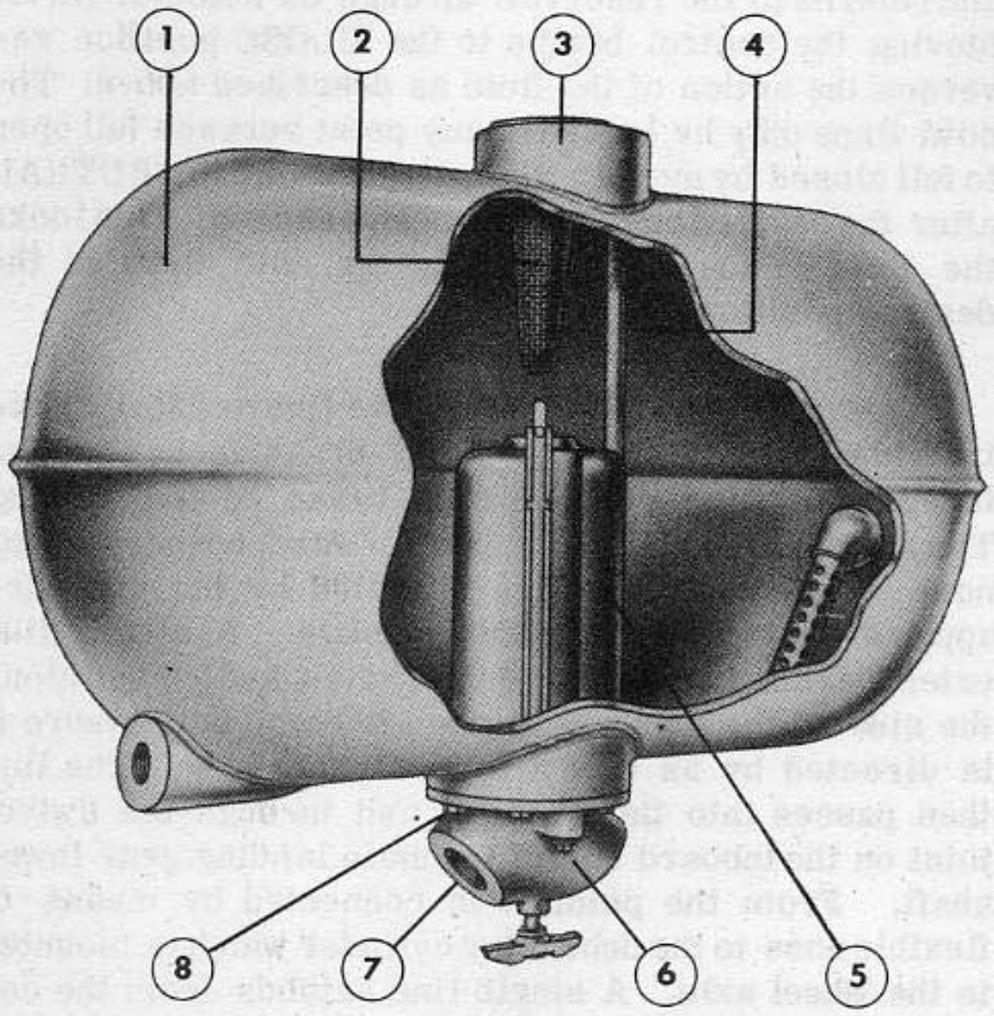
Upper cowl flaps should not be used in flight but may be operated for use during the engine ground run.

All three selector valves are located on the panel at the right side of the pilot's seat. Two lines extend from each selector valve, and pass down the right-hand side of the fuselage to the aft bomb bay. At this point the lines leading to the lower cowl flap actuating struts are directed by elbows into each inner wing panel. The lines leading to the upper cowl flap actuating struts intersect tees which direct two lines into each inner wing panel, following along the same route as the lower cowl flap lines. All lines in each inner wing pass into the nacelle and through the fire wall where they terminate in flexible hoses at points of attachment to the actuating struts. When the control handle of any one of the three selector valves is moved to the OPEN position, pressure is applied to the piston end of the actuating strut, forcing the piston back, and displacing the fluid ahead of it. The displaced fluid flows through the port in the opposite end of the strut and returns to the reservoir through the selector valve. Moving the control handle to the CLOSE position reverses the action of the fluid as described above. The cowl flaps may be locked at any point between full open to full closed by moving the control handle to NEUTRAL after the desired position has been reached. This locks the fluid in the lines, holding the cowl flaps in the desired position.

(7) BRAKE SYSTEM. (See figure 230.) - Two individual systems allow either brake to be applied independently by the hydraulic brake control valves. They are situated in the upper forward corners of the nose wheel well, and are operated by toe pressure applied on the pilot's rudder pedals. A single line extends from each brake control valve, and passes along the side of the fuselage to the aft bomb bay, where it is directed by an elbow to the inner wing. The line then passes into the nacelle, and through the swivel joint on the inboard end of the main landing gear lower shaft. From the point it is connected by means of flexible hose to the debooster cylinder which is mounted in the wheel axle. A single line extends from the debooster to the shuttle valve at each main wheel. Depression of the rudder pedals opens the pressure port on the top of the valve. The system pressure then flows through the valve to the debooster cylinder. In the debooster cylinder, the system operating pressure is reduced to 135 pounds per square inch before being applied to the brakes. As the toe pressure on the pedals is relieved, the fluid from the brakes is allowed to flow back into the large chamber of the debooster while the spring in the debooster forces the fluid in the small chamber through the brake control valve and back to the reservoir.

(8) FLUID RESERVOIR. (See figure 185.) - A fluid reservoir is mounted in the right forward corner of the front bomb bay, just below the fuselage deck. The capacity is 3.1 U.S. gallons (2.7 Imperial gallons). A measuring rod is located in the filler neck for determining the fluid level. A filter screen in the filler opening filters the fluid poured into the reservoir. A filter on the bottom of the reservoir filters the fluid going to the engine pumps.

(9) PRESSURE ACCUMULATOR. (See figure 186.) - A pressure accumulator is mounted in the left forward corner of the front bomb bay, just below the fuselage deck. The accumulator is divided into upper and lower halves by a diaphragm. During ordinary operating conditions, the upper half contains fluid around 850 pounds per square inch pressure. This acts against the air pressure in the lower half. An air pressure of 300 ± 25 pounds per square inch is preloaded in the accumulator before it is installed. The air pressure on the lower side of the diaphragm serves

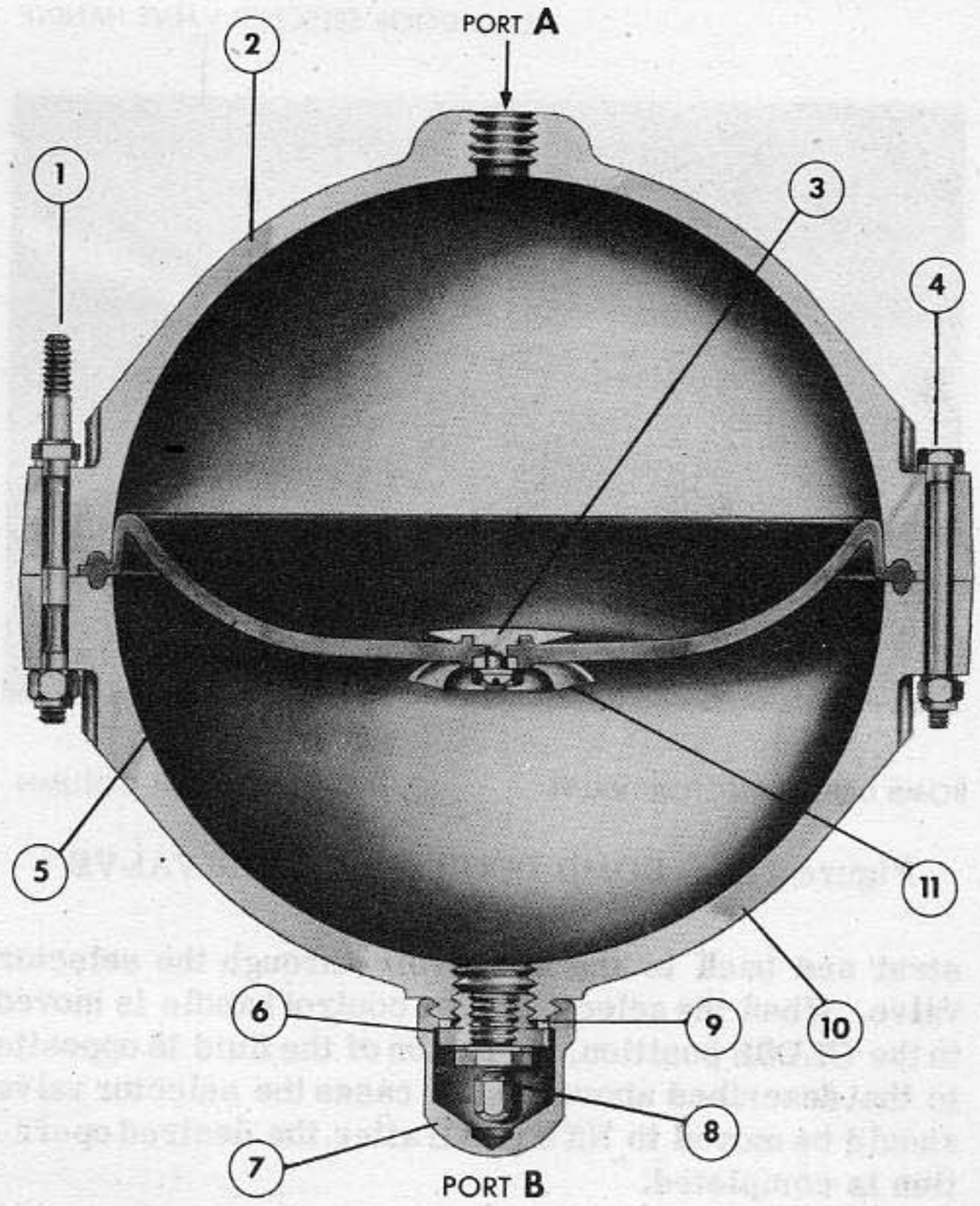


ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	5065486-6	TANK ASSEMBLY, HYDRAULIC RESERVOIR	1
2.	1064742	STRAINER ASSEMBLY, HYDRAULIC RESERVOIR FILLING	1
3.	1064712	CAP, HYDRAULIC RESERVOIR FILLING	1
	143908-115SR-124-093	WASHER	1
4.	1064739	ROD ASSEMBLY, HYDRAULIC RESERVOIR MEASURING	1
	143908-010SR016-032	WASHER	1
5.	4067820	FILTER ASSEMBLY, HYDRAULIC RESERVOIR	1
	1130488	FITTING, HYDRAULIC RESERVOIR OUTLET PACKING	1
6.	AN895-70	PLUG	1
7.	4065538	OUTLET, HYDRAULIC RESERVOIR	1
	2064872	GASKET, HYDRAULIC RESERVOIR OUTLET	1
	AC895-71	PLUG	1
8.	1066974	STUD, HYDRAULIC RESERVOIR	8
	AC365-1032	NUT	8

Figure 185 - HYDRAULIC FLUID RESERVOIR

to cushion the fluid surges which are present when the system is in operation, and furnishes fluid under pressure when it is needed in an amount which the pumps cannot provide.

(10) PRESSURE REGULATOR. (See figure 187.) - The hydraulic system pressure regulator is a cylindrical shaped unit. It has a pressure port at the top, a relief port in the side wall, and gage and pressure ports at the lower end. Pressure lines from the



ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	1059752	STUD, HYDRAULIC PRESSURE TANK	4
	AN960-516	WASHER	8
	AC365-524	NUT	4
2.	4046363	DOME, 9-INCH SPHERICAL HYDRAULIC PRESSURE TANK, UPPER	1
3.	1046469	VALVE, 9-INCH SPHERICAL HYDRAULIC PRESSURE TANK, UPPER	1
	AN320-3	NUT	1
4.	1046452	BOLT, 9-INCH SPHERICAL HYDRAULIC PRESSURE TANK	36
	AN960-516	WASHER	72
	AC365-524	NUT	36
5.	4046365	DIAPHRAGM, 9-INCH SPHERICAL HYDRAULIC PRESSURE TANK	1
6.	1046451	BUSHING, SPHERICAL HYDRAULIC PRESSURE TANK	1
7.	1049695	NUT, SPHERICAL PRESSURE TANK FILLER CAP	1
8.	AN809-1	CORE	1
	AN812-1	BODY	1
	AN813-1	CAP	1
	AN901-5A	GASKET	1
9.	143908-024C102-032	WASHER	1
10.	4046364	DOME, 9-INCH SPHERICAL HYDRAULIC PRESSURE TANK, LOWER	1
11.	1046470	VALVE, 9-INCH SPHERICAL HYDRAULIC PRESSURE TANK, LOWER	1

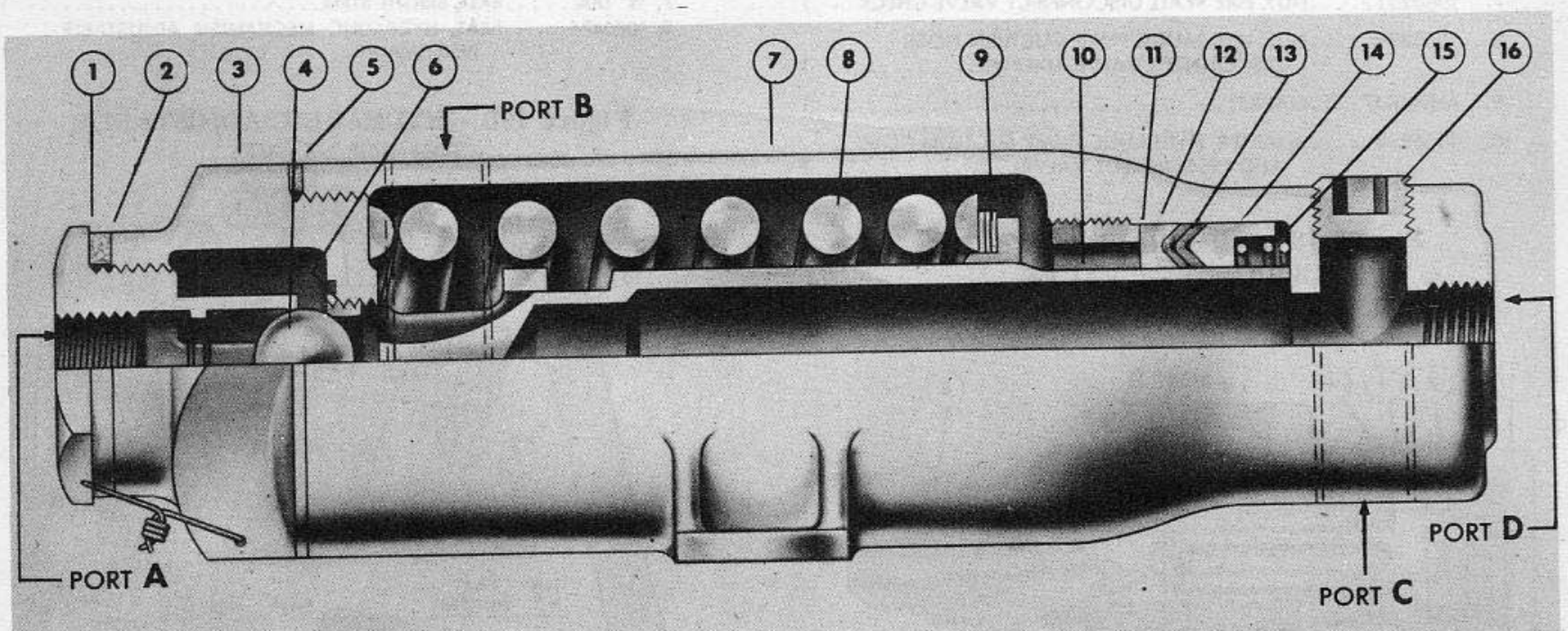
Figure 186 - PRESSURE ACCUMULATOR

two engine driven pumps connect to a side outlet tee in the top port. The pressure accumulator and the pressure regulator relief valve lines connect to the tee at the lower end. The relief port in the side is connected to the reservoir by a line. A check valve in the side outlet tee at the top of the regulator allows fluid from the pumps to flow to the tee on the pressure accumulator, then back to the bottom of the regulator. When there are no hydraulic units in operation, the system pressure builds up above normal. The pressure on the bottom of the regulator forces the spring loaded piston upward, unseating the ball check at the top. This will allow the pressure at the top port to be relieved through the port in the side wall of the regulator.

(11) DISCONNECT VALVES. (See figure 188.) - Fluid supply lines to the engine driven pumps have a disconnect valve at the fire wall of each engine section. The purpose of the valve is to allow the lines to be disconnected without excessive loss of fluid from the system.

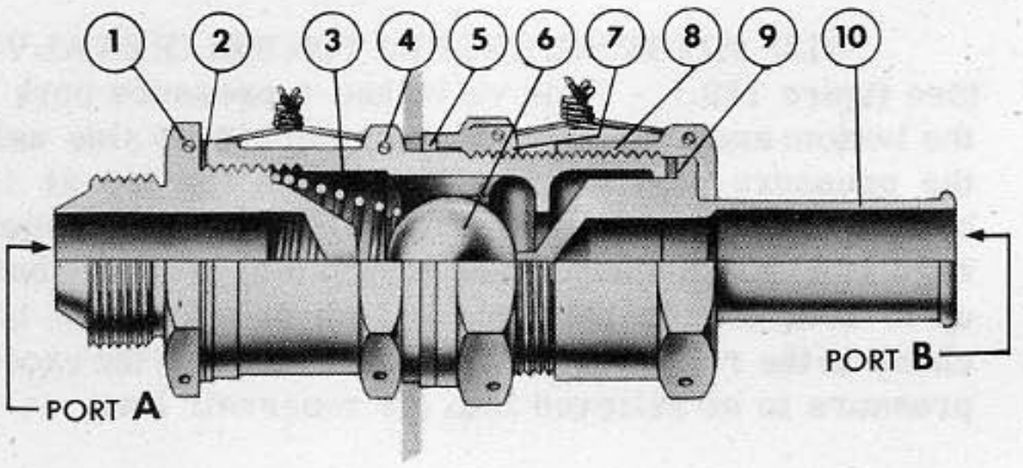
(12) PRESSURE REGULATOR RELIEF VALVE. (See figure 189.) - This valve has a pressure port at the bottom and a reservoir return port in its side wall, the pressure port being connected to the tee at the bottom of the pressure regulator. Should the pressure regulator fail to operate and the system pressure build up to 1000 pounds per square inch or more, the ball check in the relief valve will unseat allowing the excess pressure to be relieved into the reservoir line.

(13) ADJUSTABLE RELIEF VALVE. (See figure 190.) - This valve is of the ball check type, having a pressure port at one end and a reservoir return port in its side wall. The pressure port is connected to the pressure side of the left-hand manifold block, while the other port connects to the fluid return side of the same manifold block. The valve relieves the excess pressures in the system which are caused by expansion of the fluid at high temperatures, or by excessive operation of hand pump with the bypass valve in the SYSTEM position.



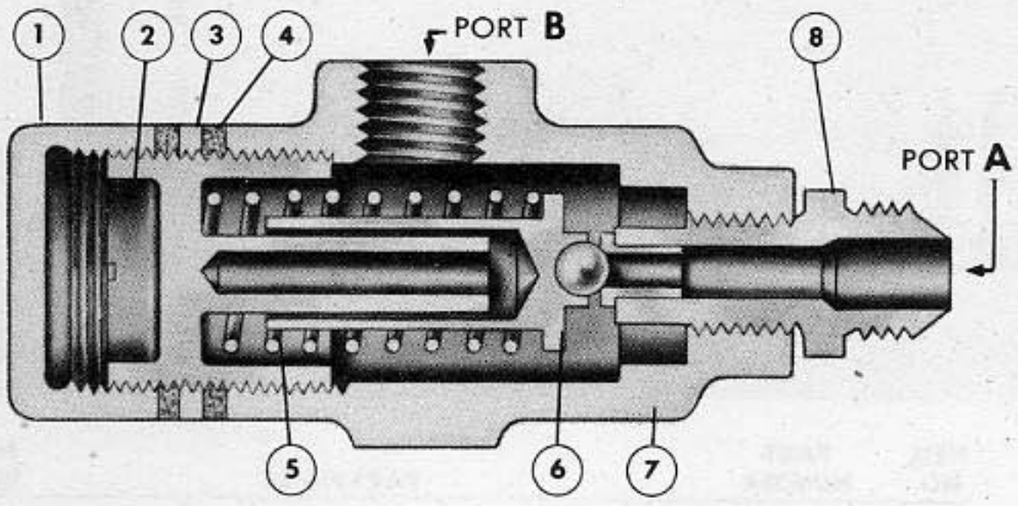
ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	2005429	BUSHING, HYDRAULIC PRESSURE REGULATING VALVE	1
2.	AN900-18	GASKET	1
3.	2005427	END, HYDRAULIC PRESSURE REGULATING VALVE	1
4.	9/16" DIA.	BALL, BRIGHT STEEL	1
5.	AN900-31	GASKET	1
6.	1066288	SEAT, NO. 8 BALL VALVE	1
7.	4005433	HOUSING, HYDRAULIC PRESSURE REGULATING VALVE	1
8.	1005430	SPRING, HYDRAULIC PRESSURE REGULATING VALVE	1
9.	143908-104R116-010	WASHER	8
10.	1005410	PISTON, HYDRAULIC PRESSURE REGULATING VALVE	1
11.	1072037	NUT, HYDRAULIC PRESSURE REGULATING VALVE	1
12.	1070625	SPACER, HYDRAULIC PRESSURE REGULATING VALVE PACKING	1
13.	5135865-4N-030	PACKING, HYDRAULIC CHEVRON	2
14.	1072036	SPACER, HYDRAULIC PRESSURE REGULATING VALVE, INNER	1
15.	1070624	SPRING, HYDRAULIC PRESSURE REGULATING VALVE PACKING	1
16.	AC895-102	PLUG	1

Figure 187 - HYDRAULIC PRESSURE REGULATOR



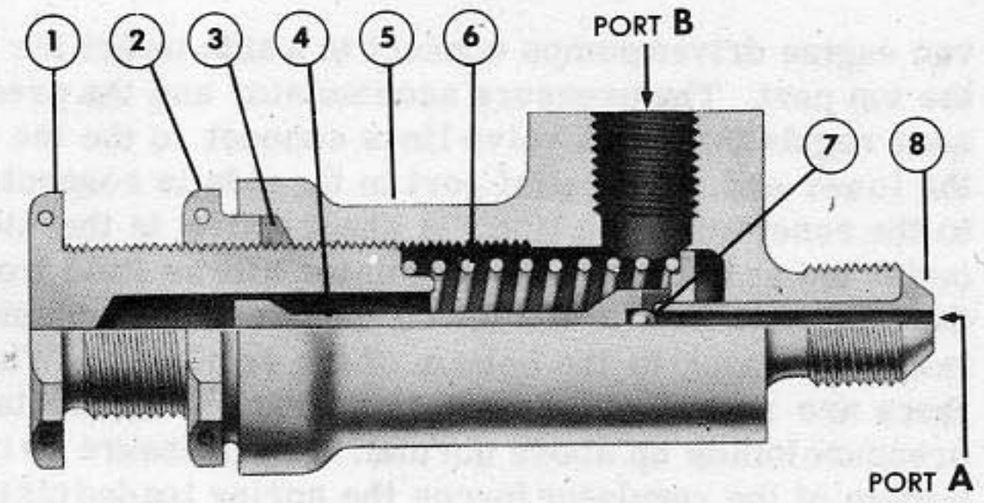
ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	1024789	UNION, HYDRAULIC PUMP SUCTION LINE DISCONNECT	1
2.	AN900-20	GASKET	1
3.	1007293	SPRING, HYDRAULIC PUMP SUCTION LINE DISCONNECT	1
4.	2007297	BODY, HYDRAULIC PUMP SUCTION LINE DISCONNECT	1
5.	143908-112S122-109	WASHER	1
6.	13 16 DIA.	BALL, STEEL	1
7.	1068251	NUT, FIRE WALL DISCONNECT VALVE CHECK	1
8.	1066829	NUT, HYDRAULIC PUMP SUCTION HOSE DISCONNECT VALVE ADAPTER	1
9.	AN900-17	GASKET	1
10.	1066830	ADAPTER, HYDRAULIC PUMP SUCTION HOSE AND DISCONNECT VALVE	1

Figure 188 - HYDRAULIC SYSTEM DISCONNECT VALVE



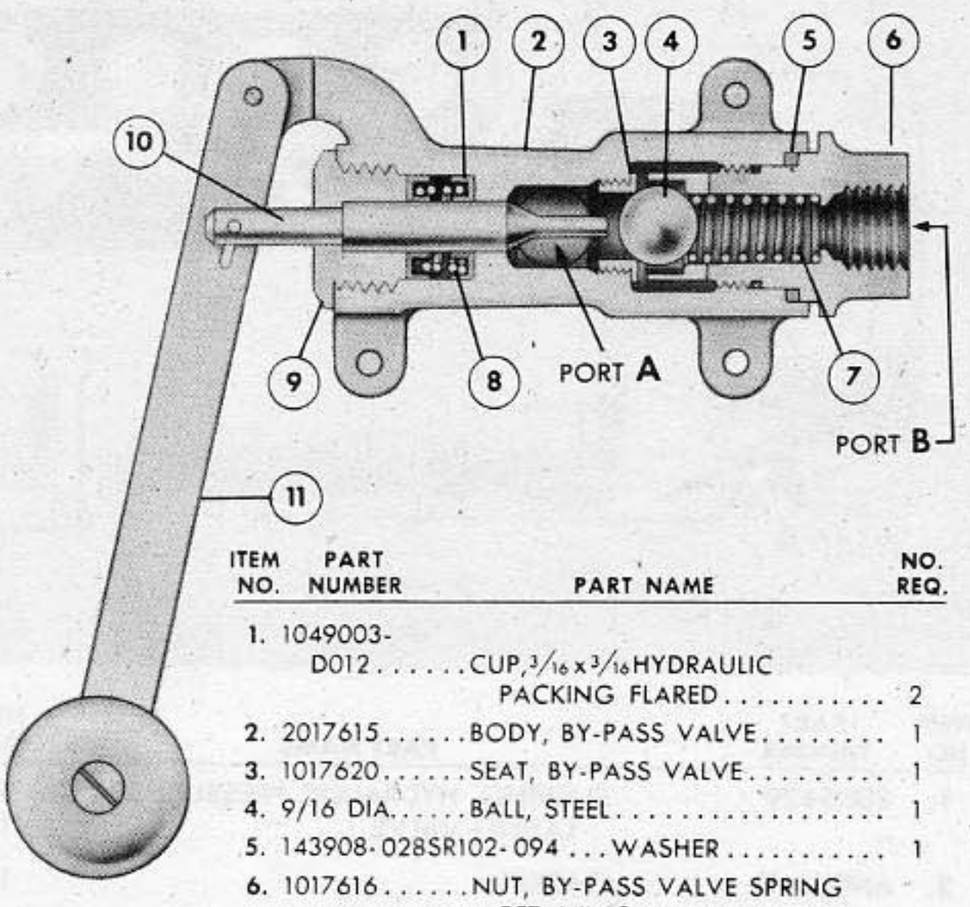
ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	147113	CAP, HYDRAULIC RELIEF VALVE	1
2.	138758	GUIDE, HYDRAULIC RELIEF VALVE	1
3.	138759	NUT, HYDRAULIC RELIEF VALVE LOCK	1
4.	1161144-20	GASKET, HYDRAULIC FITTING FIBER	2
5.	138757	SPRING, HYDRAULIC RELIEF VALVE	1
6.	1000859	STEM ASSEMBLY, HYDRAULIC RELIEF VALVE	1
7.	238754-1	HOUSING, HYDRAULIC RELIEF VALVE	1
8.	1047738	SEAT ASSEMBLY, HYDRAULIC SYSTEM RELIEF VALVE	1

Figure 189 - HYDRAULIC PRESSURE REGULATOR RELIEF VALVE



ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	1085705	SCREW, HYDRAULIC MECHANISM ADJUSTABLE RELIEF VALVE	1
2.	1085707	NUT, HYDRAULIC MECHANISM ADJUSTABLE RELIEF VALVE	1
3.	143908-020SR026-093	WASHER	1
4.	2085703	STEM, HYDRAULIC MECHANISM ADJUSTABLE RELIEF VALVE	1
5.	2085701	BODY, HYDRAULIC MECHANISM ADJUSTABLE RELIEF VALVE	1
6.	1085704	SPRING, HYDRAULIC MECHANISM ADJUSTABLE RELIEF VALVE	1
7.	⅛" DIA.	BALL, BRIGHT STEEL	1
8.	1086474	SEAT, HYDRAULIC MECHANISM ADJUSTABLE RELIEF VALVE	1

Figure 190 - HYDRAULIC ADJUSTABLE RELIEF VALVE



ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	1049003-D012	CUP, 3/16 x 3/16 HYDRAULIC PACKING FLARED	2
2.	2017615	BODY, BY-PASS VALVE	1
3.	1017620	SEAT, BY-PASS VALVE	1
4.	9/16 DIA.	BALL, STEEL	1
5.	143908-028SR102-094	WASHER	1
6.	1017616	NUT, BY-PASS VALVE SPRING RETAINING	1
7.	1017617	SPRING, BY-PASS VALVE	1
8.	1000028	SPRING	1
9.	1017619	NUT, BY-PASS VALVE PACKING	1
10.	1055358	PLUNGER, HYDRAULIC BY-PASS VALVE	1
11.	1064741	LEVER ASSEMBLY, HYDRAULIC BY-PASS VALVE	1
	AN392-11	PIN	1
	AN393-21	PIN	1
	AN960-10	WASHER	1
	AN960-6	WASHER	1

Figure 191 HAND PUMP BYPASS VALVE

ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	B8148	HANDLE ASSEMBLY, HYDRAULIC HAND PUMP	1
2.	AN24-20	BOLT	1
	AN960-416L	WASHER	1
	AN320-4	NUT	1
3.	A8116	LINK, HYDRAULIC HAND PUMP	1
4.	AN24-15	BOLT	1
	AN960-416L	WASHER	1
	AN320-4	NUT	1
5.	A8114	PISTON ASSEMBLY, HYDRAULIC HAND PUMP	1
6.	A8149	SEAT, HYDRAULIC HAND PUMP	1
7.	S303-8A	WASHER, HYDRAULIC HAND PUMP SEAT	1
8.	7/16" DIA.	BALL, STEEL	1
9.	A8113	SPRING, HYDRAULIC HAND PUMP SEAT	1
10.	B8150	BODY ASSEMBLY, HYDRAULIC HAND PUMP	1
11.	A8110	RING, HYDRAULIC HAND PUMP PACKING	1
12.	AC40B629-9-026	PACKING, HYDRAULIC HAND PUMP CHEVRON	2
13.	A8115	WASHER, FELT	1
14.	A8093	NUT, HYDRAULIC HAND PUMP RETAINING	1
15.	A8117	BOLT	1
	AN960-516L	WASHER	1
	AN310-5	NUT	1

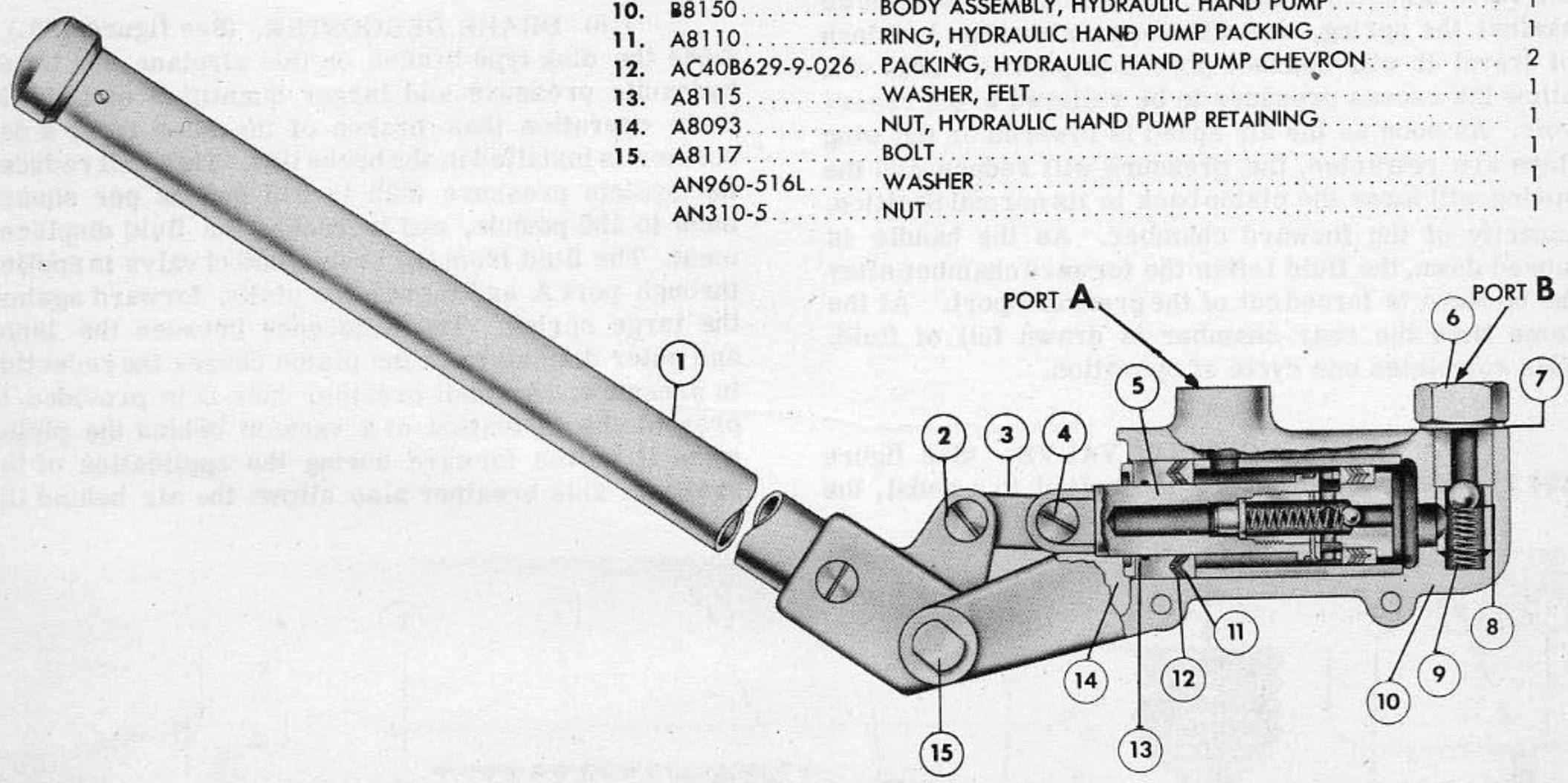


Figure 192 - HYDRAULIC HAND PUMP

(14) HAND PUMP BYPASS VALVE. (See figure 191.) - The hand pump bypass valve is a ball type valve mounted so that its control handle extends through the pilot's compartment aft bulkhead at the left side of the seat. It is assembled in the main pressure line from the pressure accumulator to the left-hand manifold block. The fluid normally flows into the side port and out the end port. The valve control handle should be kept in the SYSTEM position so that when a unit must be operated by the hand pump, the pressure will be applied directly to that unit and not to the complete system. When the valve control is in the SYSTEM position, the ball is seated, preventing any pressure built up by the hand pump from reaching the pressure accumulator and the pressure regulator units. In the case of system pressure failure during flight, the desired operation may be accomplished in much less time than building up pressure in the complete system. Movement of the control handle to TANK position allows the hand pump pressure to be stored in the pressure accumulator, registering on the system pressure gage.

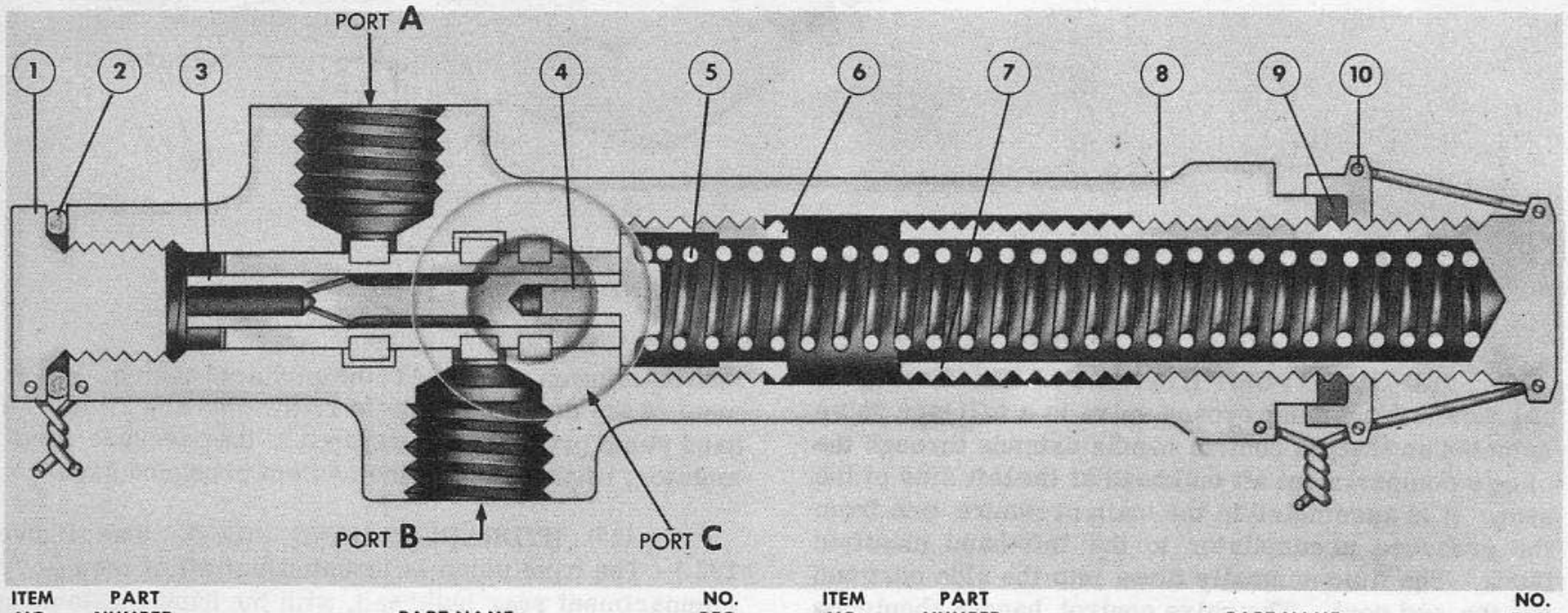
(15) HYDRAULIC HAND PUMP. (See figure 192.) - The hand pump is mounted just aft of the pilot's compartment rear bulkhead, with the handle extending forward into the pilot's compartment along the left side of the seat. The pump has an intake port at its aft end and a pressure port at its forward end. Assuming the handle to be in the UP position, the chamber forward of the piston head to be full of fluid, the operation is as follows: As the handle moves down, the chamber aft of the piston is drawn full of fluid, and the fluid in the chamber on the forward side of the piston will be forced out of the pressure port. The maximum

capacity of the forward chamber (piston in aft position) is only one-half that of the rear chamber (with piston in forward position); therefore, when the handle is moved up, and the fluid in the aft chamber is displaced through the piston check valve, half of it is forced out of the pressure port, due to the smaller capacity of the forward chamber. As the handle is moved down, the fluid left in the forward chamber after the up stoke is forced out of the pressure port. At the same time the rear chamber is drawn full of fluid. This completes one cycle of operation.

(16) WING FLAP RELIEF VALVE. (See figure 193.) - Pressure is applied at port A and normally flows through the valve and out port B to the actuating strut. Operation of the wing flaps above a speed of 180 miles per hour will cause a back pressure greater than 225 ± 25 pounds per square inch in the line between the relief valve and the actuating strut. With the valve adjusted properly, the piston will move down against the spring, and after approximately 1/4 inch of travel it will connect port B to port C. This will allow the excess pressure to be relieved to the reservoir. As soon as the air speed is lowered or the wing flaps are retracted, the pressure will reduce and the spring will force the piston back to its normal position.

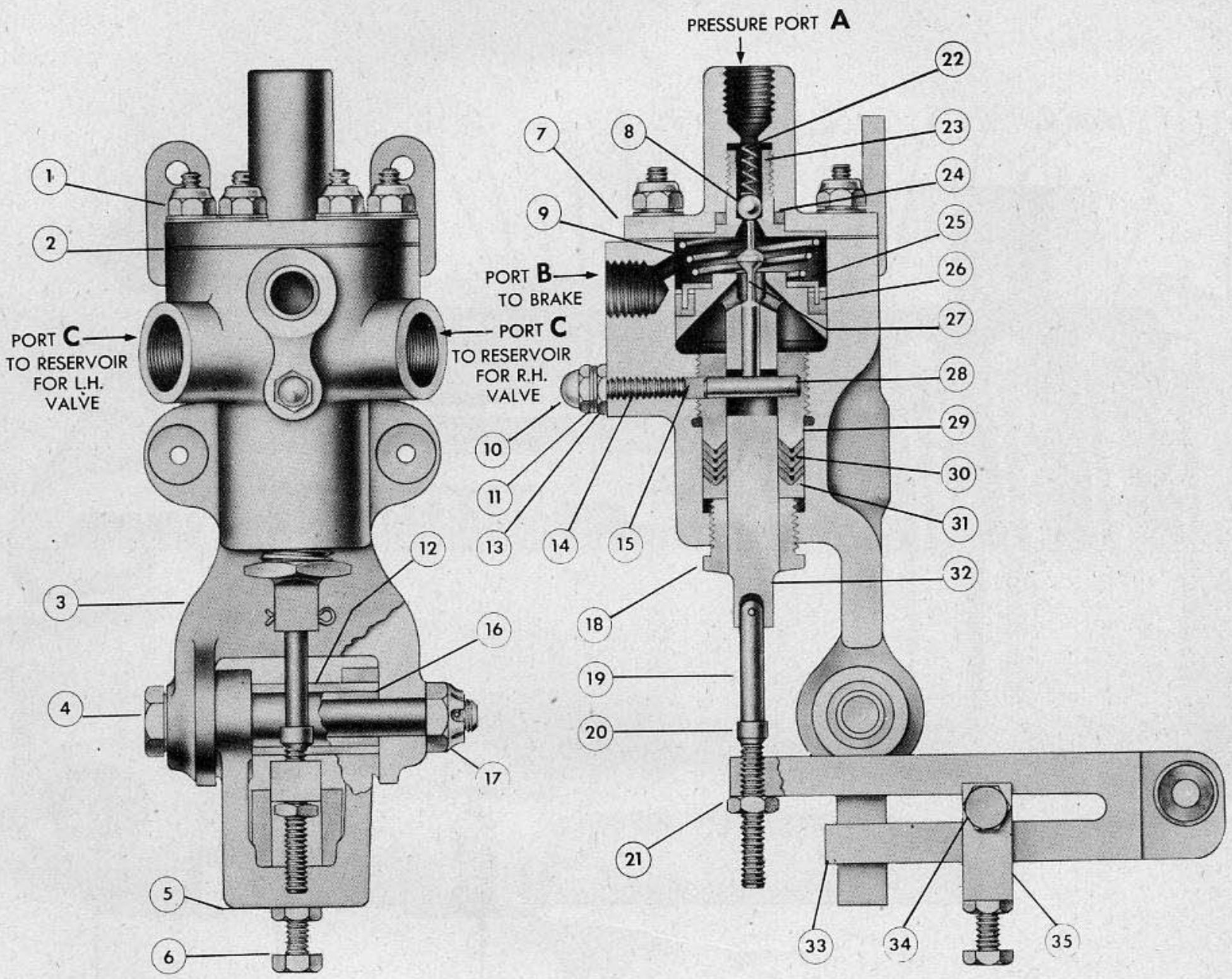
(17) BRAKE CONTROL VALVE. (See figure 194.) - When toe pressure is applied to a pedal, the piston seats with the piston valve and both move upward unseating the ball, allowing the hydraulic system pressure to enter the valve at port A and be diverted into the brake line. When the pressure in the brake line and the upper side of the piston becomes greater than the load applied to the pedals, the piston will move down until the ball is seated. If the pressure is still too great, the piston will continue to move downward until the piston valve is raised off its seat by coming in contact with the cross pin. This allows the excess pressure to be relieved through the piston head and out port C. If the pedals are fully released, all the fluid pressure will be relieved.

(18) BRAKE DEBOOSTER. (See figure 195.) - Since the disk type brakes on this airplane use lower hydraulic pressure and larger quantities of fluid in their operation than brakes of the shoe type, a debooster is installed in the brake line. This unit reduces the system pressure (825 to 875 pounds per square inch) to 135 pounds, and increases the fluid displacement. The fluid from the brake control valve is applied through port A and moves the piston forward against the large spring. The difference between the inner and outer diameters of the piston causes the reduction in pressure. A small breather hole D is provided to prevent the formation of a vacuum behind the piston when it moves forward during the application of the brakes. This breather also allows the air behind the



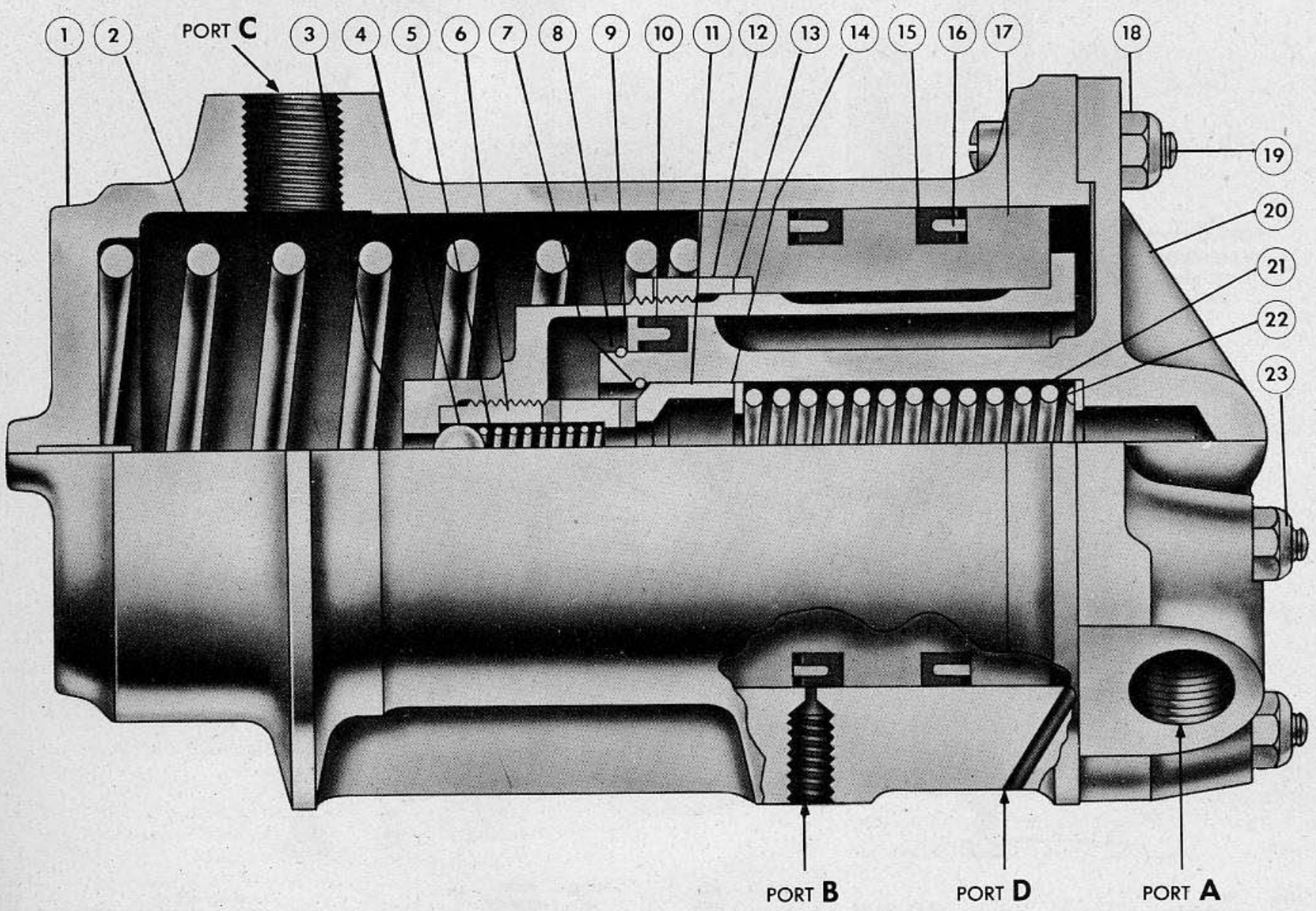
ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	1011656	PLUG, HYDRAULIC FLAP RELIEF VALVE PISTON	1
2.	AN900-8	GASKET	1
3.	1064176	PISTON, HYDRAULIC FLAP RELIEF VALVE	1
4.	1047880	GUIDE, HYDRAULIC FLAP RELIEF VALVE SPRING	1
5.	1077312	SPRING, HYDRAULIC FLAP RELIEF VALVE	1
6.	1047881	STOP, HYDRAULIC FLAP RELIEF VALVE	1
7.	1047882	PLUG, HYDRAULIC FLAP RELIEF VALVE SPRING ADJUSTING	1
8.	4061713	BODY ASSEMBLY, HYDRAULIC FLAP RELIEF VALVE	1
9.	143908-024SR030-125	WASHER	1
10.	1047883	NUT, HYDRAULIC FLAP RELIEF VALVE	1

Figure 193 - WING FLAP RELIEF VALVE



ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	AN310-4	NUT	6
	AN960-416	WASHER	6
2.	1059761	GASKET, POWER BRAKE CONTROL COVER	1
3.	5059485	HOUSING ASSEMBLY, POWER BRAKE CONTROL VALVE—L.H.	1
	5059485-1	HOUSING ASSEMBLY, POWER BRAKE CONTROL VALVE—R.H.	1
4.	AN6-30	BOLT	1
5.	AN316-4R	NUT	1
6.	110242-4-5AH	BOLT, SPECIAL FULL THREADED	1
7.	1059760	COVER, POWER BRAKE CONTROL HOUSING	1
8.	¼" DIA.	BALL, BRIGHT STEEL	1
9.	1007337	SPRING, POWER BRAKE CONTROL VALVE MAIN	1
10.	10-32	NUT, BRASS CAP	1
11.	143908-006TC-012-040	WASHER	2
12.	2033900-10D049-24	TUBE	1
13.	AN315-3R	NUT	1
14.	1007693	SCREW, POWER BRAKE CONTROL VALVE ADJUSTING NUT LOCK	1
15.	5068111-102	PLUG	1
16.	1073362	SPACER, BRAKE VALVE FORK	1
17.	AN310-6	NUT	1
18.	1007329	NUT, POWER BRAKE CONTROL VALVE PACKING	1
19.	1007965	LINK, POWER BRAKE CONTROL VALVE PISTON OPERATING	1
20.	1005307	SCREW, POWER BRAKE CONTROL VALVE OPERATING LEVER ADJUSTING	1
21.	AN316-5R	NUT	1
22.	1007336	SPRING, POWER BRAKE CONTROL VALVE	1
23.	1024864	SEAT, POWER BRAKE CONTROL VALVE	1
24.	143908-016TC020-064	WASHER	1
25.	1024866	SPACER, POWER BRAKE CONTROL VALVE SPRING	1
26.	1044344-G-104	CUP, 3/16" x 3/16" HYDRAULIC PACKING WIDE BASE	1
27.	1024865	PIN, POWER BRAKE CONTROL VALVE OPERATING	1
28.	1007332	PIN, POWER BRAKE CONTROL VALVE GUIDE	1
29.	1007331	NUT, POWER BRAKE CONTROL VALVE ADJUSTING	1
30.	5135865-4X-016	PACKING, HYDRAULIC CHEVRON	4
31.	1007330	SPACER, POWER BRAKE CONTROL VALVE PACKING	1
32.	1024867	PISTON, POWER BRAKE CONTROL VALVE	1
33.	2007339	LEVER ASSEMBLY, POWER BRAKE CONTROL VALVE LIGHT OPERATING	1
34.	1074050	BOLT, BRAKE LEVER CLAMP	1
	AC365-428	NUT	1
35.	1072046	CLAMP, POWER BRAKE LEVER FULCRUM	1

Figure 194 - **BRAKE CONTROL VALVE**



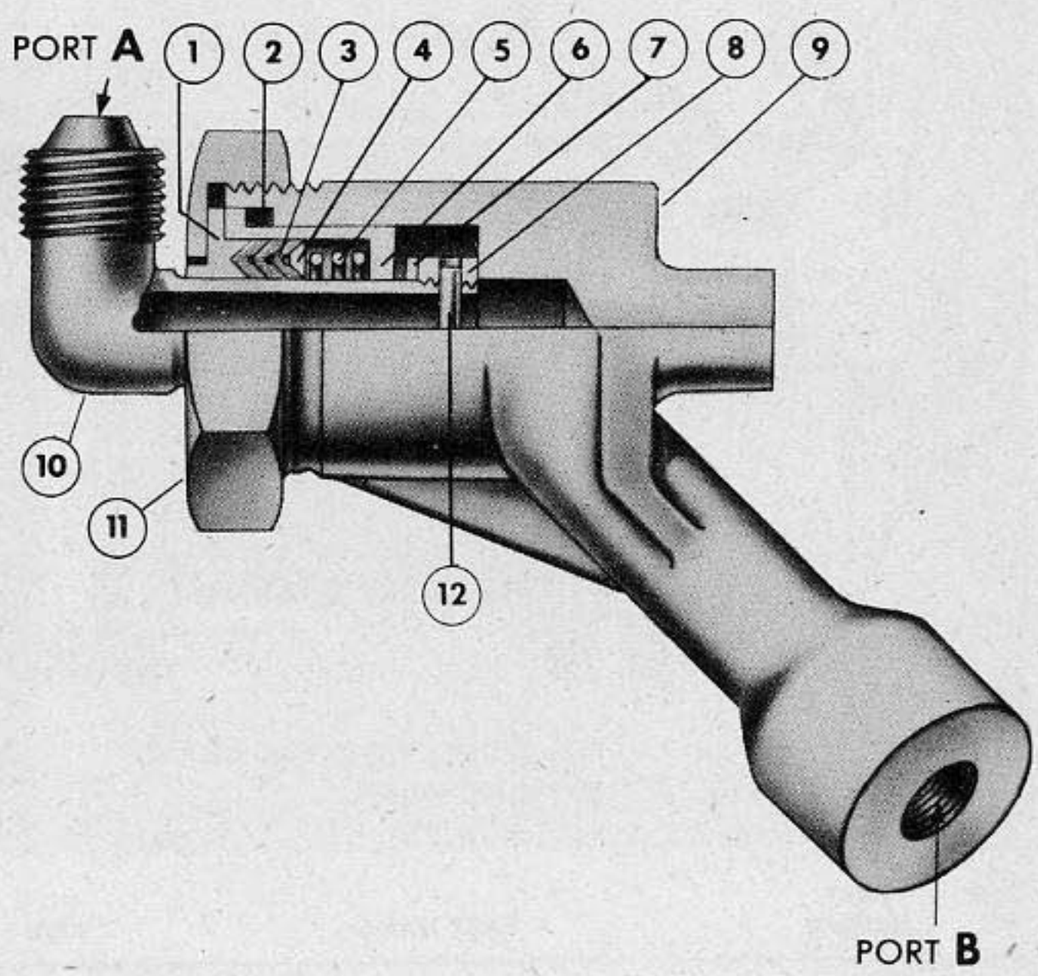
ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	4073961	HOUSING ASSEMBLY, BRAKE DEBOOSTER	1
2.	1073371	SPRING, DEBOOSTER PISTON RETURN	1
3.	2073889	CYLINDER, BRAKE DEBOOSTER INNER	1
4.	9/32" DIA.	BALL, STEEL	1
5.	1073372	SPRING, DEBOOSTER EQUALIZING VALVE	1
6.	1074551	GUIDE, DEBOOSTER EQUALIZING VALVE	1
7.	1073370	RETAINER, DEBOOSTER SPRING STOP	1
8.	1073399	RETAINER, DEBOOSTER CUP SPACER	1
9.	1073398	SPACER, DEBOOSTER INNER CUP	1
10.	1049003-D-100	CUP, 3/16" x 3/16" HYDRAULIC PACKING FLARED	1
11.	1073369	STOP, DEBOOSTER RELIEF SPRING	1
12.	1073374	NUT, BRAKE DEBOOSTER GASKET	1
13.	143908-120SR126-094	WASHER	1
14.	1074550	WASHER, DEBOOSTER RELIEF SPRING	*4
15.	1049003-D-204	CUP, 3/16" x 3/16" HYDRAULIC PACKING FLARED	2
16.	1073397	SPACER, DEBOOSTER OUTER CAP	2
17.	2073896	PISTON, BRAKE DEBOOSTER	1
18.	AC365-10L	NUT	8
	AN960-10L	WASHER	8
19.	AN502-10-16	SCREW	6
20.	2073880	COVER, BRAKE DEBOOSTER	1
21.	1073373	SPRING, DEBOOSTER RELIEF	1
22.	AN960-D516	WASHER	*1
23.	AN502-10-26	SCREW	2

*Use as necessary.

Figure 195 - BRAKE DEBOOSTER

piston to escape quickly when the piston moves back during the release of brakes. In normal operation the fluid pressure at port A is prevented from entering the large chamber outside the piston by the ball check valve in the head of the piston. Should the quantity of fluid in the large chamber diminish due to a leak while the brakes are applied, the pressure at port A will force the piston forward, further compressing the large spring. If the leak continues until the piston gets to the end of its stroke, the small pin in the end of the de-booster housing will unseat the piston ball check and allow the fluid from port A to replenish the large chamber. When the pressures on each side of the valve become equalized, the ball will reseat. Thermal expansion of the fluid in the large chamber is relieved through the bleed hole B in the lower side of the de-booster housing. The bleed hole is normally covered by the pressure sealing cup, but if the fluid in the large chamber continues to expand and the piston reaches the end of its stroke, the bleed hole is uncovered and the excess fluid will seep out.

(19) BRAKE LINE SWIVEL JOINT. (See figure 196) - A swivel joint is incorporated in each brake line at the inboard end of the lower shaft of each main landing gear assembly. Placing it at the point of landing gear rotation eliminates the necessity for using flexible hose to allow for movement of the gear.

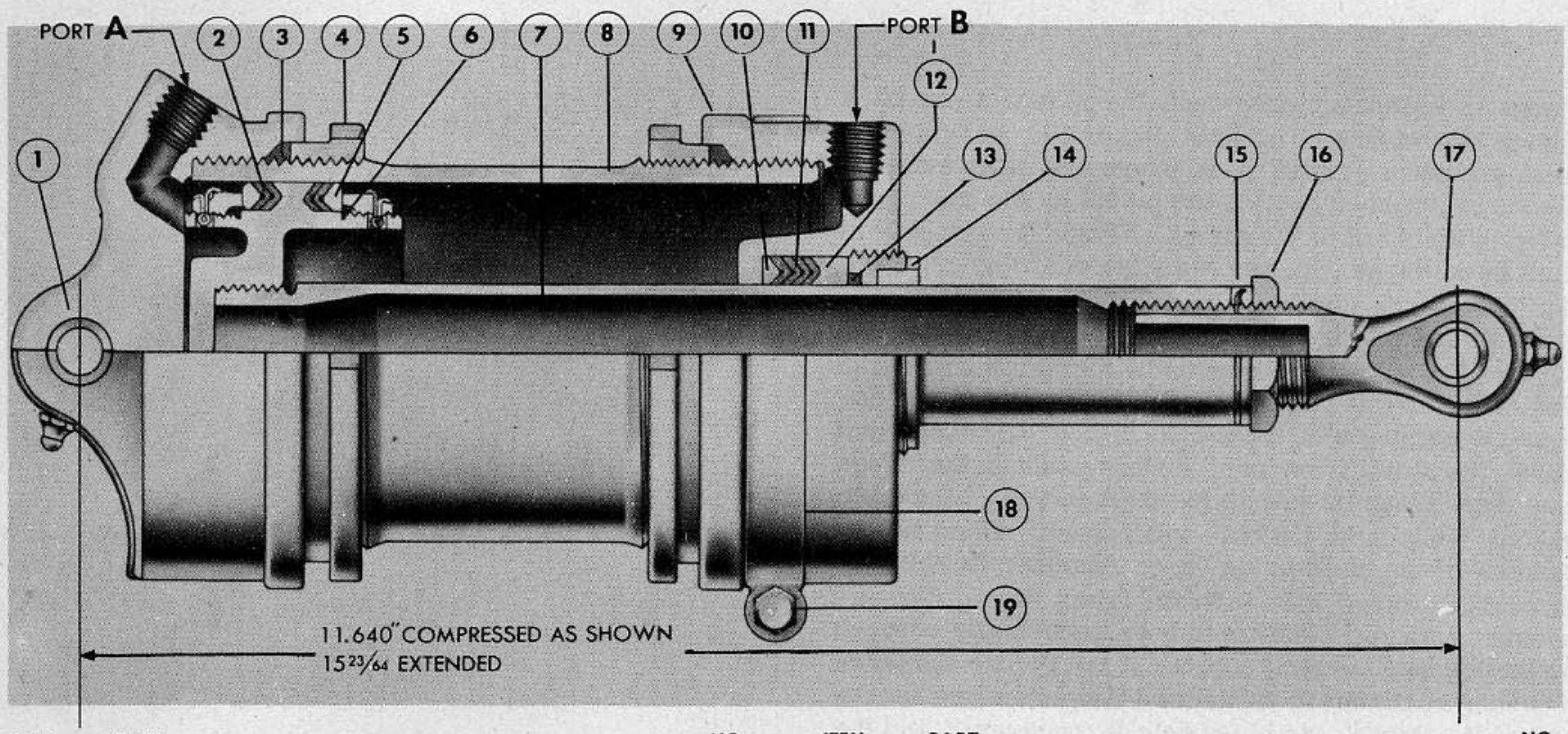


ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	1058024	COVER, HYDRAULIC BRAKE SWIVEL JOINT	1
2.	143908-029SR102-093	WASHER	1
3.	135865-3G-014C	RING, CHEVRON PACKING	3
4.	179261-014-026	RING, CENTER PACKING	1
5.	1058130	SPRING, HYDRAULIC BRAKE SWIVEL JOINT PACKING	1
6.	1058025	CUP, HYDRAULIC BRAKE SWIVEL JOINT	1
7.	143908-014B020-062	WASHER	1
8.	1058026	NUT, HYDRAULIC BRAKE SWIVEL JOINT	1
9.	4067910	BODY, HYDRAULIC BRAKE SWIVEL JOINT —L.H.	1
	4067910-1	BODY, HYDRAULIC BRAKE SWIVEL JOINT —R.H.	1
10.	1058028	ELBOW, HYDRAULIC BRAKE SWIVEL JOINT	1
11.	1058023	CAP, HYDRAULIC BRAKE SWIVEL JOINT	1
12.	4067911-2	PIN, HYDRAULIC BRAKE SWIVEL JOINT	1

Figure 196 - BRAKE LINE SWIVEL JOINT

(20) ACTUATING STRUTS. (See figure 197.)

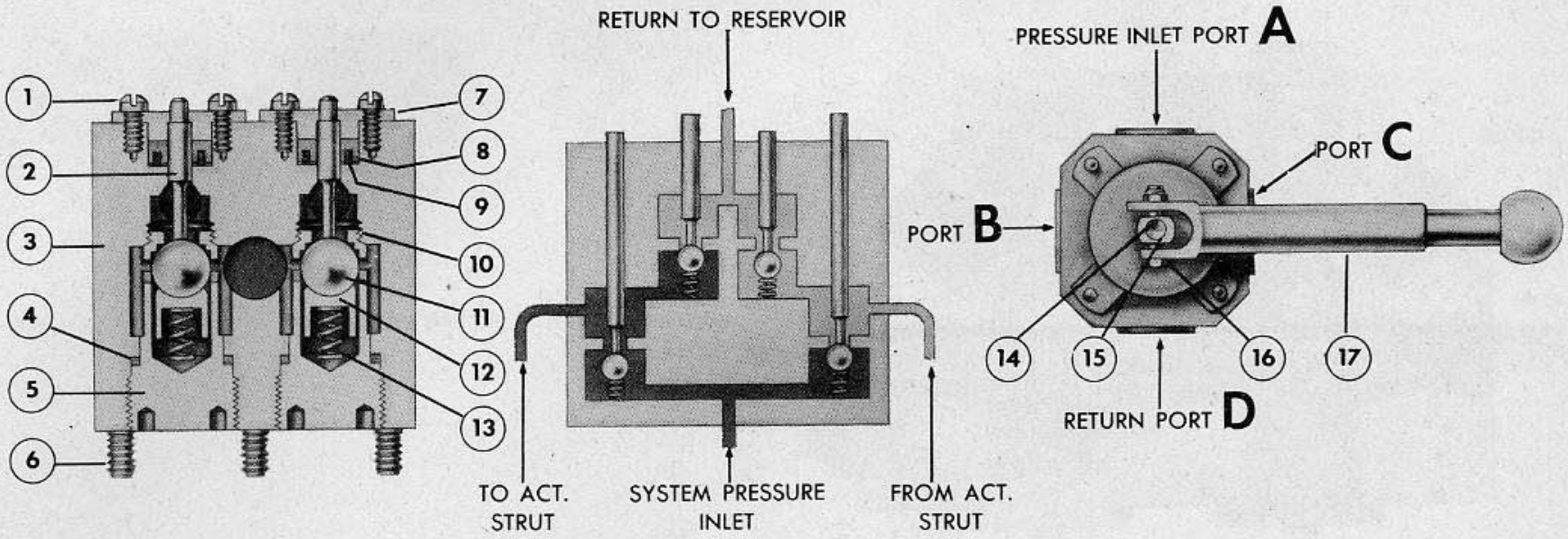
(a) GENERAL. - All the actuating struts incorporated in this airplane, except the nose wheel and main landing gear actuating struts, are identical in their arrangement and operation. The only difference is the variance of diameter and length of stroke of each strut to suit its particular need. The cylinder assembly of each strut consists of a tubular steel sleeve with aluminum alloy fittings threaded over each end and held in place by lock rings. The fitting which forms the cylinder head has a lug on the end through which a bolt may be inserted for mounting the strut in the airplane. The fitting which forms the piston end of the strut incorporates a chevron type piston packing gland that is held in place by packing rings and a retainer nut. Since the piston of the bomb door strut extends beyond the ends of the cylinder, the strut has two ends of the piston type. In all cases, each end fitting has a port for attaching a hydraulic line. The piston assembly consists of a tubular steel piston rod threaded and sweat soldered into a bronze piston head. The piston head incorporates two sets of chevron type packings similar to those in the piston end of the cylinder, both units being held in place by packing rings (which keep the packings in shape) and retainer nuts. The operation of an actuating strut is as follows: When pressure is



ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	4067891	END ASSEMBLY, WING FLAP ACTUATING STRUT	1
2.	5135865-4X-212	PACKING, HYDRAULIC CHEVRON	4
3.	1111908-308-314-187	GASKET, EXTERNAL SEAL RING	2
4.	2067361	RING, WING FLAP ACTUATING STRUT PACKING SEAL	2
5.	1012954-B212-008	RING, END PACKING	2
6.	2103292	NUT, WING FLAP ACTUATING STRUT PACKING ADJUSTING	2
7.	2119378-2	PISTON ASSEMBLY, WING FLAP ACTUATING STRUT	1
8.	2103293	BARREL, WING FLAP ACTUATING STRUT	1
9.	4067892	HEAD, WING FLAP ACTUATING STRUT	1
10.	1012954-B104-008	RING, END PACKING	1
11.	5135865-4X-104	PACKING, HYDRAULIC CHEVRON	4
12.	1067761	RING, WING FLAP ACTUATING CYLINDER	1
13.	126221-2-18-22	WASHER, PACKING	1
14.	1056350	NUT, WING FLAP ACTUATING STRUT PACKING	1
15.	1074187	WASHER, WING FLAP ACTUATING STRUT LOCK	1
16.	1074186	NUT, WING FLAP ACTUATING STRUT CLEVIS LOCK	1
17.	2069472	BOLT ASSEMBLY, WING FLAP ACTUATING STRUT EYE	1
18.	2068410	CLAMP ASSEMBLY, WING FLAP ACTUATING STRUT	1
19.	AN3-13A	BOLT	1
	AC364-1032	NUT	1

Figure 197 - INBOARD WING FLAP ACTUATING STRUT

applied to a port at one end of the strut, the piston moves toward the opposite end forcing the fluid that is ahead of it back through the selector valve to the reservoir. When the selector valve is moved to the opposite position, the same action takes place, only the piston moves in the other direction. For removal, disassembly, test, and installation of these various units, see paragraphs following.



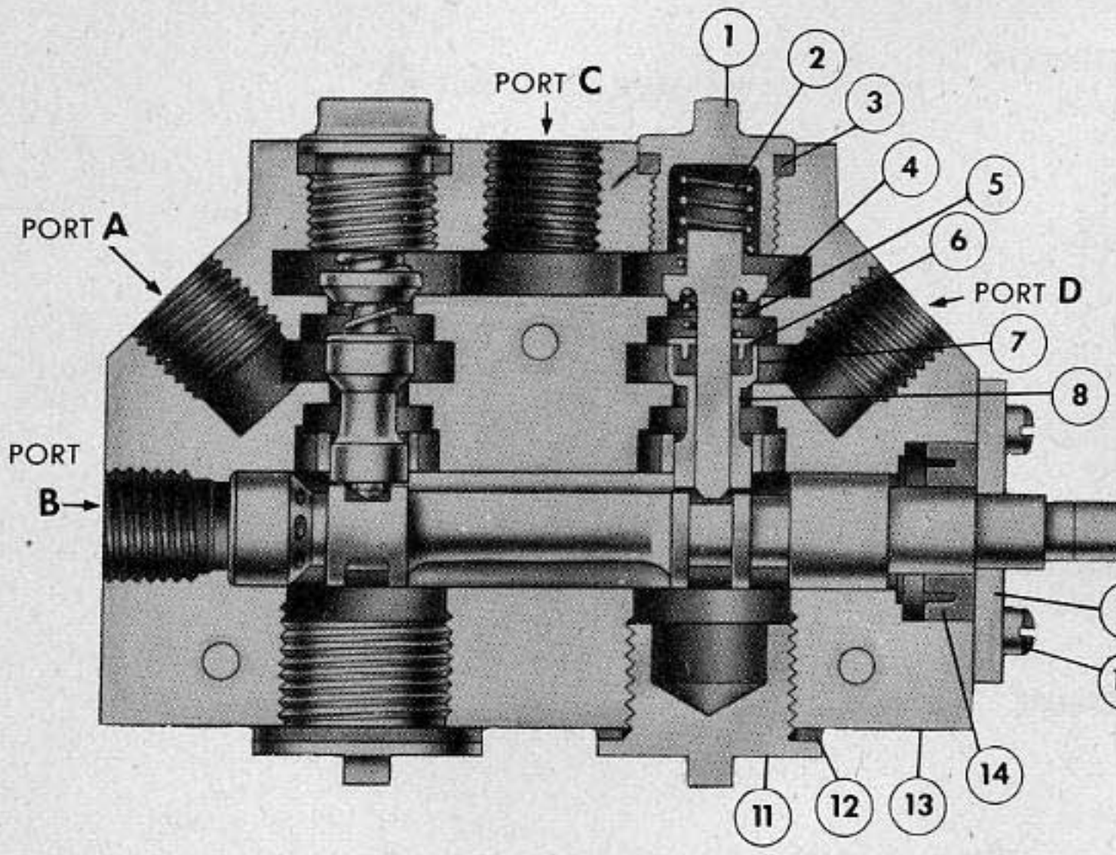
ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	AC503-8-6	SCREW	8
2.	1056227	PLUNGER, HYDRAULIC SELECTOR VALVE	4
3.	4065505	BODY, COWL FLAP HYDRAULIC SELECTOR VALVE	1
	1063678	PLUG, HYDRAULIC SELECTOR VALVE BODY DRILL HOLE	1
	143908-008TC-016-064	WASHER	1
	AC895-B-100	PLUG	3
4.	143908-026SR-100-093	WASHER	4
5.	1056225	NUT, HYDRAULIC SELECTOR VALVE	4
6.	1056232	STUD, HYDRAULIC SELECTOR VALVE TWO-WAY	4
7.	1056228	GLAND, HYDRAULIC SELECTOR VALVE	4
8.	1049003-D-008	CUP, 3/16 x 3/16 HYDRAULIC PACKING FLARED	4
9.	163768-008-010	SPACER, HYDRAULIC PACKING CUP	4
10.	1064795	SEAT, NO. 6 BALL	4
11.	5/16 DIA.	BALL, BRIGHT STEEL	4
12.	1056253	RETAINER, SELECTOR VALVE	4
13.	1056230	SPRING, HYDRAULIC SELECTOR VALVE	4
14.	1056224	SHAFT, HYDRAULIC SELECTOR VALVE	1
	143908-016B022-002	WASHER	*6
	143908-016S022-030	WASHER	1
15.	2055537	CAM ASSEMBLY, SELECTOR VALVE	1
	143908-012B020-005	WASHER	*5
16.	AN3-13	BOLT	1
	AN960-10	WASHER	1
	AC310-3	NUT	1
	178166-190-249-014	SPACER	2
17.	2064907	LEVER ASSEMBLY, UPPER COWLING FLAP HYDRAULIC VALVE	1
	1056229	SPRING, LEVER	1

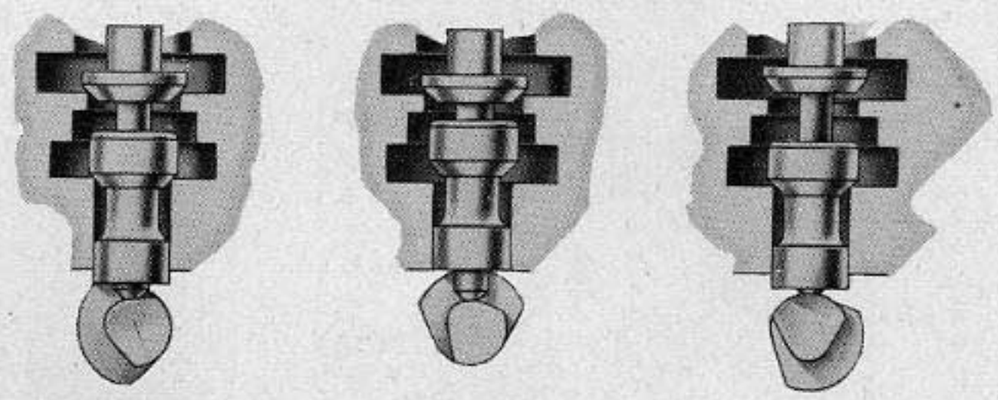
*Use as necessary

Figure 200 - FOUR-WAY SELECTOR VALVE

valve, incorporate four spring-retained ball checks which, when operated by the control handle, direct the flow of fluid. The valve control handle incorporates a round disk with the back face machined in the form of a cam with two high points opposite each other, and two low points also opposite each other, all four points being equidistant about the periphery. As the handle is rotated to any position, the high points of the cam depress two of the plungers which, in turn, unseat their respective ball checks. By depressing opposite ball checks in this manner, one line from the actuating strut is connected to the pressure side of the system, while the other is connected to the reservoir.

(b) BOMB DOOR SELECTOR VALVE. (See figure 201.) - This four-way selector valve consists of a housing with two poppet valve assemblies which are operated by the camshaft beneath them. Each valve assembly has an upper poppet that connects the pressure inlet chamber to a distribution port, and a lower poppet which connects the distribution port to the cam shaft chamber which acts as the relief port. In each valve assembly, the stem of the upper poppet extends down through the tubular stem of the lower poppet with each stem riding on its respective lift on the camshaft. When the handle is moved to either operating position, the upper poppet of one valve assembly and the lower poppet of the other are raised off their seats while the other two poppets remain seated. When the handle is moved to the other operating position, the reverse condition is true.





ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	A9101	CAP, HYDRAULIC BOMB BAY DOOR SELECTOR VALVE	2
2.	A9109	SPRING, HYDRAULIC BOMB BAY DOOR SELECTOR VALVE UPPER	2
3.	S304-A-685-566-0375	WASHER, HYDRAULIC BOMB BAY DOOR SELECTOR VALVE CAP	2
4.	A9104	STEM, HYDRAULIC BOMB BAY DOOR SELECTOR VALVE	2
5.	A9105	SPRING, HYDRAULIC BOMB BAY DOOR SELECTOR VALVE LOWER	2
6.	A9106	SPACER, HYDRAULIC BOMB BAY DOOR SELECTOR VALVE	2
7.	A9107	CUP, HYDRAULIC BOMB BAY DOOR SELECTOR VALVE	2
8.	A9108	GUIDE, HYDRAULIC BOMB BAY DOOR SELECTOR VALVE STEM	2
9.	A9114	RETAINER, HYDRAULIC BOMB BAY DOOR SELECTOR VALVE	1
10.	AC503-6-6	SCREW	4
11.	A9616	PLUG, HYDRAULIC BOMB BAY DOOR SELECTOR VALVE	2
12.	S303-8A	WASHER, HYDRAULIC BOMB BAY DOOR SELECTOR VALVE PLUG	2
13.	G9117	BODY, HYDRAULIC BOMB BAY DOOR SELECTOR VALVE	1
14.	39113-D-012	CUP, HYDRAULIC BOMB BAY DOOR SELECTOR VALVE SHAFT	1
15.	B9115	SHAFT, HYDRAULIC BOMB BAY DOOR SELECTOR VALVE	1

Figure 201 - BOMB DOOR SELECTOR VALVE

b. TROUBLE SHOOTING PROCEDURE

TROUBLE	POSSIBLE CAUSE	REMEDY
REGULATING VALVE OPERATES TOO FREQUENTLY	External leakage in power system.	Inspect all lines, fittings and hydraulic units for signs of leakage. Replace faulty fittings.
	Internal leakage in wing flap system	Remove, disassemble and repair or replace four-way selector valve.
	Leakage in cowl flap, alighting gear, carburetor air filter or bomb bay door systems	Remove and repair or replace defective units.
	Leakage in system relief valve, alighting gear relief valve or brake control valve	Remove and repair or replace defective valves
EXCESSIVE PRESSURE DROP WHEN ALIGHTING GEAR CONTROL IS OPERATED	External leakage in alighting gear system.	Repair or replace parts where leakage occurs.
	Leakage past piston packings in actuating struts	Disassemble actuating strut and replace packing.

TROUBLE	POSSIBLE CAUSE	REMEDY
LOSS OF PRESSURE	No fluid to pump.	Fill reservoir to proper level.
	Line failure	Repair or replace any lines or fittings found to be leaking on visual inspection.
	External leak at one of the units.	Remove, disassemble and repair or replace any unit found to be leaking.
	Clogged filter.	Disassemble and clean filter.

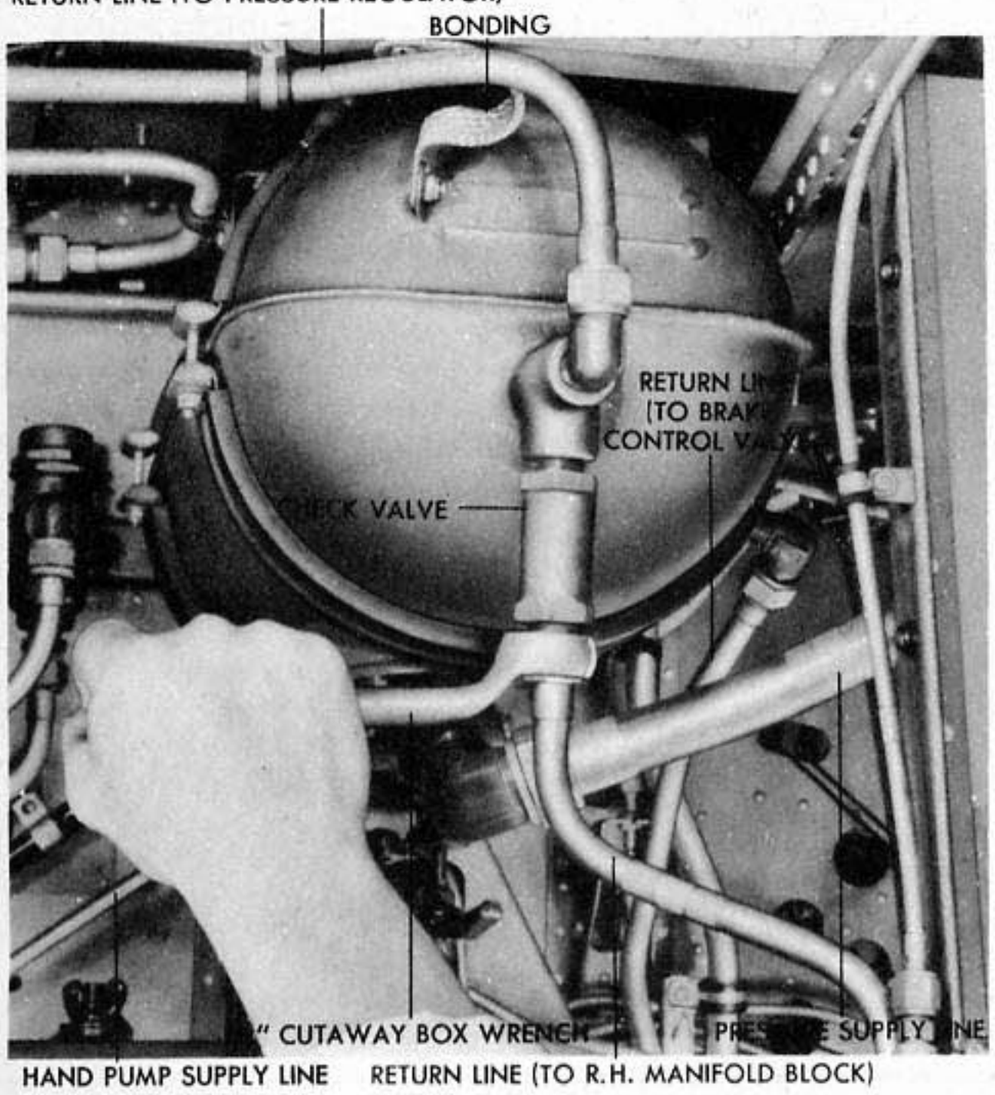


Figure 202 - REMOVING HYDRAULIC FLUID RESERVOIR

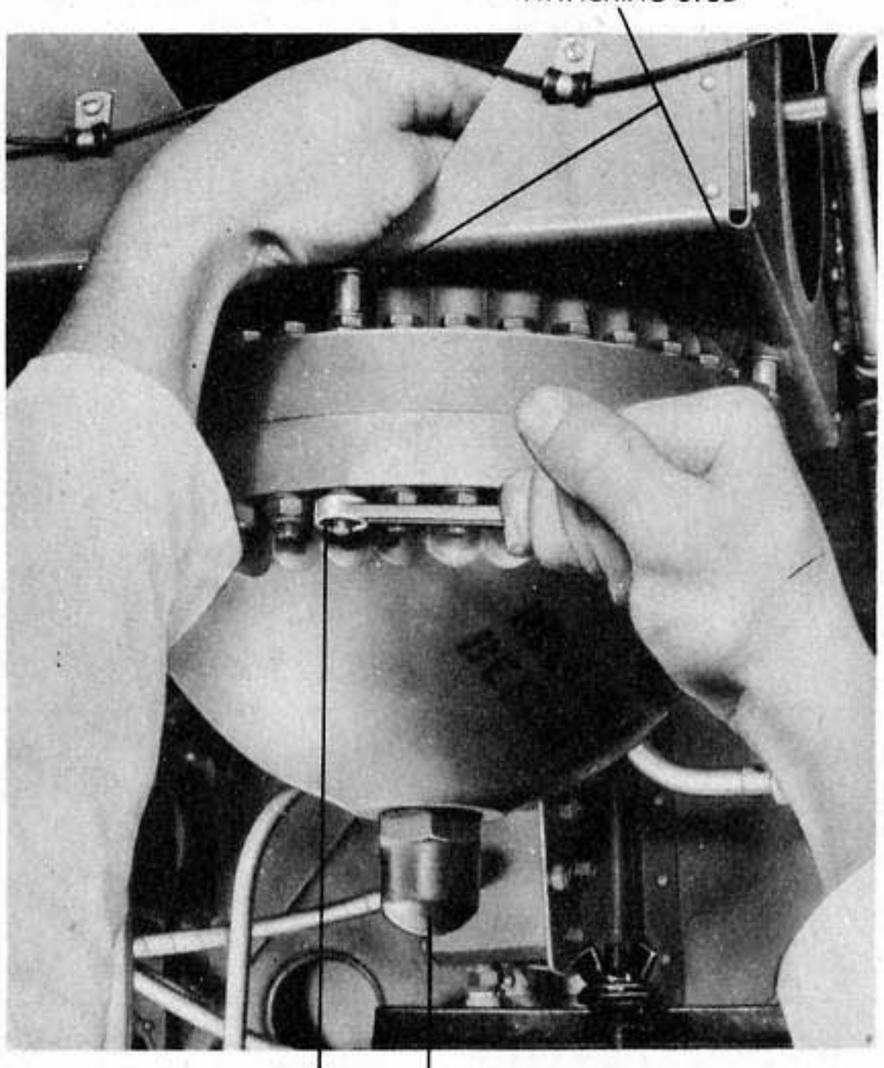


Figure 203 - REMOVING HYDRAULIC PRESSURE ACCUMULATOR

c. REMOVAL AND DISASSEMBLY.

(1) REMOVAL OF FLUID RESERVOIR. (See figure 202.)

(a) Relieve the pressure in the complete system by operating wing flaps up and down until the hydraulic pressure gage reads zero.

(b) Remove the drain plug in the bottom of the reservoir. Drain the reservoir.

(c) Disconnect and cap all lines.

(d) Remove the reservoir attaching bolts and remove reservoir.

(2) DISASSEMBLY OF FLUID RESERVOIR. (See figure 185.)

(a) Remove fluid gage rod.

(b) Remove the filler cap and strainer.

(c) Remove the fluid filter assembly.

(3) REMOVAL OF PRESSURE ACCUMULATOR. (See figure 203.)

(a) Relieve the pressure in the complete system by operating the wing flaps up and down until the hydraulic pressure gage reads zero.

(b) Relieve air pressure in the accumulator by loosening the valve assembly.

CAUTION

Loosen valve sufficiently to permit the air to escape slowly. Do not attempt to remove the valve assembly until the air pressure has been completely released.

(c) Disconnect and cap all lines.

(d) Remove attaching bolts and remove accumulator from airplane.

(4) DISASSEMBLY OF PRESSURE ACCUMULATOR. (See figure 186.)

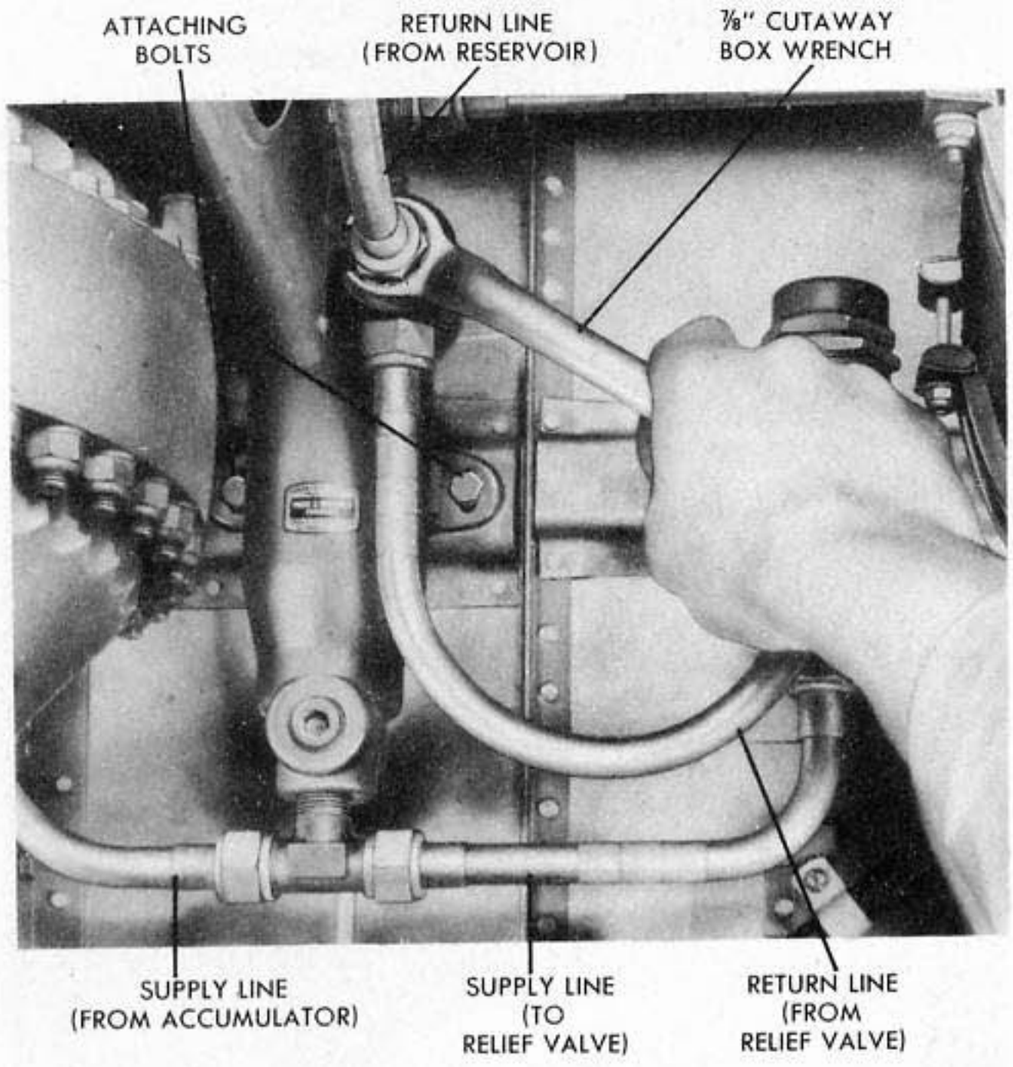
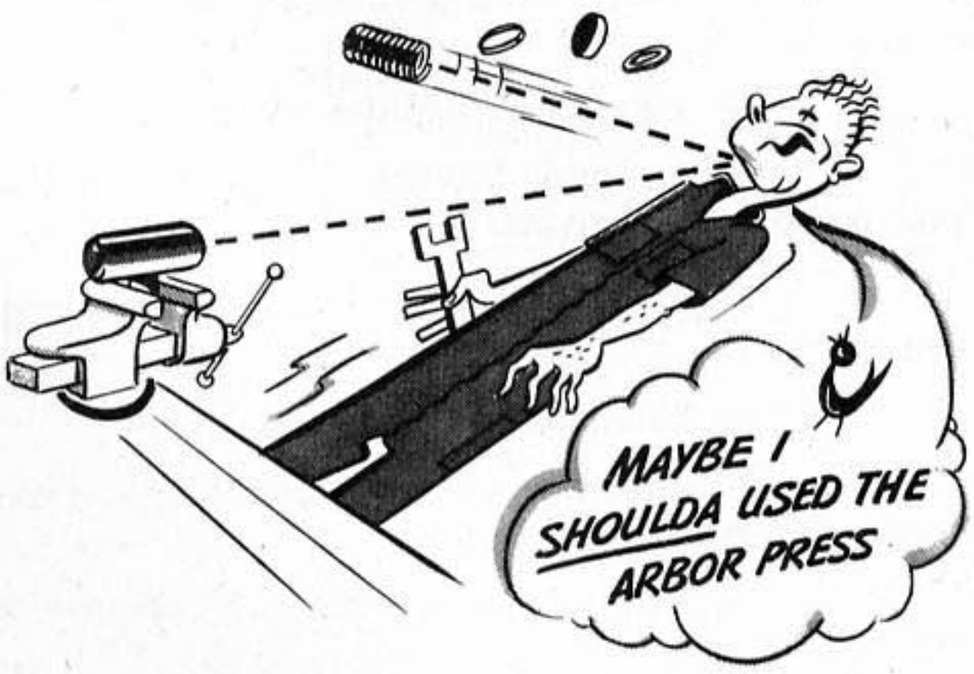


Figure 204 - REMOVING PRESSURE REGULATOR

(a) Remove valve cap nut and valve cap assembly.

(b) Remove cap nuts from studs and bolts connecting the two halves of the accumulator.

(c) Remove the two halves of the accumulator and the diaphragm.



WARNING

When disassembling the valve, take care in removing spring. It is loaded to approximately 415 pounds. Carelessness in this operation may result in serious injury to you. The valve must be held in an arbor press while unscrewing the end.

(5) REMOVAL OF PRESSURE REGULATOR. (See figure 204.)

(a) Relieve pressure in the complete system.

(b) Disconnect and cap all lines.

(c) Remove the two attaching bolts on left pressure regulator.

(6) DISASSEMBLY OF PRESSURE REGULATOR. (See figure 187.)

(a) Place valve in an arbor press and unscrew the end.

(b) Pull out the piston, spring, and shims from body.

(c) Unscrew the packing nut, and remove packing and packing spring.

(7) REMOVAL OF DISCONNECT VALVES.

(a) Relieve the pressure in the complete system.

(b) Disconnect and cap all lines.

(c) Cut lock wire and unscrew adapter nut. Remove adapter and adapter gasket (see figure 192).

(d) Remove lock nut (see figure 198) and lift valve from fire wall.

(8) DISASSEMBLY OF DISCONNECT VALVES. (See figure 188.)

(a) Cut lock wire and unscrew union from body.

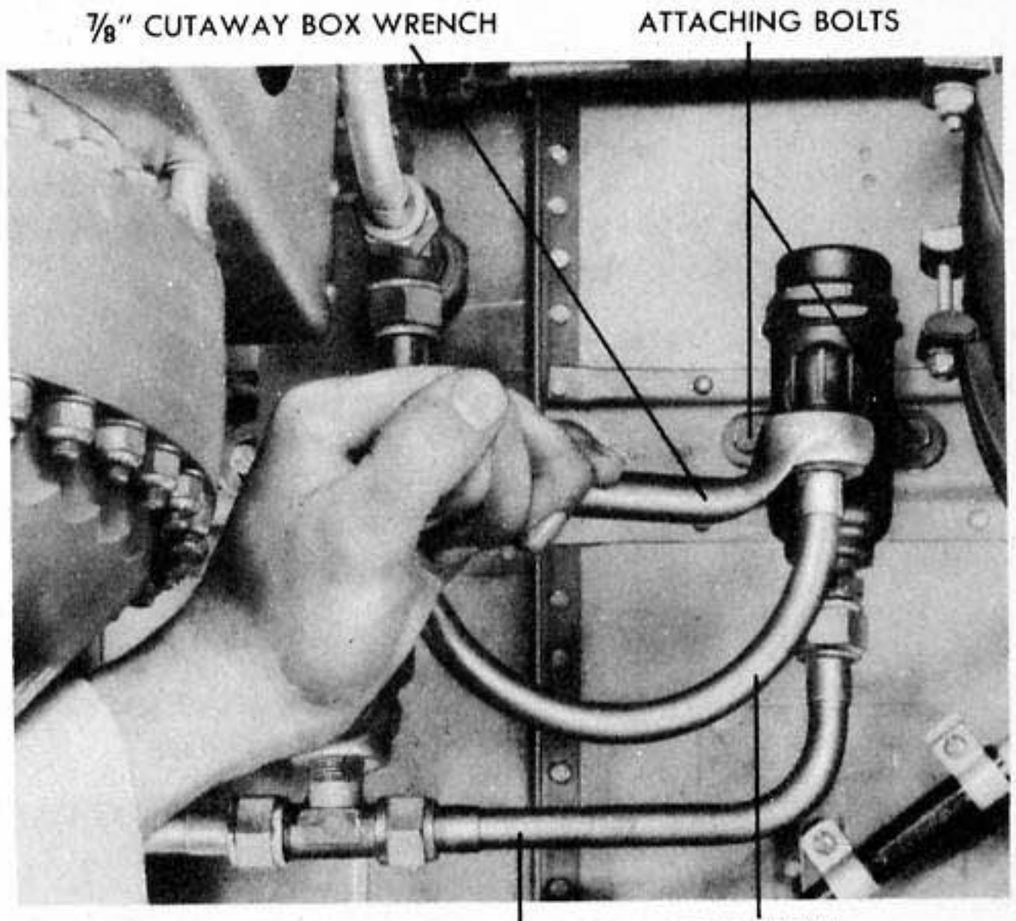


Figure 205 - REMOVING PRESSURE REGULATOR RELIEF VALVE

(b) Lift gaskets, spring, and ball from body.

(9) REMOVAL OF PRESSURE REGULATOR RELIEF VALVE. (See figure 205.)

(a) Relieve the pressure in the complete system.

(b) Disconnect and cap all lines.

(c) Remove attaching bolts and remove valve.

(10) DISASSEMBLY OF PRESSURE REGULATOR RELIEF VALVE. (See figure 189.)

(a) Remove cap, gasket, and lock nut.

(b) Remove adjusting nut, permitting spring and guide to slide out.

(c) Remove seat fitting.

(11) REMOVAL OF ADJUSTABLE RELIEF VALVE.

(a) Relieve the pressure in the complete system.

(b) Disconnect and cap all lines..

(c) Remove attaching bolts from valve and remove from airplane.

(12) DISASSEMBLY OF ADJUSTABLE RELIEF VALVE. (See figure 190.)

(a) Cut lock wires and loosen lock nut.

(b) Unscrew adjustment screw from body. Lift out seal from body. Remove lock nut from adjustment screw.

(c) Lift stem and steel ball assembly from body.

(d) If it is necessary to remove steel ball from stem, drill a small hole in center of stem and back of ball. Knock out ball.

(e) Remove ball seat from body.

(13) REMOVAL OF HAND PUMP BYPASS VALVE.

(a) Relieve the pressure in the complete system.

(b) Disconnect and cap all lines.

(c) Remove attaching bolts from valve and remove valve from airplane.

(14) DISASSEMBLY OF HAND PUMP BYPASS VALVE. (See figure 191.)

(a) Disconnect and remove handle assembly.

(b) Unscrew spring retaining nut and lift seal, spring, and steel ball from body.

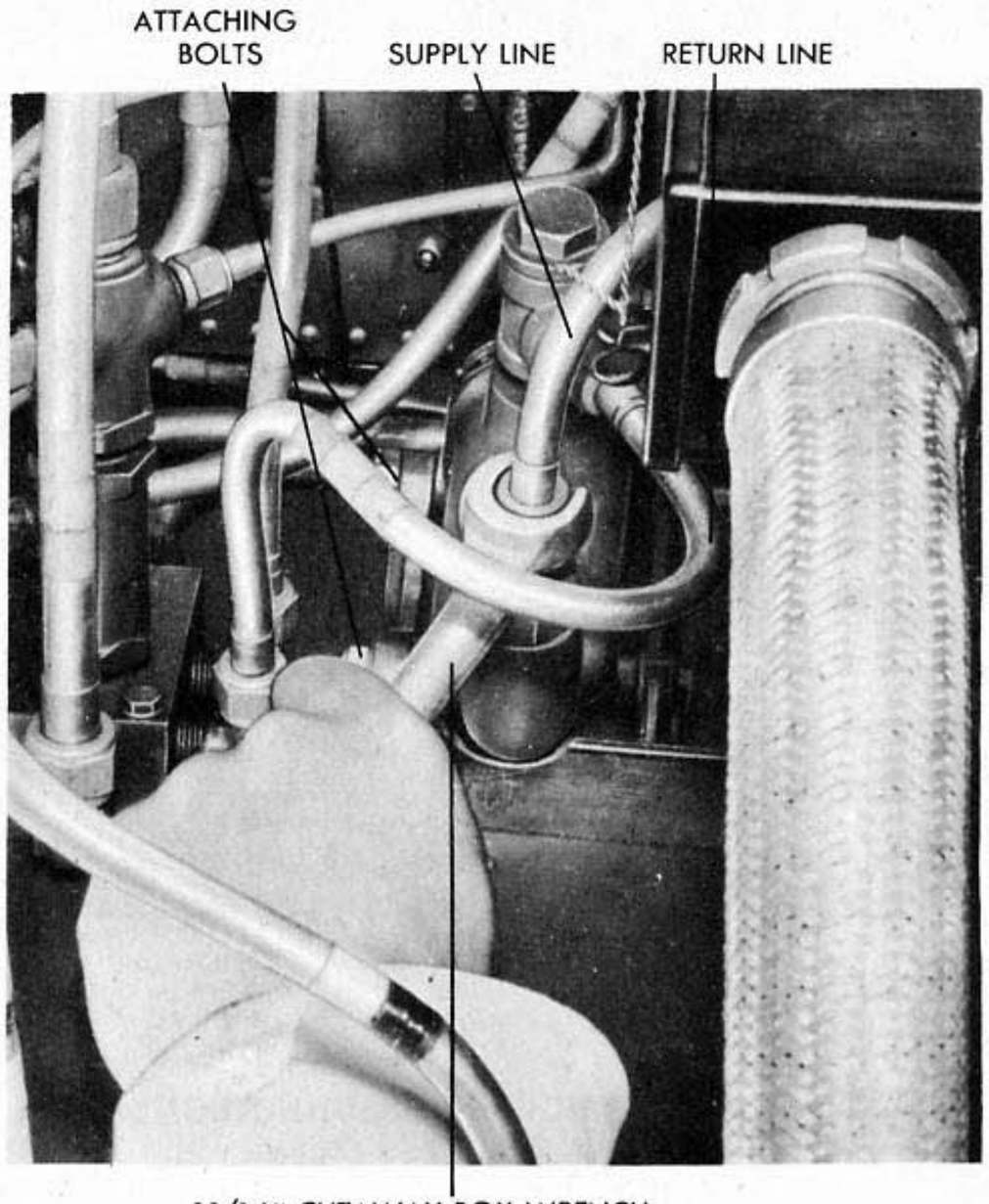


Figure 206 - REMOVING HAND PUMP

(c) Remove retainer nut and lift out plunger, spring, and cup packing.

(15) REMOVAL OF HAND PUMP. (See figure 206.)

(a) Relieve pressure in the complete system.

(b) Disconnect and cap all lines.

(c) Remove attaching bolts and remove hand pump from airplane.

(16) DISASSEMBLY OF HAND PUMP. (See figure 192.)

(a) Disconnect handle assembly.

(b) Unscrew cylinder retaining nut from inside of body. Slide out piston.

(c) Unscrew piston head and remove cup packing.

(d) Remove check seat and lift out ball check and spring.

(17) REMOVAL OF WING FLAP RELIEF VALVE. (See figure 207.)

(a) Relieve pressure in the complete system.

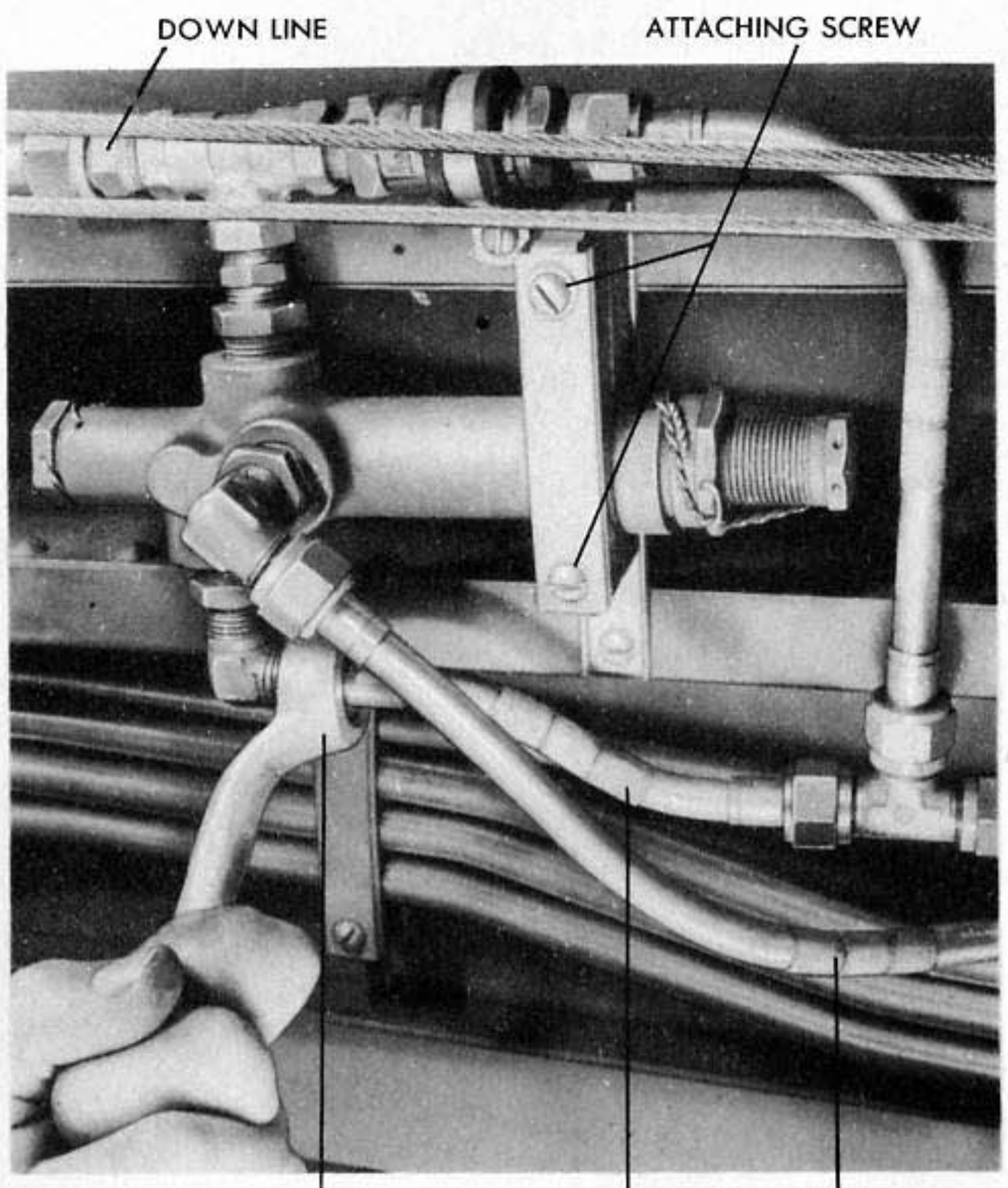


Figure 207 - REMOVING WING FLAP RELIEF VALVE

(b) Disconnect and cap all lines.

(c) Remove valve from airplane.

(18) DISASSEMBLY OF WING FLAP RELIEF VALVE. (See figure 193.)

(a) Loosen lock nut, unscrew plug, and remove spring. Remove lock nut from plug.

(b) Remove seal and spring.

(c) Remove piston stop.

(d) Slide guide and piston from body.

(e) Remove guide from piston.

(19) REMOVAL OF BRAKE CONTROL VALVE. (See figure 208.)

(a) Relieve pressure in the complete system.

(b) Disconnect and cap all lines.

(c) Remove attaching bolts.

(d) Remove valve from airplane.

(20) DISASSEMBLY OF BRAKE CONTROL VALVE. (See figure 194.)

(a) Remove the nut from screw through the lever arm and loosen the lever.

(b) Remove the cotter pin which holds the link to the piston and remove link.

(c) Remove the lock nut from the base of housing.

(d) Remove the nuts which secure the cover to the housing. Lift the cover and gasket from the housing. Screw the seat from the cover and lift out the spring, steel ball, and washer.

(e) Lift spring and valve from head of piston.

(f) Remove the piston locking screw from the face of the valve housing.

(g) Screw the piston and packing nut from the top of the housing, using a wrench on the square base of the piston. Slide the pin from its slot in piston shaft and internal packing nut. Pull piston shaft from packing nut.

(h) Remove the spacer and packing from the top of the piston.

(i) Remove the packing and packing ring from the housing.

(21) REMOVAL OF BRAKE DEBOOSTER.

(a) Relieve pressure in the complete system.

(b) Disconnect and cap all lines at the valve.

(c) Remove valve from axle.

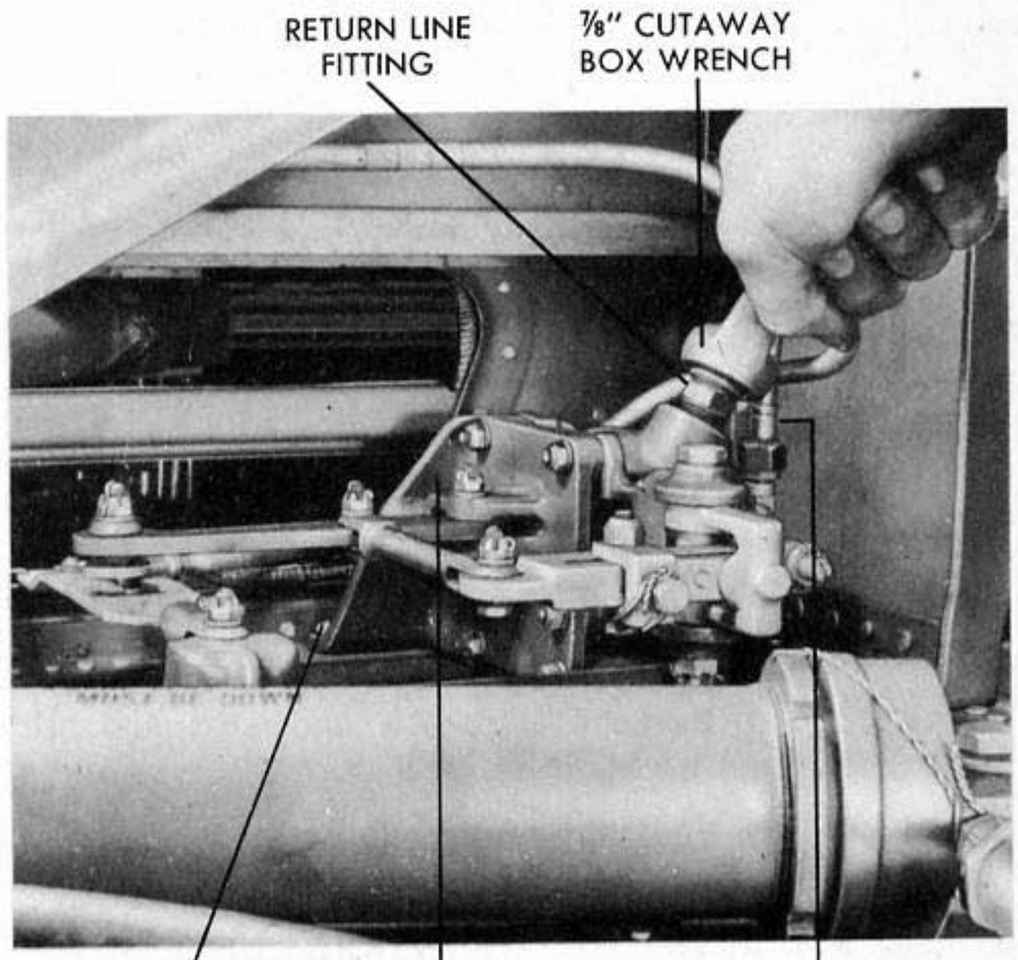


Figure 208 - REMOVING BRAKE CONTROL VALVE

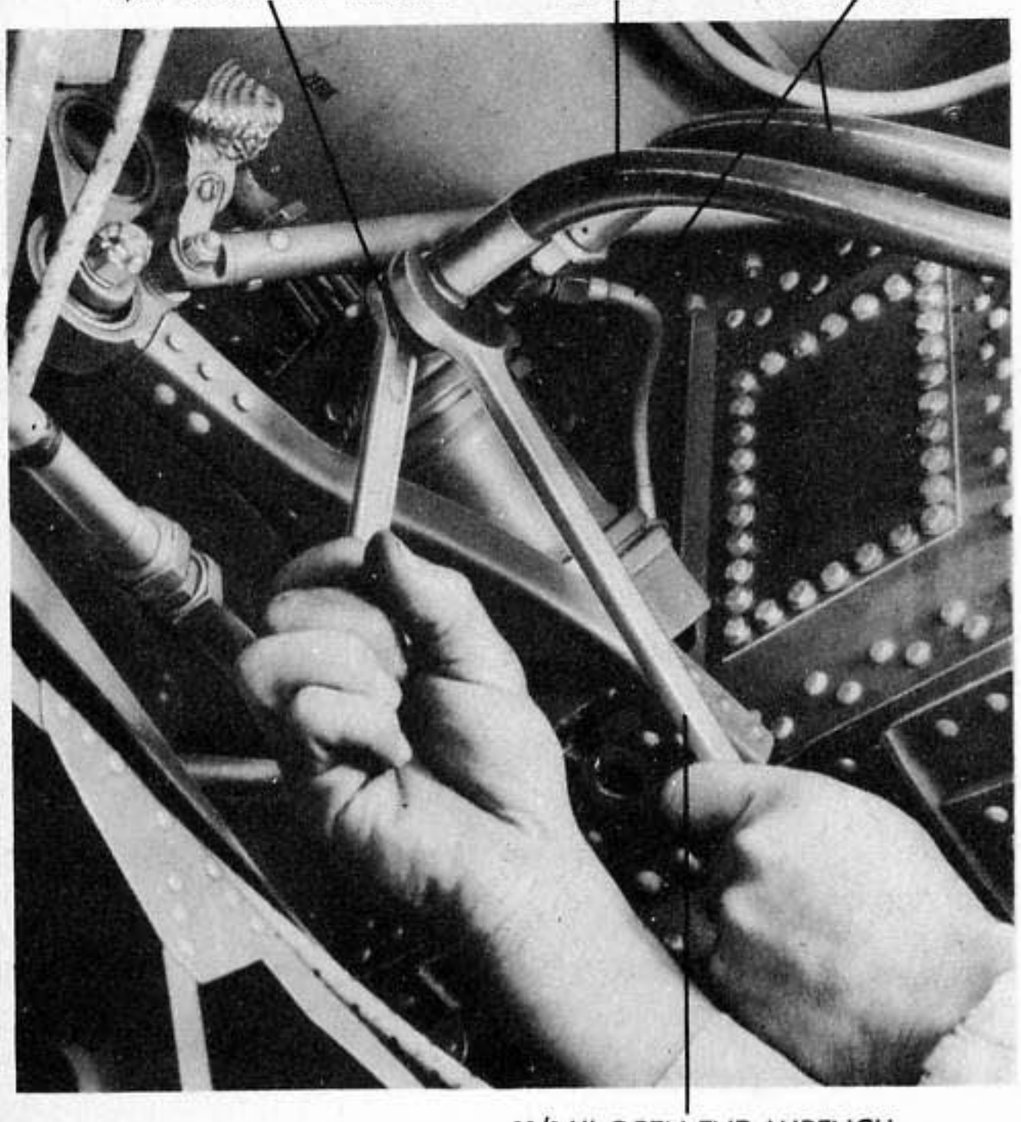


Figure 209 - REMOVING OUTBOARD WING FLAP ACTUATING STRUT

(22) DISASSEMBLY OF BRAKE DEBOOSTER. (See figure 195.)

(a) Remove bolts and cover from body.

CAUTION

Pull cover straight out until the inner chamber has been removed from body.

(b) Remove retainer, spacer, and cup from cover.

(c) Remove retainer, spring, washers, and stop from inner chamber.

(d) Slide piston assembly and spring from chamber.

(e) Remove lock nut and seal and slide piston from cylinder.

(f) Remove spring guide and ball check from the cylinder.

(23) REMOVAL OF BRAKE LINE SWIVEL JOINT.

(a) Relieve pressure in the system.

(b) Disconnect and cap all lines at the joint.

(c) Remove joint.

(24) DISASSEMBLY OF BRAKE LINE SWIVEL JOINT. (See figure 196.)

(a) Unscrew packing nut and remove elbow assembly from body.

(b) Drive out pin and remove check nut, washer, cup, spring, seal, chevron packing, and packing ring from elbow.

(c) Lift off packing nut from elbow.

(25) REMOVAL OF OUTBOARD AND INBOARD WING FLAP ACTUATING STRUTS. (See figure 209.)

(a) Relieve pressure in complete system.

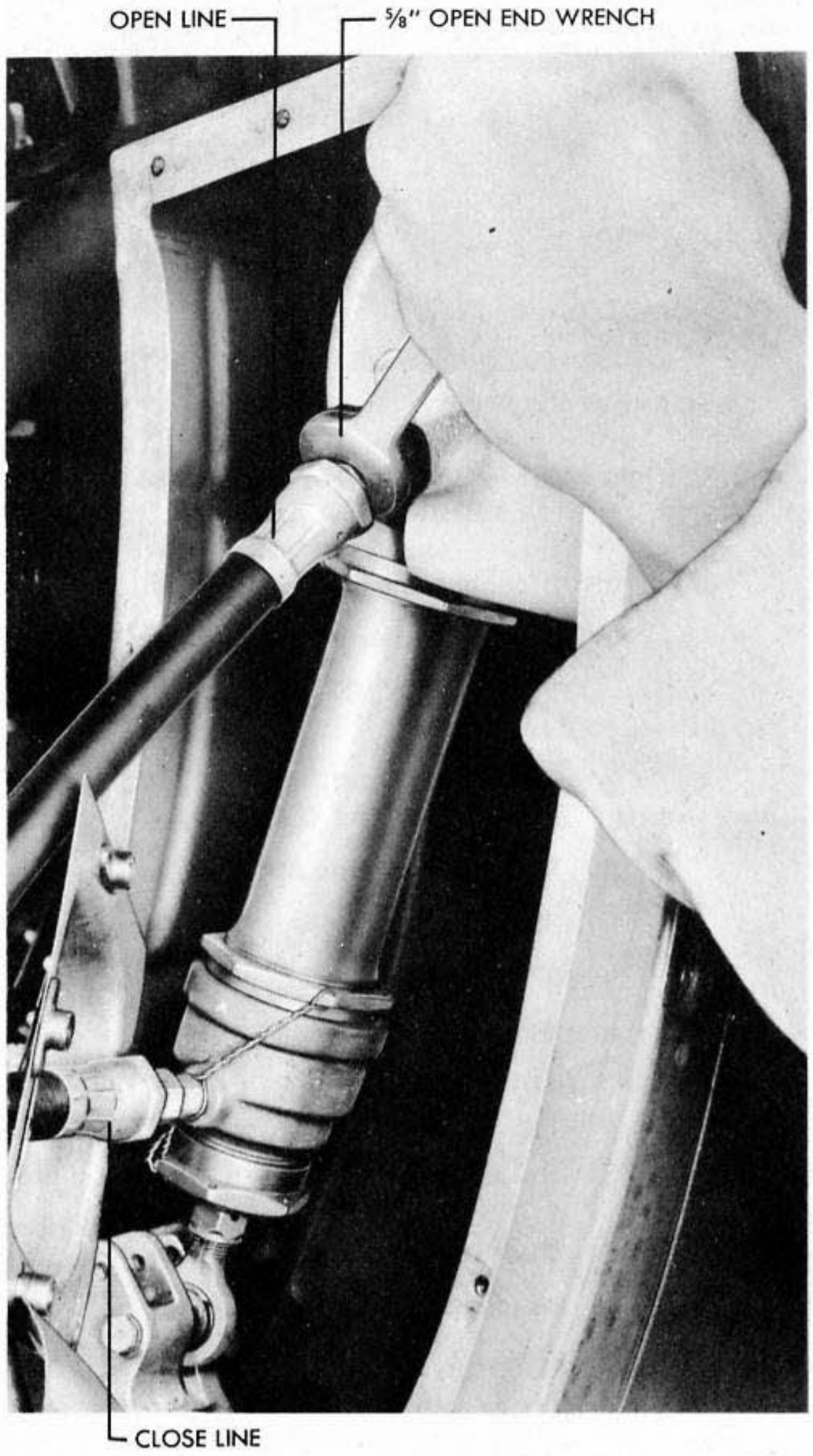
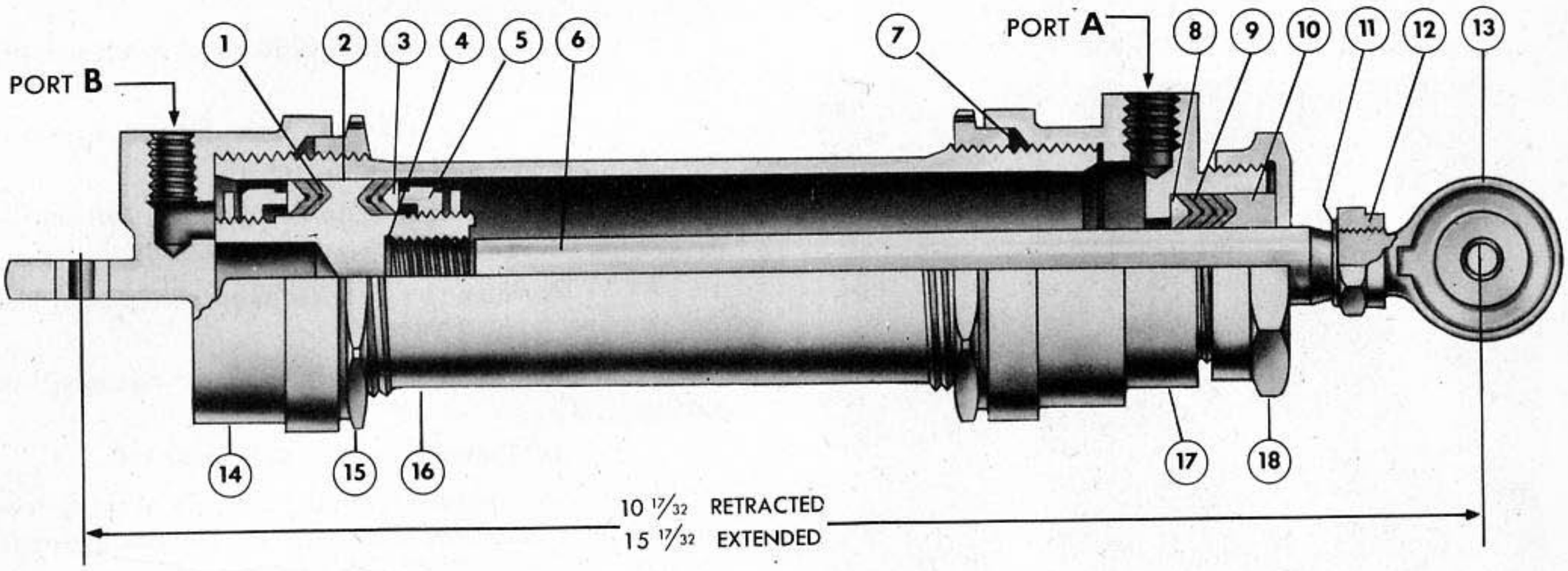


Figure 210 - REMOVING LOWER COWL FLAP ACTUATING STRUT



ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	5135865-4X-030	PACKING, HYDRAULIC CHEVRON	4
2.	2086171	PISTON, COWLING FLAP OPERATING STRUT CYLINDER	1
3.	1012954-D030-008	RING, END PACKING	2
4.	146142-095-024	PIN	1
5.	1086230	NUT, COWLING FLAP OPERATING STRUT CYLINDER PISTON PACKING	2
6.	2086177	ROD, COWLING, FLAP OPERATING STRUT CYLINDER PISTON	1
7.	1111908-124-130-187	GASKET, EXTERNAL SEAL RING	2
8.	1012954-D018-007	RING, END PACKING	1
9.	5135865-3½X-018	PACKING, HYDRAULIC CHEVRON	4
10.	1086455	RING, COWLING FLAP OPERATING STRUT CYLINDER PISTON ROD PACKING	1
11.	1086454	WASHER, COWLING FLAP OPERATING STRUT CYLINDER PISTON ROD LOCK	1
12.	1086453	NUT, COWLING FLAP OPERATING STRUT CYLINDER PISTON ROD LOCK	1
13.	2138695	END ASSEMBLY, COWLING FLAP OPERATING STRUT CYLINDER PISTON	1
14.	2137342	HEAD ASSEMBLY, COWLING FLAP OPERATING STRUT CYLINDER	1
15.	1086147	GLAND, COWLING FLAP OPERATING STRUT CYLINDER PACKING	2
16.	2086095	CYLINDER, COWLING FLAP OPERATING STRUT	1
17.	2086096	END, COWLING FLAP OPERATING STRUT CYLINDER	1
18.	1086148	NUT, COWLING FLAP OPERATING STRUT PACKING	1

Figure 211 - LOWER COWL FLAP ACTUATING STRUT

(b) Disconnect and cap all lines.

(c) Remove strut assembly from airplane.

(26) DISASSEMBLY OF OUTBOARD AND INBOARD WING FLAP ACTUATING STRUTS. (See figures 197 and 198.)

(a) Loosen head lock nut at piston end.

(b) Back off cylinder end.

(c) Remove piston assembly and cylinder end.

(d) Remove lock nut and lock washer.

(e) Remove packing nut and seal.

(f) Slide off cylinder end and packing.

(g) Remove piston head.

(h) Remove cotters, two packing nuts, and packing from piston head.

(i) Remove eyebolt from piston.

(j) Remove lock nut and seal from cylinder head and unscrew cylinder head.

(27) REMOVAL OF UPPER AND LOWER COWL FLAP ACTUATING STRUTS. (See figure 210.)

(a) Relieve pressure in the complete system.

(b) Disconnect and cap all lines.

(c) Remove cylinder from airplane.

(28) DISASSEMBLY OF UPPER AND LOWER COWL FLAP ACTUATING STRUT. (See figures 219 and 211.)

(a) Loosen cylinder end lock nut and Neoprene seal.

(b) Remove cylinder end assembly, and slide this and piston assembly out.

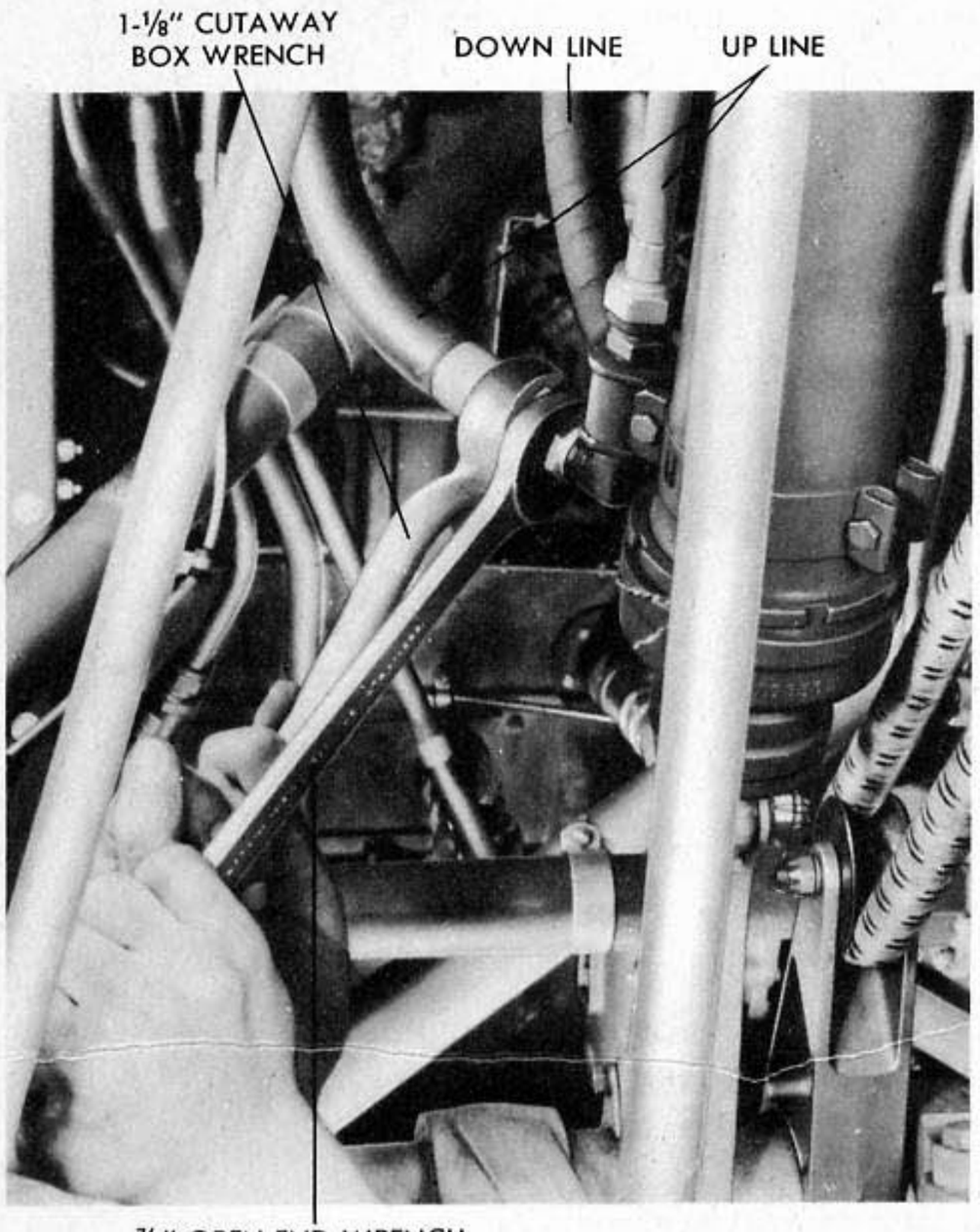


Figure 212 - REMOVING MAIN ALIGHTING GEAR ACTUATING STRUT

(c) Loosen cylinder head lock nut and seal, and remove cylinder head.

(d) Remove piston head lock nut, packing, and piston head.

(e) Slide piston rod out of cylinder end.

(f) Remove cylinder end packing nut and packing.

(g) Loosen eyebolt lock nut and remove eyebolt from piston rod.

(29) REMOVAL OF MAIN LANDING GEAR ACTUATING STRUT. (See figure 212.)

(a) Relieve the hydraulic operating pressure with the landing gear control lever in the DOWN position.

(b) Attach ground safety latch to retracting linkage.

(c) Disconnect and cap all lines.

(d) Disconnect and remove entire strut from airplane.

(30) DISASSEMBLY OF MAIN LANDING GEAR ACTUATING STRUT. (See figure 199.)

(a) Remove clamp and rigid hydraulic line from cylinder.

(b) Loosen the end lock nut and Neoprene seal at the piston end of the cylinder.

(c) Unscrew cylinder end and slide out the piston assembly.

(d) Unscrew packing nuts from piston head and remove packing assembly.

(e) Remove retaining nut, dashpot, and spring.

(f) Remove piston head from rod.

(g) Remove cylinder end and packing from piston rod. Disassemble cylinder end packing and packing nut.

(h) Loosen lock nut and lock washer on piston rod.

(i) Unscrew and remove eyebolt and adjusting nut.

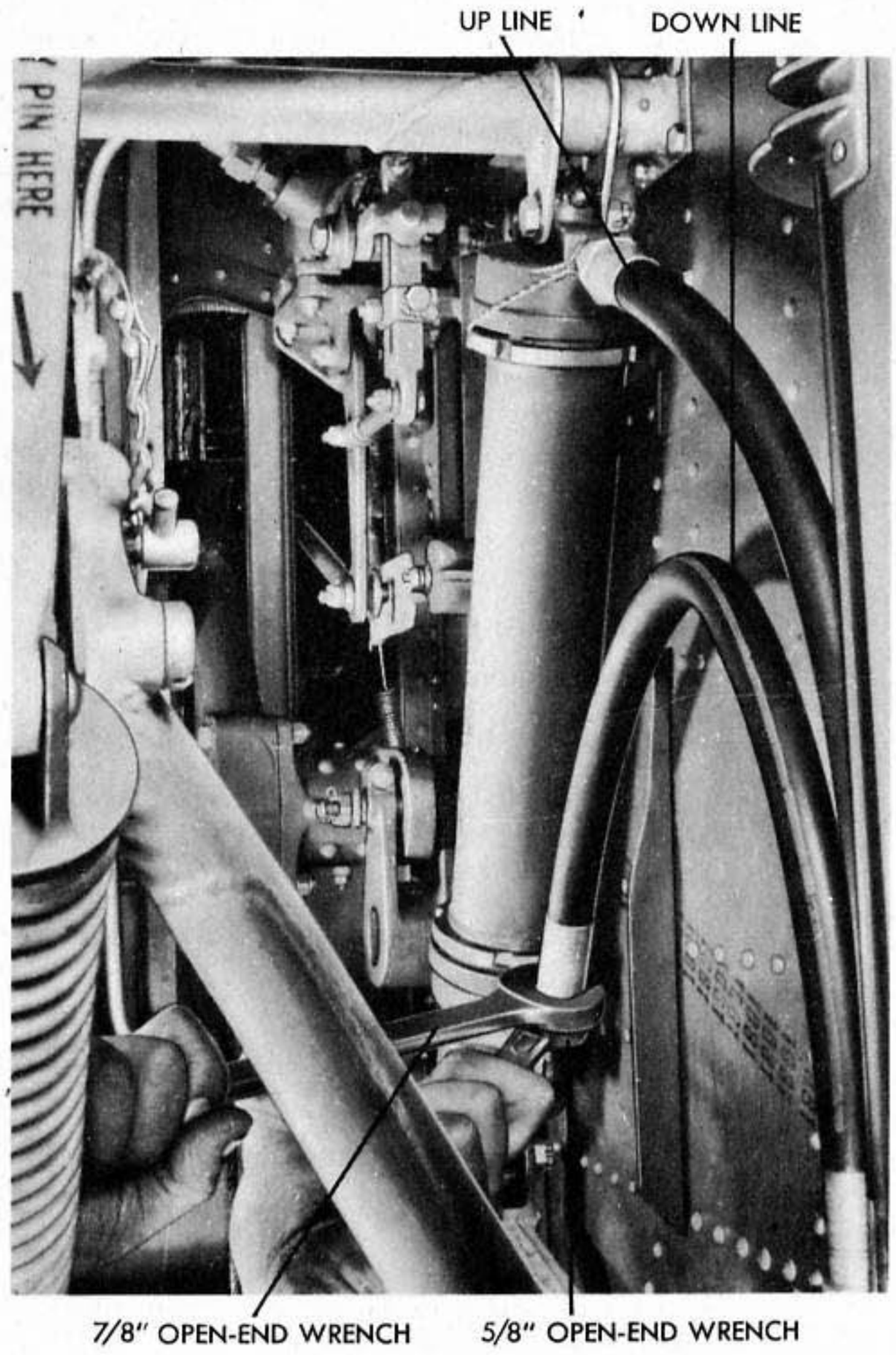
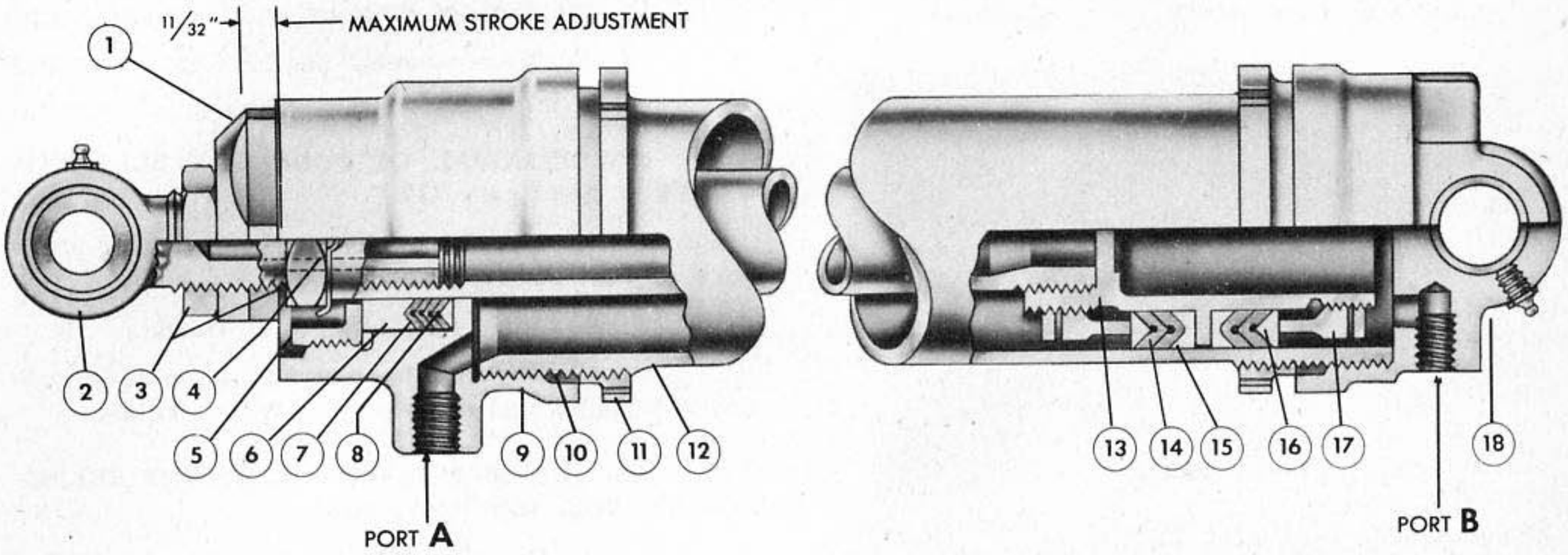


Figure 213 - REMOVING NOSE GEAR ACTUATING STRUT



ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	4067834	CAP, NOSE WHEEL ACTUATING STRUT	1
2.	2067267	BOLT ASSEMBLY, NOSE WHEEL ACTUATING STRUT EYE	1
3.	1058216	NUT, NOSE WHEEL ACTUATING STRUT CHECK	2
4.	1067769	WASHER, NOSE WHEEL ACTUATING STRUT LOCK	1
5.	1067661	NUT, NOSE WHEEL ACTUATING STRUT ROD PACKING	1
6.	1067712	RING, NOSE WHEEL ACTUATING STRUT PACKING	1
7.	5135865-4X-100	PACKING, HYDRAULIC CHEVRON	4
8.	1012954-B100-008	RING, END PACKING	1
9.	4067497	HEAD, NOSE WHEEL ACTUATING STRUT	1
10.	1111908-210-216-187	GASKET, EXTERNAL SEAL RING	2
11.	1066995	RING, NOSE WHEEL ACTUATING STRUT SEAL	2
12.	4067479	BARREL, NOSE WHEEL ACTUATING STRUT	1
13.	2068409	PISTON ASSEMBLY, NOSE WHEEL ACTUATING STRUT	1
14.	5135865-5X-112	PACKING, HYDRAULIC CHEVRON	4
15.	1012953-B112-010	RING, CENTER PACKING	2
16.	1012954-B112-010	RING, END PACKING	2
17.	1067669	NUT, NOSE WHEEL ACTUATING STRUT PISTON PACKING	2
18.	4067492	END ASSEMBLY, NOSE WHEEL ACTUATING STRUT	1

Figure 214 - NOSE GEAR ACTUATING STRUT

(j) Remove cylinder head from cylinder and remove Neoprene seal.

(31) REMOVAL OF NOSE GEAR ACTUATING STRUT (See figure 213.)

(a) Relieve the hydraulic pressure with the landing gear control lever in DOWN position.

(b) Attach ground safety latch retracting linkage.

(c) Disconnect and cap all lines.

(d) Disconnect and remove cylinder from airplane.

(32) DISASSEMBLY OF NOSE GEAR ACTUATING STRUT. (See figure 214.)

(a) Loosen end lock nut and Neoprene seal at the piston end of the cylinder.

(b) Unscrew cylinder end and slide out piston assembly.

(c) Unscrew packing nut from piston rod end and remove packing assembly.

(d) Loosen lock nuts and lock washer on eyebolt.

(e) Unscrew and remove eyebolt and adjusting nut.

(f) Remove adjusting nut and lock nut from eyebolt.

(g) Slide cylinder end assembly from piston rod.

(h) Unscrew packing nut from piston head, and remove nut and packing.

(i) Unscrew piston head from piston rod, and remove packing and packing nut.

(j) Remove packing nut and packing assembly from cylinder.

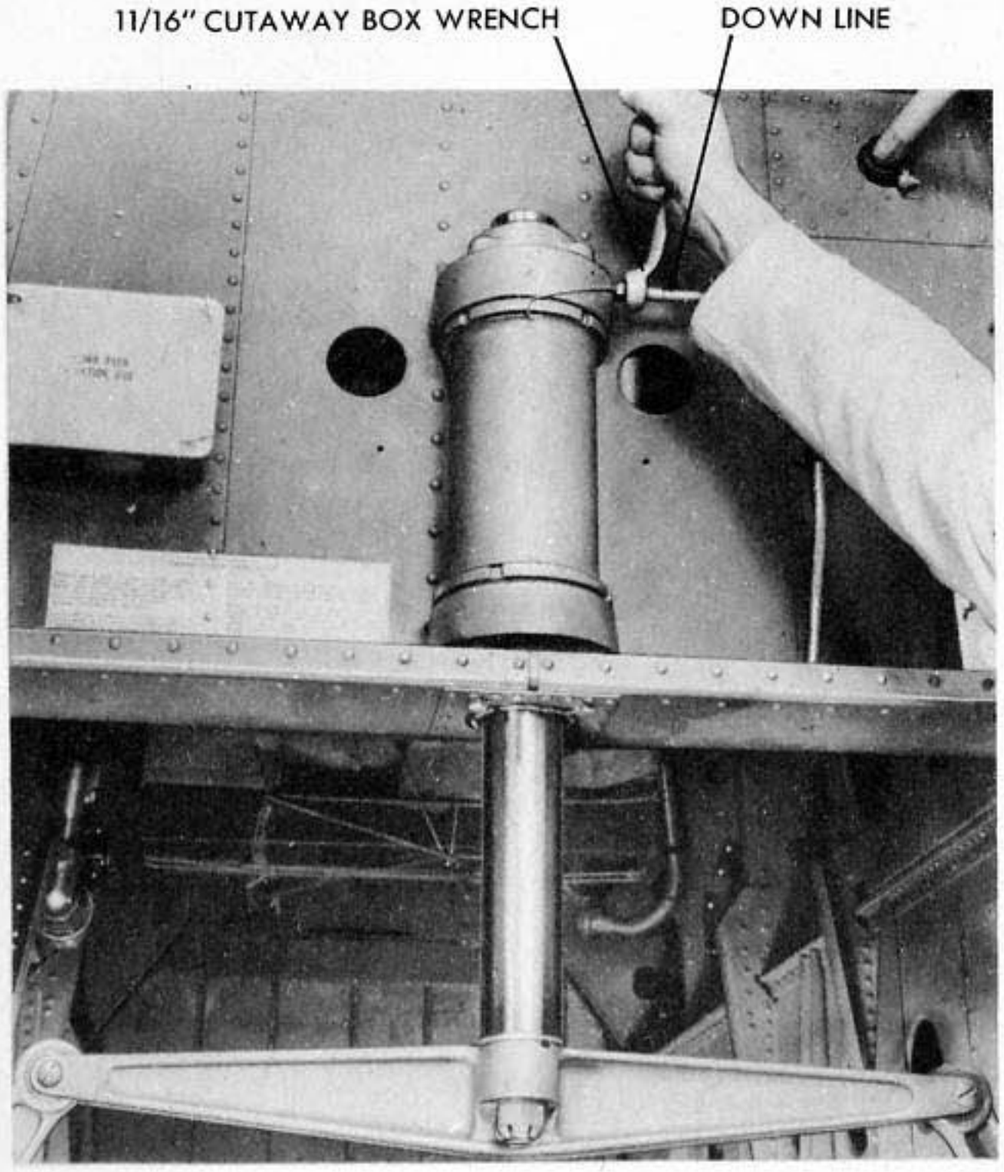


Figure 215 - REMOVING BOMB BAY DOOR ACTUATING STRUT

(k) Loosen head lock nut and seal at cylinder head.

(l) Remove cylinder head seal, and nut from cylinder.

(33) REMOVAL OF BOMB BAY DOOR ACTUATING STRUT. (See figure 215.)

(a) Relieve the hydraulic pressure in the complete system.

(b) Disconnect and cap all lines.

(c) Remove complete strut from airplane.

(34) DISASSEMBLY OF BOMB BAY DOOR ACTUATING STRUT. (See figure 216.)

(a) Loosen seal lock nuts and Neoprene seals at both cylinder heads.

(b) Unscrew and remove cylinder heads, and slide out piston assembly.

(c) Remove snap rings and washers from cylinder heads.

(d) Unscrew glands and remove packing.

(e) Unscrew packing nuts from piston, and remove packing.

(f) Remove piston from piston rod.

(g) Remove threaded end from piston rod.

(h) Remove seals and lock nuts from cylinder.

(35) REMOVAL OF FOUR-WAY SELECTOR VALVES. (See figure 217.)

(a) Relieve the hydraulic operating pressure with the control lever in the DOWN position.

(b) Disconnect and cap all lines.

(c) Remove attaching nuts from valve, disconnect handle, and remove valve from airplane.

(36) DISASSEMBLY OF FOUR-WAY SELECTOR VALVES. (See figure 200.)

(a) Unscrew retainer nuts from bottom of valve and remove springs, retainers, ball checks, plungers, and seal.

(b) Remove seats.

(c) Remove screws from top of valve and slide out the retainers, cup packing, and rings.

(37) REMOVAL OF BOMB DOOR SELECTOR VALVE.

(a) Relieve hydraulic pressure in the complete system.

(b) Disconnect and cap all lines.

(c) Remove valve from airplane.

(38) DISASSEMBLY OF BOMB DOOR SELECTOR VALVE. (See figure 201.)

(a) Remove caps and cap seals.

(b) Remove springs and valve assemblies.

(c) Disassemble valves, springs, spacers, and cups.

(d) Remove screws holding retainer and remove retainer.

(e) Remove shaft from body.

(f) Remove cup and seal from shaft.

(g) Remove plugs from body.

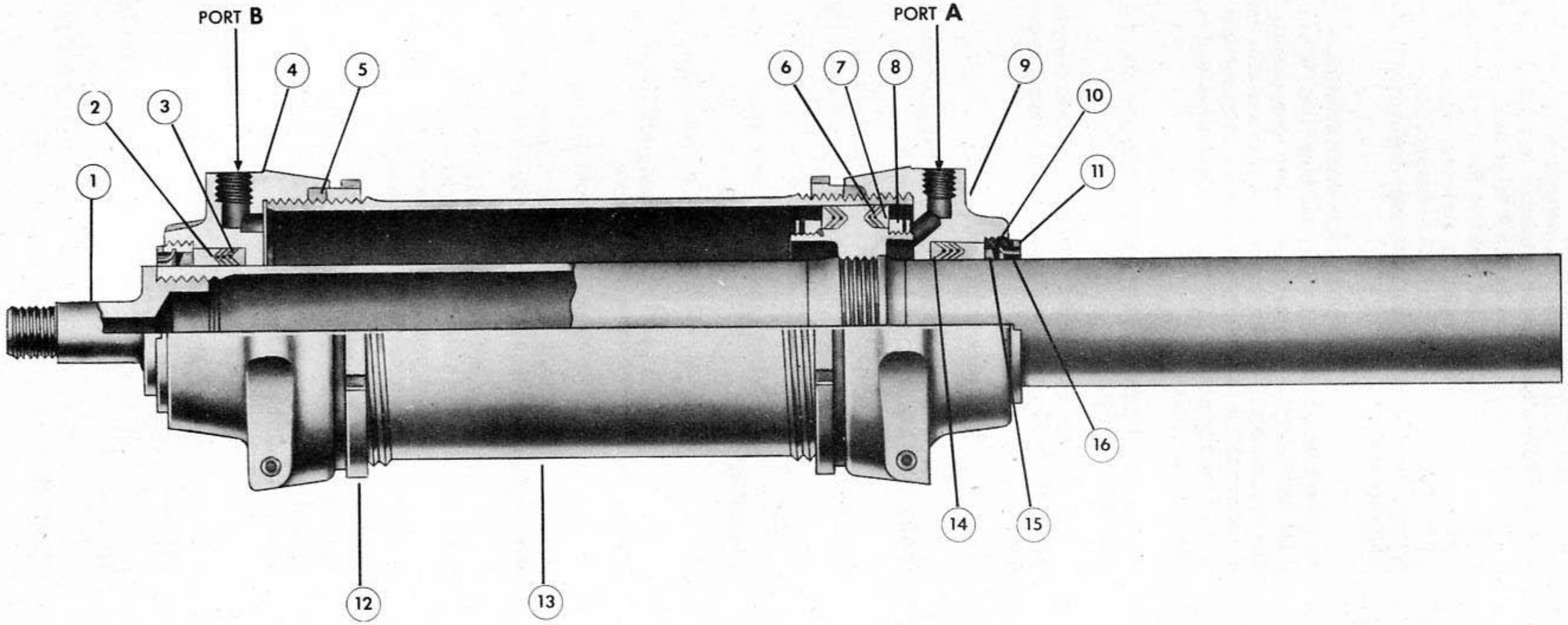
d. REPLACEMENTS.

(1) GENERAL.

(a) Clean all parts with hydraulic fluid and wipe dry with a clean cloth.

(b) Inspect all metal parts for wear or breakage. Pay particular attention to balls and ball seats, valves and valve seats, springs, and to threaded parts. Replace worn or broken parts.

(c) Replace all packings.



ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	4066510	PISTON ASSEMBLY, BOMB BAY DOOR ACTUATING STRUT	1
2.	1059854	RING, BOMB BAY DOOR ACTUATING STRUT PACKING	2
3.	5135865-5X-204	PACKING, HYDRAULIC CHEVRON	6
4.	4065573	HEAD, BOMB BAY DOOR ACTUATING STRUT	1
5.	1111908-412-418-187	GASKET, EXTERNAL SEAL RING	2
6.	5135865-6X-308	PACKING, HYDRAULIC CHEVRON	4
7.	179261-308-400	RING, CENTER PACKING	2
8.	2064893	NUT, BOMB BAY DOOR ACTUATING STRUT PACKING	2
9.	4065558	END, BOMB BAY DOOR ACTUATING STRUT	1
10.	1066206	RING, BOMB BAY DOOR ACTUATING STRUT FELT PACKING	2
11.	2064894	GLAND, BOMB BAY DOOR ACTUATING STRUT PACKING	2
12.	2064896	NUT, BOMB BAY DOOR ACTUATING STRUT SEAL	2
13.	4066543	BARREL, BOMB BAY DOOR ACTUATING STRUT	1
14.	179261-204-224	RING, CENTER PACKING	2
15.	126221-3-34-40	WASHER, PACKING	2
16.	1066205	RING, BOMB BAY DOOR ACTUATING STRUT SNAP	2

Figure 216 - BOMB BAY DOOR ACTUATING STRUT

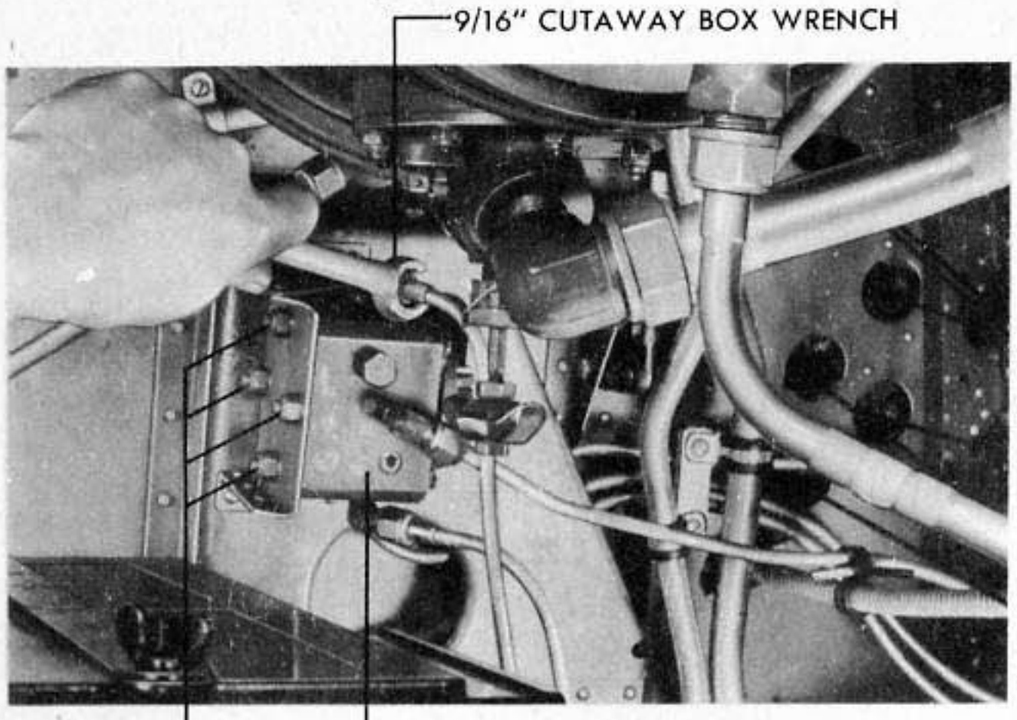


Figure 217 - REMOVING FOUR-WAY SELECTOR VALVE

e. TESTS.

(1) HYDRAULIC SYSTEM TEST PROCEDURE.

(a) GENERAL. - Following are the steps for testing the hydraulic system after a unit has been removed and reinstalled in the airplane, to ensure its correct operation. Refer to figure 182 for the relative location of the units of the system and the routing of the connecting lines.

(b) PROCEDURE.

1 Disconnect the main pressure line from the manifold block, and plug the line. This line runs from the hand pump bypass valve to the left-hand manifold block.

2 Install a 2000 pound per square inch pressure gage in the port of manifold block. Build up pressure by use of the hand pump.

3 Apply 1200 ± 50 pounds per square inch pressure so that the landing gear relief valve will operate.

4 With airplane supported on jacks, apply 1100 pounds pressure to each main system (landing gear, wing flaps, cowl flaps, etc.) then operate the actuating strut to the full limit of its travel in both directions, checking for proper clearance, adjustments, and fluid leaks.

5 Remove the test gage from the left-hand manifold block and reconnect the main pressure line.

6 Open the bypass valve and apply 1025 ± 25 pounds per square inch pressure so that the main system relief valve will operate and check for leaks.

7 Connect an outside source of fluid and pressure supply to the pressure and suction lines at either fire wall, and apply 825 ± 25 pounds per square inch pressure. Check for leaks in the pump pressure lines just before the regulator relieves. Operate each of the systems at normal fluid pressure, checking for proper fluid level in the reservoir before and after each operation.

8 Disconnect right-hand manifold block to reservoir line at reservoir, and plug line. With the hand pump bypass valve closed, build up pressure in the system with the hand pump. Operate any unit until pressure in the return system reaches 200 pounds per square inch pressure. Check all return lines and connections for leaks.

(2) TEST OF FLUID RESERVOIR BEFORE INSTALLATION.

(a) Plug outlet openings and test complete assembly to 15 pounds per square inch hydraulic pressure.

(b) Check for leaks.

(3) TEST OF PRESSURE ACCUMULATOR BEFORE INSTALLATION. (See figure 186.)

(a) With air valve removed, apply 450 pounds per square inch hydraulic pressure to port B.

(b) Check for fluid leaks.

(c) Release pressure and repeat above operations twice.

(d) Drain all fluid from accumulator.

(e) With port B open, apply 450 pounds per square inch air pressure at air valve.

(f) Submerge the accumulator in water.

(g) Check for air leaks. There must be no drop in the air pressure after the tank has set 48 hours.

(h) With the lower portion of the accumulator filled with 450 pounds per square inch air pressure, apply 1500 pounds per square inch hydraulic pressure to upper portion of accumulator.

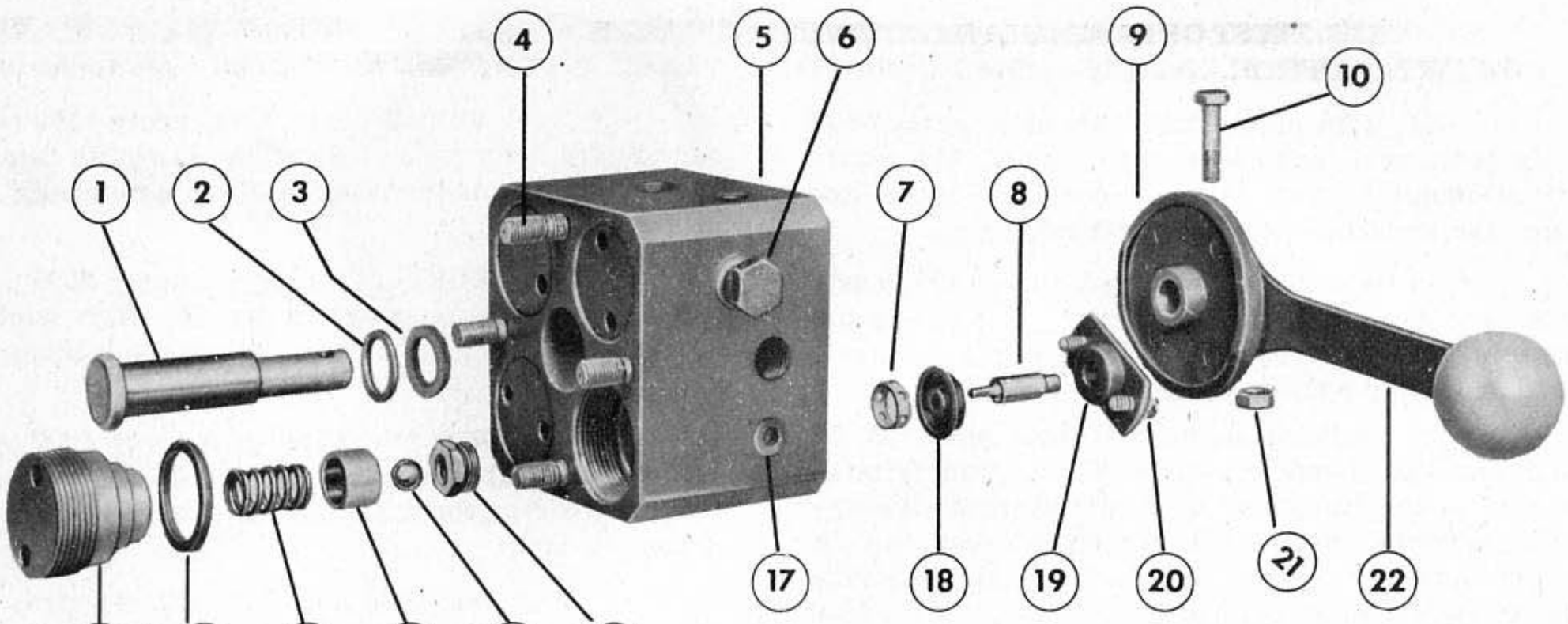
(i) Repeat this operation three times, releasing the pressure after each application. There should be no drop in the original air pressure in the lower half of the accumulator.

(j) Check each time for air or fluid leakage.

(k) Carefully release the air from the lower portion.

(l) Check for oil in air. Oil in air indicates leakage of the diaphragm.

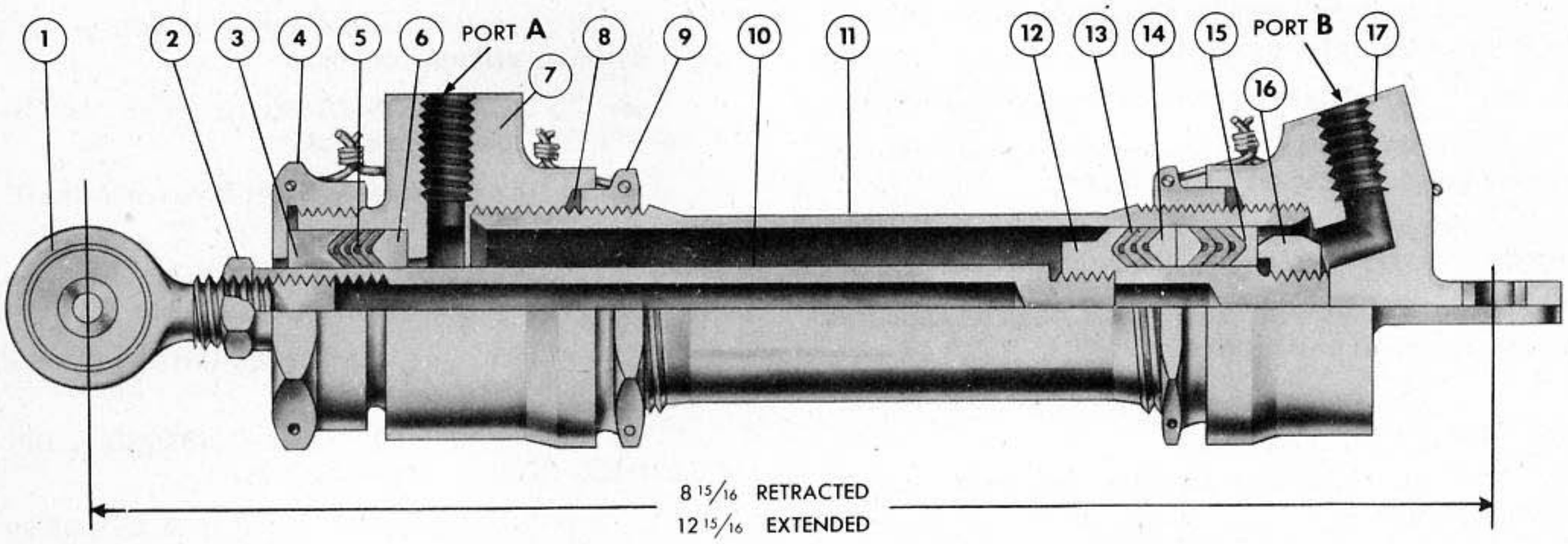
(4) TEST OF PRESSURE REGULATOR BEFORE INSTALLATION. (See figure 187.)



ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	1056224	SHAFT, HYDRAULIC SELECTOR VALVE	1
2.	143908-016S022-030	WASHER	1
3.	143908-016B022-002	WASHER	*6
4.	1056232	STUD, HYDRAULIC SELECTOR VALVE TWO-WAY	4
5.	4065505	BODY, COWL FLAP HYDRAULIC SELECTOR VALVE	1
6.	1063678	PLUG HYDRAULIC SELECTOR VALVE BODY DRILL HOLE	1
	143908-008TC016-064	WASHER	1
7.	163768-008-010	SPACER, HYDRAULIC PACKING CUP	4
8.	1056227	PLUNGER, HYDRAULIC SELECTOR VALVE	4
9.	2055537	CAM ASSEMBLY, SELECTOR VALVE	1
	143908-012B020-005	WASHER	*5
10.	AN3-13	BOLT	1
	AN960-10	WASHER	1
	178166-190-249-014	SPACER	2
11.	1056225	NUT, HYDRAULIC SELECTOR VALVE	4
12.	143908-026SR-100-093	WASHER	4
13.	1056230	SPRING, HYDRAULIC SELECTOR VALVE	4
14.	1056253	RETAINER, SELECTOR VALVE	4
15.	5 16" DIA	BALL, BRIGHT STEEL	4
16.	1064795	SEAT, NO. 6 BALL VALVE	4
17.	AC895-B-100	PLUG	3
18.	1049003-D-008	CUP, 3/16" x 3/16" HYDRAULIC PACKING FLARED	4
19.	1056228	GLAND, HYDRAULIC SELECTOR VALVE	4
20.	AC503-8-6	SCREW	8
21.	AC310-3	NUT	1
22.	2064907	LEVER ASSEMBLY, UPPER COWLING FLAP HYDRAULIC VALVE	1
	1056229	SPRING, LEVER	1

*Use as necessary

Figure 218 - FOUR-WAY SELECTOR VALVE - EXPLODED VIEW



ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	1066951	END ASSEMBLY, UPPER COWLING FLAP ACTUATING STRUT	1
2.	AN316-6R	NUT	1
3.	1066986	RING, UPPER COWLING FLAP ACTUATING STRUT PACKING	1
4.	1066932	NUT, UPPER COWLING FLAP ACTUATING STRUT PACKING	1
5.	5135865-4X-016	PACKING, HYDRAULIC CHEVRON	4
6.	1012954-B016-008	RING, END PACKING	1
7.	2067204	HOUSING, UPPER COWLING FLAP ACTUATING STRUT	1
8.	1111908-108-114-094	GASKET, EXTERNAL SEAL RING	2
9.	1066931	NUT, UPPER COWLING FLAP ACTUATING STRUT SPECIAL	2
10.	1066950	ROD, UPPER COWLING FLAP ACTUATING STRUT PISTON	1
11.	2067239	STRUT, UPPER COWLING FLAP ACTUATING	1
12.	1066933	HEAD, UPPER COWLING FLAP ACTUATING STRUT PISTON	1
13.	5135865-4X-016	PACKING, HYDRAULIC CHEVRON	6
14.	1012954-B016-008	RING, END PACKING	2
15.	1012953-B016-008	RING, CENTER PACKING	1
16.	1066169	NUT, UPPER COWLING FLAP ACTUATING STRUT CASTLE	1
17.	2067238	HEAD ASSEMBLY, UPPER COWLING FLAP ACTUATING STRUT	1

Figure 219 - UPPER COWL FLAP ACTUATING STRUT

(a) Wipe all parts clean, and use ample approved thread lubricant on threads.

(b) Assemble eyebolt and lock nut to piston rod.

(c) Slide piston end packing nut, packing, and cylinder end onto piston rod.

(d) Attach piston head to rod and place packing in position. Install packing nut.

(e) Assemble cylinder head, seal, and lock nut on cylinder.

(f) Install cylinder end seal and lock nut.

(g) Insert piston assembly in cylinder and screw on cylinder end.

(h) Tighten lock nuts against seal.

(12) INSTALLATION OF UPPER AND LOWER COWL FLAP ACTUATING STRUTS. (See figure 218.) - Install strut in airplane. Use approved thread lubricant on all threads.

(13) ASSEMBLY OF OUTBOARD AND INBOARD WING FLAP ACTUATING STRUT. (See figures 197 and 198.)

(a) Wipe all parts clean, and use ample thread lubricant on all threads.

(b) Assemble packing, packing ring, and packing nuts in piston head. Replace cotter pins.

(c) Assemble packing, wiper, and packing nut to cylinder head assembly.

(d) Slide cylinder end assembly onto shaft. (See figures 197 and 198.)

(e) Assemble eyebolt, lock washer, and nut to piston shaft.

(f) Assemble cylinder head, seal, and lock nut to cylinder.

(g) Slide piston into cylinder and assemble cylinder end.

(h) Assemble Neoprene seal and head lock at the piston end.

(14) INSTALLATION OF OUTBOARD AND INBOARD WING FLAP ACTUATING STRUTS. (See figure 209.)

(a) Install strut in airplane.

(b) Uncap and connect all lines. Use approved thread lubricant on all threads.

(15) ASSEMBLY OF BRAKE LINE SWIVEL JOINT. (See figure 196.)

(a) Wipe all parts clean and use ample approved lubricant on all threads.

(b) Place lock nut, packing rings, and chevron packing, spring and cup onto elbow.

(c) Put washer and check nut on elbow and insert pin.

(d) Put seal in position on body.

(e) Slide elbow assembly into body.

(f) Tighten lock nut sufficiently to prevent leaks, but not enough to bind operation of joint.

(16) INSTALLATION OF BRAKE LINE SWIVEL JOINT.

(a) Place joint in position in airplane.

(b) Uncap and attach all lines to swivel joint. Use approved thread lubricant on all threads.

(17) ASSEMBLY OF BRAKE DEBOOSTER. (See figure 220.)

(a) Wipe all parts clean and use ample approved thread lubricant on all threads.

(b) Assemble spring guide and ball check to cylinder.

(c) Slide piston onto cylinder and install seal and lock.

(d) Place spring over piston, and slide into chamber.

(e) Assemble stop, washer, spring and retainer into inner chamber of cover.

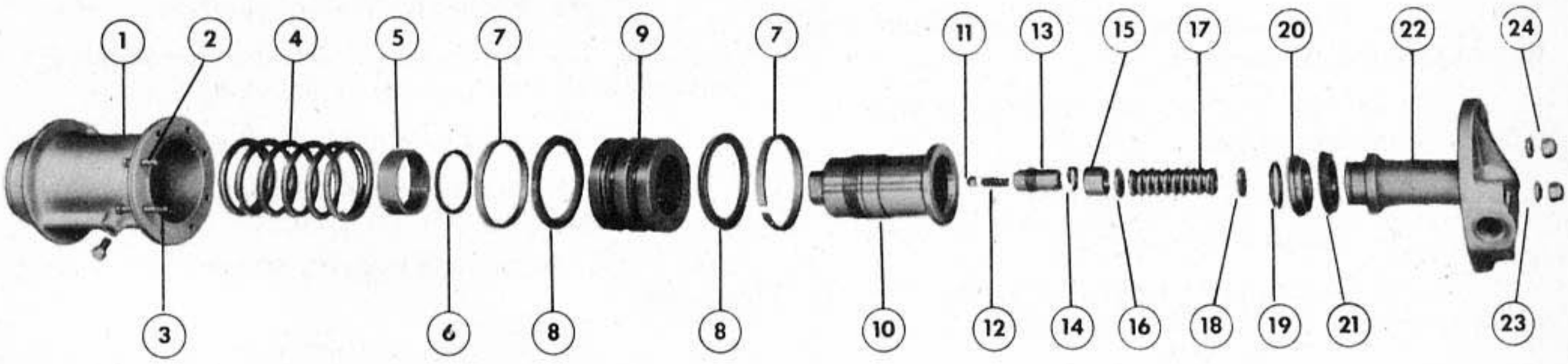
(f) Install cup, spacer, and retainer on cover.

(g) Assemble cover to body, being careful to assemble straight in until inner chamber has fully entered body. Add nuts and tighten.

(18) INSTALLATION OF BRAKE DEBOOSTER.

(a) Assemble debooster to axle.

(b) Uncap and connect all lines to debooster. Use approved thread lubricant on all threads.



ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	4073961	HOUSING ASSEMBLY, BRAKE DEBOOSTER	1
2.	AN502-10-16	SCREW	6
3.	AN502-10-26	SCREW	2
4.	1073371	SPRING, DEBOOSTER PISTON RETURN	1
5.	1073374	NUT, BRAKE DEBOOSTER GASKET	1
6.	143908-120SR126-094	WASHER	1
7.	1073397	SPACER, DEBOOSTER OUTER CUP	2
8.	1049003-D-204	CUP, 3/16 x 3/16 HYDRAULIC PACKING FLARED	2
9.	2073896	PISTON, BRAKE DEBOOSTER	1
10.	2073889	CYLINDER, BRAKE DEBOOSTER INNER	1
11.	9/32 DIA.	BALL, STEEL	1
12.	1073372	SPRING, DEBOOSTER EQUALIZING VALVE	1
13.	1074551	GUIDE, DEBOOSTER EQUALIZING VALVE	1
14.	1073370	RETAINER, DEBOOSTER SPRING STOP	1
15.	1073369	STOP, DEBOOSTER RELIEF SPRING	1
16.	1074550	WASHER, DEBOOSTER RELIEF SPRING	*4
17.	1073373	SPRING, DEBOOSTER RELIEF	1
18.	AN960-D516	WASHER	*1
19.	1073399	RETAINER, DEBOOSTER CUP SPACER	1
20.	1073398	SPACER, DEBOOSTER INNER CUP	1
21.	1049003-D-100	CUP, 3/16 x 3/16 HYDRAULIC PACKING FLARED	1
22.	2073880	COVER, BRAKE DEBOOSTER	1
23.	AN960-10L	WASHER	8
24.	AC365-10L	NUT	8

*Use as necessary.

Figure 220 - BRAKE DEBOOSTER - EXPLODED VIEW

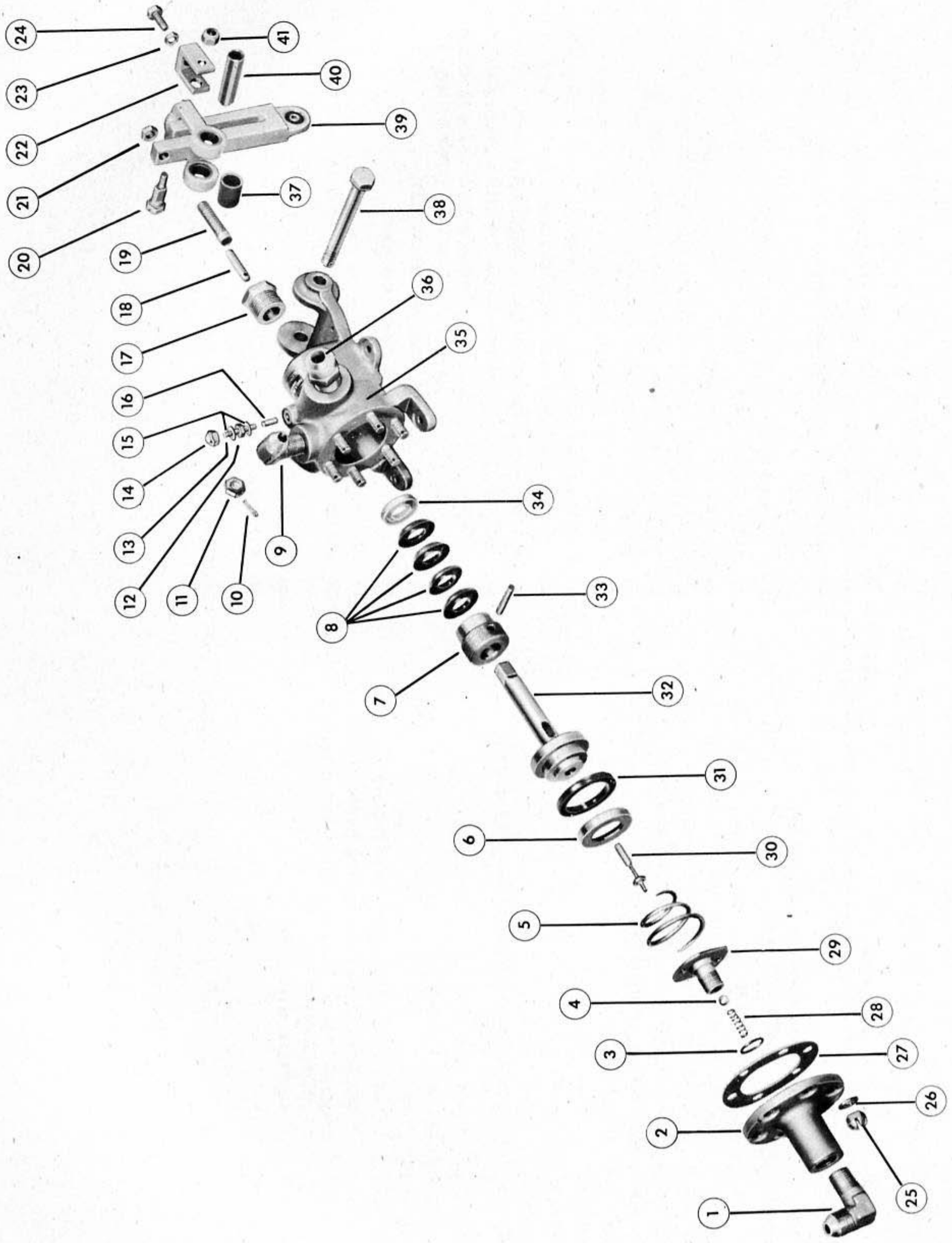


Figure 221 - BRAKE CONTROL VALVE - EXPLODED VIEW

(g) Place seal in position in body and screw adjusting screw up to its approximate position.

NOTE

The position of this screw is determined during tests.

(28) INSTALLATION OF ADJUSTABLE RELIEF VALVE.

(a) Install valve in place.

(b) Install attaching bolts.

(c) Uncap lines and attach to valve. Use approved thread lubricant on all threads.

(29) ASSEMBLY OF PRESSURE REGULATOR RELIEF VALVE. (See figure 189.)

(a) Wipe all parts clean and use ample approved thread lubricant on all threads.

(b) Assemble seat fitting, guide, and spring.

(c) Assemble adjusting nut.

(d) Assemble lock nut, gasket, and cap to body.

(30) INSTALLATION OF PRESSURE REGULATOR RELIEF VALVE. (See figure 205.)

(a) Install valve in place in airplane with its two attaching bolts.

(b) Uncap and connect all lines. Use approved thread lubricant on all threads.

(31) ASSEMBLY OF DISCONNECT VALVES. (See figure 188.)

(a) Wipe all parts clean and use ample approved thread lubricant on all threads.

(b) Place ball and spring in position in body.

(c) Install new gasket and screw union into body.

(32) INSTALLATION OF DISCONNECT VALVES.

(a) With a new gasket in position, place valve through fire wall.

(b) Assemble adapter with new gasket in place to body.

(c) Assemble adapter nut.

(d) Lock nuts in position with lock wire.

(e) Uncap and connect all lines. Use approved thread lubricant on all threads.

(33) ASSEMBLY OF PRESSURE REGULATOR. (See figure 223.)

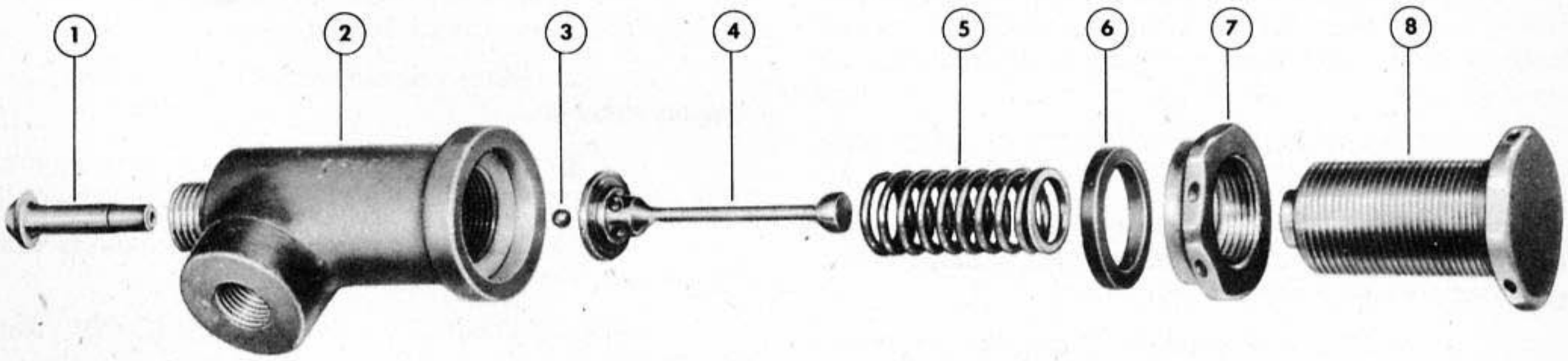
(a) Wipe all parts clean and use ample approved thread lubricant on all threads.

(b) Assemble plug, tee, reducer bushing, and elbow to top end of housing.

(c) Assemble packing spring, packing ring, two chevron packings, packing ring, and packing nut to inside of housing.

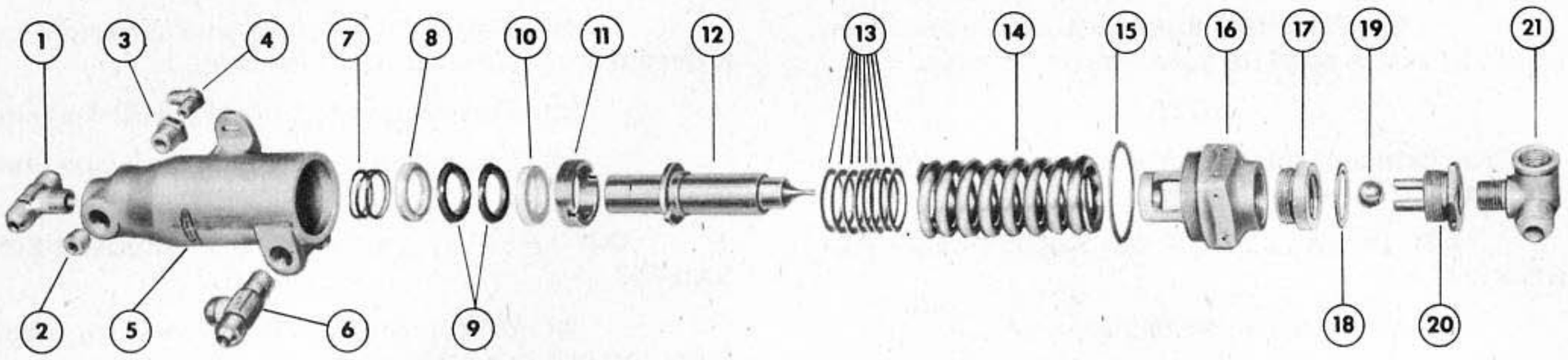
(d) Place piston, shims, and piston spring in position in housing.

(e) Place housing and end in an arbor press, and assemble end to housing, using a new gasket.



ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	1086474	SEAT, HYDRAULIC MECHANISM ADJUSTABLE RELIEF VALVE	1
2.	2085701	BODY, HYDRAULIC MECHANISM ADJUSTABLE RELIEF VALVE	1
3.	1/8 DIA	BALL, BRIGHT STEEL	1
4.	2085703	STEM, HYDRAULIC MECHANISM ADJUSTABLE RELIEF VALVE	1
5.	1085704	SPRING, HYDRAULIC MECHANISM ADJUSTABLE RELIEF VALVE	1
6.	143908-020SR026-093	WASHER	1
7.	1085707	NUT, HYDRAULIC MECHANISM ADJUSTABLE RELIEF VALVE	1
8.	1085705	SCREW, HYDRAULIC MECHANISM ADJUSTABLE RELIEF VALVE	1

Figure 222 - HYDRAULIC ADJUSTABLE RELIEF VALVE - EXPLODED VIEW



ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	AC811ST-8	TEE	1
2.	AC895-102	PLUG	1
3.	AC895-D81	BUSHING, REDUCING	1
4.	AC811CT-4D	ELBOW	1
5.	4005433	HOUSING, HYDRAULIC PRESSURE REGULATING VALVE	1
6.	AC811RT-8	TEE	1
7.	1070624	SPRING, HYDRAULIC PRESSURE REGULATING VALVE PACKING	1
8.	1072036	SPACER, HYDRAULIC PRESSURE REGULATING VALVE, INNER	1
9.	5135865-4N-030	PACKING, HYDRAULIC CHEVRON	2
10.	1070625	SPACER, HYDRAULIC PRESSURE REGULATING VALVE PACKING	1
11.	1072037	NUT, HYDRAULIC PRESSURE REGULATING VALVE	1
12.	1005410	PISTON, HYDRAULIC PRESSURE REGULATING VALVE	1
13.	143908-104R116-010	WASHER	8
14.	1005430	SPRING, HYDRAULIC PRESSURE REGULATING VALVE	1
15.	AN900-31	GASKET	1
16.	2005427	END, HYDRAULIC PRESSURE REGULATING VALVE	1
17.	1066288	SEAT, NO. 8 BALL VALVE	1
18.	AN900-18	GASKET	1
19.	9/16" DIA.	BRIGHT STEEL BALL	1
20.	2005429	BUSHING, HYDRAULIC PRESSURE REGULATING VALVE	1
21.	2104186	TEE, SPECIAL NO. 8 SIDE OUTLET	1

Figure 223 - HYDRAULIC PRESSURE REGULATOR - EXPLODED VIEW

(f) Place steel ball in position and assemble bushing to housing, using a new gasket.

(g) Assemble three-way elbow to bushing.

(34) INSTALLATION OF PRESSURE REGULATOR. (See figure 204.) - Place pressure regulator in position. Install the two attaching bolts. Uncap and connect lines. Use approved thread lubricant on all threads.

(35) ASSEMBLY OF PRESSURE ACCUMULATOR. (See figure 186.)

(a) Wipe all parts clean. Put approved thread lubricant around rim of diaphragm and its seat on the upper and lower domes.

(b) Place diaphragm in position on lower dome and put upper dome in place.

(c) Assemble bolts and studs to upper and lower domes, installing nuts loosely by hand.

(d) Select any three bolts or studs 120 degrees apart. Mark each one for identification. Measure the length of each of the selected bolts or studs with a micrometer.

(e) Tighten nuts on these studs or bolts evenly, until the bolts have lengthened 0.0065 inch, minus 0.001 inch. Use a torque wrench. Observe the torque required when nuts are tightened.

(f) Continue with balance of nuts until all are tightened to the torque required in step (5).

(g) Assemble washer and valve assembly to lower dome.

(36) INSTALLATION OF PRESSURE ACCUMULATOR. (See figure 203.)

(a) Place accumulator in position and attach with bolts.

(b) Uncap lines and attach to accumulator. Use ample approved thread lubricant on all threads.

(c) Fill lower portion of accumulator with 300 pounds per square inch air pressure.

(37) ASSEMBLY OF FLUID RESERVOIR. (See figure 185.)

(a) Assemble filter to reservoir, using a new gasket. Use an approved thread lubricant on threads.

(b) Assemble strainer and filler plug.

(c) Install fluid gage rod.

(38) INSTALLATION OF FLUID RESERVOIR. (See figure 202.)

(a) Install reservoir in position in airplane.

(b) Install reservoir attaching bolts.

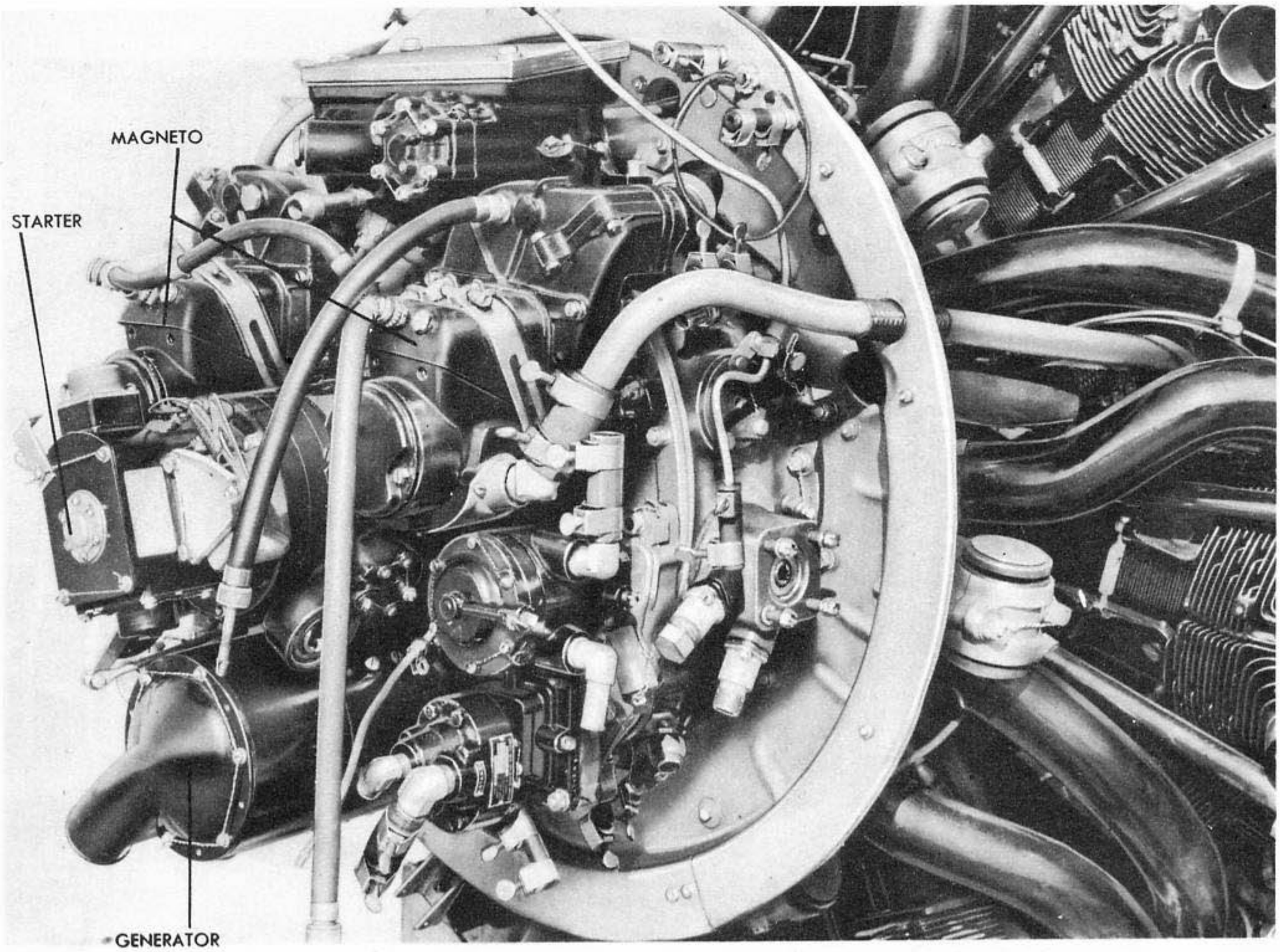


Figure 231 - ENGINE ELECTRICAL ACCESSORIES

17. ELECTRICAL SYSTEM

a. DESCRIPTION.

(1) GENERAL. - A single wire, 28-volt, grounded type, partially shielded electrical system is provided. Conventional in plan, the electrical system consists of the engine ignition and starter circuits, the generator and battery circuits, and the lighting and auxiliary circuits. A two-wire system is used in the bomb release circuits. Much vital equipment such as propellers, radios, and instruments depend upon the electrical system. Therefore the system must be in complete operating condition before take-off. There is sufficient capacity in generators and batteries so that all equipment necessary to flight may be operated with one of the generators "out". The batteries are adequate for a short flight if the generators fail, and all electrically operated equipment not essential to flight is turned OFF to conserve battery power.

(2) GENERATORS AND BATTERIES.

(a) GENERAL. - Each engine has a 28-volt generator (figure 120) whose output is controlled by a voltage regulator and reverse current relay. Two 12-volt batteries connected in series serve to start the engines in the absence of an outside source of power.

(b) GENERATORS. (See figure 231.) - Type 0-1 28-volt generators are used. A reverse current relay switch (sometimes called "generator cut-out" or "line switch") and ammeter shunt are installed in each nacelle. The voltage regulators and a panel containing two generator ON-OFF switches, two ammeters, a voltmeter, and a voltmeter selector switch are located to the right of the upper gunner's position The generators carry the load after the engines are started. Therefore the ammeters merely show the amount of current supplied to the system. The continuous electrical load is comparatively low in relation to the

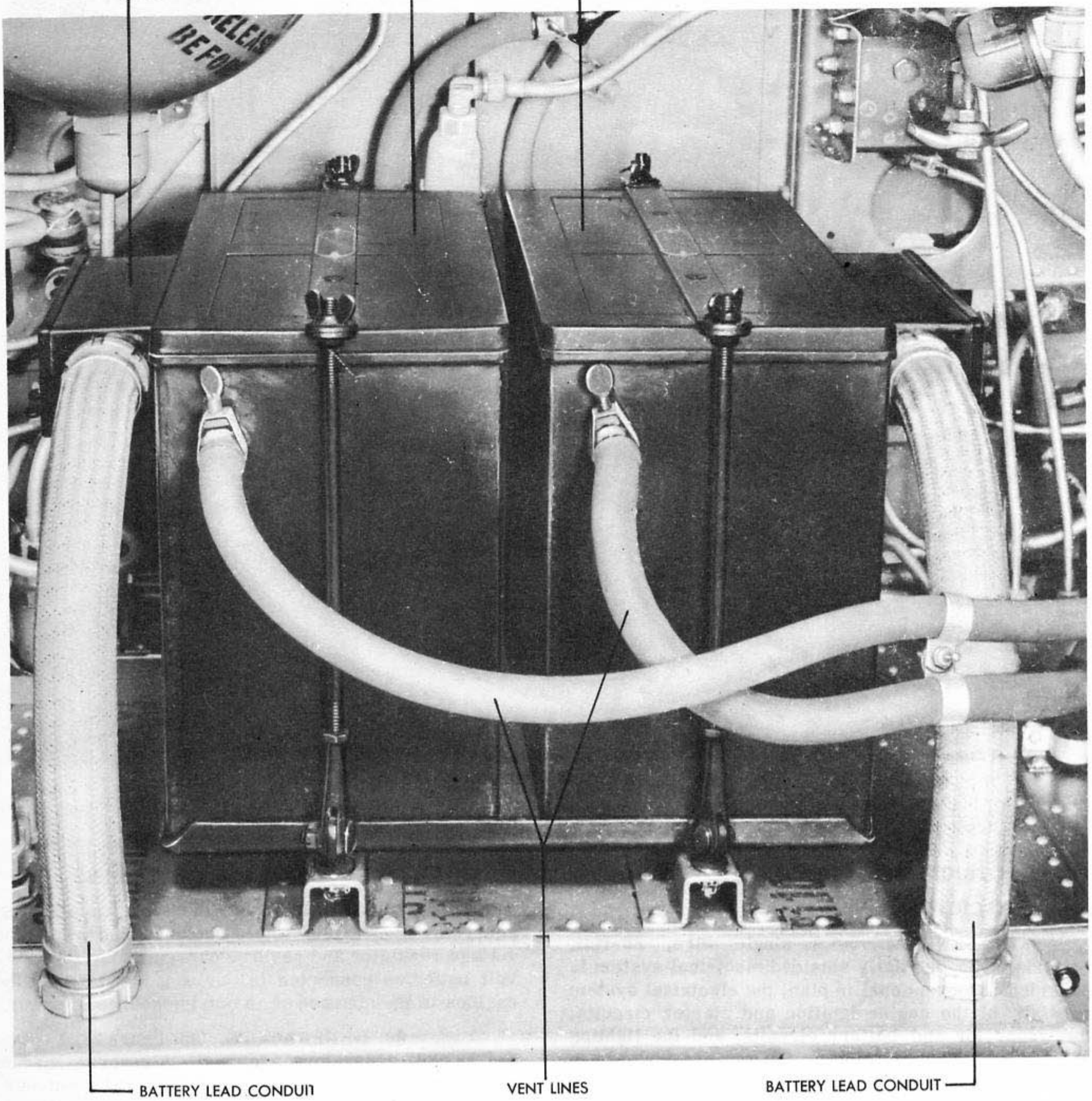


Figure 232 - INSTALLED BATTERIES

generator capacity. This additional capacity is necessary to care for emergency conditions. During long flights where the batteries become fully charged and there is little load on the electrical system the ammeter readings for the generator may be low. This is a normal condition and does not indicate that the generator, regulator, or relay switch is faulty. If the generator shows approximately normal voltage on the voltmeter in the gunner's cockpit, the voltage regulator and the generator are in working condition. During normal flight all generator switches should be ON so the generator capacity will be available immediately when required. No advantage is gained by having switches OFF.

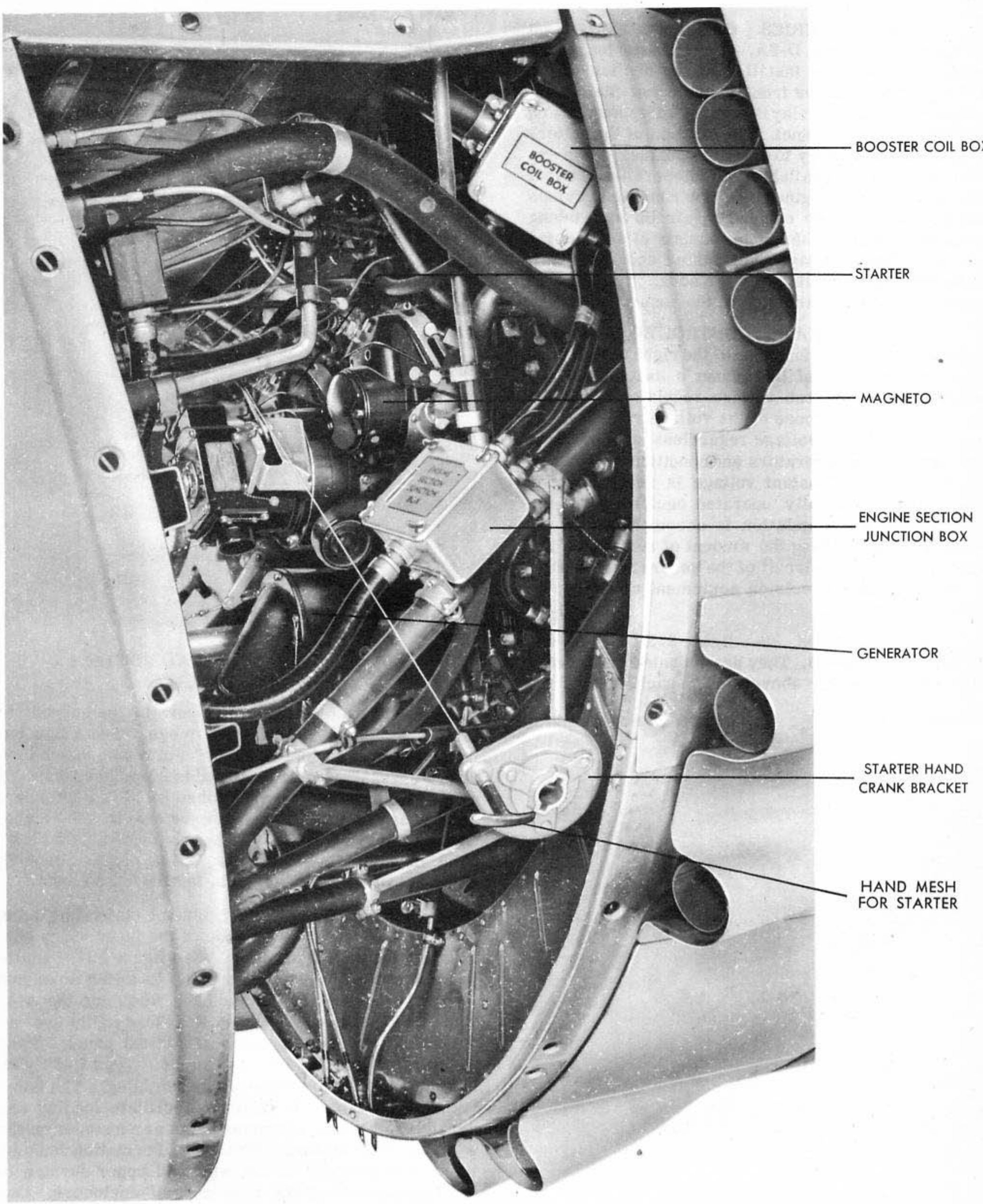


Figure 233 - ELECTRICAL EQUIPMENT ON REAR OF INSTALLED ENGINE

(c) BATTERIES. (See figure 232.) - Two 68 ampere-hour type D-6A, 12-volt batteries, connected in series, are installed in the section of the fuselage forward of the front bomb bay at Station 75. A battery disconnect relay is controlled by a switch on the pilot's electrical panel. The function of the batteries is to furnish energy to start the engines (when external power is not available) and to operate electrical circuits while the engines are not running. Fumes from the batteries are carried by air through tubing to a battery sump. The sump consists of a glass jar filled with alternate layers of baking soda and felt. The fumes are neutralized by the soda. The sump is located on the right-hand side of the nose wheel well.

(d) GENERATOR CONTROL BOX. - Mounted on the inside of the fuselage to the right of the upper gunner just forward of the gunner's switch box is a metal box containing two voltage regulators (one for each generator). Purpose of the voltage regulators is to maintain constant voltage regardless of variations in the speed of the generators and conditions of varying electrical loads. Constant voltage is necessary for much of the electrically operated equipment on the airplane. Voltage regulation is accomplished automatically by controlling the amount of resistance inserted into the field circuit of the generator. A voltage regulator is a precision equipment and must be handled with care.

(3) MAGNETOS. (See figure 233.) - Each engine has two magnetos. They are mounted on the rear of the engine slightly above and to each side of the

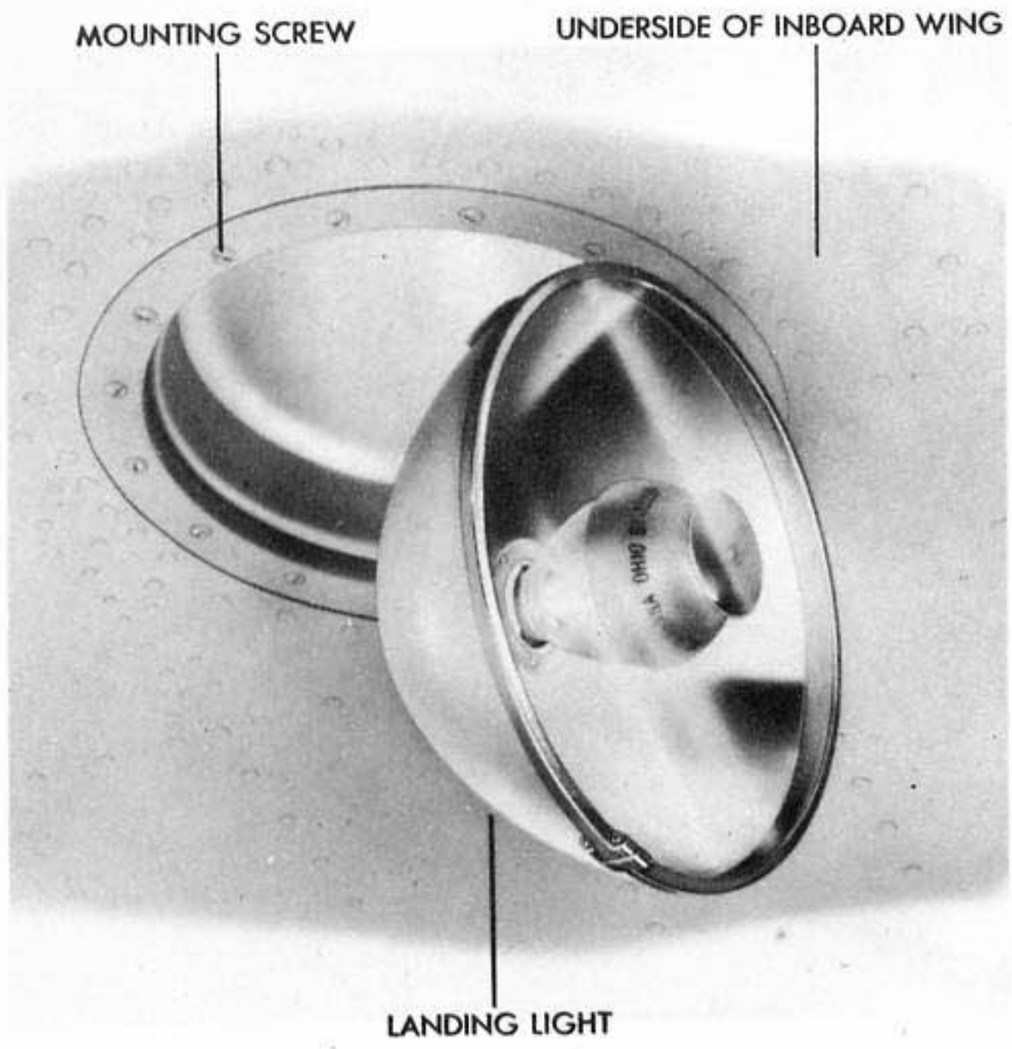


Figure 234 - LANDING LIGHT EXTENDED

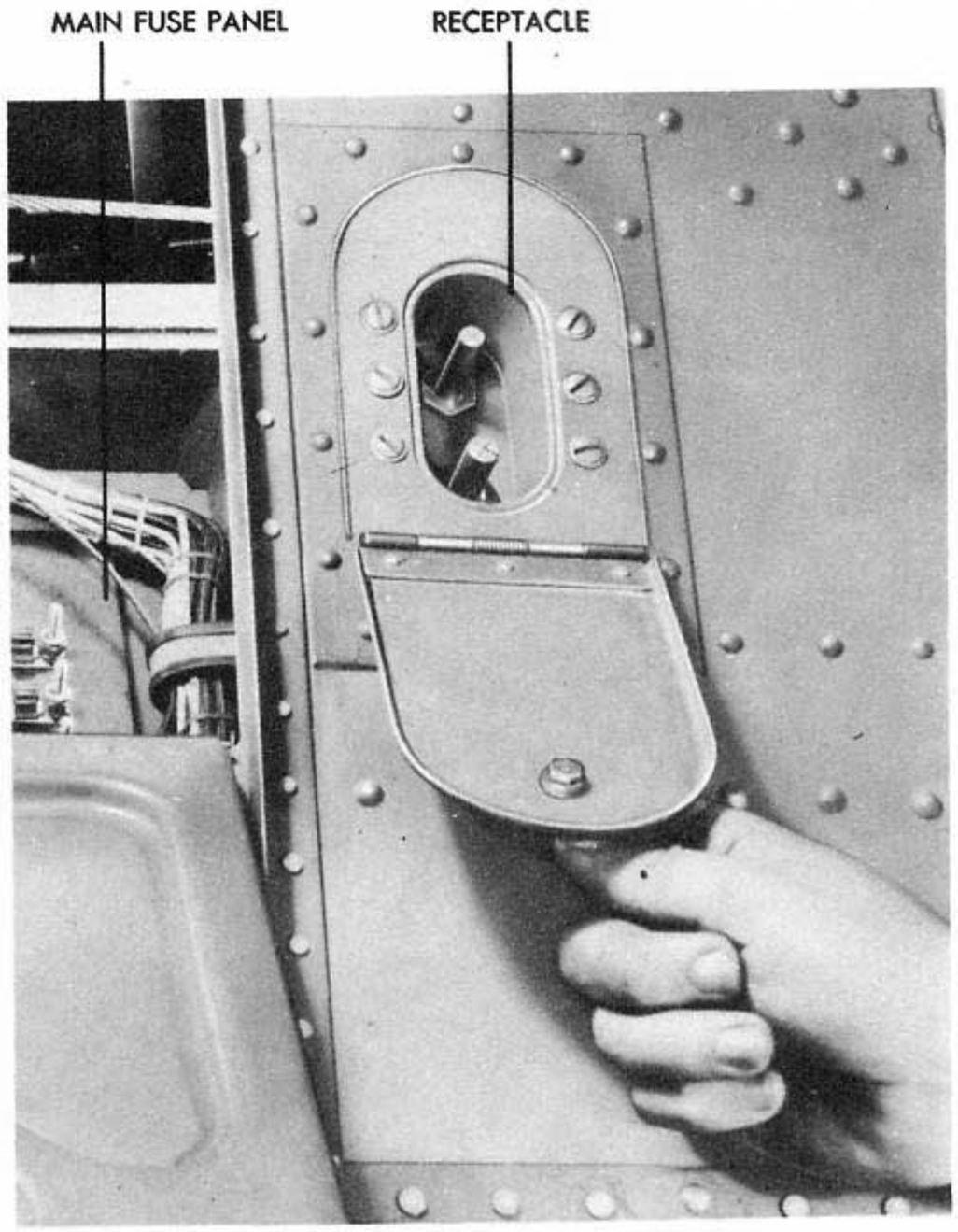


Figure 235 - EXTERNAL POWER RECEPTACLE

starter. Their function is to generate the current to furnish the spark to the spark plugs. The magnetos incorporate eight lobe breaker cam points which turn at 7/8 crankshaft speed. Pivotless type breakers are used. Both magnetos are timed on No. 1 cylinder, after which they operate with fixed timing. The right-hand magneto fires the front spark plugs and the left-hand magneto fires the rear spark plugs. Booster coils, mounted on the engines, facilitate starting.

(4) LIGHTS. - Two ST-1220A F-24 landing lights are installed on the under side of the inner wings outboard of the engine nacelles. (See figure 234.) Built-in drive motors cause these lights to swing down and forward when turned ON and back flush into the wing when OFF. Control switches for these lights are installed on the pilot's upper electrical panel. Each cockpit is lighted by type A-6 lights. Type C-5 lights are used for the instrument panel lighting. The bomb racks have extension lights to facilitate loading and servicing. Type A-8 running lights are mounted on the wing tips and vertical stabilizer. Formation keeping lights are mounted on the wing and upper surface of the fuselage aft of the rear cockpit enclosure. One upward and three downward recognition lights are mounted on the fuselage. They are operated from a control box in the pilot's cockpit. They are wired so

that any combination of downward lights may be selected. Wiring to the tail navigation light allows it to be used both as a navigation and "resin" light. Alternate red, green, and clear lenses are provided. An access door permits changing of the lens.

(5) EXTERNAL POWER FOR STARTING ENGINES AND FOR CHECKING EQUIPMENT. - To ensure that batteries will be charged at take-off so they will be adequate for emergency conditions, use an external electrical supply such as a battery cart or portable 28-volt power plant to start the engines. Plug the external power supply into the external power receptacle on the left side of the nose wheel well. (See figure 235.) If an external power supply is not available, an energizer may be used to start the engines. If a portable power plant is used, it may be connected to the airplane a short time before take-off and the main line and battery switches turned on so the batteries will charge. Use external power for checking of electrically operated equipment on the ground. If an external power supply is being used, all electrically controlled units in the airplane may be operated with the main battery switch and the master ignition switch OFF. To start the engines on the external power supply, the master ignition switch must be ON. When changing over from the external power supply to the airplane's batteries with the engines running, the main battery switch must be ON before the external supply plug is disconnected.

(6) SWITCHES.

(a) GENERAL. (See figure 236.) - Mounted on the left side of the pilot's cockpit, the ignition switch is separately shielded from other electrical equipment. Most other circuits are controlled by standard Army Air Forces toggle switches. All switches are OFF in the UP position except those which control the emergency alarm bell and the jettison of the small bombs container.

(b) MAIN BATTERY SWITCH. - Conventional operation of the main battery switch on the pilot's lower electrical panel controls the circuit from the airplane's batteries by operating a master relay located on a box below the batteries at Station 75. (See figure 237.) If the batteries are used as a source of power, both the main battery switch and the master ignition switch must be ON before any of the electrically controlled units can be used.

(c) IGNITION SWITCH. - The ignition switch is located in the upper left corner of the pilot's instrument panel. (See figure 236.) The ignition switch unit incorporates a master ignition switch and two individual engine switches as follows:

1 MASTER IGNITION SWITCH. - The master ignition switch has two positions controlling circuits as follows:

OFF. - All magneto circuits are closed (grounded) and the circuits to all electrically controlled units in the airplane are open (magnetos and all electrically controlled units are inoperative).

ON. - All magneto circuits are open (ungrounded) and the circuits to all electrically controlled units are closed (magnetos and all electrically controlled units are operative).

2 INDIVIDUAL ENGINE SWITCHES. - Each individual engine switch controls the ignition of one engine and has four positions controlling circuits as follows:

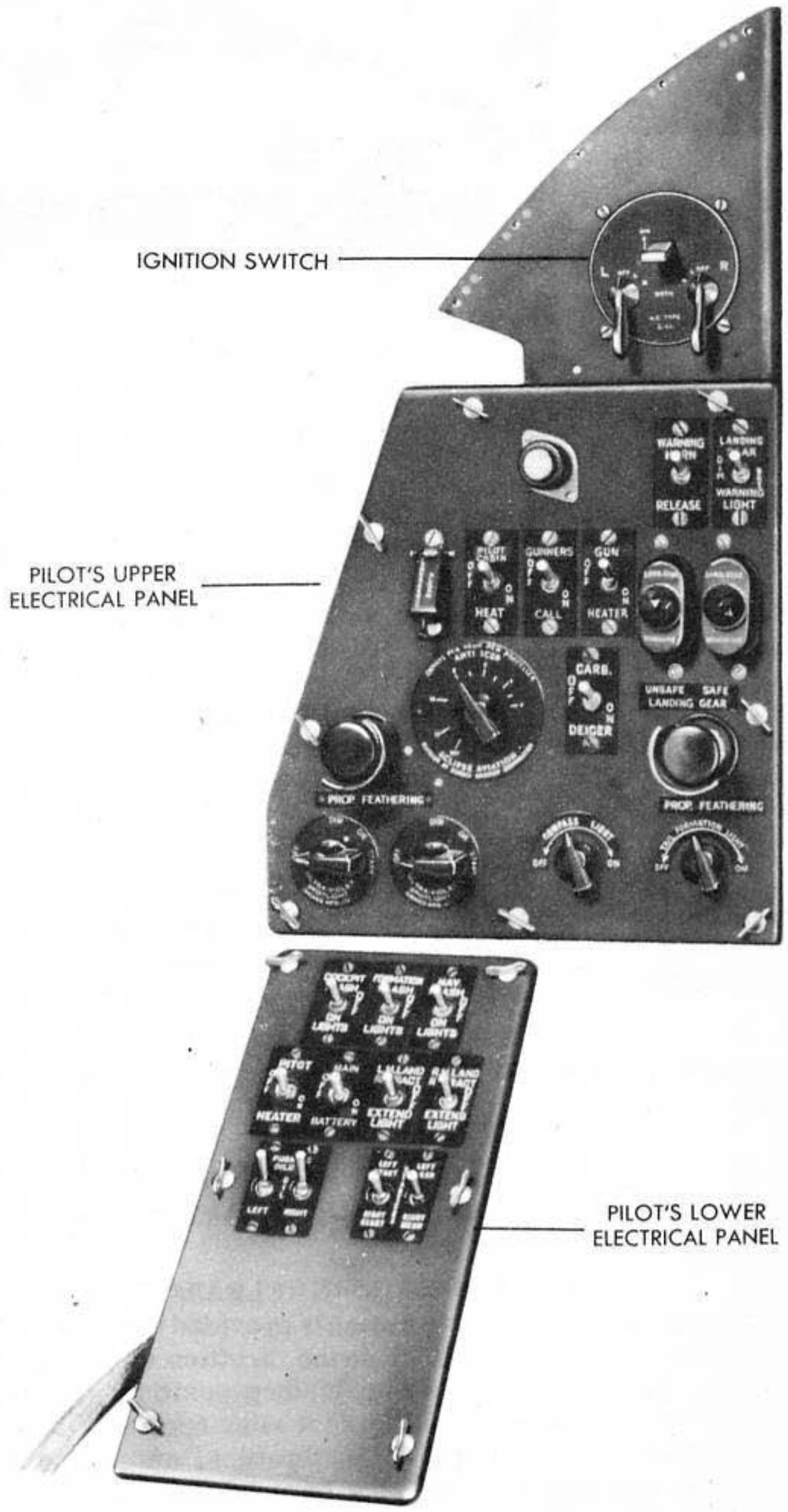


Figure 236 - PILOT'S ELECTRICAL CONTROLS

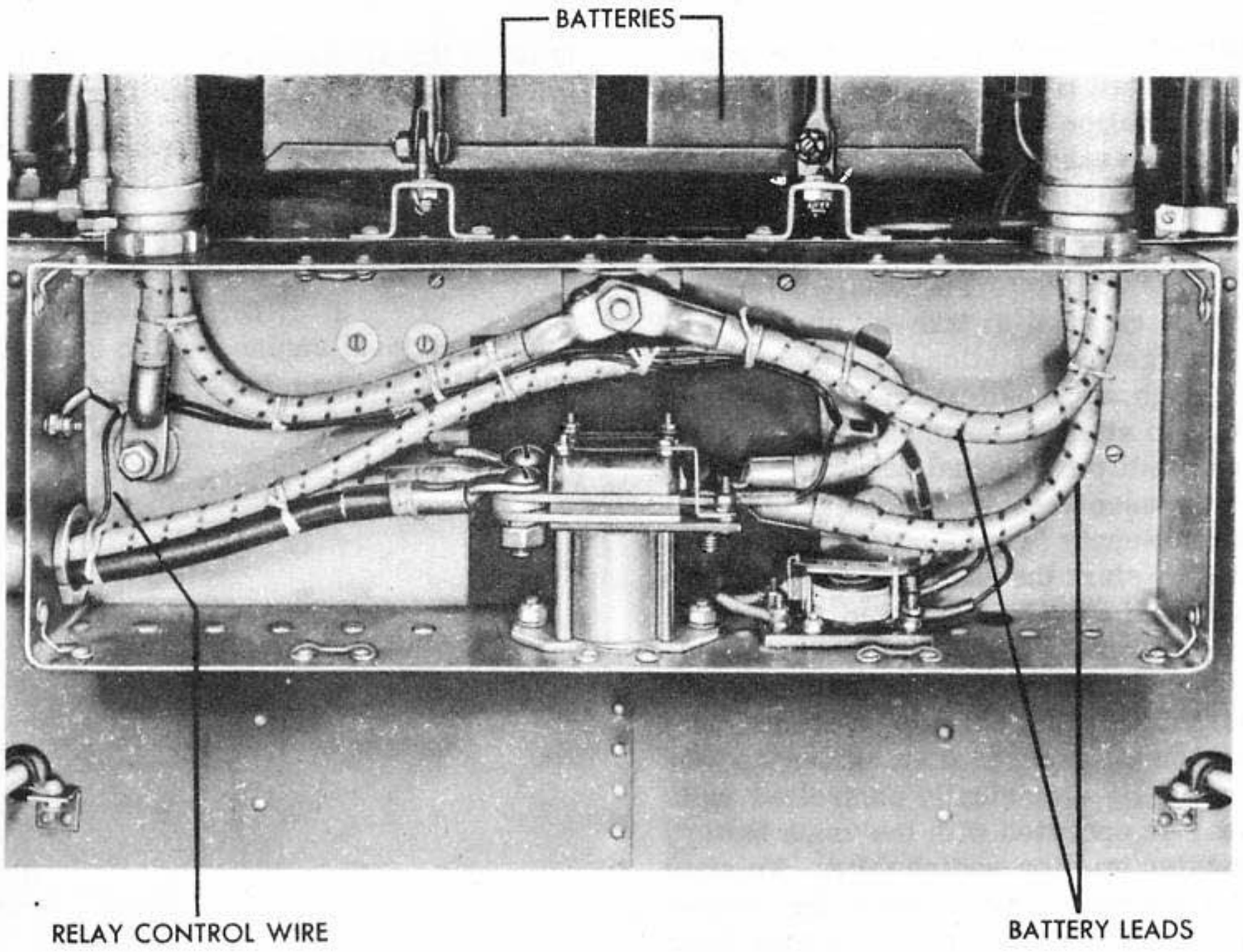


Figure 237 - MASTER BATTERY SWITCH BOX

OFF. - Both magneto circuits are closed (both magnetos inoperative) with the master switch ON or OFF.

L. - The left magneto circuit is open (left magneto operative) and the right magneto circuit is closed (right magneto inoperative) with the master switch ON.

R. - The right magneto circuit is open (right magneto operative) and the left magneto circuit is closed (left magneto inoperative) with the master switch ON.

BOTH. - Both magneto circuits are open (both magnetos operative) with the master switch ON.

(d) SWITCHES ON PILOT'S UPPER ELECTRICAL PANEL; (See figure 238.)

1 WARNING HORN RELEASE SWITCH. - The warning horn release switch is provided to silence the horn if it is desired to close the throttles when the landing gear is not latched in landing position. The horn circuit is automatically reset after operation of the release switch opening the throttles, and if the throttles are again closed, the horn will sound until the horn release switch is operated.

NOTE

If only one throttle is closed with the landing gear not latched in landing position, the warning horn release switch will silence the horn for only an instant. To quiet the horn, the throttle must be opened beyond the horn operating position.

2 LANDING GEAR WARNING LIGHTS SWITCH. - A green signal light is provided to indicate that the landing gear is down and latched in landing position. A red signal light will show at all other times. These lights may be made dim or bright by operation of the warning lights switch.

3 GUNNER CALL LIGHT SWITCH. - Conventional operation of the gunner call light switch will illuminate the call light on the gunner's electrical panel.

4 HEATING SYSTEM SWITCH. - Conventional operation of the switch will energize the fuel ignition plug of the heating and vent system heating unit.

5 PROPELLER FEATHERING SWITCHES. - A switch is provided for each propeller and is operated by pushing the respective switch for the propeller to be feathered. The switch will automatically release when the propeller blades reach the

full feathered position. To unfeather the propeller, push in on the switch and hold until the engine windmills at 600 to 800 rpm. Then release the switch.

6 PROPELLER ANTI-ICER RHEOSTAT. - Operating this rheostat (on the left-hand side of the pilot's instrument panel) turns on and regulates the anti-icer fluid pump so that fluid may be supplied to each propeller. A supply of two to four quarts per hour is considered satisfactory for normal operation under icing conditions.

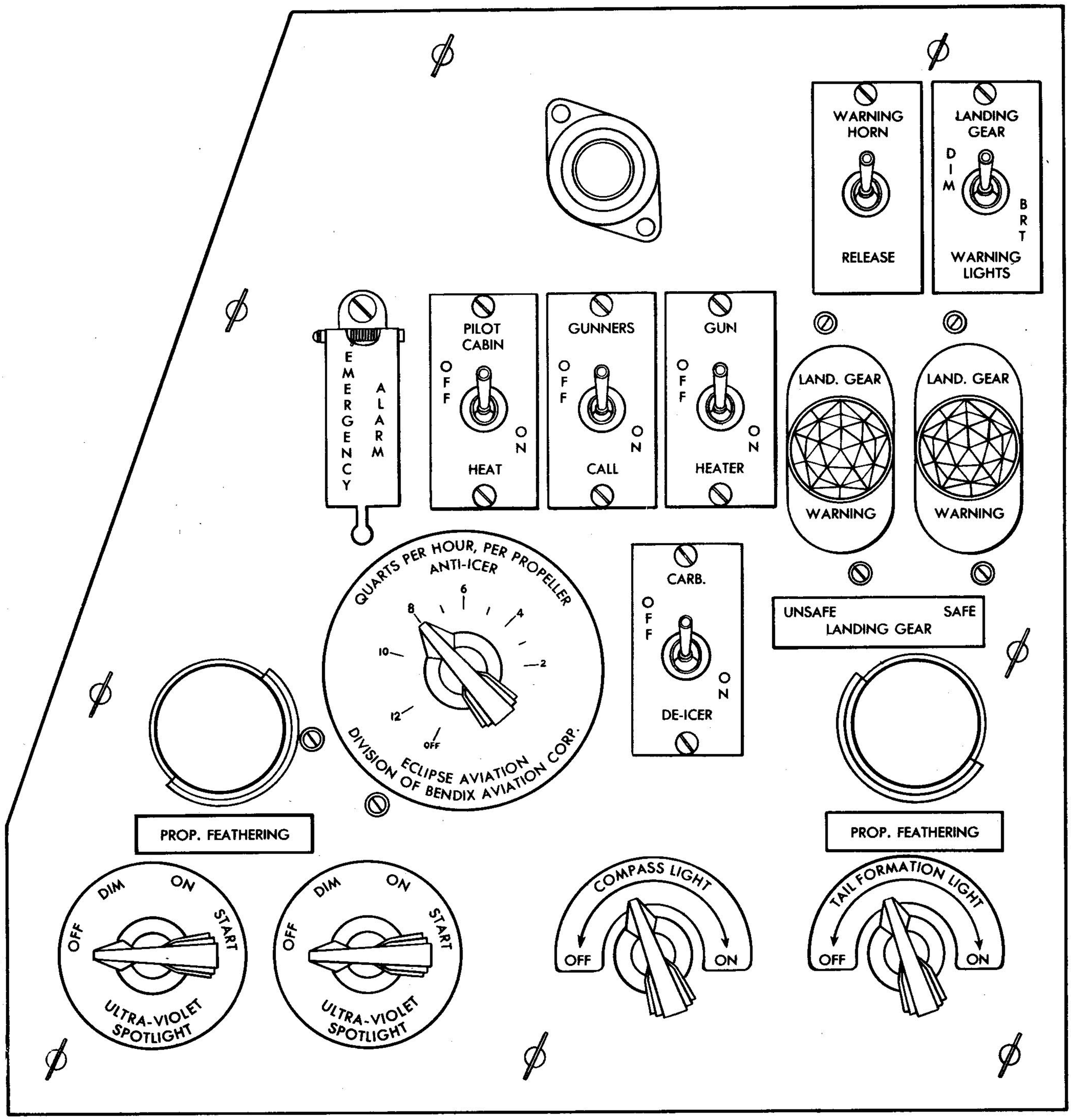


Figure 238 - PILOT'S UPPER ELECTRICAL PANEL

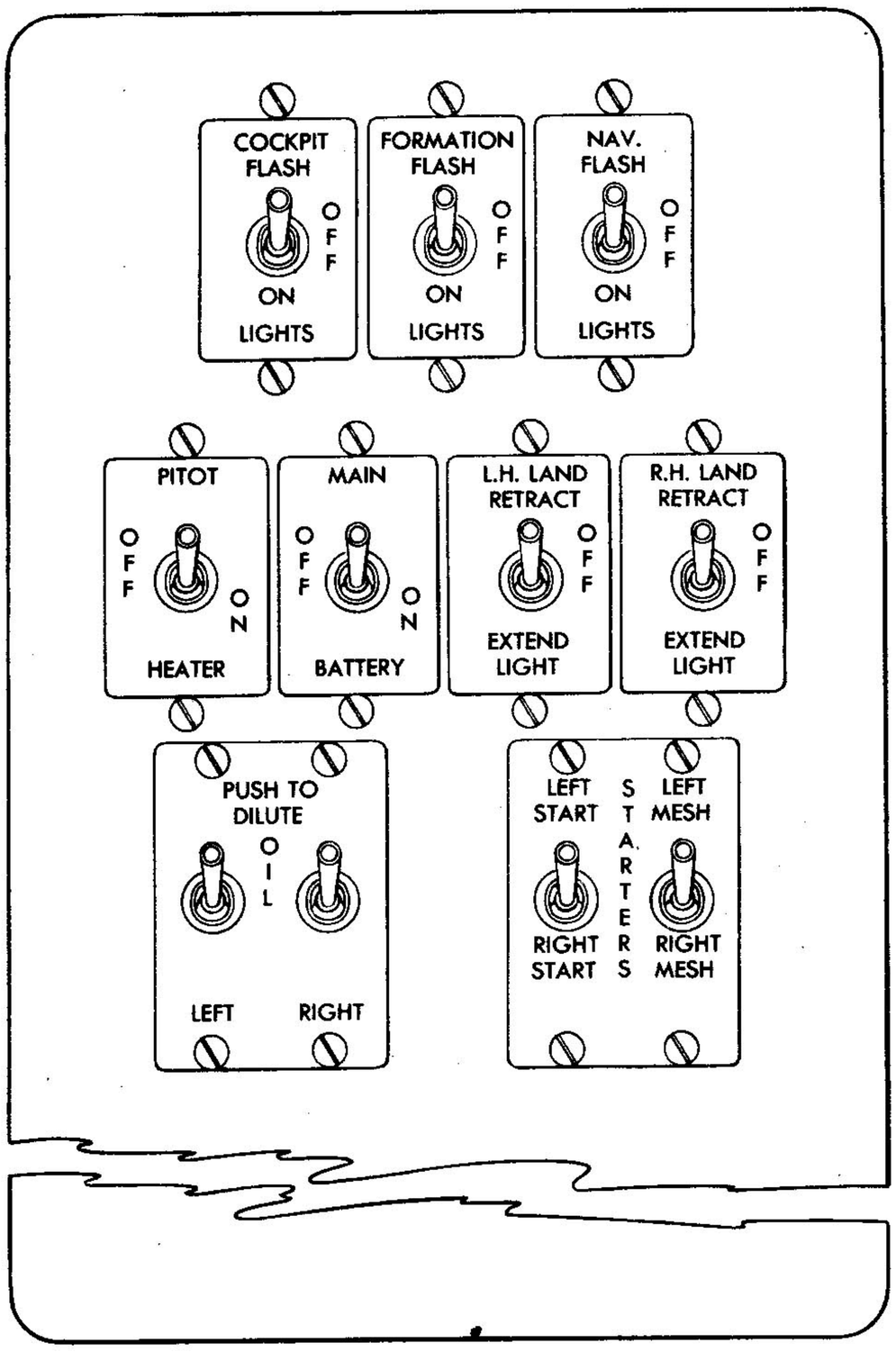


Figure 239 - PILOT'S LOWER ELECTRICAL PANEL

7 INSTRUMENT LIGHTING CONTROLS. - The upper panel also incorporates a compass light switch and rheostat, tail formation light switch and rheostat, and control switches for the fluorescent lights.

(e) SWITCHES ON THE PILOT'S LOWER ELECTRICAL PANEL. (See figure 239.) - The pilot's lower electrical panel is located on the left side of the cockpit just below the upper electrical panel. In addition to the main battery switch previously described, the lower panel contains the following:

1 LANDING LIGHT SWITCHES. - Switches are provided to control the extension and retraction of the landing lights in the lower surface of the inner wing. To extend light, hold the respective switch in the EXTEND position until the light is fully lowered (approximately 12 seconds time is required). A cut-off switch in the operating mechanism will automatically stop the actuating motor when the light reaches its fully extended position. When the light has lowered approximately 10 degrees from its flush (up) position, a switch in the lamp will automatically turn on the light. To retract the light, hold the switch in the RETRACT position until the light is fully retracted. The cut-off switch will automatically stop the actuating motor when the light reaches its fully retracted position. The switch in the lamp unit will automatically turn off the light when it has raised within 10 degrees of its retracted position. The retraction or extension of the landing lights may be stopped at any position between full UP and full DOWN by releasing the operating switches.

2 OIL DILUTION SWITCHES. - An individual switch is provided to operate the oil dilution system of each engine. The switches are normally operated during the engine stopping procedure when a subsequent cold weather start is anticipated.

3 ENGINE STARTER SWITCHES. - Two switches are provided for engine starting. The starter is energized by the START switch and engaged by the MESH switch. In starting the right engine, depress the START switch, and when the inertia wheel is up to speed (about 30 seconds), depress the MESH switch (not over 45 seconds), still keeping the START switch depressed. In starting the left engine, lift up the switches while proceeding in a similar manner as when starting the right engine.

4 MISCELLANEOUS SWITCHES. - The lower panel also contains switches for cockpit lights, formation keeping lights, navigation lights, and pitot heater.

(f) RECOGNITION LIGHT SWITCHES. - The recognition lights are controlled by a Morse key switch and a color selecting switch just aft of the instrument panel on the right side of the pilot's cockpit. A master switch controls the circuit in the recognition lights system. Three indicator lights adjacent to the control switches illuminate simultaneously with the external lights.

(g) PILOT'S EXTENSION LIGHT SWITCH. - A conventionally operated switch is mounted on the extension light box, which is installed in the right rear corner of the pilot's cockpit.

(h) BOMB RELEASE SWITCHES. - Release of bombs is controlled electrically by means of selector switches on the right side of the cockpit, a push button switch on the wheel and a quadrant release switch in the pilot's compartment. Two jettison switches are provided for emergency release of bombs.

(i) FIXED GUN CONTROL SWITCHES.

1 SELECTOR SWITCHES. - Mounted on the cowling in the left-hand side of the cockpit are three selector switches for the six forward firing fixed guns. One switch controls the upper pair of guns, one switch the center pair, and one switch the lower pair.

2 TRIGGER SWITCH. - The fixed forward guns are electrically fired (selector switches must be ON) by a trigger switch on the control wheel. This switch operates a relay controlling the gun firing solenoids.

(j) FUEL QUANTITY GAGE SELECTOR SWITCH. - The airplane is equipped with a fuel quantity gage selector switch. This switch enables the pilot to connect the fuel indicator to the liquidometer unit in any gasoline tank.

(k) RELAY SWITCHES (sometimes called generator cut-out). - A relay switch is mounted in a metal box in each nacelle on the aft side of the fire wall above and left of the fire wall junction box. The relay switches connect the generators to the airplane electrical system when the generator voltage is sufficiently high. However, the relays will close only when the generator switches (in the gunners' cockpit) are closed. The relay switches open automatically in case the generator voltage becomes lower than the system voltage causing a reverse current to flow.

CAUTION

Never close the reverse current relay manually by pressing the contacts together as serious damage may result to the relay, the electrical system and to the person.

Relays on the A-20G airplane are in accordance with AAF Spec. 94-32278 and are either General Electric (Model 3GTR72A1A), Westinghouse (Part 1240224) or Leece-Neville (Part 24552). These three types are interchangeable but wherever possible a relay should be replaced by one of the same brand.

(l) GUNNERS' SWITCH BOX (sometimes called the junction box). - Mounted on the inside of the fuselage to the right of the upper gunner aft of the generator control box is a metal box which comprises the main electrical control panel. On the cover are mounted two ON-OFF generator switches, two ammeters, one voltmeter, a voltmeter selector switch, and pilot to gunners' call lights.

(7) MAIN FUSE PANEL. (See figure 240.) - Mounted on the left side of the fuselage in the nose wheel well between Stations 37 and 75 is the main fuse panel. Access to the area is through a hinged cover on the inside of the nose wheel well. Its cover is attached by Dzus fasteners.

(8) MISCELLANEOUS ELECTRICAL EQUIPMENT.

(a) EMERGENCY ALARM. - An emergency alarm bell is installed at the upper rear gunner's station. It is controlled by a switch in the pilot's compartment.

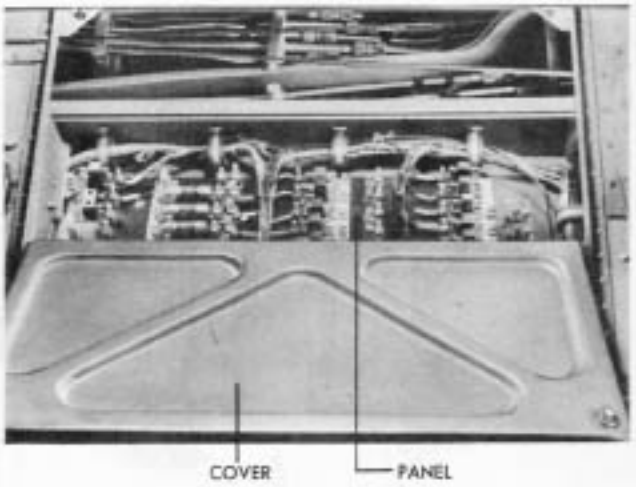


Figure 240 - MAIN FUSE PANEL

(b) ELECTRIC DRIVES. - Electric drives are used for extending and retracting the landing lights, and for operating the fuselage fuel tank booster pump and the propeller feathering pumps.

(c) CONDUIT, FITTINGS, PLUGS, RECEPTACLES, AND FUSES. - Conduit is used in the engine sections and in the ignition circuit and where mechanical protection of wiring is required. Standard fittings are used to attach conduit to junction boxes and control panels. AN-735 and AN-755 clamps are used where intermediate support and bonding to the airplane is required. Standard Army Air Forces and Cannon quick disconnect plugs are provided forward of the fire wall, the wing joint, and other locations where easy removal

Figure 241 - ALIGHTING GEAR WARNING HORN