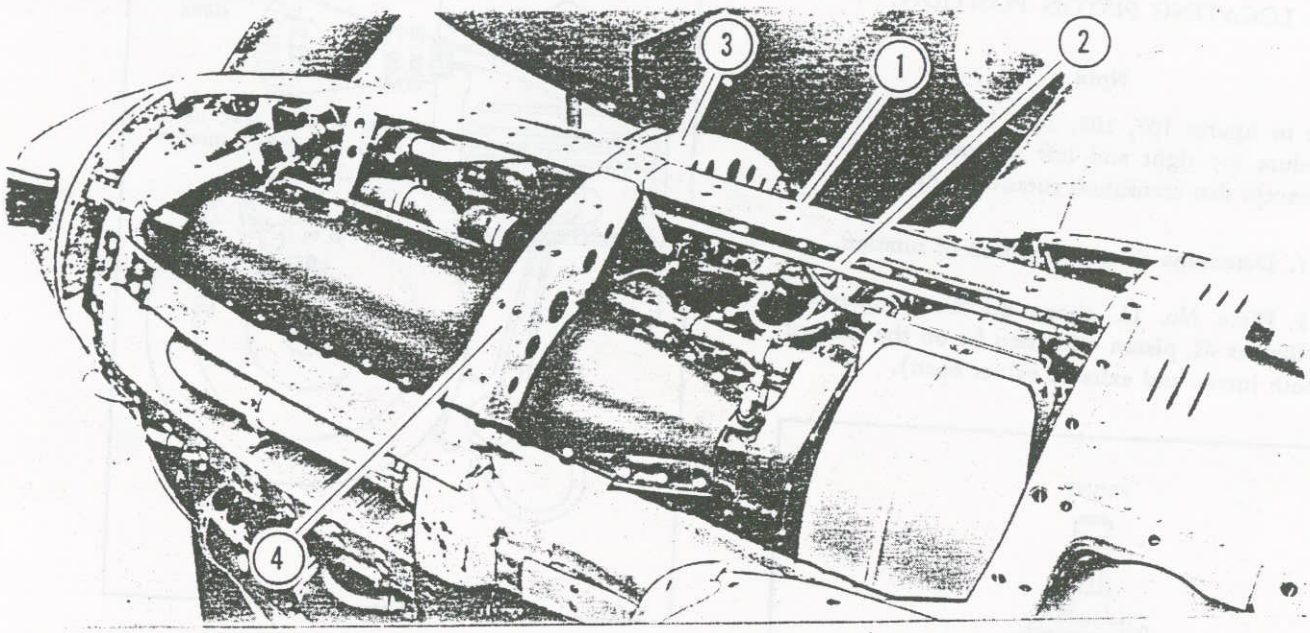


Figure 103 — Engine Disconnection Points (Nacelle, Upper)

Note

Be sure that all transferred tubes and fittings are placed on the new engine in the same relative position and angle as they were on the old engine.

(i) Install engine, mounting structure, and associated equipment on the airplane.

(2) HOISTING AND ATTACHING.
(See figure 104.)

(a) Hoist engine into position and attach inboard and outboard side truss bolts first "7" (figure 99) and "2" (figure 101).

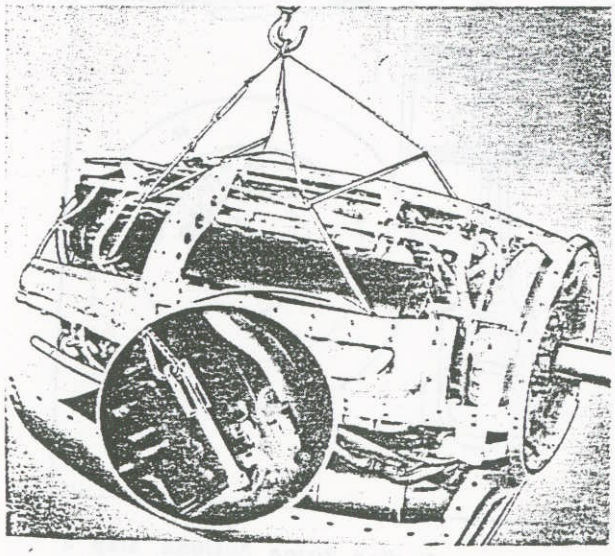


Figure 104 — Engine Hoisting Sling

IMPORTANT

Before inserting bolts the holes must be aligned with a "bullet" type drift pin. (This can be made from an engine mount bolt.)

(b) With the aid of a hoist, jockey the engine back and forth until the tubular diagonal attachment holes "8" (figure 99) and "3" (figure 101), are aligned accurately enough to permit perfect alignment with a "bullet" type drift pin.

(c) Connect all tubing, electrical conduit, fittings, controls, and air ducts.

CAUTION

Check the entire installation, system by system, for loose connections, nuts, bolts, clips, and fairleads. Check to be sure there are no interferences, chafing or rubbing between tubing, conduit, controls, etc.

(3) FINAL INSTALLATION CHECK.

(a) After the engine is connected, fill and vent carburetor as follows:

1. Open fuel tank valve.

2. Set mixture control at "AUTO RICH" and throttle at half open.

3. Operate fuel booster pump by "flicking" the switch "ON" and "OFF" to raise fuel pressure to four lb/sq in. Continue to operate booster at this pressure until fuel appears at supercharger drain.

(b) LOCATING PISTON POSITION.

Note

Refer to figures 107, 108, 109, 110, and 111. Procedure for right and left engines is identical except that crankshaft rotation is opposite.

1. Determine normal direction of rotation.

2. Place No. 1L piston on the compression stroke. Number 6L piston will then be on the exhaust stroke (both intake and exhaust valves open).

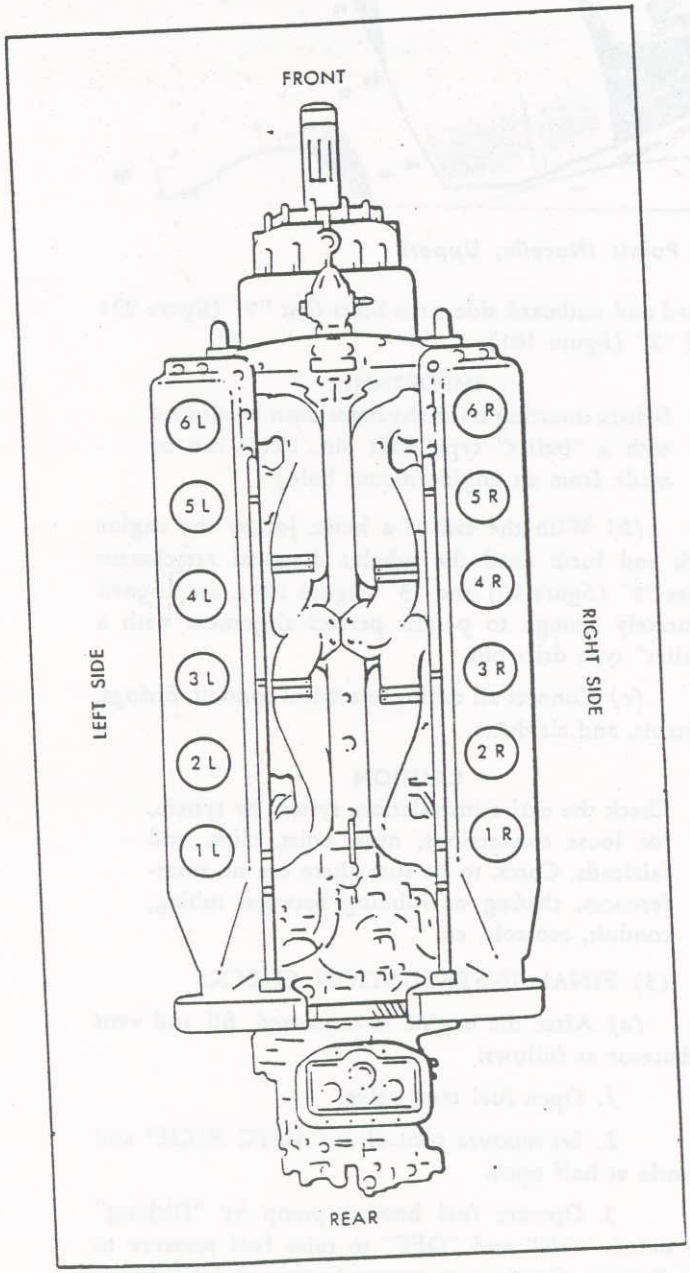


Figure 107 — Cylinder Identification Diagram

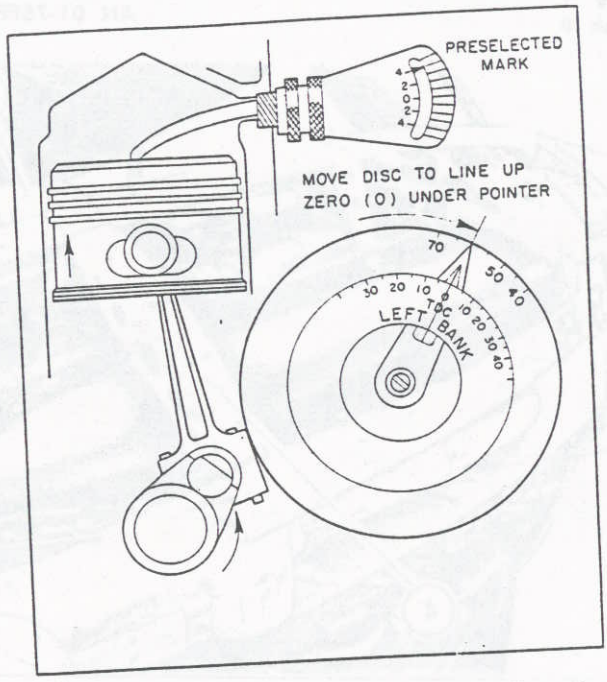


Figure 108 — Finding Piston Position, Step 1

3. Rotate propeller shaft in the direction of rotation until No. 6L piston moves up and forces the top center indicator hand to index with the preselected mark (No. 4) on the top half scale of the top center indicator, as shown in figure 108.

4. Loosen clamp screw and set magneto timing disc on zero using the inside scale as shown on figure 108.

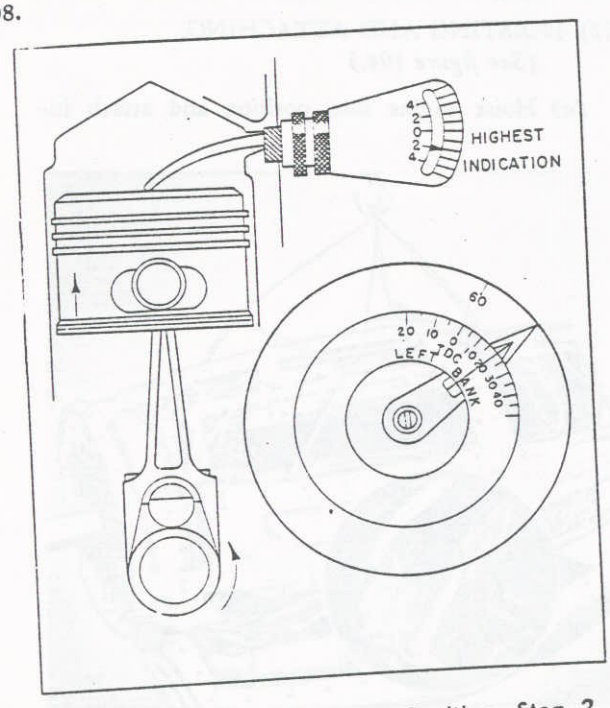
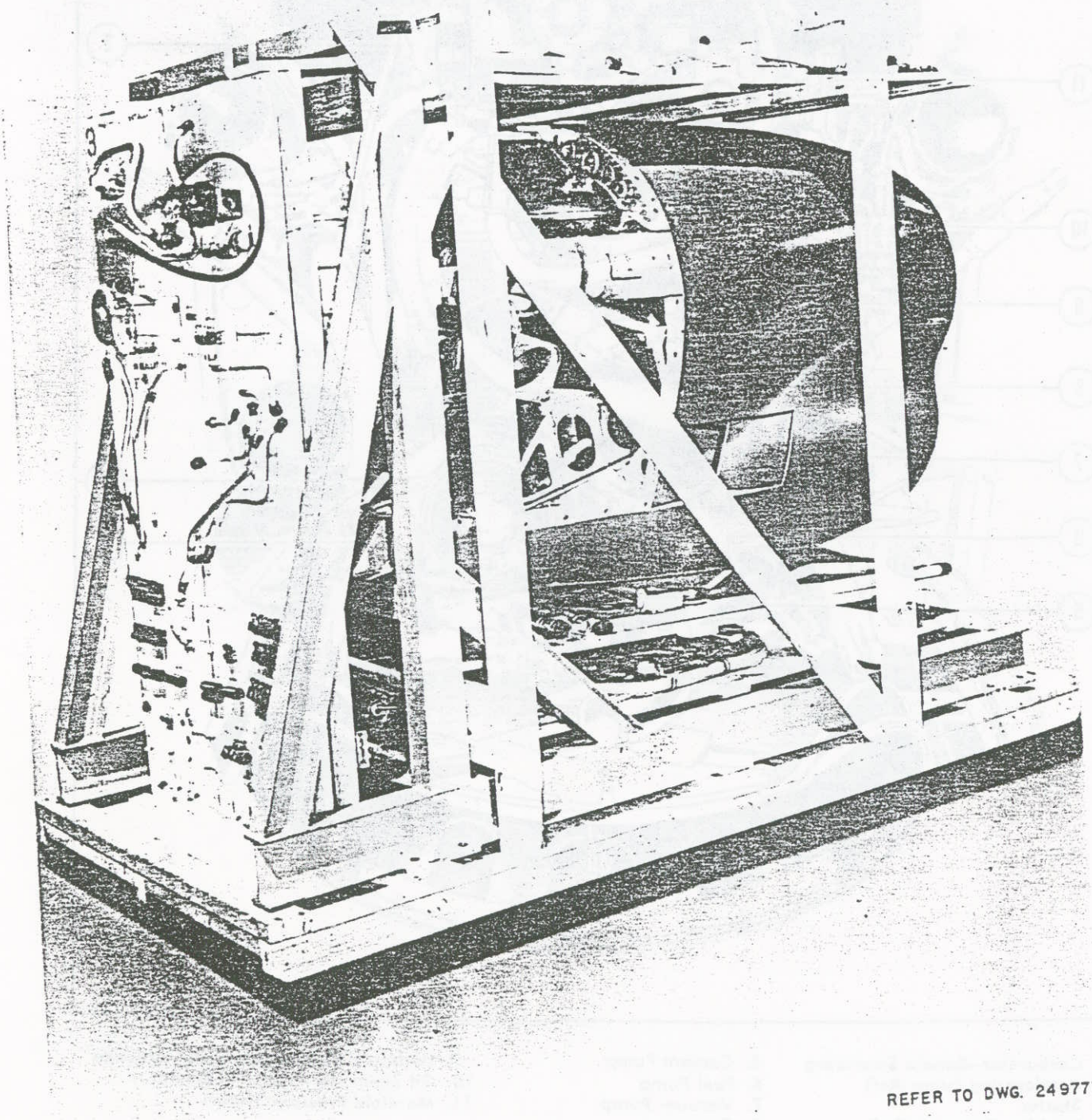
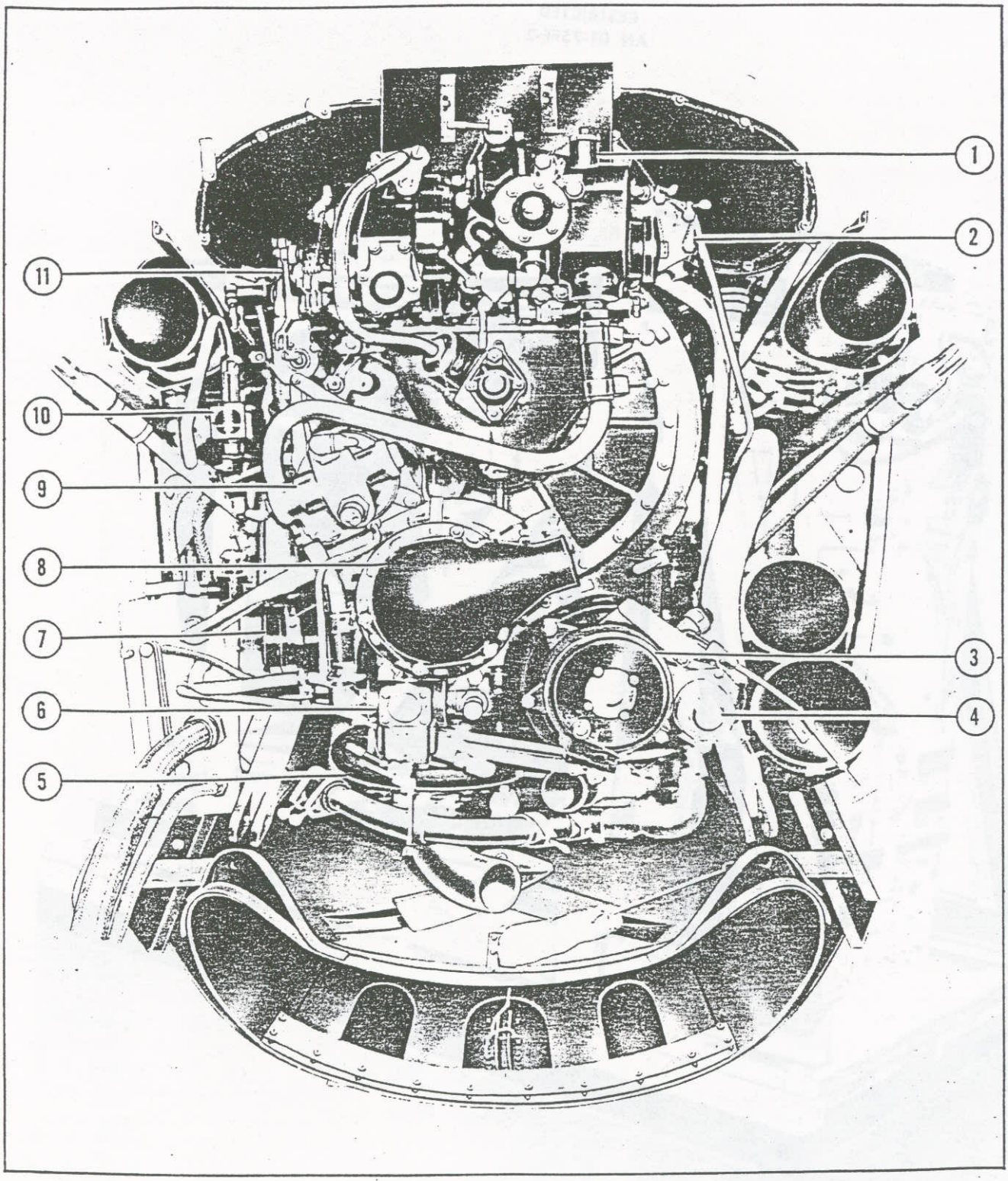


Figure 109 — Finding Piston Position, Step 2



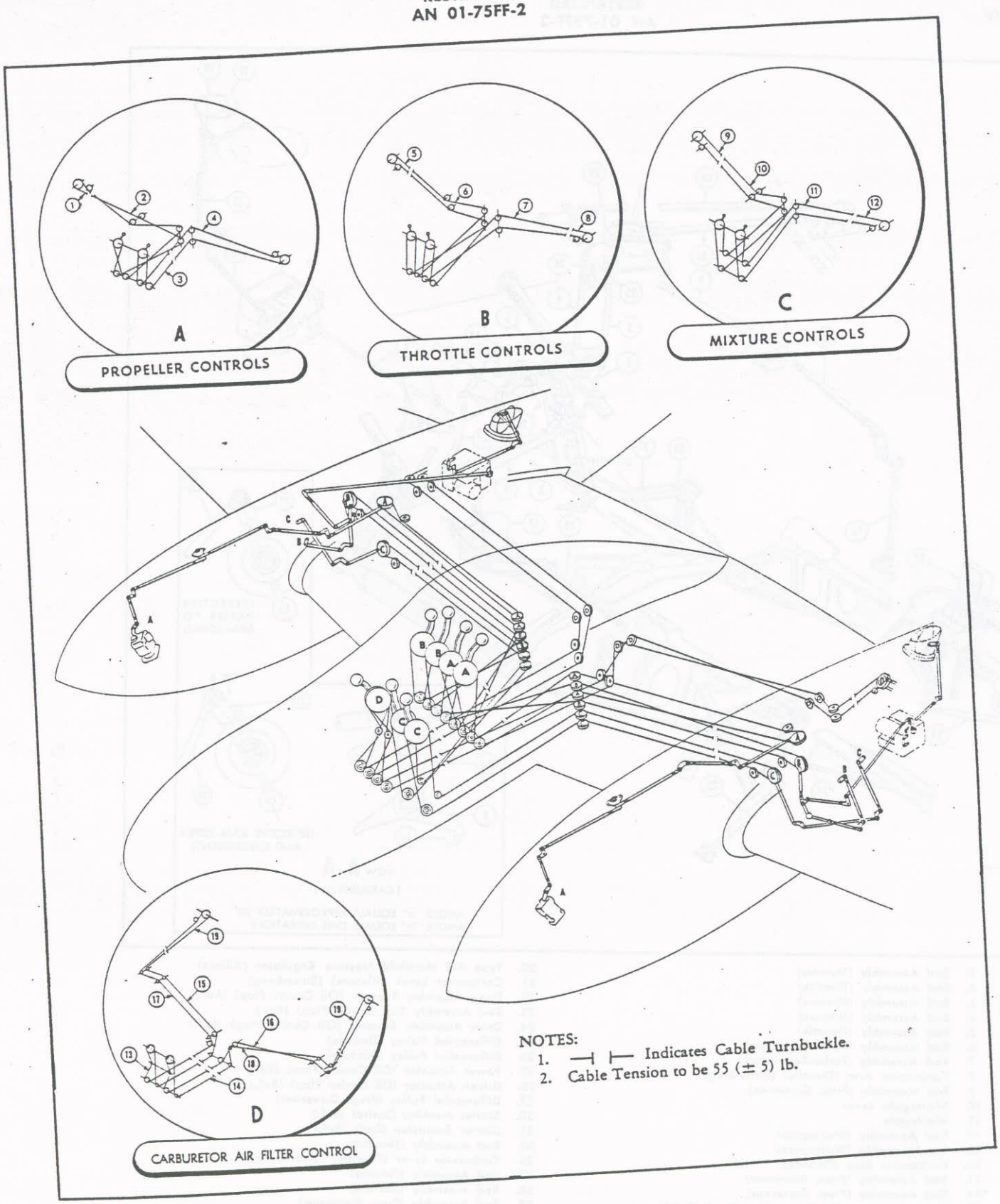
REFER TO DWG. 249777

Figure 113 — Engine Quick-change Unit



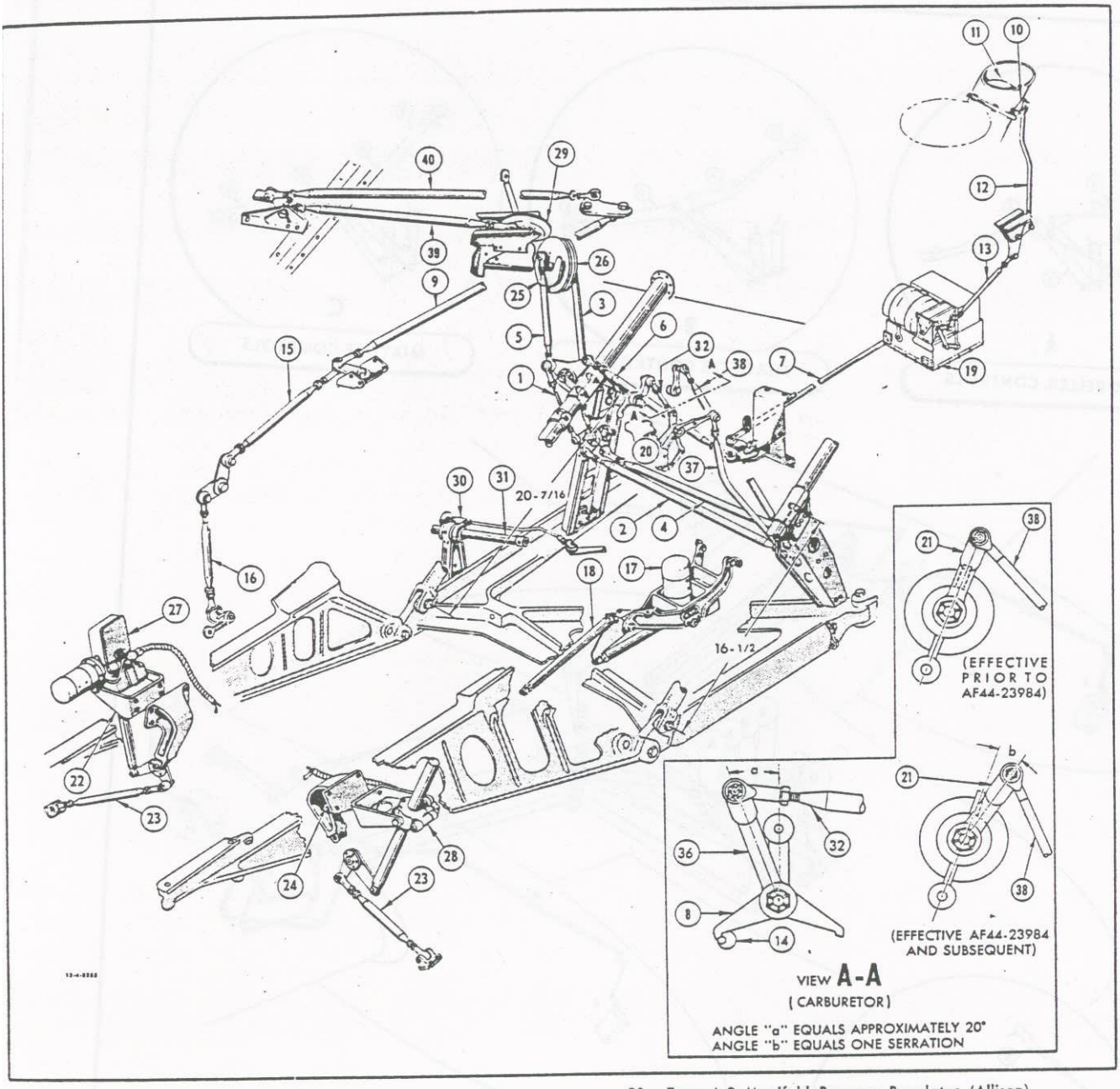
1. Carburetor—Bendix Stromberg
2. Accelerating Pump (Ref)
3. Starter
4. Meshing Solenoid (Ref)
5. Coolant Pump
6. Fuel Pump
7. Vacuum Pump
8. Generator
9. Hydraulic Pump—New York Airbrake
10. Oil Separator—Vacuum System
11. Manifold Pressure System

Figure 114 — Engine Accessories, Right-Hand Engine (Aft View)



For Key to Cables, See Section IX.

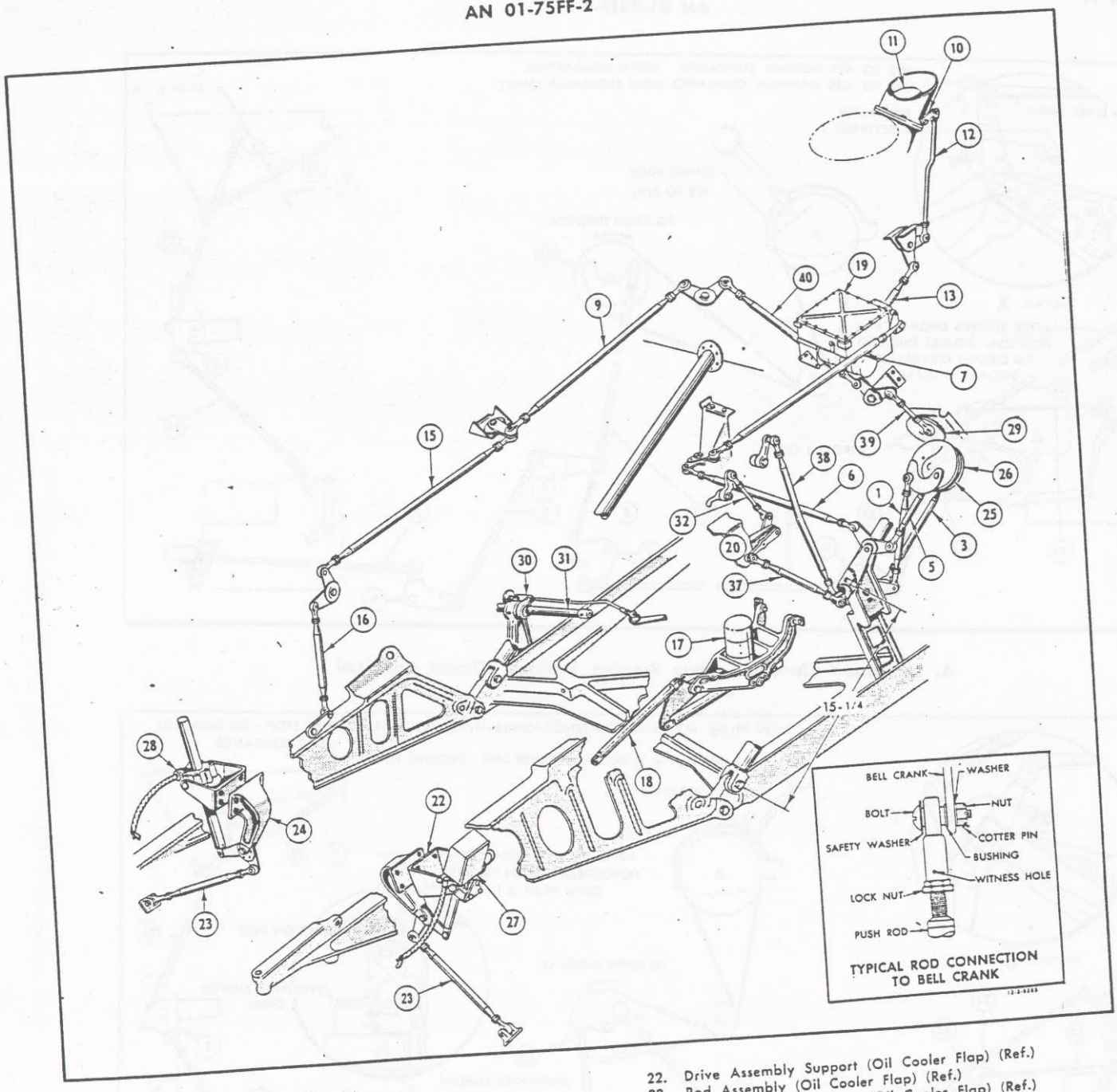
Figure 115 — Power Plant Control System



1. Rod Assembly (Throttle)
2. Rod Assembly (Throttle)
3. Rod Assembly (Mixture)
4. Rod Assembly (Mixture)
5. Rod Assembly (Throttle)
6. Rod Assembly (Turbo-Regulator)
7. Rod Assembly (Turbo-Regulator)
8. Carburetor Arm (Throttle) (Stromberg)
9. Rod Assembly (Prop. Governor)
10. Wastegate Lever
11. Wastegate
12. Rod Assembly (Wastegate)
13. Rod Assembly (Wastegate)
14. Carburetor Stop (Throttle)
15. Rod Assembly (Prop. Governor)
*16. Rod Assembly (Prop. Governor)
17. Operator Assembly (Intercooler Flap) (Ref.)
18. Rod Assembly (Intercooler Flap) (Ref.)
19. Type C-2 Turbo-Regulator (General Electric)
20. Type A-2 Manifold Pressure Regulator (Allison)
21. Carburetor Lever (Mixture) (Stromberg)
22. Drive Assembly Support (Oil Cooler Flap) (Ref.)
23. Rod Assembly (Oil Cooler Flap) (Ref.)
24. Drive Assembly Support (Oil Cooler Flap) (Ref.)
25. Differential Pulley (Throttle)
26. Differential Pulley (Mixture)
27. Power Actuator (Oil Cooler Flap) (Ref.)
28. Driven Actuator (Oil Cooler Flap) (Ref.)
29. Differential Pulley (Prop. Governor)
30. Starter Meshing Control (Ref.)
31. Starter Extension Shaft (Ref.)
32. Rod Assembly (Throttle)
36. Carburetor Lever (Throttle) (Stromberg)
37. Rod Assembly (Throttle)
38. Rod Assembly (Mixture)
39. Rod Assembly (Prop. Governor)
40. Rod Assembly (Prop. Governor)

* Removed — Effective Serial AF44-24309.

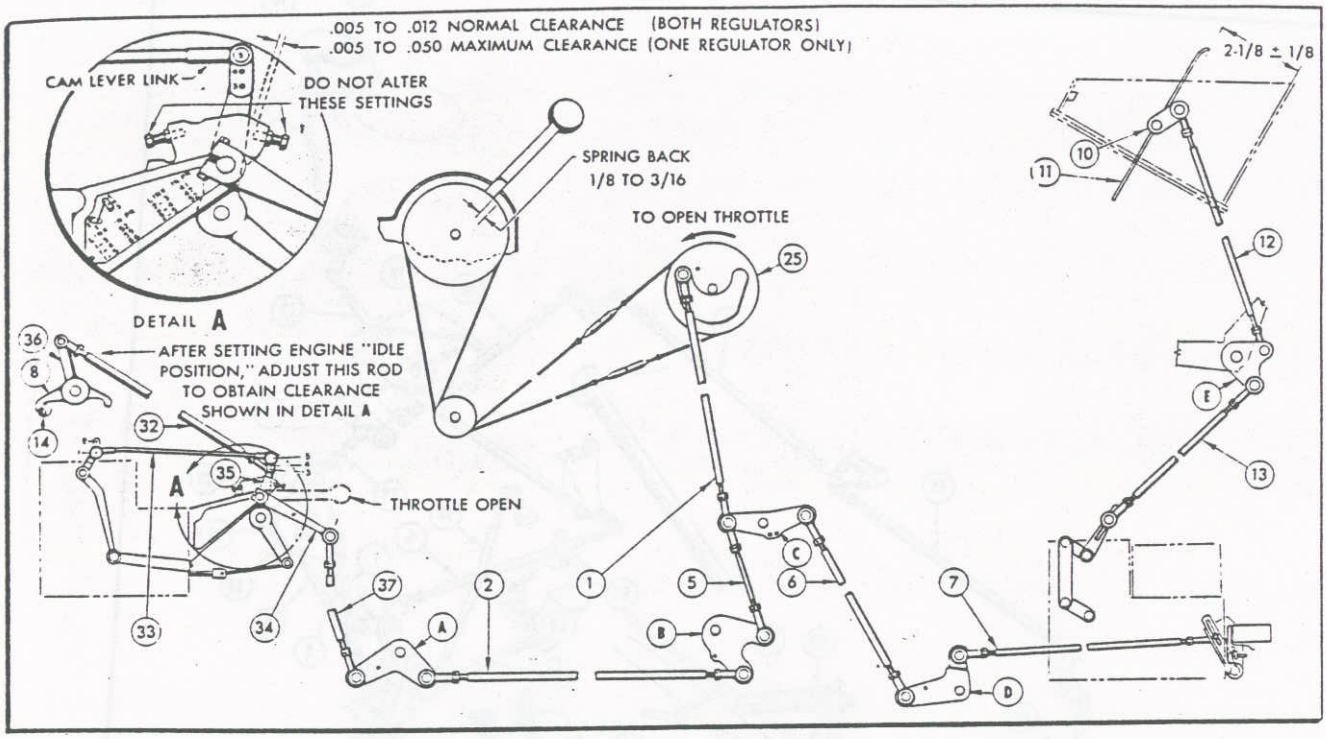
Figure 116 — Power Plant Controls, Left-Hand Engine



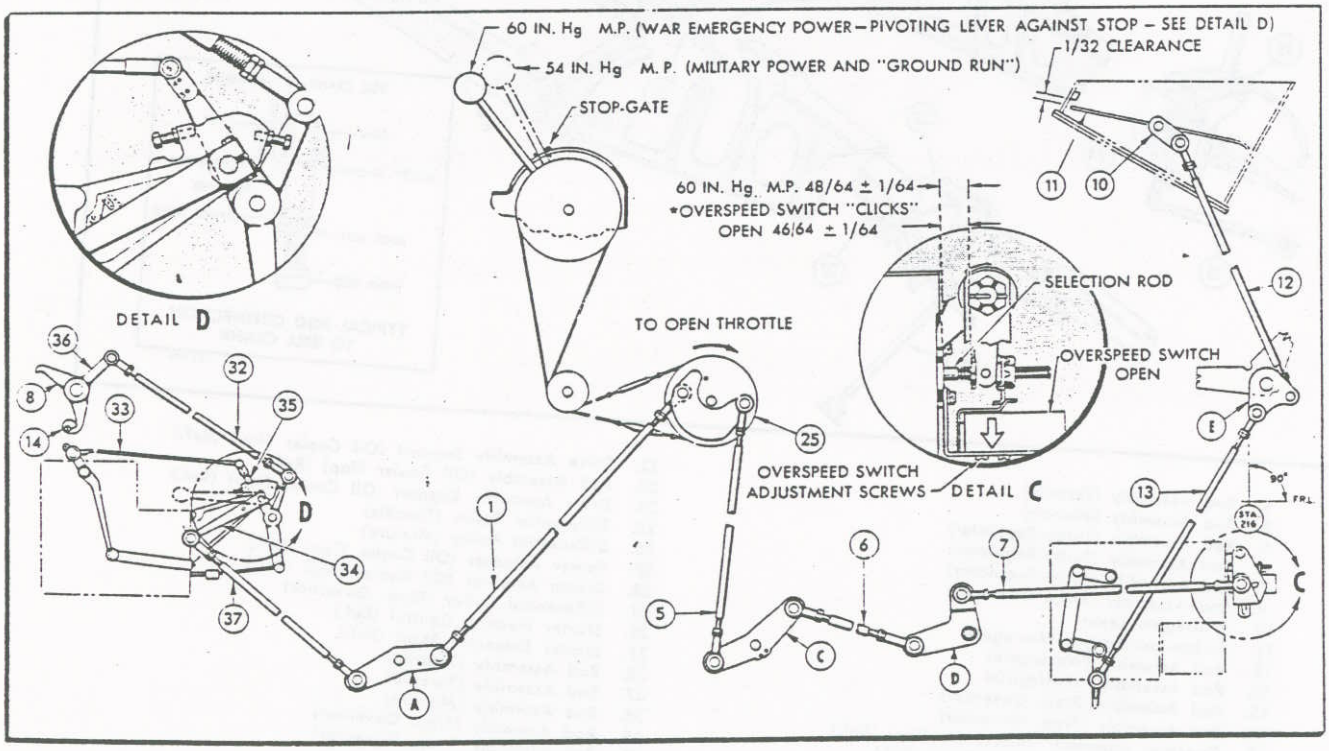
1. Rod Assembly (Throttle)
3. Rod Assembly (Mixture)
5. Rod Assembly (Turbo-Regulator)
6. Rod Assembly (Turbo-Regulator)
7. Rod Assembly (Turbo-Regulator)
9. Rod Assembly (Prop. Governor)
10. Wastegate Lever
11. Turbosupercharger Wastegate
12. Rod Assembly (Wastegate)
13. Rod Assembly (Wastegate)
15. Rod Assembly (Prop. Governor)
*16. Rod Assembly (Prop. Governor)
17. Operator Assembly (Intercooler Flap) (Ref.)
18. Rod Assembly (Intercooler Flap) (Ref.)
19. Type C-2 Turbo-Regulator (General Electric)
20. Type A-2 Manifold Pressure Regulator (Allison)
22. Drive Assembly Support (Oil Cooler Flap) (Ref.)
23. Rod Assembly (Oil Cooler Flap) (Ref.)
24. Drive Assembly Support (Oil Cooler Flap) (Ref.)
25. Differential Pulley (Throttle)
26. Differential Pulley (Mixture)
27. Power Actuator (Oil Cooler Flap) (Ref.)
28. Driven Actuator (Oil Cooler Flap) (Ref.)
29. Differential Pulley (Prop. Governor)
30. Starter Meshing Control (Ref.)
31. Starter Extension Shaft (Ref.)
32. Rod Assembly (Throttle)
37. Rod Assembly (Throttle)
38. Rod Assembly (Mixture)
39. Rod Assembly (Prop. Governor)
40. Rod Assembly (Prop. Governor)

* Removed — Effective Serial AF44-24309.

Figure 117 — Power Plant Controls, Right-Hand Engine



A. Left-Hand Throttle System Rigging Settings (Closed Position)



B. Right-Hand Throttle System Rigging Settings (Open Position)

Figure 118 — Throttle Controls Adjustment, C-2 and A-2 Regulator Installations

A type C-2 turbo-regulator, combined with a type A-2 manifold pressure regulator, is incorporated in the power-plant-control system and provides automatic power regulation of the engines.

Note

For detailed information governing:

Type C-2 turbo-regulator, refer to paragraph 17 *d* (3), this section.

Type A-2 manifold pressure regulator, refer to paragraph 17 *b* (3), this section.

The throttle linkages to the C-2 turbo-regulator and A-2 manifold pressure regulator are always adjusted to provide sufficient carburetor inlet (deck) pressure to take care of a wide range of engine speed requirements at any selected manifold pressure. Therefore, under normal conditions the compressor discharge pressure will be slightly excessive. The A-2 manifold pressure regulator controls this overlap at normal powers by closing the throttle butterfly a small amount, if necessary.

(2) RIGGING PROCEDURE. *(See figures 115, 116, 117, and 118.)*—(All item numbers, letters, and detail letters refer to figure 118 unless otherwise indicated.)

CAUTION

Accomplish rigging procedure carefully to prevent "separation" of cockpit levers.

(a) Set the throttle control levers 7/16 inch forward of the extreme aft position and tighten friction lock. This places throttle levers in initial "spring back" position. For instructions on readjustment of the levers, see paragraph *(o)* following.

(b) Connect cables at turnbuckles, but do not tighten. Turnbuckles are located behind inspection plates "130" L/R (figure 5).

(c) Install cable lock on pulleys "25" L/R (a hook similar to a shoe hook will be helpful in this operation).

(d) Adjust cables at turnbuckles to 55 (± 5) pounds tension until aligning pin (or 3/16-inch bolt) will pass through pulleys "25" L/R (figures 116, 117, and 118) and pulley bracket.

(e) Remove aligning pins at "25" L/R when adjustment removes tension from pins.

(f) Test system for operation.

Note

Pulley "25" RH must turn clockwise, and pulley "25" LH must turn counterclockwise, when viewed looking aft, as throttles are advanced.

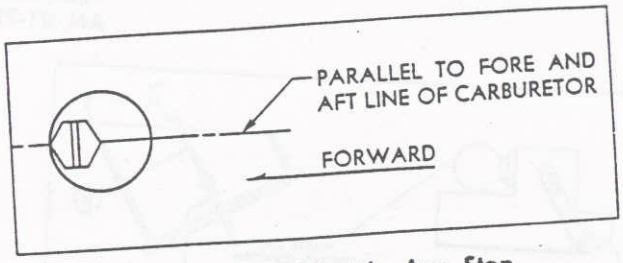


Figure 119 — Throttle Arm Stop

(g) Match the L/R carburetor throttle arm stops "14" (figure 118) as shown in figure 119 (only if engine idle speed has not been adjusted).

(h) Place carburetor throttle arm "8" in fully closed position against throttle stop "14" and set lever "36" as indicated on view A-A; figure 116.

(i) With arm "8" in closed position, adjust and install carburetor throttle rod "32" to maintain a clearance of .005 to .012 inch normal clearance (.005 to .050 inch maximum, one regulator only) between regulator closed (low) position stop and pivoting crank lever "35." (See view A, figure 118.)

(j) Check position of main lever arm "34" attached to manifold pressure regulator on RH and LH engines. Arms must be as near as possible to position shown in figure 120.

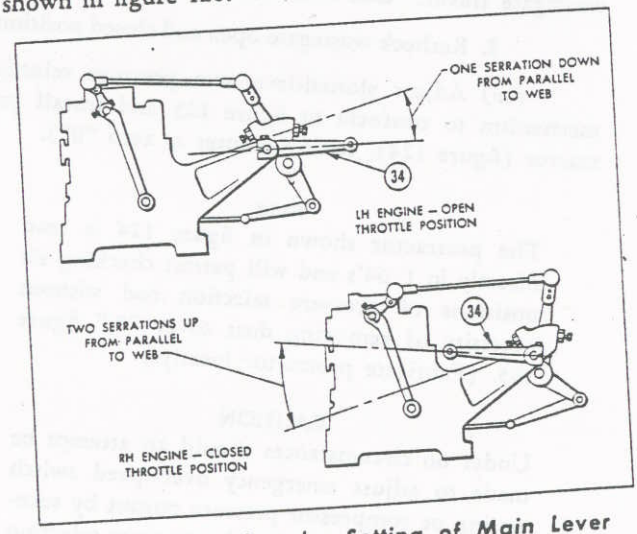


Figure 120 — Angular Setting of Main Lever Arm, Manifold Pressure Regulator

(k) Adjust bell crank brackets to dimensions given below:

BELL CRANK BRACKETS
(See figure 116 and 117)

Item	*Length-In.*	*Item*	*Length-In.*
LH Inboard	20 7/16	RH Inboard	15 1/4
LH Outboard	16 1/2	RH Outboard	None

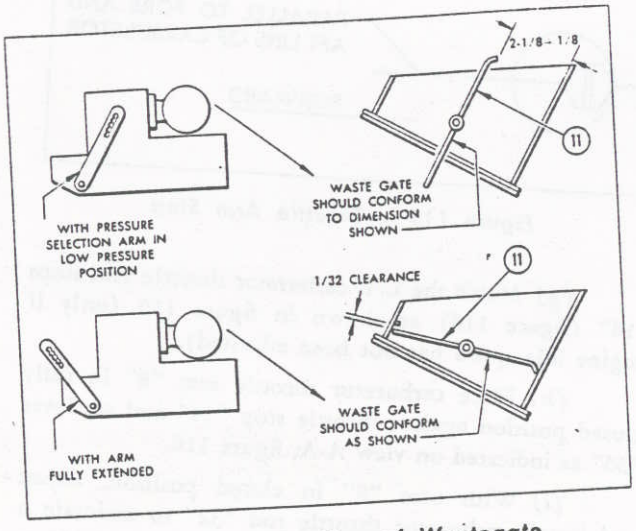


Figure 122 — Position of Wastegate

If wastegate open position is incorrect proceed as follows:

1. Clamp bell crank "1" to prevent movement.

2. Adjust and shift rod "13" to next hole in the motor output slotted-lever-arm. ("In"—to decrease wastegate travel. "Out"—to increase wastegate travel.)

3. Recheck wastegate open and closed positions.

(w) Adjust slotted-lever-arm pressure selection mechanism to conform to figure 123 and install protractor (figure 124), setting pointer at zero "0").

Note

The protractor shown in figure 124 is read directly in 1/64's and will permit checking all positions of pressure selection rod without necessity of removing dust cover "5," figure 195. (Fabricate protractor locally.)

CAUTION

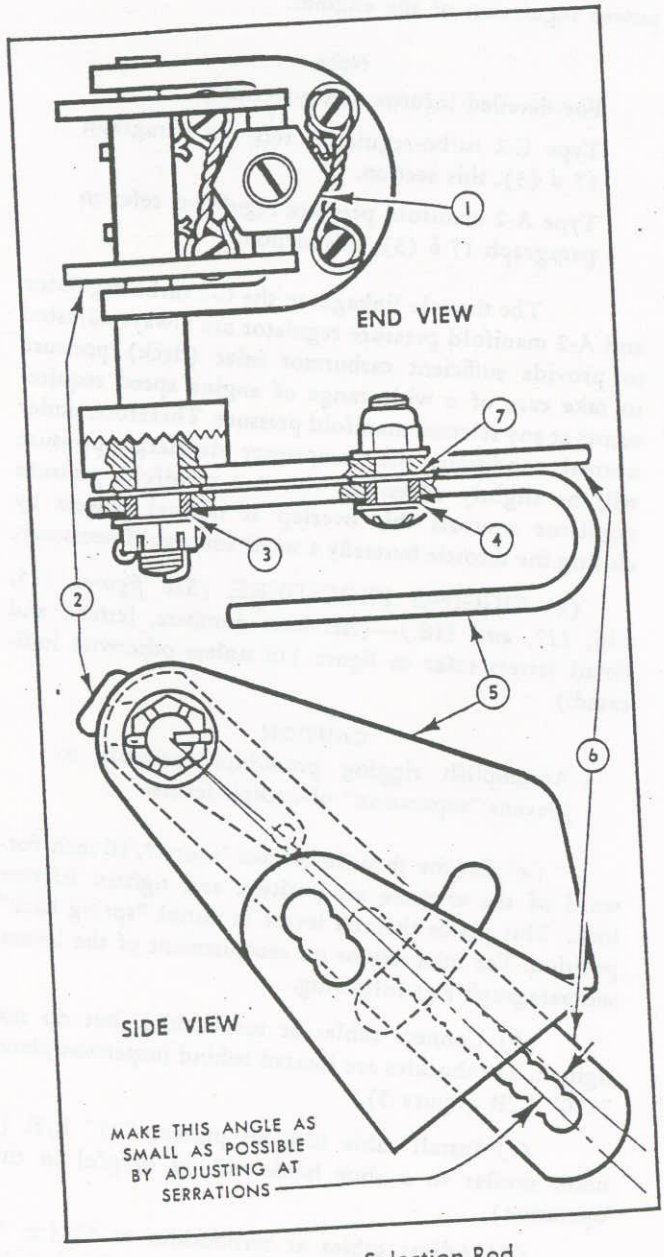
Under no circumstances should an attempt be made to adjust emergency over-speed switch setting or compressor pressure output by turning the nut on the end of the pressure selection rod. This nut is adjusted at the factory or at the repair depot and must remain locked.

(x) Install rod "7," using hole farthest from pivot point in override control arm (figure 125).

CAUTION

Under no circumstances should override arm mechanism be lubricated.

(y) Loosen friction lock in cockpit. Insert piece of paper between forward stop and pivoting lever of manifold pressure regulator. Move cockpit throttle lever forward until regulator pivoting lever arm barely strikes paper. Disregard over-travel of cockpit lever. Tighten friction lock. (See Detail D.)



1. Pressure Selection Rod
2. Yoke
3. Spacer
4. Spacer
5. Override Arm
6. Pressure Selection Lever
7. Washer

Figure 123 — Angle Setting, Pressure Selection Lever

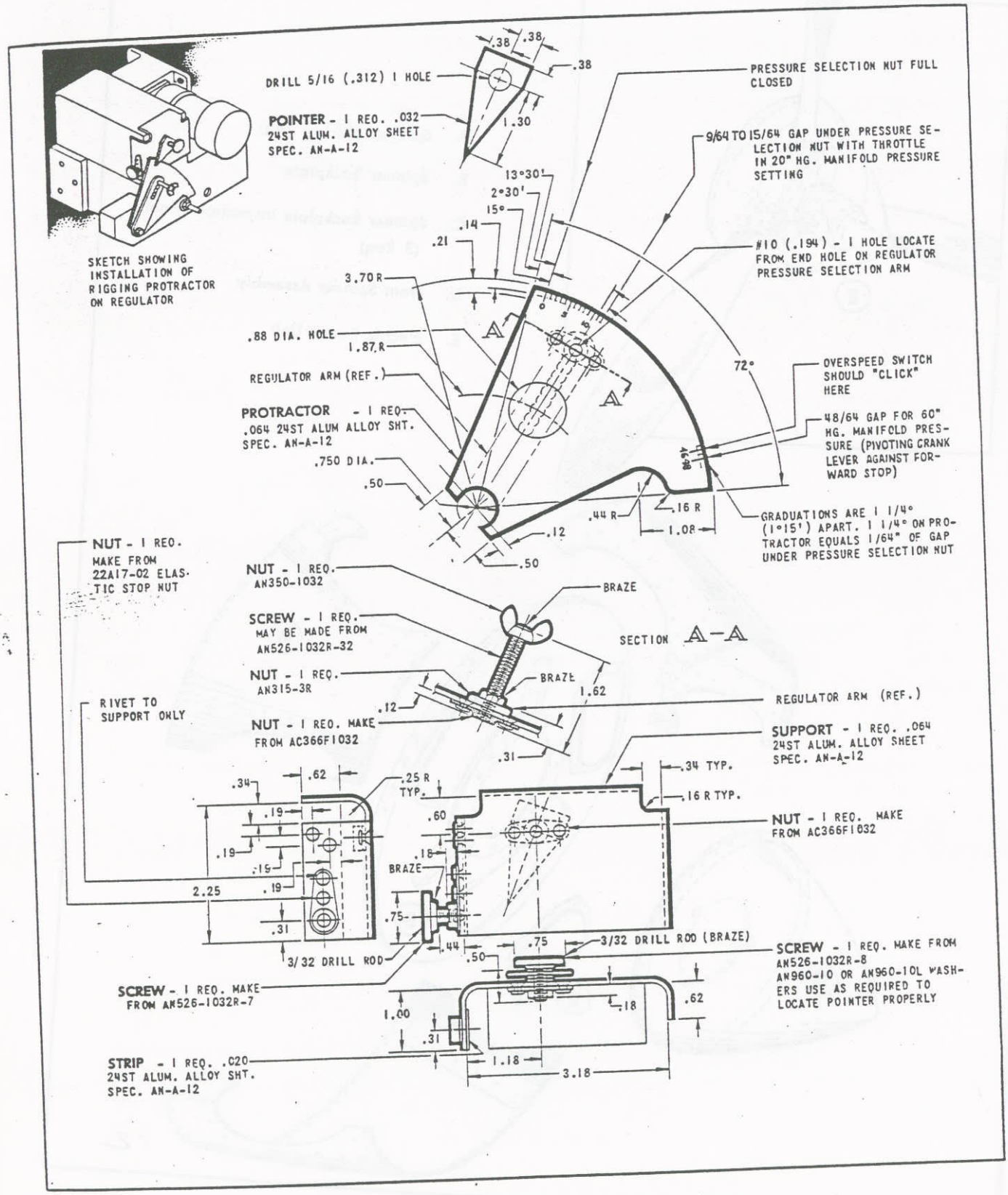


Figure 124 — Rigging Protractor, C-2 Regulator

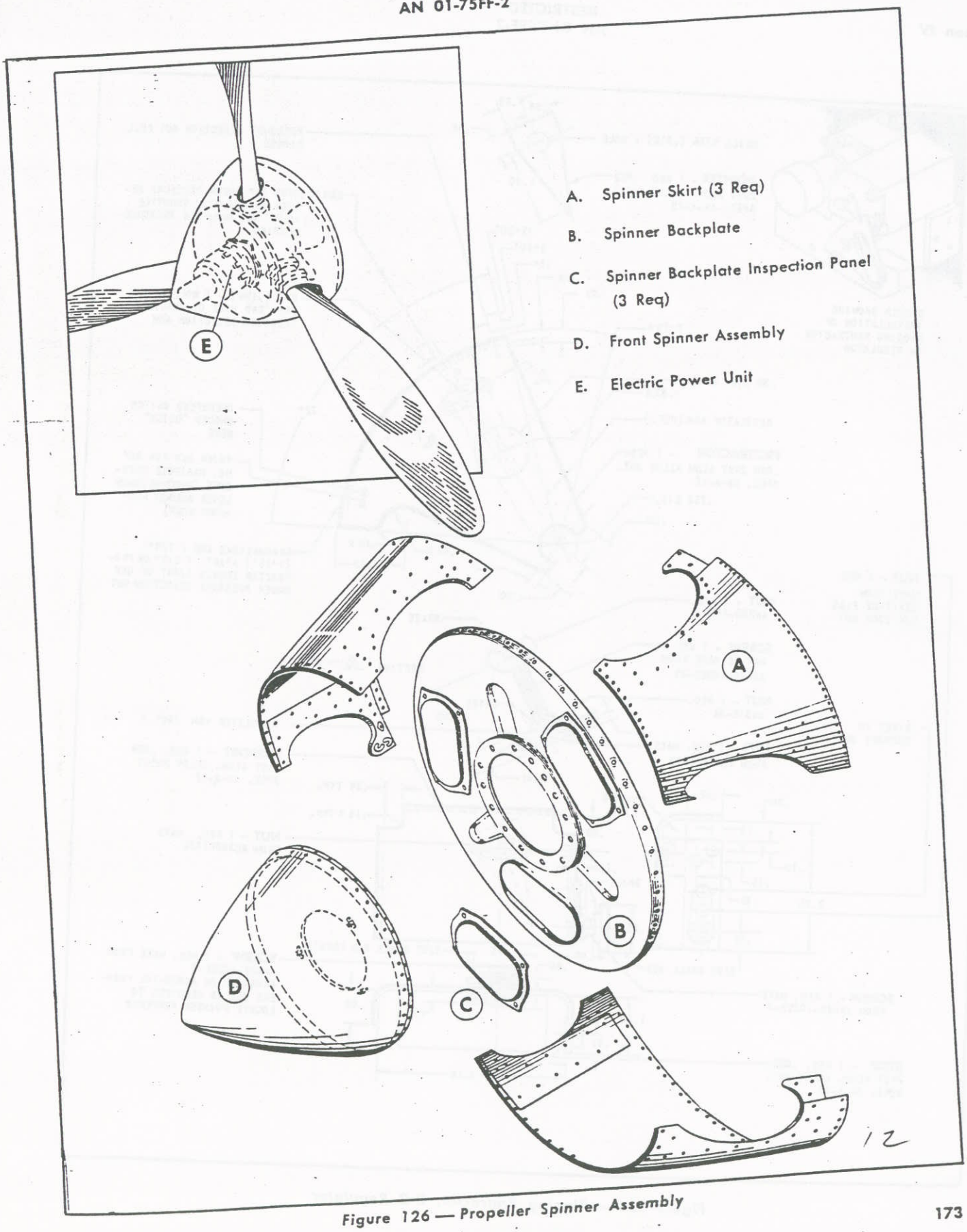
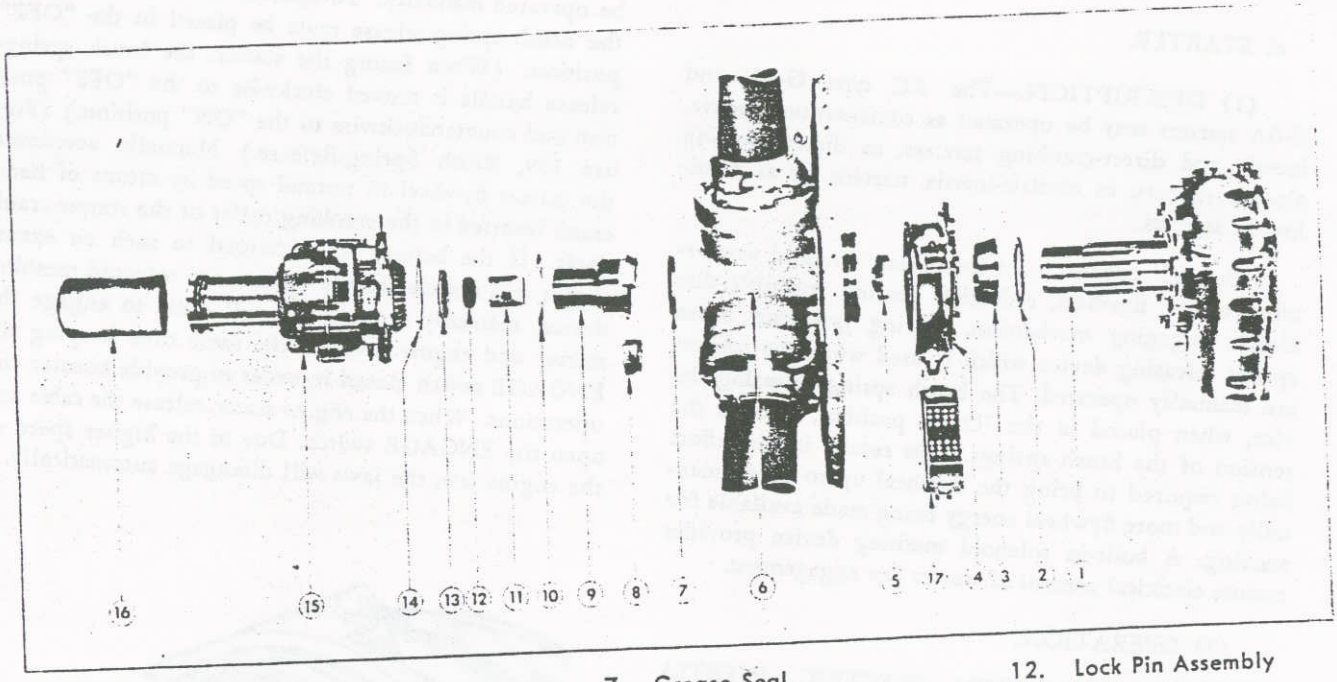


Figure 126 — Propeller Spinner Assembly



1. Propeller Shaft
2. Shim (for use if required)
3. Rear Cone
4. Slip Ring Housing
5. Propeller Shaft Adapter
6. Propeller Hub Assembly
7. Grease Seal
8. Front Cone Half
9. Propeller Shaft Nut
10. Snap Ring
11. Shaft Nut Lock
12. Lock Pin Assembly
13. Grease Seal
14. Neoprene Seal
15. Power Unit
16. Electric Motor Cover
17. Brush Assembly

Figure 127 — Propeller Assembly Sequence

(c) Place protractor on hub at a 90-degree angle to first setting. Center protractor bubble. Angle showing on scale is ground angle of airplane.

(d) Turn propeller until one blade is in a horizontal position. Place protractor, now set at 90 degrees, against hub and turn propeller until bubble is centered. Blade is now in a true horizontal position. Do not move propeller.

(e) Measure 42 inches along blade from center of hub. Place protractor at this spot, on thrust or flat side of blade, perpendicular to blade and center bubble. Angle found, plus ground angle, represents angle of pitch for this blade. Repeat this procedure for feather and high pitch. Also repeat for other blades. High pitch angle should be 57.7 degrees and low pitch angle 22.7 degrees. If blades do not have angles corresponding to these and deviation is great, it is possible blade gears are not matched properly with power gear. Remove power unit and check each blade gear setting with index mark of hub center line on inner circumference of hub face. Index mark should be in line with a point two and one-quarter teeth past end of gear segment, measuring from end of gear on which propeller rotation letter "L" or "R" is stamped.

(6) ASSEMBLY. — Propellers are often shipped with two blades removed.

CAUTION

Do not disturb blade clamp bolts.

(a) Remove hub with its one blade from packing case and place on a clean surface, slip rings down. Place remaining blades on a clean surface with blade bearings not resting on surface.

(b) Thoroughly clean sockets and blade assemblies of anti-rust compound, and coat hub barrel and bearings with hub lubricant, Specification AN-G-4, grade AA.

Note

A No. 2 shank blade requires preload shims as follows:

*Blade Gear Numbers**	*Shim Numbers*	*Actual Shim Thickness*
.000	—0	.062
.002	—2	.059
.004	—4	.056
.006	—6	.053

*Stamped on outer circumference of blade gear. This number must correspond with dash number following part number on shim.

d. STARTER.

(1) DESCRIPTION.—The AC type G-5A and G-6A starters may be operated as combination electric-inertia and direct-cranking starters, as direct-cranking electric starters, as electric-inertia starters, or as hand-inertia starters.

The unit consists of a heavy-duty integral accelerating motor, flywheel, reduction gearing, multiple disc clutch, engaging mechanism, driving jaw, and brush spring releasing device which is used when the starters are manually operated. The brush spring releasing device, when placed in the "OFF" position, releases the tension of the brush springs. This results in less effort being required to bring the flywheel up to speed manually and more flywheel energy being made available for starting. A built-in solenoid meshing device provides remote electrical control of starter jaw engagement.

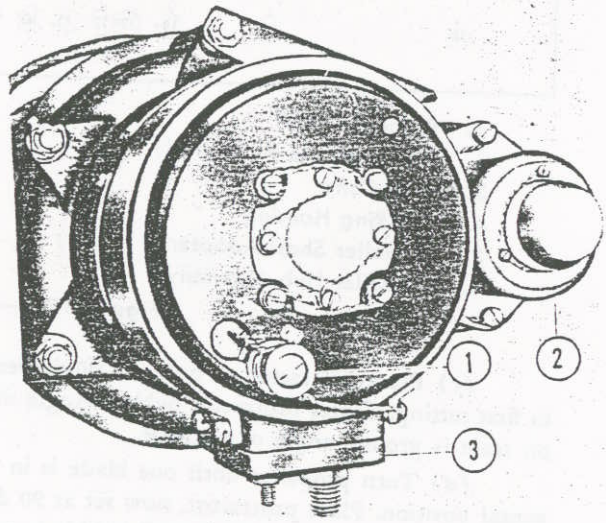
(2) OPERATION.

(a) COMBINATION ELECTRIC INERTIA AND DIRECT CRANKING.—Operation of the starter as a combination electric inertia and direct cranking starter is recommended for cold weather starting. When used in this manner, energy is stored in a flywheel which is keyed directly on the motor armature shaft. When the flywheel has reached its normal operating speed of 16,000 rpm, in from 12 to 15 seconds, the starter and engine jaws are engaged and the energy stored in the rotating flywheel is transmitted to the engine jaw through a reduction gearing and torque over-load release mechanism The torque overload release unit is a spring-loaded multiple-disc clutch. The purpose of the clutch is to protect the starter during backfire of the engine or under excessive loads. The energy stored in the flywheel is used to overcome the heavier "break-away torque," after which the lighter load of continuous cranking is assumed by the electric motor.

(b) DIRECT CRANKING.—Operation of the starter as a direct-cranking electric starter is recommended only when the engine is still warm from previous running and immediate and continuous cranking is desired. By closing the START and ENGAGE switches simultaneously the entire load of starting is assumed by the electric motor.

(c) ELECTRIC INERTIA. — Operation of the unit as an electric inertia starter is recommended for an emergency wherein the source of electrical energy is not sufficient to carry the load of continuous cranking.

(d) HAND INERTIA. — For emergency operation when the source of electrical energy is not sufficient to provide proper electrical operation, the starter may be operated manually. To operate the starter manually, the brush spring-release must be placed in the "OFF" position. (When facing the starter, the brush spring-release handle is moved clockwise to the "OFF" position and counterclockwise to the "ON" position.) (Figure 139, Brush Spring-Release.) Manually accelerate the starter flywheel to normal speed by means of hand crank inserted in the cranking collar of the starter crank shaft. If the battery is discharged to such an extent that it will not electrically operate the solenoid meshing device, manually operate the pull cable to engage the starter and engine jaws, at the same time keeping the ENGAGE switch closed in order to provide booster coil operations. When the engine starts, release the cable and open the ENGAGE switch. Due to the higher speed of the engine jaw, the jaws will disengage automatically.



1. Brush Spring Release Handle
2. Meshing Solenoid
3. Terminal Block

Figure 139 — Starter Brush Spring Release

(3) REMOVAL.

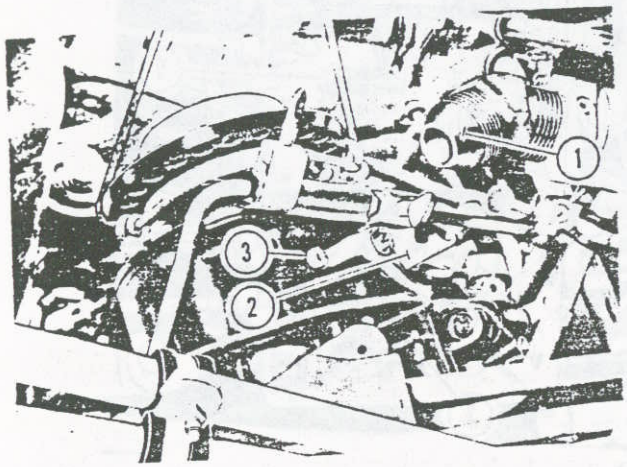
(a) LEFT-HAND STARTER. *(See figure 140.)*

1. Remove top aft, inboard aft, and bottom aft engine cowling panels.

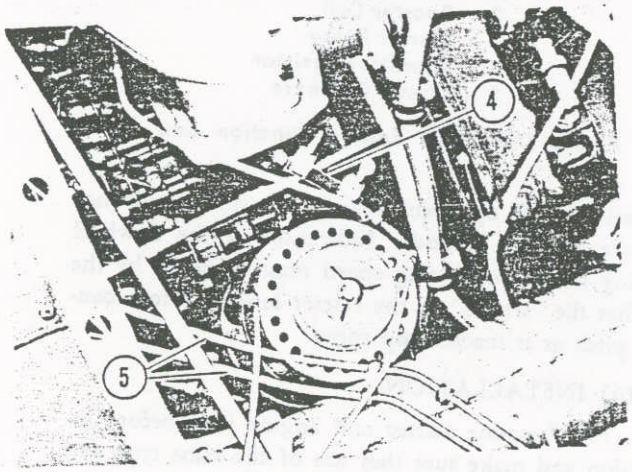
2. Disconnect manual engage handle by removing pulley from bracket and clevis pin from starter engaging arm.

3. Remove bolt attaching extension shaft to starter crank socket and pull out extension shaft.

4. Remove strip holding generator wire clip to starter housing by removing ½-inch nut on housing bolt.



Step A



Step B

1. Line to Wing Tank
2. Starter Crank Socket
3. Manual Engage Handle
4. Pressure Line Connection
5. Pitot Lines

Figure 140 — LH Starter Removal

5. Disconnect wires from starter terminal block.

6. Remove clip holding large flex conduit to crank extension support and drop conduit to provide clearance.

7. Remove wing tank fuel line from strainer to check valve and if necessary loosen hose clamps on fuel line from check valve and oil pressure gage lines, to provide greater clearance.

8. Loosen hose clamp on pressure line between carburetor and header tank and pull line forward to allow space for starter removal between distributor housing and carburetor accelerator pump.

9. Disconnect pitot lines at union and pull lines aft for greater clearance.

10. Remove nuts holding starter to engine.

11. Tie rope around starter, drop motor end and turn starter 90° counterclockwise to start (figure 140—Step A). Then attach two ropes to starter remove and pull up vertically through space provided (figure 140—Step B). Rotate starter 45° clockwise so starter engage solenoid will pass between oil pressure fitting and fair-lead.

(b) RIGHT-HAND STARTER. *(See figure 141.)*

1. Remove outboard aft and bottom aft engine cowling panels.

2. Remove lower intercooler duct section.

3. Disconnect manual engage handle by removing pulley from bracket and clevis pin from starter engaging arm.

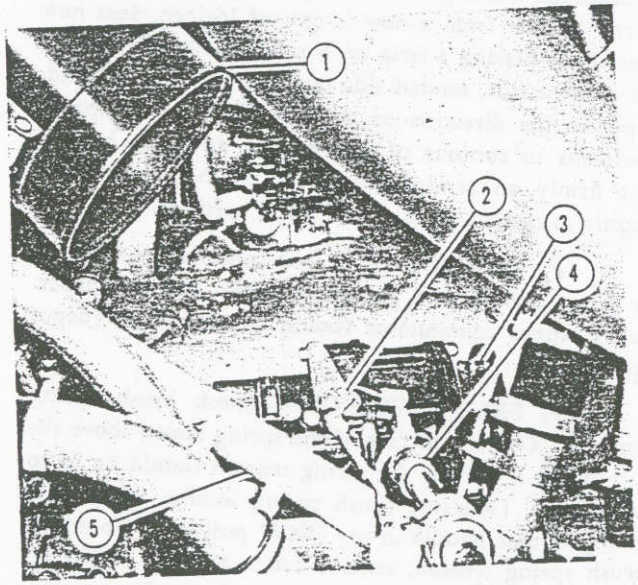
4. Remove bolt attaching extension shaft to starter crank socket and pull out extension shaft.

5. Disconnect wires from starter terminal block.

6. Remove oil pressure gage line.

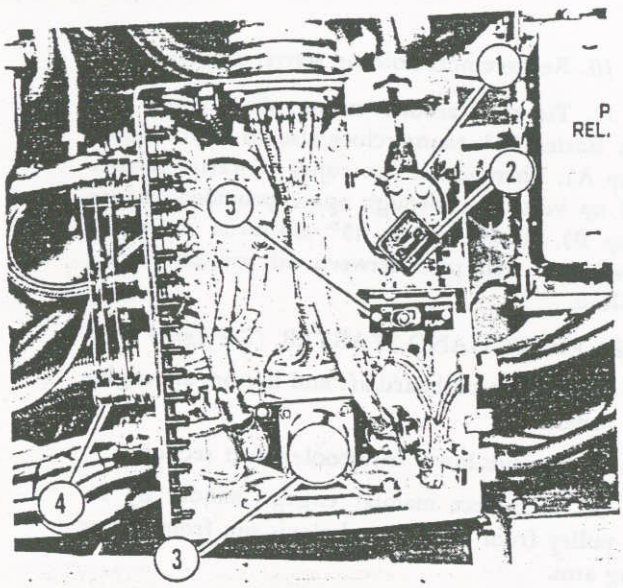
7. Remove nuts holding starter to engine.

8. Pull starter aft, turn drive-end up and remove over outboard engine diagonal support (figure 141).



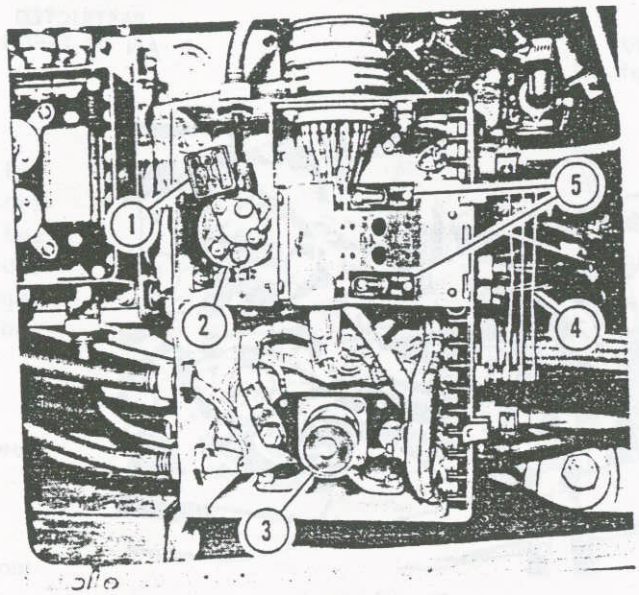
1. Lower Intercooler Duct Section
2. Manual Engage Handle Pulley
3. Starter Hold-Down Bolts
4. Starter Crank Socket
5. Outboard Engine Diagonal Support

Figure 141 — RH Starter Removal



1. Booster Coil
2. Condenser
3. Starter Relay
4. Equalizer Resistor
5. Circuit Breaker

Figure 142 — LH Engine Junction Box



1. Condenser
2. Booster Coil
3. Starter Relay
4. Equalizer Resistor
5. Circuit Breakers

Figure 143 — RH Engine Junction Box

(4) MAINTENANCE.

(a) BRUSHES.—Brushes must be a free fit in the holders without excessive side play. Binding brushes and holders must be wiped clean with a cloth moistened in unleaded white gasoline. Replace brushes if they are worn $^{3}/_{16}$-inch from a new length of ½-inch. Seat new brushes by placing a strip of No. 000 sandpaper around the commutator, sanded side out, and pulling the sandpaper in the direction of rotation. Be sure sandpaper conforms to contour of commutator and that brushes rest firmly on sandpaper. After seating, clean thoroughly to remove all sand and metal particles.

(b) COMMUTATOR.—If commutator is rough or dirty, smooth and polish with No. 000 sandpaper. Badly scored commutator should be resurfaced (depot operation).

(c) BRUSH SPRINGS. — Check brush spring tension. With the surface of the spring raised above the top of brush holder, the spring tension should be 24 to 28 ounces. (Measure brush spring tension with brush spring release handle in the "ON" position.) To adjust brush spring tension, remove cotter pin and rotate adjusting sleeve clockwise to increase the spring tension, or counterclockwise to decrease the spring tension; replace cotter pin when correct adjustment is reached.

(5) TEST.—Test the starter for normal operation by closing starter switch and checking time required for flywheel to reach operating speed. The time should not be more than 17 seconds. Indication of the flywheel reaching normal operating speed may be noted by the fact that the "whine" of the starter levels off to a constant pitch as it reaches top speed.

(6) INSTALLATION.

(a) Examine starter and engine jaws before installation and make sure they are of the same type and are of correct rotation for proper engagement.

(b) Reverse removal procedure for left- and right-hand starters.

e. BOOSTER COIL. (See figures 142 and 143.)

(1) DESCRIPTION.—The booster coil is a small induction coil which furnishes a supplementary high voltage during engine starts. Each booster coil is energized through its respective starter ENGAGE switch and is located in the respective engine junction box.

(2) REMOVAL.

(a) Remove inboard side aft engine cowl panels.

(b) Remove engine junction box covers.

(c) Disconnect low tension lead from booster coil terminals.

(d) Pull out high tension lead.

(e) Remove condenser from coil.

(f) Remove two screws and remove coil.

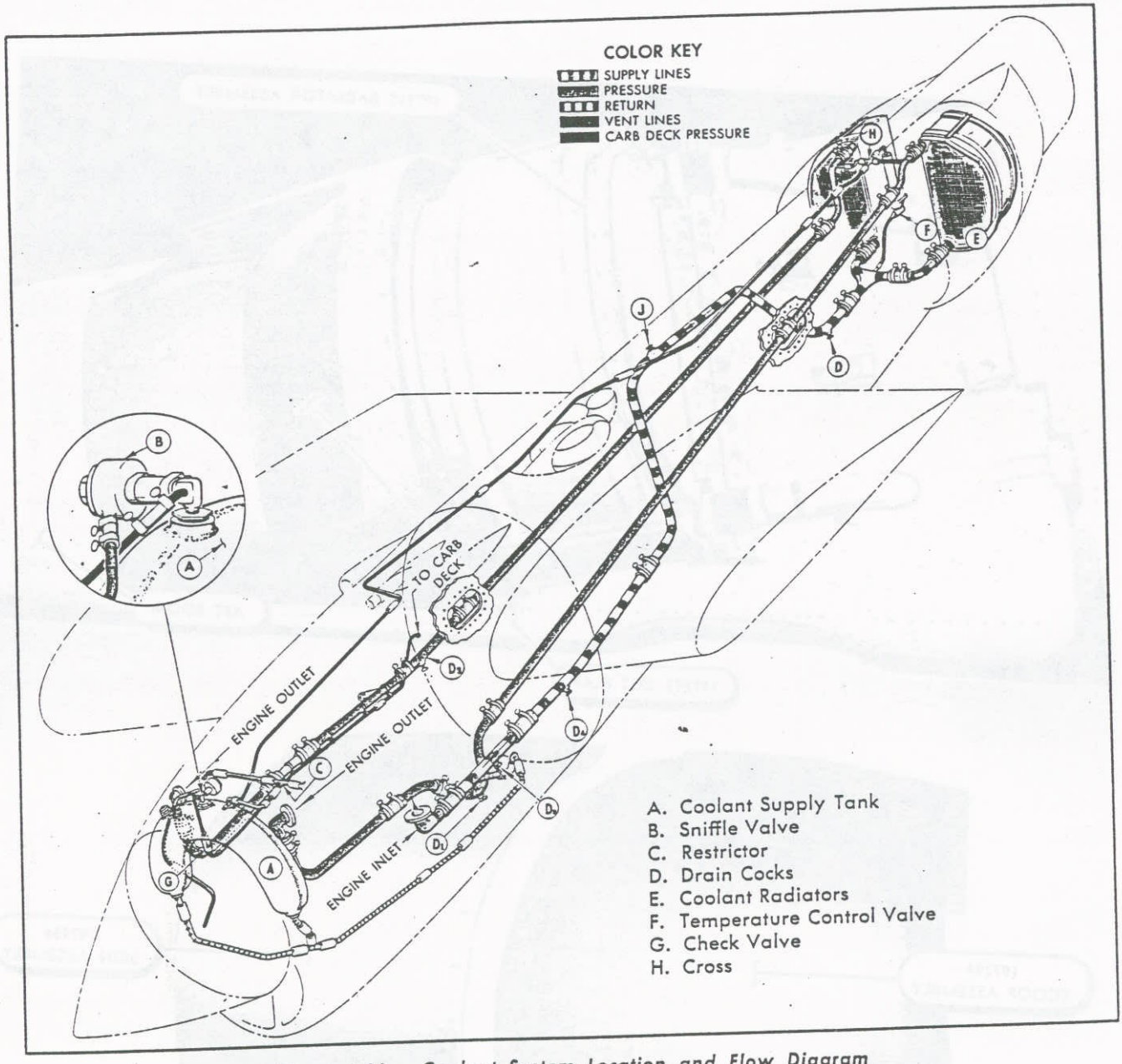


Figure 144 — Coolant System Location and Flow Diagram

5. "D_1" engine section (remove panel "8," figure 96).

4. "D_2" engine section (remove panel "8," figure 96).

(c) TO FLUSH.

1. Airplanes previously serviced with inhibited glycol (NaMBT):

a. Drain the cooling system when coolant is hot. Use clean containers to catch the fluid.

b. With the drains open, run water through system with hose in expansion tank filler neck until the drain water is clean.

c. Close all drains and fill the cooling system with water.

d. Drain the water from the cooling system.

e. Repeat c, preceding.

f. Run engine until coolant temperature reaches 90° C (194° F).

g. Drain cooling system. If drain water is dirty repeat c and f, preceding, until water drains clean.

h. Wait at least five minutes for water to drain and then fill with flushing solution of used ethylene glycol.

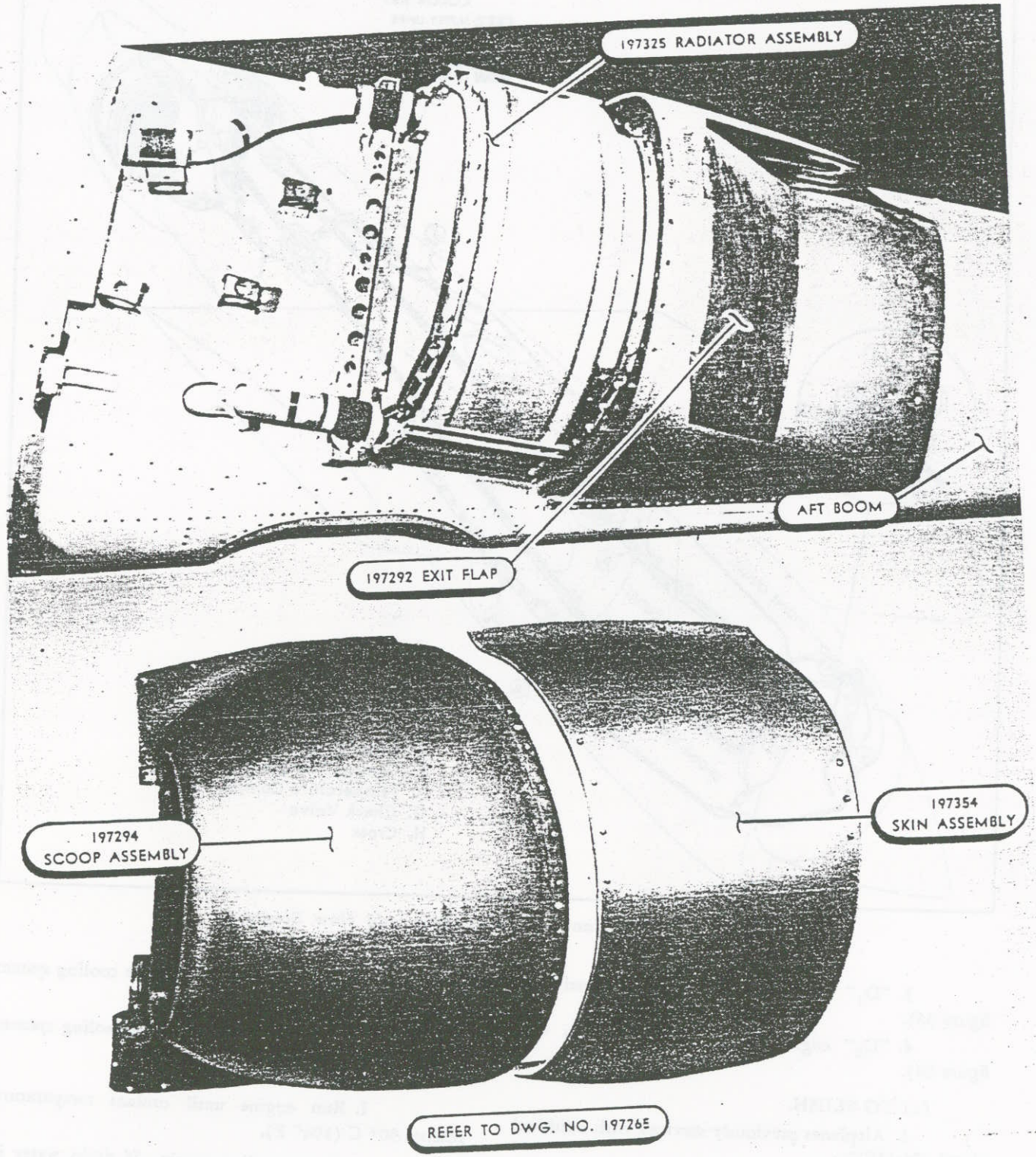


Figure 146 — Coolant Radiator Installation

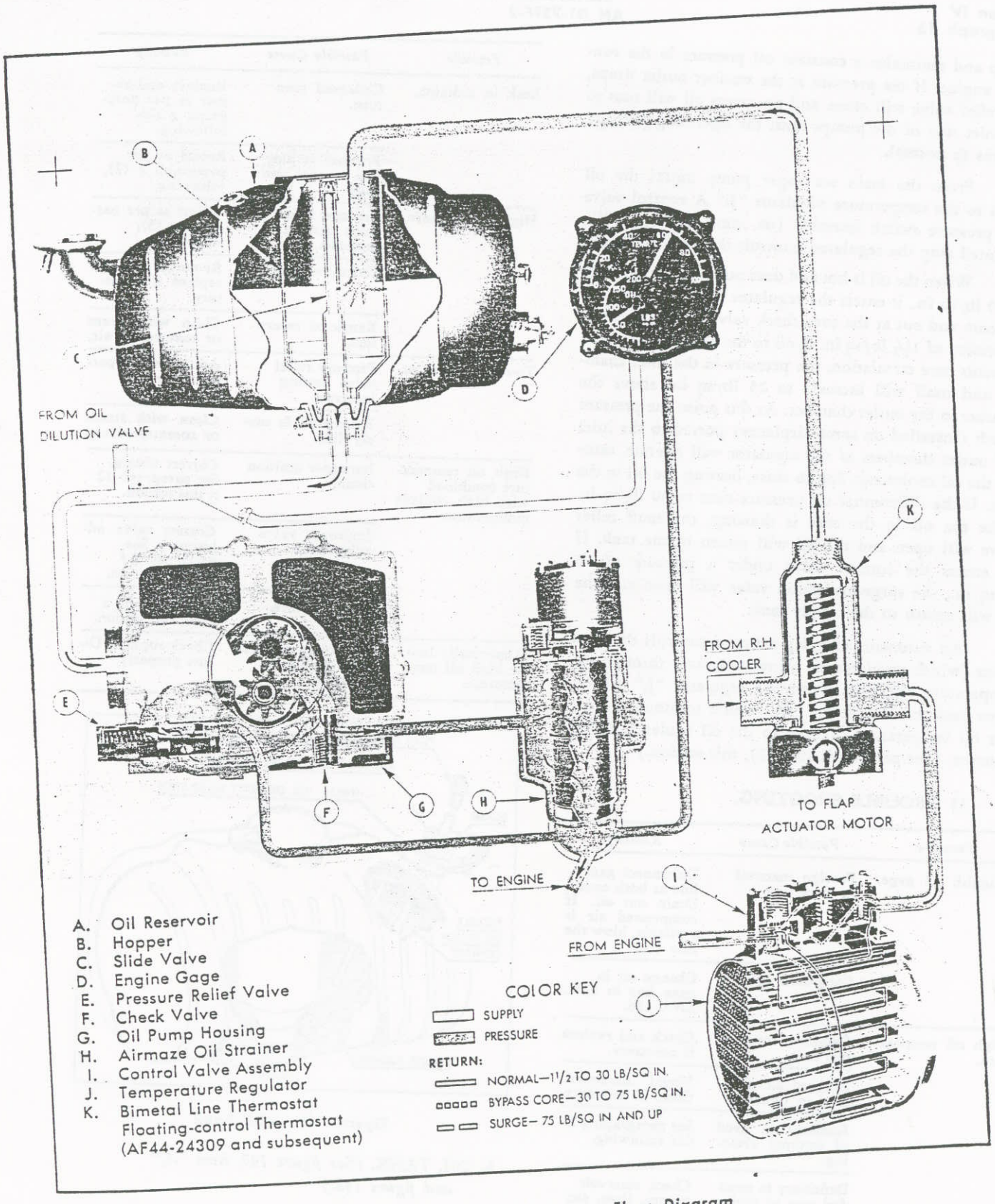


Figure 147 — Engine Oil System Flow Diagram

pump and maintains a constant oil pressure in the running engine. If the pressure at the strainer outlet drops, the relief valve will close, and no excess oil will pass to the inlet side of the pumps until the operating pressure returns to normal.

From the main scavenger pump outlet the oil flows to the temperature regulator "J." A control valve and pressure switch assembly (on some airplanes) "I", mounted atop the regulator, controls the path of the oil.

When the oil is hot and does not exceed a pressure of 75 lb/sq in., it enters the regulator and flows through the core and out at the core check valve, which opens at a pressure of 1½ lb/sq in. If oil in the core congeals and prevents core circulation, the pressure in the inlet chamber and muff will increase to 25 lb/sq in. above the pressure in the outlet chamber. At this point the pressure switch (installed on some airplanes) ported to the inlet and outlet chambers of the regulator will operate, causing the oil cooler exit flap to close, heating the oil in the core. If the differential oil pressure rises to 30 lb/sq in. while the oil in the core is thawing, the muff relief valve will open and the oil will return to the tank. If oil enters the control valve under a pressure of 75 /sq in., the surge-protection valve will open and the oil will return to the supply tank.

An automatic exit flap actuator controls the flow of air (which regulates the oil temperature) through the temperature regulator. From the regulator "J," the oil flows into the thermostat "K," which transmits corrective oil temperature changes to the oil cooler exit flap actuator. (See paragraph 20 *g* (2), this section.)

(3) TROUBLE SHOOTING.

Trouble	*Possible Cause*	*Remedy*
Sluggish oil gage.	Foreign material in gage line.	Disconnect gage line at both ends. Drain out oil. If compressed air is available, blow the line free.
	Congealed oil.	Change oil in gage line to Spec. AN-C-116.
High oil temperature.	Defective thermostat unit.	Check and replace if necessary.
	Plugged air passage in radiator.	Visual inspection. Clean if necessary.
	Radiator in need of internal cleaning.	See paragraph *g* 2 *(d)*, following.
	Deficiency in specified rate of engine oil flow.	Check reservoir pumps, lines, etc. for restrictions.
	Congealed oil in radiator cooling element.	Close flaps until circulation is restored.
Leak in radiator.	Collapsed core tube.	Remove and repair as per paragraph *g* (2), following.
	Fracture at junction of core and shell.	Repair as per paragraph *g* (2), following.
High oil pressure.	Pressure relief valve setting incorrect.	Adjust as per paragraph *e* (3), following.
	Defective gage.	Remove, test, and replace if necessary.
	Restricted return line.	Clean with steam or compressed air.
Low oil pressure.	Pressure relief valve setting incorrect.	Adjust as per paragraph *e* (3), following.
	Restriction in supply line.	Clean with steam or compressed air.
High oil temperature combined with high coolant temperature.	Improper ignition timing.	Correct timing. See paragraph 12 *c*, this section.
	Improper valve adjustment.	Correct valve adjustment. See paragraph 8 *f* (2), this section.
	Lean mixture.	See paragraph 8 *c* (3), this section.
Abnormally low or high oil temperature.	Improper oil supply, quality, or dilution.	Check supply. Dilute properly.

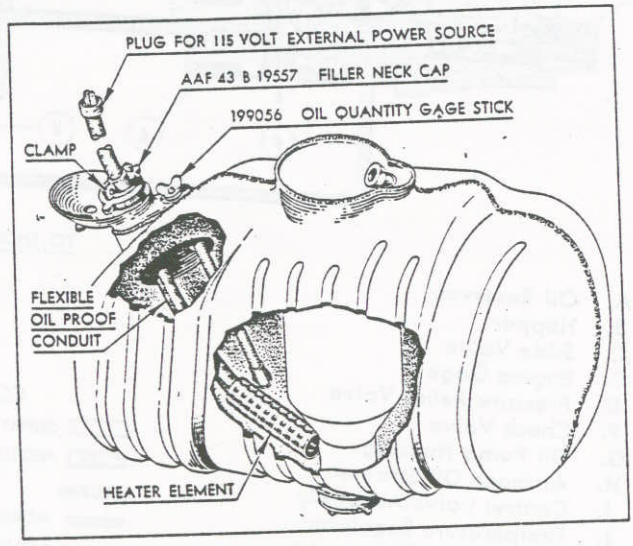


Figure 148 — Oil Tank

b. OIL TANK. *(See figure 147, item "A," and figure 148.)*

(1) DESCRIPTION.—Oil tanks fabricated from 3SO aluminum alloy, Spec. QQ-A-359, are mounted on the front face of each fire wall. A slide valve "C"

sequent to AF44-24309 are equipped with the improved "floating-control" thermostat.

For detailed information, see paragraph 20 *g*, this section, and figure 279.

i. OIL COOLER FLAP ACTUATORS.
(See figures 152 and 153.)

(1) DESCRIPTION.—The oil cooler exit flaps are actuated by an electrically driven jack screw mechanism. The oil cooler actuator assembly consists of two units, the power unit and the driven unit. The power units contain an electric motor, a spur and worm gear speed reducer, and a lead screw. A switch box is mounted on the power unit which contains the position contact and limit switches. (See paragraph 20 *g* (4) and 20 *i* (2), this section.)

The driven unit contains only a worm gear speed reducer and a lead screw. It is driven by the power unit through a flexible shaft.

Each unit operates its respective exit flap through a bell crank and push-pull rods attached to the lead screw clevis.

(2) REMOVAL.

(a) POWER UNIT.

1. Remove bolt attaching actuator lead screw to bell crank.

2. Disconnect flexible drive shaft at actuator.

3. Disconnect breeze from switch assembly.

4. Remove two bolts securing outer actuator pivot to bracket.

5. Remove actuator.

(b) DRIVEN UNIT.

1. Remove bolt attaching lead screw to bell crank.

2. Disconnect flexible drive shaft at actuator.

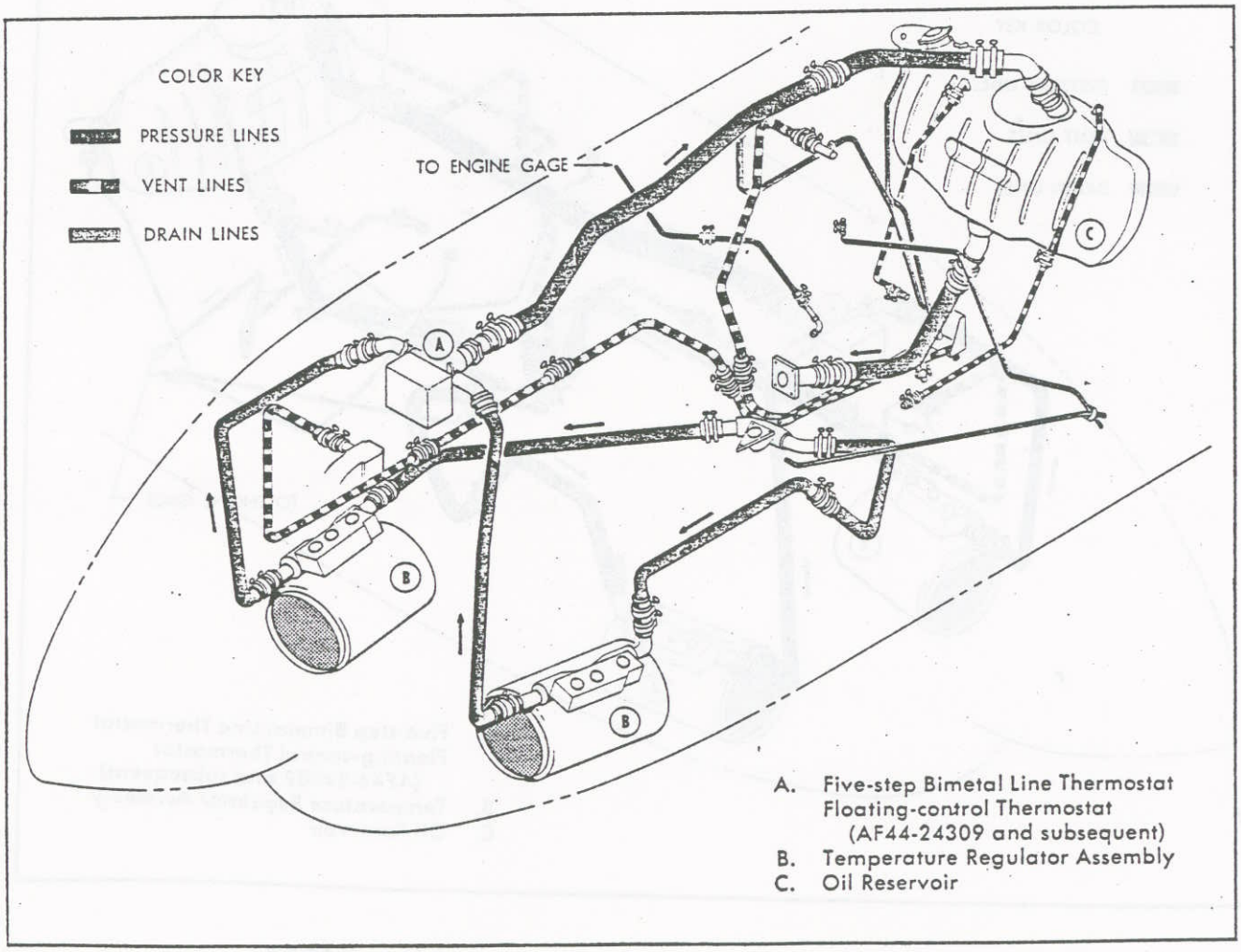


Figure 150 — LH Engine Oil System Location and Flow Diagram

3. Remove four bolts holding pivot to bracket and remove unit.

(3) DISASSEMBLY.

(a) POWER UNIT. *(See figure 152.)*

1. Remove limit and position switch box. (See paragraph 20 *i* (3), this section.)

a. JACK SCREW.

(1) Remove ten screws, items "2," "33," and "30" from bearing housing items "3" and "34."

(2) Remove bearing housing from main gear housing "29."

(3) Remove pin from end assembly "48."

(4) Remove shields covering jack screw "12."

(5) Remove jack screw from main gear housing "29."

CAUTION

When removing jack screw keep shims, spacers, and bearings in sequence.

b. WORM GEAR.

(1) Remove housing "13" containing right angle drive.

CAUTION

In removing right angle drive housing, do not drop coupling "10" between worm gear and right angle drive.

(2) Remove four screws "44" holding electric motor to main gear housing.

(3) Remove electric motor "43."

(4) Remove spur gear pin "42," and spur gear "40."

(5) Remove retainer "24."

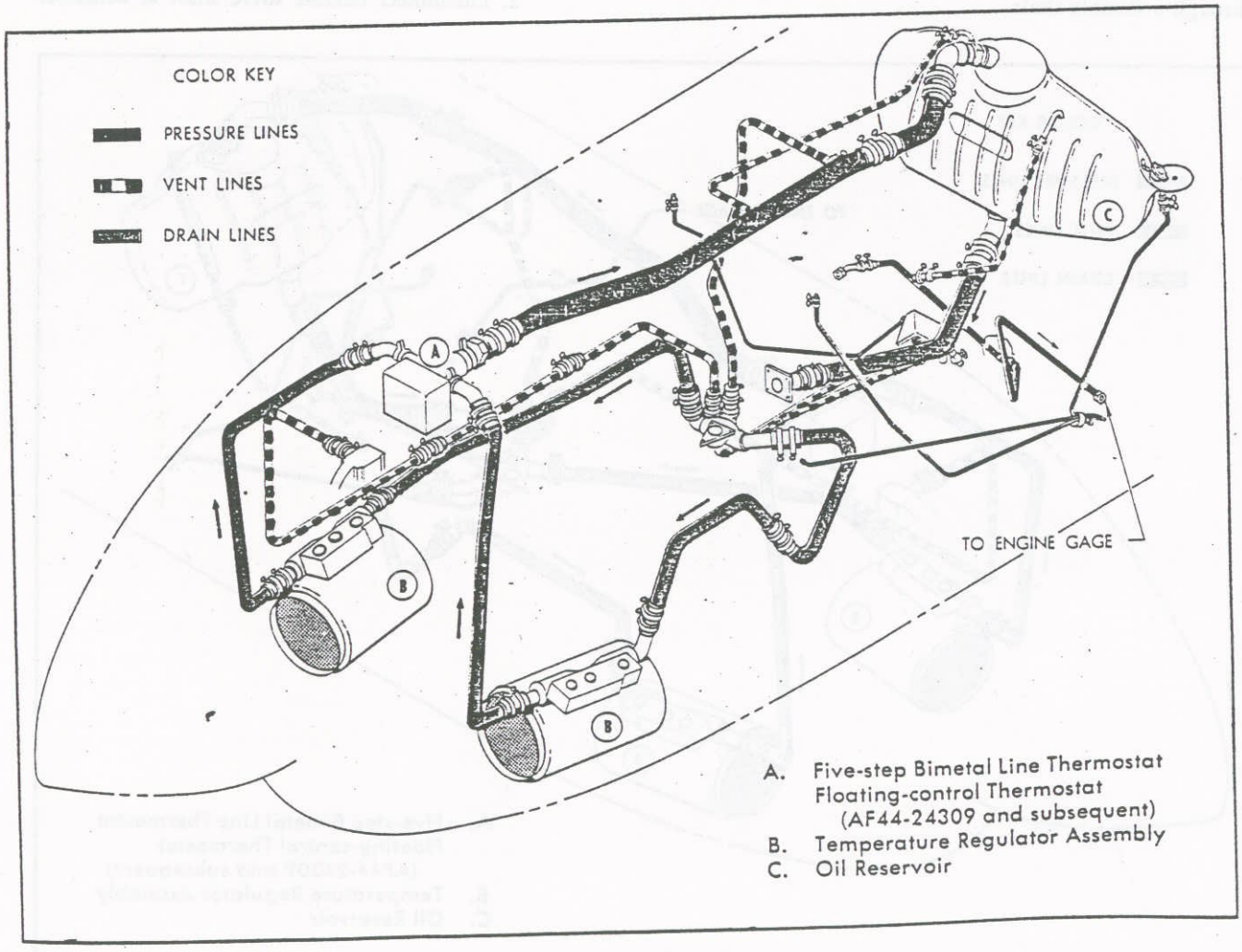


Figure 151 — RH Engine Oil System Location and Flow Diagram

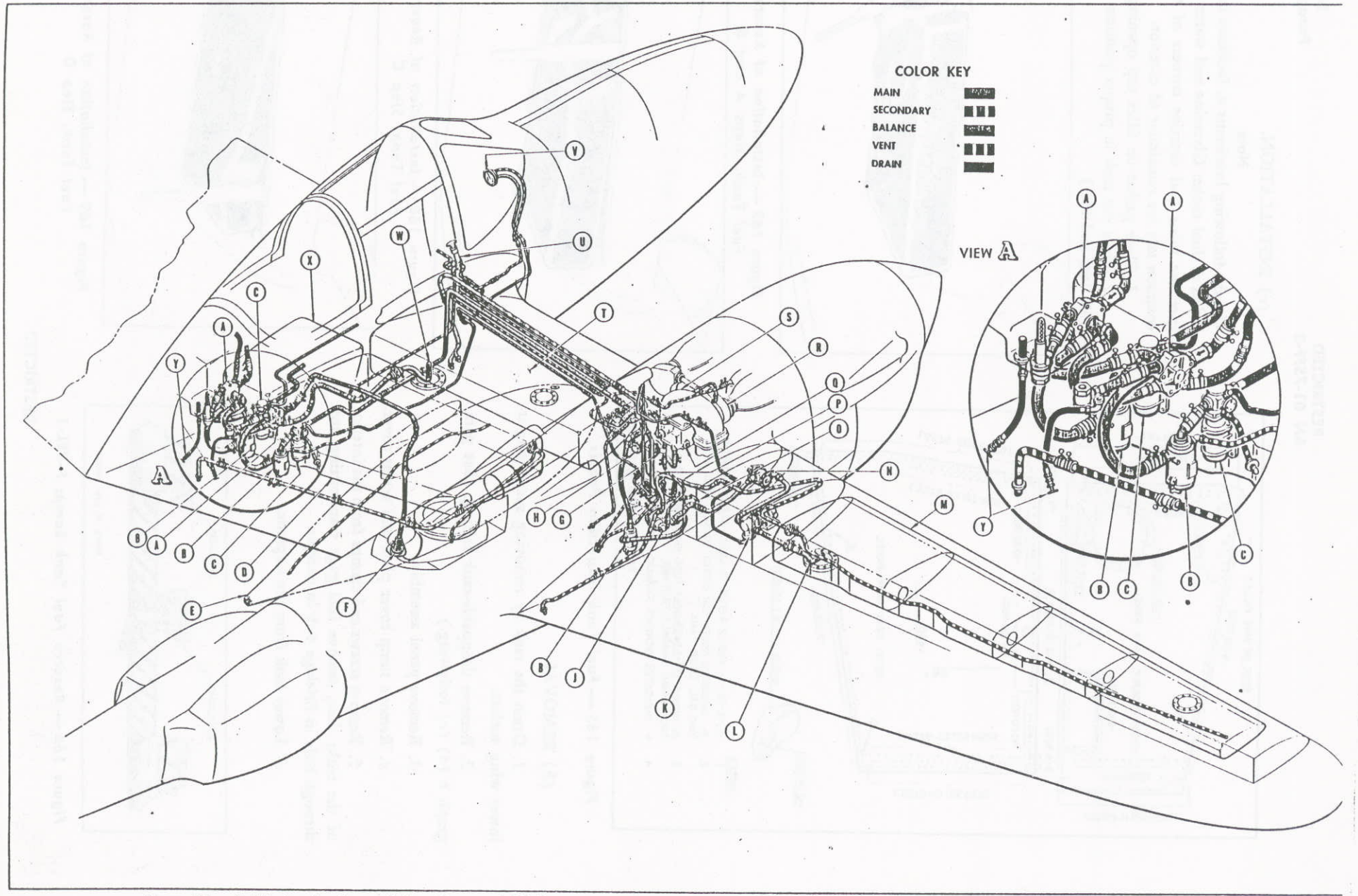


Figure 155 — Fuel System Location and Flow Diagram; P-38L-1

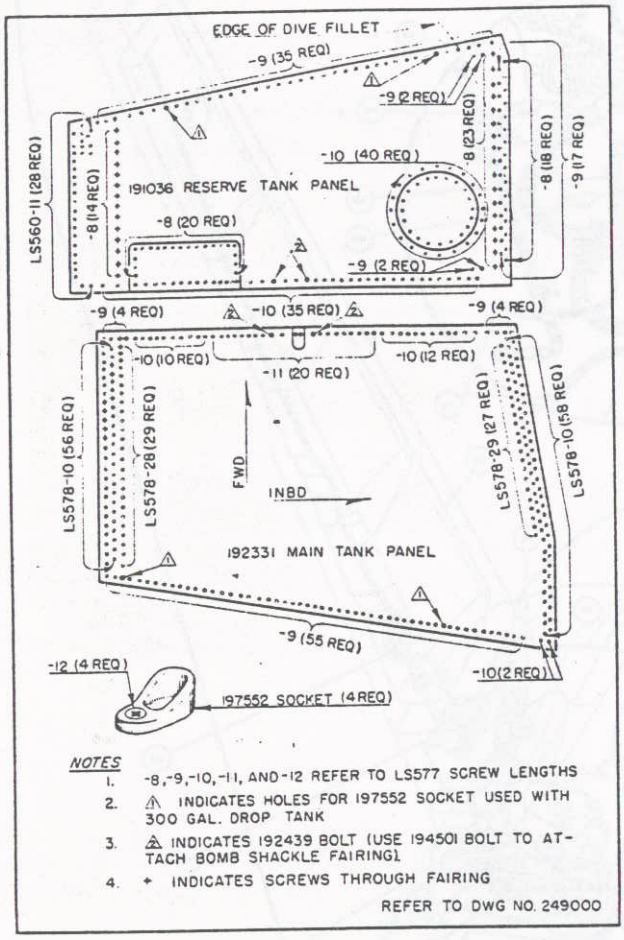


Figure 165 — Fuel Tank Inspection Panels

(b) REMOVAL.

1. Drain the tank by removing sump plug in lower wing surface.

2. Remove droppable-tank fairing. (See paragraph *b* (4) *(c)* following.)

3. Remove panel assembly.

4. Remove sump cover plate and access cover.

5. Remove screws and clamps from the interior of the tank; then, remove fuel gage transmitting unit through hole in fuselage web in cockpit.

6. Lower tank from the airplane.

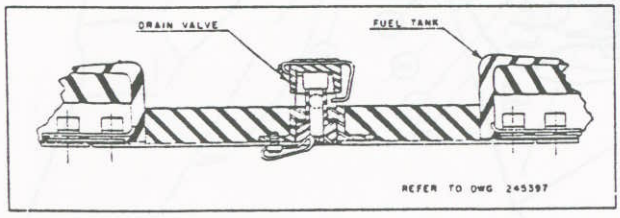


Figure 166 — Reserve Fuel Tank Sump; P-38L-1

(c) INSTALLATION.

Note

Use the following lubricants to facilitate installation of fuel tanks: Glycerine and water mixture for tubes and exterior corners of tank; common talc for remainder of exterior.

1. Place gasket on filler cap opening.

2. Place the tank in proper position. (See figures 167, 168, and 169.)

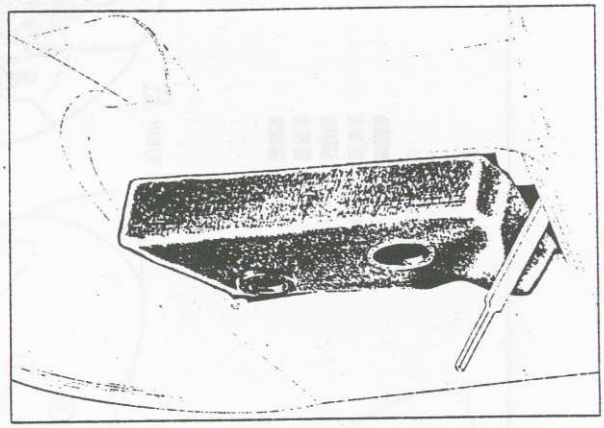


Figure 167 — Installation of Reserve Fuel Tank, Steps A and B

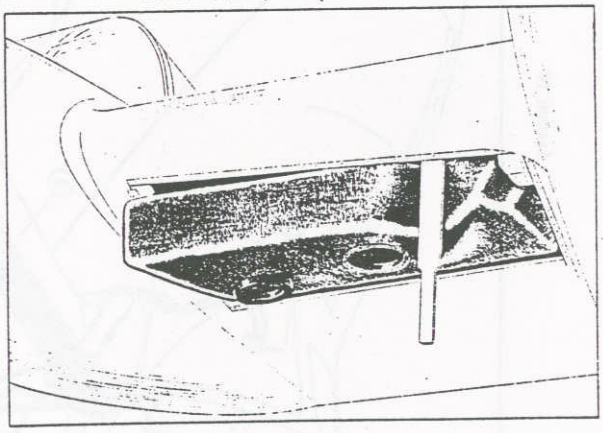


Figure 168 — Installation of Reserve Fuel Tank, Step C

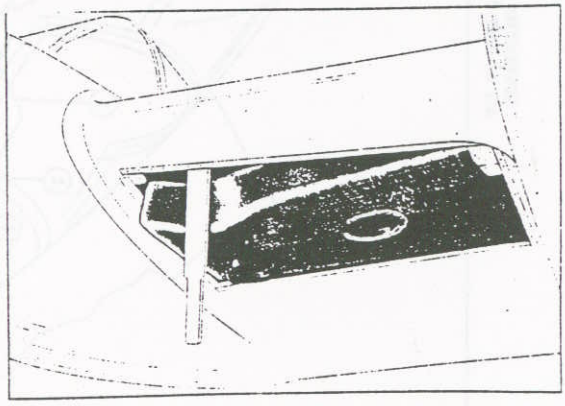


Figure 169 — Installation of Reserve Fuel Tank, Step D

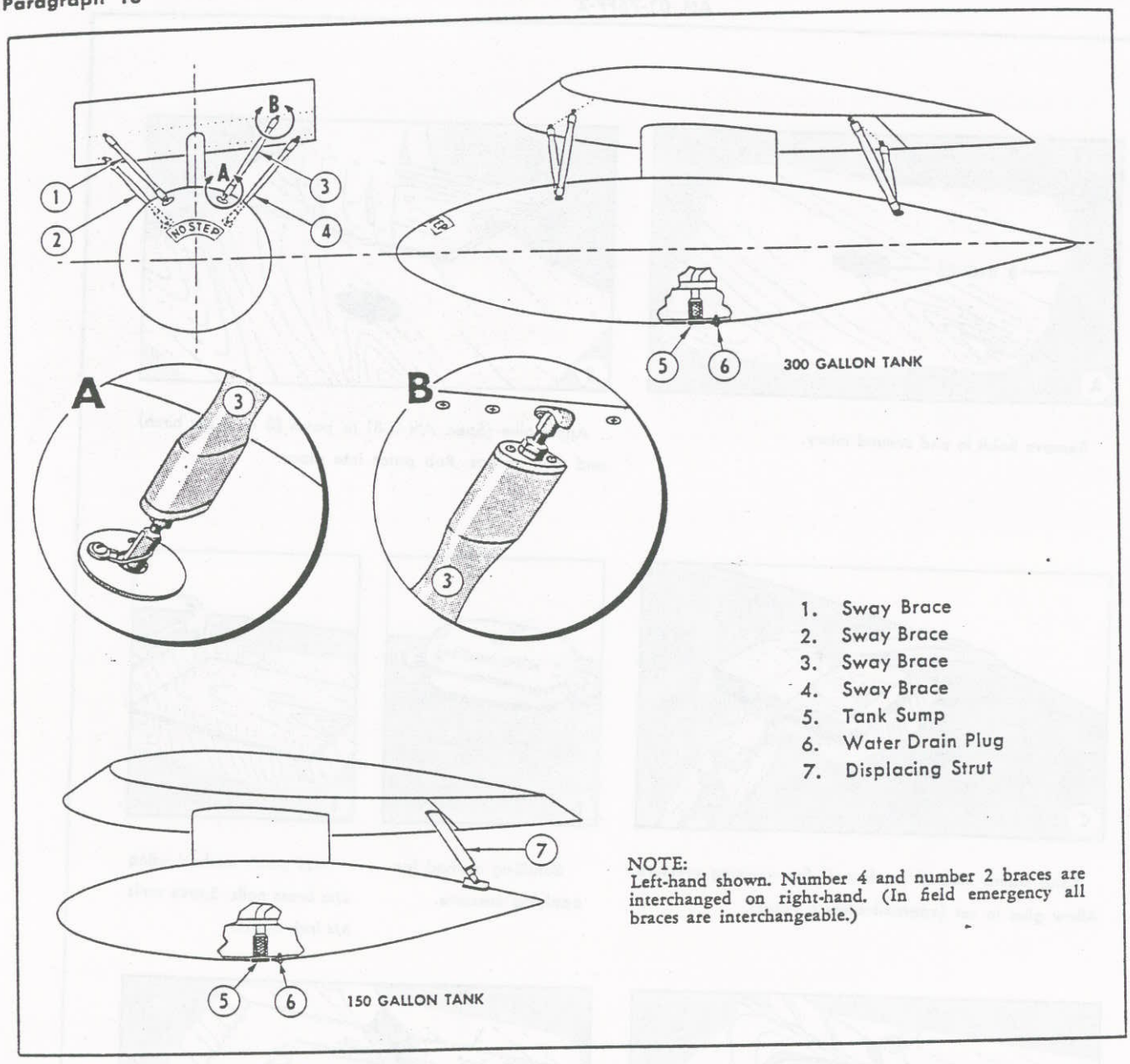


Figure 170 — Droppable Tank Attachment

a. Place the aft inboard corner of the tank in position. Use a curved tube about twelve inches long inserted in the fuel line to guide the fuel line into the tank nipple.

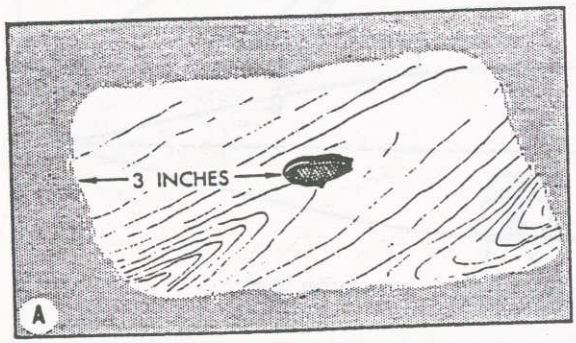
b. Position the aft side on the control shroud and push the aft outboard corner in place by collapsing the tank downward and inward from the outboard side.

c. Force the forward outboard corner into position by collapsing the tank downward and inward at the outboard forward side.

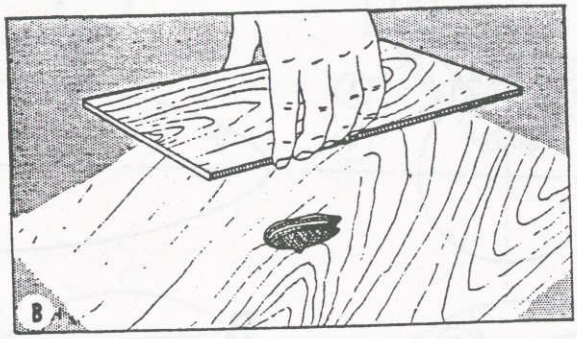
d. Work the forward inboard corner into position by collapsing the tank downward and inward at the inboard forward side.

3. If the filler neck on the top side of the tank should catch, correct by pushing downward on the tank from the filler cap opening on the upper surface of the center section.

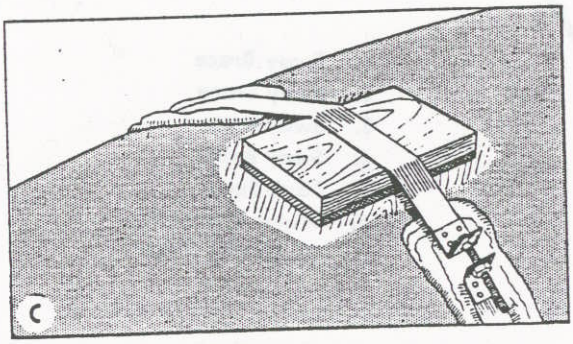
4. When necessary insert the fuel line into its corresponding tank sleeve by pushing the tank upward and letting the tank slide down on the tube.



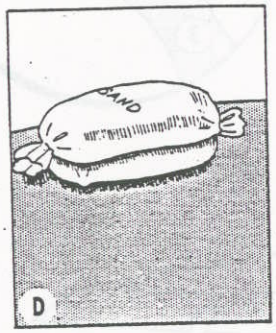
Remove finish in and around injury.



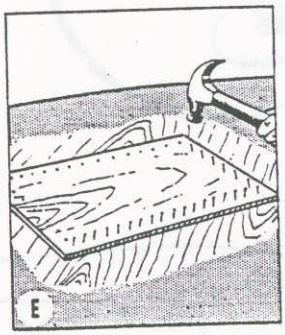
Apply glue (Spec. AN-G-8) to patch (3 or 5 ply birch) and tank surface. Rub patch into place.



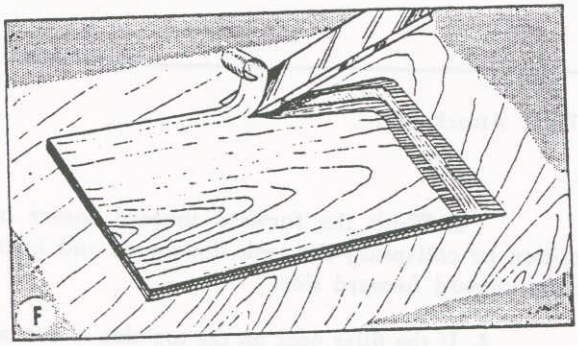
Band clamp method (preferred) for applying pressure. Allow glue to set (approximately 6 hours).



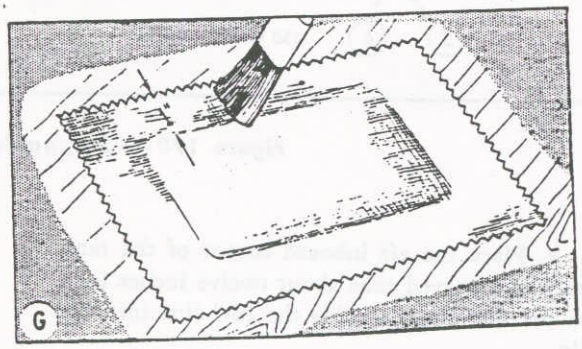
Sandbag method for applying pressure.



Nail patch method using 5/16 brass nails. Space nails 3/4 inch apart.

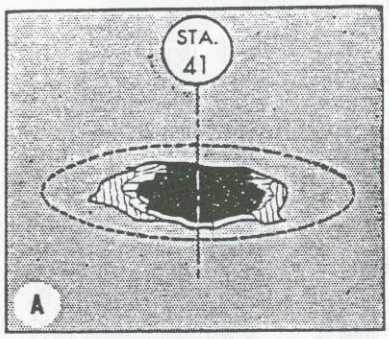


Use chisel and rough sandpaper to bevel edges of patch.

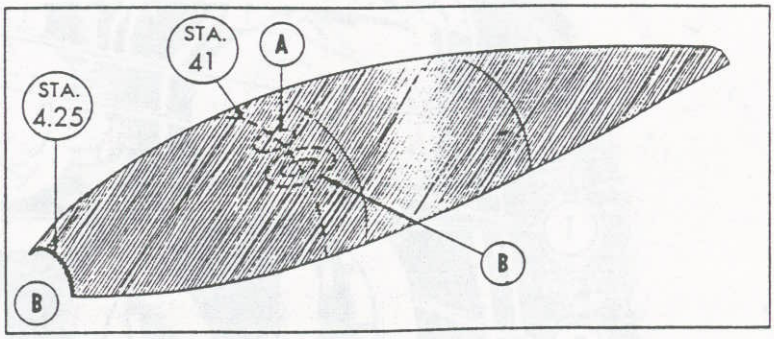


Apply dope (Spec. AN-TTD-514) over the repaired area. Smooth fabric into place. Puncture any bubbles that form and apply dope again. Allow to dry. Refinish according to Spec. AN-C-83.

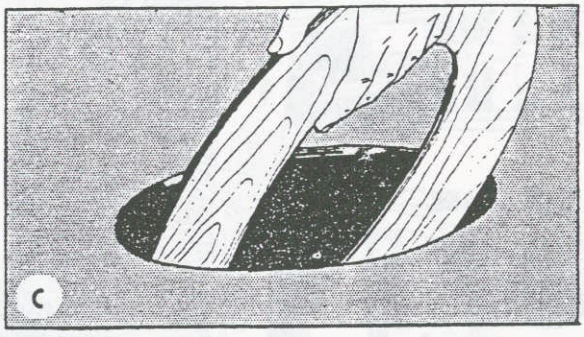
Figure 171 — Plywood Droppable Tank, Small Hole Repair



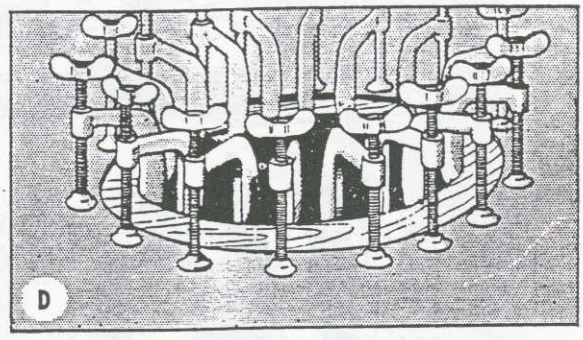
Cut an elliptical hole around the damaged area. Cut from directly below so that sawdust will not fall into tank.



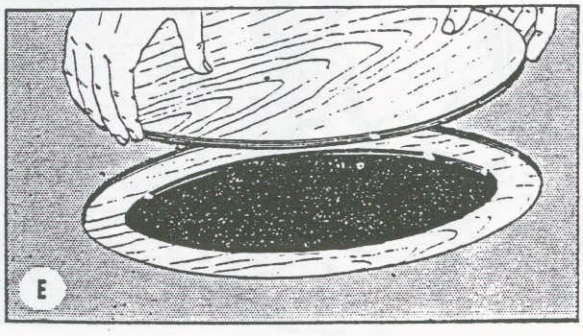
Cut patch "A" from spare skin section to fit tank cutout. Cut elliptical backing plate "B" one inch larger than patch "A." Cut hole in plate "B" one inch smaller than patch "A."



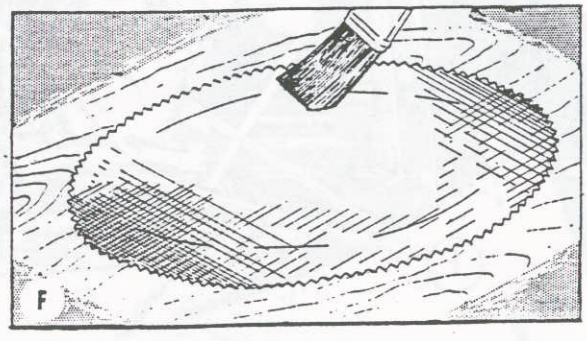
Apply glue (Spec. AN-G-8) to underside of tank cutout and top side of backing plate "B", then insert plate through cutout in tank.



Apply pressure with as many "C" clamps as possible and allow glue to set (approximately 6 hours).



Insert flush patch "A" into cutout in tank and apply pressure with a band clamp or weights as shown in Fig. 171.



Remove finish around patch and apply fabric (Spec. AN-16-128) and two coats of dope (Spec. AN-TTD-514). Refinish in accordance with Spec. AN-C-83.

Figure 172 — Plywood Droppable Tank, Large Hole Repair

Note

Always determine fuel selector valve setting by "click" or "feel" and not solely by dependence on the position of the control handle pointer in the cockpit. If this precaution is not taken, the gate will not be in perfect alignment with the ports in the valve allowing fuel to flow between tanks.

(2) REMOVAL.

(a) Remove recognition light panel "82" and access panel "153" (figure 3).

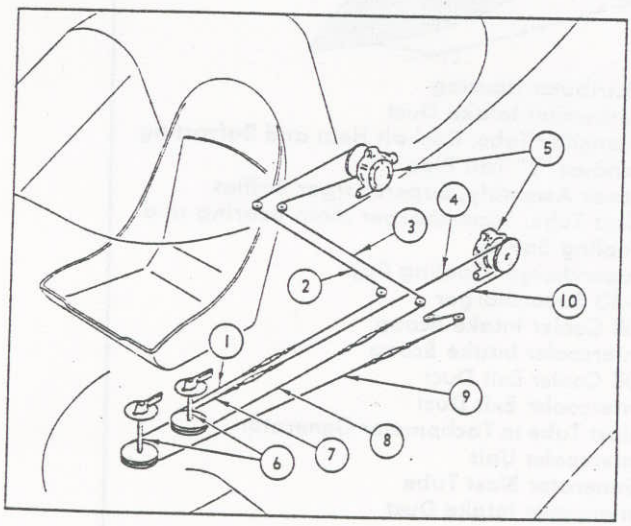
(b) Drain fuel tanks.

(c) Disconnect fuel lines.

(d) Remove three bolts holding valve.

(e) Remove unit.

(3) MAINTENANCE REPAIRS. — Clean valve thoroughly to remove any foreign matter which may have collected inside the ports.



1. Fuel Tank Selector Valves
2. Fuel Tank Selector Valve Controls

For Key to Cables, See Section IX.

Figure 174 — Fuel System Cable Controls

(4) ADJUSTMENT. *(See figure 174.)*

(a) Place selector valve control "2" in "OFF" position.

(b) Detach selector valve "1" from mounting bracket and selector valve drum.

(c) Rotate selector valve yoke until it clicks into the "OFF" position.

Note

The "OFF" position is the droppable fuel tank inlet port.

(d) Tighten cable turnbuckles located behind panel "80," (figure 3).

(e) Move selector valve controls through all positions. Check for "click" of valve as each position is indicated.

(f) Adjust as required at cable turnbuckles, or, if complete rotation is not obtained, remove the selector valve and center the selector valve drum to allow complete rotation of the selector valve controls.

(5) TEST.—Test statically the outlet port with 35 lb/sq in. pressure for three minutes and the inlet ports with five lb/sq in. pressure for two minutes.

CAUTION

Whenever fuel cock assemblies or controls are disconnected, carefully check the parts upon reassembly to insure correct indication of the control-handle pointers.

d. FUEL STRAINERS. *(See figure 175, item "D.")*

(1) DESCRIPTION.—Two type C-4 fuel strainers are located just forward of the selector valves. Additional strainers are located in the engine bay sections. The strainer cover, providing a sump and drain cock, is held securely in place by a spring steel clamp supported by two bolts. One of the supporting bolts is fastened by a wing nut to expedite opening the strainer for the removal of the screen.

(2) REMOVAL.

(a) FUSELAGE FUEL STRAINERS.

1. Remove recognition light panel "82" (figure 3).

2. Disconnect lines.

3. Remove one bolt holding each strainer.

4. Remove units.

(b) WING TANK FUEL STRAINERS.

1. Remove engine bay section side and bottom cowl formers.

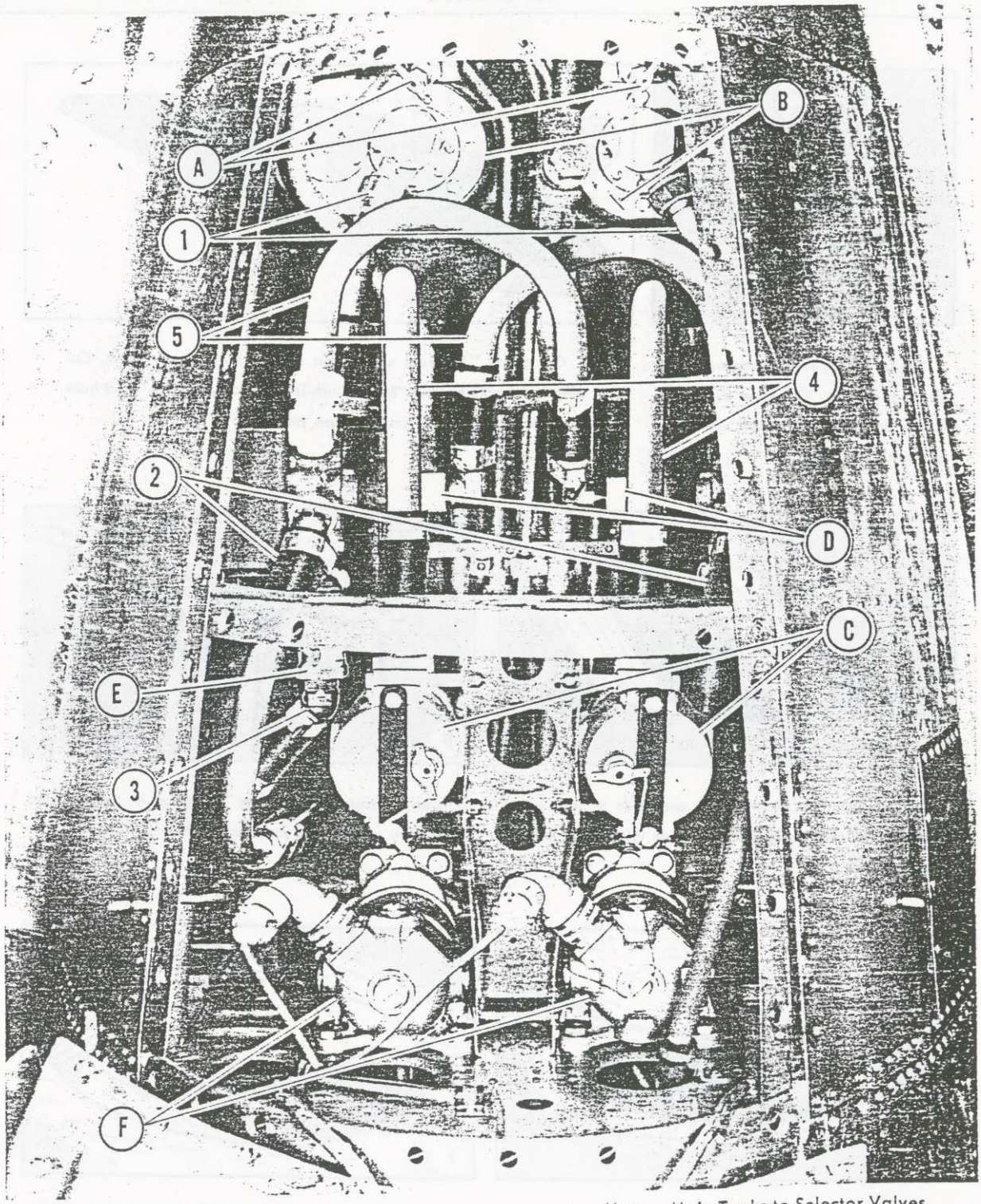
2. Disconnect fuel lines.

3. Remove the two bolts securing the strainer.

4. Remove the strainer.

e. FUEL PUMPS.

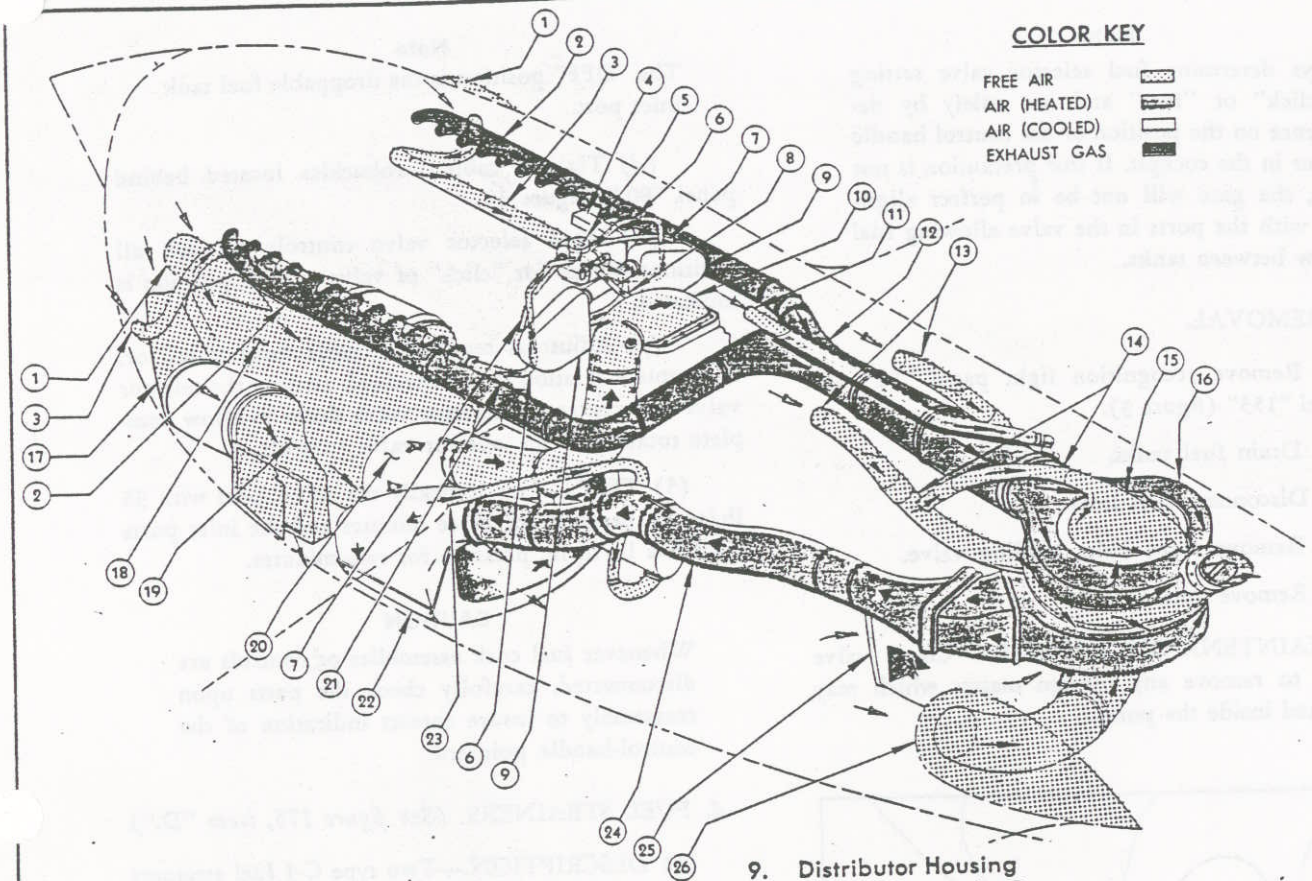
(1) GENERAL.—Fuel pumps provide positive fuel pressure at all times. The two engine-driven pumps are

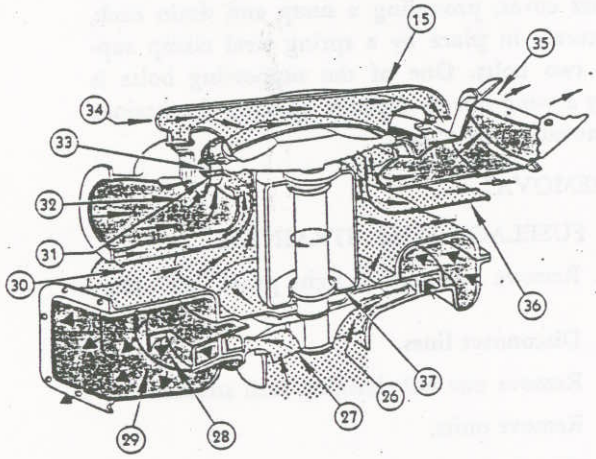


A. Drain Cocks
B. Main and Surge Tank Sumps
C. Strainers
D. Selector Valves
E. Check Valve
F. Booster Pumps

1. Lines—Main Tanks to Selector Valves
2. Lines—Reserve Tanks to Selector Valves
3. Line—Droppable Tank to Selector Valve
4. Lines—Selector Valves to Strainers
5. Lines—Cross Suction

Figure 175 — Fuel Compartment, Bottom Aft Fuselage; P-38L-1

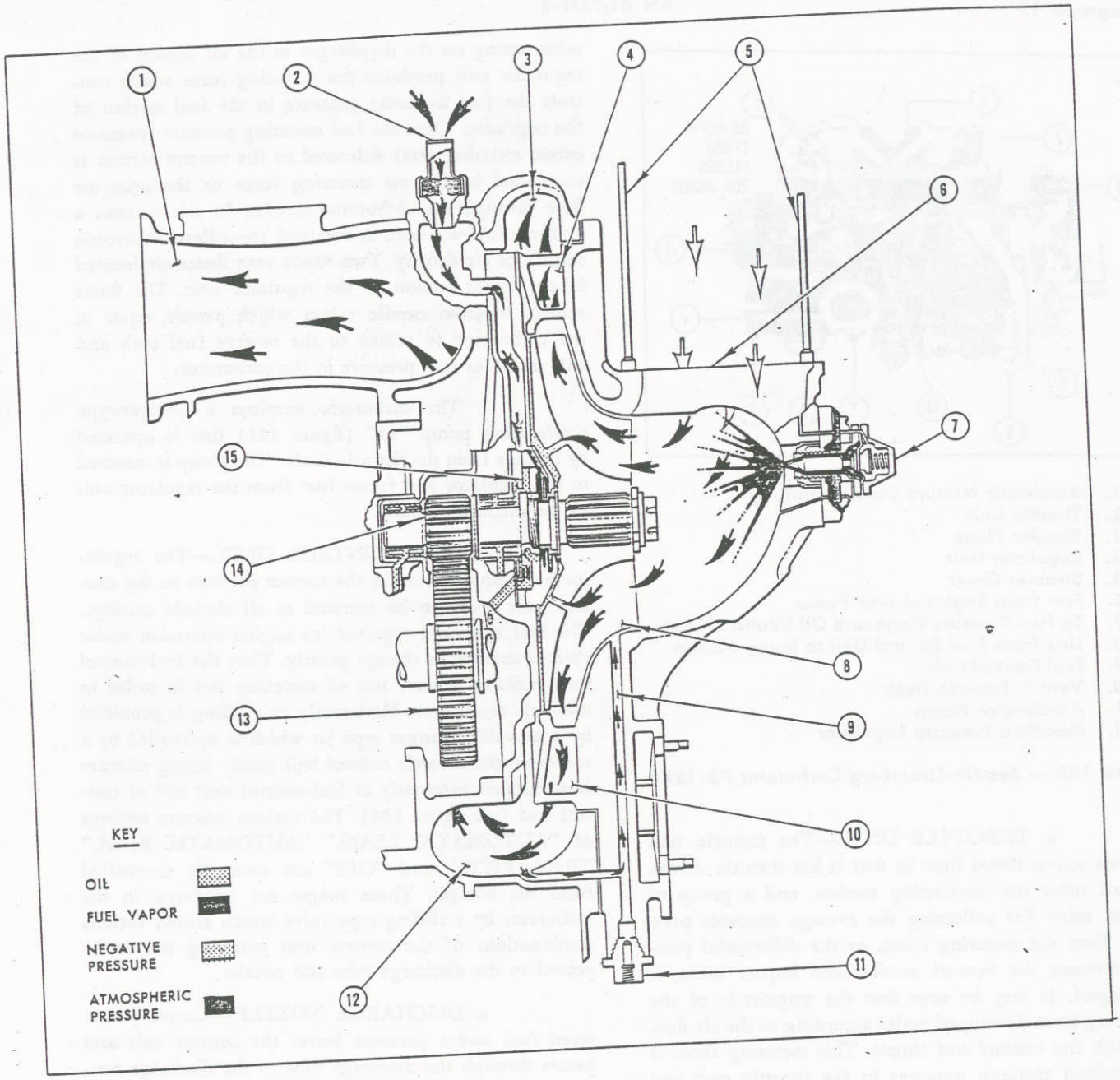




CUTAWAY SHOWING OPERATION OF SUPERCHARGER

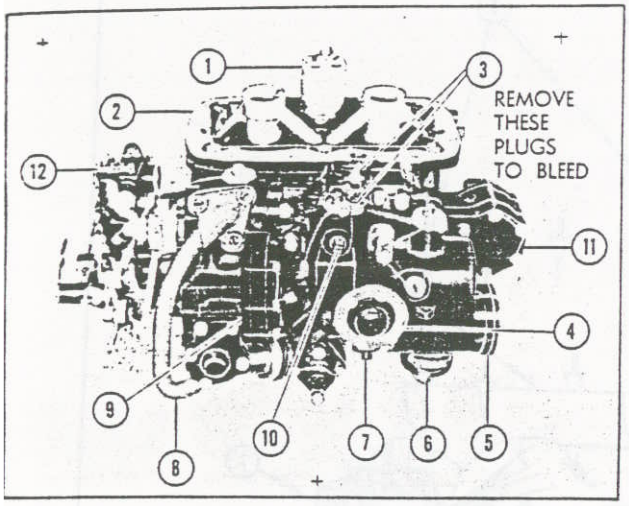
1. Scoop, Exhaust Manifold and Shroud
2. Exhaust Manifold
3. Spark Plug Blast Tube
4. Electrical Relay Box
5. Magneto
6. Magneto Blast Tube
7. Air Pressure to Distributor Housing
8. Air Pressure to Magneto Unit
9. Distributor Housing
10. Carburetor Intake Duct
11. Intensifier Tube, Cockpit Heat and Defrosting
12. Exhaust "Y" Tail Pipe
13. Cover Assembly, Supercharger Baffles
14. Blast Tube, Supercharger Main Bearing and Cooling Baffles
15. Supercharger Cooling Cap
16. B-33 Supercharger
17. Oil Cooler Intake Scoop
18. Intercooler Intake Scoop
19. Oil Cooler Exit Duct
20. Intercooler Exit Duct
21. Blast Tube to Tachometer Generator
22. Intercooler Unit
23. Generator Blast Tube
24. Intercooler Intake Duct
25. Air Filter
26. Supercharger Air Intake Scoop
27. Impeller
28. Diffuser Vanes
29. Compressed Air Outlet to Intercooler
30. Free Air from Cover Assembly
31. Nozzles
32. Nozzlebox Inlet Exhaust Gas from Engine
33. Turbine Wheel
34. Slip-stream Air
35. Waste Gate
36. Air Baffle
37. Shaft Housing Containing Turbo Lubrication System

Figure 180 — Induction and Exhaust System



1. Fuel-air Mixture to Manifolds
2. Supercharger Seal Vent
3. Scroll
4. Diffuser Vanes
5. Carburetor Mounting Studs
6. Air Inlet
7. Fuel Injector Nozzle
8. Impeller
9. Regurgitation Tube
10. Diffuser Vanes
11. Induction System Drain
12. Scroll
13. Supercharger Drive Gear
14. Supercharger Pinion Gear and Shaft
15. Pressure Type Seal

Figure 181 — Fuel Induction System Diagram



1. Automatic Mixture Control Unit
2. Throttle Unit
3. Bleeder Plugs
4. Regulator Unit
5. Strainer Cover
6. Fuel from Engine-driven Pump
7. To Fuel Pressure Gage and Oil Dilution Valve
8. Line from Fuel Control Unit to Spray Nozzle
9. Fuel Control Unit
10. Vent to Reserve Tank
11. Accelerator Pump
12. Manifold Pressure Regulator

igure 182 — Bendix-Stromberg Carburetor, PD-12K8

a. THROTTLE UNIT.—The throttle unit ollows conventional lines in that it has throttle valves, enturi tubes for developing suction, and a group of mpact tubes for collecting the average entrance pres- ire. Thus the metering force, or the differential pres- e between the venturi suction and impact tubes, is eveloped. It may be seen that the magnitude of the etering force developed varies according to the air flow rough the venturi and throat. This metering force is ansmitted through passages in the throttle unit and comes the force or motive power for operation of the gulator unit.

b. AUTOMATIC MIXTURE CONTROL.— ie automatic mixture control is a metallic bellows sponsive to variations in temperature and pressure nich operate a contoured valve. It maintains the cor- ct fuel/air ratio in the carburetor under conditions varying air temperature and pressure. This is accom- ished by the contoured valve automatically varying e impact tube pressure and thus the metering pressure th air temperature and density changes.

c. REGULATOR UNIT.—The pressure dif- ential between the venturi suction and the impact tubes acting on the diaphragm in the air section of the regulator unit produces the metering force which controls the fuel metering pressure in the fuel section of the regulator. Thus, the fuel metering pressure (pressure across metering jets) delivered to the control section is controlled by the air metering force or the mass air flow through the carburetor throats. In this manner a uniform fuel/air ratio is obtained regardless of throttle setting or air density. Two vapor vent floats are located in the upper section of the regulator unit. The floats actuate inverted needle valves which permit vapor in the carburetor to return to the reserve fuel tank and still maintain fuel pressure in the carburetor.

The carburetor employs a plunger-type accelerating pump "11" (figure 182) that is operated by linkage from the throttle shaft. The pump is attached to the regulator and forces fuel from the regulator unit to the discharge nozzle.

d. FUEL-CONTROL UNIT.—The regulator unit supplies fuel at the correct pressure to the control unit ready to be metered at all throttle settings. The fuel/air ratios required for engine operation under various conditions change greatly. Thus the fuel-control unit contains several sets of metering jets in order to meet all conditions. Moderately rich idling is provided by a movable plunger type jet which is controlled by a rod from the throttle control bell crank. Idling mixture is adjustable externally at fuel-control unit end of control rod (see figure 184). The various mixture settings of "AUTOMATIC LEAN," "AUTOMATIC RICH," "FULL RICH," and "OFF" are manually controlled from the cockpit. These ranges are produced in the carburetor by a sliding type valve which allows various combinations of the control unit metering jets to be ported to the discharge tube and nozzle.

e. DISCHARGE NOZZLE.—Correctly metered fuel under pressure leaves the control unit and passes through the discharge tube to the discharge nozzle. The discharge nozzle consists of a plunger type nozzle valve, spring-loaded in the closed position. A diaphragm at one end of the plunger allows the fuel pressure to overcome the plunger spring and open the nozzle valve when fuel pressure is in excess of 4 lb/sq in. This is to prevent the leakage of fuel when the engine is not operating.

3. TROUBLE SHOOTING.

CAUTION

Check carburetor specifications and setting to be sure that they are correct for the engine make and model on which the carburetor is installed. Do not change carburetor adjust-

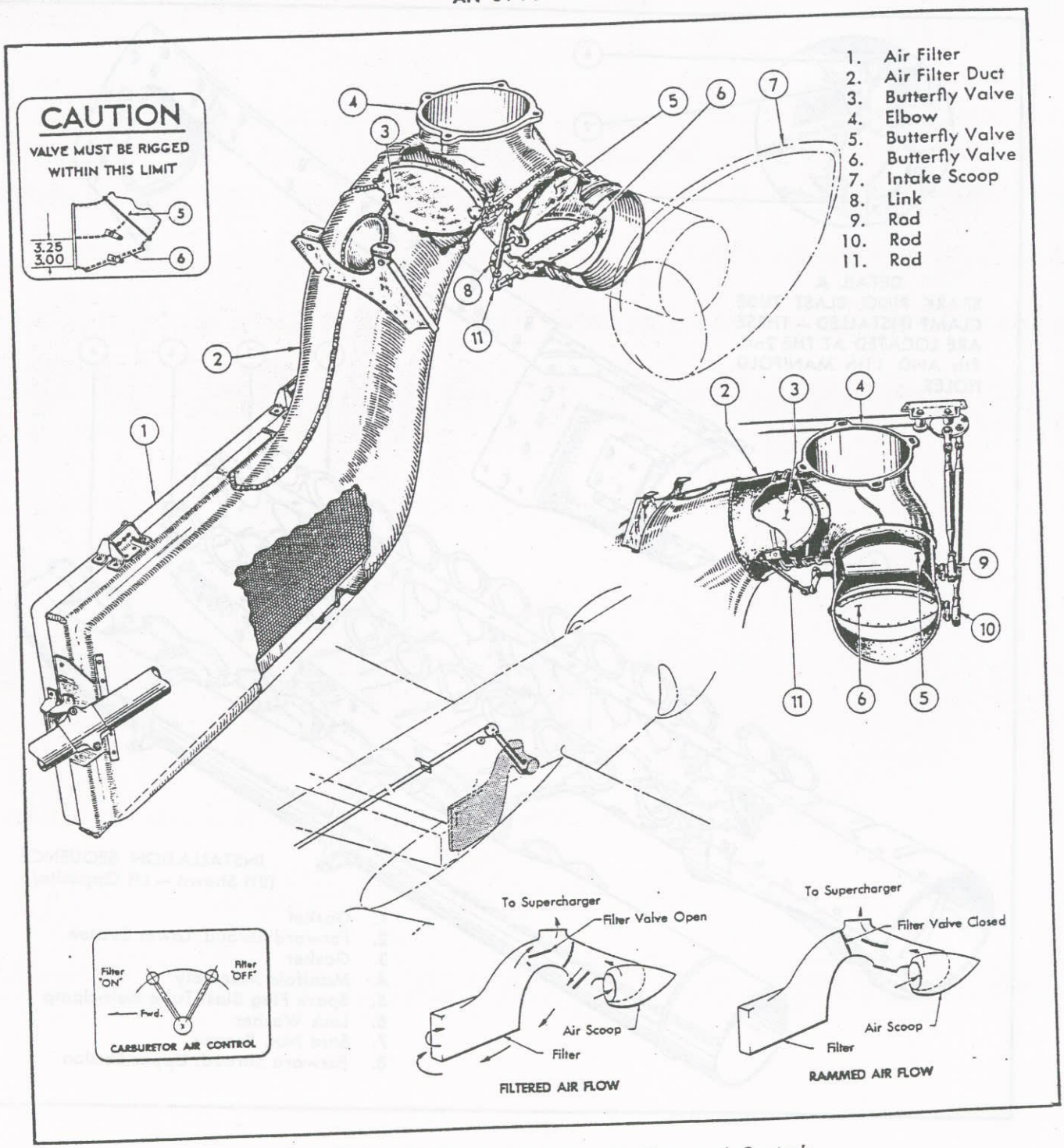


Figure 188 — Induction System, Air Filter and Controls

on the side control stand is used to operate both systems. A differential pulley with attached push-pull rods transmits the cable action to the air intake and filter valves.

b. OPERATION.—When the control lever is in the full aft "OFF" position, rammed air will be supplied. Filtered air will be supplied with the control lever in full forward "ON" position.

c. REMOVAL AND INSTALLATION. *(See figures 115 and 188.)*

(1) Remove the following:

(a) Pilot's seat.

(b) Cover plates "89" and "90" (figure 3).

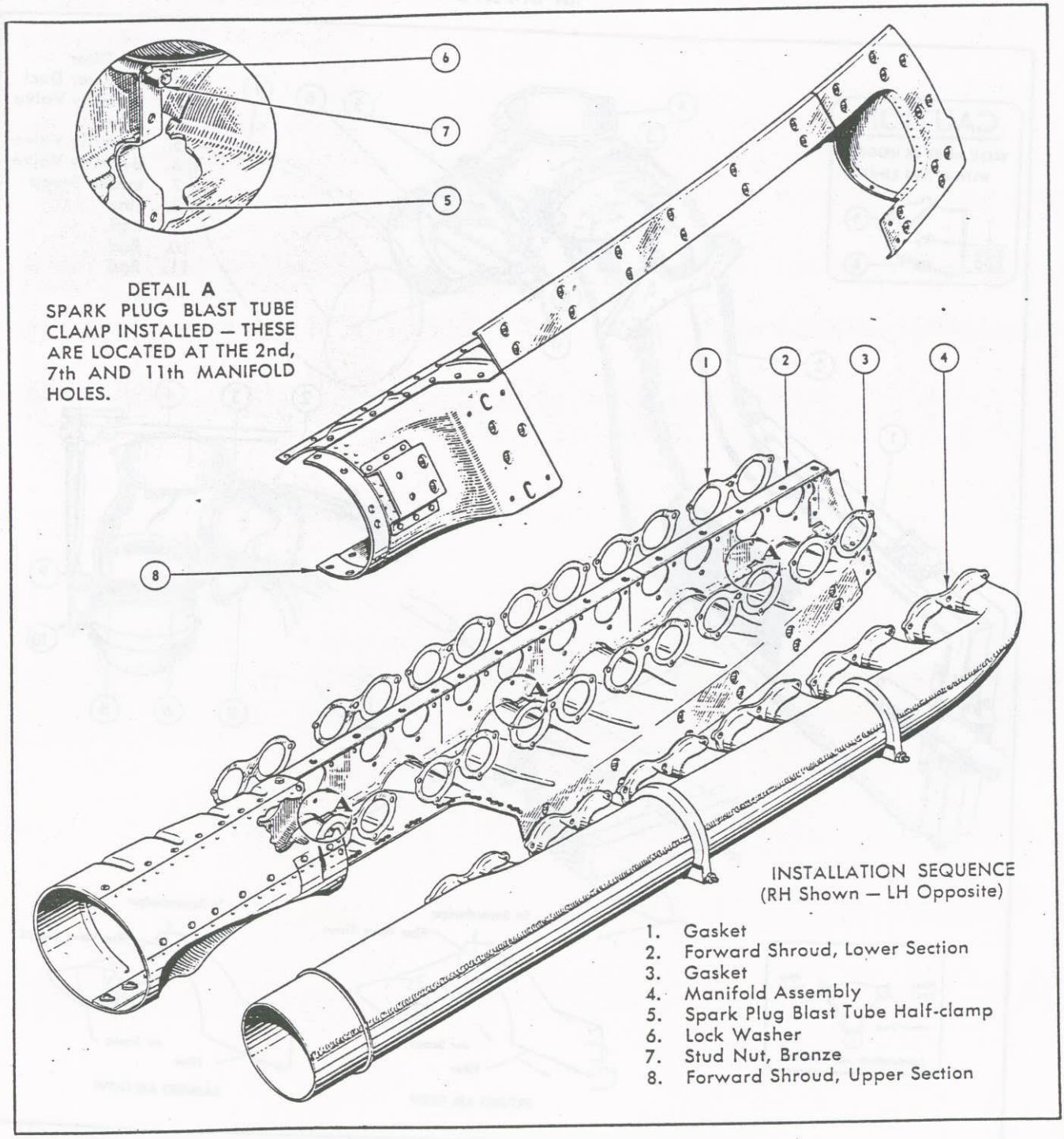


Figure 189 — Exhaust Manifold and Shrouds

(b) REMOVAL. *(See figure 189.)*

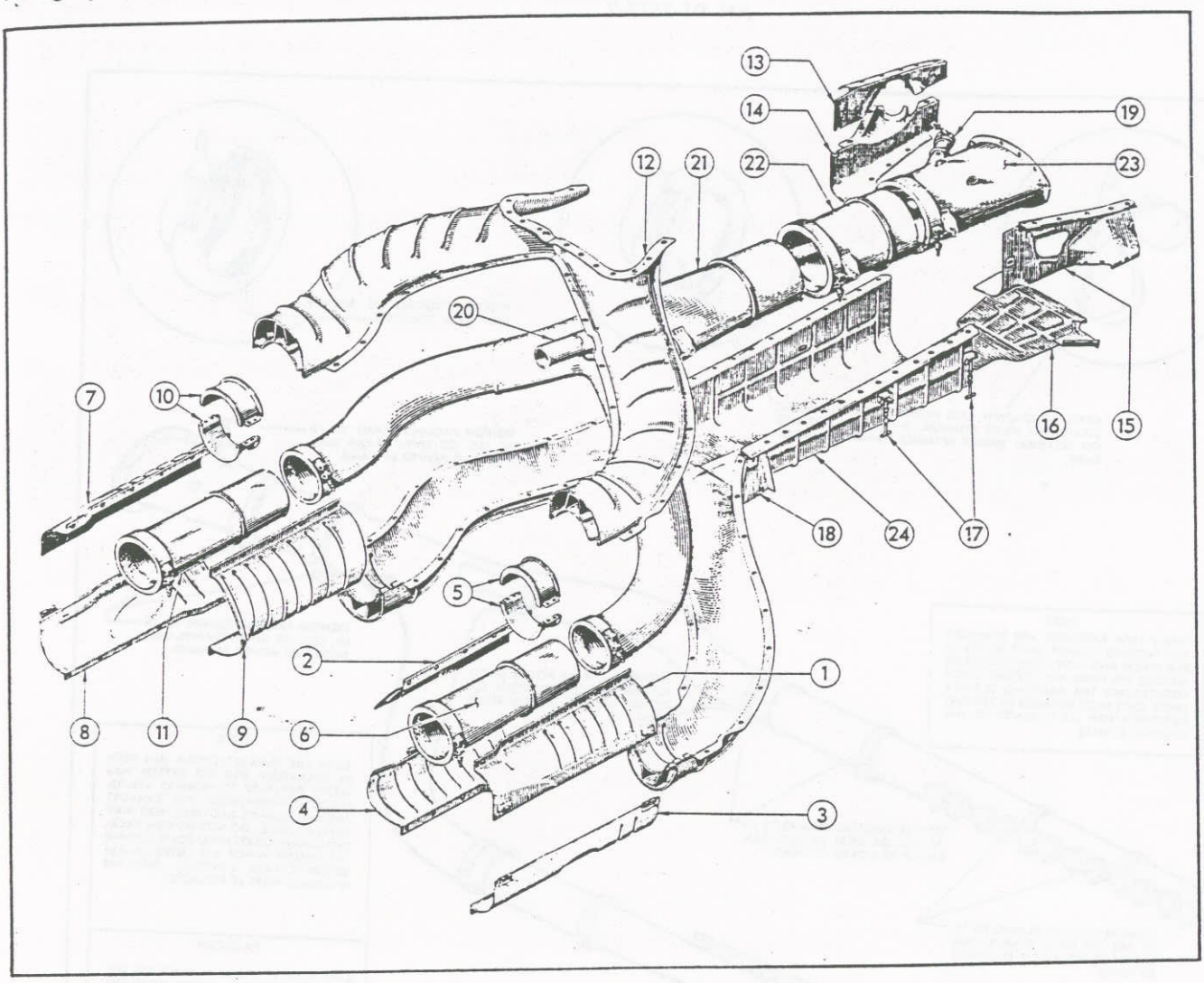
1. Remove top and side cowl panels "1", "2", "3", "5", "6", and "7". (See figure 96.)

2. Release fasteners and remove shrouds "1", "2", "3", "7", "8", and "9" surrounding sleeve assembly "6" (figure 190).

3. Loosen clamps on sleeve assembly "6" and tail-pipe "21" (figure 190).

4. Remove sleeve clamp "5" (figure 190).

5. Drive sleeve assembly "6" into tail-pipe "21" (figure 190).



1. Sleeve Assembly, Upper Quarter LH
2. Sleeve Assembly, Upper Quarter Inboard LH
3. Sleeve Assembly, Lower Quarter LH
4. Sleeve Assembly, Lower Quarter Inboard LH
5. Half Clamp
6. Sleeve Assembly, Forward
7. Sleeve Assembly, Upper Quarter RH
8. Sleeve Assembly, Lower Quarter RH
9. Sleeve Assembly, Inner Half RH
10. Half Clamp
11. Sleeve Assembly, Forward
12. Shroud Assembly, "Y" Stack Upper
13. Panel Transition Section, Upper RH
14. Panel Transition Section, Lower RH
15. Panel Transition Section LH
16. Panel Transition Section, Bottom LH
17. Barrel Assembly
18. Support Assembly
19. Sleeve
20. Intensifier Tube
21. "Y" Assembly, Tail Pipe
22. Sleeve Assembly
23. Transition Assembly
24. Shroud Assembly, "Y" Stack Lower

Figure 190 — Exhaust "Y" Stack

6. Remove screws at "5" and "6" (figure 102) which secure the cowl formers to the exhaust shroud. Remove screws of wing fillet formers.

7. Remove front bulkhead connections to the shroud at "7" (figure 102).

8. Remove exhaust manifold palnuts (or lock washers) and stud nuts.

9. Remove the three spark plug blast tube clamps.

10. Remove manifold "4", gaskets "3", shroud "2", and gaskets "1" (figure 189).

CAUTION

Cover exhaust ports with suitable material to keep out dust and foreign matter.

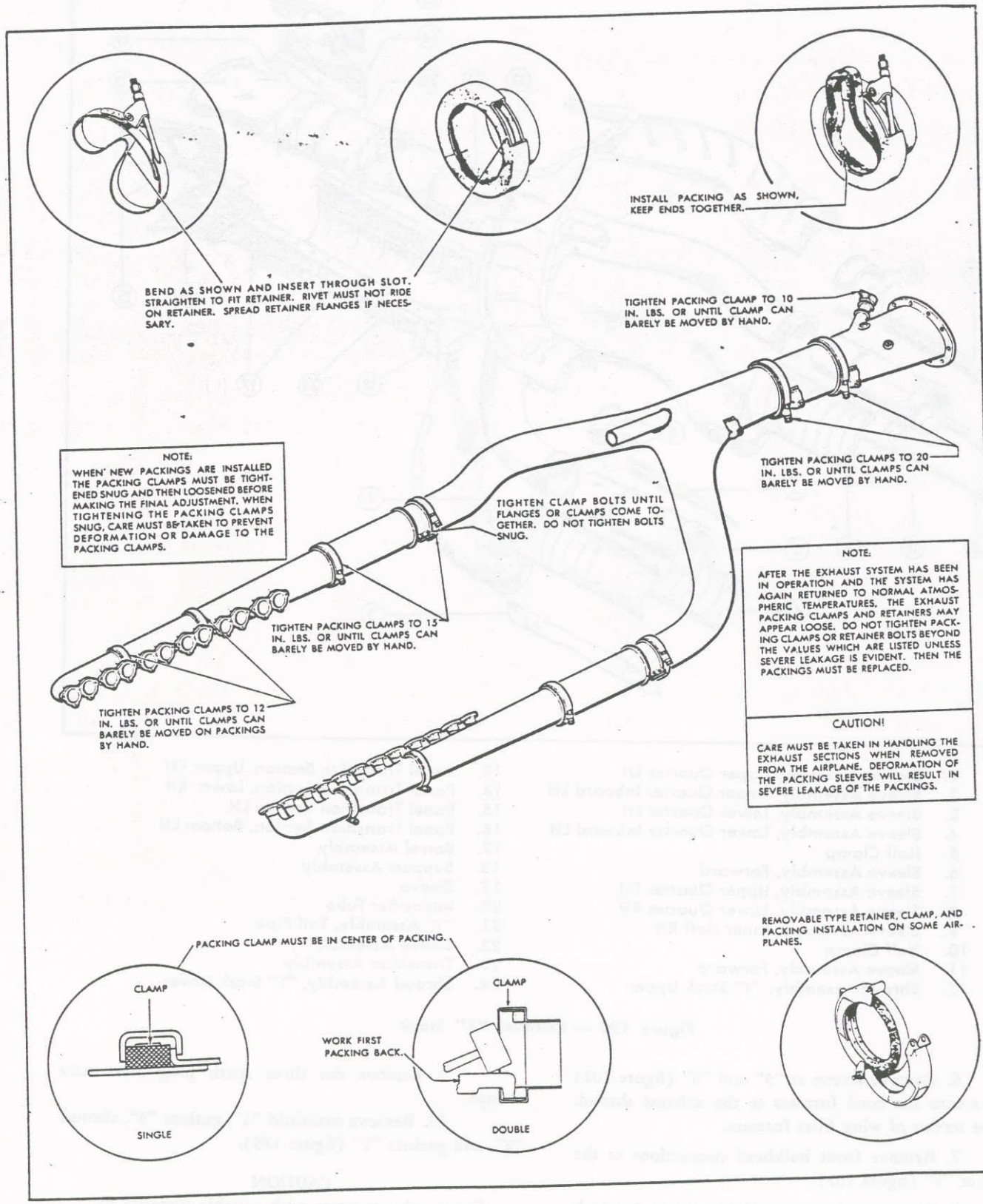
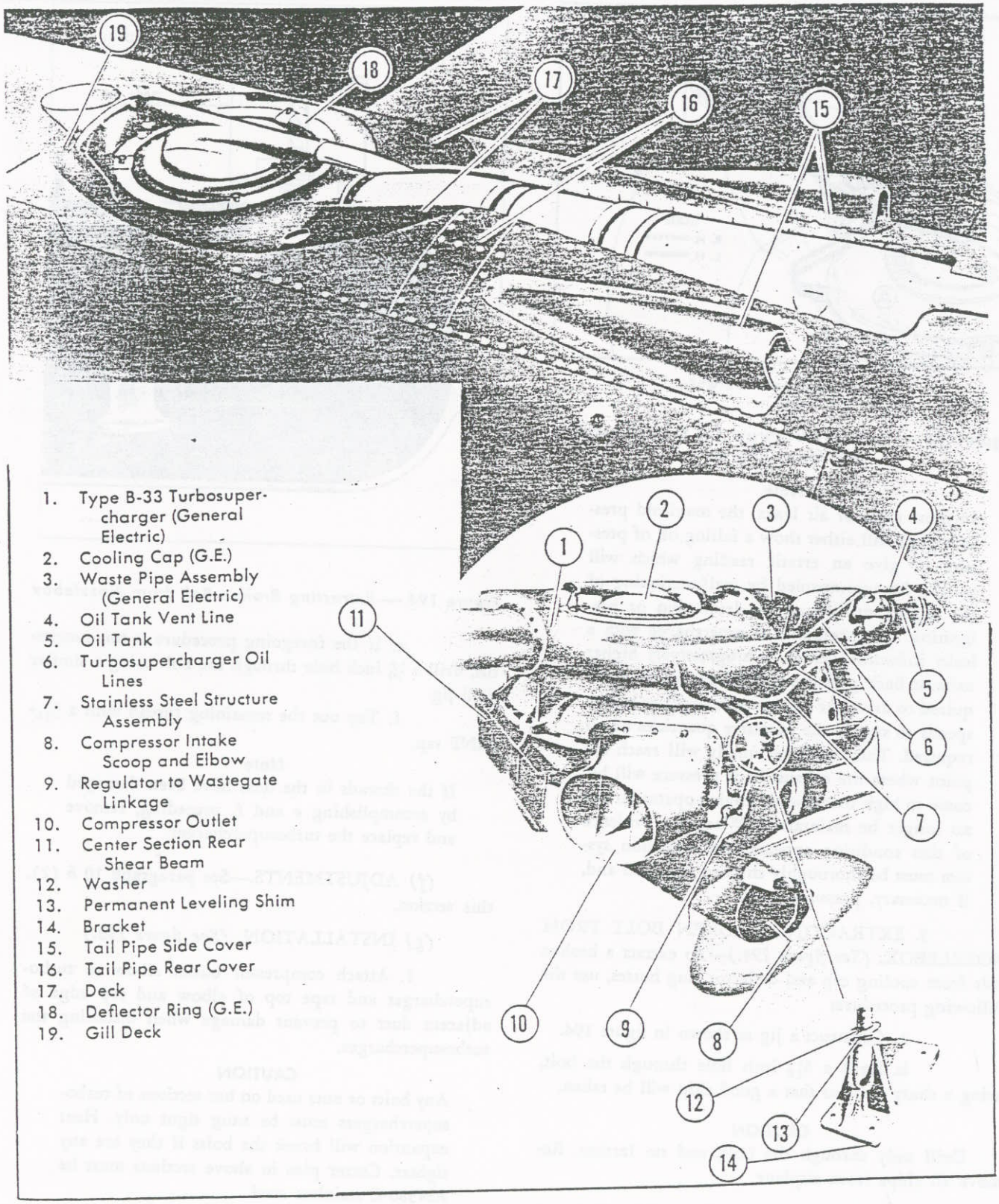
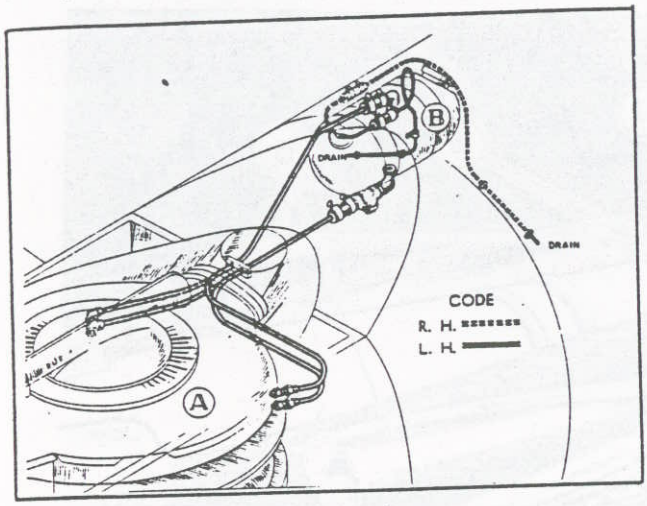


Figure 191 — Exhaust Packing Installation



1. Type B-33 Turbosupercharger (General Electric)
2. Cooling Cap (G.E.)
3. Waste Pipe Assembly (General Electric)
4. Oil Tank Vent Line
5. Oil Tank
6. Turbosupercharger Oil Lines
7. Stainless Steel Structure Assembly
8. Compressor Intake Scoop and Elbow
9. Regulator to Wastegate Linkage
10. Compressor Outlet
11. Center Section Rear Shear Beam
12. Washer
13. Permanent Leveling Shim
14. Bracket
15. Tail Pipe Side Cover
16. Tail Pipe Rear Cover
17. Deck
18. Deflector Ring (G.E.)
19. Gill Deck

Figure 192 — Turbosupercharger Installation



A. Turbosupercharger
B. Oil Tank

Figure 193 — Turbosupercharger Oil System Location and Flow Diagram

Note

In most cases of air leaks, the manifold pressure gage will either show a falling off of pressure or give an erratic reading which will usually be accompanied by malfunctioning of the engine manifested by detonation or preignition. In attempting to supercharge with a leaky induction system, a progressively higher exhaust back pressure is built up, which is required to drive the turbosupercharger at higher speeds to supply the excessive quantities of air required. This condition finally will reach the point where the exhaust back pressure will become so high that normal engine operation can no longer be maintained. Whenever evidence of this condition appears, the induction system must be thoroughly checked for leaks and, if necessary, pressure tested.

3. EXTRACTING BROKEN BOLT FROM NOZZLEBOX. *(See figure 194.)*—To extract a broken bolt from cooling cap and deflector ring bosses, use the following procedure:

a. Construct a jig as shown in figure 194.

b. Drill a $\frac{3}{16}$ inch hole through the bolt, using a sharp drill so that a good chip will be taken.

CAUTION

Drill only through the bolt, and no farther. Remove all chips from airplane.

c. Fill the hole in the boss with a penetrating oil and allow it to soak.

d. Remove the broken bolt with a No. 3 screw extractor "Easy-Out."

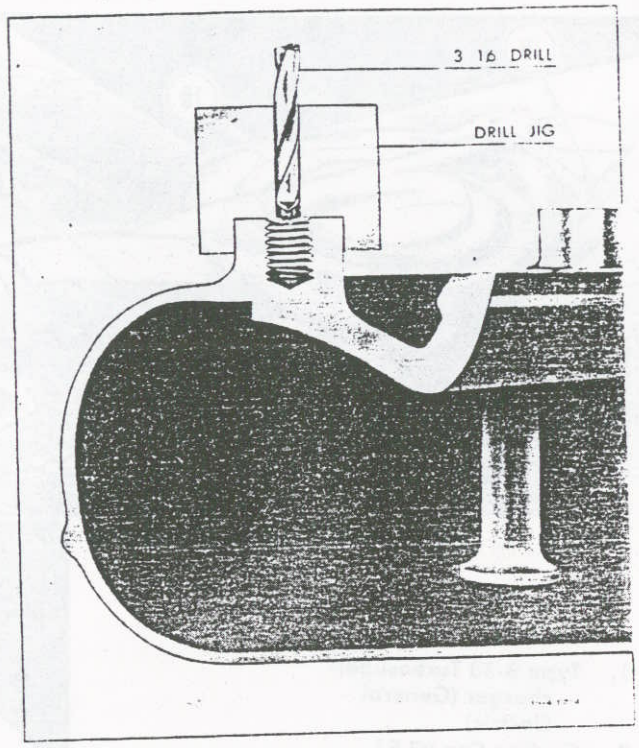


Figure 194 — Extracting Broken Bolt from Nozzlebox

e. If the foregoing procedure is not successful, drill a $\frac{1}{4}$ inch hole through the bolt using a similar drill jig.

f. Tap out the remaining thread with a $\frac{5}{16}$-24NF tap.

Note

If the threads in the boss have been damaged by accomplishing e and f, preceding, remove and replace the turbosupercharger.

(f) ADJUSTMENTS.—See paragraph 10 *b* (2), this section.

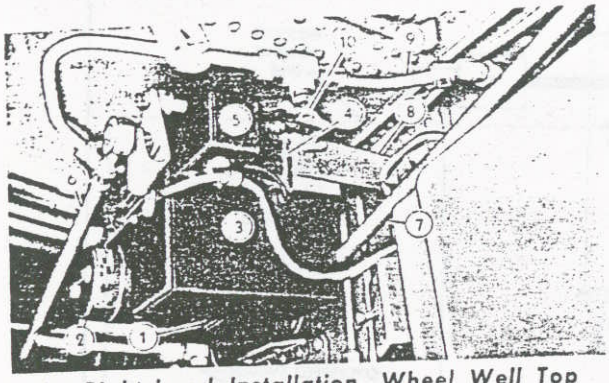
(g) INSTALLATION. *(See figure 192.)*

1. Attach compressor outlet elbow to turbosupercharger and tape top of elbow and top edge of adjacent duct to prevent damage when installing the turbosupercharger.

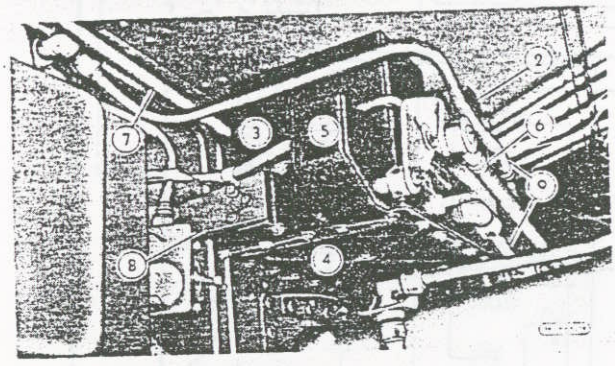
CAUTION

Any bolts or nuts used on hot sections of turbosuperchargers must be snug tight only. Heat expansion will break the bolts if they are any tighter. Cotter pins in above sections must be AN380-C stainless steel.

2. Inspect all passages through turbosupercharger and ducts to and from turbosupercharger for freedom from foreign matter.



A. *Right-hand Installation, Wheel Well Top*



B. *Left-hand Installation, Wheel Well Top*

1. Wastegate Motor Gear Box
2. Wastegate Motor
3. Tuned Circuit Box
4. Pressure Box
5. Dust Cover—Pressure Selection Rod and Emergency Overspeed Switch
6. Linkage—Throttle to Regulator
7. Linkage—Regulator to Wastegate
8. Rear Mounting Bracket
9. Pressure Sensing Line
10. Drain Cock

Figure 195 — Type C-2 Turbosupercharger Regulator

Refer to paragraph 10 *b* (1), this section, for general information pertaining to the relationship of the C-2 turbo-regulator to the A-2 manifold pressure regulator.

(b) OPERATION.—The type C-2 turbo-regulator is shown schematically in figure 196. The following is a detailed description of the regulator operation and an explanation of the function of each part shown in the schematic diagram.

The airtight pressure (or control) box is subjected to compressor discharge pressure which is the quantity to be regulated. An evacuated bellows "A" within the box is opposed by the pressure selection spring "B," the tension of which is controlled by the lever "C." This lever is operated by the throttle lever in the cockpit. For conditions of equilibrium the force on the bellows and the tension in the spring must be equal and opposite.

If the regulator is at equilibrium, that is, the box pressure times the effective bellows area balances the spring tension, and the pressure should increase due to change in altitude or indicated air speed, then the force on the bellows area will be greater than the spring tension, thus the bellows will be compressed. If the pressure should decrease, the force on the bellows area will be less than the spring tension, thus the bellows will extend.

This motion is made to operate the wastegate in order to correct for the pressure change by means of the pivoted arm "D" which engages the contacts "E" and "F." These contacts are in series with the limit switches "G" and "H" which control the total wastegate travel.

The contacts "E" or "F" operate the relays "I" or "J" which energize the clutch brake "W" and the respective fields of the motor "V" in order to open or close the wastegate "X." Opening or closing the wastegate changes the pressure in the nozzlebox thus controlling the turbo speed, which in turn determines the output pressure of the compressor.

The arm "D" pivoted at "Z" is held in contact with one end of the slot "O" by means of the spring "L." This arrangement allows the overspeed torque motor "N" to take control away from the bellows "A" and spring "B" by means of the cam and roller at "M." When regulating pressure, the pin in the end of the arm "D" is up against the side of the slot "O" farthest from the bellows. When the turbo rotor reaches overspeed, the armature of the torque motor "N" (view A-A) is rotated against the tension at the spring "Q" so that the cam "M" engages the roller on the arm "D" in order to operate the contacts at "E" and "F." The arm is then free to move in the slot "O" and the bellows "A" comes up against the stops "P," as the pressure in the box is reduced to hold constant turbo speed of 24,000 rpm.

The overspeed torque motor "N" is operated by the output of the alternating current generator "R" driven by the turbo oil pump through a flexible shaft. The output of this generator is run first through a tuned circuit consisting of the capacitance "U" and "U'" and

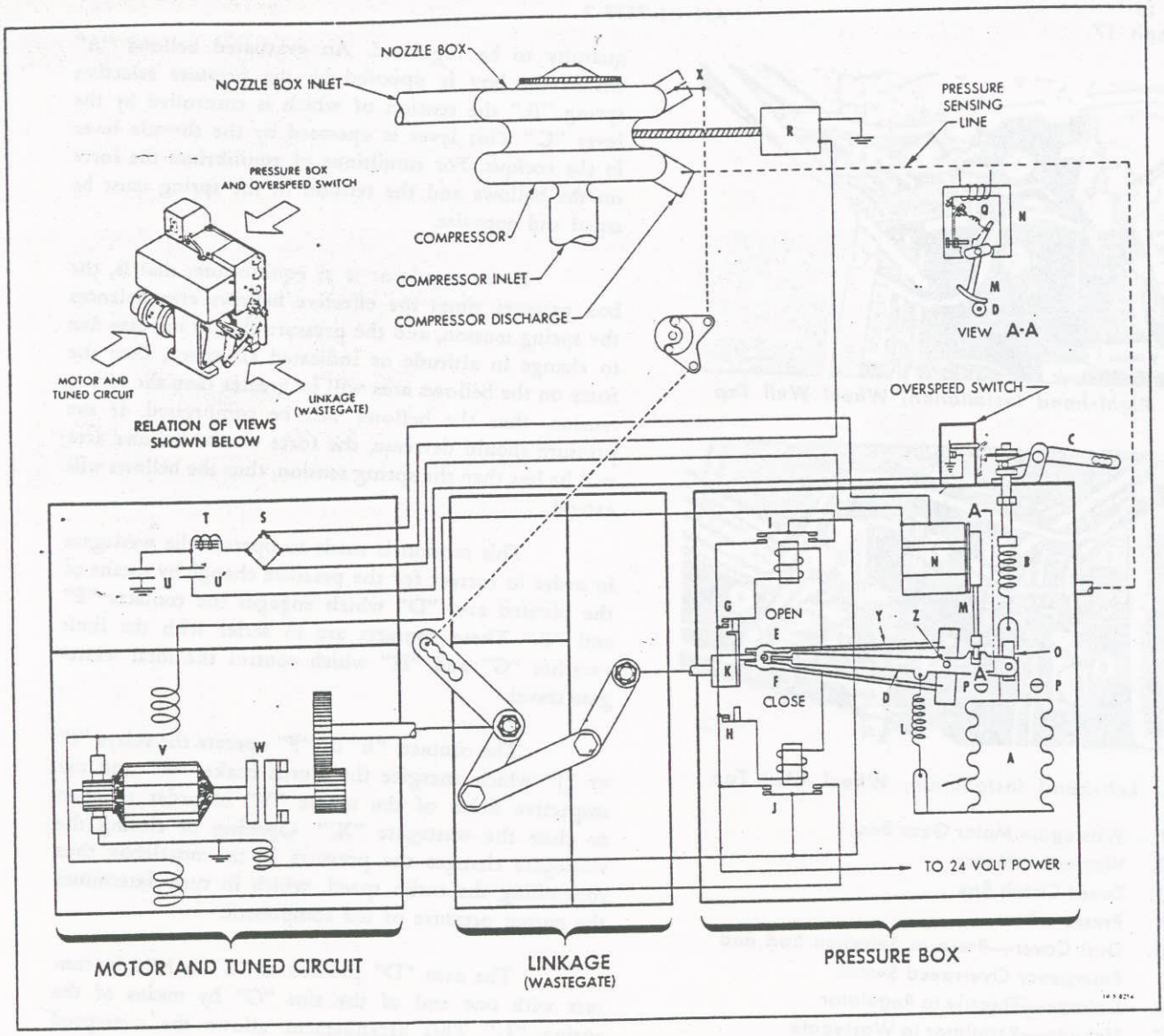


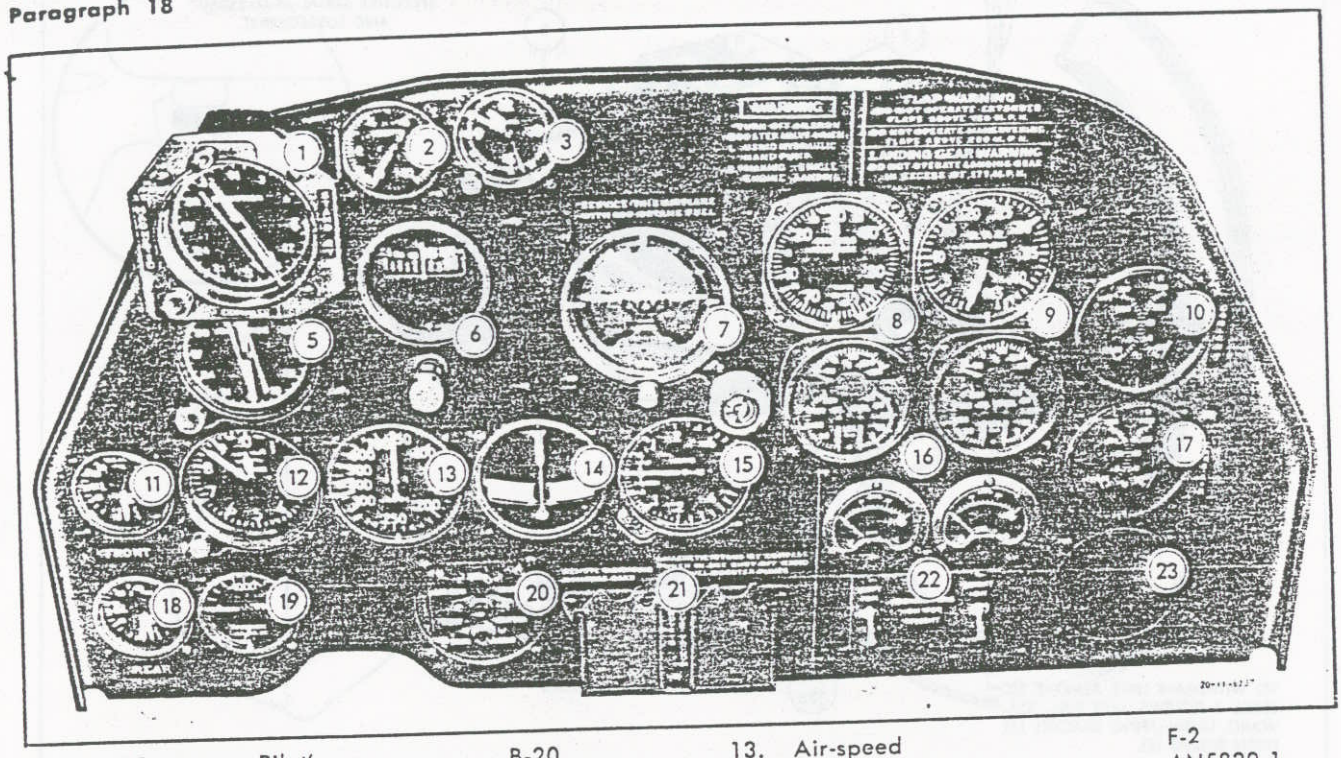
Figure 196 — Type C-2 Turbosupercharger Regulator Diagram

the inductance "T" and then through rectifier "S" which furnishes direct current to operate the torque motor. The purpose of the tuned circuit is to make the overspeed control more sensitive when operating near the maximum turbo speed. The increased sensitivity of the tuned circuit is accomplished by making the effect of the capacitance balance the effect of the inductance just above maximum turbo speed so that at this point, called the resonant frequency, the current flowing in the circuit is limited only by its resistance.

The second capacitance "U'" may be open-circuited by opening the normally closed contacts of the emergency overspeed switch. The purpose of this switch is to allow a higher turbo speed to be held when military engine powers are required. The switch is operated by the pressure control lever "C" so that when the pressure selection rod is fully extended to call for high manifold pressures, the contacts are opened. Opening the switch contacts reduces the total capacitance, which increases the resonant frequency of the tuned circuit, thus increasing the regulated maximum turbo speed to 26,400 rpm.

Note

At serial AF44-25059, the C-2 regulator is replaced with type C-2A which incorporates multi-speed control for selective War Emergency Power. Additional capacitance connectors give four turbo speed settings which are above



1.	Compass, Pilot's	B-20
2.	Vacuum Gage	AN5771-5
3.	Clock	AN5743-1
5.	Compass, Remote Indicator	AN5730-2A
6.	Turn Indicator	AN5735-1
7.	Flight Indicator	AN5736-1
8.	Manifold Pressure	AN5770-2
9.	Tachometer	AN5530-2
10.	Coolant Temperature	AN5795-6
11.	Fuel Level Gage, Front	GE Model 8DJ-12LAF
12.	Altimeter	AN5760-2
13.	Air-speed	F-2
14.	Bank and Turn	AN5820-1
15.	Rate of Climb	AN5825-1
16.	Engine Gages	AN5773-1
17.	Carburetor Air Temperature	AN5795-6
18.	Fuel Level Gage, Rear	GE Model 8DJ-12LAE
19.	Hydraulic Pressure	AN5771-4
20.	Landing Gear Warning	199474
21.	Vacuum Regulating Valve	Parker 4561-1-⅛D
22.	Ammeters	F-1
23.	(Removed)	

Figure 197 — Instrument Panel

18. INSTRUMENTS.

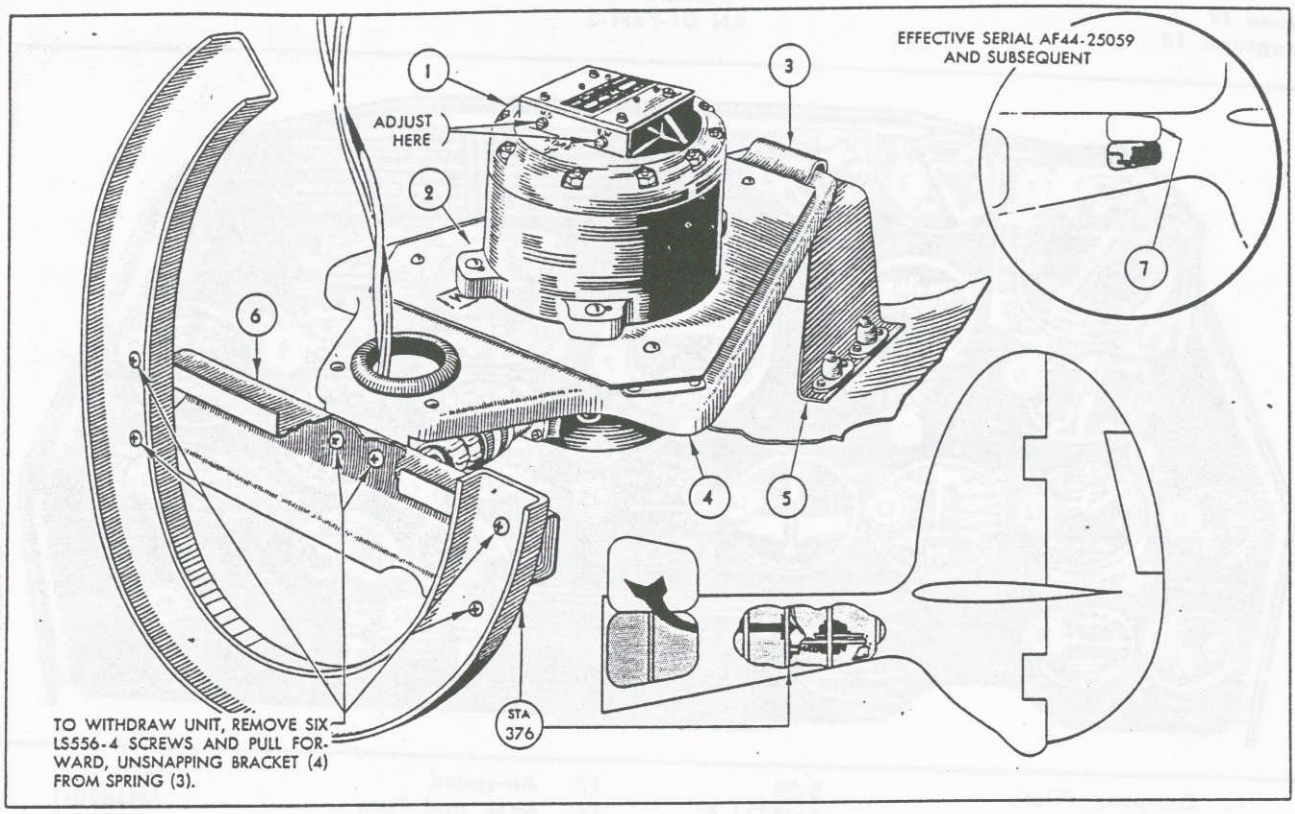
a. INSTRUMENT PANEL.

(1) DESCRIPTION.—The instrument panel is attached to the fuselage by four Lord type vibration mounts. The forward side of the panel is made accessible by removing the screw-attached skin panels in front of and below the windshield. In addition to the flight and engine instruments, the panel carries the bank and turn vacuum regulating valve; landing gear warning lights; compass deviation card holders; and instructions for flaps, landing gear, machine gun charger operation, radio call, fuel service, compass, and generators.

Each instrument case and cover glass is indexed with a white painted line at the bottom of the instrument. The following table shows the limit marking on the various instruments.

Instrument	*Red Line (Maximum)*	*Green Arc (Desired)*	*Red Line (Minimum)*	*Red Arc (War Emer.)*
Tachometer	3000	2100-2300	1600	
Manifold Pressure	54	27-35	21	54-59 ½
Fuel Pressure		14-18		
Oil Pressure	85	60-70	55	
Oil Temperature	96-97	60-95	40	
Coolant Temperature	125	105-115	85	
	†125	100-110	85	
Hydraulic Pressure		1250-1550		
Carburetor Air Temperature	45°C			
Air-speed Indicator	*420	**370	***290	
	Red Line	Long Yellow Line	Short Yellow Line	

*I. A. S. at 10,000 ft. alt.
**I. A. S. at 20,000 ft. alt.
***I. A. S. at 30,000 ft. alt.
†Effective AF44-23934 and subsequent.



1. Remote Compass Transmitter
2. Tray Assembly
3. Spring
4. Bracket Assembly
5. Support Assembly
6. Support Assembly
7. Access Door

Figure 199 — Remote Compass Transmitter Installation

the following manner: Turn the compass inverter "OFF" and disconnect the electrical plug to the installed transmitter. Connect the master transmitter to the disconnected electrical plug of the cable. Turn "ON" the inverter and manually turn the pointer of the master transmitter. If the indicator follows the master transmitter correctly, the trouble is then in the installed transmitter. If it fails to follow correctly, the trouble is in the indicator or the inter-connecting cables. The wiring may be checked with an ohmmeter and the source of the trouble located.

Check all wiring against remote compass wiring diagram (figure 313).

When it has been established that all wiring is correct, make certain that all mechanical parts of the unit are in good condition.

1. TRANSMITTER.

Trouble	*Possible Cause*	*Remedy*
Swirl of liquid gives erratic indication.	Not enough liquid in the bowl.	Forward to repair depot for filling.
Leakage of compass liquid.	Leaky gasket.	Forward to repair depot for impregnated gasket replacement.
Compensator does not have sufficient effect.	Weak compensator magnets.	Forward to repair depot for remagnetization of compensator magnets.

2. INDICATOR.

Trouble	*Possible Cause*	*Remedy*
Erratic indication.	Loose pointer.	Forward to repair depot for replacement or rework.
Sluggish operation.	Dirty jewels and pivots.	Forward to repair depot for cleaning.

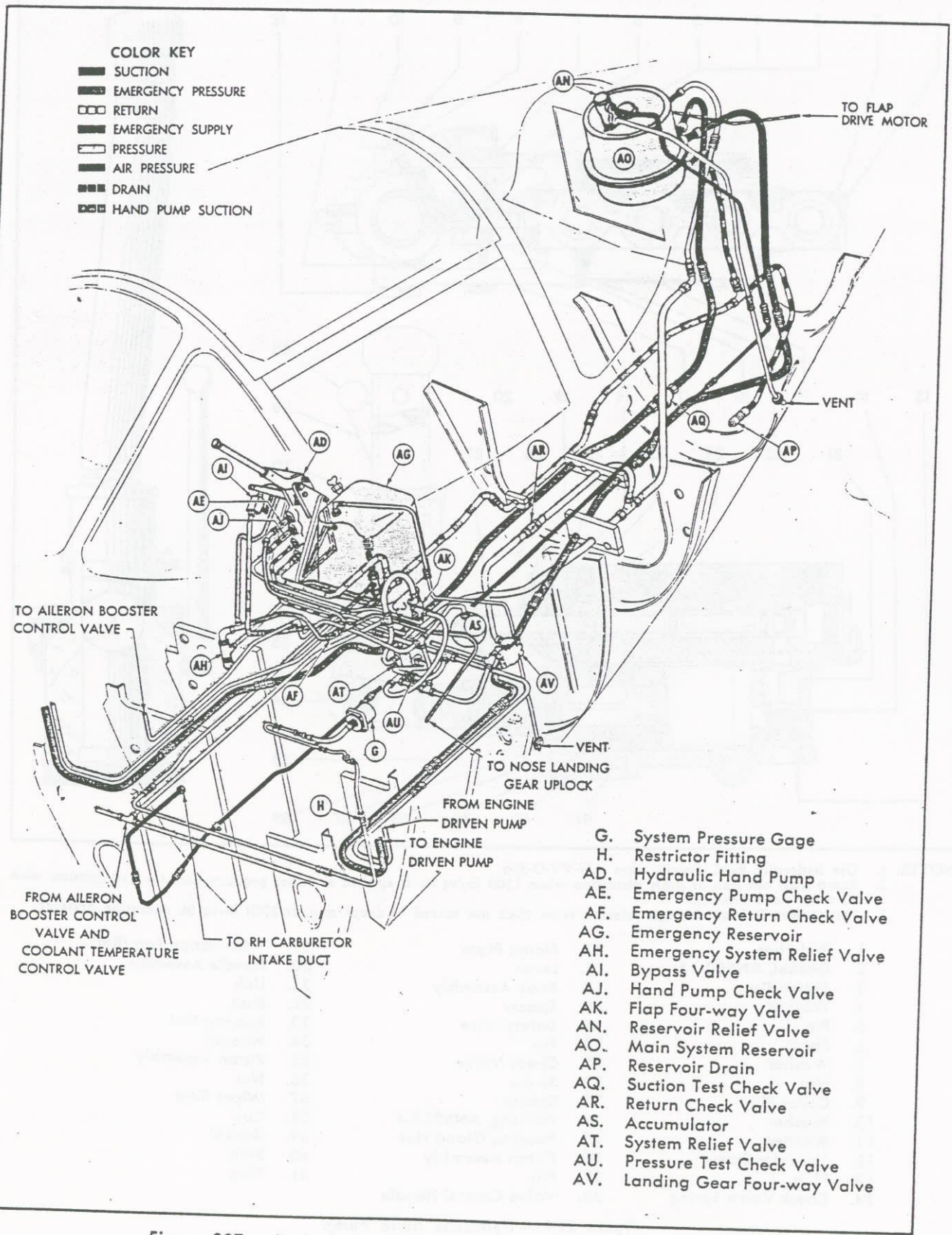
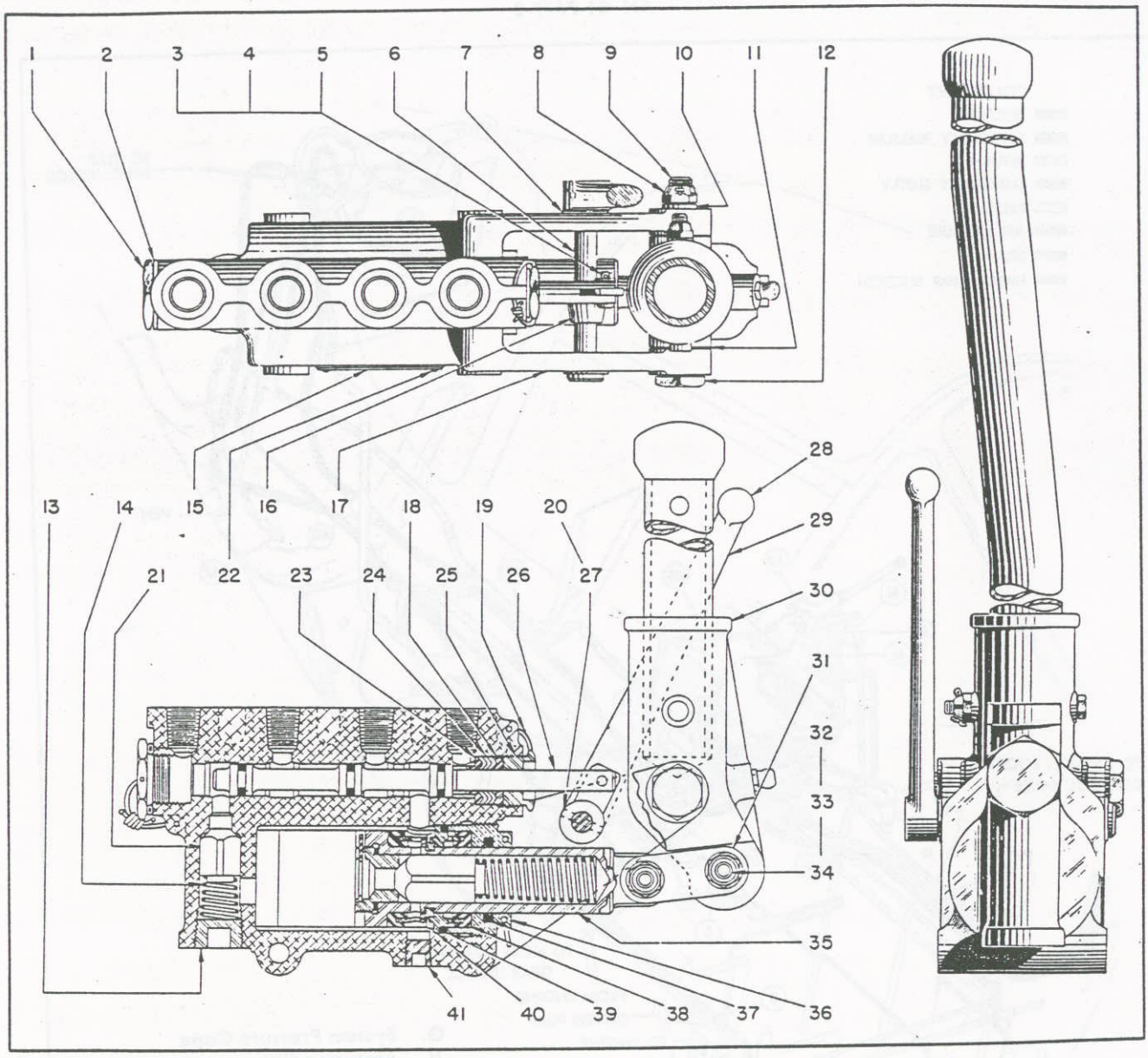


Figure 207 — Basic Hydraulic System Location and Flow Diagram



NOTES: 1. Use hydraulic fluid, Specification AN-VV-O-366.
2. Pump shall not leak or show distortion when 1500 lb/sq in. is applied at either pressure port for five minutes with all other ports blocked.
3. Port-to-port leakage through selector valve shall not exceed 45 drops/min. at 1000 lb/sq in. operating pressure.

1. End Plug
2. Gasket, AN900-12
3. Cotter Pin
4. Washer
5. Pin
6. Shaft
7. Washer
8. Nut
9. Cotter Pin
10. Washer
11. Washer
12. Shoulder Screw
13. Plug
14. Check Valve Spring
15. Name Plate
16. Lever
17. Body Assembly
18. Spacer
19. Safety Wire
20. Pin
21. Check Valve
22. Screw
23. Spacer
24. Packing, AN6225-4
25. Packing Gland Nut
26. Piston Assembly
27. Pin
28. Valve Control Handle
29. Information Tag (Ref)
30. Handle Assembly
31. Link
32. Stud
33. Bearing Nut
34. Washer
35. Piston Assembly
36. Nut
37. Wiper Ring
38. Cup
39. Gasket
40. Ring
41. Plug

Figure 214 — Hydraulic Hand Pump

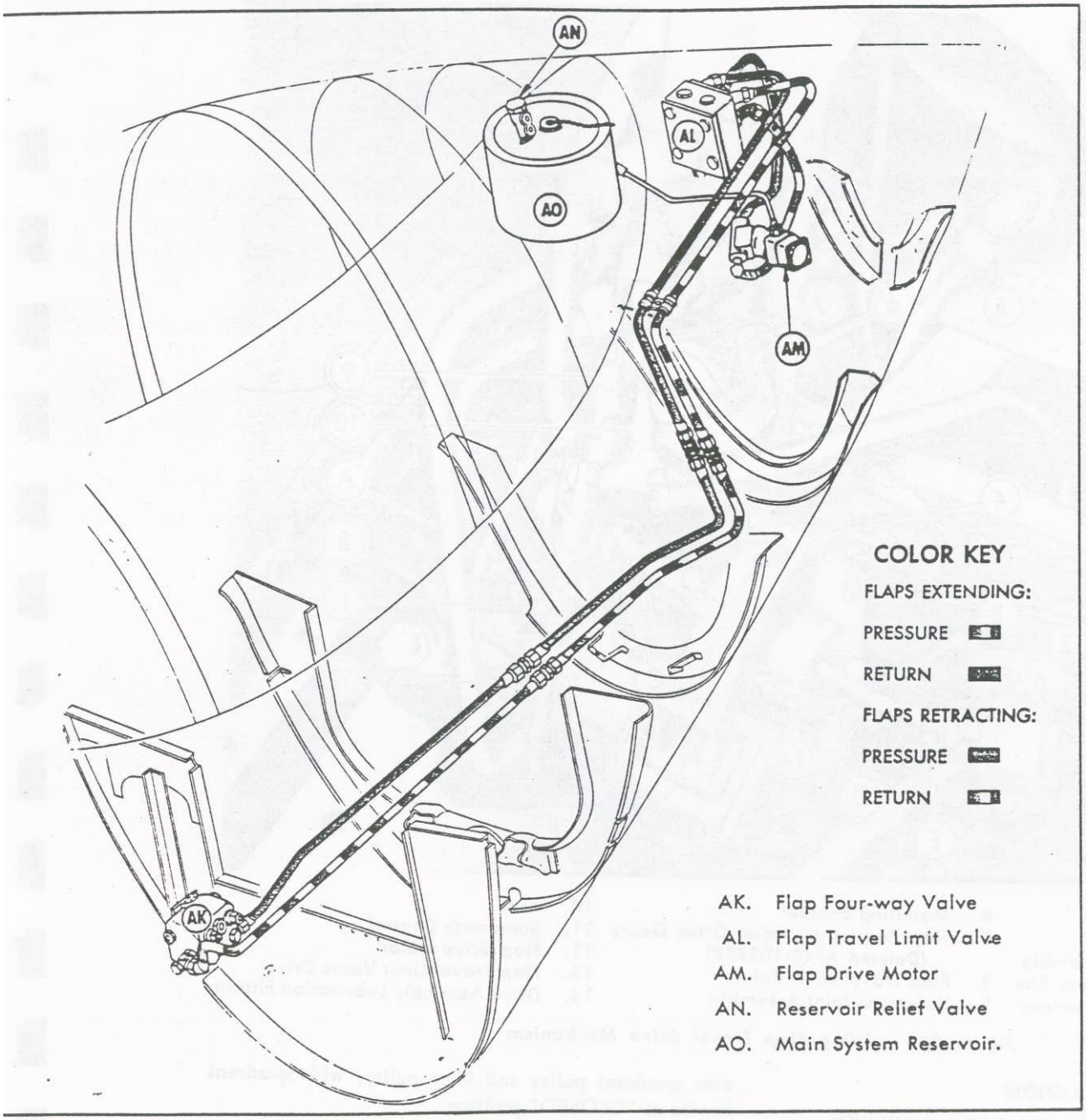
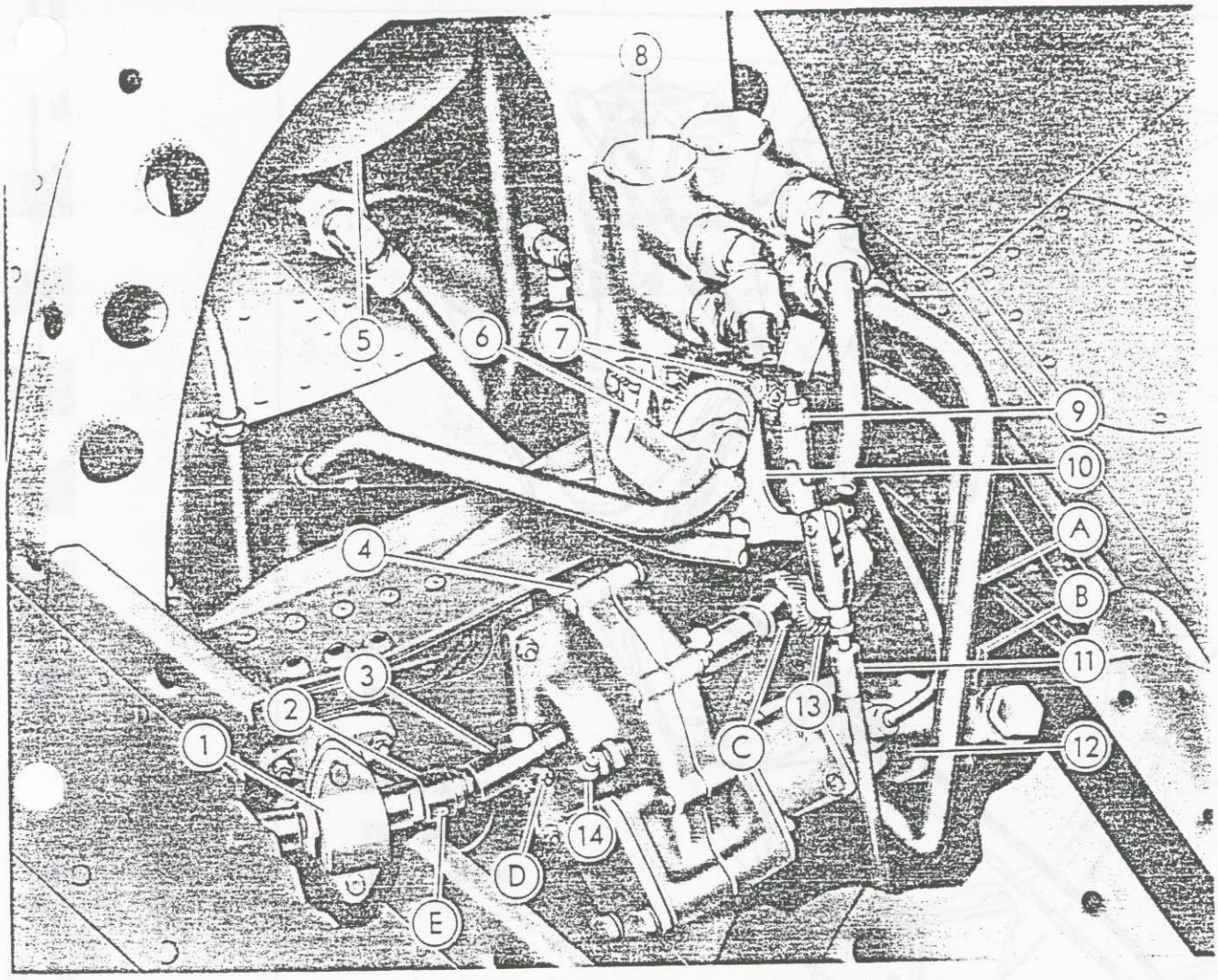


Figure 215 — Wing Flap Hydraulic System Location and Flow Diagram

ERING." In addition, it is possible by manual control use the flaps in any position between "UP" and)OWN" by holding the cockpit control handle in the JP" or "DOWN" position until the desired amount of ıp is reached, and then returning to "OFF" position.

The flap control system consists of a four-way lector valve, a drive motor, and a travel limit valve)aragraph *e* (1) *(d)*, following).

When the flap control lever in the cockpit is moved to the "DOWN" position, hydraulic fluid under pressure flows into the pressure inlet of the four-way valve, through the inlet check valve to the down line, and thus to the travel limit valve. Passing through the travel limit valve at "B," pressure is transmitted to the flap actuating motor which drives actuating screw "J" through the gear box. Fluid then returns through check valve "A" to the four-way valve up line through the unloading valve and back to the reservoir.



1. Bearing Assembly
2. Collar
3. Universal Joint Assembly
4. Drive Assembly Gear Box
5. Hydraulic Fluid Reservoir
6. Mounting Bracket
7. Flap Position Indicator Drive Gears (Deleted AF42-103979)
8. Flap Travel Limit Valve
9. Universal Joint Assembly
10. Arm
11. Simmonds Control
12. Flap Drive Motor
13. Flap Travel Limit Valve Drive
14. Drive Assembly Lubrication Fitting

Figure 219 — Wing Flap Travel Drive Mechanism

CAUTION

In removing screws be sure to note correct location of each screw, as all are of different lengths. (See figure 221.)

(7) Remove unit.

(8) Remove cable lock, and pull cable through hat section.

c. STRINGING.

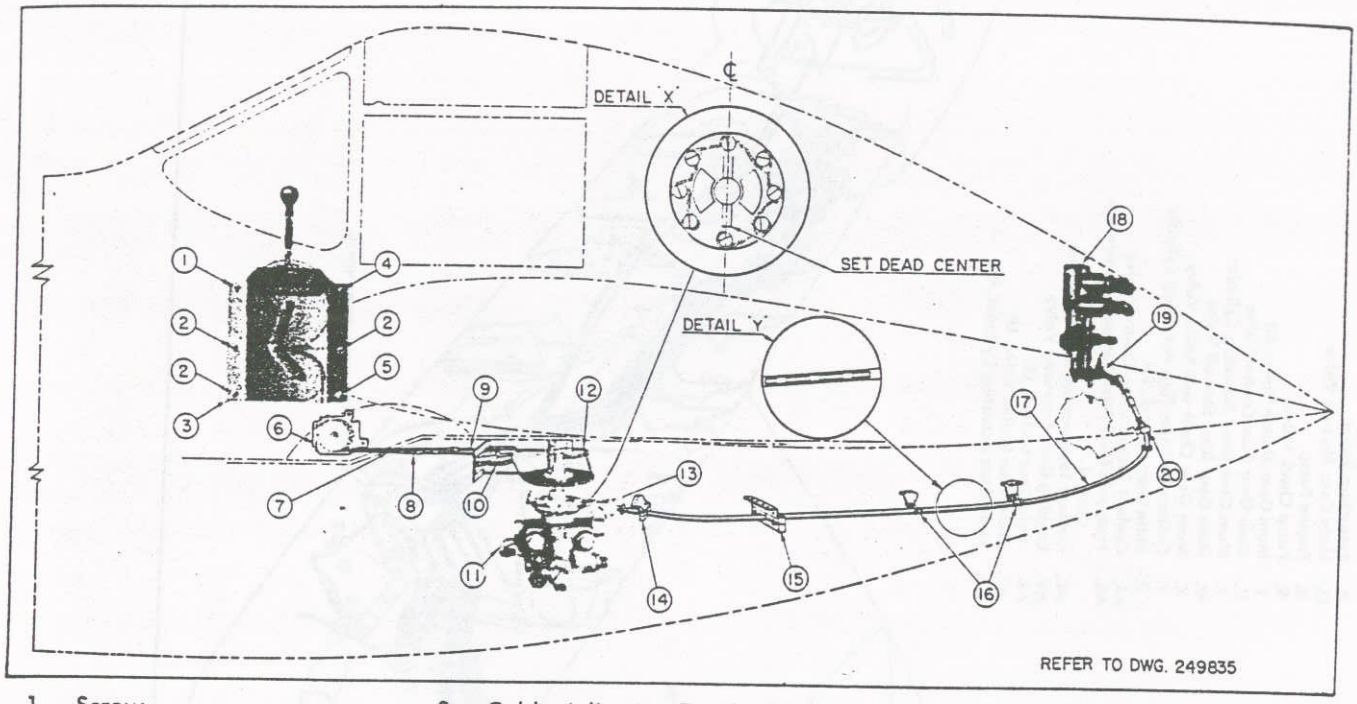
(1) With lock plate and axle bolts in place quadrant cover, replace pulleys on axles and string the cables. Outboard cable goes aft; inboard cable goes over quadrant pulley and idler pulley, with quadrant handle in "CLOSED" position.

(2) Drop cables through hat section.

(3) Replace screws in flanges; be sure to install proper lengths. (See figure 221.) Tighten axle bolts and screws in lock plate.

(4) String cables through fairing along floor, but do not push ends with turnbuckles through slot.

(5) Reassemble pulley bracket "6," string cables, take care to get aft cable on outboard pulley. Install and secure lock plate with one screw. Tighten axle bolt.



1. Screw
2. Screw
3. Control Quadrant Cover
4. Screw
5. Screw
6. Pulley Bracket Assembly
7. Forward Inboard Cable
8. Cable Adjusting Turnbuckle
9. Aft Outboard Cable
10. Inboard Pulley Assembly
11. Aircraft Accessories Flap Four-way Valve
12. Outboard Pulley Assembly
13. Cam Assembly
14. Fair-lead
15. Fair-lead
16. Adel Clips
17. Simmonds Control
18. Flap Travel Limit Valve
19. Hinged Lever
20. Clip

Figure 221 — Maneuvering Flap Control

d. Disconnect flap travel rod at universal joint "9."

e. Remove four center-line bolts which hold back of valve to bulkhead and lift out valve.

3. DISASSEMBLY AND OVERHAUL.
(See figure 220.)

a. Remove shear pin "27."

b. Loosen nuts and cotter keys "1" and turn rocker "26" until lever clears gear "18," then push out rocker.

c. Unscrew guide nut "4" and slide out stem "3" and spring "5."

d. Examine spring "5" and replace if necessary.

e. Remove gland nut "6."

f. Remove packing adapter "9."

g. Remove seals "7" and "8" and replace if necessary.

h. Remove retainer nut "17."

i. Remove gasket "16" and replace if necessary.

j. Examine ball "13" and seat "11" for scoring, abrasions, and corrosion. If seat requires lapping proceed as follows:

(1) Select a short length of tubing having an inside diameter slightly smaller than the ball; and force ball into end of tube so that a little more than half the ball extends from tube.

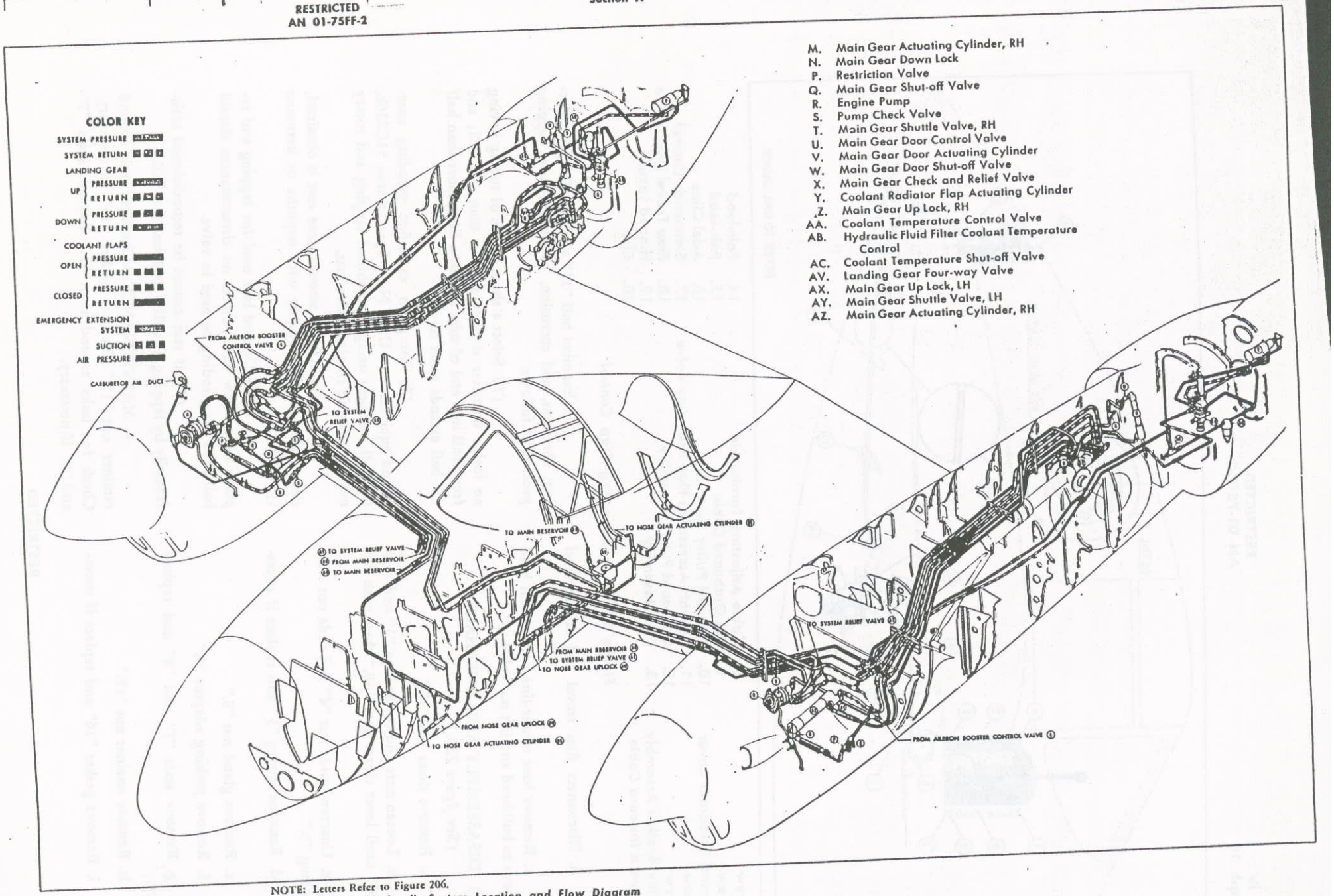
(2) Using an extra-fine grinding compound equivalent to U. S. Navy Specification 51C226b, lap ball into seat using a combined tapping and rotary motion to avoid ringing valve seat.

(3) After a smooth, true seat is obtained, clean valve seat thoroughly with naphtha or kerosene (paraffin oil).

(4) Discard ball used for lapping and replace with a new ball. Under no circumstances should ball used for grinding be used in valve.

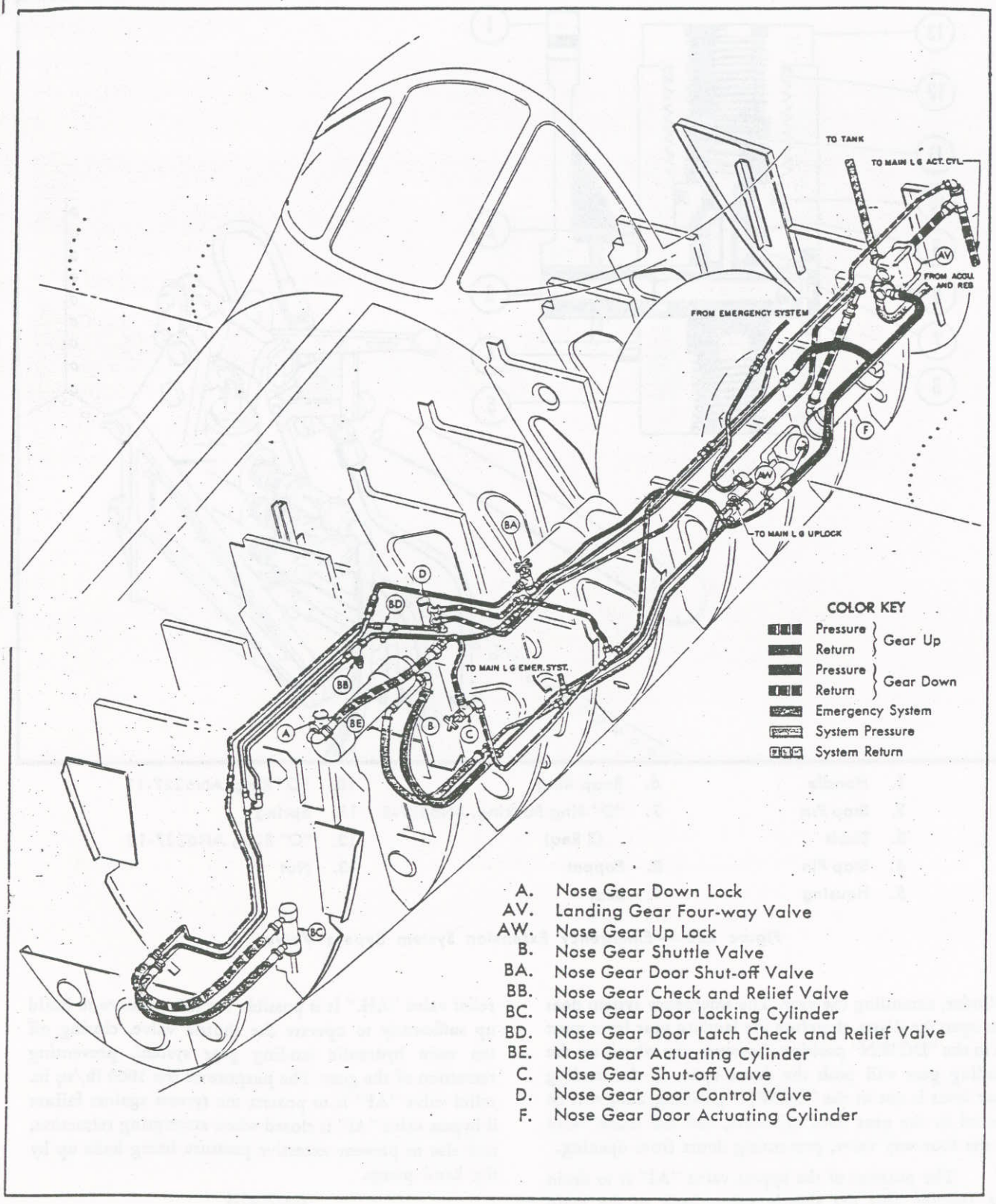
(5) If seat cannot be reconditioned satisfactorily by lapping, install a new seat and ball.

4. MAINTENANCE.—Check for leaks around retainer nut "17." Replace gasket "16" if necessary. Check for leaks around stem "3." Replace seals "7" and "8" if necessary.



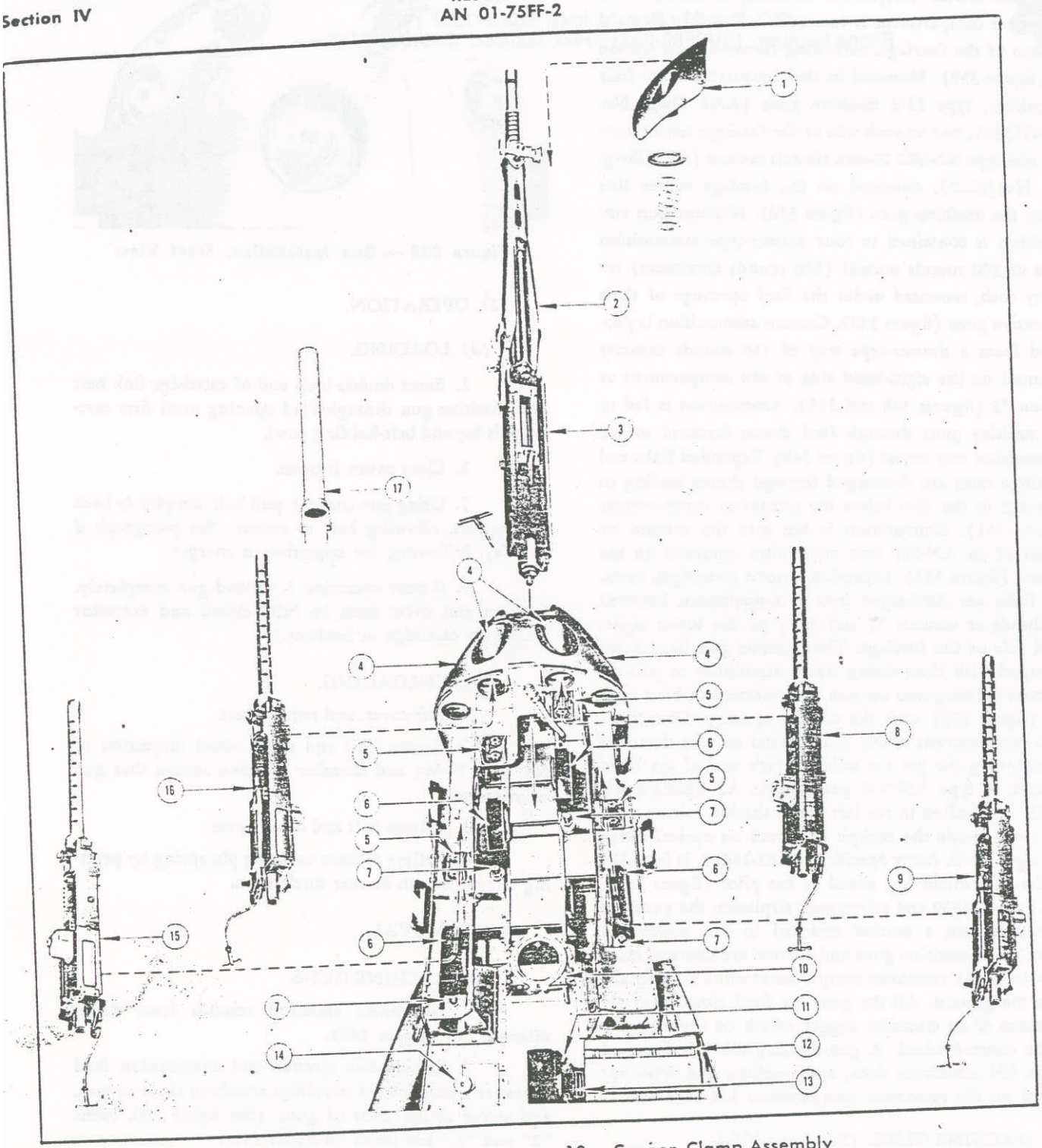
NOTE: Letters Refer to Figure 206.

Figure 241 — Main Landing Gear and Coolant Hydraulic System Location and Flow Diagram



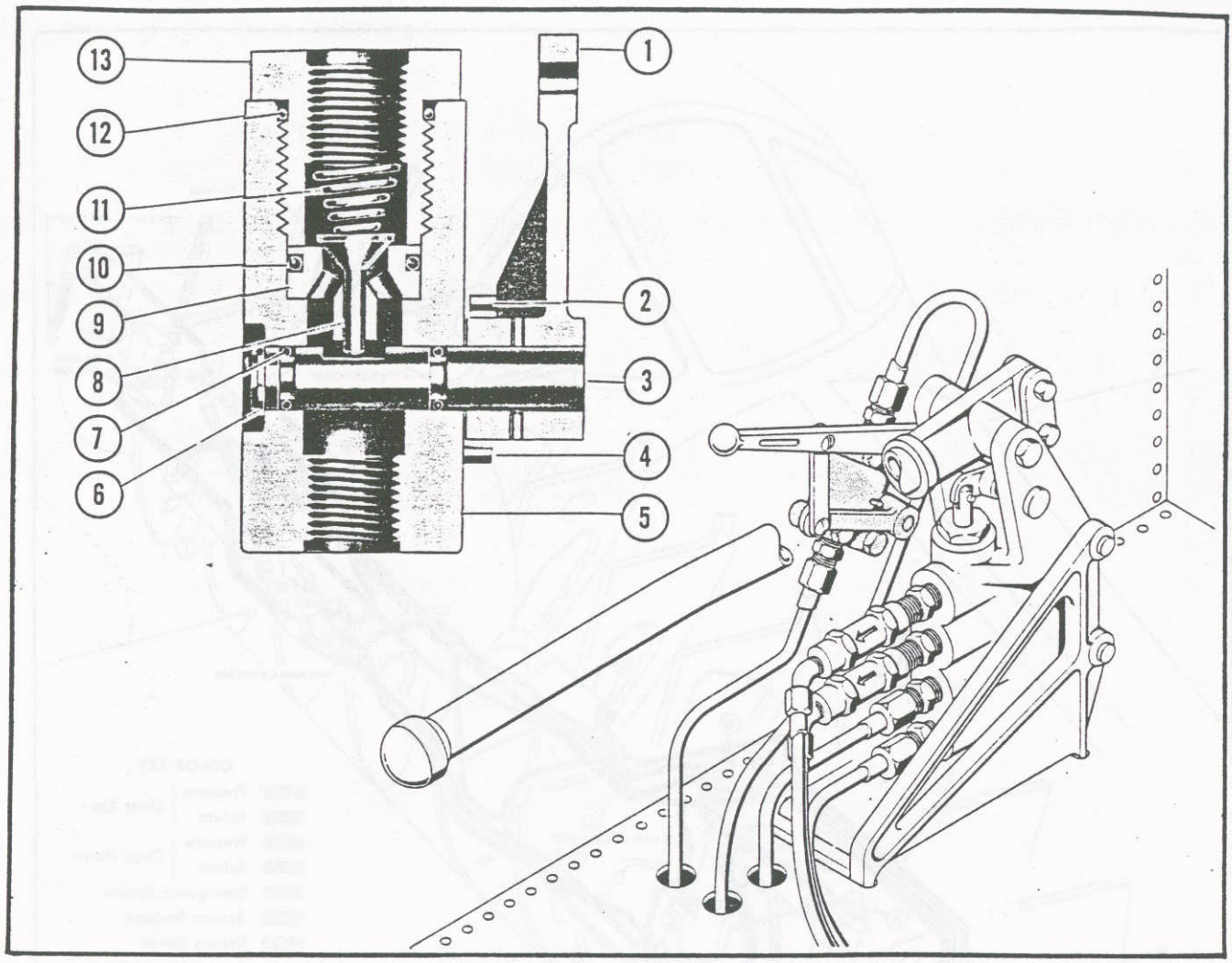
NOTE: Letters Refer to Figure 206.

Figure 242 — Nose Landing Gear Hydraulic System Location and Flow Diagram



1. Cannon Blast Tube Assembly
2. Cannon Cradle Assembly
3. 20 MM Aircraft Cannon
4. Machine Gun Blast Tubes
5. Machine Gun Front Trunnion Assembly
6. Machine Gun Case Ejection Chute
7. Machine Gun Rear Mounting Post
8. .50 Cal. Machine Gun No. 1—Upper Right
9. .50 Cal. Machine Gun No. 3—Lower Right
10. Cannon Clamp Assembly
11. Cannon Case Ejection Chute
12. Cannon Ammunition Tray Pedestal Track
13. Cannon Link Ejection Chute
14. Cannon Ammunition Feed Chute Adjustment Post
15. .50 Cal. Machine Gun No. 4—Lower Left
16. .50 Cal. Machine Gun No. 2—Upper Left
17. Machine Gun Barrel Sleeve—All Machine Guns

Figure 339 — Armament Compartment



1. Handle
2. Stop Pin
3. Shaft
4. Stop Pin
5. Housing
6. Snap Ring
7. "O" Ring Packing, AN6227-5 (2 Req)
8. Poppet
9. Seat
10. "O" Ring, AN6227-11
11. Spring
12. "O" Ring, AN6227-12
13. Nut

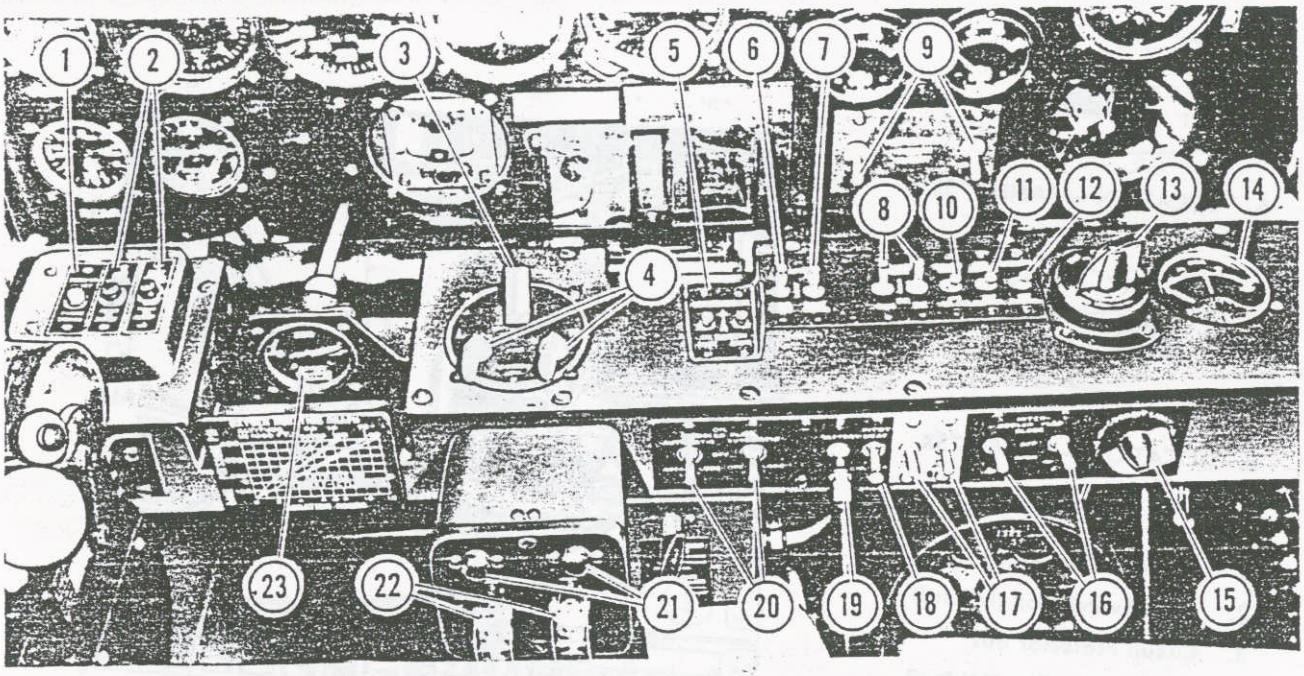
Figure 256 — Emergency Extension System Bypass Valve

cylinder, extending the gear. The emergency system does not open the doors, therefore the landing gear lever must be in the "DOWN" position; however, the wheels on the landing gear will push the doors open. If the landing gear lever is not in the "DOWN" position, fluid will be locked in the gear door cylinders, and the check valve in the four-way valve, preventing doors from opening.

The purpose of the bypass valve "AI" is to drain any leakage past the shuttle valve, back to the main reservoir "AO." If the bypass valve is not open any leakage past the shuttle valve will build up pressure in the line between the shuttle valve and the 1000 lb/sq in. relief valve "AH." It is possible for this pressure to build up sufficiently to operate the shuttle valve, closing off the main hydraulic landing gear system, preventing retraction of the gear. The purpose of the 1000 lb/sq in. relief valve "AF" is to protect the system against failure if bypass valve "AI" is closed when attempting retraction, and also to prevent excessive pressure being built up by the hand pump.

CAUTION

When operating landing gear system on ground checks, make certain landing gear doors are in the open position.



1. Circuit Protector — Feathering Lights
2. Circuit Protectors — Propeller Circuit
3. Ignition Master Switch
4. Ignition Switches
5. Oil Dilution Switches
6. Starter Switch
7. Engage Switch
8. Position Light Switches
9. Generator Switches
10. Landing Light Switch (Circuit Breaker)
11. Gun Heaters Switch (Circuit Breaker)
12. Remote Compass Switch (Circuit Breaker)
13. Fluorescent Cockpit Light Rheostat
14. Voltmeter
15. Cockpit Light Rheostat
16. Intercooler Flap Switches
17. Automatic Coolant Control Override Switches
18. Pitot Heat Switch (Circuit Breaker)
19. Battery Disconnect Switch
20. Automatic Oil Cooler Flap Switches
21. Propeller Feathering Warning Lights
22. Propeller Feathering Switches
23. Oxygen Pressure Gage

Figure 261 — Main Switch Box

2. Make sure the edges of replacement conduit are smooth and free from burrs that may fray the wire insulation.

3. Use only cushioned-type clamps on flexible conduit.

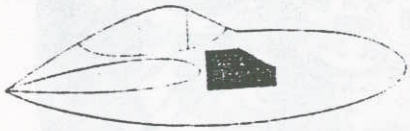
4. Check exposed conduit for oil or moisture absorption.

(3) CIRCUIT PROTECTORS AND FUSES.

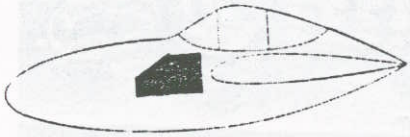
(a) All branch circuits, with one exception, are controlled and protected against a sustained overload by thermal, switch-type automatic circuit breakers, or by toggle switches and separate push-button-type automatic circuit protectors. The radio crash switch circuit is protected by a fuse. For amperage limits and location of circuit protectors and fuse, refer to the circuit protection chart. All circuit breakers and circuit protectors in the fuselage are accessible to the pilot in flight. Two types are used.

1. The PSM or PLM is a manual reset, "trip-free" circuit protector. In normal position, a conductive snap-acting disk bridges the terminals maintaining the circuit. At overload, the resistance heat caused by current passing through the disk snaps the disk into reverse position, opening the circuit. It will remain in this position until manually reset by the push button. It cannot be held in closed position by the reset button if overload conditions exist.

2. The AN3160 switch breaker also uses a metal contact. At overload, the thermal breaker opens the circuit, and a spring pulls the handle to the "OFF" position. After a short time, the contact cools and the breaker can be reset. Type AN3160 switch breaker, as used with the gun heaters, pitot heater, contact heater, and remote compass, are "non trip-free." The contacts may be held closed regardless of the amount of overload by holding the switch in the "ON" position.

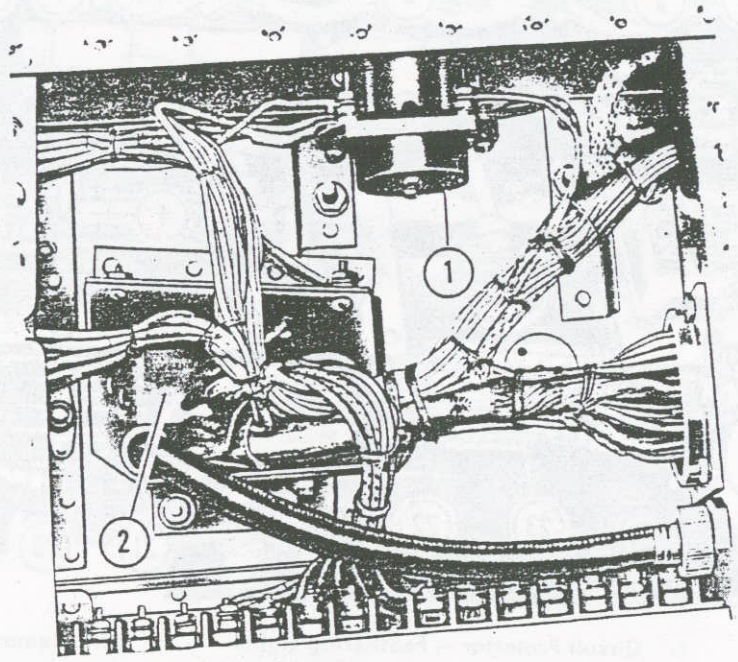


A. LOCATION – PANEL 75L

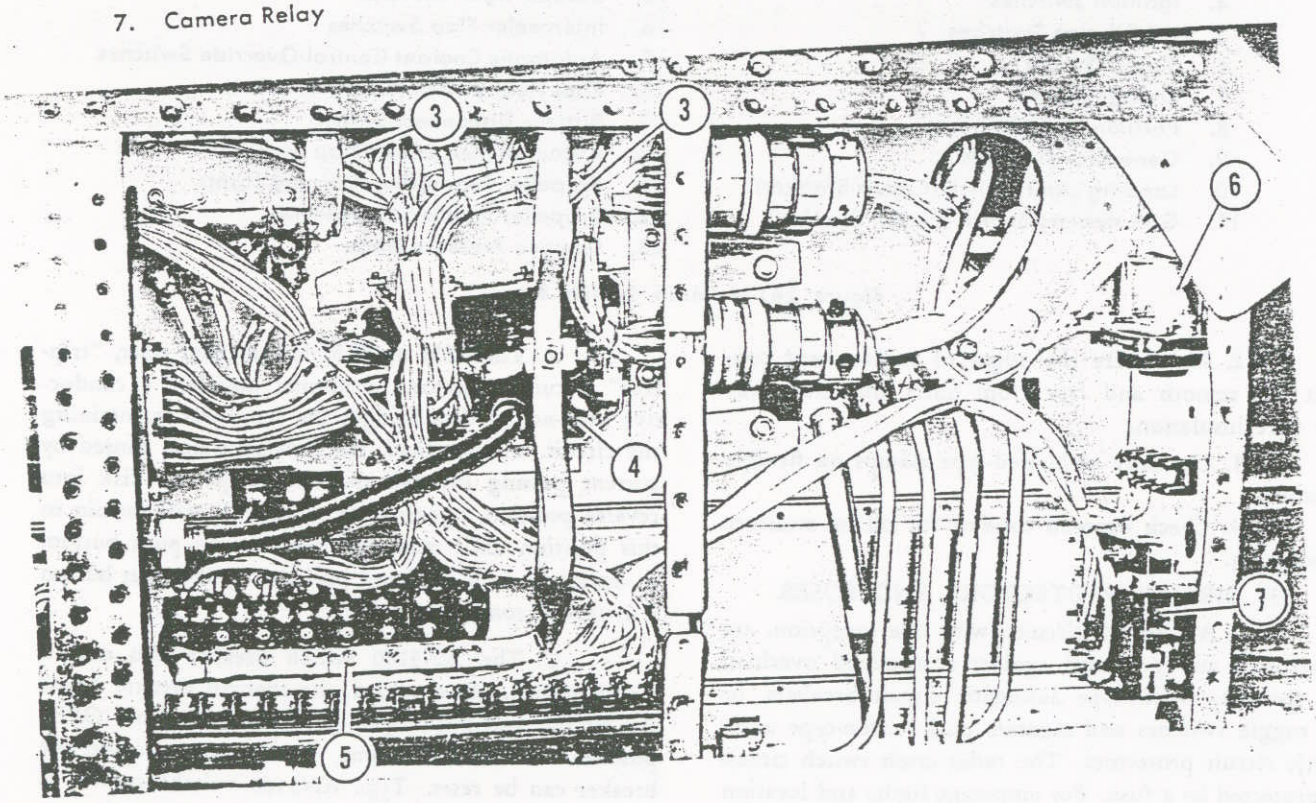


B. LOCATION – PANEL 75R

1. Machine Gun Relay
2. Main Switch Box (LH End)
3. Circuit Protector Bus
4. Main Switch Box (RH End)
5. Circuit Protectors
6. Cannon Relay
7. Camera Relay



A. Left-Hand



B. Right-Hand

Figure 262 — Main Junction Boxes

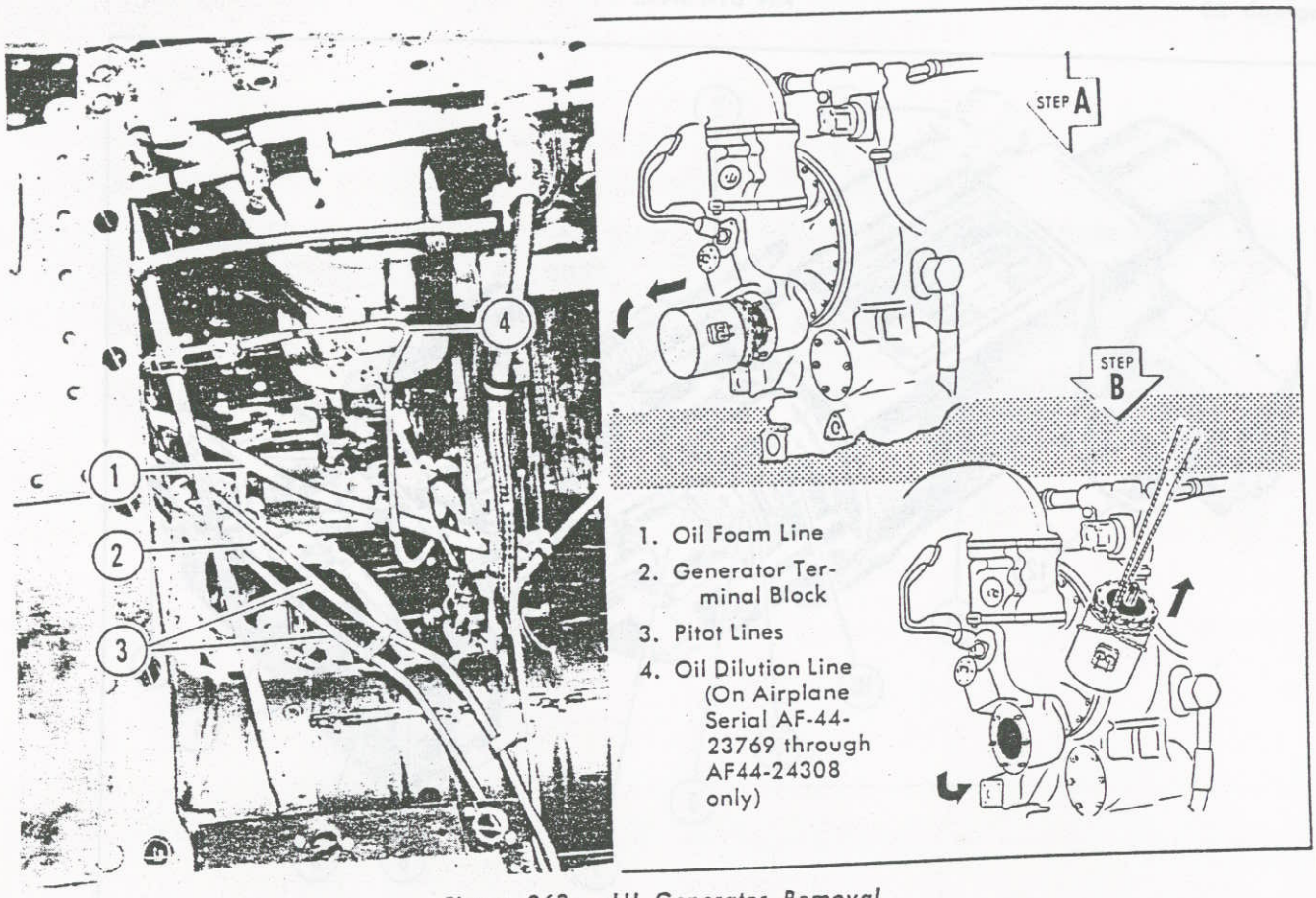


Figure 263 — LH Generator Removal

(*b*) REMOVAL.

1. LH GENERATOR.

a. Remove aft outboard, inboard, and upper cowling on LH engine.

b. Disconnect blast tube from generator.

c. Break pitot lines at unions and move back for clearance.

d. Disconnect generator wires.

e. Remove nuts holding generator. Lower commutator end and lift up through top inboard side.

2. RH GENERATOR.

a. Remove aft inboard, outboard, and bottom cowling.

b. Remove lower induction system duct.

c. Remove section of blast tube attached to generator.

d. Remove oil pressure gage line.

e. Remove oil dilution line. (AF44-24309 and subsequent.)

f. Disconnect generator wires.

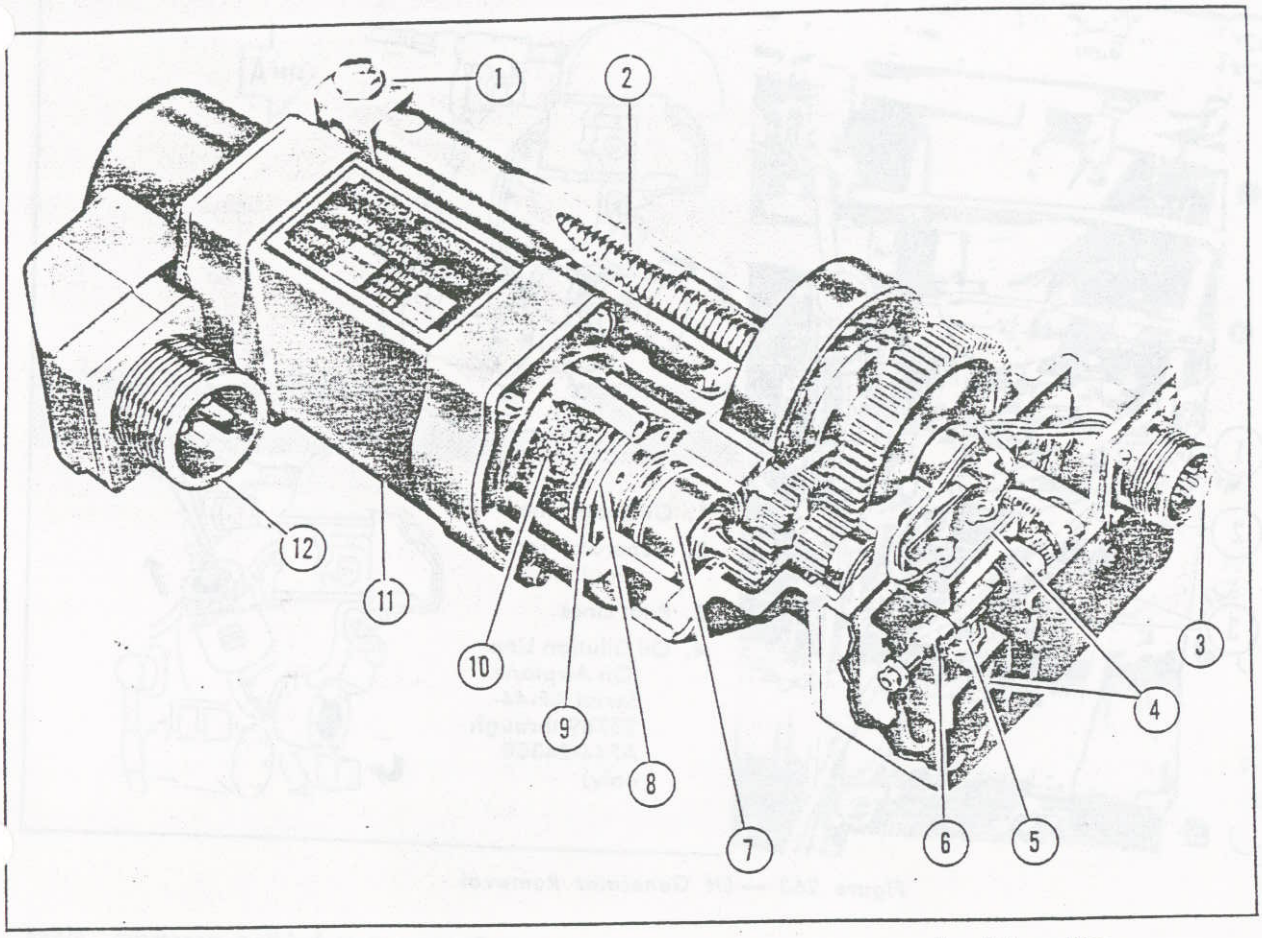
g. Remove nuts holding generator. Move generator aft, rotate unit, and remove through outboard side above the support bay diagonal strut.

(*c*) MAINTENANCE.

1. Replace any brushes that are gummy or oil soaked. (Brush surfaces absorb oil, causing a high voltage contact drop which decreases the output of the generator and increases its temperature.) If oil is observed in the generator, remove the generator and check the drive pad oil seal.

2. Replace brushes if they are worn: Delco-Remy—replace at 3/4-inch overall length; Leece-Neville —replace at 1/2-inch overall length. (Generators used above 25,000 feet altitude will consume brushes very rapidly. If the airplane is used at such altitudes, brushes must be checked after each flight of one hour or more duration.)

3. When replacing a brush, the new brush must be seated by wrapping No. 000 sandpaper around the commutator, sanded side *out* and pulling the sandpaper in the direction of rotation. Be sure sandpaper conforms to contour of commutator, and that brushes rest firmly on sandpaper.



1. Jack Screw Nut
2. Jack Screw Assembly
3. Limit Switch Electrical Connector
4. Limit Switches (Microswitch)
5. Cam
6. Camshaft Lock Nut
7. Double Row Bearing
8. Cork Brake Disc Facing
9. Driven Disc
10. Solenoid
11. Motor Housing
12. Motor Electrical Connector

Figure 281 — Electric Dive Flap Actuator

Trouble	*Possible Cause*	*Remedy*
Actuator motor runs continuously, slipping clutch.	Limit switch inoperative causing actuator to jam.	Adjust limit switches. Replace clutch plate assembly if damaged.
	Limit switch wiring grounded.	Check wiring and plug in limit switch circuit. Replace defective wiring or plug.
Actuator does not stop instantaneously when current to motor is shut off.	Cork ring on brake disc has become glazed.	Remove clutch plate assembly and replace cork ring.
	Clutch plate does not engage cork brake ring.	Remove clutch plate assembly and replace.
Flap operates slow.	Jack screw binding because of corrosion.	Remove unit and clean jack screw assembly.
	Gears corroded.	Remove actuator and replace.
	Brake dragging.	Remove clutch plate assembly and replace.
	Flap hinge bent.	Repair or replace.
	Motor rpm low due to rough or dirty commutator.	Remove motor assembly and replace.
Limit switch fails to shut-off motor at proper instant.	Switch loose in mounting.	Tighten mounting nuts.
	Shut-off cam has shifted position on cam shaft.	Adjust cam and tighten lock nut.
Flaps retract too tightly against wing.	Jack screw retracts too far in actuator.	Adjust jack shaft nut.
Flap does not fit snugly in retracted position.	Actuating arm bracket improperly centered.	Loosen lock nut on adjusting bracket screw and turn to correct.

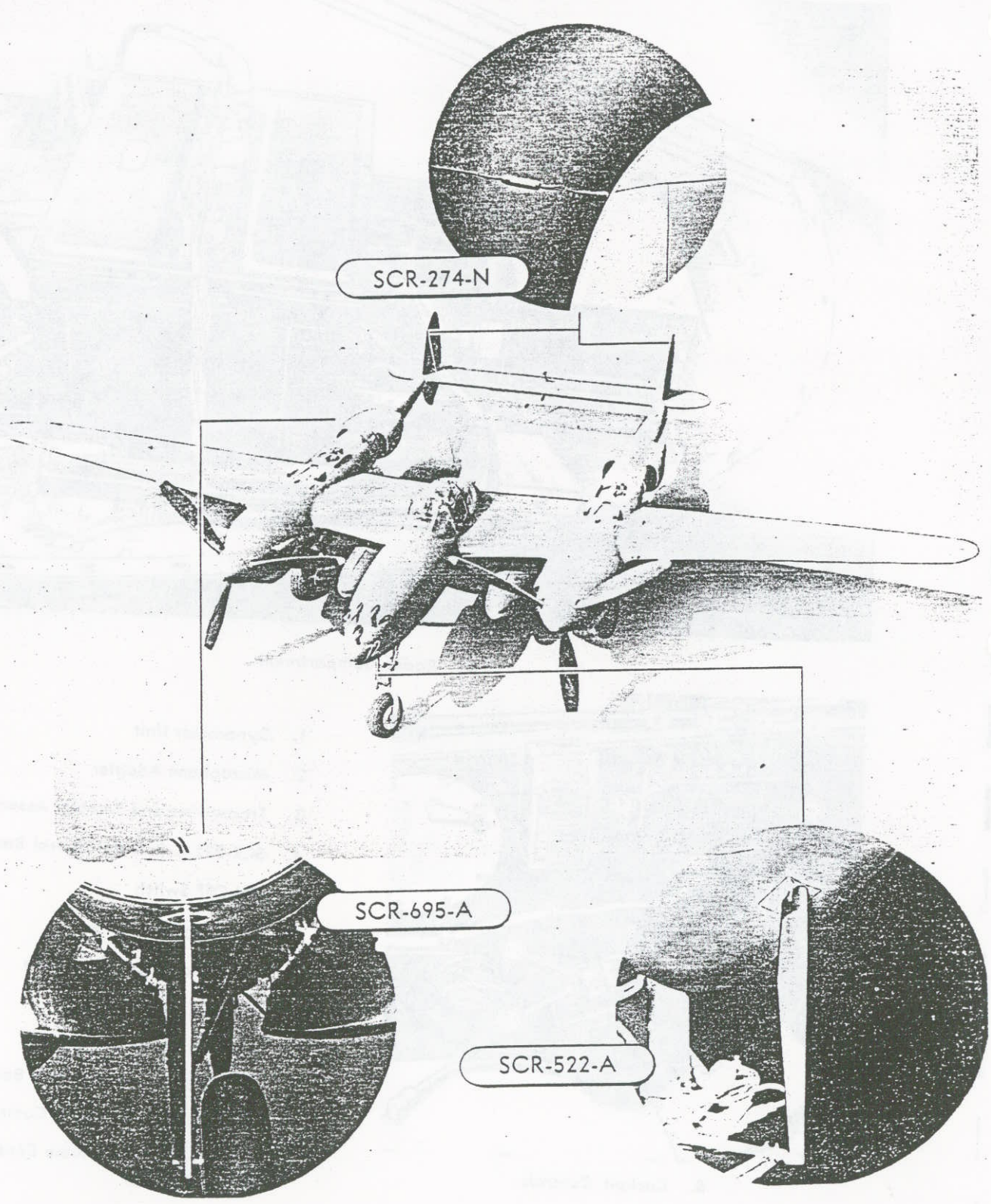
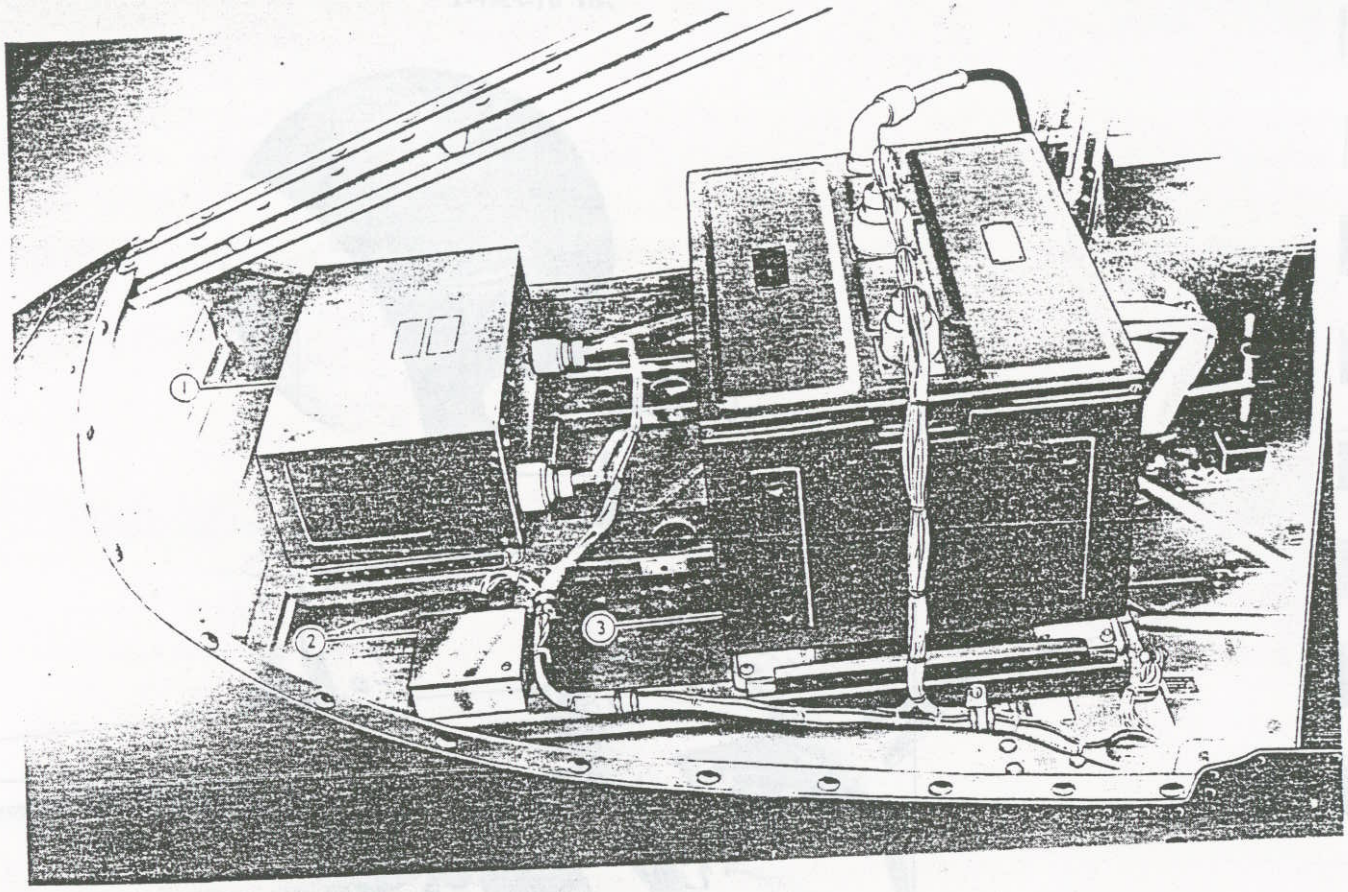
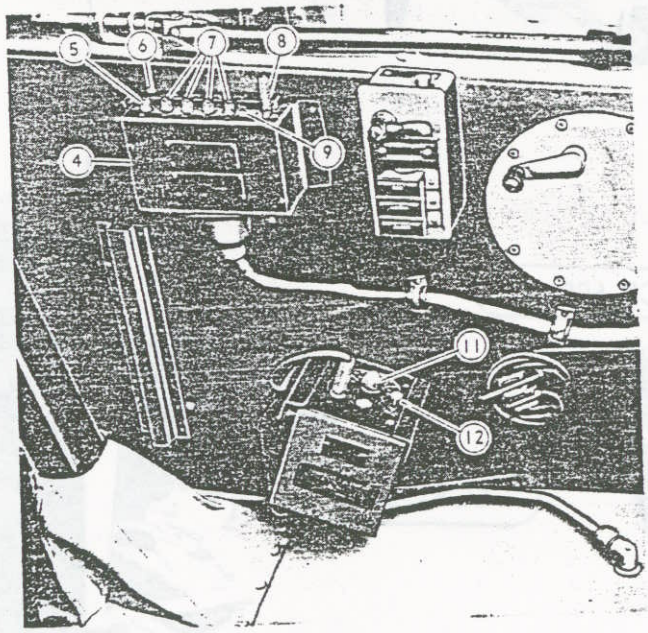


Figure 325 — Radio Antennas



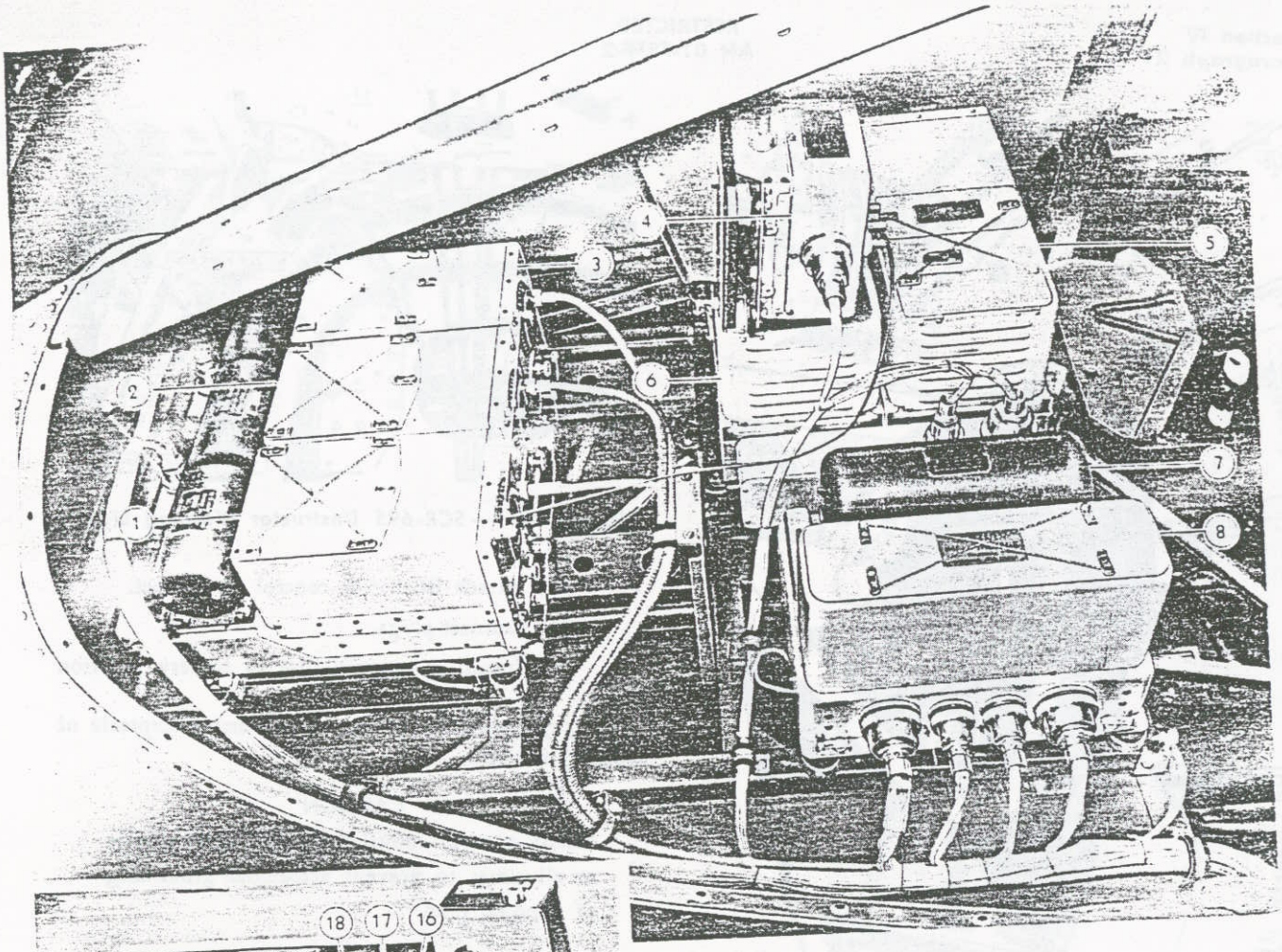
A. *Radio Compartment*



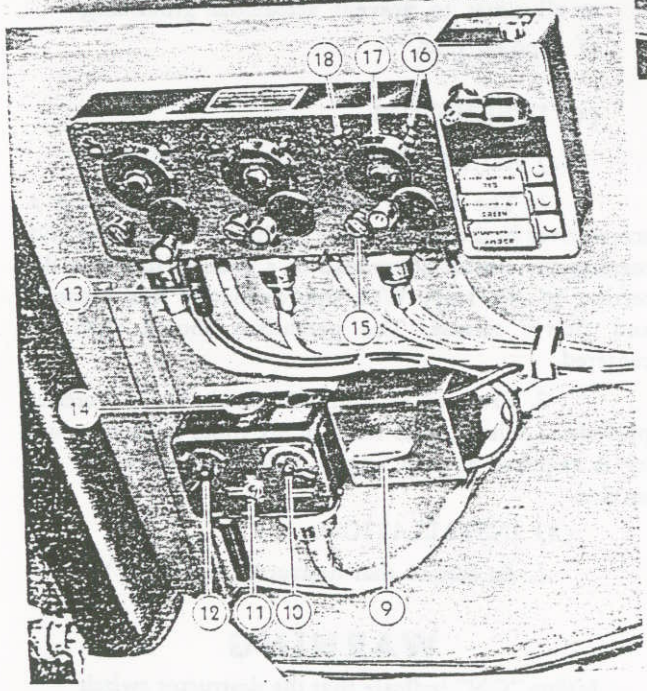
B. *Cockpit Controls*

1. Dynamotor Unit PE-94-A
2. Microphone Adapter M-299
3. Transmitter and Receiver Assembly
4. SCR-522-A Remote Control Box (BC-602-A)
5. ON-OFF Switch
6. Dimming Mask Lever
7. Frequency Change Switches
8. T-R-REM Switch
9. T-R-REM Switch Lock Lever
10. Identification Light Control Box
11. Beacon Receiver Tuning Control
12. Beacon Receiver Volume Control and ON-OFF Switch

Figure 327 — SCR-522-A Radio Installation



A. *Radio Compartment*



B. *Cockpit Controls*

1.	Receiver	BC-454A
2.	Receiver	BC-453A
3.	Receiver	BC-455A
4.	Antenna Relay Unit	BC-422A
5.	Transmitter	BC-458A or BC-459A or BC-696A
6.	Transmitter	BC-457A
7.	Dynamotor	DM-33A
8.	Modulator	BC-456A
9.	Radio Range Filter	
10.	Transmitter Selector Switch	
11.	Transmitter Power Switch	
12.	Transmitter Control Switch	
13.	Telephone Plug (in "A" Jack)	
14.	Transmitter Key	
15.	Receiver Volume Control	
16.	Receiver Control Switch	
17.	Receiver Tuning Dial and Crank	
18.	Headset Selector Switch	

Figure 328 — SCR-274-N Radio Installation

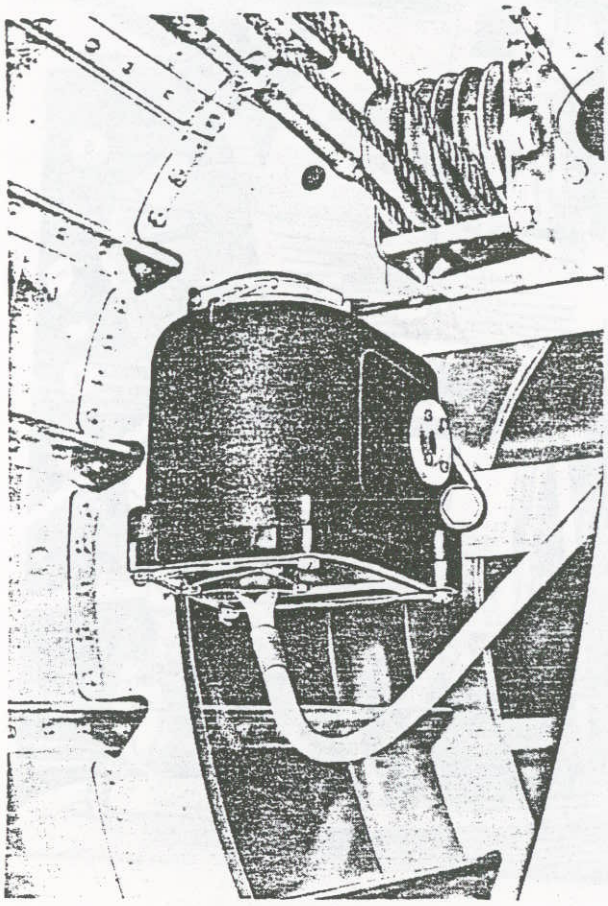


Figure 330 — Inertia Crash Switch

4. Insert receiver in boom as follows:

a. Hold set with plug side facing opposite boom.

b. Insert in boom, top first.

c. After set is in boom, move forward and turn so it is upright.

d. Slide set forward about 12 inches and turn counterclockwise 90 degrees.

e. Line up pins with holes in rear of rack, fasten thumb screws, and safety.

Note

Be sure thumb screws are tight.

5. Install antenna and cable plugs.

Note

Replacement AN-95-A antennas must be 14 inches long (total length).

(3) INSTALLATION OF COCKPIT CONTROLS—SCR-695-A RADIO.

(See figure 329.)

(a) Install FT-345-A bracket.

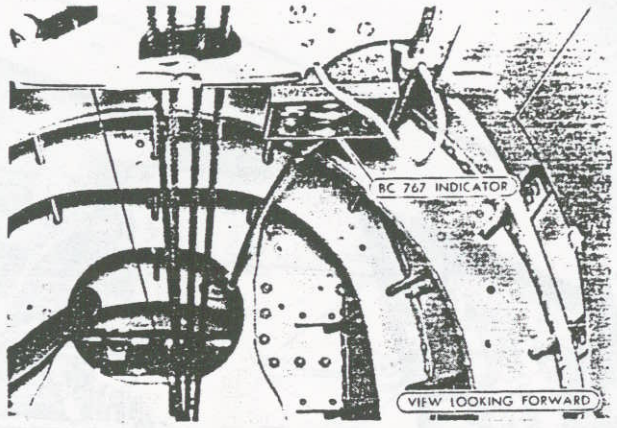


Figure 331 — SCR-695 Destructor Warning Light

(b) Attach RC-255-A control on bracket.

(c) Connect plugs.

(d) Install 20-ampere fuse in battery junction box.

(e) Install PL265 on unused male receptacle of RC255A control.

CAUTION

PL265 must be installed on unused receptacle at all times to prevent accidental grounding of exposed pins.

(4) DESTRUCTOR.

(a) ADJUSTMENT—INERTIA UNIT.

1. The inertia switch is reset by inserting a screwdriver in the inboard side of the switch housing and turning the slotted screwhead in a counterclockwise direction to the stop. Wait approximately five seconds and slowly release. The pendulum should then be centered.

2. Pressure of arm will hold pin in vertical position. (A horizontal force of six times force of gravity is required to trip trigger.) Switch is now set for service.

(b) INSTALLATION.

1. Be certain that destructor lights are "OFF."

WARNING

Lights "ON" indicate that the destructor switch has been tripped and must be reset. This must be done before destructor tray is inserted in set, otherwise a serious explosion will occur.

2. When lights are "OFF," slide destructor into set and connect plug.

22. ARMAMENT.

a. GENERAL. *(Reference Drawing 233878.)*—The armament compartment is located in the upper forward portion of the fuselage, extending forward from station 95 (figure 339). Mounted in the compartment are four .50-caliber, type M-2 machine guns (AAF Dwg. No. H39G5332), two on each side of the fuselage center line; and one type AN-M2 20-mm aircraft cannon (AAF Dwg. No. H41J9229), mounted on the fuselage center line below the machine guns (figure 338). Machine gun ammunition is contained in four drawer-type ammunition trays of 300 rounds normal (500 rounds maximum) capacity each, mounted under the feed openings of their respective guns (figure 348). Cannon ammunition is provided from a drawer-type tray of 150 rounds capacity mounted on the right-hand side of the compartment at station 75 (figures 348 and 353). Ammunition is fed to the machine guns through feed chutes fastened to the ammunition tray covers (figure 348). Expended links and cartridge cases are discharged through chutes leading to openings in the skin below the armament compartment (figure 351). Ammunition is fed into the cannon by means of an AN-M1 feed mechanism mounted on the cannon (figure 353). Expended cannon cartridges, cases, and links are discharged into a compartment between bulkheads at stations 75 and 87½ on the lower right-hand side of the fuselage. The machine gun barrels are equipped with close fitting sleeve assemblies to prevent air from blowing into the gun compartment. A blast tube "1" (figure 339) seals the cannon opening. The armament compartment hoods and channel may be detached by removing the pin (or bolt) at each end of the hood channel. A type AN-N-6 gun camera, AF Specification 31353, is installed in the left bomb shackle fairing (figure 354). Inside the cockpit enclosure an optical reflex gun sight, U. S. Army Specification 93-24659, is installed on the windshield just ahead of the pilot (figure 352). (On AF44-24309 and subsequent airplanes, the gunsight is mounted on a bracket attached to the windshield frame.) The machine guns and cannon are charged manually from the armament compartment while the airplane is on the ground. All the guns are fired simultaneously by means of an electrical trigger switch on the RH grip of the control wheel. A gun-sighting chart is fastened to the LH armament door, and machine gun tools are stowed on the armament compartment LH rear web.

b. MACHINE GUNS. *(See figure 339.)*

(1) DESCRIPTION.—The four .50-caliber machine guns are mounted on quick-release trunnion fittings, items "5" and "7," bolted to gun channels in the fuselage structure.

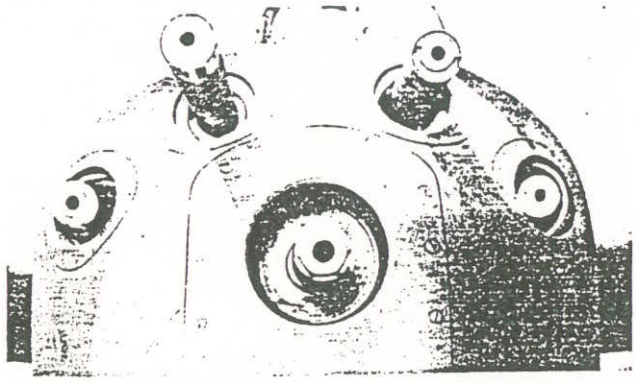


Figure 338 — Gun Installation, Front View

(2) OPERATION.

(a) LOADING.

1. Enter double-loop end of cartridge link belt into machine gun through feed opening until first cartridge is beyond belt-holding pawl.

2. Close cover, if open.

3. Using gun charger, pull bolt completely back and release, allowing bolt to return. See paragraph *d* (1) *(a)*, following, for operation of charger.

4. Repeat operation 3, to load gun completely. (Action and cover must be fully closed and extractor must grip cartridge in feedway.)

(b) UNLOADING.

1. Lift cover, and remove belt.

2. Retract bolt and make visual inspection of feedway, T-slot, and chamber to make certain that gun is unloaded.

3. Release bolt and lower cover.

4. Relieve tension on firing pin spring by pressing trigger button or sear mechanism.

(3) REMOVAL.

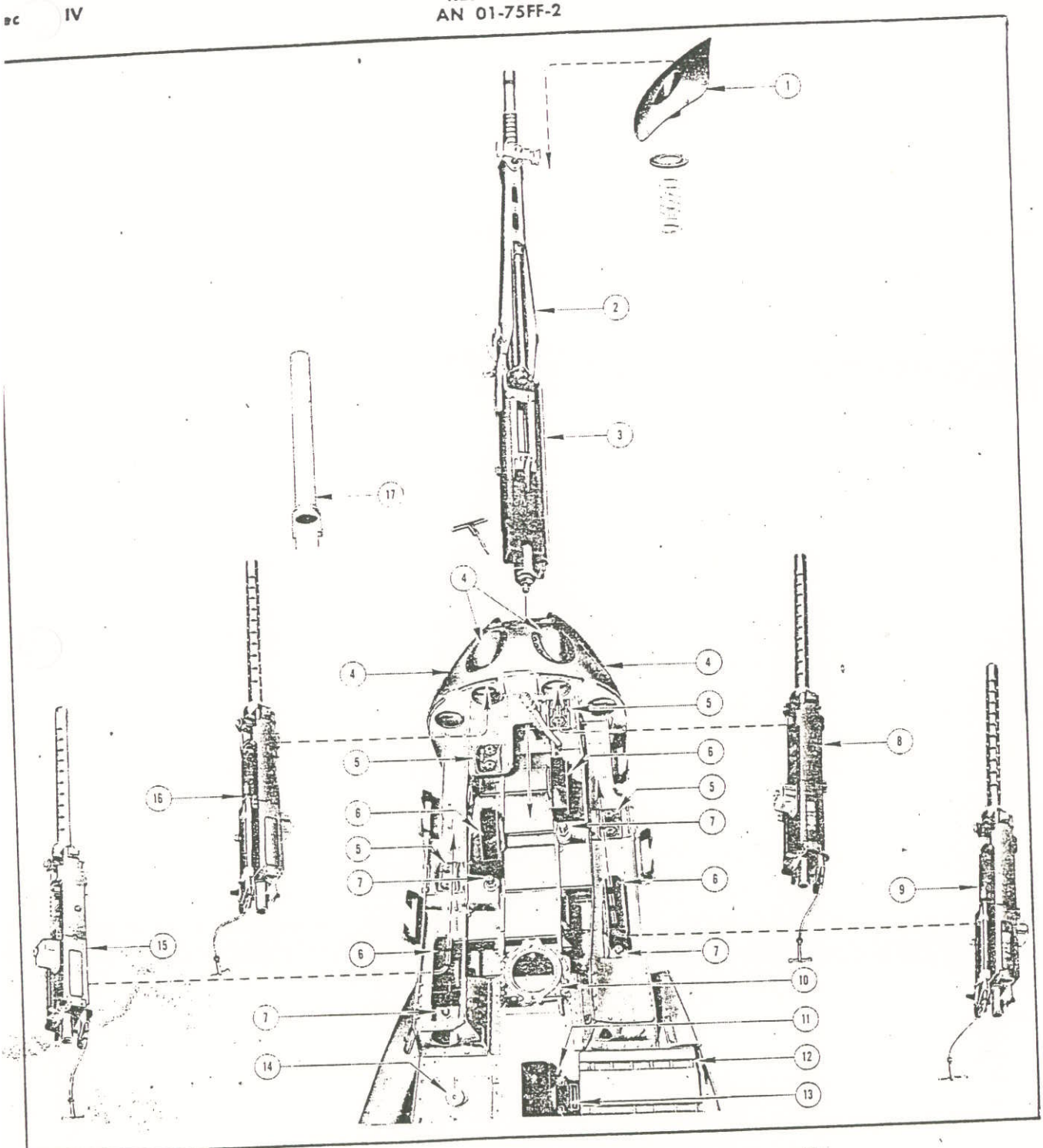
(a) MACHINE GUNS.

1. Disconnect electrical conduit from firing solenoid "6" (figure 340).

2. Release link ejection and ammunition feed chutes at spring-loaded couplings attaching them to gun, and swing chutes clear of gun. (See figure 340, items "2" and "5," and insert on figure 341.)

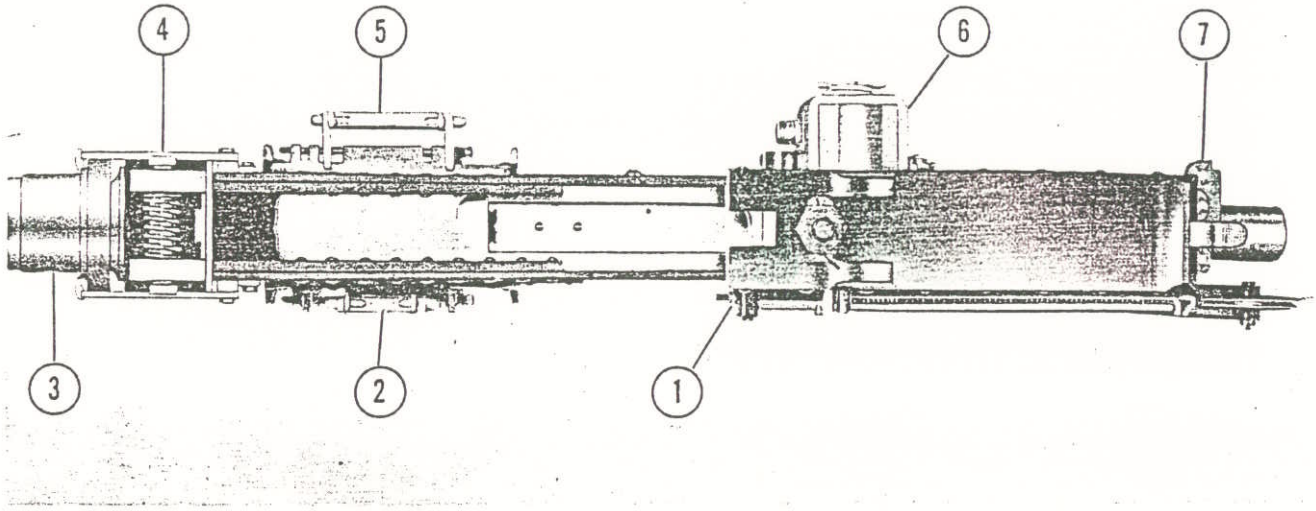
3. Fold and pull charger handle "4" or "5" through tube in pedestal (figure 355).

4. Release collar on rear mounting post by turning locking ring clockwise as far as possible. Raise gun



1. Cannon Blast Tube Assembly
2. Cannon Cradle Assembly
3. 20 MM Aircraft Cannon
4. Machine Gun Blast Tubes
   Machine Gun Front Trunnion Assembly
   Machine Gun Case Ejection Chute
7. Machine Gun Rear Mounting Post
8. .50 Cal. Machine Gun No. 1—Upper Right
9. .50 Cal. Machine Gun No. 3—Lower Right
10. Cannon Clamp Assembly
11. Cannon Case Ejection Chute
12. Cannon Ammunition Tray Pedestal Track
13. Cannon Link Ejection Chute
14. Cannon Ammunition Feed Chute Adjustment Post
15. .50 Cal. Machine Gun No. 4—Lower Left
16. .50 Cal. Machine Gun No. 2—Upper Left
17. Machine Gun Barrel Sleeve—All Machine Guns

Figure 339 — Armament Compartment



1. Charger Cable Adjusting Nut
2. Link Ejection Chute Attachment
3. Gun Barrel Jacket Sleeve
4. Front Trunnion Pin and Spring
5. Feed Chute Attachment
6. Machine Gun Solenoid
7. Back Plate Assembly

Figure 340 — Machine Gun Detail, Bottom View

slightly. (See figure 341, item "3.") On AF44-23871 and subsequent airplanes, a quick-release knob replaces the locking ring. Remove cotter pin and withdraw knob from post.

5. Withdraw spring-loaded pin in front mounting trunnion "4" (figure 340) about one-fourth inch. If necessary, pry out on head of pin with front trunnion tool No. 197420 (figure 342) which is provided in the armament tool bracket (figure 351). (In the absence of this tool, use a large screw driver.) Raise gun barrel to clear trunnion, then release pin.

6. Lift gun slightly off its mountings. If gun sticks, strike it sharply with the hand. Move gun aft until muzzle clears blast tube and lift out of airplane.

7. Remove trunnion pin and spring from gun by taking out cotter pin. (See figure 340, item "4.")

Note

If gun is to be left out of airplane, remove detachable parts of front trunnion and rear post from gun, and reinstall in airplane.

8. Remove barrel sleeve assembly by loosening bolts attaching straps to machine gun breech mechanism.

(b) BARREL.

1. Remove machine gun from airplane, being careful not to disturb rear post adjustment, as outlined in paragraph *b* (3) *(a)*, preceding.

2. Remove barrel sleeve assembly by loosening bolts attaching straps to machine gun, and sliding sleeve off barrel.

3. Release cover latch and open cover.

4. Release backplate latch lock and remove backplate.

5. Pull driving spring rod to left and out of receiver (breech mechanism housing).

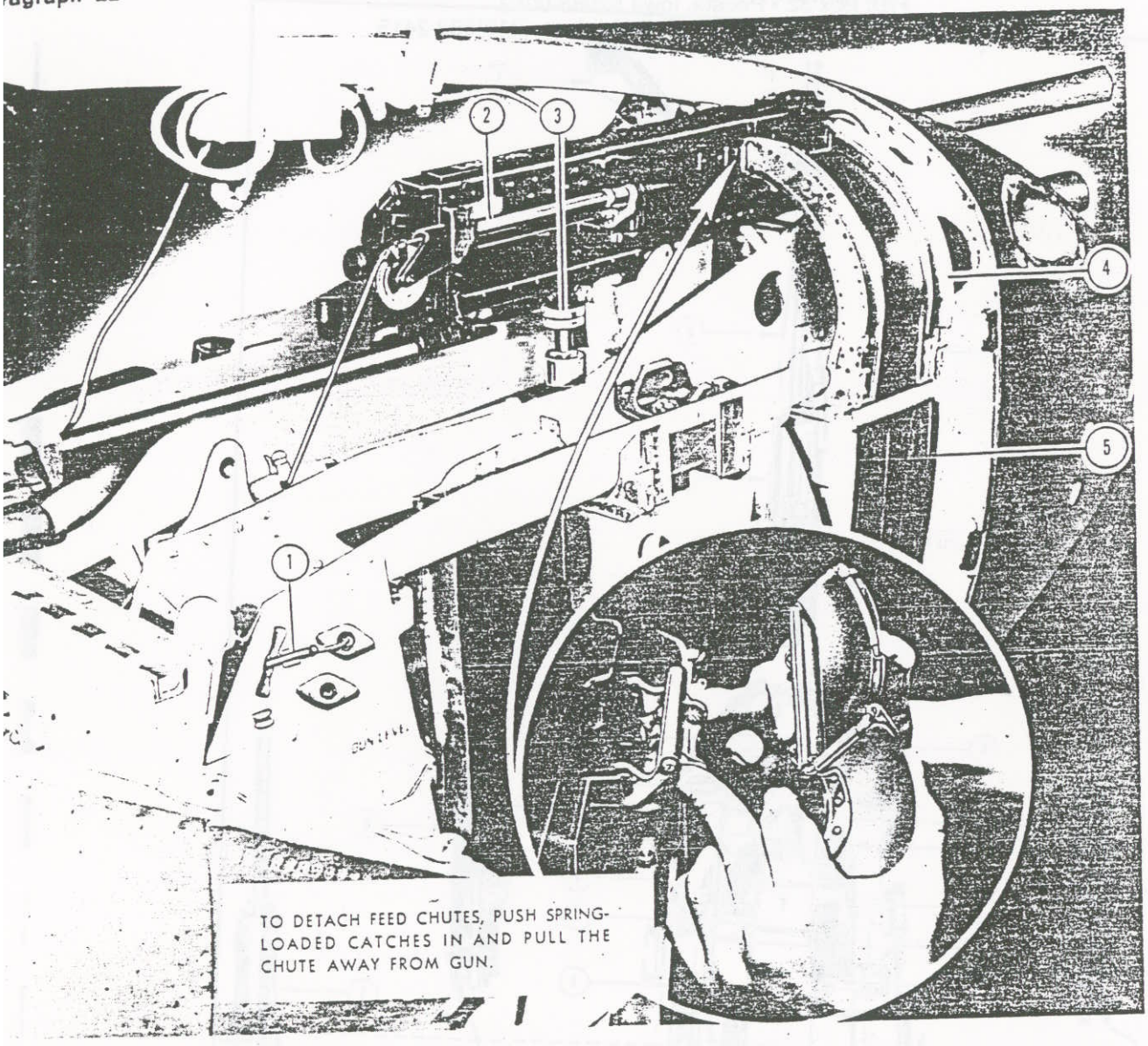
6. Remove bolt in extractor.

7. Insert punch through hole in RH side plate and compress spring lock.

8. Withdraw buffer body barrel extension and barrel from receiver. Remove buffer body from extension before completely withdrawing barrel.

9. Unscrew barrel from extension.

(4) REPLACEMENT.—When installing a replacement machine gun, remove the charging pin and replace with the longer pin No. 245047. (See figure 347, item "6.") This change will assure that the charger hook will fully engage pin.



1. Charger Cable Handle, Stowed
2. Machine Gun Charger Unit
3. Rear Mounting Post
4. Feed Chute
5. Ammunition Tray

Figure 341 — Machine Gun Installation

(5) ADJUSTMENT.

(a) Time each machine gun by adjusting solenoid nut until gun will just fire, then advance nut two notches from that point in same direction and safety wire in position. (See figure 350, item "3.")

(b) Align each machine gun at rear mounting post. For lateral adjustment, back off lock screw in horizontal adjusting screw. Turn horizontal adjusting screw in desired direction and reset lock screw.

For vertical adjustment see insert, figure 351. (Use special wrenches 193981 and 193982, stowed in armament compartment.)

(6) MAINTENANCE.

(a) If airplane is to be flown with guns installed but not to be fired, protect barrels with waterproof tubes or paper held in place by masking tape.

(b) After each mission in which guns have been fired, clean guns and place a patch of masking tape across muzzles to protect interior of barrels.

The machine gun barrel sleeves are provided with nose caps "7" (figure 343) which are recessed to permit installation of paper seals.

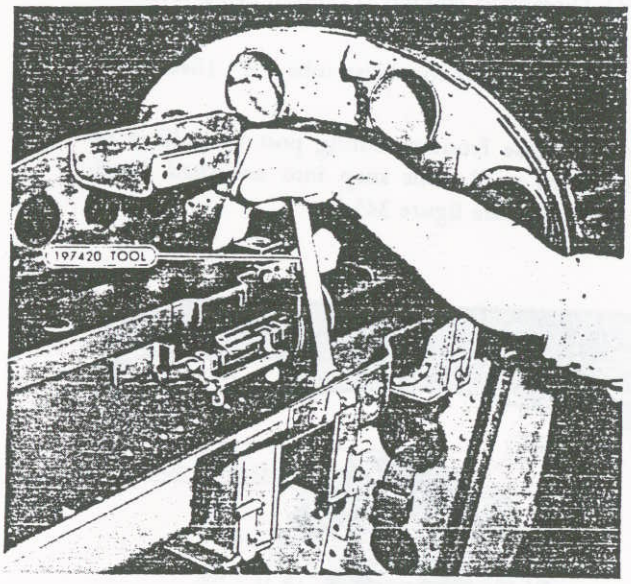


Figure 342 — Removal of Front Trunnion Pin

(7) INSTALLATION. — Reverse removal procedure.

CAUTION

When installing a gun, it is essential that both front trunnion adapter and rear collar be properly seated and locked. Failure to observe this precaution may cause gun to jump off mount during firing resulting in serious damage.

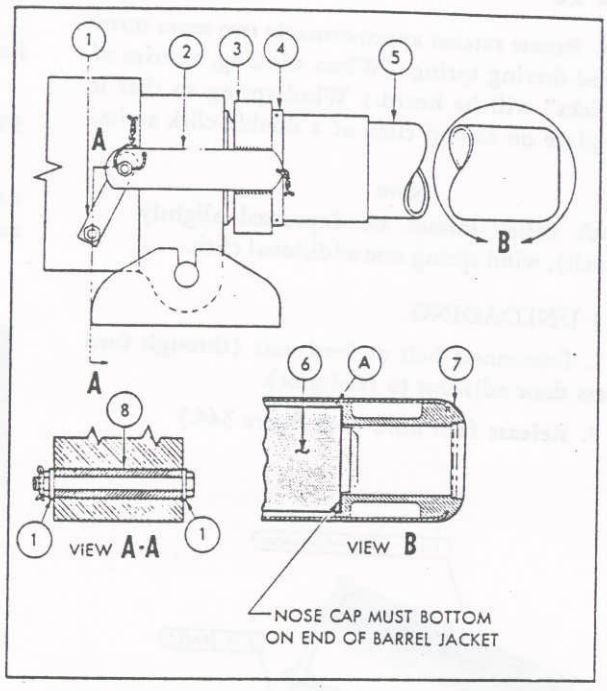
Slip sleeve over barrel jacket until shoulder in nose cap bottoms on front end of barrel jacket. Securely attach sleeve to machine gun.

Note

Sleeve cap must bottom. Check to make certain that narrow ledge "A" (figure 343) inside nose cap does not catch on end of barrel jacket. Sleeve can be adjusted by turning sleeve socket until cap bottoms. Safety wire sleeve to retaining ring.

c. CANNON. *(See figure 339.)*

(1) DESCRIPTION.—A 20-mm aircraft cannon is mounted on the airplane center line just below the two lower machine guns. A welded cradle assembly houses the cannon and mounts it to the fuselage structure, with an adjustable forward mounting post and a fixed rear pedestal.



1. Link
2. Retainer Ring Strap
3. Retainer Ring
4. Sleeve Socket
5. Sleeve Assembly
6. Machine Gun Jacket and Barrel
7. Sleeve Nose Cap
8. Bushing

Figure 343 — Installation of Machine Gun Barrel Sleeve

(2) OPERATION. *(See figure 353.)*

(a) LOADING.

1. Charge cannon. See paragraph *e* (2), following.

2. Install belt feed mechanism. See paragraph *g* (9) *(b)*, following.

3. Feed double-loop end of cartridge-link belt into feed chute (open side of links up at tray opening).

4. Rotate tensioning shaft of feed unit until one set of teeth on sprockets is aligned with belt guide. Push belt three or four rounds into sprocket teeth (by finger pressure applied through access door in feed chute adjacent to unit). See paragraph *g* (8) and (9), following, for operation of feed unit and adjustment of feed chute.

5. Rotate hexagon extension of tensioning ratchet with a wrench. (This draws belt into feed mechanism until a round is forced into place in cannon breech.)

WARNING

Gun is now loaded.

6. Rotate ratchet approximately two more turns to wind feed driving spring. (When winding, a series of double "clicks" will be heard.) Wind spring so that it is held in place on second click of a double click series.

Note

If rack roller cannot be depressed slightly (1/8 inch), wind spring one additional click.

(b) UNLOADING.

1. Disconnect belt at feed unit (through feed chute access door adjacent to feed unit).

2. Release feed unit. (See figure 344.)

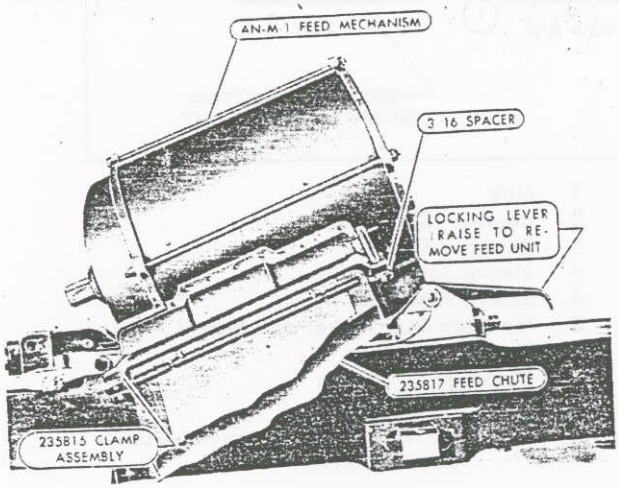


Figure 344 — Removal of Cannon Feed Mechanism

3. Empty mechanism by pushing cartridges from mouth of unit.

Note

To remove last round, open link chute cover and, with a screw driver, push lower end of front feed lever so that it rotates and last cartridge retainer is withdrawn.

(3) REMOVAL OF CANNON AND CRADLE.

(a) Disconnect cannon feed chute at quick-release coupling. (See figure 348.)

(b) Remove ammunition tray.

(c) Disconnect link ejection chute from feed mechanism at quick-release coupling "13" (figure 339).

(d) Raise locking lever and remove feed mechanism with feed chute. (See figure 344.)

(e) Remove handle of manual charger from stowage clip. (See figure 346.)

(f) Disconnect conduit at cannon firing solenoid. Remove solenoid.

(g) Remove cannon blast tube "1." (See figure 339.)

(h) Release front mounting post by pulling on unlocking cams until cams snap into unlocked (horizontal) position. (See figure 345.)

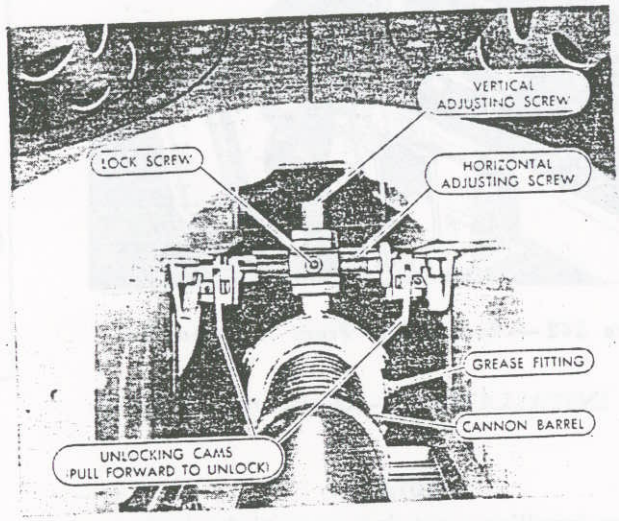
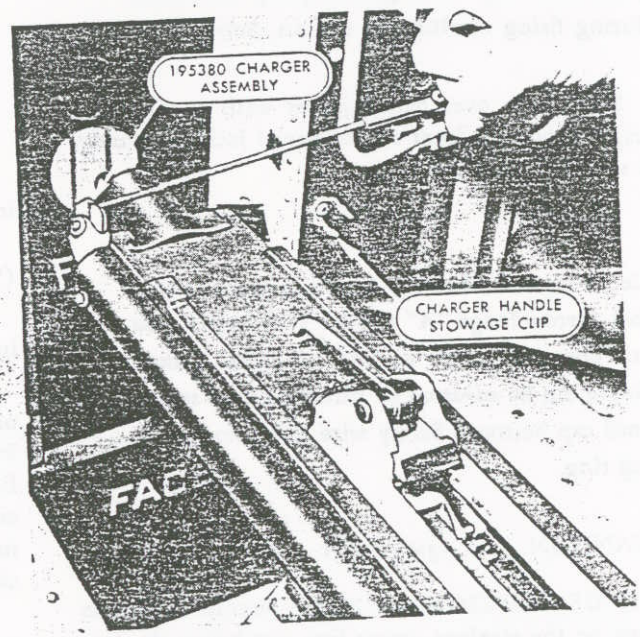


Figure 345 — Cannon Adjustment and Front Mounting Post



TO CHARGE: Pull charger handle up and out approximately 8 inches or until bolt engages trigger mechanism.

Figure 346 — Manual Cannon Charger

(i) Release clamp "10" on cannon pedestal. (See figure 339.)

(j) Move cannon forward, engage cradle wheels in tracks, and slide cannon and cradle assembly forward out of nose of airplane.

CAUTION

When sliding cannon out, be careful to prevent cannon from striking gun-supporting structure. Use a stand or support in removing the cannon as it weighs approximately 115 pounds.

(4) DISASSEMBLY.

Note

Cannon and cradle must be removed from the airplane.

(a) Remove lock nut, coil spring, and adjacent parts from muzzle-end of cannon.

(b) Disconnect tie rod "9" (figure 353), anchoring magazine carrier to cradle.

(c) Slide cannon aft out of cradle.

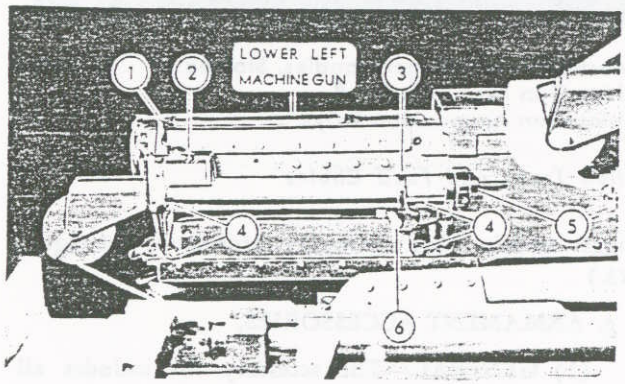
(5) ADJUSTMENT.

(a) Loosen pedestal clamp "10" (figure 339), allowing cannon and cradle to rotate freely.

(b) Remove cannon-blast tube from nose of fuselage.

(c) Bore sight cannon as outlined in paragraph *h*, following. Make adjustment at vertical and horizontal adjusting screws on front support as indicated on figure 345.

(d) Replace blast tube. Tighten pedestal clamp.



1. Charger Trigger
2. Trigger Lock
3. Outer Slide
4. Mounting Screws
5. Cable Adjustment Nut
6. Charging Pin

Figure 347 — Machine Gun Charger

d. MACHINE GUN CHARGING.

(1) DESCRIPTION.—The chargers are operated manually by means of handles in the armament compartment. Two handles are stowed on each outboard panel of the lower left and right machine gun pedestals. (See figure 355, items "4" and "5," and figure 348.) Each handle is connected by a cable to a gun charger mounted on the side of the gun. The chargers are mounted on the inboard sides of the guns to facilitate installation of electrical gun heaters.

(2) OPERATION. *(See figure 347.)*

(a) Remove charger handle from stowage clip and pull out until trigger "1" engages beveled shoulder on outer slide "3," thus holding machine gun bolt in rear position.

Note

Trigger lock "2" must always be pinned in forward (unlocked) position.

(b) Return handle to original position and replace in clip.

(c) Trip trigger lever "1" to release machine gun bolt.

(3) REMOVAL.

(a) Fold and pull handle through tube in machine gun pedestal.

(b) Remove four machine screws "4" (figure 347) attaching charger to gun.

(4) ADJUSTMENT.—Adjust the cable length at threaded cable terminal "5" (figure 347) to accommodate various gun positions.

e. CANNON CHARGING.

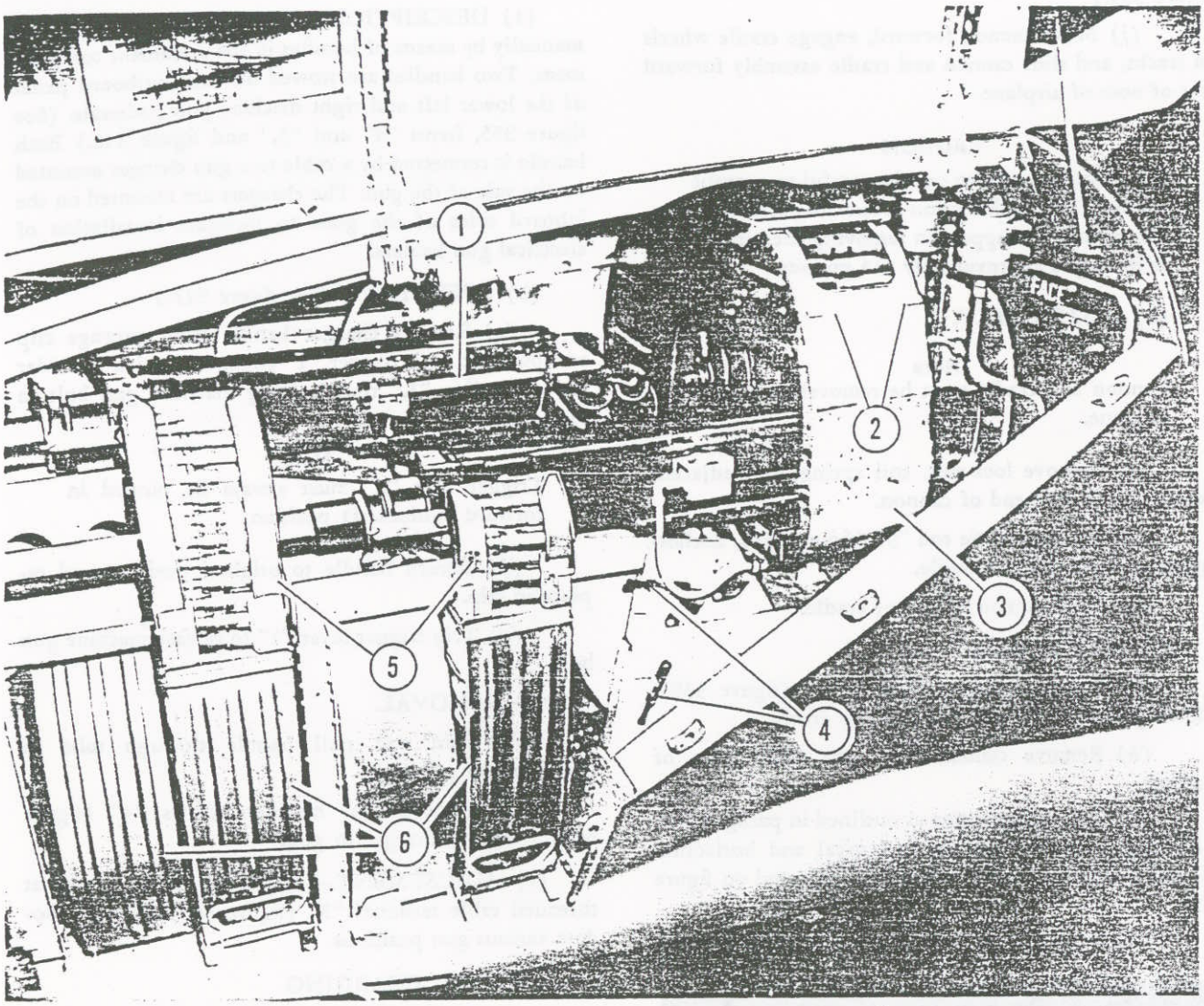
(1) DESCRIPTION. — A spring-type cannon charger is mounted on the lower RH side of the cannon and is operated manually from the armament compartment to charge the gun. The charger handle is stowed in a clip on the compartment fire wall at the left of the cannon. Charging is accomplished by pulling the charger handle to engage a piston in the charger with the cannon bolt. Further movement of the piston retracts the bolt to a point where it is caught and held by the trigger mechanism. The charger spring returns the piston and handle to their original positions.

(2) OPERATION. *(See figure 346.)*

(a) Remove charger handle from stowage clip.

(b) Pull handle up, out, and forward, about eight inches, until bolt engages trigger mechanism.

(c) Return handle to original position and replace in clip.



1. Machine Gun Charger
2. Quick Release Couplings
3. Cannon Feed Chute
4. LH Machine Gun Charger Handles, Stowed
5. Machine Gun Feed Chutes
6. Machine Gun Ammunition Trays

Figure 348 — Machine Gun Ammunition Trays and Feed Chutes

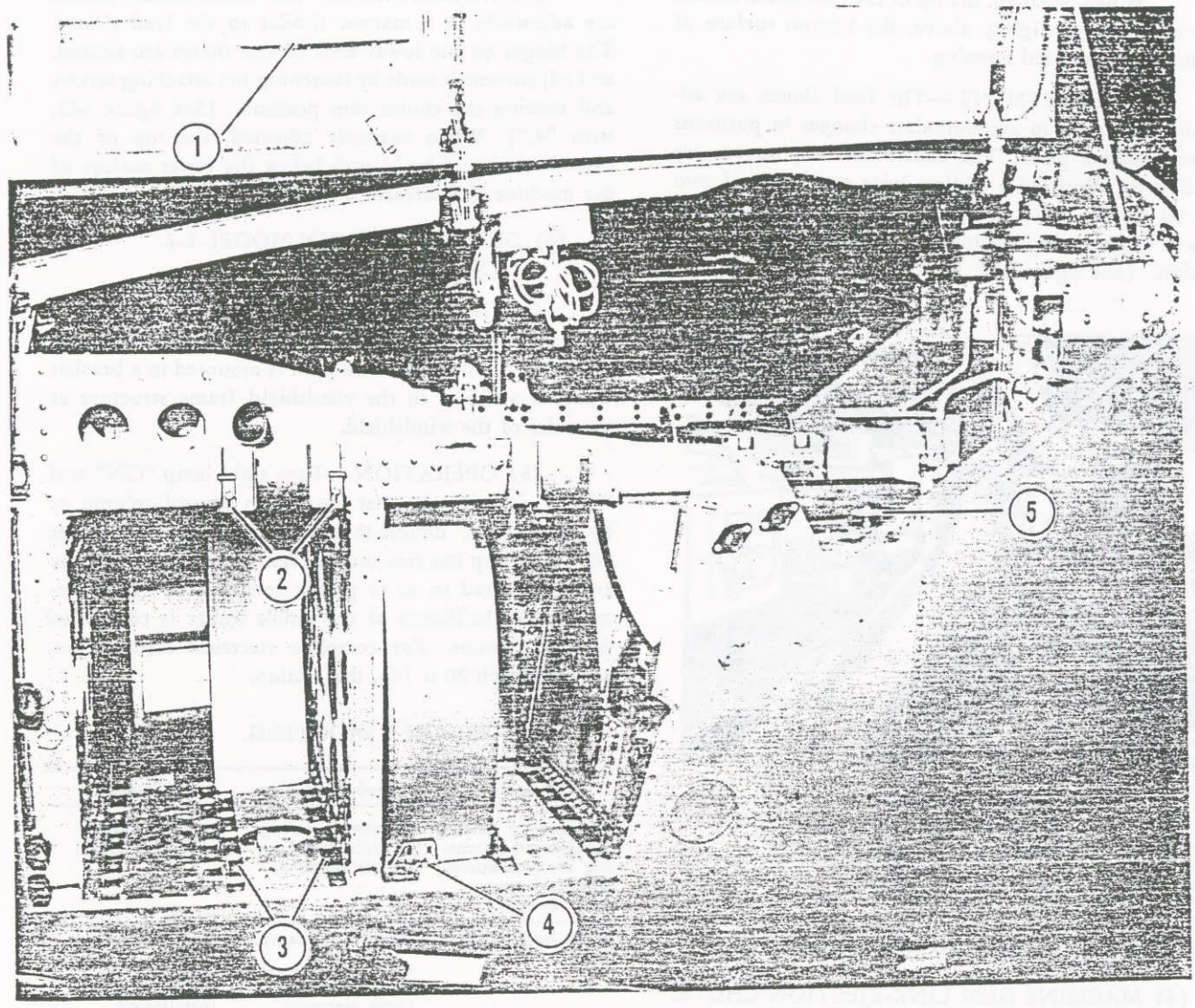
f. ARMAMENT FIRING CONTROL.—The firing control for machine guns, cannon, and camera, consists of a trigger switch on the right grip of the control wheel, a master armament switch on the control column junction box, a G-9 firing solenoid on the side of each machine gun receiver, and an AN-M2 firing solenoid on the under side of the cannon receiver.

The master armament switch has three positions: "OFF," "GUNS AND CAMERA," and "CAMERA." The guns can be fired only when the master switch is in the "GUNS AND CAMERA" position, but the gun camera may be operated in either the "GUNS AND CAMERA" or "CAMERA" position by pressing the trigger switch. (For additional information see figure 323.)

g. ARMAMENT ACCESSORIES.

(1) GENERAL.—The accessory list includes all equipment necessary to operate the guns and cannon. A gun camera and gun sight are included as part of the accessories.

(2) MACHINE GUN AMMUNITION TRAY. — *(See figure 348.)*—Four drawer-type ammunition trays of 300 rounds normal capacity (500 rounds maximum) each are carried beneath the machine guns. On some airplanes, a wooden filler is bolted in bottom of each



1. Gun Sighting Chart
2. Machine Gun Feed Chute Adjustment
3. Machine Gun Ammunition Tray Tracks
4. Machine Gun Case-ejection Chute Adjustment
5. Cannon Feed Chute Adjustment

Figure 349 — Armament Compartment, Left-Hand

tray, limiting the tray capacity to 300 rounds. The trays roll in guide tracks and are locked in place by engaging and turning handle pins in slotted openings at the outboard ends of the tracks. Ammunition loading procedure is indicated on the side of each tray. Each tray weighs 10 to 14 lb empty, 107 lb when loaded with 300 rounds, and 165 lb when loaded with 500 rounds. Covers are provided to close the tops of the trays and are bolted to the gun-supporting structure. The inverted ends of the tray covers are formed to guide the ammunition into the feed chutes.

CAUTION

When placing tray in airplane be sure top of tray fits properly inside tray cover.

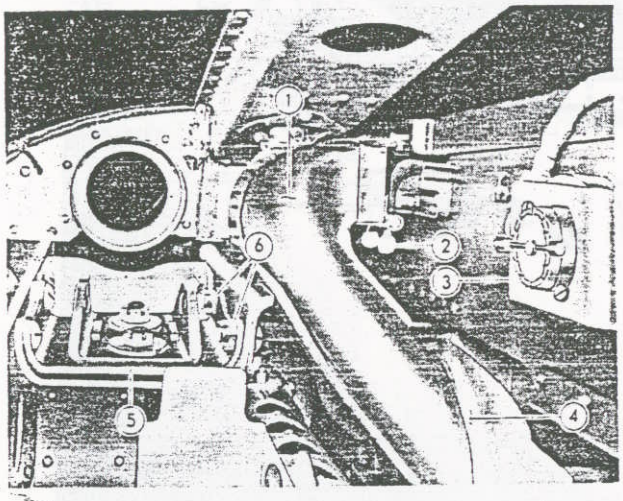
(3) MACHINE GUN AMMUNITION FEED CHUTES.

(See figure 341, item "4," and figure 348.)

(a) DESCRIPTION.—Ammunition feed chutes guide the ammunition from the tray to the machine gun feed openings. The feed chutes are mounted on pins bolted to the tray covers and are attached to the guns by means of spring-loaded quick-release couplings. (See insert, figure 341.)

When installed, the lip of the feed chute should be even with, or slightly above, the bottom surface of the machine-gun-feed opening.

(b) ADJUSTMENT.—The feed chutes are adjustable vertically to accommodate changes in positions of the machine guns. The chutes and tray covers are attached by means of a sliding joint consisting of two knurled fittings held in place by a bolt. Adjustment is made by loosening the joint and moving the tray into position. (See figure 349, item "2.")



1. Link-ejection Chute
2. Quick Release Couplings
3. Machine Gun Solenoid
4. Case-ejection Chute
5. Upper Left Front Trunnion

Figure 350 — Upper RH Link-ejection Chute

(4) MACHINE GUN LINK-EJECTION CHUTE. *(See figure 350.)*—Tubular link-ejection chutes are provided to guide the expended links into the case-ejection chutes. Each link-ejection chute "1" slides into oval-shaped openings on the inboard side of case-ejection chute "4" and attaches to the machine gun by a spring-loaded, quick-release coupling "2."

(5) MACHINE GUN CASE-EJECTION CHUTE.

(a) DESCRIPTION. *(See figures 339 and 351.)* —A case-ejection chute extends downward from each machine-gun breach leading to an opening in the fuselage skin below the armament compartment, permitting expended cartridge cases and links to be discharged overboard. The upper portions of the case-ejection chutes are quickly removable, being fastened by sliding clips at the top and hinges at the bottom. The hinge pins are removable by hand to provide for removal of the chutes from the airplane; however, the machine guns must be removed first.

(b) ADJUSTMENT.—The case-ejection chutes are adjustable in a manner similar to the feed chutes. The hinges on the lower ends of the chutes are slotted, and adjustment is made by loosening the attaching screws and moving the chutes into position. (See figure 349, item "4.") When correctly adjusted, the top of the case chute should be 1/8 inch below the lower surface of the machine gun breach.

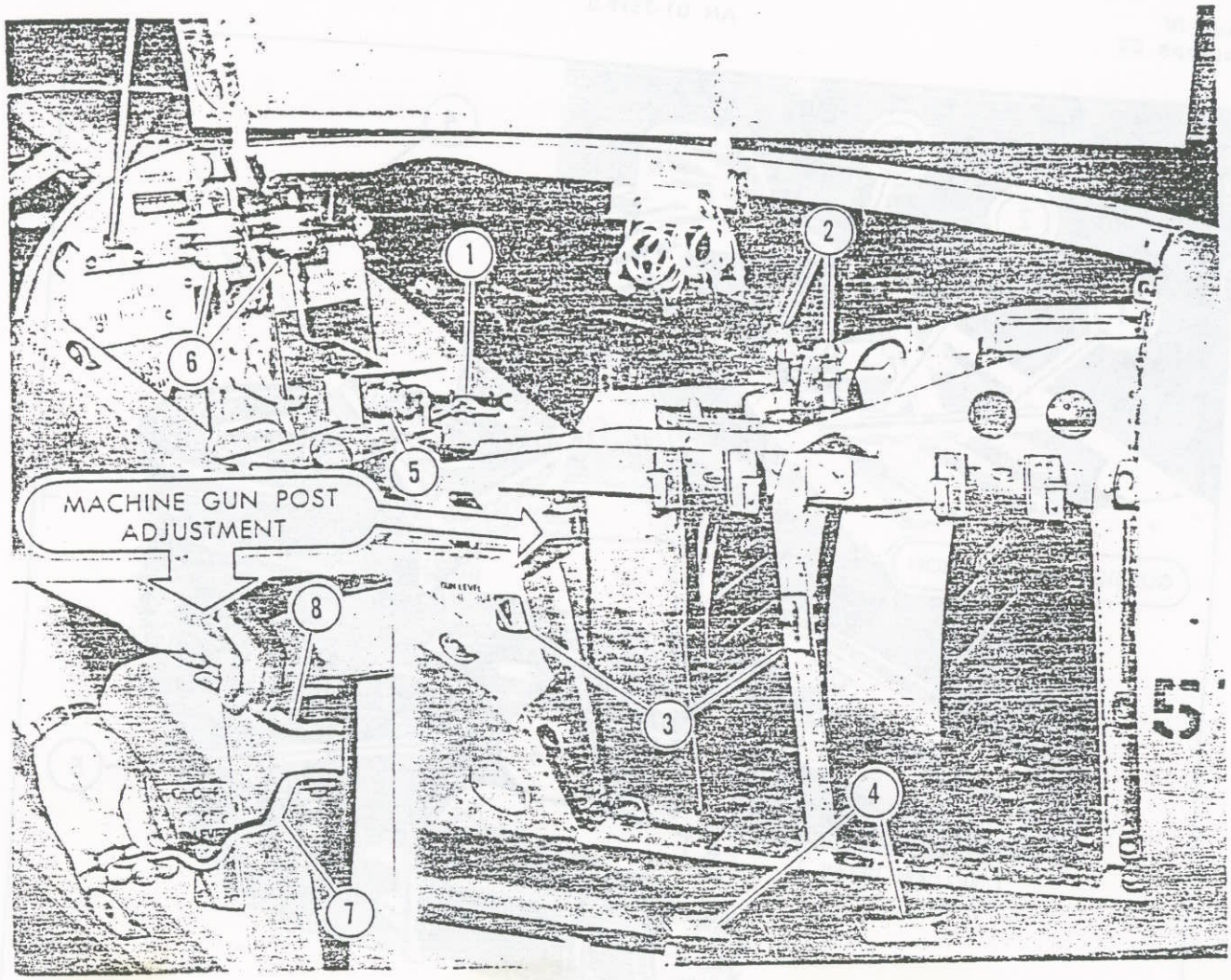
(6) GUNSIGHT—LYNN MODEL L-3. *(See figure 352.)*

(a) DESCRIPTION.—The Lynn gunsight is a compact optical reflex sight having an integral reflector glass set at 45 degrees. The sight is mounted to a bracket which is attached to the windshield frame structure at the sides of the windshield.

(b) OPERATION.—Turn sight lamp "ON" and "OFF" either by rheostat control on control column or by single-pole, double-throw switch on lamp holder "6." The lamp has two independent filmaments, and the switch is wired so as to permit selection of either filament. The brilliance of the reticle image is controlled by the rheostat. For complete electrical information, see paragraph 20 *w* (4), this section.

(c) TROUBLE SHOOTING.

Trouble	*Probable Cause*	*Remedy*
Fogging of lenses. (Moisture condensing on lens assembly inside gun sight body.)	Hermetic sealing of sight body no longer effective.	Replace and realign gun sight.
Sight lamp inoperative.	Burned out lamp.	Replace lamp.
	Electrical short, loose electrical connection, faulty switches, or faulty rheostat.	Check electrical installation.
	Bonding link (ground) not installed.	Install link.
Excessive parallax.	Improper adjustment of the main lens assembly.	Replace and realign gun sight.
Gun sight out of alignment.	Improper alignment.	Realign gun sight as directed in paragraph *h*, following.
	Azimuth adjustment screws not seated.	Realign gun sight. Check that screws are firmly seated.
	Elevation adjustment knob rotated from bore sight setting.	Reset knob to original alignment as indicated by the deviation dial.
	Mounting bracket shifted as a result of using sight as a handhold.	Realign gun sight.



1. Machine Gun Adjusting Tools, Stowed
2. Machine Gun Rear Adjustment Posts
3. Gun Leveling Lugs
4. Ejection Chute Openings
5. Brake Master Cylinder (Ref.)
6. Brake Fluid Reservoirs (Ref.)
7. Wrench, 193981
8. Wrench, 193982

Figure 351 — Armament Compartment, Right-Hand

Trouble	*Probable Cause*	*Remedy*
	Mounting bracket loose.	Tighten bracket. Realign gun sight.
	End play in shaft of elevation adjustment knob.	Loosen set screw in end of shaft, shorten shaft slightly and retighten set screw. Realign gun sight.
Elevation adjustment knob inoperative.	Excessive adjustment in one direction.	Replace and realign gun sight.

(d) REMOVAL.

1. Disconnect electrical plug "7" at gunsight.

2. Remove four machine screws holding sight to mounting bracket.

3. If necessary to remove bracket from windshield, remove bolts attaching structure to windshield frame.

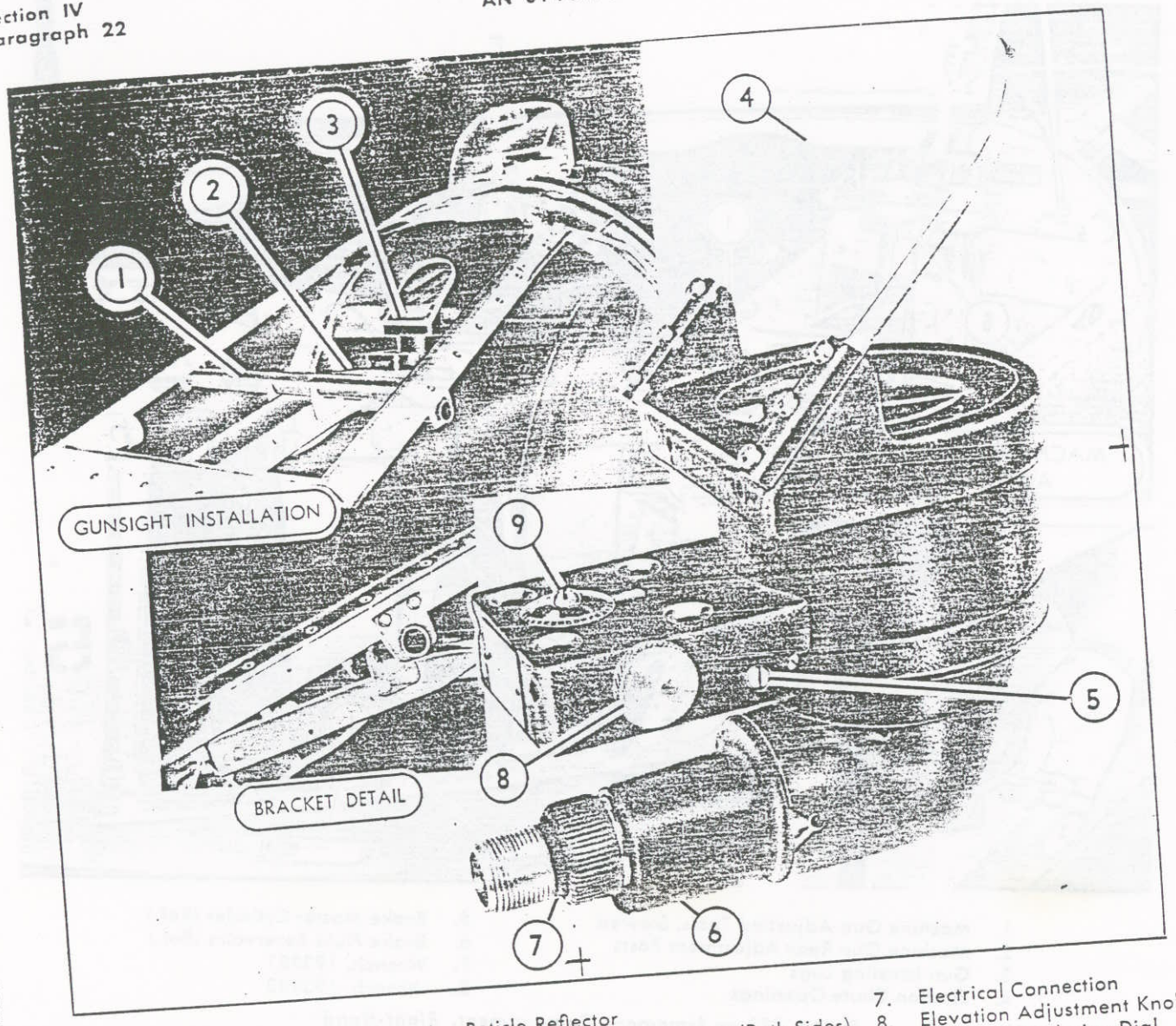
CAUTION

Do not pull on bracket or use gunsight as a handhold.

(e) REPLACEMENT.—In order to replace the No. 844 Mazda lamp (type G-9, 28-V, 21-21, Cp. double-contact base), pull out spring-loaded lamp holder "6."

Note

A clip is provided on gunsight bracket to hold a spare lamp in readiness for installation by pilot. On AF44-24309 and subsequent airplanes, two additional bulbs are stowed on LH side of windshield cockpit web.



1. Windshield Mounting Bracket
2. Gunsight Bracket
3. Lynn Gunsight
4. Reticle Reflector
5. Azimuth Adjustment Screw (Both Sides)
6. Gunsight Light Housing
7. Electrical Connection
8. Elevation Adjustment Knob
9. Elevation Deviation Dial

Figure 352 — Lynn Gunsight

(*f*) ADJUSTMENT. — Adjust the gunsight so that the line of sight (from the pilot's eye) is parallel to the line of flight at the desired indicated air speed. (See paragraph *h*, following.)

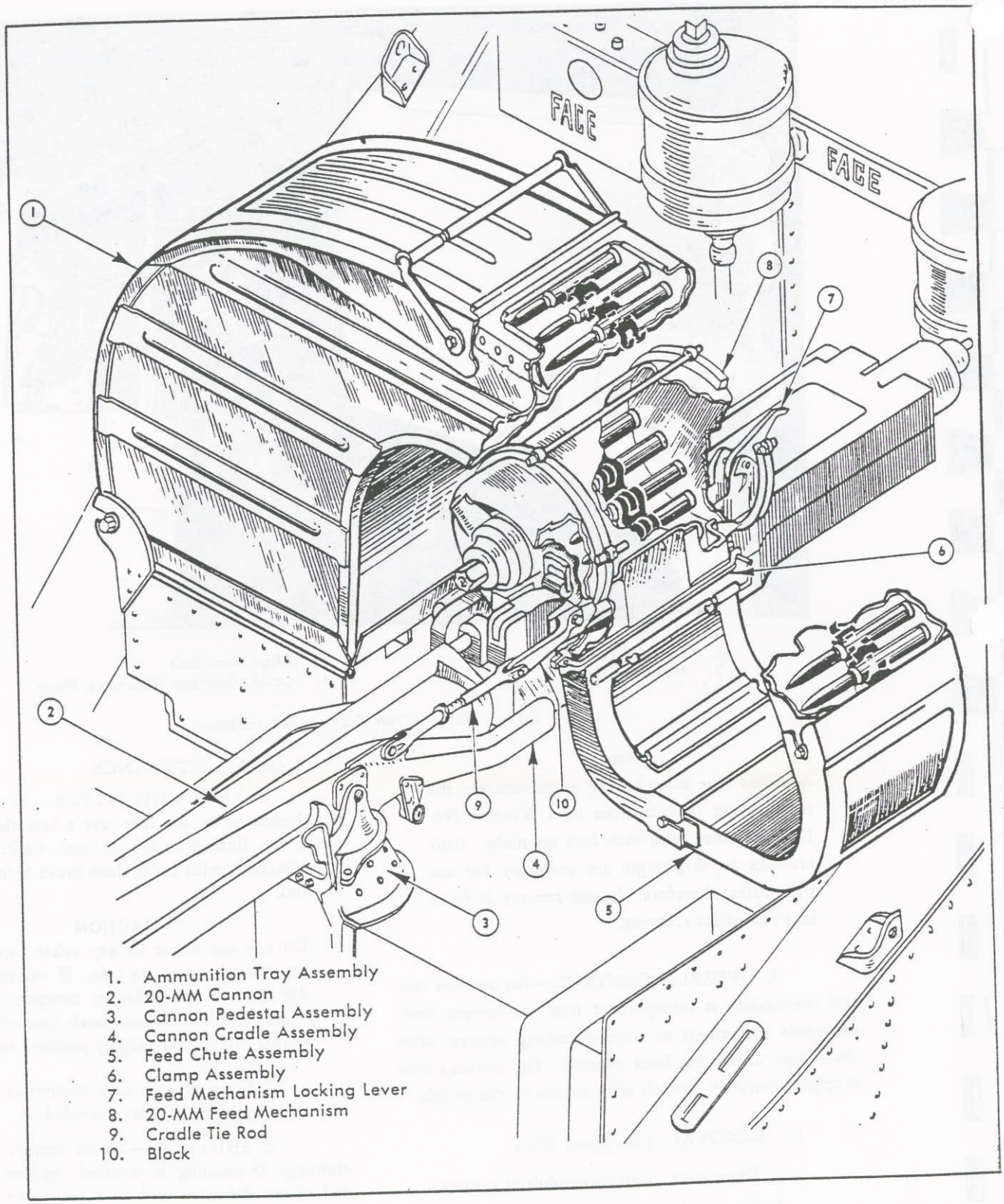
1. Make vertical adjustment of sight reticle by means of knob "8" on left side of gunsight base. Turn knob clockwise to raise reticle image. (One turn of knob (4 clicks) is equivalent to one-mil movement of sight line. If knob is locked, loosen setscrew in opposite end of shaft, unscrew shaft slightly and retighten setscrew.)

Note

The dial "9" indicates in mils any deviation of the elevation adjustment knob from its original alignment. When gunsight is realigned, loosen screw holding dial and reset dial to zero.

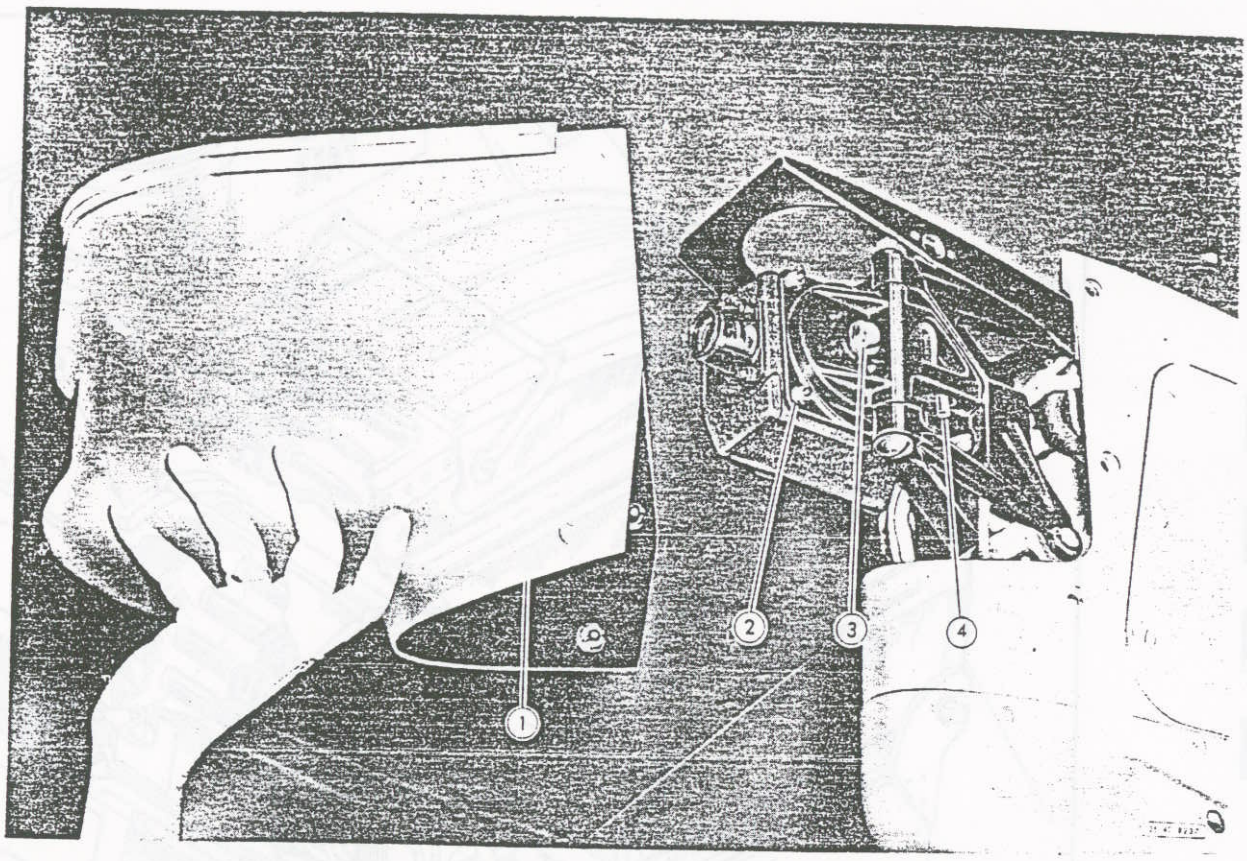
2. Make lateral adjustment of reticle by means of azimuth adjusting screws "5," one on each side of gunsight base. Loosen setscrew on side toward which sight is to be turned and then tighten opposite screw.

(7) CANNON AMMUNITION TRAY AND LOADING. (*See figure 353, item "1."*)—An ammunition tray of 150 rounds capacity is mounted on rollers in tracks on the right-hand side of the cannon. The tray is similar to the .50-caliber ammunition trays and is removed and installed in the same manner. The tray weighs 36 lb empty and 128 lb loaded with 150 rounds.



1. Ammunition Tray Assembly
2. 20-MM Cannon
3. Cannon Pedestal Assembly
4. Cannon Cradle Assembly
5. Feed Chute Assembly
6. Clamp Assembly
7. Feed Mechanism Locking Lever
8. 20-MM Feed Mechanism
9. Cradle Tie Rod
10. Block

Figure 353 — Cannon Feed System



1. Camera Fairing
2. Mounting Studs
3. Alignment Bolt
4. Catch, Camera Mounting Plate

Figure 354 — Gun Camera Installation

Note

A minus blue filter having approximately the transmission characteristics of a Wratten No. 12 is provided with each lens assembly. Calibrations on diaphragm are corrected for use with filter, therefore, do not remove it from lens except for cleaning.

3. OVERRUN CONTROL.—An overrun control mechanism is incorporated into the camera body to permit the camera to continue taking pictures after the trigger switch has been released. The overrun time is approximately 5 seconds after release of the switch.

(c) REMOVAL. *(See figure 354.)*

1. Disconnect electrical conduit at camera.

2. Remove four nuts "2" from camera mounting studs.

3. Remove camera.

(d) MAINTENANCE.

1. LENS AND FILTER.—To clean two exposed surfaces of the lens, use a lens tissue, or a soft, clean, dry, lintless cotton or linen cloth. Dust off any gritty particles with a soft clean brush before using paper or cloth.

CAUTION

Do not use water or any other liquid under any circumstances on lens. If rubbing with a dry cloth is not sufficient, dampen surface by breathing on it. Never touch lens with fingers as this will corrode highly polished surfaces.

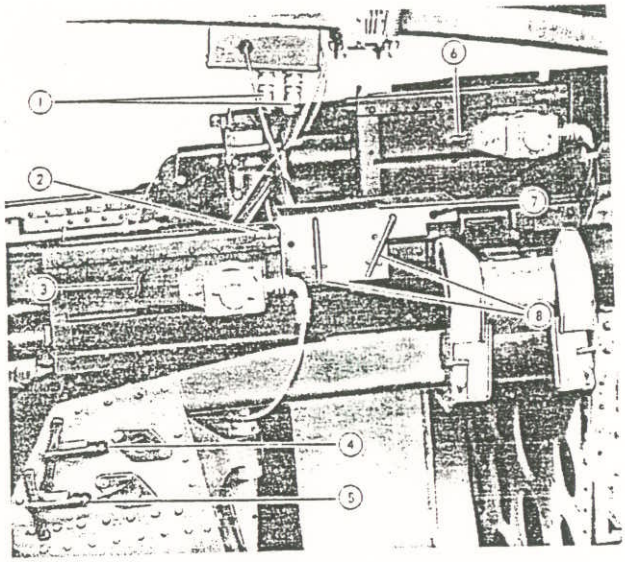
Clean filter in same manner as lens, and store only in a dry place in cases provided.

2. SHUTTER. — Never remove a shutter for cleaning. If cleaning is required, replace entire camera and return defective unit to a sub-depot for overhaul.

(e) ADJUSTMENT.—The camera mount is adjustable when the bolt "3" (figure 354), controlling the modified ball and socket, is loosened.

Note

It will be necessary to realign gun camera whenever gunsight is synchronized to a new gunsighting, or if camera becomes loose in mount. (Refer to paragraph *b* (3), following, for alignment procedure.



1. Disconnect Plugs—Gun Heaters
2. Machine Gun Cover (Ref.)
3. Lower Right Machine Gun
4. Charger Handle—Upper Right Machine Gun
5. Charger Handle—Lower Right Machine Gun
6. Upper Right Machine Gun
7. Electric Gun Heater
8. Heater Clamps

Figure 355 — Electric Gun Heater

(13) GUN HEATERS. *(See figure 355.)*

(a) DESCRIPTION.—The heaters are 24-volt d-c, 100- to 108-watt two-wire units. The machine gun heaters, H and A Manufacturing Co. Part No. 50GRS-L4S and -RS (or equivalent), are mounted on the top and outboard sides of the machine gun receivers. Two levers "8" clamp heater "7" to machine gun cover plate "2." The cannon heater, H and A Manufacturing Co. Part No. 20C5S (or equivalent), is clamped in a similar manner to the top and left side of the cannon receiver just behind the feed unit.

The control switch is on the main switch box in the cockpit.

(b) REMOVAL. *(See figure 355.)*

1. Disconnect electrical plugs "1" at junction box.

2. Raise gun cover "2."

3. Swing clamps "8" 90 degrees from locked position and remove heater unit.

(c) MAINTENANCE.—As a means of protecting the gun heater wires from excessive heat if they contact the heater units, wrap contacting portion of cord with "fiber-glass" tape and secure with brass safety wire.

b. ARMAMENT BORE SIGHTING.

(1) GENERAL. — The gunsight, machine guns, cannon, and camera are adjusted in accordance with the gunsighting chart which is fastened to the under side of the armament compartment hood.

Three sets of leveling data points are provided in the airplane. Two fixed sets of plates are mounted in the cockpit on the upper fuselage channels: Longitudinal reference line leveling plates parallel to fuselage (figure 359), lateral leveling plates are parallel to lateral axis of airplane (figure 358). The third set of gun leveling lugs, which are adjustable (figure 360), are mounted in the armament compartment on the RH vertical web and are set at an angle of 0° 14′ to the fuselage reference line. To compensate for slight differences existing between various airplanes, the gun leveling lugs of each airplane are set individually.

Alignment screws, for attachment of plumb bobs, are located 3⅞ inches to the left of the airplane center line, one on the fuselage nose section at station 25 3/16 and one on the leading edge of the horizontal stabilizer, each identified by a red circle. The gunsight is first adjusted at a predetermined speed, in order that the sight line will be parallel to the line of flight, then the machine guns are adjusted at their rear mounting posts, and the cannon at its first front mounting post, so that their line of fire intersects the sight line at the desired range. For the method of adjusting gunsight, machine guns, cannon, and camera, see their respective paragraphs.

Figure 363 shows the angle of attack of the thrust line of the airplane with respect to the indicated air speed for various loading conditions and accelerations.

(2) GUN SIGHTING CHART. *(See figure 356.)* —The gun sighting chart shows the angle between the flight line of the airplane at various indicated air speeds and the line established by the leveling data. (Loading —Full useful load less one-half fuel load at a positive acceleration of one *g*.)

The solid vertical line, which is the datum point for the horizontal axis of the chart, indicates the setting of the gun leveling lugs, located in the armament compartment.

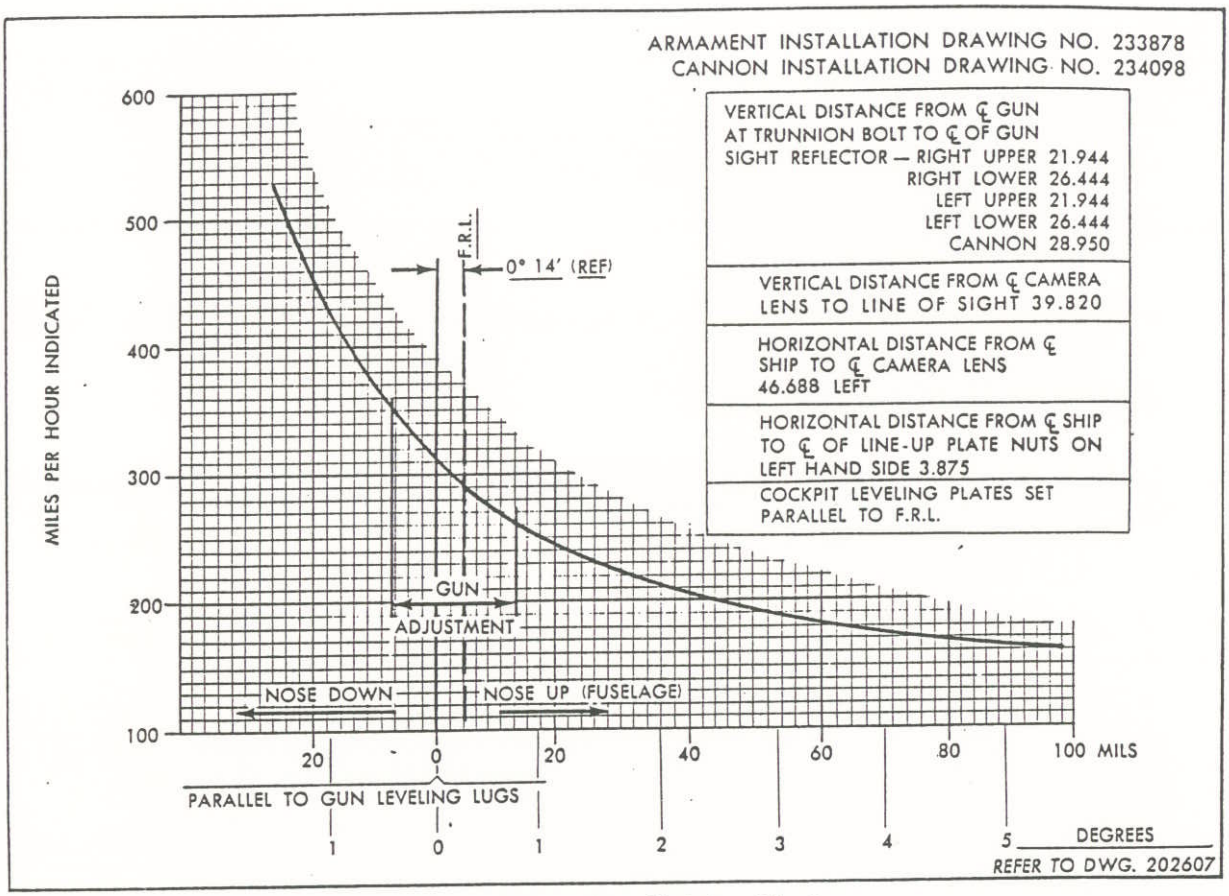


Figure 356 — Gun Sighting Chart

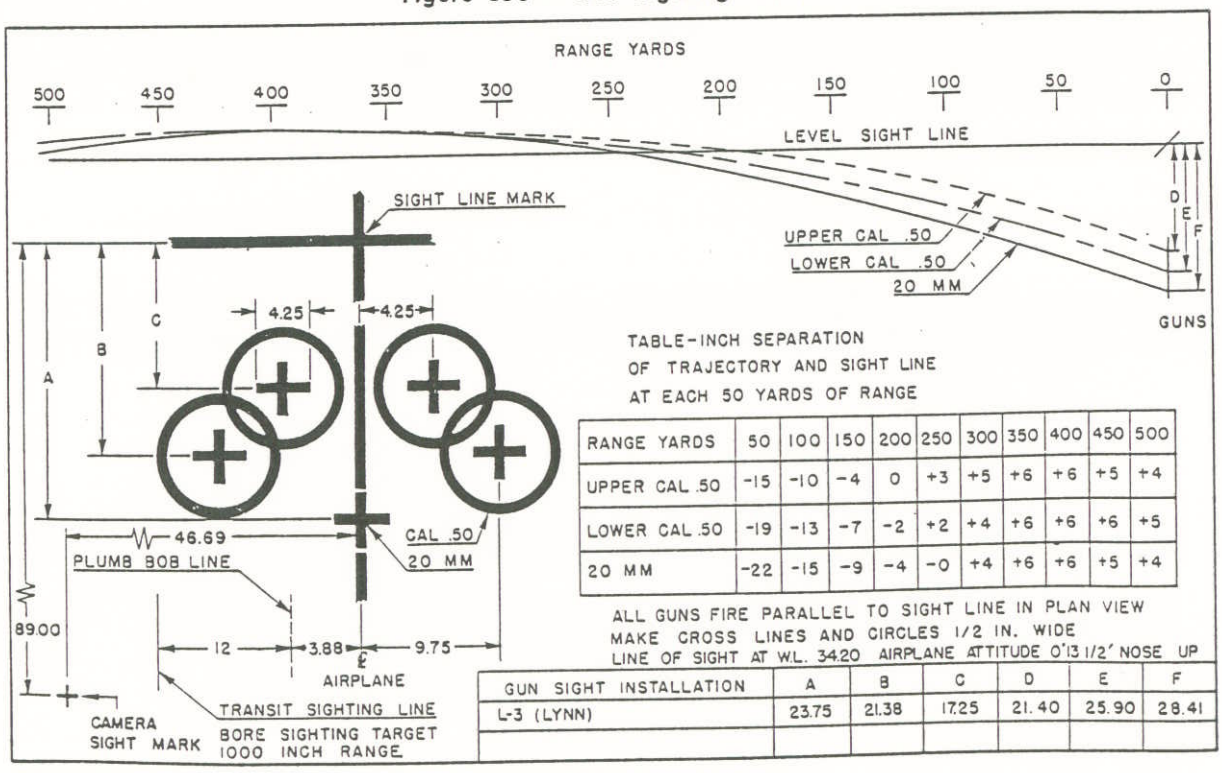


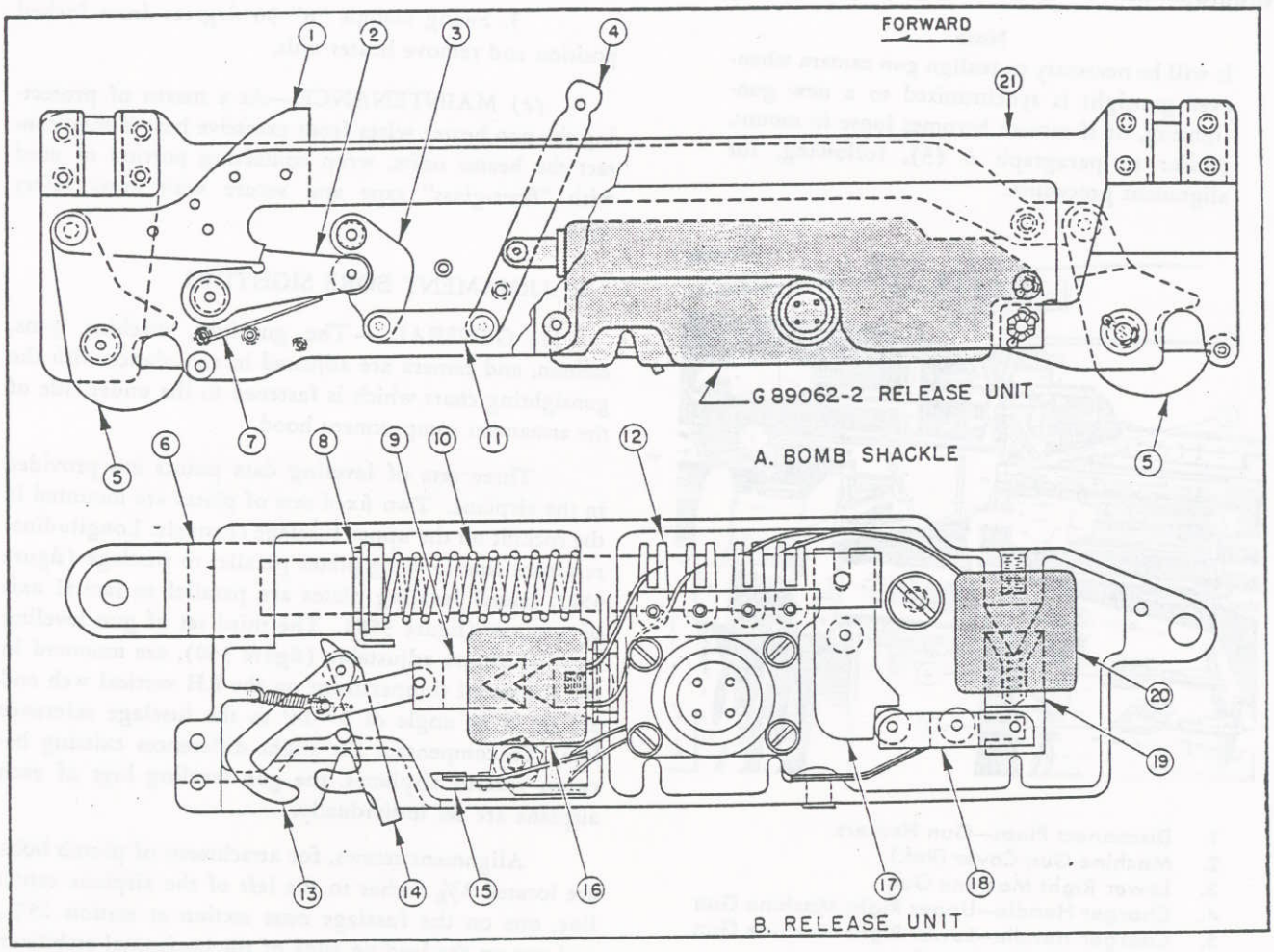
TABLE-INCH SEPARATION OF TRAJECTORY AND SIGHT LINE AT EACH 50 YARDS OF RANGE

RANGE YARDS	50	100	150	200	250	300	350	400	450	500
UPPER CAL .50	-15	-10	-4	0	+3	+5	+6	+6	+5	+4
LOWER CAL .50	-19	-13	-7	-2	+2	+4	+6	+6	+6	+5
20 MM	-22	-15	-9	-4	-0	+4	+6	+6	+5	+4

ALL GUNS FIRE PARALLEL TO SIGHT LINE IN PLAN VIEW
MAKE CROSS LINES AND CIRCLES 1/2 IN. WIDE
LINE OF SIGHT AT W.L. 34.20 AIRPLANE ATTITUDE 0°13 1/2' NOSE UP

GUN SIGHT INSTALLATION	A	B	C	D	E	F
L-3 (LYNN)	23.75	21.38	17.25	21.40	25.90	28.41

Figure 357 — Bore Sighting Chart



OPERATION

LOADING:

CAUTION—Test electrical "RELEASE," "ARM" and "SAFE" circuits for proper operation before loading. (See figure 322.)

1. To cock release unit move link "1" forward and then move cocking arm "4" to extreme aft position.
2. To open hooks move cocking arm "4" forward and at same time move link "1" aft which will force stop "2" down. Return cocking arm "4" aft to hold stop "2" down, allowing free movement of hooks "5" by operating link "1."
3. Place bomb (or tank) in position. Move link "1" to extreme forward position to engage hooks "5" in bomb (or tank) supporting lugs. Move cocking arm "4" forward to allow stop "2" to engage link "1." Return cocking arm "4" aft.

NOTE—When loading bomb move safety hook "14" to rear to open arming ring and release hook "14" to engage ring.

RELEASING:

1. When arming switch in cockpit is in either "SAFE" or "ARM" position, pushing electrical release button in cockpit energizes solenoid "20" moving lever "18" from lever "17." Spring "10" forces plunger "6" forward moving cocking arm "4" forward. This arm, by means of clevis "11," pulls hook "3" to rear, unlocking link "1." The weight of the bomb (or tank) moves hooks "5" forward releasing bomb (or tank).
2. As plunger "6" moves forward, the lip on washer "8" pushes safety hook "14" to the rear opening switch "15." Opening switch "15" de-energizes the arming and release solenoids and turns off the amber light in cockpit indicating that the bomb (or tank) has been released.

ARMING (Bomb Only):

1. To release armed—place arming switch in cockpit on "ARM" (red arming light glows). This energizes solenoid "16" moving plunger "9," pulling hook "13" directly under safety hook "14." When bomb is released, hook "13" pulls arming wire from bomb.
2. To release safe—place arming switch on "SAFE" (green safe light glows). This indicates bomb is dropped safe since hook "13" stays in forward position.

1. Link Assembly
2. Stop Assembly
3. Hook
4. Cocking Arm
5. Hook
6. Plunger Assembly
7. Spring
8. Washer
9. Plunger Assembly
10. Spring
11. Clevis
12. Connector Assembly
13. Hook
14. Hook
15. Switch Assembly
16. Solenoid
17. Lever
18. Lever Assembly
19. Plunger
20. Solenoid
21. Case Assembly

Figure 364 — Bomb Shackle Assembly and Operation

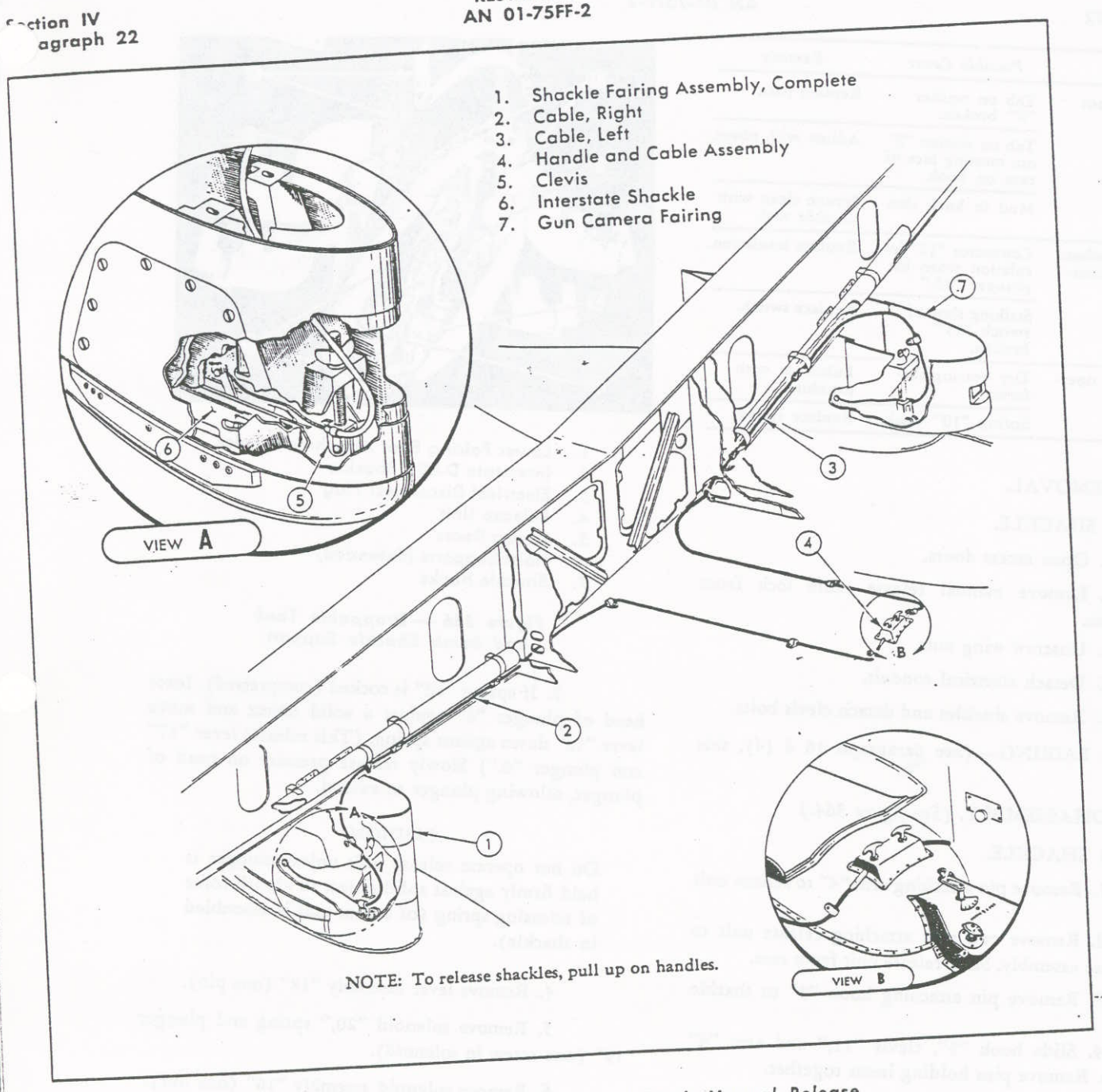


Figure 365 — Droppable Tank and Bomb Manual Release

e. Set target over other stake and, compensating for difference of elevation between two stakes, adjust target height so that its horizontal sight-line mark is at same elevation as reticle image on gunsight reflector.

f. Adjust gunsight reticle to coincide with target horizontal sight-line mark.

(b) Align machine guns, cannon, and camera.

1. Use proper sighting telescopes, bore sight guns and make adjustments so that they line up with their respective sight-line marks on target. If telescopes are not available, machine guns and cannon can be bore sighted by sighting through barrels after removing backplate group and bolt mechanism.

Note

Before adjusting guns, disconnect ammunition feed chutes because changed gun positions necessitate readjustment of these attachments.

Trouble	*Possible Cause*	*Remedy*
Safety hook not operating.	Tab on washer "8" broken.	Replace part.
	Tab on washer "8" not meeting face of cam on hook.	Adjust with pliers.
	Mud in hook slot.	Scrape clean with suitable tool.
Short circuit when release unit operating.	Connector "12" insulation worn by plunger "19."	Replace insulation.
	Striking shoe of switch "15" broken.	Replace switch.
Release unit operates slowly.	Dry bearing surfaces.	Lubricate with graphite.
	Spring "10" weak.	Replace spring.

(4) REMOVAL.

(a) SHACKLE.

1. Open access doors.

2. Remove manual release cable lock from cocking arm.

3. Unscrew wing nuts.

4. Detach electrical conduit.

5. Remove shackles and detach clevis bolts.

(b) FAIRING.—(See paragraph 16 *b* (4), this section.)

(5) DISASSEMBLY. *(See figure 364.)*

(a) SHACKLE.

1. Remove pin attaching arm "4" to release unit plunger.

2. Remove two pins attaching release unit to shackle case assembly. Slide release unit from case.

3. Remove pin attaching hook "3" to shackle case.

4. Slide hook "3", clevis "11," and arm "4" from case. Remove pins holding items together.

5. Remove stop assembly "2" (one pin).

6. Remove spring "7" (one pin).

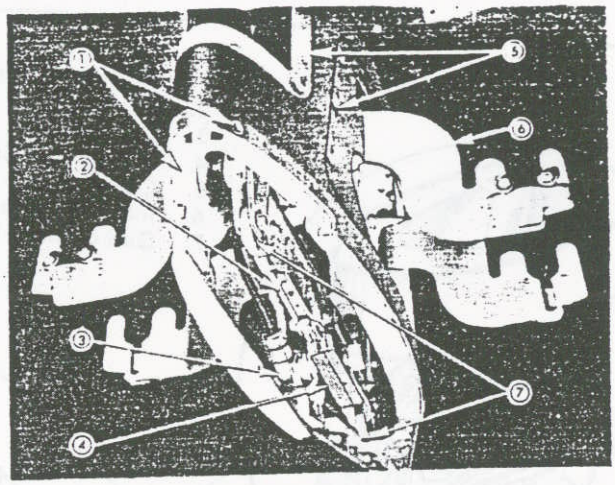
7. Remove two pins attaching hooks "5" to shackle case.

8. Slide hooks and link assembly "1" from case. Remove pins attaching hooks to link.

(b) RELEASE UNIT.

1. Remove release unit from shackle case assembly. Refer to steps *1* and *2* of *(a)*, preceding.

2. Remove screw attaching release unit cover to case. Carefully pry off cover.



1. Lower Fairing Boot Attachment Holes
2. Interstate D-820 Shackle
3. Electrical Disconnect Plug
4. Release Unit
5. Access Doors
6. Hoist Supports (Extended)
7. Shackle Hooks

Figure 366 — Droppable Tank and Bomb Shackle Support

3. If spring "10" is cocked (compressed), force head of plunger "6" against a solid object and move lever "18" down against spring. (This releases lever "17" and plunger "6.") Slowly release pressure on head of plunger, allowing plunger to extend.

CAUTION

Do not operate release unit unless plunger is held firmly against solid object to absorb force of releasing spring (or unless unit is assembled in shackle).

4. Remove lever assembly "18" (one pin).

5. Remove solenoid "20," spring and plunger "19" (one screw in solenoid).

6. Remove solenoid assembly "16" (one nut).

7. Remove connector assembly "12."

8. Remove switch assembly "15."

9. Remove hook "13" (one pin, spring, and arm).

10. Remove hook "14" (one pin and spring).

11. Insert screw driver into slot in end of plunger "6" and rotate plunger until lip of washer "8" faces open side of case.

12. Insert screw driver under lip of washer and pry washer from plunger groove.

CAUTION

Hold plunger head against solid object to prevent injury when spring "10" is released.

13. Remove plunger and spring.

(6) ASSEMBLY. *(See figure 364.)*

(a) SHACKLE.—Reverse removal procedure.

Note

Pin attaching forward end of release unit to shackle case is undersize to permit a slight "float" of the release assembly during movement of the plunger to avoid bending of release mechanism.

(b) RELEASE UNIT.

1. Insert plunger "6" and spring "10" in body of unit.

2. Compress spring by pressing plunger head against solid object.

3. Rotate plunger head until small hole in plunger groove is upward.

4. Insert washer while plunger spring is compressed.

CAUTION

Check to see that washer fits tightly on plunger before releasing pressure on plunger head. Perform step 5 before releasing plunger.

5. Insert screw driver into plunger head slot and rotate plunger to normal position.

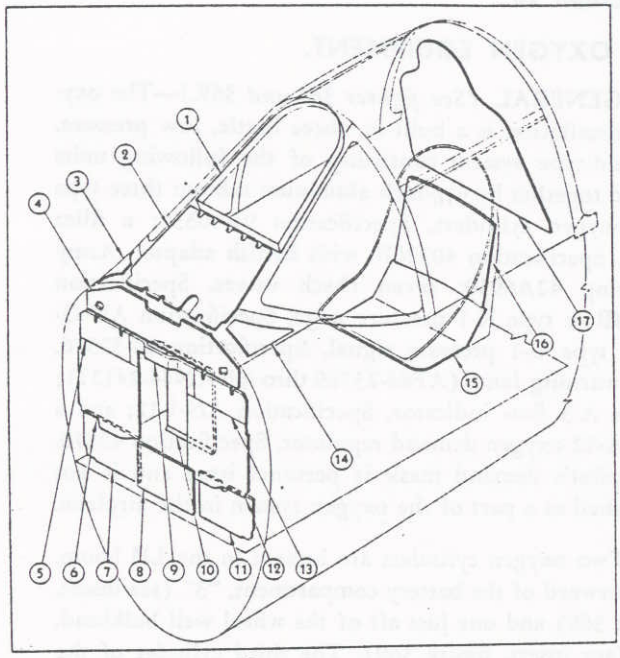
6. Bend washer lip to move hook just clear of arming ring slot when plunger is in released position.

7. Perform steps 1 through 10 of paragraph (5) *(b)*, preceding, in the reverse order.

(7) HANGING OF BOMBS.—See Section V, paragraph 3.

j. ARMOR PLATE AND PILOT'S PROTECTION. *(See figure 367.)*

(1) ARMOR PLATE.—The armor plate consists of small pieces of 3/8-inch and/or 1/4-inch face-hardened steel placed in the armament compartment and cockpit. To facilitate handling, removal, and replacement, the pieces are small and are attached separately in their respective places. The pilot is protected from frontal attack by armor plate mounted on the aft bulkhead of the armament compartment and by bullet-proof glass in the front windshield panel. Two pieces of armor plate line the back and bottom of the pilot's seat and give protection from below and behind. A single piece of armor plate mounted behind and above the seat provides additional rearward protection. Circular deflectors on the turbosuperchargers protect the pilot from possible fragmentation of supercharger rotor blades.



	3/8-Inch	Weight (Lb)	1/4-Inch	Station
1		73.32		125.0
2			13.66	98.0
3			1.53	96.5
4	14.35			94.6
5			2.86	94.6
6			8.83	94.6
7			5.33	94.6
8			3.93	95.4
9			1.77	94.6
10			9.78	99.9
11			5.00	94.6
12			8.78	94.6
13			2.88	94.6
14			1.53	96.5
15			20.70	138.0
16			16.46	147.5
17	50.50			156.0

Figure 367 — Fuselage Armor Plate

Note

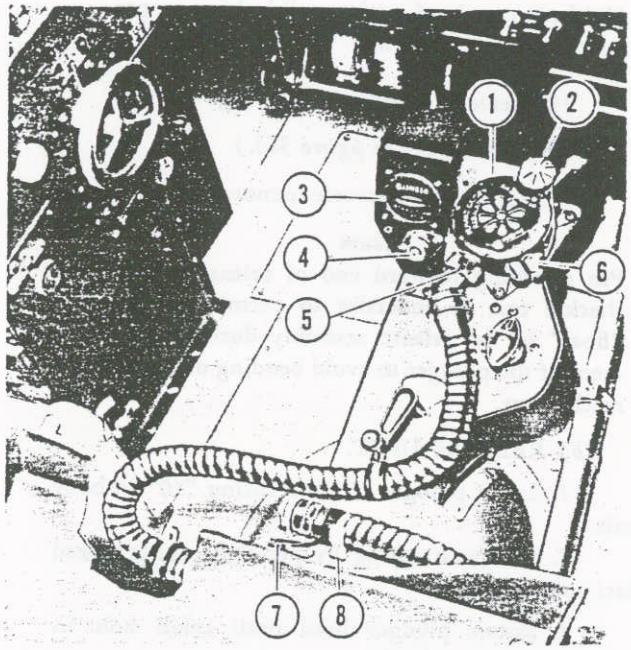
When installing armor plate be sure side with "FACE" stenciled on it faces side of initial impact. When removing and installing armor plate be sure to remove and install bonding for each plate. Remove armor plate paint beneath bonding for positive contact.

(2) BULLET-PROOF GLASS WINDSHIELD. *(See figure 367, item "1.")*—The front panel of the windshield is made of a panel of bullet-proof glass to supplement the forward armor plate protection.

23. OXYGEN EQUIPMENT.

a. GENERAL. *(See figures 368 and 369.)*—The oxygen installation is a built-in, three bottle, low pressure, demand-type system consisting of the following units linked together by 5/16-inch aluminum tubing: three type F-1 oxygen cylinders, Specification 94-40330; a filler valve, Specification 40326B, with British adapter, Army Drawing 42A6950; seven check valves, Specification 40324B; a type K-1 pressure gage, Specification AN-G-13; a type G-1 pressure signal, Specification 94-32376, with warning lamp (AF44-23769 through AN44-24121); a type A-3 flow indicator, Specification AN-I-12; and a type A-12 oxygen demand regulator, Specification 40370. The pilot's demand mask is personal issue and is not furnished as a part of the oxygen system in the airplane.

Two oxygen cylinders are located in the LH boom, one forward of the battery compartment, "3" (see insert, figure 369) and one just aft of the wheel well bulkhead, "1" (see insert, figure 369). The third cylinder of the system is located in the RH boom, corresponding to the position of cylinder "1." A separate filler line from the filler valve in the RH wheel well connects the cylinders, and check valves are provided to insure no escape of oxygen from the filler plug or from the system in case one cylinder develops a leak. The pressure gage is mounted just below the instrument panel, and the flow indicator and demand regulator are located between the pilot's legs forward of the nose wheel dome. On some airplanes a pressure signal is installed on the instrument panel which provides a visual warning, when the system pressure drops below 100 lb/sq in.



1. Demand Regulator
2. Emergency Valve
3. Flow Indicator
4. Oxygen Pressure Warning Light (AF44-23769 to AF44-24121)
5. Knurled Elbow Nut
6. AUTO-MIX Control
7. Mask Connector
8. Supply Hose Supporting Clip

Figure 368 — Oxygen System Cockpit Controls

b. GROUND OPERATION.

(1) Check regulator for proper operation as follows: With emergency valve closed and auto-mix in "OFF" position, and outer elbow gland removed or tube to mask disconnected, momentarily close off outlet with thumb or palm of hand. If emergency valve or second stage regulating valve is leaking, second stage diaphragm will press against cover. If this occurs in less than two seconds' time, regulator should be replaced.

(2) Test operation of shutters in flow indicator by inserting *eraser* end of pencil through large threaded hole in back of instrument, and press gently against bellows and release. Failure of shutters to open and close indicates a weak or broken spring, or a defective shutter assembly. If this takes place, replace indicator.

(3) Connect indicator to supply system, raise pressure in indicator to 10 lb/sq in. and shut off supply. If, at the end of 5 minutes, shutters have not begun to close, bellows and body assembly do not leak.

(4) Check oxygen pressure to make sure it is approximately 400 lb/sq in.

(5) Make sure mask and breather tube connections are tight, and knurled collar on regulator-breather-tube attachment is secure.

c. TROUBLE SHOOTING. *(See figure 369.)*

Trouble	*Probable Cause*	*Remedy*
Pressure gage reading drops when system is not being used.	Leak in system between check valves "K" and "L".	Check tubing, fittings and instruments for possible leaks.
Pressure in system lost when one cylinder leaks.	Check valve stuck or installed backwards.	Inspect check valves and reverse or replace.
Oxygen gage fails to register when system is on.	System empty.	Recharge cylinders.
	Gage stuck.	Tap gage lightly to release hand.

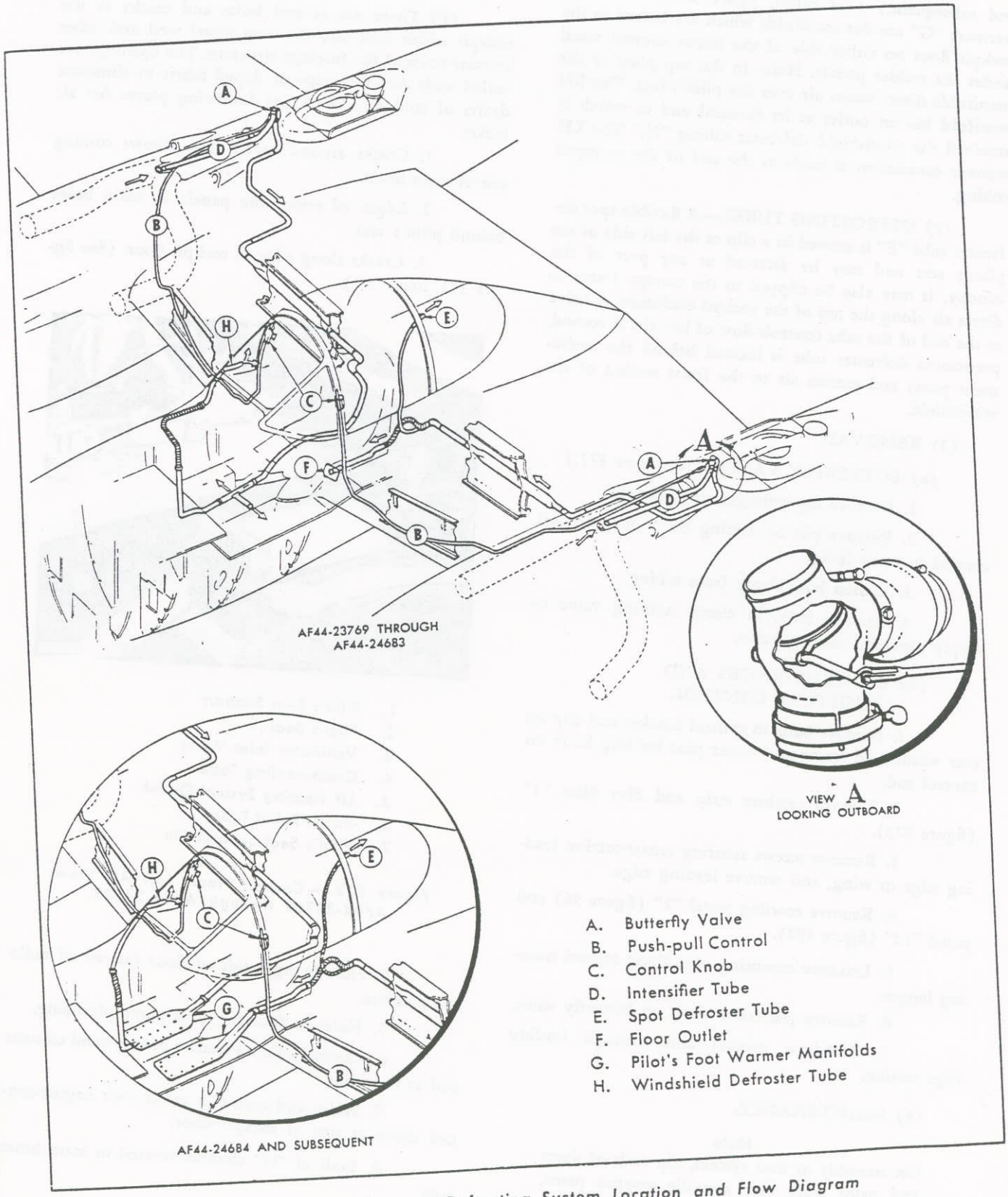


Figure 371 — Heating and Defrosting System Location and Flow Diagram

(b) PILOT'S FOOT WARMERS. (AF44-24684 and subsequent.) *(See insert, figure 371.)*—The foot warmers "G" are flat manifolds which are bolted to the cockpit floor on either side of the center control stand under the rudder pedals. Holes in the top plate of the manifolds direct warm air over the pilot's feet. The RH manifold has an outlet at its forward end to which is attached the windshield defroster tubing "H." The LH warmer connection is made at the end of the wrapped tubing.

(c) DEFROSTING TUBES.—A flexible spot defroster tube "E" is stowed in a clip at the left side of the pilot's seat and may be directed at any part of the canopy. It may also be clipped to the canopy frame to direct air along the top of the cockpit enclosure. A valve at the end of the tube controls flow of hot air. A second, permanent defroster tube is located behind the instrument panel and carries air to the front section of the windshield.

(2) REMOVAL.

(a) BUTTERFLY VALVE. *(See figure 371.)*

1. Remove supercharger cover panels.

2. Remove pin connecting clevis on push-pull control to valve lever.

3. Loosen hose clamp from tubing.

4. Remove bolts in clamp holding valve to supply pipe and remove valve.

(b) CONTROL KNOBS AND PUSH-PULL CONTROL.

1. Remove bolts in control bracket and clip on rear windshield frame and cotter pins holding knob on control rod.

2. Remove retainer strip and dive fillet "1" (figure 373).

3. Remove screws securing center-section leading edge to wing, and remove leading edge.

4. Remove cowling panel "2" (figure 96) and panel "12" (figure 192).

5. Unscrew mounting clips along control housing length.

6. Remove pin from clevis on butterfly valve.

7. Withdraw control unit through leading edge section.

(3) MAINTENANCE.

Note

On assembly of duct system, dip ends of ducts and paint seals with metallic stopper paint, Specification LAC 1-703, to prevent heat loss.

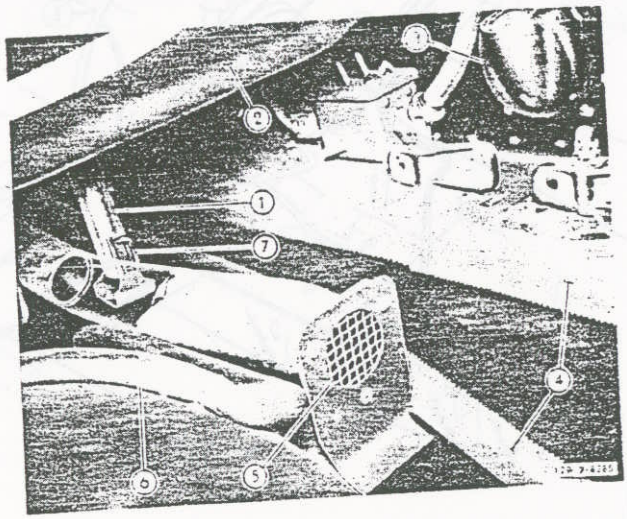
(a) Additional wrapping of asbestos tape may be put on heater tubes to cover all exposed hot surfaces.

(b) There are several holes and cracks in the cockpit which lead into the nose wheel well and other interior parts of the fuselage structure. The openings are sealed with AN-T-12 tape or doped fabric to eliminate drafts of cold air. Check the following places for air leaks:

1. Cracks around heater tube elbows coming out of main beam.

2. Edges of removable panels in main beam behind pilot's seat.

3. Cracks along edge of cockpit floor. (See figure 372, item "4.")



1. Pilot's Seat Support
2. Pilot's Seat
3. Ventilator Inlet Valve
4. Crack-sealing Tape
5. LH Heating System Outlet
6. Pilot's Relief Tube
7. Pilot's Seat Support Pin

Figure 372 — Cockpit Floor, Left Aft View; AF44-23769 through AF44-24683

4. Hole in right side of floor just aft of radio junction box.

5. Holes in floor for hand pump plumbing.

6. Control column leather boot around column and at floor line.

7. Holes and cracks in cover over engine-control cables at rear of cockpit floor.

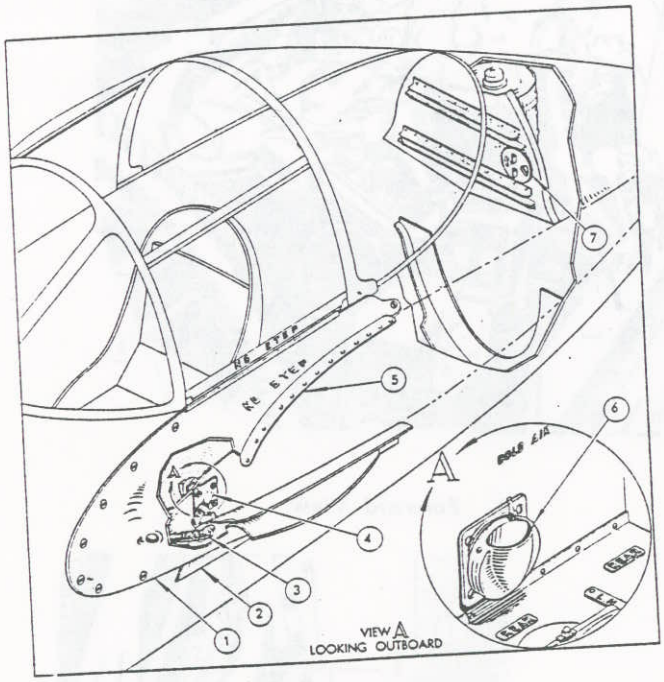
8. Ends of "U" channel riveted to main beam web.

9. Hole in cockpit for antenna transmission line.

10. Leather seals at rudder cable cut-out in floor.

11. Air seals at engine control stand, side window, fillet Dzus holes, and control column.

(4) ADJUSTMENT.—Rig butterfly valve "A" so that valve is closed tightly in "OFF" position when knobs in cockpit indicate full "OFF."



1. Dive Fillet
2. Panel "146"
3. Hose
4. Adapter
5. Dive Fillet Retainer Strip
6. Ventilator — Intake
7. Ventilator — Exhaust

Figure 373 — Cockpit Ventilating System

b. VENTILATING SYSTEM. *(See figure 373.)*

(1) DESCRIPTION.—Cold air is supplied to the cockpit through a hose "2" which connects a controllable ventilator valve "4" to an opening in the leading edge of the left wing dive fillet "1." An adjustable exhaust vent "5" is provided on the left side of the bulkhead aft of the radio compartment on which the main hydraulic reservoir is mounted. This vent is accessible from removable panel "83" (figure 3).

(2) OPERATION.—To open, turn ventilator "4" until outlet is on top. To close, turn ventilator until outlet faces down.

(3) MAINTENANCE.—If ventilator fails to function, felt seal is misaligned in valve. Remove valve, disassemble, and cement felt seal to valve base with synthetic rubber cement.

(4) REMOVAL.

(a) Remove dive fillet retainer strip and dive fillet on left side and panel "146" (figure 373), and disconnect flexible tube to inlet.

(b) Remove four bolts through base into upper shear web.

(c) Remove unit.

25. FURNISHINGS AND MISCELLANEOUS EQUIPMENT.

a. PILOT'S SEAT. *(See figure 374.)*

(1) DESCRIPTION. — The pilot's seat is made from molded phenolic cloth, Specification AN-RR-S-176, and is mounted above the nose wheel dome on a removable, welded tubular frame. Armor plate is installed in the bottom and on the back of the seat. A handle, located on the right side of the seat, is provided for height adjustment, and a release for the shoulder harness is placed on the lower left-hand side. A shoulder harness, AC41G8725, and a belt, type B-11, U.S. Army Specification 94-3067, are government-furnished equipment, and are included with the seat assembly.

(2) REMOVAL.

(a) Remove "U" bolts attaching silhouette armor plate to seat support assembly. It is not necessary to remove armor plate completely when removing pilot's seat; however, plate should be supported to prevent damage to lower rubber support mountings. (See figure 374.)

(b) Remove four hose clamps "12" (figure 374) attaching seat frame to support assembly.

(c) Remove nuts and withdraw pin "7" (figure 372) from seat support floor bracket.

(d) Lift seat from airplane.

(3) INSTALLATION. — Reverse removal procedure.

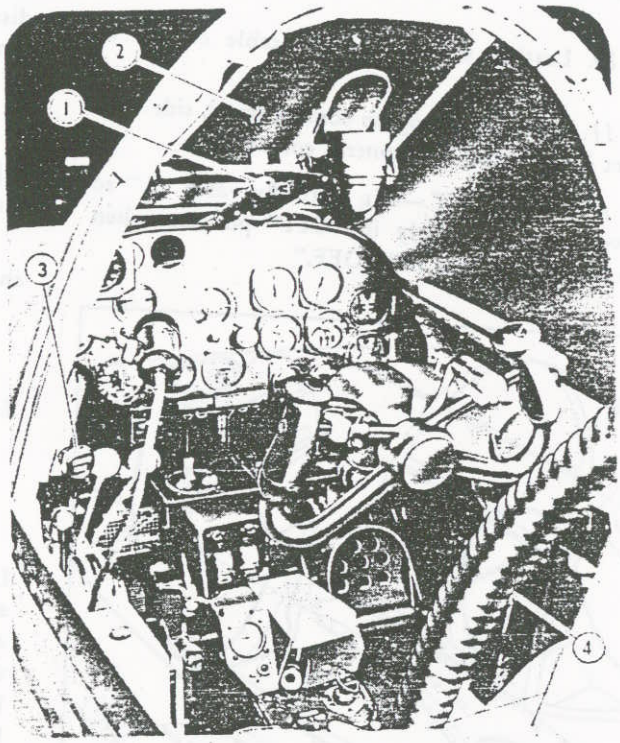
Note

Replace seat support floor bracket pin on RH side with nut on forward side of bracket.

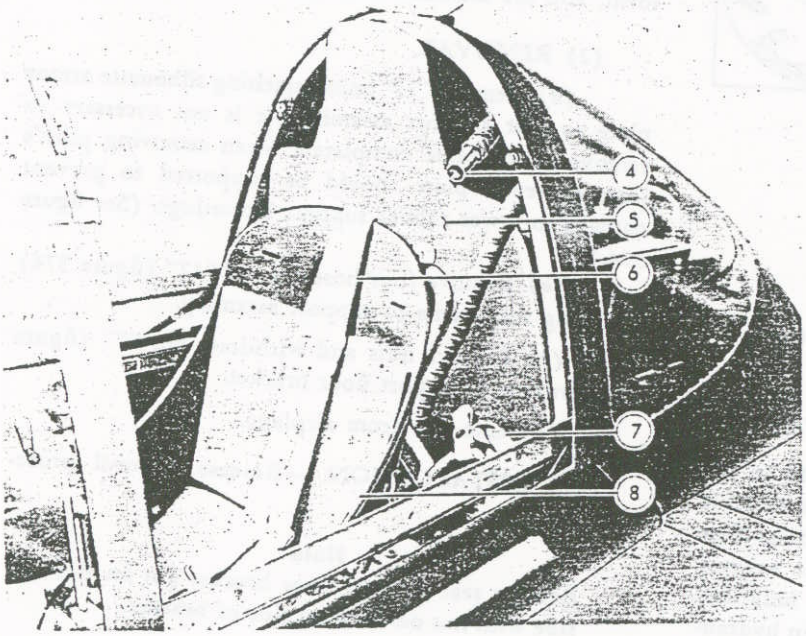
b. PYROTECHNIC EQUIPMENT. *(See insert "B," figure 374.)*

(1) DESCRIPTION. — An AN-M-8 pyrotechnic pistol, Ordnance Drawing 42-44; a pistol holder, type

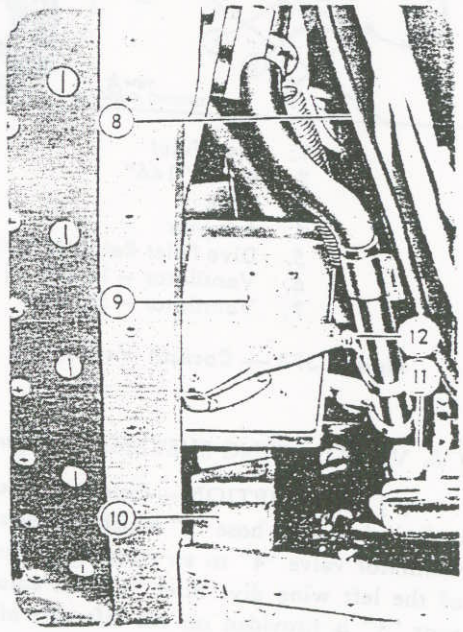
1. Spare Gunsight Light Bulb (Ref)
2. Bullet-proof Windshield
3. Cockpit Heat Control Knob
4. Spot Defroster Tube
5. Silhouette Armor Plate
6. Shoulder Strap
7. Flare Pistol Support
8. Pilot's Seat
9. First Aid Kit Stowage Box
10. Map Case
11. Safety Belt
12. Pilot's Seat Quick Removal Clamps



A. Forward View



B. Aft View, Left-hand



C. Aft View, Right-hand

Figure 374 — Fuselage Furnishings

SECTION V

USEFUL OR MILITARY LOAD INSTALLATION, WEIGHT AND BALANCE

1. 50 CAL. MACHINE GUN.

a. GENERAL.—The ammunition for each machine gun is carried in a drawer type tray located beneath each machine gun. The capacity of each tray is 500 rounds (165 lb) but normal load is 300 rounds (107 lb).

b. LOADING. *(See figure 376.)*—Ammunition loading procedure is indicated on the side of each tray and is as follows:

(1) Remove tray from airplane.

(2) Place end of ammunition belt in outboard corner of tray with shell pointing forward.

(3) Feed belt inboard in bottom of tray, then reverse direction and lay second layer of belt over first layer of belt. Continue laying succeeding layers over preceding layers until desired capacity is reached.

(4) Place loose end of ammunition belt in outboard corner of tray and install tray in the tracks provided on the floor of the armament compartment.

(5) Feed loose end of belt through feed chute into machine gun until first shell clicks into place. (See figure 376.)

(6) Lock ammunition tray in tracks by turning grip handle into locking slot. (See figure 348.)

2. 20 MM CANNON.

a. GENERAL.—The ammunition for the cannon is carried in a drawer type tray mounted on the right-hand side of the cannon. The tray capacity is 150 rounds (128 lb).

b. LOADING. *(See figure 376.)*

(1) Remove tray cover.

(2) Place end of 20 mm ammunition belt in outboard corner of tray with shell pointing forward.

(3) Feed belt inboard in bottom of tray, then reverse direction and lay second layer of belt over first layer of belt. Continue laying succeeding layers over preceding layers until desired capacity is reached.

(4) Place loose end of ammunition belt in outboard corner of tray and feed belt through ammunition chute into automatic feed mechanism.

(5) Place cover on tray and lock into position.

3. BOMBS.

a. GENERAL.—An Interstate D-820 bomb shackle is mounted under the main beam at wing station 48 L&R.

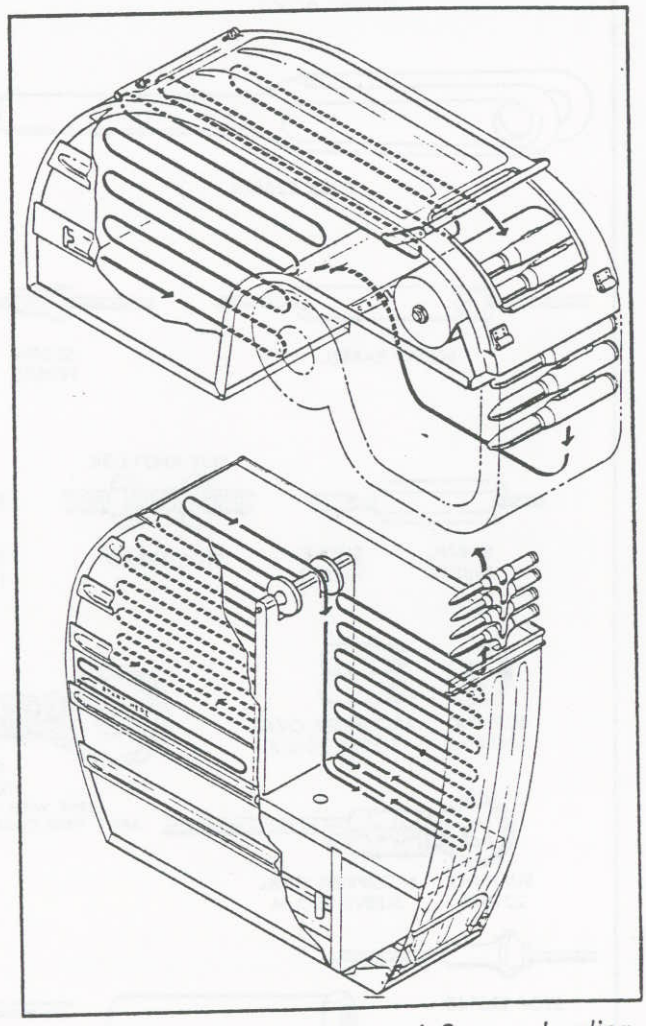


Figure 376 — Machine Gun and Cannon Loading

Each shackle is capable of supporting one 2000 lb bomb (maximum capacity).

b. LOADING. *(See figure 377.)*

(1) Remove lower fairing boot of support. Screws to replace those on fairing boot will be found in inside stowage bags. (See Note below and figure 366.)

(2) Open nose and side access doors.

(3) Loosen bomb shackle from support by unscrewing each wing nut as much as required.

(4) Remove fuel line hose and clamps below wing fitting and cap fitting.

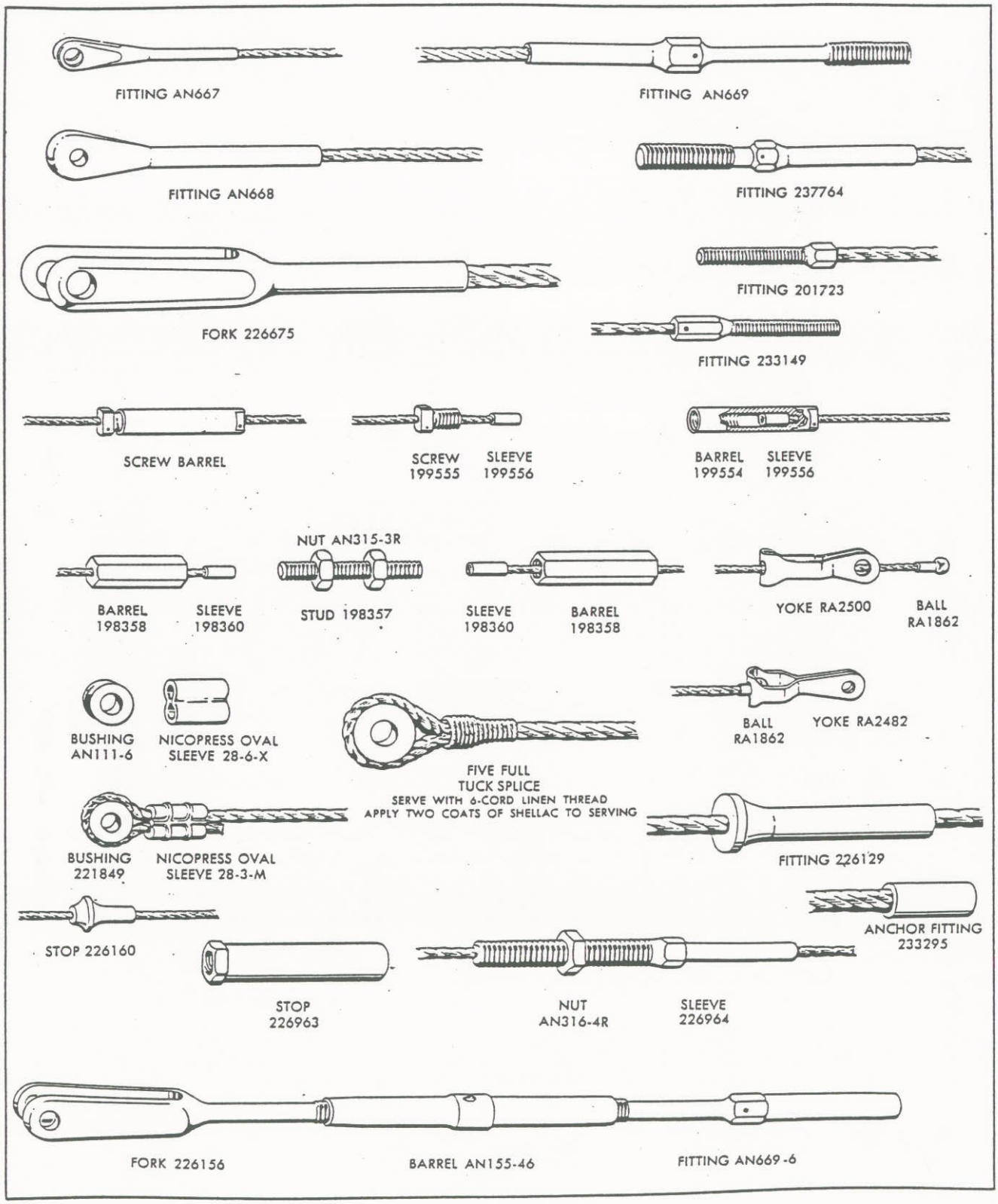


Figure 380 — Cable Fittings

FUEL SYSTEM

Preflight

Check quantities of fuel in all tanks. Fill if necessary and enter the quantities on the Flight Report, Form No. 1A. Fill the fuel tanks with 100+ octane fuel, Specification AN-F-29 or AN-F-28. Specification AN-VV-F-781, Amendment 5, may also be used.

Note

Each time a fuel tank is to be filled, drain all strainers and tank drains to remove any accumulation of foreign matter or water in the sumps. Resafety all drain cocks properly.

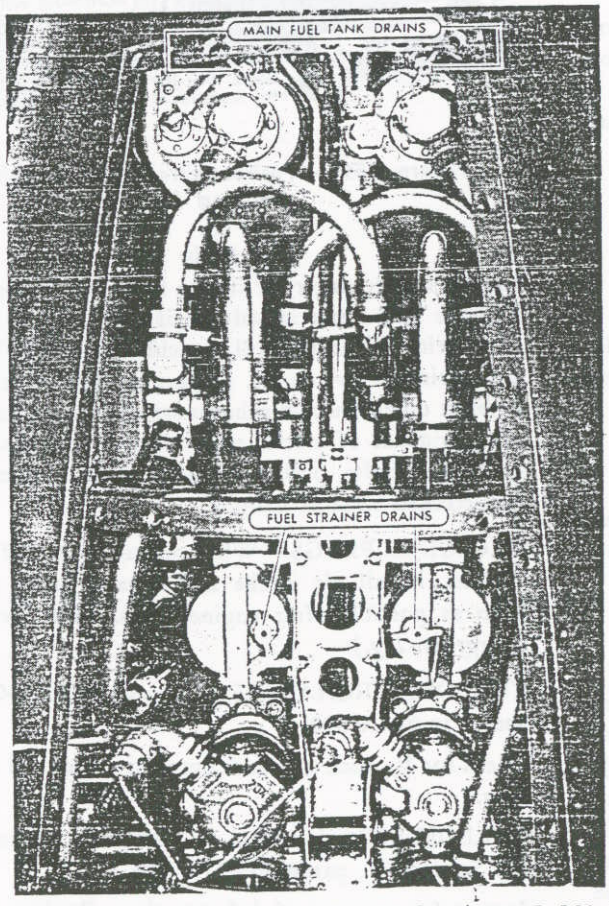


Figure 383 — Fuel Drains, Lower Fuselage; P-38L-1

CAUTION

Inspect the reserve fuel tank vent line for proper installation and tightness of connecting fittings. (This line is located under the oil tank filler cap access door and can be conveniently inspected when checking or replenishing the oil supply.)

CAUTION

Connect and thoroughly ground the airplane and the refueling tank.

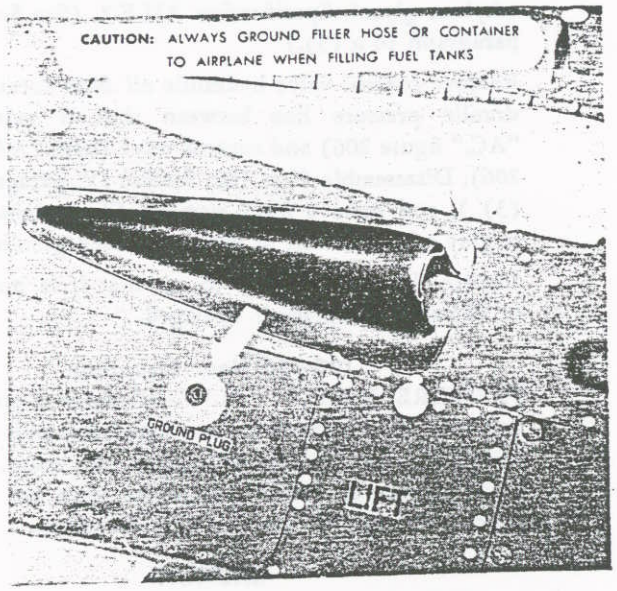


Figure 384 — Ground Plug

WING TANK SOLENOID VALVE.—If rough engine operation is noted, and if the outer wing tanks are empty and the engine pump only is drawing fuel from the main tanks, inspect outer wing tank solenoid shut-off valve for air leakage into the main fuel system. The condition is not experienced with the main boost pump "ON." Refer to Section IV, paragraph 16 *i*.

CAUTION

Resafety drain cocks before flight.

TANK SELECTOR VALVES.—Turn valves through all tank positions to check for binding. Check sway braces of 300-gallon droppable tanks, if installed, for proper adjustment (braces should be secure but not tightened to the extent of stressing rods).

PRIMER.—Inspect fuel system primer for leaks when locked in the "OFF" position with the right-hand booster pump "ON."

Daily

Inspect all clamps and brackets which support tubes for cracks, security, and anchorage, fuel lines for signs of wear due to vibration or chafing, fuel boost pump for leaks, and all overflow or drain lines for security of mounting, kinks, breaks, or stoppage, and extension beyond the cowling. (This is necessary to avoid the collection of fuel vapors inside the cowling and fuselage.) Remove and clean all fuel strainers and inspect them for breaks or tears.

Check radiators, expansion tanks, and hose connections for leaks, particularly at radiator cores and in area of welds. Check system drain plugs for tightness and safetying.

Drain and flush the coolant system. Fill with fresh ethylene glycol, Specification AN-E-2. (See Section IV, paragraph 14 *a* (3).)

Remove control valve hydraulic oil filter located in hydraulic pressure line between shut-off valve (item "AC," figure 206) and control valve (item "AA," figure 206). Disassemble filter (see Section IV, paragraph 19 *f* (3)), and remove filter element. Clean element thoroughly with kerosene or white unleaded gasoline.

Inspect element carefully to see that it is not broken or damaged. Replace if damaged.

100-120 Hour Inspection

PRESSURE RELIEF VALVE.—Remove scum, foam, and gum deposits from coolant expansion tank pressure-relief-valve by flushing with clean hot water. Force a small stream of water (no wider than an ordinary pencil) through the valve in both directions.

CAUTION

Subjecting valve to high water pressure may damage the valve aneroid.

Engine Overhaul

TEMPERATURE CONTROL VALVE.—Remove, disassemble, clean and inspect coolant temperature control valve. See Section IV, paragraph 19 *f* (2).

ENGINE VALVES

Inspection

Inspect and readjust at first 5-hour and every 200-hour inspection thereafter: all rocker arm bracket stud nuts and all valve tappet clearance.

Refer to Section IV, paragraph 8 *f* (2).

200-240 Hour Inspection

Inspect and adjust valve mechanism. Check for broken springs. Check for condition of cylinder head cover gaskets. (On cold engine 10° to 30°C (50° to 100°F)), intake valve should be set to a clearance of .015 inch and the exhaust valve to a clearance of .020 inch.) While valve covers are removed, inspect distributor shaft upper ball bearings for excessive wear or side motion of the bearing in the housing. If this condition is evident, refer to T.O. 02-5A-39 for detailed service information.

MANIFOLDS AND TURBOSUPERCHARGERS

Preflight

SUPERCHARGER WASTEGATE.—Check the operation by placing battery switch to "ON" and operating wastegate to see if it completely opens and closes.

SUPERCHARGER REGULATOR SENSING LINE.—Open drain cock in each forward boom wheel well to remove moisture from supercharger regulator sensing line. Check for leaks and loose or broken fittings. (See figure 389.)

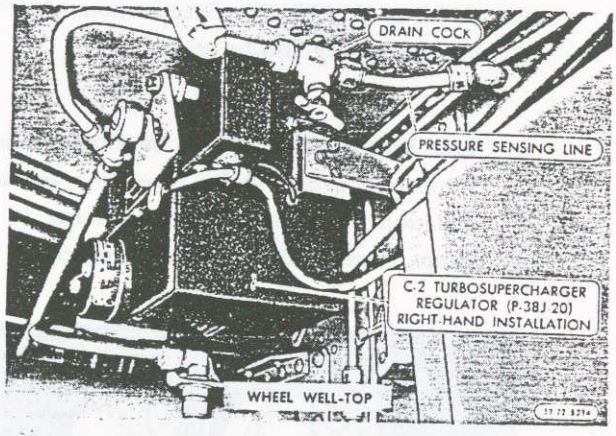


Figure 389 — Turbosupercharger Regulator Sensing Line

Daily

Inspect supercharger air intake filter for contamination. Remove and clean in solvent if dirty. After cleaning, spray with lubricating oil, Specification AN-VV-O-446, and drain for two hours. Inspect security of attachment of blast tubes. Inspect exhaust system for general condition, evidence of cracks, security of attachment, missing or broken bolts, pulled or loose studs, blown gaskets, and cracked exhaust flanges.

EXCLUDER PLUGS.—When operating in arid or arctic regions, install air intake and exhaust stack plugs as soon as possible after engine stops. (See Section III, paragraph 2 *g*.)

TURBOSUPERCHARGER CLEARANCES.—Check as shown in figure 390.

Check for $\frac{3}{32}$-inch clearance between wheel and deflector ring.

TURBOSUPERCHARGER.—Check for broken bolts. See Section IV, paragraph 17 *c* (2).

Inspect for warpage of deflector ring. Replace deflector ring if warpage has seriously distorted the nozzlebox or nozzlebox diaphragm. Inspect weld around base of deflector ring and nozzlebox. Inspect deflector ring for cracks and gouges. (Cracks or gouges will not be cause for replacement unless the ring is split or ruptured.)

TURBINE BUCKETS.—If any bucket is stretched to the point that the band does not have the support of the adjacent bucket, replace the supercharger. Minor elonga-

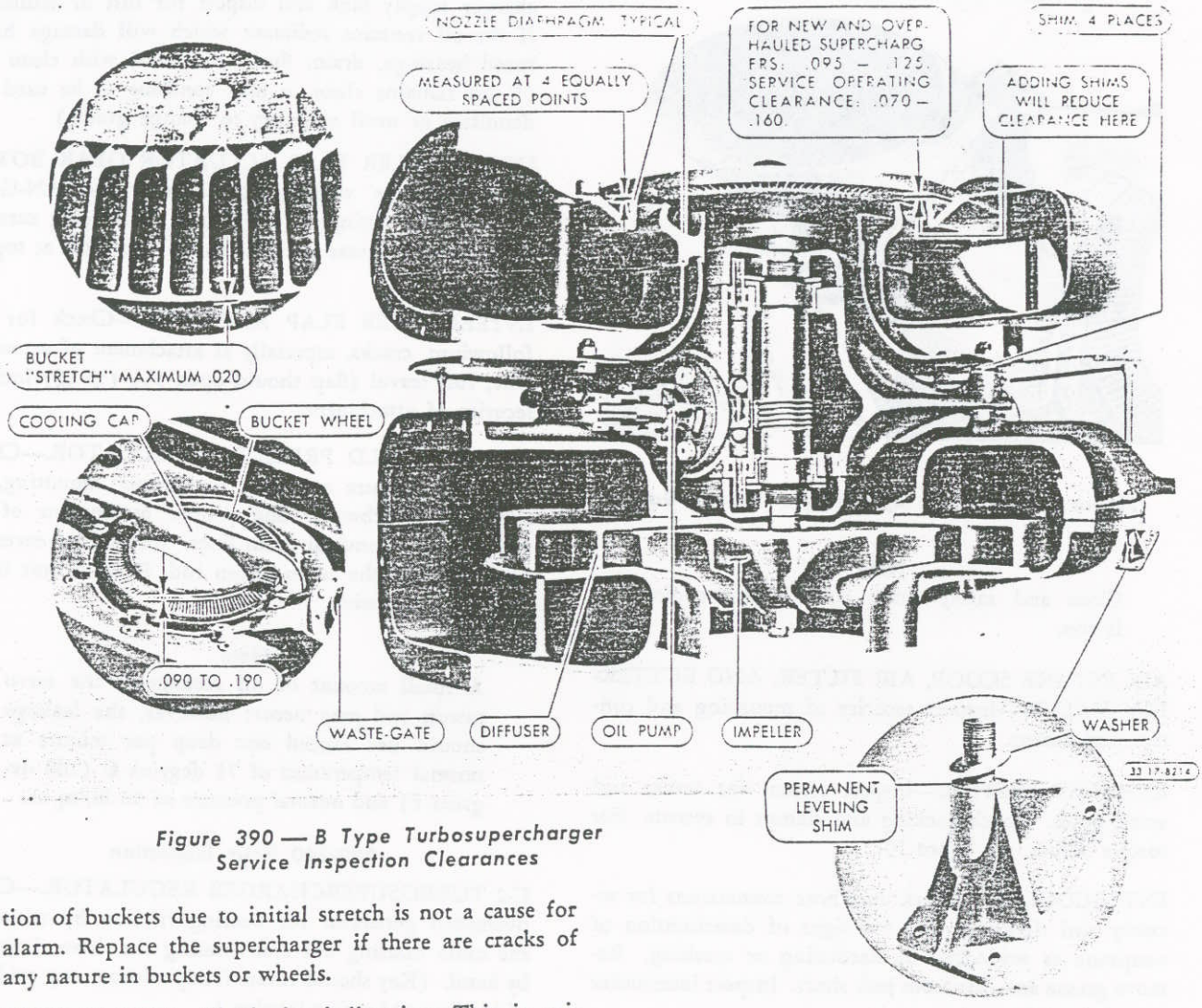


Figure 390 — B Type Turbosupercharger Service Inspection Clearances

tion of buckets due to initial stretch is not a cause for alarm. Replace the supercharger if there are cracks of any nature in buckets or wheels.

NOZZLE BOX.—Check for ballooning. This is evidenced by a rising of the metal between stays. Look for cracks and cupping near welds in area of stays.

WASTEGATE SYSTEM.—Inspect to determine that it works freely. Control arm clevis nut should not be tight. Apply penetrating oil to wastegate operating parts. In case of wastegate warpage, disassemble and straighten gate and shaft. Dress shaft ends to remove deposits. Replace wastegate assembly if this does not give freedom of operation.

Check spindle linkage (indicated by arrow, figure 391) for seizure, as rapid corrosion at this point due to exhaust gases may result in the binding of the control, with resultant loss of control of turbo-speed and manifold pressure. Lubricate if necessary.

EXHAUST MANIFOLD PACKING CLAMPS.—Packing clamps should be adjusted and maintained not tighter than just snug when cold, thus allowing for expansion of the manifold joints when hot.

25-30 Hour Inspection

C-2 TURBOSUPERCHARGER REGULATOR.—Inspect for security: all mounting bolts on the regulator control box and overspeed generator, all pressure connections between the regulator control box and the point where the pressure-sensing line connects to the turbosupercharger compressor discharge duct, and all mechanical linkages between the cockpit and the regulator control box and between the regulator control box and the waste gate. See Section IV, paragraph 10 *b* (2).

Inspect the electric wiring from the airplane power supply to the regulator control box and the overspeed generator for chafing, the disconnect plug on the overspeed generator for loose wires and for tight mechanical junction of the two parts of the connector, and the flexible cable that connects the turbosupercharger oil pump to the overspeed generator for tight fittings.

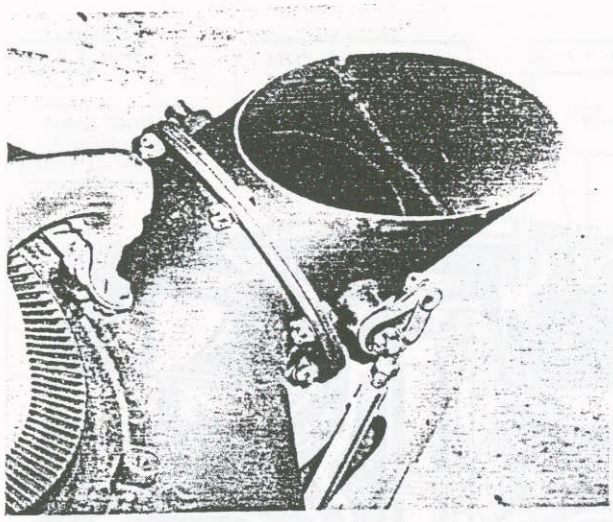


Figure 391 — Turbosupercharger Waste Gate

Note

Close and safety drain cock before engine is run.

AIR INTAKE SCOOP, AIR FILTER, AND BUTTERFLY VALVE.—Inspect security of mounting and control attachment.

EXHAUST SYSTEM.—Inspect system for cracks and small holes. Check packing and clamps in system. For torque values, see figure 191.

INTERCOOLER.—Check duct hose connections for security and tightness, and for signs of deterioration of neoprene as evidenced by hardening or cracking. Remove grease and dirt from jack shaft. Inspect intercooler core for cracks.

SUPERCHARGER OIL TANK.—Check tank bond strap to ascertain that it has sufficient clearance of adjacent tubing.

50-60 Hour Inspection

C-2 TURBOSUPERCHARGER REGULATOR.—Inspect wastegate-drive mechanism for evidence of binding. Check linkage between the regulator control box and the cockpit for proper relation of cockpit lever position and the gap under the calibrating nut on the control box. See figure 118.

TURBOSUPERCHARGER.—Inspect all lines for evidence of deterioration and test all control lines and connections for tightness. Inspect for cracks in the sheet-metal parts of the exhaust manifold and the nozzle box. Inspect wastegate control push-pull rod clevis for evidence of corrosion.

Draw off a small amount of oil from the turbosupercharger supply tank and inspect for dirt or sediment. If the oil contains sediment which will damage high-speed bearings, drain, flush, and refill with clean oil. (If oil remains clean, it may continue to be used indefinitely or until necessary to change grade.)

INTERCOOLER FLAP ACTUATOR GEAR BOX.—Pack gear box with grease, Specification AN-G-10, through zerk fitting on lower part of housing casting. Fill box until grease squeezes out of vent hole at top of casting.

INTERCOOLER FLAP ASSEMBLY.—Check for the following: cracks, especially at attachment of actuating unit; full travel (flap should open $5\frac{1}{2}$ ($\pm \frac{1}{4}$) inches; security of attachment.

A-2 MANIFOLD PRESSURE REGULATOR.—Check manifold pressure regulator for proper mounting, security of attachment, and proper attachment of oil pressure lines, and oil drain lines. Inspect for excessive oil leakage at the servo piston rod. Replace unit if oil leakage is excessive.

Note

A small amount of oil seepage at the servo piston rod may occur; however, the leakage should not exceed one drop per minute at normal temperature of 71 degrees C (160 degrees F) and normal pressure of 50 lb/sq in.

200-240 Hour Inspection

C-2 TURBOSUPERCHARGER REGULATOR.—Check overspeed generator for bearing friction by removing the cable housing nut and rotating the drive shaft key by hand. (Key should rotate freely without any evidence of binding or bearing friction.)

Normal Engine Overhaul

500-600 Hour Inspection

C-2 TURBOSUPERCHARGER REGULATOR. — Remove regulator control box and overspeed generator and send to repair depot for overhaul.

TURBOSUPERCHARGERS.—Remove and send to depot for overhaul.

PROPELLERS AND ACCESSORIES

Preflight

For operational check, refer to Section III, paragraph 2 *g*, and Pilot's Flight Operating Instructions, T.O. 01-75-1.

Daily

Check propeller for proper installation; spinners, bolts,

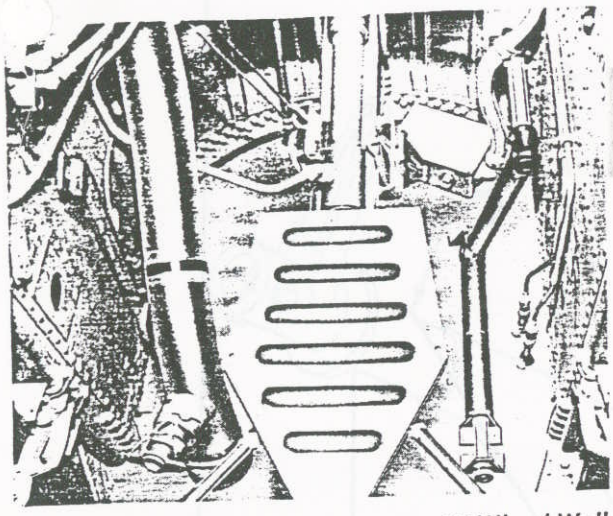


Figure 392 — Hand Crank Stowage, LH Wheel Well

100-120 Hour Inspection

BULKHEAD ASSEMBLY, FRONT COWLING.—Inspect bulkhead forward of reduction gear housing for cracks, and if cracks are found, stop-drill and weld or replace bulkhead.

CYLINDER HOLD-DOWN NUTS.—While the engine is cold, tighten nuts as follows: Loosen one nut at a time and bring it in contact with the boss without loading the stud. Tighten by turning through 90 to 110 degrees. Cotter each nut after final tightening. Tighten exhaust flange nuts.

Engine Overhaul Inspection

GENERAL.—Change and overhaul engines after 480 hours (± 20 percent) running time unless required sooner by malfunctioning or failure of an engine part. At engine change periods when replacements are available, replace all accessory pumps (except those with less than 100 hours service since last overhaul). This includes electric- and engine-driven units.

If general information on ground and flight testing of newly-installed engines is desired, refer to T.O. 02-1-4A.

COCKPIT

Daily

Inspect windshield for cracks, chips, discoloration, and security of attachment. Inspect plexiglas for cracks, scratches, and presence of gritty matter that will cause scratches.

After Flight

Inspect pilot's relief tube. Clean if necessary.

25-30 Hour Inspection

Inspect pilot's seat for security of attachment (including supports and brackets), for condition, and for functioning of adjusting mechanism. Check plexiglas for tears and cracks around bolts and screws. Check condition and operating mechanism of side canopy, of top hatch release and inspect hinges for freedom from binding. Check security of aft canopy support strut, clamps, and center support assembly. Inspect pilot's relief tube for kinks or breaks. Be sure it is coiled under the seat properly and is easily available. Inspect security of linen patches and cockpit seals.

50-60 Hour Inspection

Inspect condition of emergency hatch release mechanism cables, clean where they pass over pulleys, and cover them with rust-preventive compound, Specification AN-C-52, type 2. Check security of emergency hatch hinge. Check date safety belt was last tested, and if over the time limit for the type B-11 belt, remove and test the belt, or replace by one tested within the specified time period.

100-120 Hour Inspection

SIDE CANOPY.—Inspect the operating cables, clean, and cover with rust-preventive, Specification AN-C-52, type 2. Inspect operating mechanism of side canopy for wear, damage, and proper functioning.

Annual Inspection

SAFETY BELTS.—Remove and weight-test the safety belts on January 1 of each year.

FLIGHT CONTROL MECHANISM

Preflight

AILERONS.—Operate ailerons through their full travel a number of times. Perform operation with engines running and aileron boosters "ON." (If there is any dirt or metal particles in the booster cylinder or control valve they will jam the valve during operation and thus be discovered prior to takeoff.)

25-30 Hour Inspection

Inspect all turnbuckles, pulleys, guides, fair-leads, brackets, fittings, push-pull rods, and horns for proper attachment, general condition, and safety. Check cables, push-pull rods, and horns to be sure they are not chafing structural members or installations. Check cables for proper tension (first 25-, subsequent 100-hour). (Refer to Section IV, paragraph 4.)

Wipe all accessible parts clean (except the cables and fair-leads). Control cables that are found to be frayed (individual wires broken) will be considered serviceable unless there are more than six broken wires in any one-inch length of the cable. Carefully note the number of broken wires, particularly where the cables pass over pulleys or guides. Inspect for broken, loose, or misaligned pulleys. If lost motion exists in any control

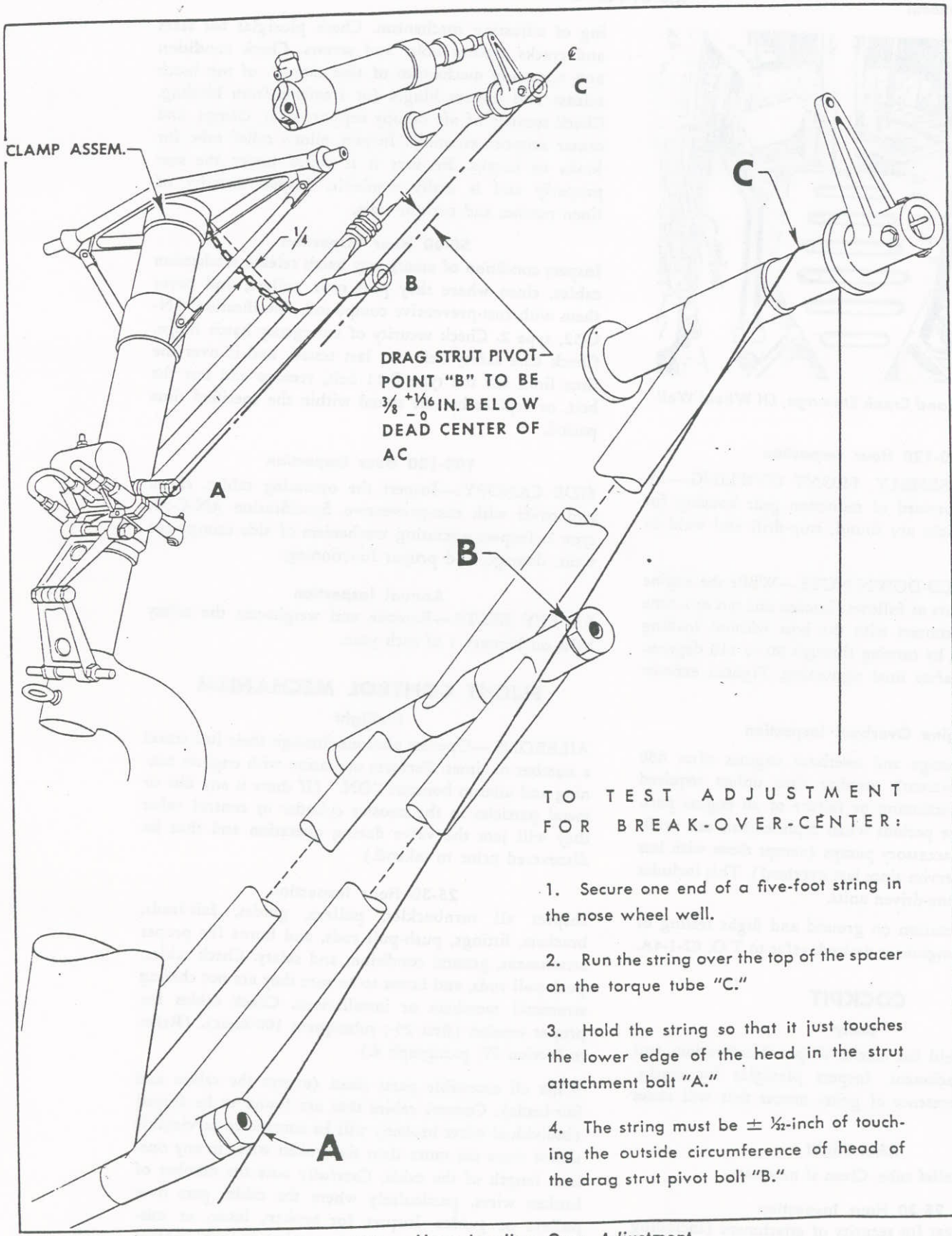


Figure 396 — Nose Landing Gear Adjustment

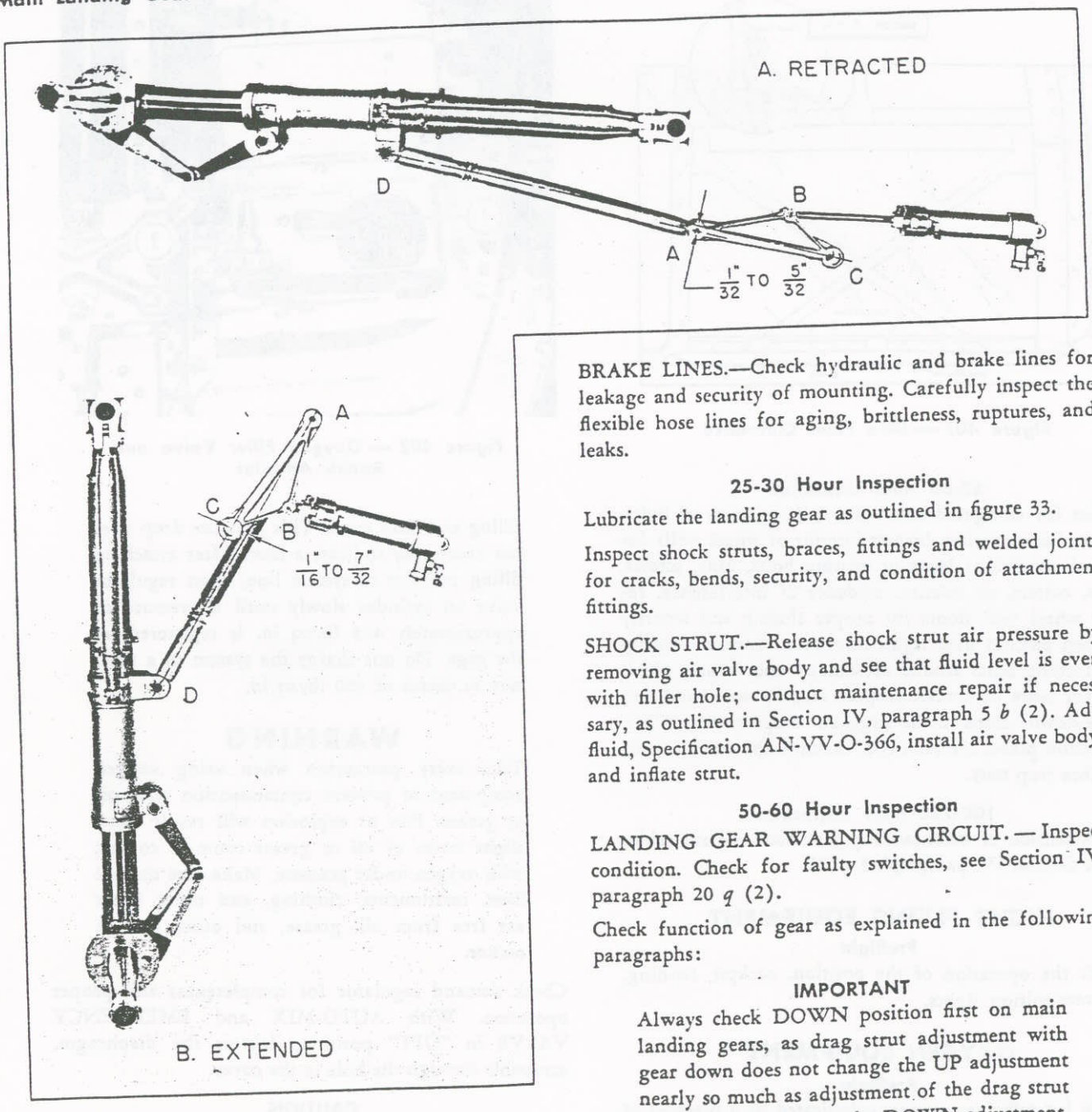


Figure 400 — Main Landing Gear Adjustment

Daily

Inspect for general condition of struts, braces, drag links, and retracting mechanism. Check thoroughly all welds on struts for cracks.

Wipe clean all accessible portions of the wheel well, wheel well door, and actuating mechanism of the landing gear doors. Inspect the shock strut and axle hub for fluid leaks. Wipe shock strut pistons with a cloth saturated with hydraulic fluid, Specification AN-VV-O-366.

BRAKE LINES.—Check hydraulic and brake lines for leakage and security of mounting. Carefully inspect the flexible hose lines for aging, brittleness, ruptures, and leaks.

25-30 Hour Inspection

Lubricate the landing gear as outlined in figure 33.

Inspect shock struts, braces, fittings and welded joints for cracks, bends, security, and condition of attachment fittings.

SHOCK STRUT.—Release shock strut air pressure by removing air valve body and see that fluid level is even with filler hole; conduct maintenance repair if necessary, as outlined in Section IV, paragraph 5 *b* (2). Add fluid, Specification AN-VV-O-366, install air valve body, and inflate strut.

50-60 Hour Inspection

LANDING GEAR WARNING CIRCUIT. — Inspect condition. Check for faulty switches, see Section IV, paragraph 20 *q* (2).

Check function of gear as explained in the following paragraphs:

IMPORTANT

Always check DOWN position first on main landing gears, as drag strut adjustment with gear down does not change the UP adjustment nearly so much as adjustment of the drag strut with gear UP changes the DOWN adjustment.

With gear in UP position:

Check clearance between gear and lines. Clearance must be ¼ inch.

Check the distance up lock extends into axle. (See figure 399.) Put putty in axle, run gear up; with gear locked, pull down on gear, then lower gear and measure impression in putty. If adjustment is incorrect, remove the two bolts holding lock latch pin in up lock groove. Turn up lock pin clockwise to reduce "bite" of pin, counterclockwise to increase "bite."

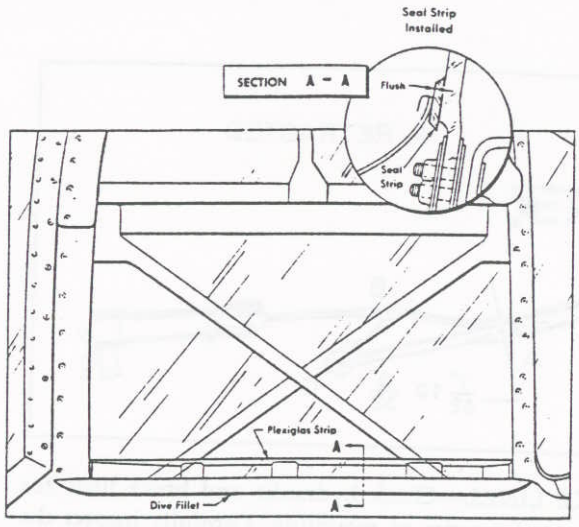


Figure 401 — Dive Fillet Clearance

50-60 Hour Inspection

Inspect for elongated bolt holes and tightness of bolts. Inspect for corrosion. Inspect interior of wheel wells for general condition; loose or missing bolts, nuts, screws, rivets, cotters, or safeties; evidence of interference. Inspect wheel well doors for proper closing and security of linen patches over lightening holes. Inspect security of attaching bolts around aft canopy and inspect plexiglas for tears or cracks. Inspect security and condition of tie-down straps in the baggage compartment. When inspection plates are removed, examine the condition of the fibre stop nuts.

100-120 Hour Inspection

Check tension of main landing gear door control cables as per Section IV, paragraph 3 *c* (2).

NIGHT FLYING EQUIPMENT

Preflight

Check the operation of the position, cockpit, landing, and recognition lights.

OXYGEN EQUIPMENT

Preflight

Check for sufficient oxygen as indicated by a pressure of 400 lb/sq in. to 425 lb/sq in. immediately after recharging.

Note

Before filling oxygen system, thoroughly clean all dirt, oil, and grease from the filler box. Filler couplers without cover box must be very carefully cleaned before being used. After filling bottles, pressure may drop as much as 30 lb/sq in., as oxygen becomes heated during filling and later cools. This pressure drop does not necessarily indicate a leak. After attaching filling cylinder to system line, open regulator valve on cylinder slowly until a pressure of approximately 425 lb/sq in. is registered on the gage. Do not charge the system to a pressure in excess of 450 lb/sq in.

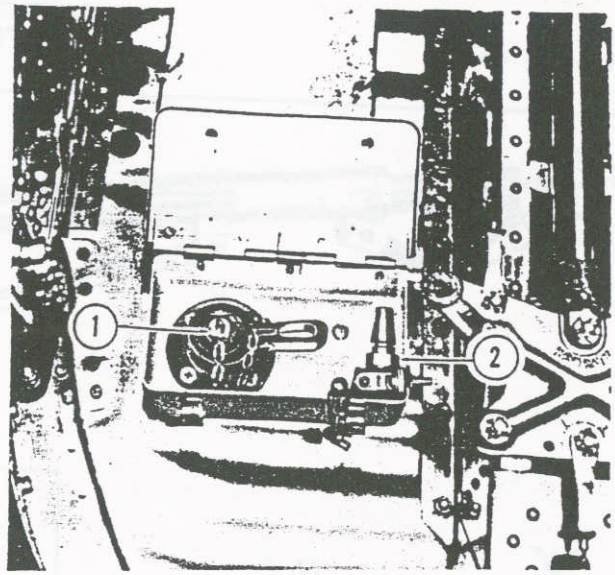


Figure 402 — Oxygen Filler Valve and British Adapter

WARNING

Take every precaution when using oxygen equipment to prevent contamination with oil or grease. Fire or explosion will result when slight traces of oil or grease come in contact with oxygen under pressure. Make sure that all lines, instruments, clothing, and other items are free from oil, grease, and other foreign matter.

Check demand regulator for completeness and proper operation. With AUTO-MIX and EMERGENCY VALVE in "OFF" position, depress the diaphragm, accessible through the hole in the cover.

CAUTION

Do not use any sharp-pointed instrument to depress the diaphragm.

A noticeable stream of oxygen should pass through the elbow indicating that the oxygen is flowing freely. Release the button and open the EMERGENCY valve to ascertain that it is in operating condition. Breathe through mask with regulator emergency control and AUTO-MIX control "OFF" to ascertain that flow indicator is operating correctly. Check for sufficient oxygen