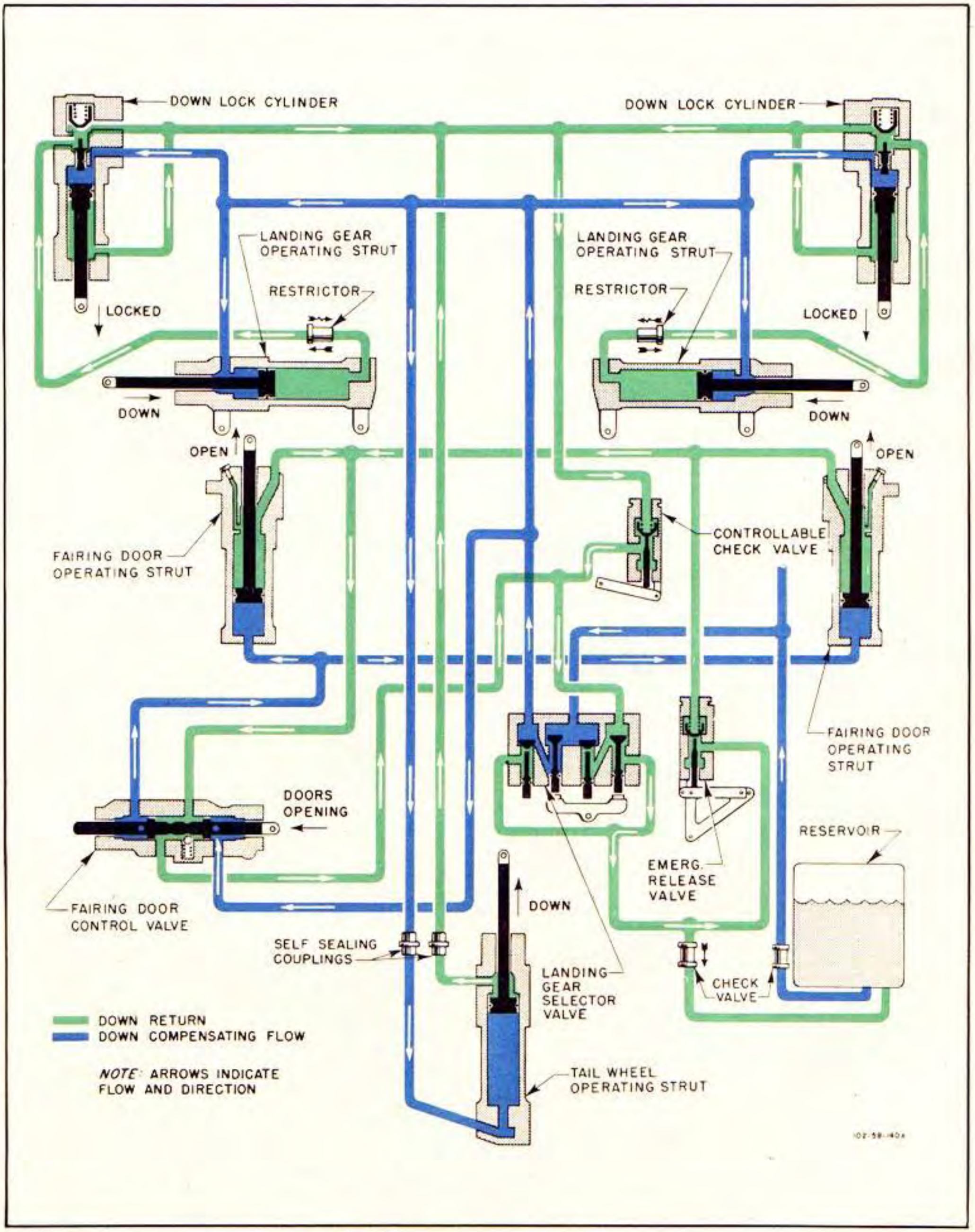


Figure 318—Hydraulic Landing Gear System Flow Chart—Fairing Doors Opening, Gear Extending

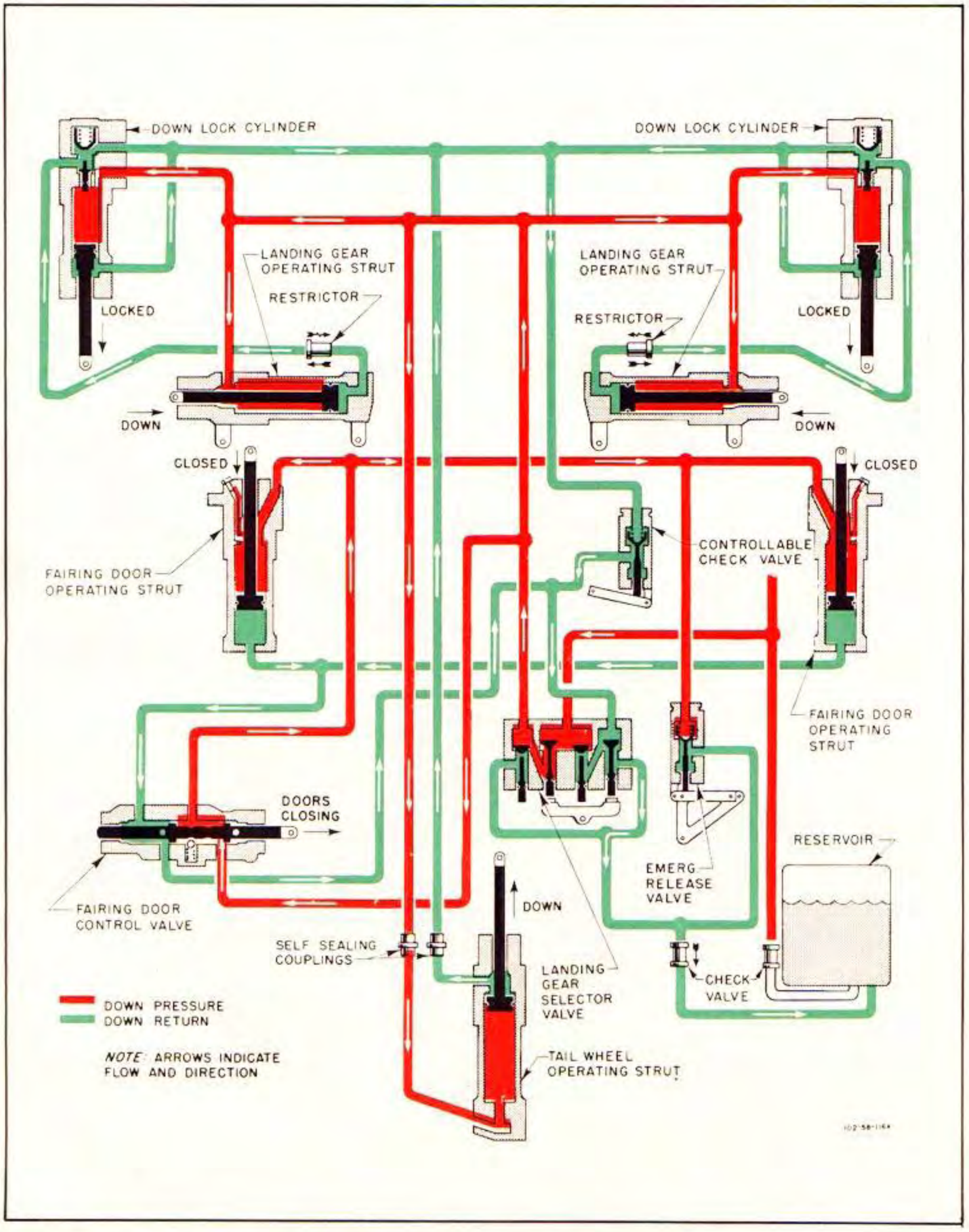


Figure 319—Hydraulic Landing Gear System Flow Chart—Gear Down, Fairing Doors Closing

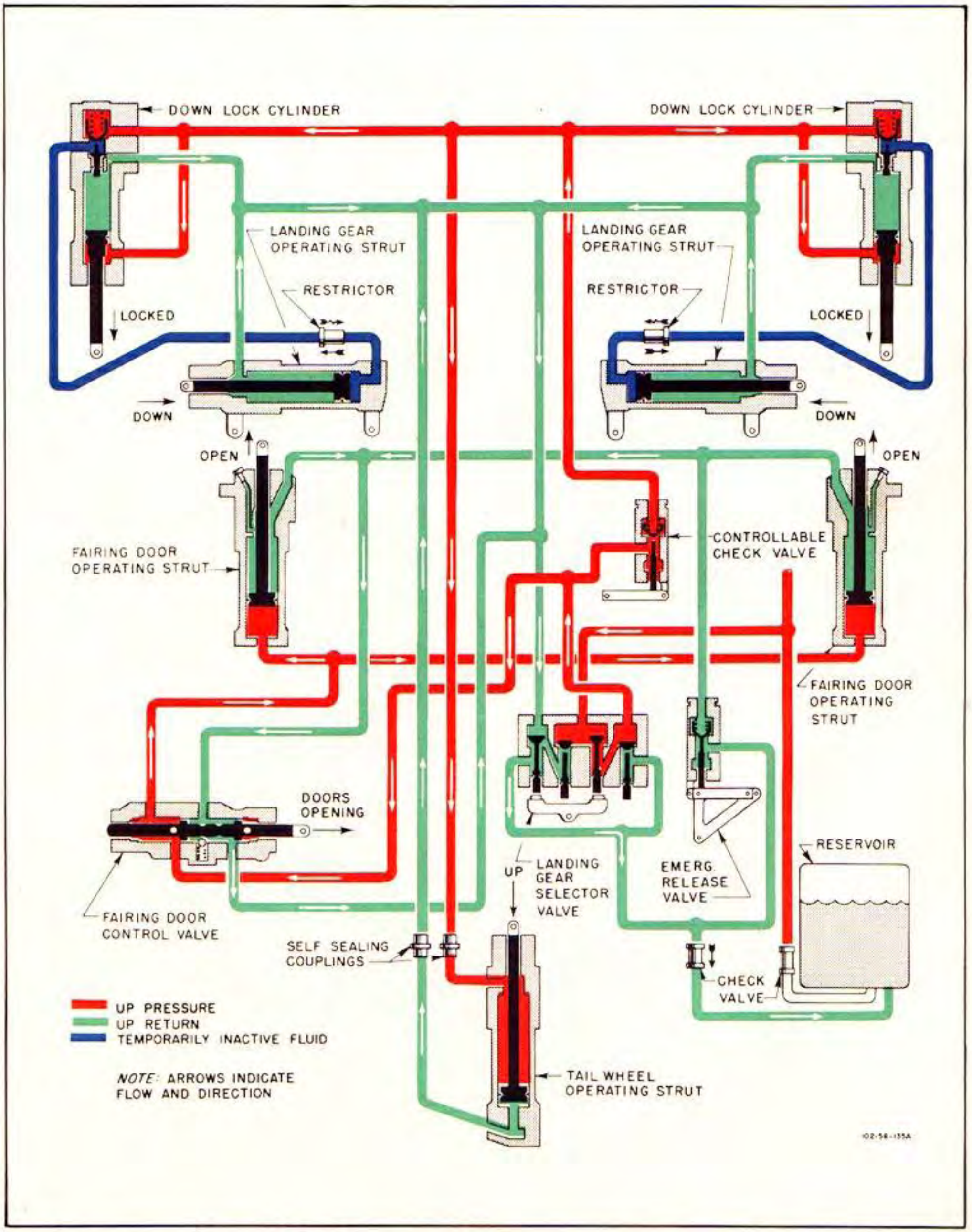


Figure 320—Hydraulic Landing Gear System Flow Chart—Fairing Doors Opening, Gear Retracting

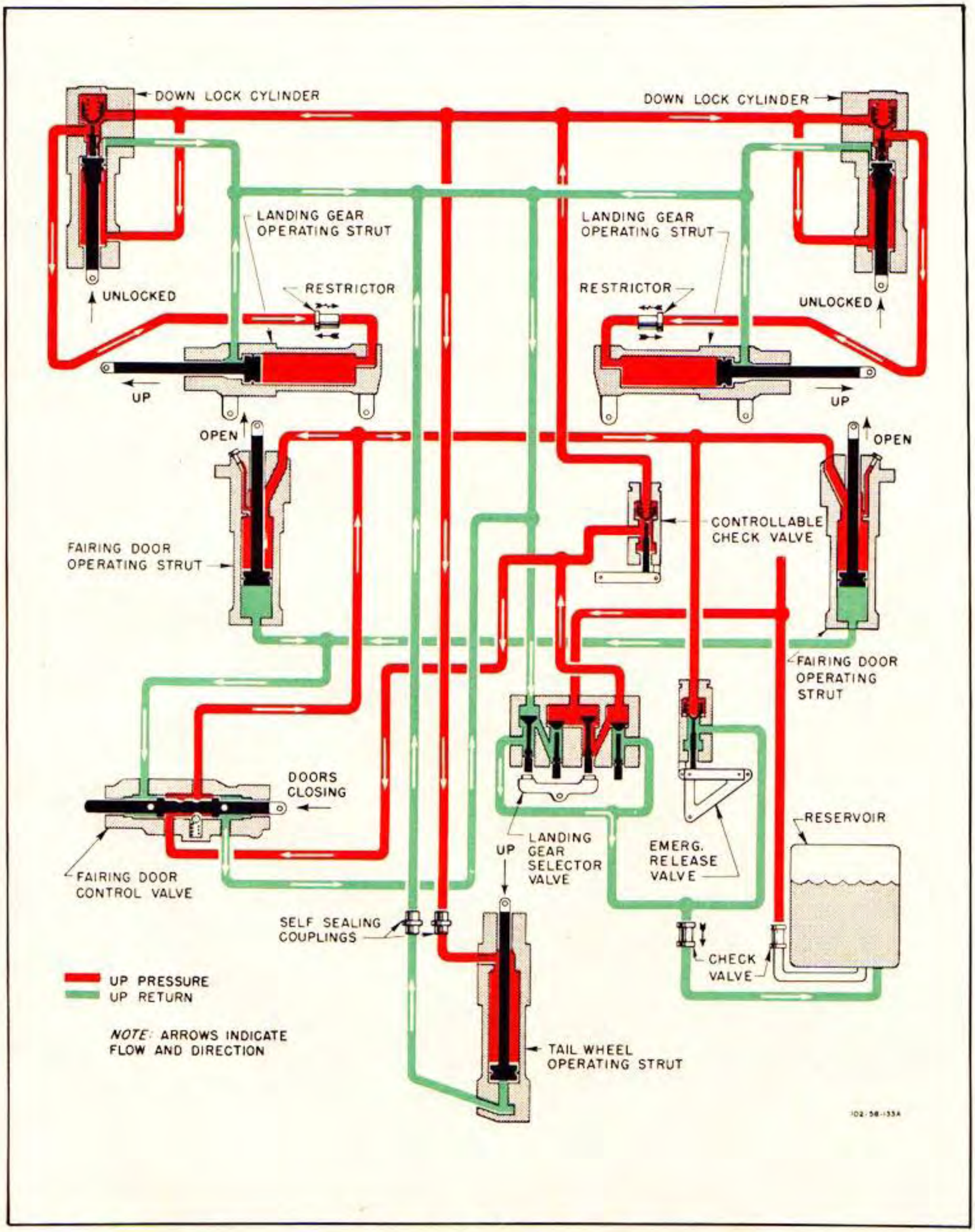


Figure 321—Hydraulic Landing Gear System Flow Chart—Gear Up, Fairing Doors Closing

2. Set the rod, which links the control handle to the bellcrank installed on the longeron, to a measurement of 15¼ inches.

3. Set the link rod, extending between the longeron bellcrank and the bellcrank assembly on the wing center rib, to a measurement of 15 inches.

4. With the landing gear selector valve in neutral, connect link rod between bellcrank assembly and selector valve arm.

(b) ADJUSTING LANDING GEAR OPERATING STRUT LINKAGE.

1. Bottom the piston in the cylinder (full in position).

2. Pull the piston rod out ⅛ inch from bottom; this leaves ⅜ inch of the piston showing. With the gear in down-locked position, adjust the main gear actuating rod so that the mushroom head bolt in the rod is directly above the gear position indicator switch.

3. Adjust the piston rod clevis and connect the gear actuating rod.

(c) ADJUSTING LANDING GEAR DOWN-LOCK LINKAGE.

1. Release pressure in system and push in the actuating arm at the strut link end to pull down-lockpin, allowing the gear to swing inward.

2. Release actuating arm, allowing the pin to go against the face of the torque arm, and then push in actuating arm to pull pin.

3. Adjust the down-lock valve rod to the actuating arm until movement of the pin is ⅛ (± ⅛) inch (clearance between torque arm and pin with pin completely pulled).

Note

The down-lock strut should pull the down-lockpin while an inward pull of 35 pounds is applied to the tow ring near wheel.

(d) ADJUSTING FAIRING DOOR CONTROL VALVE LINKAGE.

1. Move the control valve shaft to feel the inner and outer detent positions. Pull the shaft to the outer detent and the crossbar to the outboard edge of the slot. Then adjust the fairing door control valve rods so that the crossbar is at a 90-degree angle to the valve and the valve bellcrank is at a 90-degree angle to the rod.

2. In each wheel well, adjust the pin (which contacts the brake flange of the wheel when the gear is in the up position) to a measurement of 3⅜ inches from the lowest point of the stringer directly above the pin to the lower end of the pin.

3. Loosen the cable which extends from the top of each landing gear strut to the bellcrank and pin assembly.

4. With the test stand, raise the gear. When the gear is up, striking the pin, the control valve plunger should be in the inner detent so as to close the doors.

5. If the control valve plunger does not move in far enough, lengthen the pins. If the control valve plunger moves too far, shorten the pins.

6. Lower the gear to the down-locked position. Then tighten the fairing door control valve cables equally, until the control valve plunger moves to the outer detent position.

(e) TESTING FAIRING DOOR CONTROL VALVE ADJUSTMENT.

1. With the test stand running, hold one gear in the down-locked position and place the landing gear control handle in the "UP" position. The opposite gear will retract but the fairing doors should not close until the gear being held down is released and also reaches the up position.

2. Hold one gear up by holding the fairing doors closed, and move the landing gear control handle to the "DOWN" position. The opposite gear will go to the down-locked position, but the fairing doors should not close until the gear being held up is released and reaches the down-locked position.

Note

During the operation, reduce the test stand flow to approximately 1.5 gpm or turn test stand off when the gear is partially down, to eliminate excessive jarring of the airplane.

3. Repeat both operations on the opposite gear. If operation does not meet test specifications, readjustment is necessary.

(f) ADJUSTING FAIRING DOOR OPERATING STRUTS.

1. Loosen the jam nut on the operating strut and back out the rod end approximately 2 or 3 turns. Connect the operating strut to the fairing doors. Then close the fairing doors with hydraulic pressure and observe the approximate door gap.

2. Exhaust hydraulic pressure. Adjust the rod end of the operating strut so that the doors will close tightly all the way around. Then lock rod end of operating strut by tightening jam nut.

Note

Make a final check to see that the doors seat properly. There should be no gap in the doors or any buckling of the wing skin.

(g) ADJUSTING EMERGENCY RELEASE VALVE.—With the emergency valve control knob pulled out, screw the valve lever adjusting screw in until the valve is just open. Then screw it in two additional turns. When handle is pushed in, the valve should be closed for pressure to be built up and held. With the emergency release knob in and the landing gear in the up position (fairing doors disconnected), adjust the link rod, extending from the emergency release valve lever to the door lock torque tube bellcrank, so that the bolt on the bellcrank clears the end of the slot in link rod by ⅛ inch.

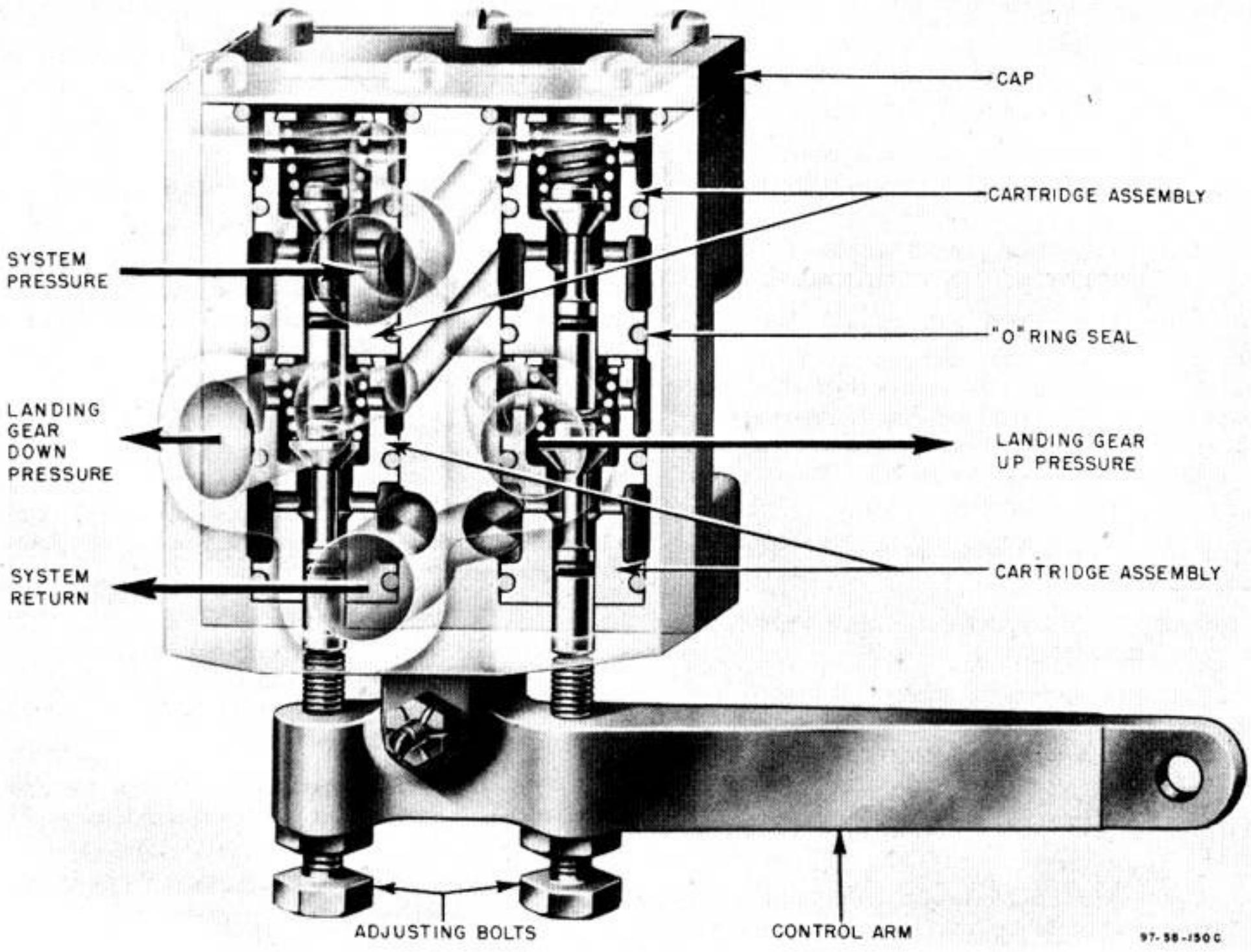


Figure 322—Hydraulic Landing Gear Selector Valve

(3) LANDING GEAR SELECTOR VALVE.

(See figure 322.)

(a) DESCRIPTION.—The landing gear selector valve is mounted on a bracket near the center beam at the rear of the right wheel well. A control rod interconnects it with the cockpit landing gear control handle. The valve consists of four cartridges and a control lever provided with setscrews for proper adjustment of the cartridge plungers. "O" rings seal off flows between the cartridges and between the fluid access holes. When the landing gear control handle in the cockpit is positioned to extend the gear, the selector valve cartridges will be mechanically positioned. Main system static pressure is thereby free to flow to the poppet chamber of the opposite cartridge to which the down side of the landing gear and tail wheel operating struts are connected. Return flow from the operating struts is admitted to the valve and as the corresponding cartridge poppet is unseated, free flow is established back to the reservoir. Return fluid in the other two cartridges will not unseat the poppets because of greater pressure in the opposing poppet chambers. When the pilot's control handle is positioned for landing gear up, the opposite set of cartridge plungers is depressed, reversing the flows. Pressure flow is directed to the up side of the landing gear operating struts and return flow from its down side enters the valve, where free flow is established past the unseated poppet to the system return port.

(b) REMOVING LANDING GEAR SELECTOR VALVE.—To remove the selector valve (in the right wheel well), disconnect the lines and control linkage, and remove the two attaching bolts.

(c) DISASSEMBLING LANDING GEAR SELECTOR VALVE.—Remove cap from top of valve and pull out cartridges, being careful not to damage seal rings. Figure 323 shows valve cartridge.

(d) REPLACEMENTS – LANDING GEAR SELECTOR VALVE.—When replacing cartridges, care must be taken not to damage seal rings. If the spare cartridges have been stored with seal rings on them, the rings may be swelled and cause difficulty in putting cartridges in valve. If so, replace all the ring seals.

(e) ASSEMBLING LANDING GEAR SELECTOR VALVE.—Be sure the correct size seal rings are used, and that they are not damaged when cartridge is installed. Safety the cap.

(f) TESTING AND ADJUSTING LANDING GEAR SELECTOR VALVE.

1. With return port plugged and with handle in neutral position, apply 2000 pounds per square inch pressure at pressure port. Screw in both adjusting screws until there is equal amount of flow from both cylinder ports. Back off adjusting screws until pressure valves just seat and shut off flow entirely; then back off screws enough so that return poppet will just close before pressure poppet opens. Lock screws in place. There should be no leakage.

2. Plug pressure and return ports and apply 1200 pounds per square inch pressure at port C. Push handle toward valve. There should be no leak at port A. With handle in neutral position, check flow from port C to port A at 3 gpm. Back pressure should be 50 pounds per square inch maximum. Reverse and repeat same procedure from A to C.

3. Normal travel of handle not to exceed 7/16 (± 1/16) inch either side of neutral to check flow of operations.

4. Apply 1200 pounds per square inch pressure at pressure port and operate handle to alternate positions to check flow (3 gpm at 25 pounds per square inch maximum back pressure).

5. With all other ports plugged, apply 2000 pounds per square inch pressure at return port and check for external leaks.

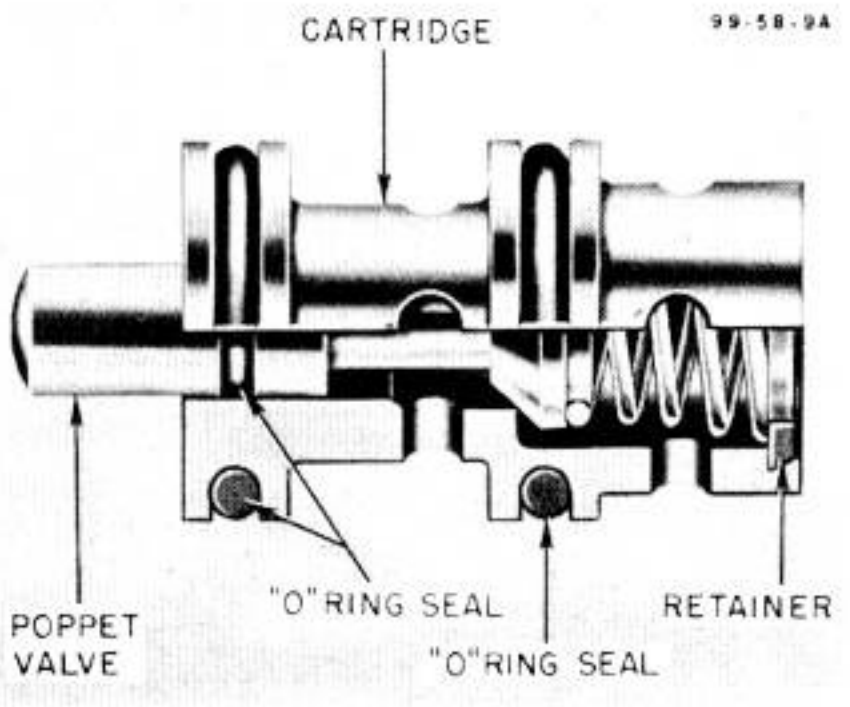


Figure 323—Hydraulic Landing Gear Selector Valve Cartridge

(4) HYDRAULIC LANDING GEAR DOWN-LOCK STRUT. *(See figure 324.)*

(a) DESCRIPTION.—The landing gear down-lock actuating struts are located adjacent to the inboard side of the landing gear support casting in each wheel well and are linked to the down-lockpin. A poppet valve in the lock strut prevents the fluid from flowing to the landing gear operating strut before the lockpin has been retracted. When the landing gear control handle is in "DOWN," pressure flow is directed to extend the piston and lock the down-lockpin. Return flow from the operating strut enters the down-lock

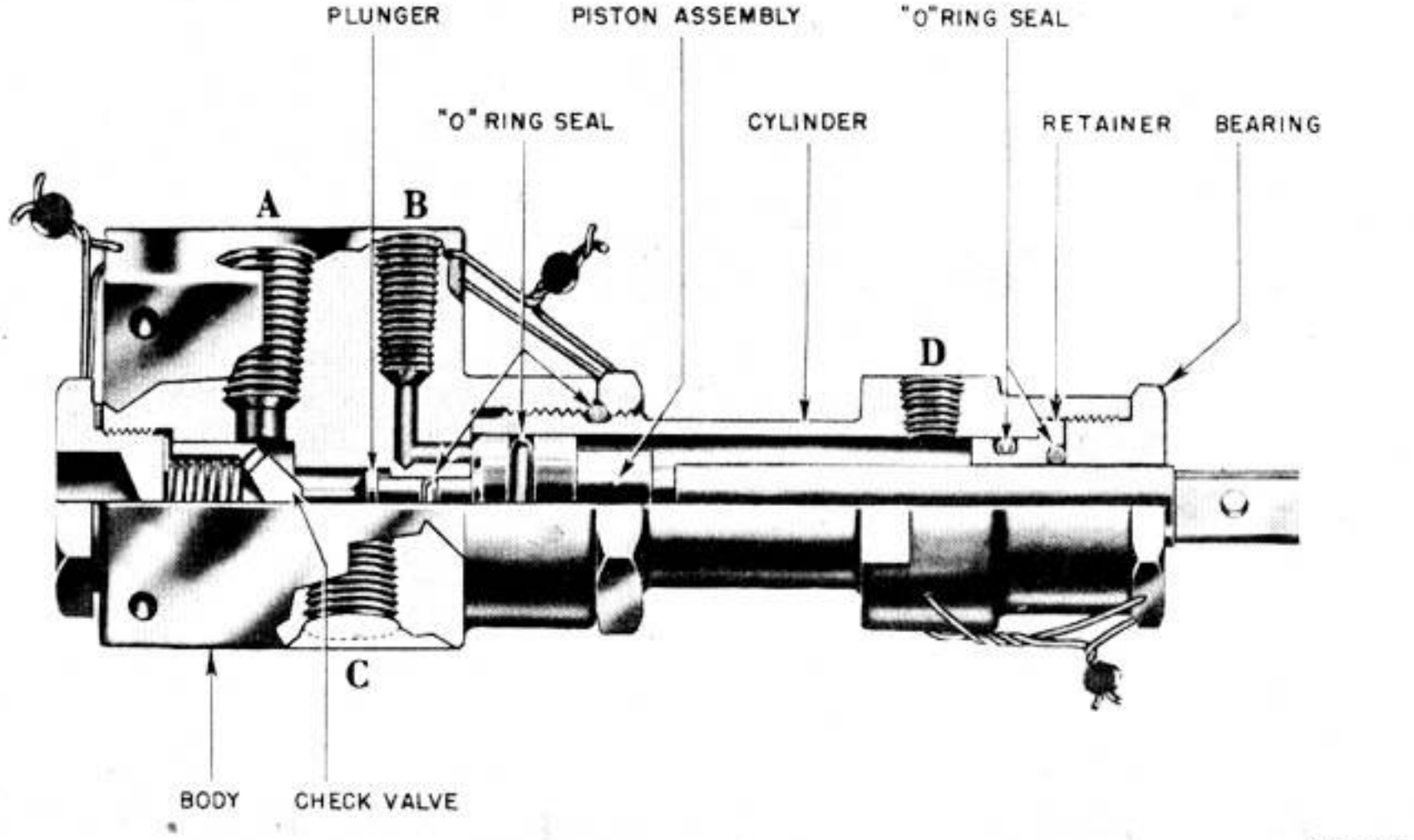


Figure 324—Hydraulic Landing Gear Down-lock Strut

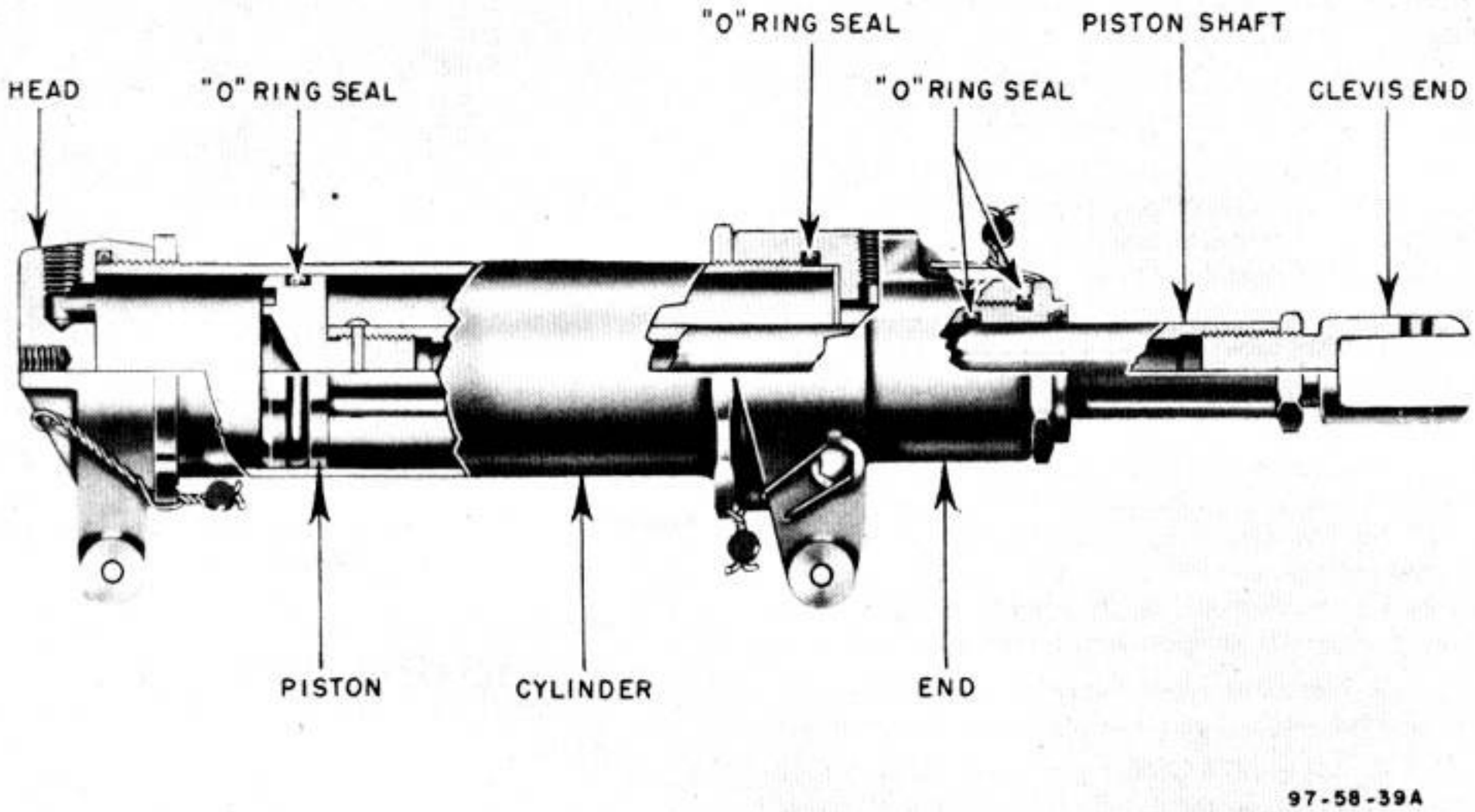


Figure 325—Hydraulic Landing Gear Operating Strut

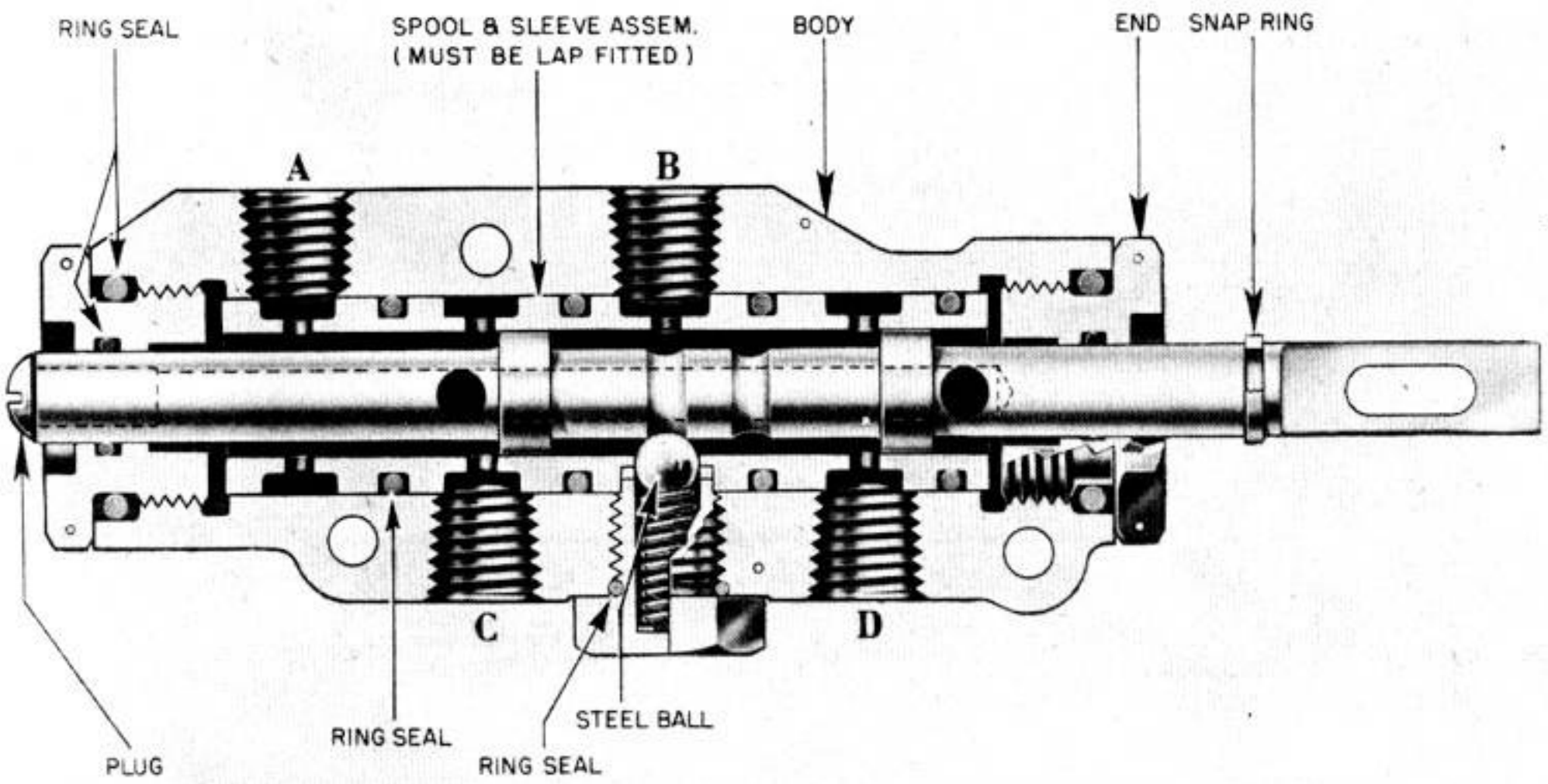


Figure 326—Hydraulic Fairing Door Control Valve

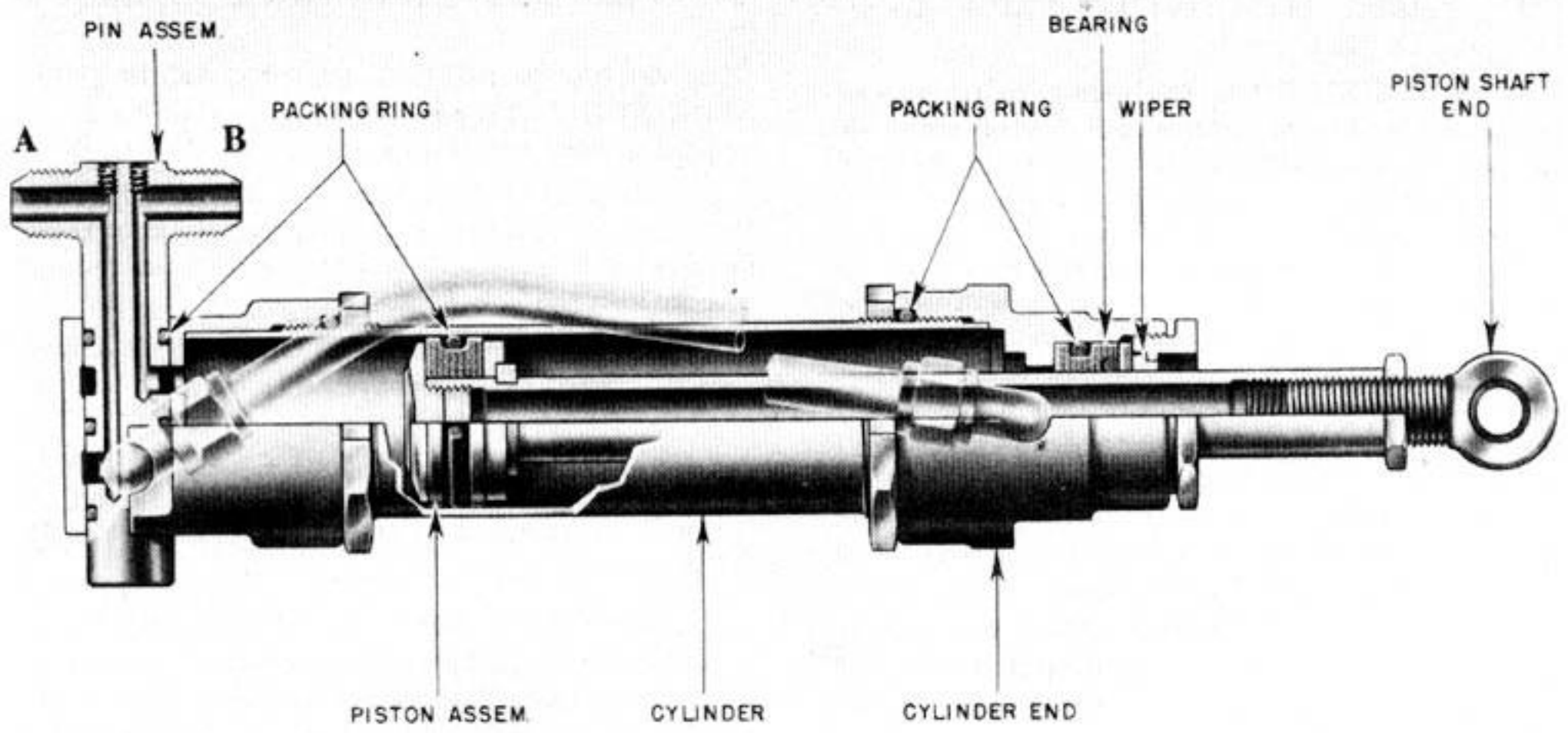


Figure 327—Hydraulic Fairing Door Operating Strut

strut, there flows past the one-way valve and out to the reservoir. When the operation is reversed to retract the gear, fluid flows to the down-lock strut to retract the lock piston and disengage the landing gear down-lock. At the end of its travel, the down-lock piston moves the plunger which mechanically opens the poppet valve, admitting pressure flow to the up side of the landing gear operating strut.

(b) REMOVING DOWN-LOCK STRUT.—The down-lock strut is in the landing gear bay. Disconnect the lines and linkage, and remove the two attaching bolts.

(c) DISASSEMBLING DOWN-LOCK STRUT.—Remove bearing from end of cylinder. Remove retainer and piston assembly. Unscrew nut in the end of the body, and remove the check valve and plunger.

(d) REPLACEMENTS—DOWN-LOCK STRUT.—Make sure that ring seal replacements are the proper size, and are not twisted when installed.

(e) INSTALLING DOWN-LOCK STRUT.—Attach with two bolts, connect lines to lock, and hook up linkage.

(f) TESTING DOWN-LOCK ACTUATING STRUT.

1. Apply 2000 pounds per square inch pressure at port A. Check for leaks. Release pressure at port A and push piston to the bottom to open valve. Test for free flow from port C. Pull piston rod. Valve should close and hold 2000 pounds per square inch pressure.

2. Apply pressure at port C. There should be free flow out port A.

3. Apply 2000 pounds per square inch pressure at port B. There should be no leakage from ports C or D.

4. Apply 2000 pounds per square inch pressure at port D. There should be no leakage from port B.

5. Apply 3 gpm flow at port C. With A open, pressure at port C should not exceed 50 pounds per square inch.

(5) HYDRAULIC LANDING GEAR OPERATING STRUT. *(See figure 325.)*

(a) DESCRIPTION.—The landing gear operating struts, one in each wheel well, are accessible when the gear is extended. The strut is the conventional piston-type, being connected into the system in such a manner that the piston extends to retract the gear, and retracts to extend the gear.

(b) REMOVING LANDING GEAR OPERATING STRUT.—Disconnect lines and linkage, and remove the four attaching bolts.

(c) REPLACEMENTS—LANDING GEAR OPERATING STRUT.—Piston may be removed by taking off clevis end and cylinder end. If strut leaks around piston rod, retainer nut packing seals may be replaced without removing strut from airplane by disconnecting linkage, removing clevis end, and unscrewing retainer nut and sliding it off over piston rod end.

(d) INSTALLING LANDING GEAR OPERATING STRUT.—Attach with four bolts and connect lines and linkage. Adjust linkage so that strut piston is ⅛ inch to ⅜ inch from bottom in gear down position.

(e) TESTING LANDING GEAR OPERATING STRUT. *(Refer to paragraph 19. b. (4) (d) in this section.)*

(6) FAIRING DOOR CONTROL VALVE. *(See figure 326.)*

(a) DESCRIPTION.—The landing gear fairing door control valve is bolted to the left side of the wing center rib. This valve distributes pressure and return flows for the opening and closing of the wheel well fairing doors, and is interconnected by cable and rod linkage to the landing gear shock struts in such a manner as to perform these functions automatically upon the extension or retraction of the gear. When the gear is being extended, the fairing door control valve is positioned to direct system pressure to the open side of the fairing door struts. Return flow from the closed side of the struts flows through the valve and back to the reservoir. As the gear reaches the extended position, it shifts the fairing door control valve to direct system pressure to the closed side of the fairing door struts. Return flow is routed through the valve and back to the reservoir. When the gear is being retracted, system pressure is directed to the opposite side of the fairing door control valve to open the doors. As the gear reaches the up position, it repositions the valve to direct pressure flow to close the doors and complete the landing gear cycle.

(b) REMOVING FAIRING DOOR CONTROL VALVE.—The control valve is accessible from the left wheel well. To remove, disconnect the lines, linkage, and the three attachment bolts.

(c) REPLACEMENTS—FAIRING DOOR CONTROL VALVE.—To remove spool and sleeve, remove ball and spring snap, take plug out of end of the spool, remove opposite valve end, and pull out spool and sleeve. As the spool and sleeve must be lap-fitted, replace them as a unit.

(d) INSTALLING FAIRING DOOR CONTROL VALVE.—Attach valve by three bolts, connect lines, and connect control linkage.

(e) TESTING AND ADJUSTING FAIRING DOOR CONTROL VALVE.—Plug ports C and D and apply 1000 pounds per square inch pressure at port A. Maximum leakage from B: 50 drops per minute with valve in either position. Apply 2000 pounds per square inch pressure at ports C and D with ports A and B plugged. Check for external leaks. Adjust spring load on position ball by adding or removing washers so that 15 pounds to 25 pounds load is required to move valve spool from one position to another when there is no hydraulic pressure.

(7) HYDRAULIC FAIRING DOOR OPERATING STRUT. *(See figure 327.)*

(a) DESCRIPTION.—The fairing door struts, one in each wheel well, are attached to the wing main spar. The strut has a swivel-type head for movement when doors are opening and closing. The struts attach to the doors at the rear inboard corner.

(b) REMOVING FAIRING DOOR OPERATING STRUT.—It is necessary to remove the attaching bracket along with the operating strut as the swivel pin does not have sufficient clearance. Disconnect lines and linkage to door.

(c) REPLACEMENTS—FAIRING DOOR OPERATING STRUT.—The packing rings on the bearing may be replaced without removing the strut.

(d) INSTALLING FAIRING DOOR OPERATING STRUT.—Assemble the bracket and the strut before installing in the airplane. Bolt the bracket in place and connect the lines and linkage.

(e) TESTING FAIRING DOOR OPERATING STRUT. *(Refer to paragraph 19. b. (4) (d) in this section.)*

(8) HYDRAULIC LANDING GEAR CONTROLLABLE CHECK VALVE AND FAIRING DOOR EMERGENCY RELEASE VALVE. *(See figure 328.)*

(a) DESCRIPTION.—The controllable check valve in the landing gear system, and the emergency release valve in the fairing door system, are similar. The valve in the controllable check valve assembly is used as the landing gear up-lock; it has a small groove which allows slight leakage to relieve high pressure due to thermal expansion, and also has a different type of control lever. The controllable check valve is connected into the landing gear up pressure line, and is linked to the landing gear control lever. When the landing gear control handle is in the up position the check valve is closed; this arrangement prevents the landing gears from falling back when pressure is directed to closing the fairing doors. When the landing gear control handle is moved to the down position, the valve is opened to allow free flow for lowering the gear. The fairing door emergency valve is connected between the door operating struts up pressure line and system return line and is linked to the door locks. When the pilot's emergency release handle is pulled, the door locks are unlocked and the emergency valve is opened, relieving pressure on the doors up side of the fairing door struts and allowing the doors to fall open.

(b) REMOVING CONTROLLABLE CHECK VALVE AND EMERGENCY RELEASE VALVE.—The controllable check valve is accessible in the left wheel well. To remove the valve, disconnect the lines and linkage, and remove the two attaching bolts. The emergency release valve is accessible in the right wheel well. To remove the valve, disconnect the lines and linkage, and remove the two attaching bolts.

(c) REPLACEMENTS—CONTROLLABLE CHECK VALVE AND EMERGENCY RELEASE VALVE.—Remove valve end for access to seal rings.

(d) INSTALLING CONTROLLABLE CHECK VALVE AND EMERGENCY RELEASE VALVE.—Attach with two bolts and connect lines and linkage.

e. With engine running at 1800 rpm, turn "ON" the generator-disconnect switch. Then turn on an electrical load of about 50 amperes and note the reading on voltmeter.

f. Run engine up to 3000 rpm and note reading on voltmeter. If there is a difference of more than ½ volt between this reading and the previous reading, replace the regulator.

(d) REVERSE-CURRENT RELAY.

1. DESCRIPTION.—The reverse-current relay, mounted in the generator control box, connects the generator to the airplane's electrical system when the generator voltage reaches 26.5 volts or above. When generator voltage falls below 26.5 volts, a reverse current will flow from the battery to the generator and cause the relay to open automatically. However, the relay will only operate when the generator-disconnect switch is turned "ON."

2. REMOVING REVERSE-CURRENT RELAY.

a. Make sure that no external power is connected to the airplane, and that the battery-disconnect switch is "OFF."

b. Remove the access door just forward of the windshield, and remove the cover on the generator control box.

c. Remove the four wires from the terminals on the relay. If another reverse-current relay is not to be installed immediately, tape wires No. 42 and 8 to prevent a possible serious short circuit to ground should the battery-disconnect switch be turned "ON" or an external power be applied to the airplane.

d. Remove the four mounting screws and remove the relay.

CAUTION

Handle the reverse-current relay with care.

3. INSTALLING REVERSE-CURRENT RELAY.

a. Make sure that battery-disconnect switch is "OFF" and that no external power is connected to the airplane.

b. Position the relay and install the four mounting screws.

c. Connect the wires to the relay in accordance with the wiring diagram given at the end of this paragraph.

d. Adjust the relay. *(See 4. following.)*

e. Replace cover on generator control box and access door.

4. ADJUSTING REVERSE-CURRENT RELAY.

a. Start engine and permit it to attain operating temperature.

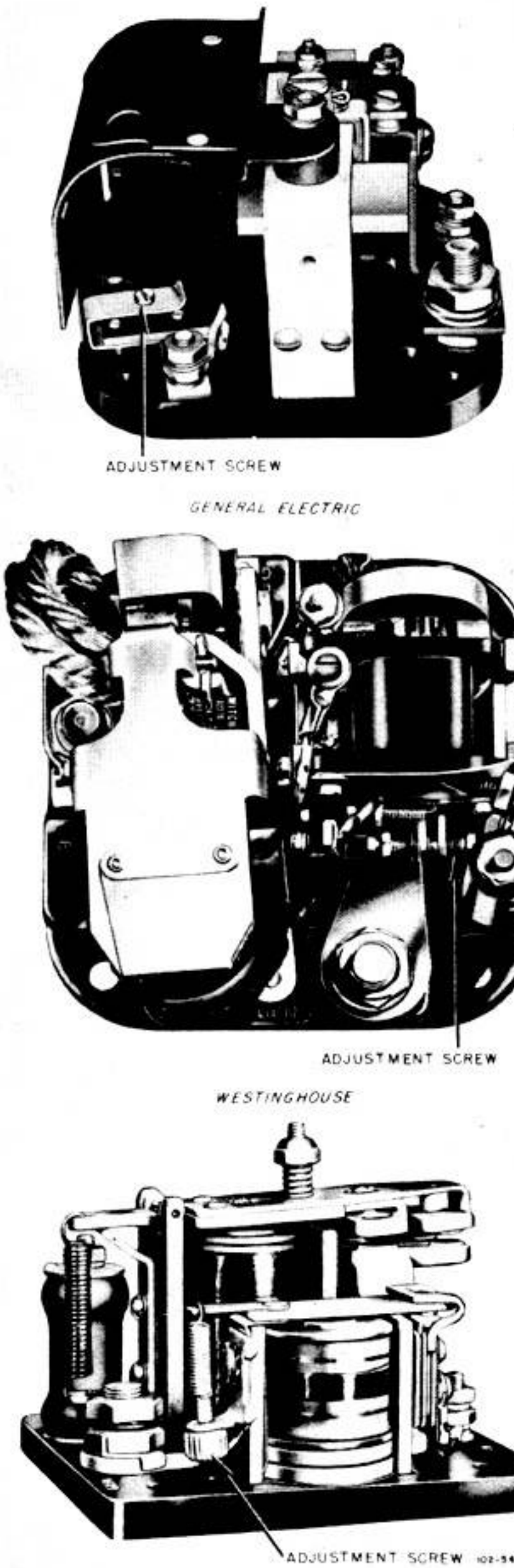


Figure 344—Reverse-current Relay Adjustment

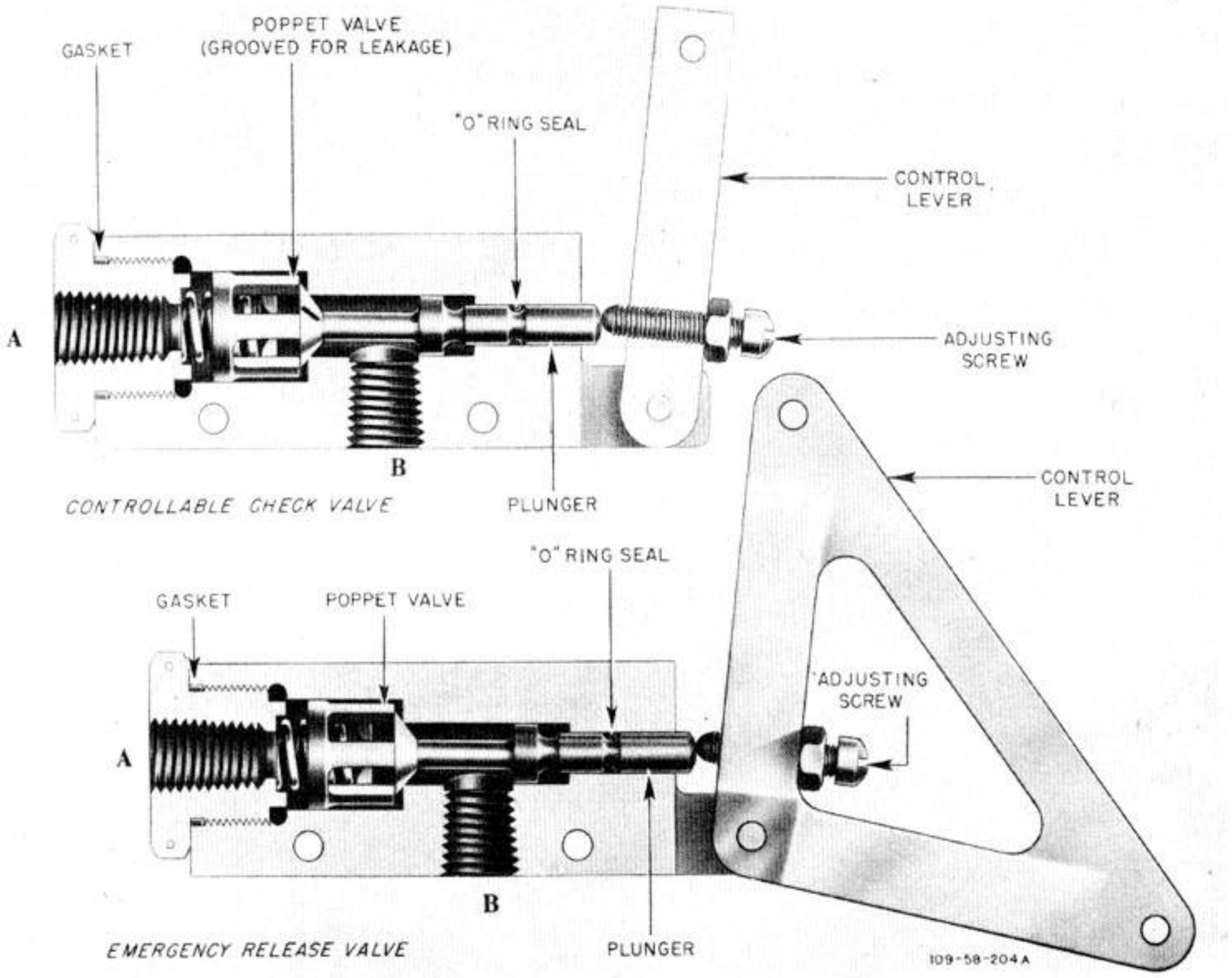


Figure 328—Hydraulic Controllable Check Valve and Emergency Release Valve

(e) TESTING AND ADJUSTING LANDING GEAR CONTROLLABLE CHECK VALVE AND FAIRING DOOR EMERGENCY RELEASE VALVE.—When testing controllable check valve assembly, apply 1000 pounds per square inch pressure at port A. With valve seated, leakage at port B should be ¾ to 1¼ pints per minute. With valve opened by handle, there should be free flow from A to B on both valves. Apply flow at B; there should be free flow out A on both valves. When testing emergency release valve assembly, apply 2000 pounds per square inch pressure at A; there should be no leakage. Test both valves by plugging A. Apply 2000 pounds per square inch pressure at B, and check for external leaks.

f. WING FLAP HYDRAULIC SYSTEM. *(See figure 329.)*

(1) GENERAL DESCRIPTION.—A single hydraulic operating strut operates the wing flaps through movement of a torque tube. System pressure and return flows for the operation of the flap strut are regulated by the wing flap control valve, which is controlled by a handle on the aft end of the pilot's control pedestal. A restrictor valve in the flaps down pressure line restricts flows to and from the operating strut, thereby preventing too rapid movement of the flaps. Preselection of flap positions is accomplished by a follow-up control linkage interconnecting the flap torque rod *(figure 330)* with the system control valve and flap control in pilot's cockpit. With the flaps in the up position, the follow-up linkage is as shown in black, none of the selector valve plungers being depressed. To lower the flaps, the control lever in pilot's cockpit is preselectively set, for instance, at 30 degrees. The follow-up linkage is thereby positioned as shown in green. Valve lever depresses valve plungers, admitting system pressure to the down side of the operating strut and establishing return flow to the reservoir from the up side of the flap actuating strut. As the flap torque rod turns upon lowering the flaps, the follow-up linkage is again displaced, this time by the action of torque rod arm and control link. Then as the follow-up arm (shown in green) is moved, pressure is gradually reduced on valve plungers until, in the position shown in red, the follow-up arm has attained its initial

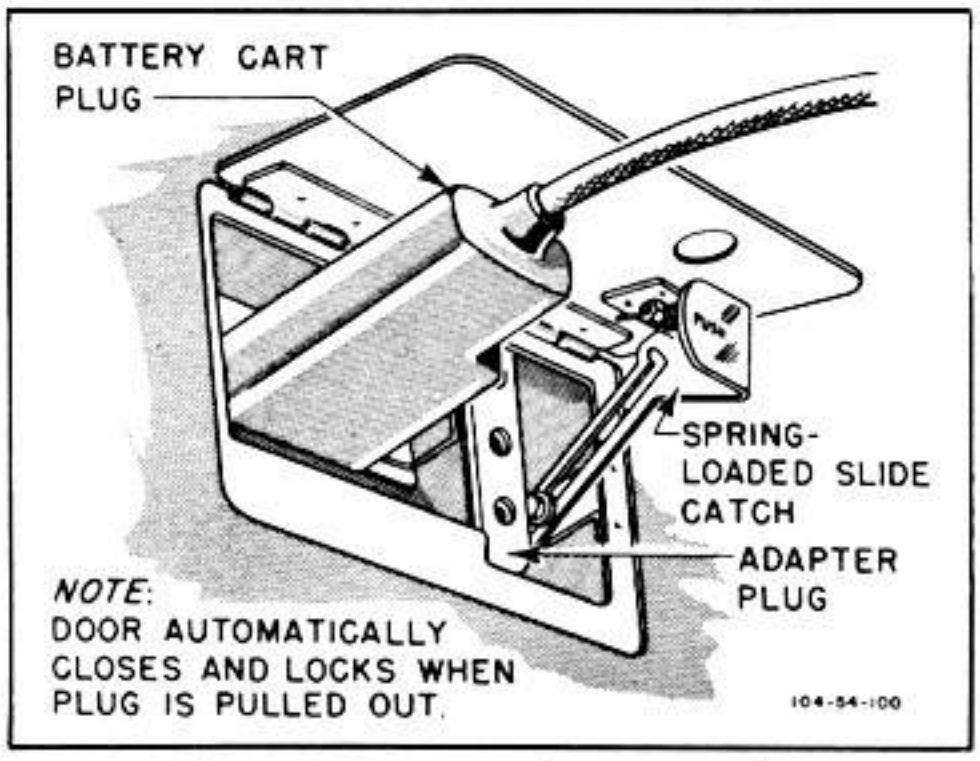


Figure 345—External Power Socket

b. Attach the positive lead of an external voltmeter to the "B" terminal on voltage regulator, and the negative lead to the airplane electrical ground.

c. Turn "ON" generator switch.

d. Gradually increase speed of engine until a current reading is noted on the ammeter on the right switch panel. The voltmeter will show a slight drop as relay closes. The voltage reading immediately before closing of the relay is the relay closing voltage, and should be between 26 and 26.5 volts. If voltage is not between these values, adjust relay. *(See figure 344.)*

(3) ALTERNATING CURRENT INVERTER.—A 400-cycle, 26-volt alternating current, required for the remote-reading compass, is supplied by a battery-driven rotary inverter mounted on the right side of the cockpit floor, just aft of the firewall. On early airplanes, the inverter is on forward left side of instrument subpanel. On later airplanes, the inverter is mounted on the right side of the generator control box. There is no control switch, as the inverter is connected directly to the electrical system and operates whenever the battery-disconnect switch is closed, or whenever the electrical system is *hot*.

(4) EXTERNAL POWER SOCKET.—An external power socket *(figure 345)* on the right side of the fuselage just above the trailing edge of the wing permits the attachment of an external source of power for starting, ground checks, and for charging the battery. *(See paragraph 20. c. (1) (d) of this section.)* The access door is spring-loaded to permit removal of the plug without entering the propeller blast. An adapter plug is furnished to facilitate the connection of the British type external power supply.

CAUTION

The proper external voltage (24 volts) is stenciled on the external power socket access door. This voltage must be adhered to, to prevent damage to units in the electrical system.

d. IGNITION SYSTEM.—See paragraph 13 of this section.

e. ENGINE STARTING SYSTEM.—See paragraph 14 of this section.

f. OIL AND COOLANT RADIATOR AIR OUTLET FLAP ACTUATORS.

(1) DESCRIPTION.—The outlet flaps operate entirely electrically through two automatic temperature-controlled actuators, a Type R-4310 for the oil and a Type R-4250 for the coolant flap. *(See figure 347.)* Each actuator has a thermostat and capillary bulb, two relay switches, a reversible motor, four limit switches, and two interrupter switches. See figure 346 for internal wiring of the actuator. The capillary-controlled thermostat governs the opening or closing of the scoop by controlling the rotation of the electric motor, which in turn operates a screw jack attached to the flap. In case of thermostat failure, manual operation switches on the scoop or left switch panel may be placed in either the "OPEN" or "CLOSED" position; the scoops are stopped in any position when switch is placed in the "OFF" position.

(2) REMOVING COOLANT RADIATOR AIR OUTLET FLAP ACTUATOR.

(a) Remove the access door located just aft of the coolant radiator flap in the bottom of the fuselage.

(b) Remove capillary bulb from coolant line just forward of radiator, and coil the line, taking particular care not to damage it. Remove electrical connector plug.

Note

If it is necessary at any time to remove either unit from the airplane for any reason other than a temperature check, the diastat may be disconnected from the actuator and left in the airplane. Diastats are interchangeable on units of the same type number only. To remove the diastat, remove the

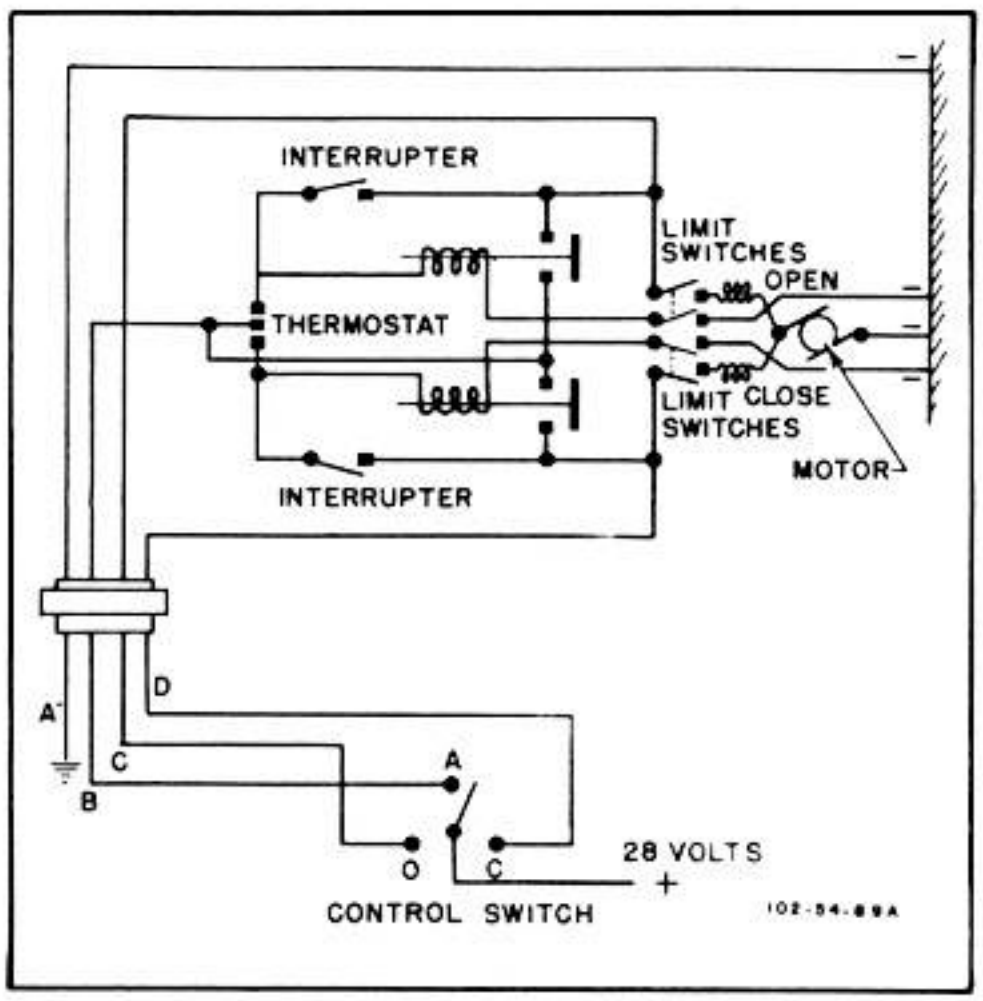


Figure 346—Internal Wiring of Radiator-Air Outlet Flap Actuator

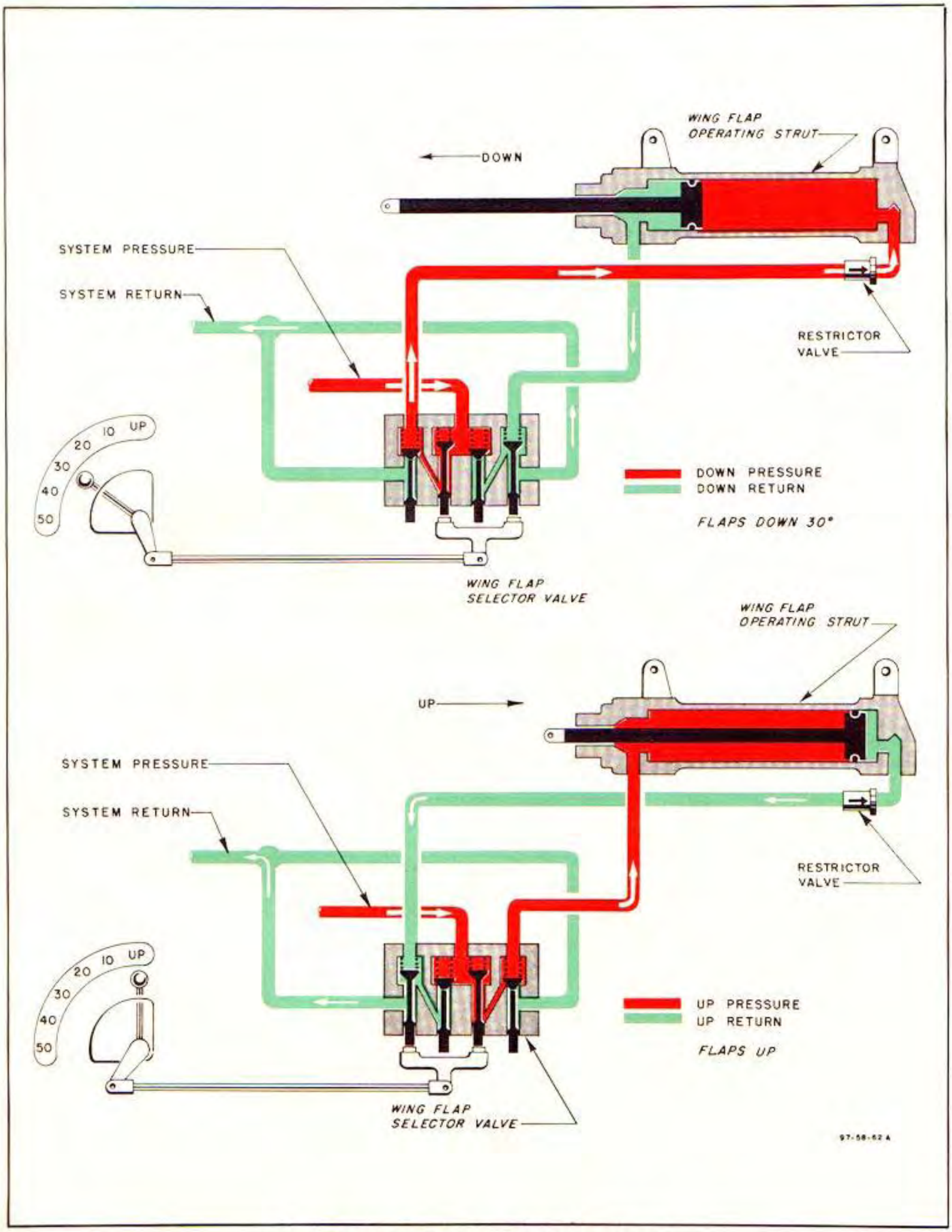


Figure 329—Hydraulic Wing Flap System Flow Chart

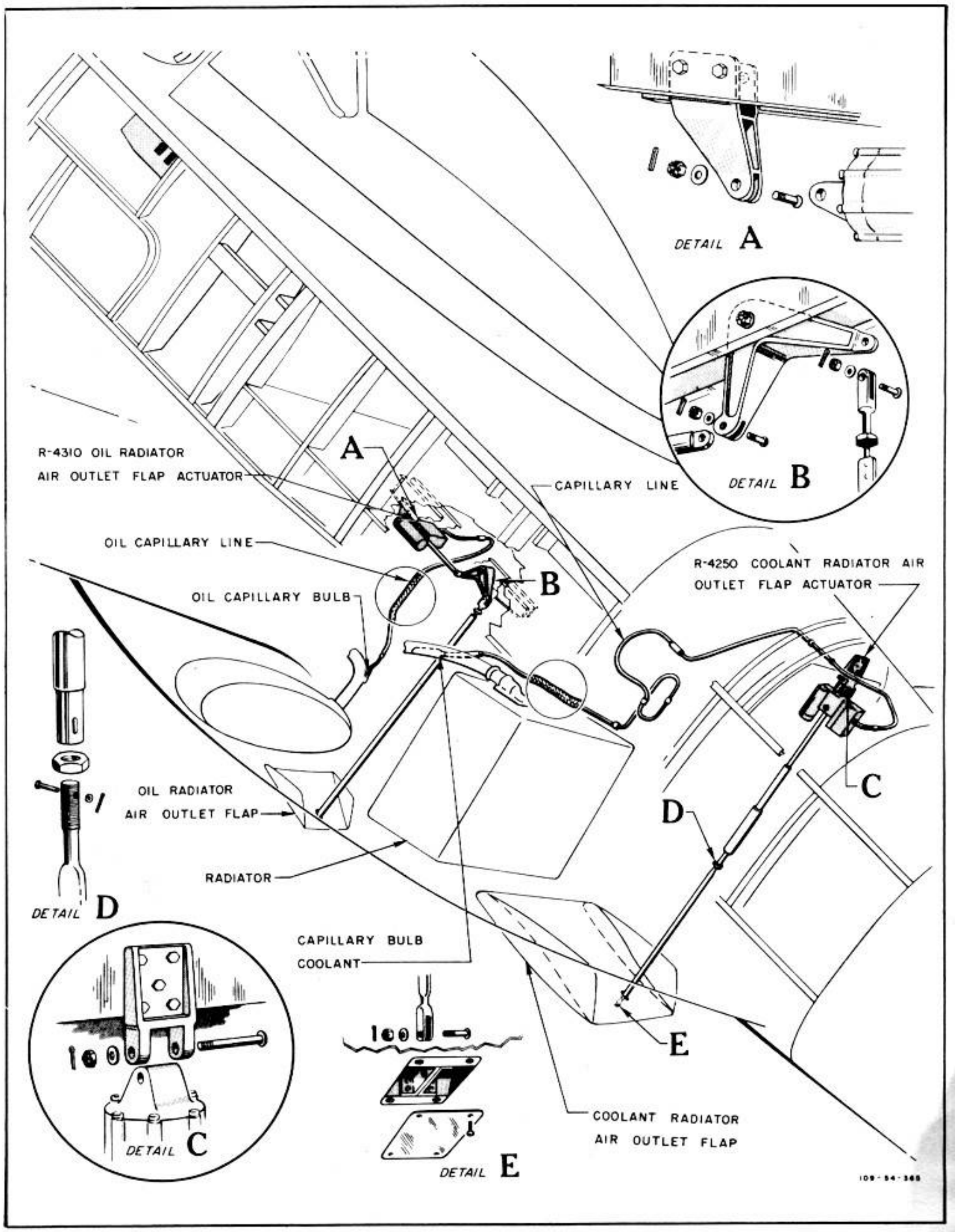


Figure 347—Oil and Coolant Radiator Air Outlet Flap Actuators

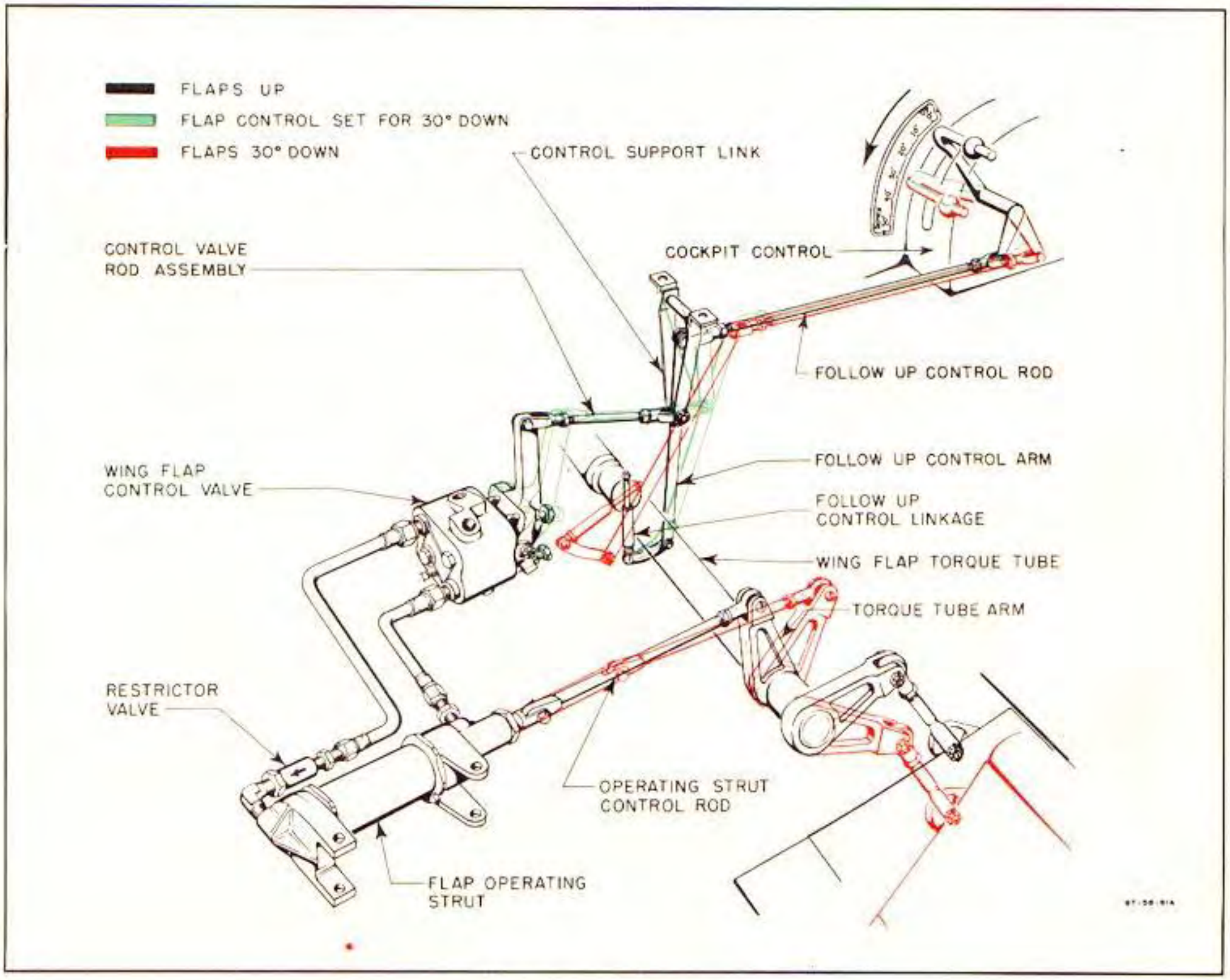


Figure 330—Preselective Flap Control Mechanism

positioning relative to the valve lever, and pressure on the valve plungers is entirely relieved. Flows to and from the strut are thereby automatically shut off. The flaps are now in the 30 degrees down position and will remain locked in that position until another flap setting is preselected.

(2) WING FLAP CONTROL ADJUSTMENT AND OPERATION.

(a) Disconnect control rod from the control valve lever.

(b) On early airplanes, adjust the link from the operating strut to the torque tube arm to approximately 10⅜ inches. On later airplanes with swivel end operating strut, screw the operating strut clevis end out to a distance of approximately half of the adjusting threads.

(c) Operating by hand, move the control valve to the up position and allow the operating strut to bottom. Adjust links extending from the torque tube arms to the flaps so that the flaps are against the stops just before the operating strut bottoms. Excessive deflection of the flap mechanism is undesirable.

(d) Move the control valve to the down position. When flaps are full down, there should not be less than 46 degrees down movement or less than 1/16-inch overlap between wing skin and the flap rubbing strip. To increase flap travel, shorten the link or clevis end from operating strut to torque tube arm and readjust links from torque tube arms to flaps. To decrease travel, lengthen the link or clevis end from the operating strut to torque tube arm and readjust the links from torque tube arms to flaps.

(e) To adjust the control rod which connects to the control valve lever, shorten to increase flap travel at intermediate positions, lengthen to decrease flap travel at

shield over the control unit and remove the four screws that hold the thermostat diaphragm in place.

(c) Disconnect the connecting rod, between the scoop flap and the actuator, at the scoop flap end.

(d) Unscrew the rod from the driven-end fitting of the actuator, remove the bolt at its main fitting, and remove the actuator.

CAUTION

Never lift or carry the actuator by the braided capillary tubing.

(3) REMOVING OIL RADIATOR AIR OUTLET FLAP ACTUATOR.

(a) Remove the two rear wing fillets for access to the actuator.

(b) Remove the capillary bulb and coil the line, taking particular care not to damage it. Remove the electrical connector plug.

Note

If it is necessary at any time to remove either unit from the airplane for any reason other than a temperature check, the diastat may be disconnected from the actuator and left in the airplane. Diastats are interchangeable on units of the same type number only. To remove the diastat, remove the shield over the control unit and remove the four screws that hold the thermostat diaphragm in place.

(c) Disconnect the driven-end fitting from the bellcrank; then remove the bolt through the main fitting at the motor end and remove the actuator.

CAUTION

Never lift or carry the actuator by the braided capillary tubing.

(4) REPLACING ACTUATOR TEMPERATURE-SENSITIVE ELEMENT. *(See figure 348.)*

(a) Remove the dust cover (6) covering control switches.

(b) Remove the four screws (7) and the temperature-sensitive element (8) can be removed.

CAUTION

Do not disassemble automatic temperature control unless this is necessary for cleaning or repairing, as the temperature setting may be changed.

(c) Replace with new unit of the same type.

(5) CALIBRATING ACTUATOR TEMPERATURE-SENSITIVE ELEMENT.

(a) Remove the pointer on the adjusting screw.

(b) Insert the coolant temperature-sensitive bulb in an oil bath having a temperature ranging from 115°C (240°F) to 118°C (245°F). For the oil-sensitive bulb, the temperature range is from 85°C (185°F) to 87°C (190°F). Place the control switch in automatic position. After the temperature bulb has been in the bath for at least ten minutes, turn the adjusting screw until the screw jack runs all the way out on R-4250, and all the way in on R-4310, opening the limit switch. Do not turn adjustment screw too far at any one time as this adjustment is critical.

CAUTION

During calibration of temperature-sensitive element, do not heat the capillary bulb in any manner other than in a bath of liquid, preferably oil, and do not exceed the maximum temperature limitations of 143°C (290°F) on the coolant unit and 113°C (235°F) on the oil unit. Higher temperatures will distort the temperature-sensitive elements or melt the solder.

(c) Insert the coolant temperature-sensitive bulb in an oil bath having a temperature ranging from 102°C (215°F) to 105°C (220°F). For the oil-sensitive bulb, the temperature is from 71°C (160°F) to 73°C (165°F). Place the control switch in "AUTOMATIC" and allow bulb to remain in the bath for at least ten minutes; then check if screw jack has retracted (for the R-4250 actuator) or extended (for R-4310 actuator) to where the limit switch has opened. Turn the adjusting screw slightly if this is not the case.

(d) Place the temperature-sensitive bulb back into the first oil bath and check that the screw extends or retracts until the limit switch opens. This is a double check to establish that the actuator is operating properly to both the high and low limits. Check the manual "CLOSE" and "OPEN" positions to see that they operate properly. The unit is ready to be installed in the airplane.

(6) CHANGING ACTUATOR MOTOR BRUSHES. *(See figure 348.)*

(a) Remove snap ring at brush holder and turn brush holder cap counterclockwise, using a large, wide screwdriver to avoid breaking the bakelite covering of the cap.

(b) When cap is removed, pull on the terminal of the brush to remove it. If too tight, insert a knife blade between brush holder and terminal.

(c) Insert new brush, and make sure that curvature of the brush fits the commutator.

(d) Replace the brush cap and snap ring.

(7) REPLACING ACTUATOR MOTOR. *(See figure 348.)*—To replace the motor, the actuator must be removed from the airplane. Remove control box cover. When replacing actuator motor, be careful not to disturb the relationship of the mechanism and the control switches. If possible, stop the unit in a position where the cam is opposite the operating bars for the limit switches. If this is not possible, the position of the cam in respect to the operating bars for the limit switches should be observed and restored after the new motor is placed in the unit.

(a) Remove screws (10). It will not be necessary to remove screws (18).

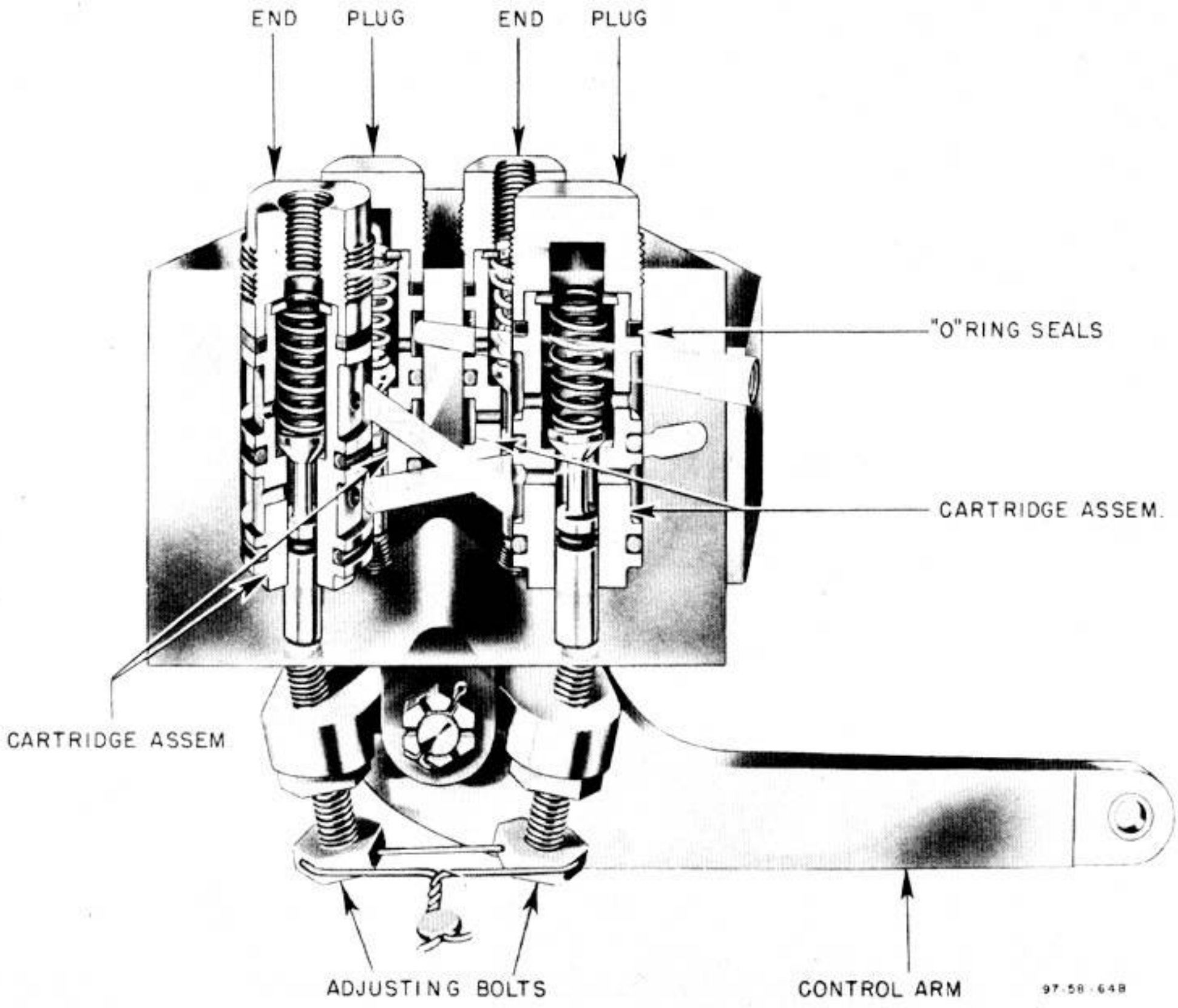


Figure 331—Hydraulic Wing Flap Control Valve

intermediate positions. Moving the handle from "UP" position, the adjustments are as follows:

To 10-degree mark—flaps should move 8-11 degrees.
To 20-degree mark—flaps should move 18-21 degrees.
To 30-degree mark—flaps should move 28-32 degrees.
To 40-degree mark—flaps should move 38-42 degrees.

Moving or checking flaps from down to any position except fully up is not required, as flaps are seldom used in this manner in flight. Tighten the locknut after adjustment.

(f) When flap control valve is left in a mid-position and the unloader valve does not stay unloaded for the minimum required time, check the poppet clearance at the control valve. The adjusting bolts should just touch poppets on one side, and the clearance on the opposite side should be .002 inch to .004 inch at both poppets.

(3) HYDRAULIC WING FLAP CONTROL VALVE. *(See figure 331.)*

(a) DESCRIPTION.—The flap system control valve is bolted to a bracket attached to the inboard side of the left lower longeron. The control valve, which is connected to the main hydraulic system pressure line after the engine pump unloading valve, is controlled from the cockpit through the preselective flap position follow-up linkage. The valve has four cartridges, a control lever provided with screws and check nuts to permit accurate adjustment of the lever in the neutral position, and a thermal relief valve. With the valve in the neutral position, thermal expansions are relieved out the thermal relief valve to the reservoir. The cartridge assembly characterizes the wing flap control valve. The four cartridges are identical. *(See figure 334.)*

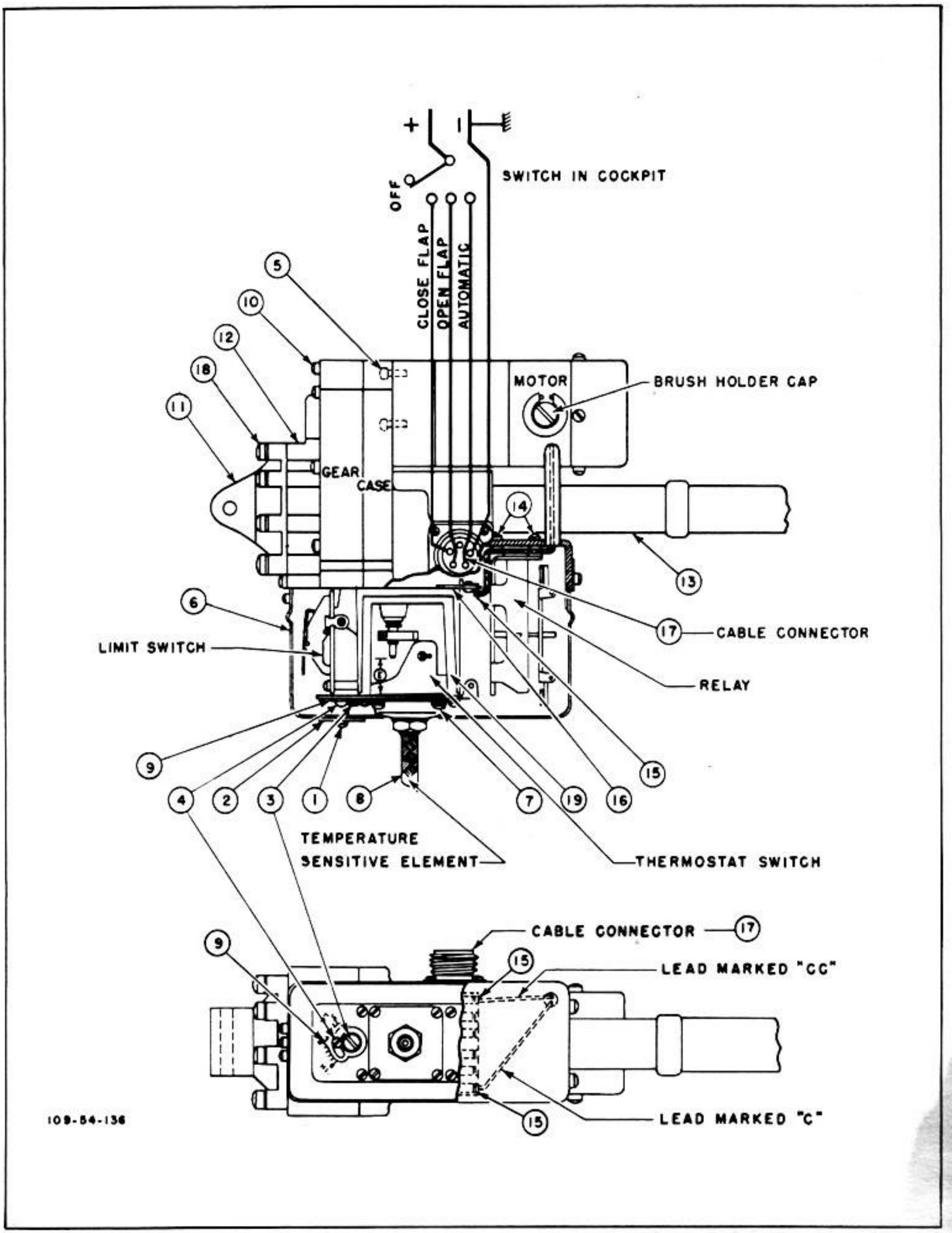


Figure 348—Radiator Air Outlet Flap Actuator Details

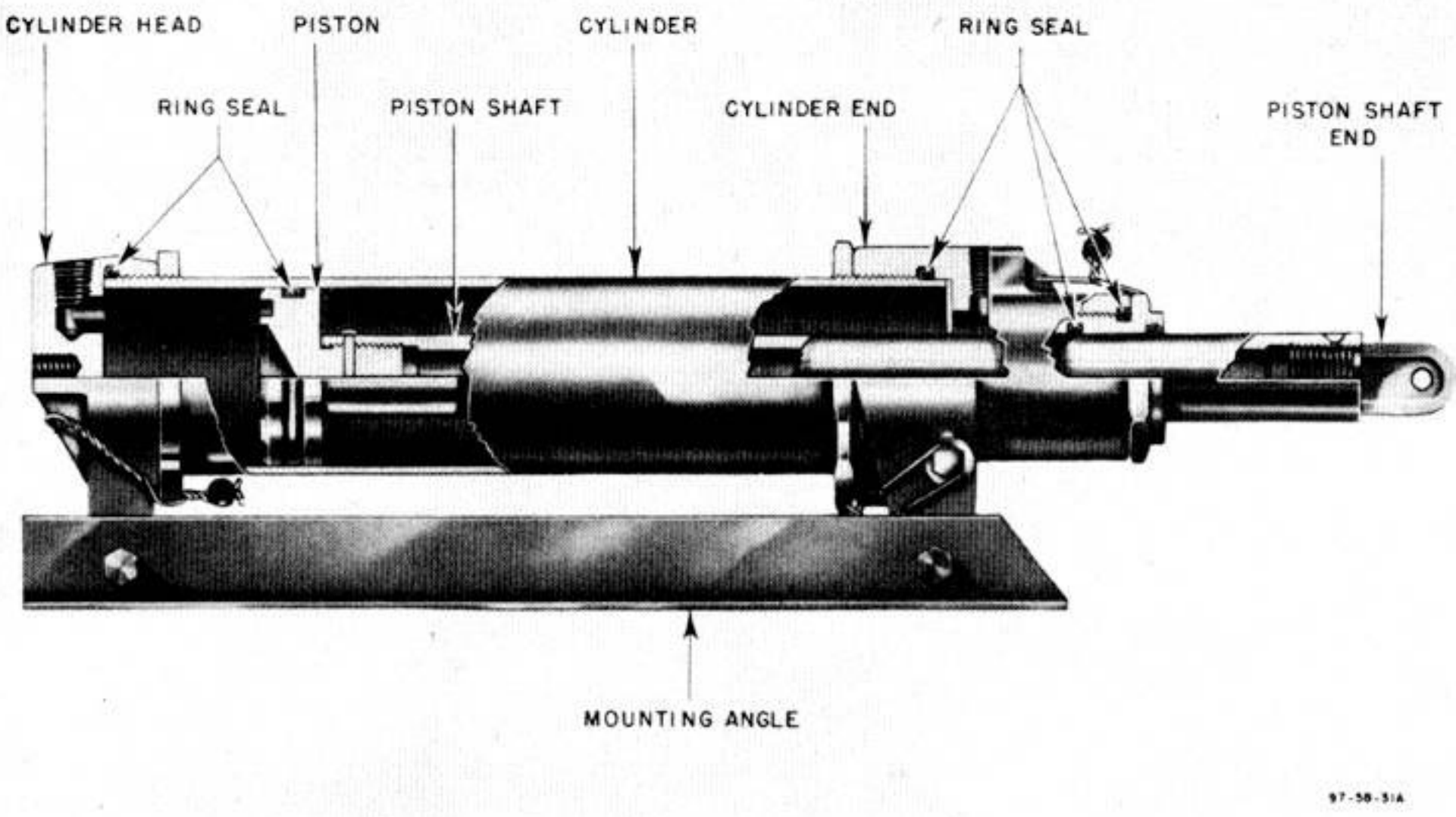


Figure 332—Hydraulic Wing Flap Operating Strut—Early Airplanes

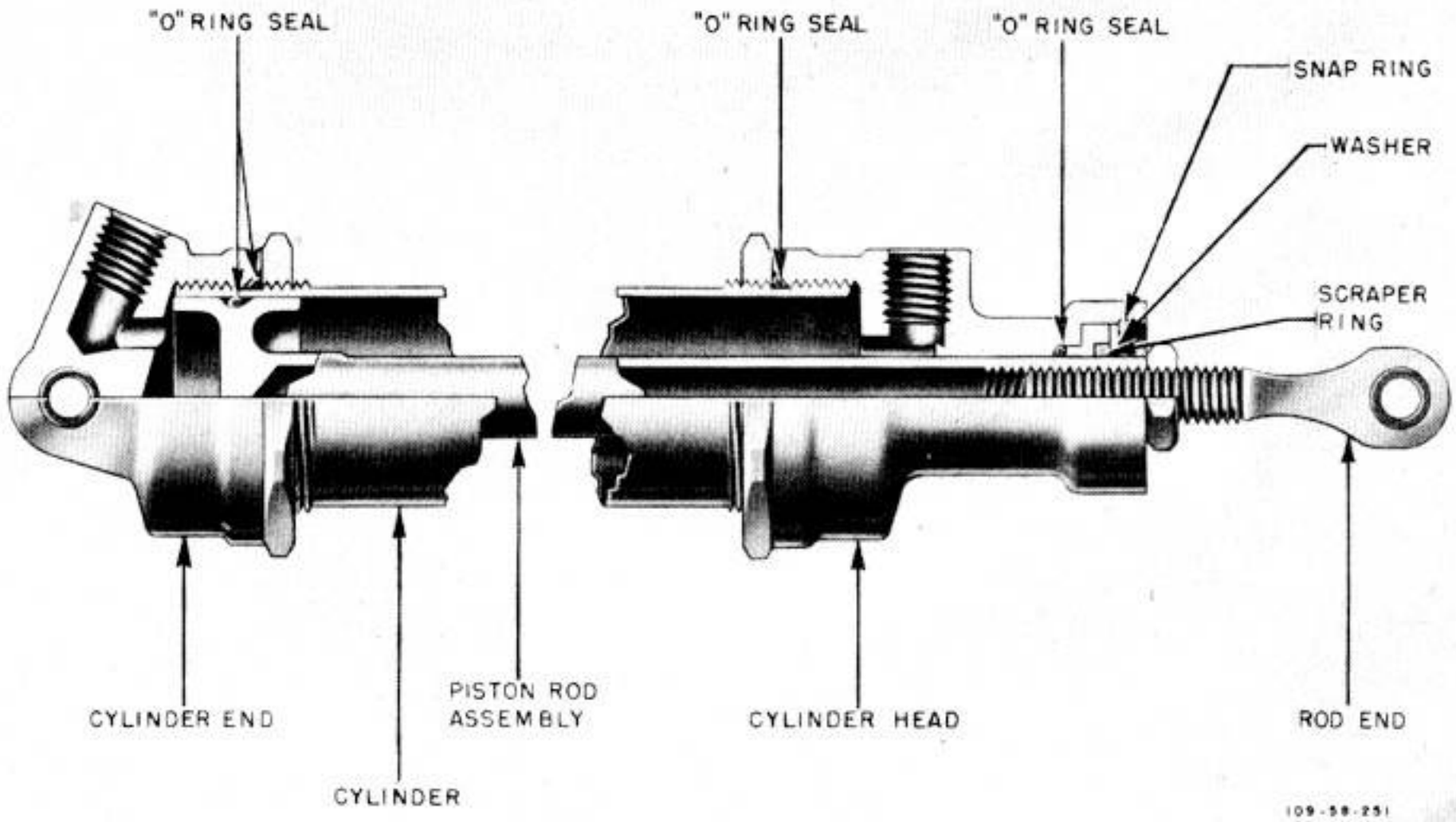


Figure 333—Hydraulic Wing Flap Operating Strut—Later Airplanes

(b) Turn entire assembly (11, 12, and 13) 90 degrees, and remove motor screws (5).

(c) Remove screws (14). The motor leads will then be accessible and can be disconnected from their terminals.

(d) Insert the new motor and reconnect the leads. Connect lead "C" to the terminal on the far side of the cable connector (17), and lead "CC" to the terminal on the near side of the cable connector. Make sure the leads are pulled out of the motor as far as possible; otherwise the leads might rub on the commutator and short out the motor.

Note

Shielded wire (early models) on motor should be taped so that the inner wire does not short-circuit to the shielding.

(e) Replace the jackscrew assembly, making sure that the cam on the follow-up screw is in approximately the same position as it was before. When removing the drive shaft assembly (11, 12, and 13), the cam will turn. Be sure that it does not move past the operating bars for the limit switches. In case the original position is lost, it can be restored by measuring the distance E from the top of the mounting posts (19) to the end of follow-up screw. This distance should be 5¾4 inch when the cam is located in a position corresponding to closed flap. For the R-4250 actuator, the cam should contact the right-hand operating bar when looking from relay toward limit switch. For the R-4310 actuator, the cam should contact the left-hand operating bar when looking from relay toward limit switch. The unit is ready for installation in the airplane.

CAUTION

Do not loosen the screw holding the limit switch cam on the follow-up shaft. The stroke of the screw jack cannot be varied by moving this cam. If the limit switch cam is loosened, the automatic temperature control will shift its control range and the follow-up shaft thread will jam.

(8) INSTALLING COOLANT RADIATOR AIR OUTLET FLAP ACTUATOR.

(a) Hang the unit in the airplane by means of the upper or main fitting at the motor end of the actuator. Leave the other end free to turn.

(b) Turn "OFF" the cockpit control switch and plug in the electrical connector. Leave the driven-end lower fitting free to turn, and operate the unit by the manual position of the cockpit switch in the "CLOSE" position until the limit switch in the unit stops the motor. Turn "OFF" the cockpit switch.

(c) Turn the driven-end fitting on the actuator to the right until the screw retracts to its shortest over-all length. Then back it off approximately ¾ turn, plus or minus ¼ turn to the left. Maintain this position of the screw jack through all further adjustment procedures.

(d) Screw into the actuator's driven-end fitting the end of the rod assembly that connects the actuator to the scoop flap. This rod should be screwed in until the hole through its threaded part is approximately in the center of the slot in the driven-end fitting.

(e) Locate and mark the position of the scoop flap that will clear the jammed closed position at its point of jamming by ¼ (± 1⁄16) inch.

(f) Screw the connecting rod assembly into the driven end of the actuator just enough so that when the lower end of the connecting rod is attached to the scoop flap and the actuator screw jack is in the predetermined position, the scoop flap matches the clearance mark. *(See (e) preceding.)*

(g) Install the capillary bulb in its well in the coolant line.

(9) INSTALLING OIL RADIATOR AIR OUTLET FLAP ACTUATOR.

(a) Hang the unit in the airplane by means of the main fitting at the motor end of the actuator.

(b) Turn "OFF" the control switch in the cockpit and plug in the electrical connector .

(c) Hold or support the unit so that the screw jack may turn freely; then "OPEN" the control switch until the limit switch in the unit stops the motor. Turn "OFF" control switch.

(d) Turn the driven-end fitting on the actuator to the right until the screw is fully retracted; then turn it out approximately 1¼ turns, plus or minus ¼ turn, and connect it to the bellcrank. This setting must not be disturbed during the adjustment procedure.

(e) "CLOSE" the cockpit switch to operate the unit until the limit switch stops the motor. Check the scoop flap for 3⁄16-inch, plus or minus 1⁄16-inch, clearance between the duct and the flap. If necessary, adjust the fitting on the upper end of the connecting rod to match the corresponding arm of the bellcrank.

(f) Install the capillary bulb in the well in the oil line.

(10) CORRECTING ACTUATOR TEMPERATURE-SENSITIVE ELEMENT AFTER INSTALLATION. —If the scoop flap does not close or open entirely at the specified temperatures, a temperature adjustment within plus or minus 5°C may be made as follows:

(a) Remove access door at the rear of the coolant radiator flap on the bottom of the airplane for coolant unit, or right wing fillet for oil unit. Loosen screw (1) clamping the adjustment coverplate (2) to the dust cover housing (6). *(See figure 348.)*

(b) Swing back the coverplate to expose the adjusting screw (3). Loosen the screw (4), which clamps the pointer (9), one turn.

(c) Turning the adjusting screw (3) counterclockwise raises the control temperature; turning the screw clockwise lowers the control temperature. It should not be necessary to move the adjusting screw over 2 or 3 degrees; however, if a temperature adjustment greater than 5 degrees is necessary, remove the pointer and the screw may then

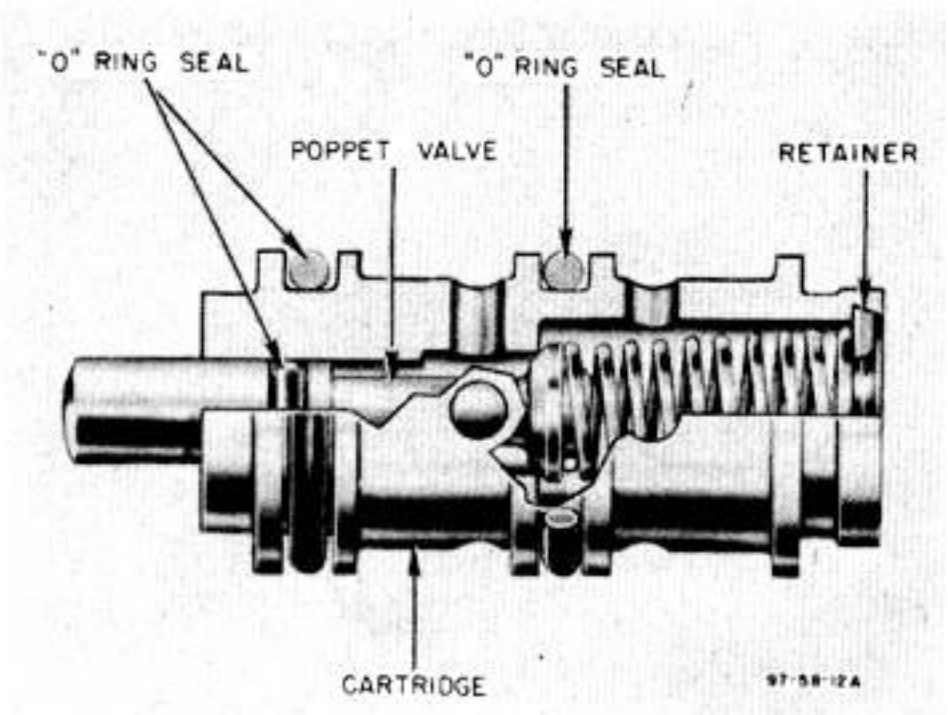


Figure 334—Hydraulic Wing Flap Control Valve Cartridge

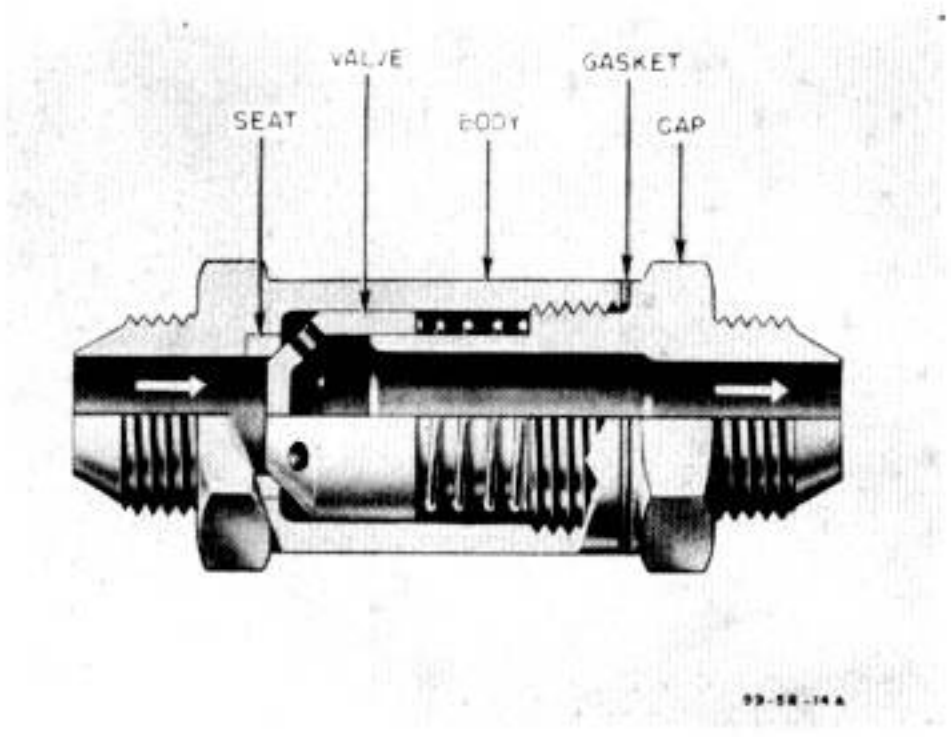


Figure 335—Hydraulic Check Valve

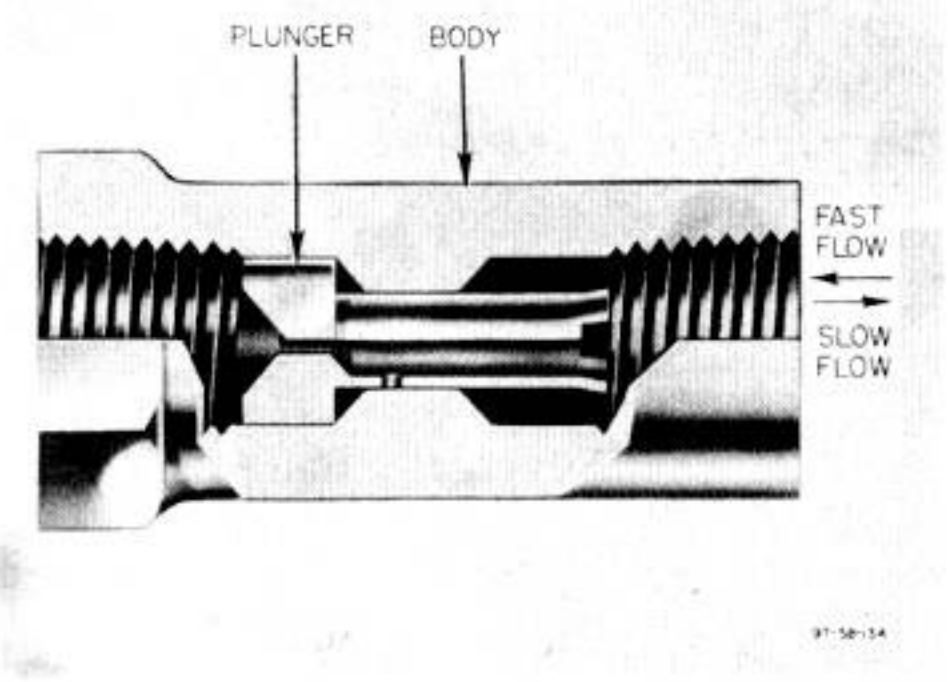


Figure 336—Hydraulic Restrictor Valve

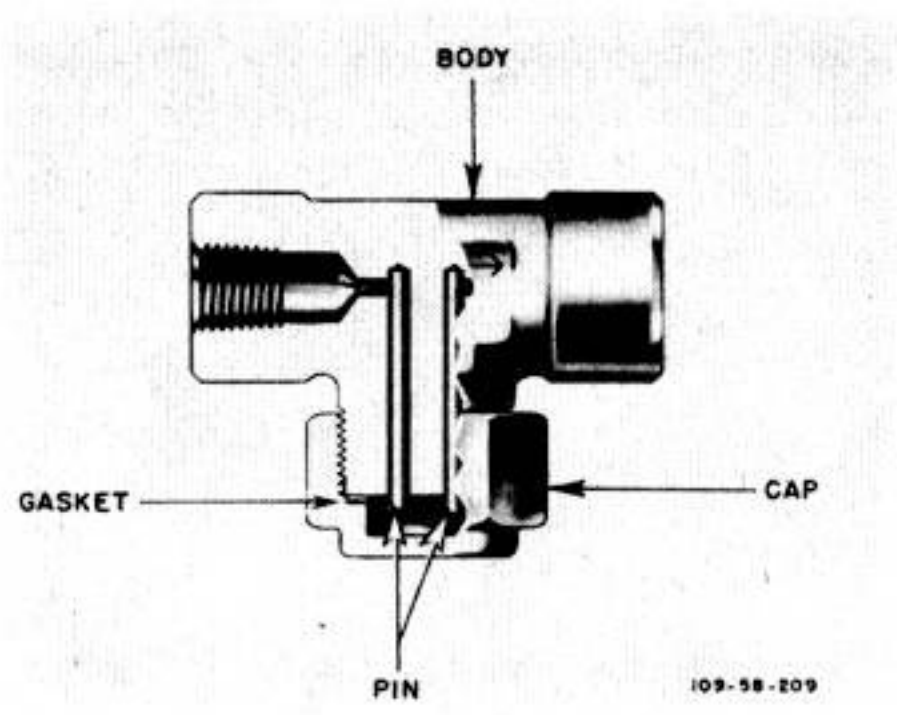


Figure 337—Hydraulic Pressure Snubber

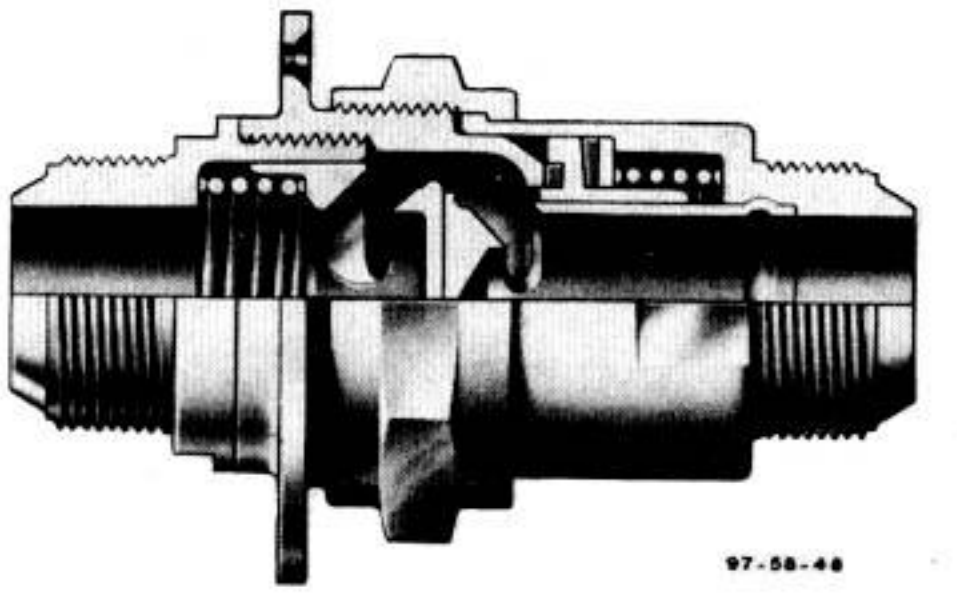


Figure 338—Hydraulic Disconnect Coupling (Connected)

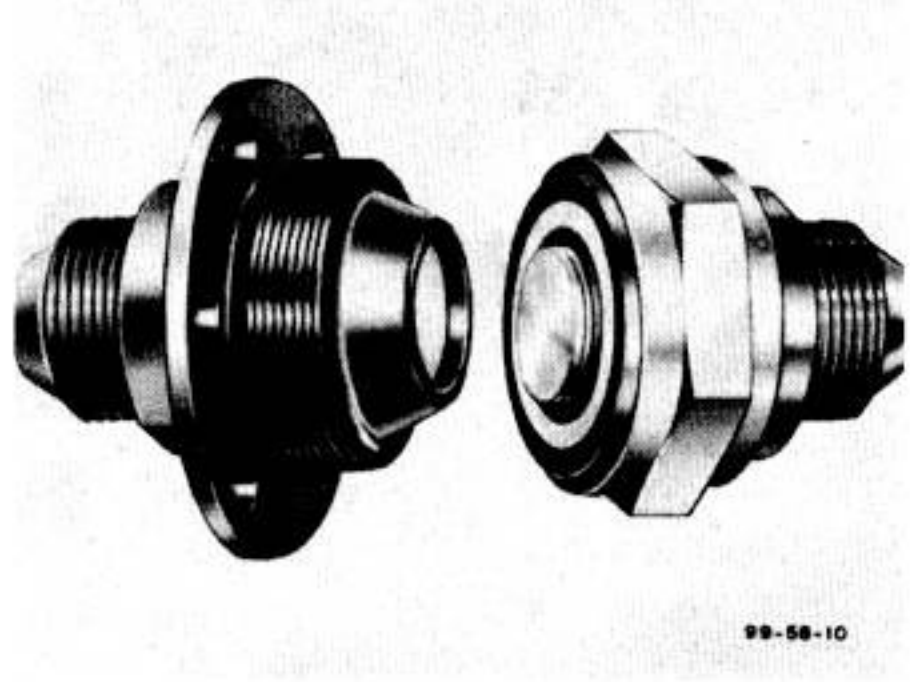


Figure 339—Hydraulic Disconnect Coupling (Disconnected)

be turned as far as necessary. There is a definite limit for lowering the temperature. On control R-4250 the lowest temperature is 98°C (210°F); on control R-4310 the lowest temperature is 68°C (155°F). Generally, if an adjustment greater than the pointer permits is necessary, it indicates a defective temperature-sensitive element, which should be replaced.

Note

This adjustment should be made with the engine operating until the liquid reaches the temperature desired. The control switch in the cockpit should be in "AUTOMATIC."

(d) Retighten the screw clamping the pointer, and close the coverplate; the unit is ready for operation.

CAUTION

Do not attempt to make adjustments within the gear box on the gear train, and do not force any switch movement, as all parts are relatively light and sensitive.

g. ELECTRICAL INDICATORS AND TRANSMITTERS.—Electrical indicators are provided for tachometer, oil temperature, coolant temperature, remote-reading compass, and carburetor air temperature. Refer to paragraph 18 for information concerning these instruments.

h. LIGHTING EQUIPMENT. *(See figure 340.)*

(1) LANDING LIGHT.

(a) DESCRIPTION.—The 250-watt, Type PAR-46 landing light is mounted on a spring-loaded swivel mount

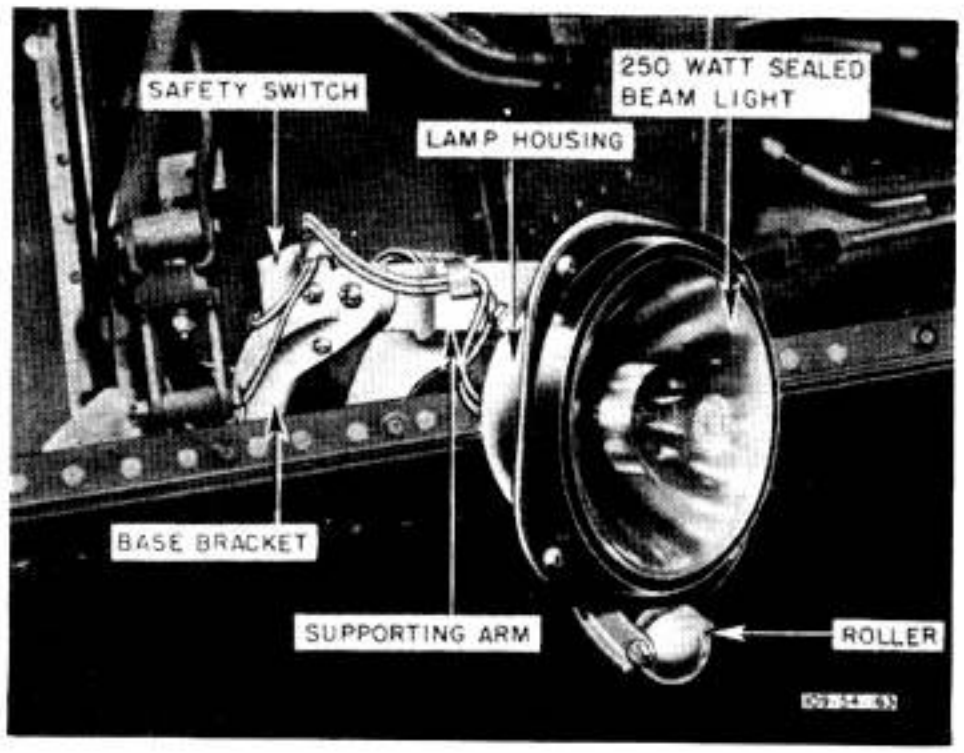


Figure 349—Landing Light

(figure 349); when the landing gear is extended, the spring moves the light into operating position. When the gear is retracted, the left landing gear fairing pushes the lamp up into the wheel well. The landing light is electrically controlled by a switch mounted on the left switch panel. A spring-loaded safety switch, installed adjacent to the light and actuated by the light support arm, is connected in series with the control switch.

(b) ADJUSTING THE LANDING LIGHT.

1. HORIZONTAL ADJUSTMENT.—Loosen the three housing attachment bolts at the back of the lamp, and move the lamp in the slotted mounting holes to obtain the

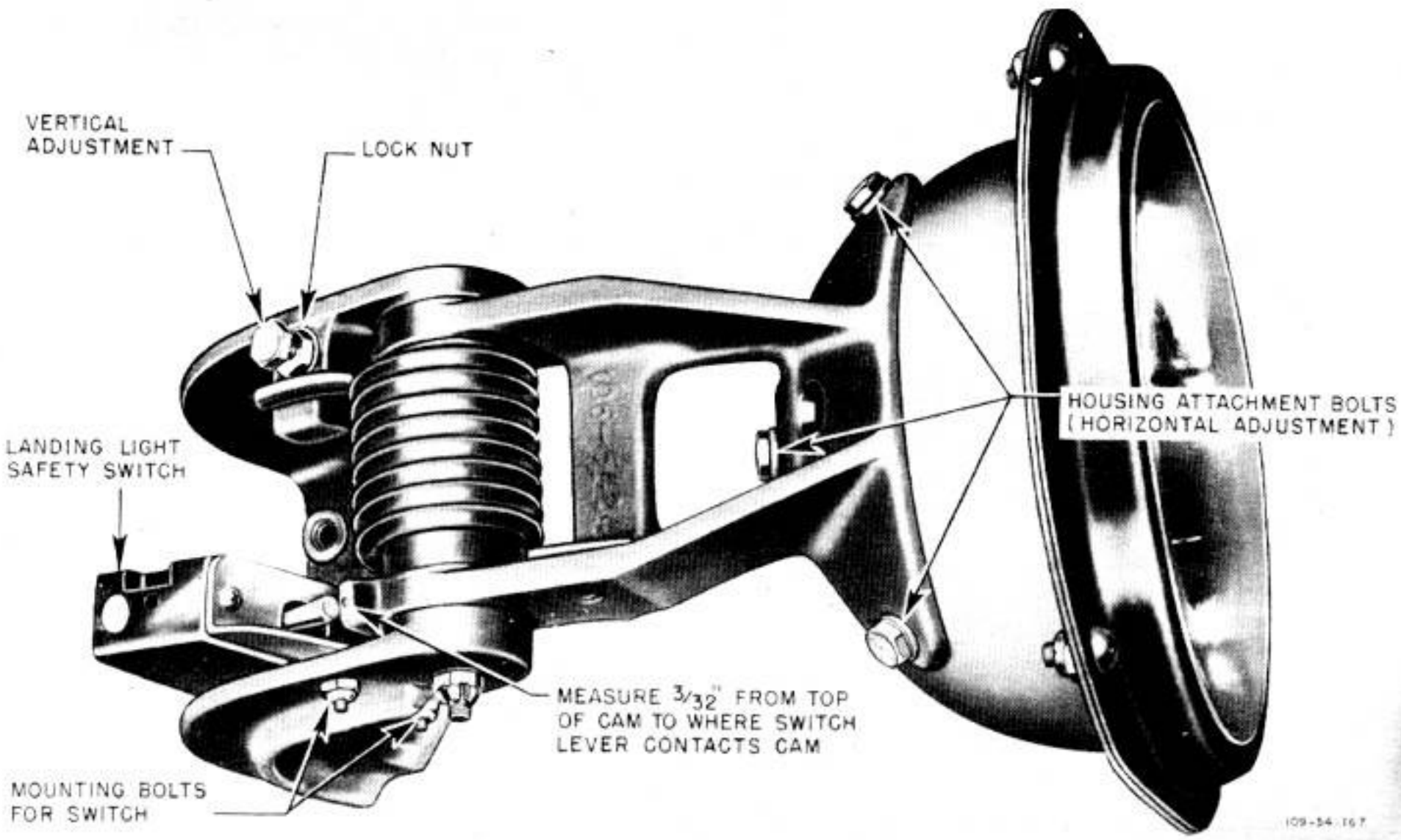


Figure 350—Landing Light Adjustment

(b) REMOVING WING FLAP CONTROL VALVE.—Remove left rear wing fillet for access. Then disconnect lines and linkage and remove the two bolts.

(c) REPLACEMENTS—WING FLAP CONTROL VALVE.—When replacing cartridges, be careful not to damage the seal rings. All cartridges are interchangeable.

(d) INSTALLING WING FLAP CONTROL VALVE.—Be sure valve is correctly adjusted and tested before installation. Attach valve with two bolts, connect lines, and connect and adjust the control linkage.

(e) TESTING AND ADJUSTING WING FLAP CONTROL VALVE.

1. With adjusting screws backed off, apply 2000 pounds per square inch pressure at pressure port. Check for external leaks and cylinder port leaks.

2. Set thermal relief valve to relieve at 1400 to 1600 pounds per square inch pressure.

3. Apply 1200 pounds per square inch pressure at cylinder and pressure ports simultaneously. Adjust setscrews on one side so that lever is at an angle of approximately 90 degrees to body of valve, and just touching poppets. Adjust other side to .002 clearance between setscrews and poppets with valve in neutral.

4. Apply flow of 2 gpm at pressure port. With valve in neutral, there should be no flow at either cylinder port. Check flow from either cylinder port by alternating movement of lever.

(4) WING FLAP OPERATING STRUT. *(See figures 332 and 333.)*

(a) DESCRIPTION.—The flap operating strut is conventional in design and function. The strut piston is connected directly to the flap torque rod actuating bellcrank, lowering the flaps on the extension and raising them on the retraction stroke. The flap strut is mounted on the right-hand side under the radio shelf aft of the flap torque rod. Pressure flows to the strut are regulated by the selector valve.

(b) REMOVING WING FLAP OPERATING STRUT.—Remove the right rear wing fillet for access. Then disconnect lines and linkage and remove the attaching bolts.

(c) INSTALLING WING FLAP OPERATING STRUT.—Thoroughly test the strut before installation. To install, attach with bolts, and connect lines and linkage.

(d) TESTING AND ADJUSTING WING FLAP OPERATING STRUT. *(Refer to paragraph 19. b. (4) (d) in this section.)*

g. MISCELLANEOUS HYDRAULIC UNITS.

(1) HYDRAULIC SYSTEM CHECK VALVES. *(See figure 335.)*—Standard one-way check valves at various points of the system permit flow in one direction only. When installing check valves, make sure the arrow showing flow direction is in the right direction for the free flow desired.

(2) HYDRAULIC SYSTEM RESTRICTOR VALVES. *(See figure 336.)*—Restrictor valves provide a fixed restricted two-way flow. The faster flow is always toward the hexagonal end. When the flow is toward the hexagonal end, the plunger is forced in that direction far enough to uncover the holes in the plunger, allowing the larger amount of oil to flow. When flow is in the opposite direction the plunger is forced to move back, covering up the holes and restricting the flow in that direction.

(3) HYDRAULIC SYSTEM PRESSURE SNUBBER. *(See figure 327.)*—The line which interconnects the system with the hydraulic pressure gage on the pilot's instrument subpanel is equipped with a snubber to dampen the oscillations of the gage needle caused by shocks within the system and pulsations from the engine-driven pump. The snubber consists of an orifice and a floating plunger, which, being free to move about within the chamber, overcomes the oscillations in the pressure line by failing to synchronize with the impulses.

(4) HYDRAULIC SYSTEM DISCONNECT COUPLINGS. *(See figures 338 and 339.)*—Self-sealing couplings at the firewall make it possible to disconnect and reconnect the hydraulic suction and pressure lines serving the engine-driven pump without losing fluid or allowing air into the system. The disconnect couplings are used in connection with a ground test stand, and for removing the complete engine section from the fuselage. The coupling consists of two halves connected by a nut. Unscrewing the nut automatically closes the valves as the action of springs forces them to seat against the apertures of the coupling halves. Tightening the nut forces the halves together to overcome the tension of springs in such a manner that when the nut is drawn completely tight, an internal aperture equaling the cross section of the connecting lines is obtained.

20. ELECTRICAL SYSTEM.

a. GENERAL DESCRIPTION.—The electrical system is of the 24-volt, single-wire, direct-current type, powered by a 100-ampere engine-driven generator system. A 24-volt storage battery supplies current when the generator system is inoperative or when generator output is less than 26.5 volts. An A.C. inverter provides 400-cycle, 26-volt alternating current for remote-compass operation. The metallic structure of the airplane serves as a ground, and a static ground wire is attached to the bottom of the fuselage aft of the tail wheel. Most of the wiring is in open bundles, supported by clips and protected by tubing. The ignition wiring is shielded in flexible conduit supported by the ignition harness. On later airplanes, certain electrical units have shielded wiring to cut down the amount of radio interference. All circuits are protected by either circuit breakers or circuit-breaker switches. Wiring diagrams are at the end of this paragraph.

desired position. *(See figure 350.)* Then tighten the three attaching bolts. An adjustment of 6 degrees in either direction can be made.

2. VERTICAL ADJUSTMENT.—Loosen the locknut on the bolt on the base bracket, and turn the bolt in or out for the desired vertical adjustment. Then tighten the locknut securely.

(c) ADJUSTING LANDING LIGHT SAFETY SWITCH.—After adjustment of the landing light, be sure to check that the toggle safety switch cuts out when the light is pushed into the retracted position. Adjust the safety switch as follows:

1. Loosen the two bolts which hold the switch to the base bracket. *(See figure 350.)*

2. Move the switch up or down in the mounting holes and measure 3/32 inch from the top of the cam to the point where the toggle lever contacts the cam. Make this adjustment with the light in the down position.

3. Hold the switch to prevent its moving, and tighten the mounting bolts.

4. Check the operation of the switch again after the adjustment has been made.

(2) POSITION LIGHTS.—A Type A-8 colored light is mounted on the outer edge of each wing tip. Weatherproof tinted lenses are used, red on the left wing and green on the right wing. A Type D-1 white position or rudder light is on the trailing edge of the rudder. This light, as well as the wing lights, is on a separate circuit and is controlled by an individual switch. Each switch permits operation at two light intensities. With wing light switch on "DIM," current flows through a 15-ohm, 20-watt resistor, reducing the brilliancy of the lamp. In "DIM," the rudder light switch places a 125-ohm, 20-watt resistor in series with the light. As the airplane is equipped with a remote compass, the left wing tip position light is insulated from ground, the current passing through a twisted pair of wires to reduce the magnetic influence on the remote compass.

(3) RECOGNITION LIGHTS.—Early airplanes are equipped with four recognition lights: a white lamp (AN3097-2) on top of the fuselage aft of the enclosure, and a red (AN3096-5), a green (AN3096), and an amber (AN3096-4) lamp grouped together on the underside of the right wing near the tip. A bank of four B-9A control switches are on the control panel above the right switch panel. The lamps can be set to burn continuously, or to flash off and on by means of a Type 8586 keying switch mounted in a box just above the right switch panel. On later airplanes, the upper recognition light, control switch, and the wiring are deleted.

CAUTION

While the airplane is on the ground, do not permit the lights to burn for any length of time, as the heat will seriously damage the lens.

(4) COCKPIT LIGHTS.—A Type A-7 cockpit light which incorporates a built-in switch at each light assembly is installed on each side of the cockpit; the lights' brilliancy is controlled by a Type E-1, 200-ohm 25-watt rheostat on the front switch panel.

(5) INSTRUMENT LIGHTS.—A Type C-5 lamp assembly on each side of the instrument panel shroud provides invisible and controlled visible light, selected by rotation of the lamp lens housing. The rheostats controlling these lights are mounted on the left and right switch panels, and are marked "FLUOR LIGHT."

i. LANDING GEAR WARNING SYSTEM (Early Airplanes).

(1) DESCRIPTION.—The landing gear position indicating system consists of four microswitches, connected in parallel, and an indicator light connected through a throttle microswitch connected in parallel with a fairing door microswitch. This system indicates the position of the main gear (up or down and locked) when the throttle is retarded. The switches are located as follows:

(a) Two switches, a Type WZ-7RQ1T and a Type YZ-7RQ1T, adjacent to each main gear.

(b) One switch, Type WZ-7RQ1T, mounted on a bracket to the main gear fairing door timing valve.

(c) One switch, Type YZ-2RQ1T, mounted directly under the throttle quadrant and operated by the throttle lever. *(See figure 351.)*

(d) A push-button test switch connected to the red jeweled signal light is used to test the condition of the lamp. These two units are mounted side by side on the left side of the instrument panel.

(2) ADJUSTING THE THROTTLE WARNING SWITCH (Early Airplanes).

(a) Run engine up to a manifold pressure of 22 in. Hg at an rpm of from 2300 to 2500 with propeller pitch control in "FULL INCREASE RPM." Mark this throttle setting on the quadrant.

(b) Cut the engine and set throttle at the mark on the quadrant.

(c) Hold in one of the main gear microswitches on either landing gear.

Note

Wheel fairing doors must be closed.

If an extra man is not available to assist with this adjustment, place a wad of cloth against the switch plunger so it will remain in while making the throttle switch adjustment. This procedure is not necessary if airplane is on jacks and gear can be retracted.

(d) Slightly loosen both the mounting screws so switch will move fore and aft in its slotted mounting hole. *(See figure 351.)*

(e) Turn the battery-disconnect switch "ON." Move throttle switch against the cam on throttle rod until the landing gear position indicator light burns. Tighten the mounting screws.

b. ELECTRICAL SYSTEM TROUBLE SHOOTING.—Before removing an electrical unit believed to be defective, check the voltage at the unit. If the voltmeter indicates 24 volts, the unit is probably defective and should be repaired or replaced with a unit which has been tested and is known to be in operating condition. If the voltmeter shows no indication at the unit, check the wiring from the unit to the power source.

WARNING

In trouble shooting an electrical circuit, it is necessary in most cases to remove various plugs and terminal box covers to make the circuit accessible. Extreme care must be taken in testing with plugs and covers removed, as "live" points are thus exposed. Whenever such testing is necessary, remove all power from the circuit, make necessary circuit changes or meter connections, and then apply the power.

TROUBLE	PROBABLE CAUSE	REMEDY
	BATTERY	
Electrolyte consistently below top of plates.	Leakage.	Seal case or replace battery.
	Boiling over because of high generator voltage.	Adjust or replace voltage regulator.
Freezing.	Exposure to low temperature and not properly charged. Specific gravity of electrolyte too low.	Thaw slowly in a warm room. Recharge.
Loss of capacity.	Loss of electrolyte.	Seal case or replace battery.
	Low temperature.	Thaw in warm room. Recharge battery.
	High discharge.	Replace battery.
	Overcharging for long periods.	Replace battery or adjust or replace voltage regulator, if necessary.
	Internal short circuits.	Replace battery.
	Length of service.	Replace battery.
Battery discharged.	Loss of capacity.	(See preceding "trouble.")
	Reverse-current relay* improperly adjusted.	Readjust relay.
	Load left on or external short.	Check switches and wiring.
	Voltage regulator improperly adjusted.	Adjust regulator.
Reversal of polarity.	Battery charged in wrong direction.	Replace battery or recharge with proper polarity.
	GENERATOR	
Generator operating within rated speed range, but voltage output low or erratic (or excessive sparking at generator brushes).	Voltage regulator improperly adjusted.	Adjust regulator.
	Voltage regulator inoperative.	Replace regulator.
	Grounded or open field coil.	Replace entire yoke assembly or generator.
	If the voltage is only two volts, the generator is operating on residual magnetism.	Clean and tighten any loose or high-resistance connections.
	Loose or high-resistance electrical connections.	Clean and tighten all electrical connections.
	Brushes excessively worn.	Replace brushes.
	Brushes binding in the brush boxes.	Clean brushes and brush boxes.
	Excessive side play of brushes in brush boxes.	Replace the brushes.
	Brushes not properly seated.	Reseat or replace brushes.
	Low brush spring tension.	Replace spring if necessary.

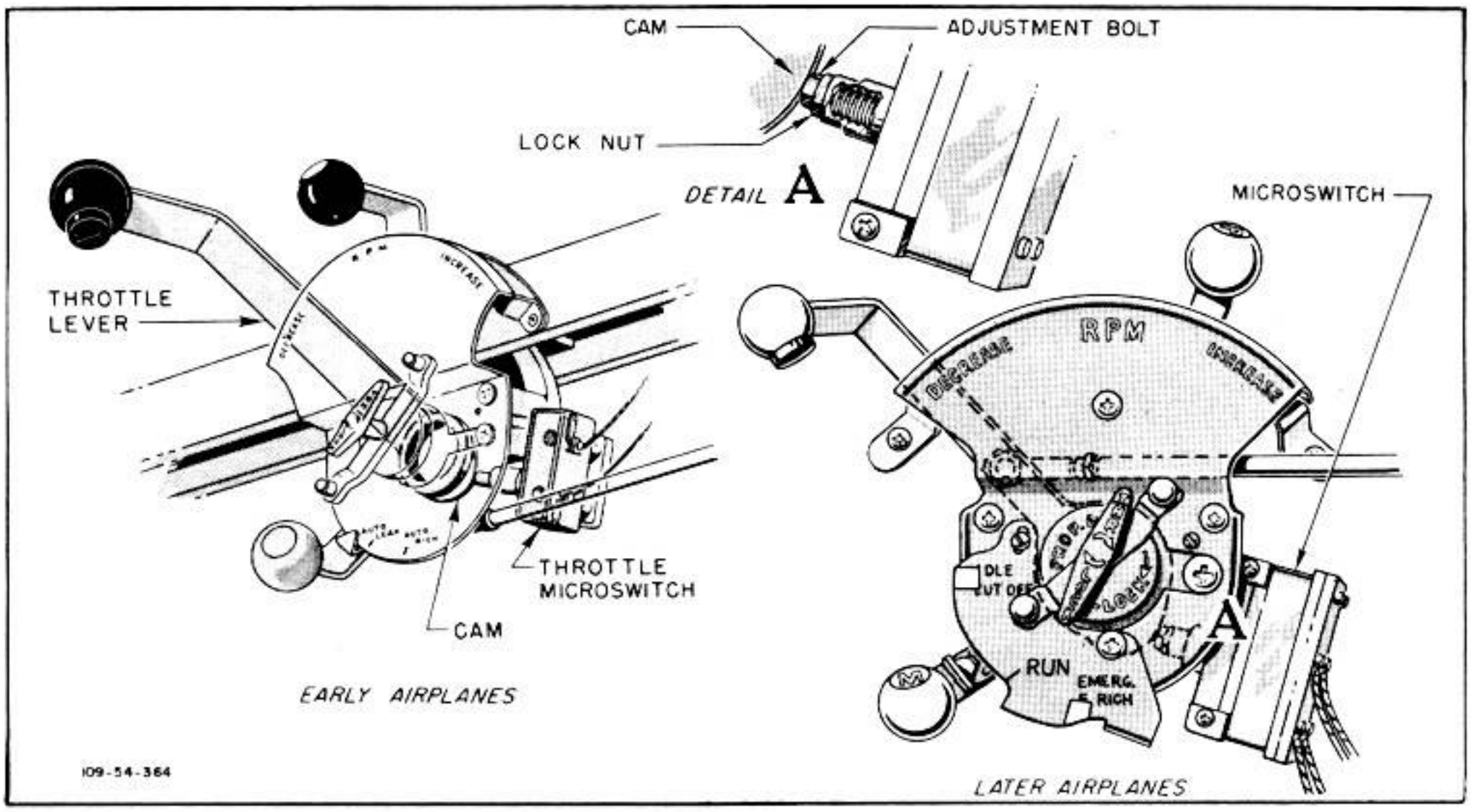


Figure 351—Throttle Switch Adjustment

(f) Work the throttle back and forth across the mark on the quadrant. At the same time observe that indicator light burns during the time the throttle crosses the mark on the quadrant, to full closed position. When throttle passes the mark toward full on position, the light must go off.

(g) Turn the battery-disconnect switch "OFF."

CAUTION

When the adjustment is completed, remove the cloth holding the main gear switch in. If cloth is not removed, the landing gear warning system will be inoperative while the airplane is in flight.

j. LANDING GEAR WARNING SYSTEM (Late Airplanes).

(1) DESCRIPTION.—The landing gear warning system on late airplanes differs from the system used in early airplanes in that a warning horn is utilized in addition to the red light to indicate a wheels-up landing when the throttle is retarded below minimum cruising. A green light is added to indicate a safe landing condition. The system consists of the following:

(a) A green and a red indicator light adjacent to each other on the left instrument subpanel.

(b) Two A-25K, 50-ohm resistors, which complete the green light circuit to ground and at the same time protect the landing gear strut and lockpin switches from shorting 28 volts to ground.

(c) A Type J-2 warning horn on the upper left fuselage just aft of the rear armor plate.

(d) An NA-1015-24 warning horn cut-out relay on the upper left-hand fuselage frame at station 155½.

(e) A No. 9-A warning horn cut-out switch in the pilot's front switch panel.

(f) Two Type WZ-7RQIT S.P.S.T. N.C. switches, each operated by a main gear strut actuating rod.

(g) Two Type YZ-7RQIT S.P.S.T. N.O. switches, each operated by a main gear down-lockpin actuating rod.

(h) Two Type BZ-7RQIT S.P.D.T. N.C. switches, each operated by a main gear fairing door.

(i) One Type DB-RH1 D.P.D.T. switch, operated by the throttle lever.

(2) OPERATION.—The lights and warning horn operate as follows:

(a) Green light off, red light off, horn silent: gear up and locked, throttle forward beyond minimum cruising power, fairing doors closed.

(b) Green light off, red light on, horn sounding: gear up and locked, throttle retarded below minimum cruising power, fairing doors closed.

(c) Green light off, red light on, horn silent: gear not in up-locked or down-locked positions (regardless of throttle position), and/or fairing doors open.

TROUBLE	PROBABLE CAUSE	REMEDY
	Dirty commutator.	Clean with a cloth moistened in Varsol or undoped gasoline.
	Scored or pitted commutator.	Replace generator, change armature, or turn down commutator in lathe.
	Shorted or open armature coils.	Replace generator.
	Incorrect wiring.	Rewire.
Generator operating within rated speed range but voltmeter indicates zero.	Loose or high-resistance field coil assembly terminals.	Clean and tighten terminals.
	Wiring not properly connected.	Rewire.
	Grounded or open field coil assembly.	Replace yoke assembly or replace generator.
	Generator field demagnetized.	Flash the field.
Generator operates within rated speed range with line switch closed, but system ammeter indicates low or no output.	Improper operation of reverse-current relay.	Readjust or replace relay.
	Incorrect wiring.	Rewire.
	Generator field demagnetized.	Flash field.
	Burned-out ammeter.	Replace ammeter.
Generator operating within rated speed range but system ammeter reads off scale in the wrong direction.	Ammeter circuit reversed.	Rewire.
System ammeter fluctuates excessively when indicating full rated load.	Generating system is overloaded.	Relieve overload.
	Improper operation of voltage regulator.	Readjust or replace.
	Note Since generated voltage is held at an almost constant value, the current output depends entirely upon the condition of the battery and the amount of external load. When the battery is fully charged and there is no load on the system, little or no current will flow between generator and battery.	
GENERAL ELECTRIC REVERSE-CURRENT RELAY		
Contacts will not close.	No generator output.	Check voltage regulator and generator.
	Resistor open.	Replace resistor.
	Small contacts will not make contact when closed.	Readjust.
	Small terminals shorted.	Rewire.
	Coils damaged.	Replace relay.
	Open circuit between generator and switch.	Rewire.
	Generator polarity reversed.	Flash field.

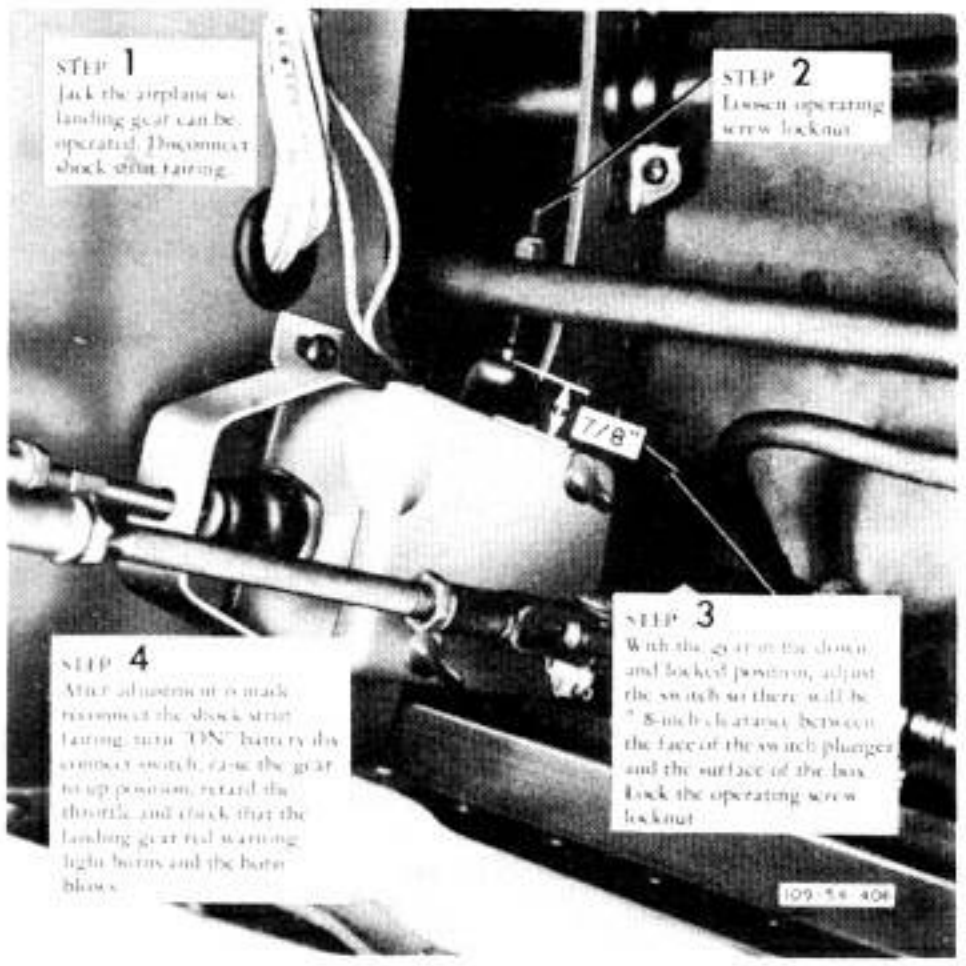


Figure 352—Adjusting Main Gear Actuating Rod Switch

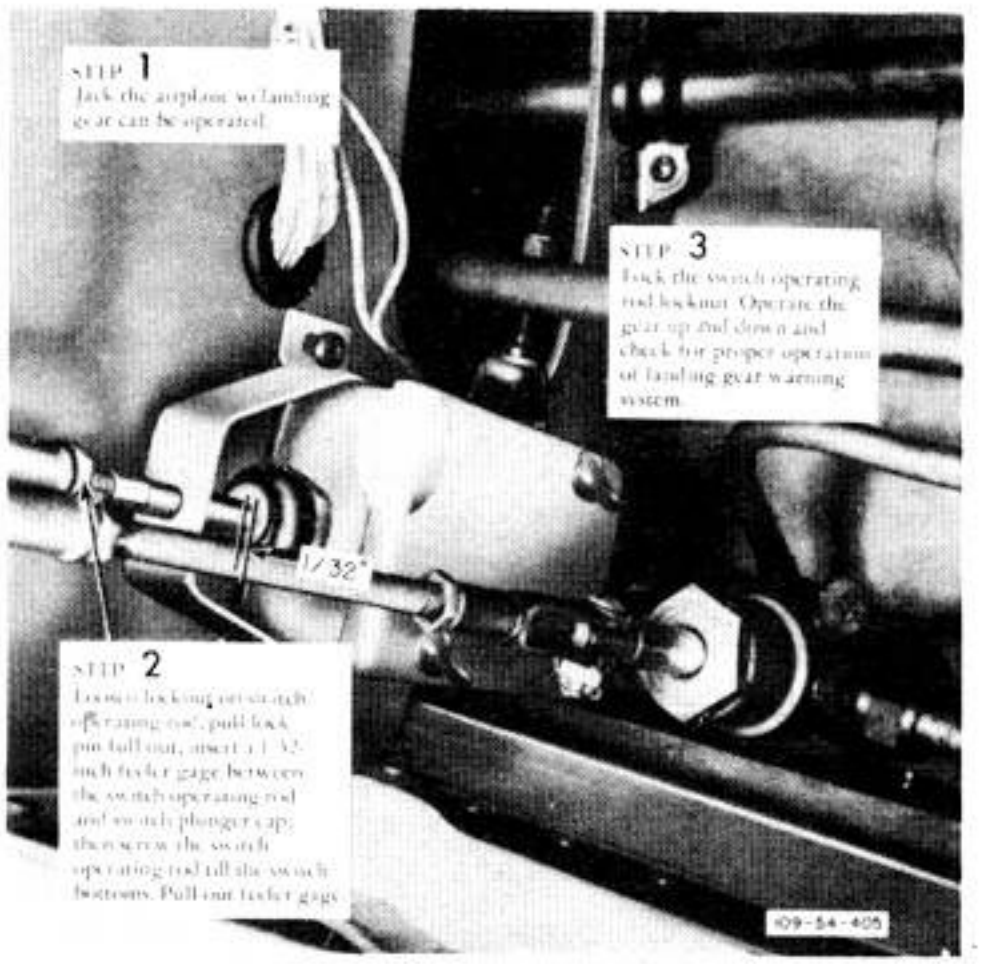


Figure 353—Adjusting Main Gear Down-lock Position Switch

(d) Green light on, red light off, horn silent: gear down and locked (regardless of throttle or fairing door position), and doors closed.

Note

The horn can be silenced either by advancing the throttle, or pressing the warning horn cutout switch button on the front switch panel. The holding coil in the relay will keep the circuit open to the horn until the throttle is advanced or the landing gear is extended.

(3) ADJUSTING THROTTLE WARNING SWITCH (Late Airplanes).

(a) Run engine up to a manifold pressure of 22 in. Hg with propeller pitch control in "FULL INCREASE RPM." Mark this throttle setting on the quadrant.

(b) Cut the engine and set throttle at the marked setting on the quadrant.

(c) Have an assistant hold in one of the down-lockpin microswitches on either landing gear. If a man is not available, wad cloth against the microswitch plunger to hold it in.

Note

This procedure is not necessary if airplane is on jacks and the gear can be retracted.

(d) Close the landing gear fairing doors.

(e) Either turn "ON" the battery-disconnect switch, or connect an external source of power to the airplane.

(f) Loosen locknut on the microswitch plunger *(figure 351)* and screw the plunger against the throttle lever cam until the switch clicks; the horn will blow and the red light will burn. Tighten the locknut securely after adjustment.

(g) Work the throttle back and forth across the mark on the quadrant, and check that red landing gear warning light burns and the horn sounds while the throttle is anywhere between the mark on the quadrant and the full closed position. When throttle passes the mark approximately ½ inch, measured along guard plate, toward full on position, the light must go out and the horn must be silenced.

(h) Turn "OFF" the battery-disconnect switch, or disconnect the external source of power from the airplane.

CAUTION

If a cloth wad was used to hold in the down-lockpin switch, remove it.

(4) ADJUSTING THE MAIN GEAR STRUT ACTUATING ROD SWITCH. *(See figure 352.)*

(a) Jack the airplane so landing gear may be operated.

(b) Disconnect shock strut fairing.

(c) Loosen the switch operating screw locknut.

(d) With the gear in the down and locked position, adjust the switch so there will be 7/8-inch clearance between the face of the plunger and the surface of the box. Lock the adjusting screw in place.

(e) Turn "ON" battery-disconnect switch, or connect an external power supply to the airplane.

(f) With the gear up and locked, retard the throttle and check that the landing gear warning light burns.

TROUBLE	PROBABLE CAUSE	REMEDY
Contacts will not open.	Small contacts sticking. Moisture between small contacts.	Increase gap. Clean and dry.
	LEECE-NEVILLE REVERSE-CURRENT RELAY	
Relay will not adjust properly.	Battery circuit open. No load. Battery terminals loose or corroded. Coil damaged. Resistor open or disconnected.	Clean and tighten. Replace relay. Replace resistor.
	OIL DILUTION SOLENOID	
Solenoid inoperative.	Defective coil. No power to coil due to defective switch or wiring. Not grounded.	Replace solenoid. Replace switch or rewire circuit. Ground.
	BATTERY-DISCONNECT SOLENOID	
Solenoid inoperative.	No power to coil due to defective switch or wiring. Defective coil. Plunger binding. Not grounded.	Replace switch or rewire circuit. Replace solenoid. Remove and wash plunger and housing with carbon tetrachloride. Change spring compression only as a last resort. Ground.
Intermittent operation.	Plunger binding. Loose electrical connection. Badly burned points.	See remedy under "Solenoid inoperative." Clean and tighten electrical connections. Dress points or replace unit.
	SUPERCHARGER ANEROID SWITCH	
Supercharger will not shift to "high" blower. No indication on high blower warning light.	Supercharger solenoid defective. Open circuit breaker. Warning light burned out. Defective control switch; stays in "low" position. Aneroid switch defective or out of calibration. Broken wire to solenoid.	Replace. Reset circuit breaker. Replace. Replace switch. Remove and recalibrate or replace. Repair.
	RADIATOR AIR OUTLET FLAP ACTUATOR	
Actuator will not operate.	No voltage at unit. Motor burned out, due to: (1) Brake stuck closed. (2) Jamming of follow-up screw, or jack-screw. (3) Cam passing limit switch, due to brake stuck open. Driving gears stripped.	Correct external wiring to connector plug. Remove actuator for overhaul. Replace with new unit. Replace actuator.

(5) ADJUSTING MAIN GEAR DOWN-LOCKPIN SWITCH. *(See figure 353.)*

(a) Jack the airplane so landing gear may be operated.

(b) Disconnect shock strut fairing.

(c) Unlock the gear.

(d) Loosen locknut on switch operating rod, which is connected to the lockpin assembly. Adjust for a measurement of 1/2-inch $\pm \frac{0}{1/64}$ between the lockpin rod, when full out, and the top of the switch plunger when it is depressed to its limit of overtravel. Tighten the locknut on the switch operating rod.

(e) Retard the throttle and operate the gear, checking the operation by means of the warning light.

(6) ADJUSTING MAIN GEAR FAIRING DOOR MICROSWITCH (P-51D-5A-10-NA and P-51D-5A-10-NT).

(a) With the main gear down and locked, pull the emergency down lever at the base of the control stick so doors can be pulled down for access to the fairing door microswitch.

(b) Move the switch in the slotted mounting holes until there is a clearance of 1/4 inch between the top of the switch plunger and the timing valve plunger, which actuates the switch.

(7) ADJUSTING MAIN GEAR FAIRING DOOR SWITCHES (P-51D-15-NA).

(a) With the airplane parked on the ground, pull the emergency gear down handle, at the base of the control stick so as to gain access to the door switches.

(b) Engage the switch plunger until the switch clicks. At this point there must be a clearance of 3/16 inch between the end of the switch plunger and the *inside groove* in the skin. *(See figure 354.)*

(c) If the clearance is not correct, loosen the two switch mounting screws and move the switch in the slotted mounted holes for the correct adjustment.

(d) Tighten the switch mounting screws.

(8) ADJUSTING MAIN GEAR FAIRING DOOR SWITCHES (P-51D-20-NA and P-51D-15-NT).

(a) Jack the airplane. Retract the landing gear, closing the fairing doors. Disconnect the landing gear oleo strut fairings.

(b) Exhaust the hydraulic pressure so the doors can be lowered manually.

(c) On each door, unlock the aft lock and lower the door until the front lock hook is riding on the roller.

Note

The aft door lockspring must be moved out of the way to allow the hook to pass under the roller.

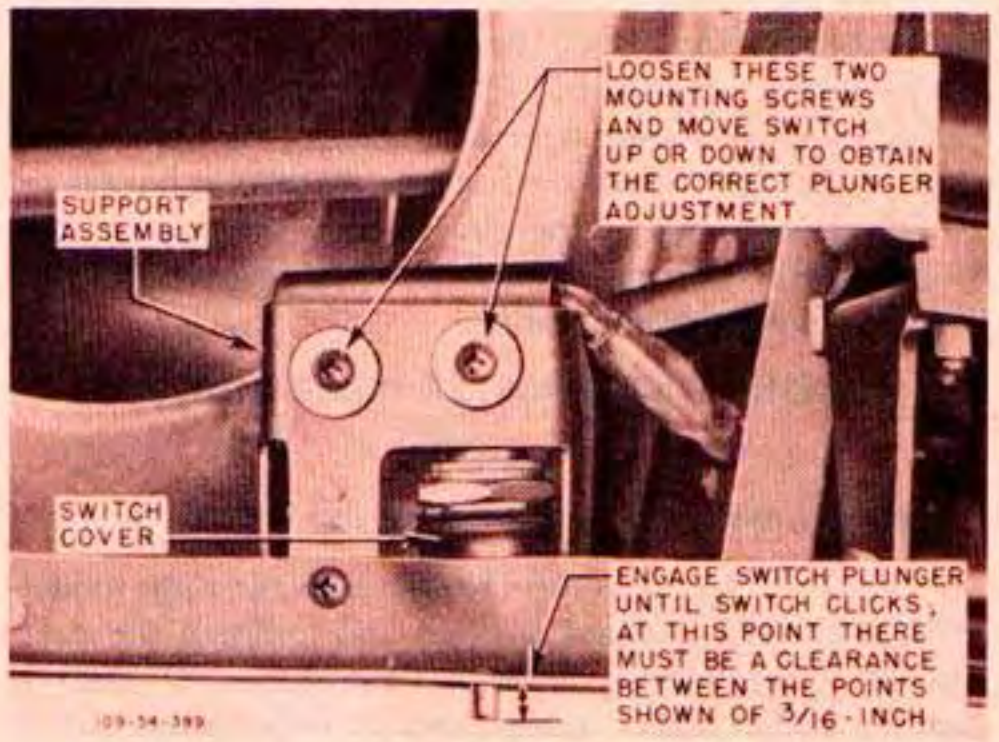


Figure 354—Adjusting Main Gear Fairing Door Switches—Late Airplanes

(d) Loosen the two fairing door switch mounting screws. Insert a 3/16-inch thickness gage between the door and the switch plunger. Move the switch down on the thickness gage until the switch bottoms (plunger in as far as it will go); then tighten the mounting screws.

(e) Reconnect the landing gear oleo strut fairings; then operate the gear for a final check.

k. FUEL BOOSTER PUMP (Early Airplanes).—The electrical portion of the fuel booster system consists of three TFD-13000-2 electric-driven pumps, one Type C-2 control switch, and two fuel pump selector switches. The booster pumps for the main fuel tanks (installed inside them), and the booster pump for the fuselage tank (at the bottom aft right side of the tank) are controlled by a switch, marked "NORMAL," "EMERGENCY," and "OFF." When this switch, which is on the front switch panel, is placed in the "EMERGENCY" position, part of the current flows through a one-ohm, 80-watt resistor to the lower fuel pump selector switch, and then directly to the positive brush of the selected pump in addition to the normal current to the motor field through the upper selector switch. This additional current in the emergency circuit results in higher motor speed, and thus a higher fuel pressure from the pump is attained. The selector switches on the underside of the fuel tank selector handle are actuated by the control shaft of the selector handle. In "NORMAL" position, the resistor circuit is cut out and current flows only to the upper selector switch and on to the booster pump selected. A decreased motor speed results in a lower fuel pressure from the pump. This circuit is fused with a 20-ampere circuit breaker. For further information on this item, refer to section IV, paragraph 15.

l. FUEL BOOSTER PUMPS (Late Airplanes).

(1) DESCRIPTION.—The fuel booster system consists of three TFD-13000-2 electric-driven booster pumps, one master switch, one fuel pump selector switch, and a variable 7 1/2-ohm, 25-watt resistor in series with the emergency circuit to each pump. When the master switch on the front switch panel is turned "ON," current flows to the fuel tank selector switch, which is actuated by the control shaft of the

TROUBLE	PROBABLE CAUSE	REMEDY
Actuator operation not stable; hunting occurs.	Broken spring in thermostat switch assembly.	Replace actuator.
	Too little clearance between thermostat switch points.	Replace actuator.
	Follow-up screw inserted with insufficient clearance.	Replace actuator.
Radiator flap fully open or fully closed, and will not return automatically.	Motor limit switch is breaking before relay limit switch.	Automatic operation can be temporarily restored by turning cockpit switch "OFF" and then to manual position for opposite direction. For permanent remedy, remove unit for overhaul.
	Cam has passed limit switch due to reversed motor leads, or motor brake sticking open.	Remove for overhaul.
	Jackscrew improperly located during installation.	Properly locate jackscrew. Make sure motor was not damaged by continued attempts at operation after jamming.
	Jackscrew jammed due to improper position of follow-up screw.	Remove unit for overhaul.
Actuator will not respond properly to operation of cockpit switch.	Wiring between cockpit control switch and actuator reversed.	Correct wiring in accord with airplane wiring diagram.
	Plug forced into socket in wrong position.	Install plug correctly.
Power of motor reduced.	Badly worn brushes.	Replace the brushes.
Motor drags. Brake discs overheat. Binder on cork brake disc loose.	Too close on adjustment between the rotating and stationary disc, allowing them to contact.	Remove unit for overhaul.
	Too much end play in motor shaft.	Remove unit for overhaul.
	Not enough motor shaft end play.	Remove unit for overhaul.
	Too much spacing between the motor discs preventing, under some conditions, the brake from disengaging when control calls for running.	Remove unit for overhaul.
Excessive sparking at the commutator with excessive brush wear.	Arrows on motor misaligned.	Remove unit for overhaul.
	Grease in motor.	
Relay chatters on all loads.	Broken interrupter switch contact loop strips.	Remove unit from airplane for overhaul.
	Relay armature is bent, not making contact on all four bracket tangs.	Replace unit.
Unit operates satisfactorily at low or medium loads but chatters two or three times at maximum load before jackscrew shaft makes a full turn.	Cam on interrupter switch worn, or interrupter switch operating lever bent.	Replace actuator and overhaul.
Coolant radiator flap partially closes (oil, partially opens) and then jams.	Pin loose or missing from jackscrew dust guard.	Replace pin.

selector handle. This switch feeds both the normal and emergency circuits simultaneously. The three resistors in the emergency circuits are mounted forward of the instrument panel on the right side of the fuselage. As there is no way to cut the resistors out of the circuit from the cockpit, the booster pumps will run at only one speed, supplying from 12 to 14 pounds per square inch.

(2) ADJUSTING BOOSTER PUMP RESISTORS.

Note

Engine must be stopped during this adjustment.

(a) For access to the resistors, push the right rudder pedal to extreme forward position and unfasten the dzus fastener at the bottom of the bracket. Raise the bracket slightly and pull it back into the cockpit as far as the wiring will permit.

(b) To supply 28 volts D.C. to the electrical system, connect a motor generator set to the external socket on the airplane.

Note

It is imperative that 28 volts D.C. be used when adjustment is made as this is the condition under which the pump will work during flight.

(c) Position the fuel tank selector handle for the fuel booster pump to be adjusted.

(d) Select the resistor in the circuit to the booster pump to be adjusted. Loosen the screw in the adjustable band. Slide the resistor band along the resistor until there is an indication of between 13.5 to 15.5 pounds per square inch fuel pressure on the fuel pressure gage.

Note

Extreme care should be exercised to avoid damage to these resistors, as they are very delicate.

(e) Tighten the screw on the resistor arm.

(f) Adjust the other two booster pump resistors in the same manner.

CAUTION

Because of a variance between the pumps, the adjustment made for one pump will not necessarily be the same for another. Adjust each resistor to the booster pump it serves.

m. OIL DILUTION SOLENOID.—The oil dilution solenoid valve, connected between the fuel line and the oil system, is mounted on the right-hand engine mount jury brace just forward of the firewall, and is controlled by a switch on the front switch panel.

n. SUPERCHARGER ANEROID AND SOLENOID (Early Airplanes).

(1) DESCRIPTION.—The supercharger solenoid, on the left side of the supercharger case, is electrically operated through an aneroid switch which opens and closes at certain carburetor entrance pressures. On early airplanes, a Delco No. 5067200 switch is mounted in the left corner of the cockpit floor, just aft of the firewall. An amber signal light on the front switch panel indicates when the supercharger is in *high*

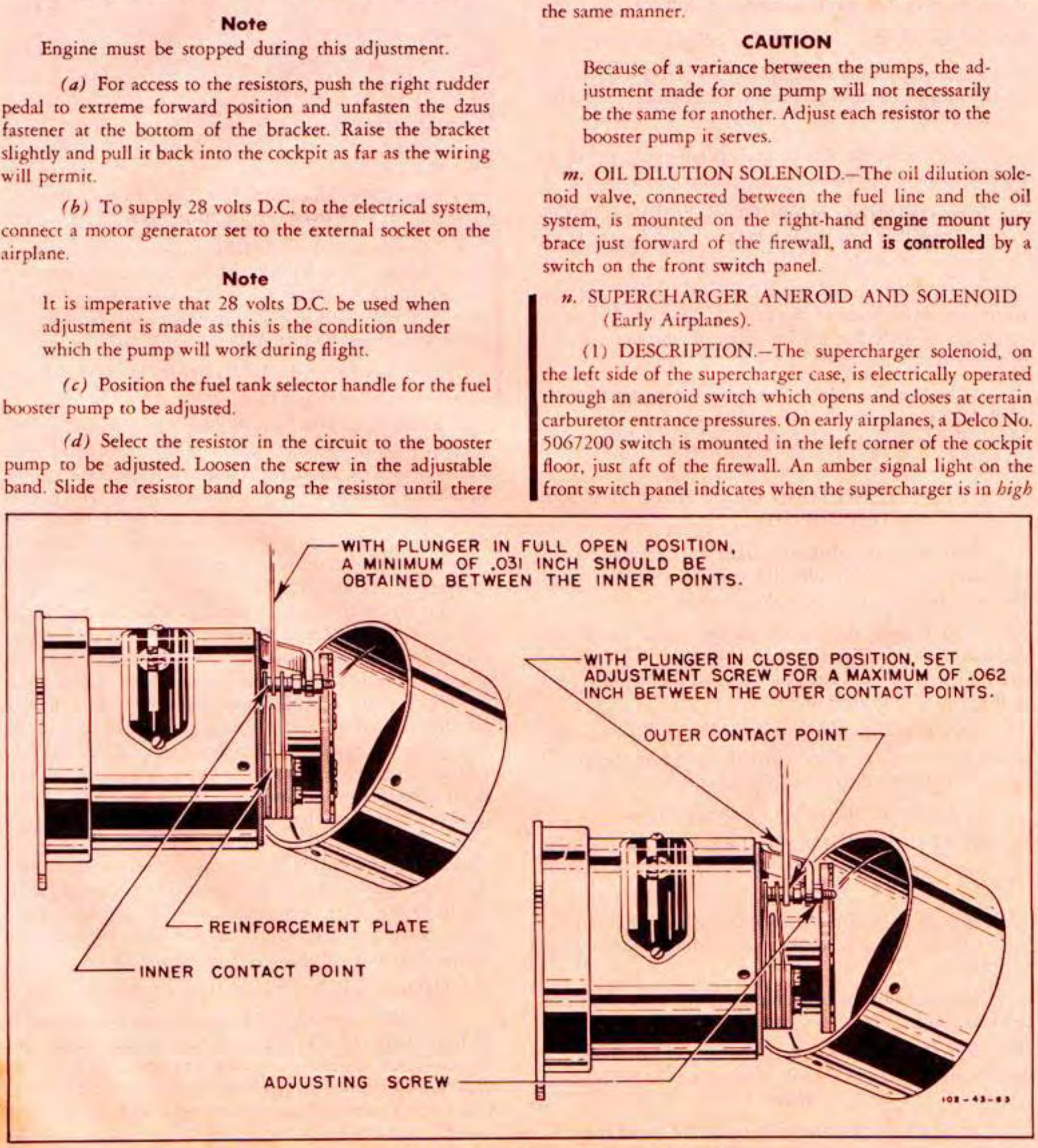


Figure 355—Adjusting Supercharger Solenoid

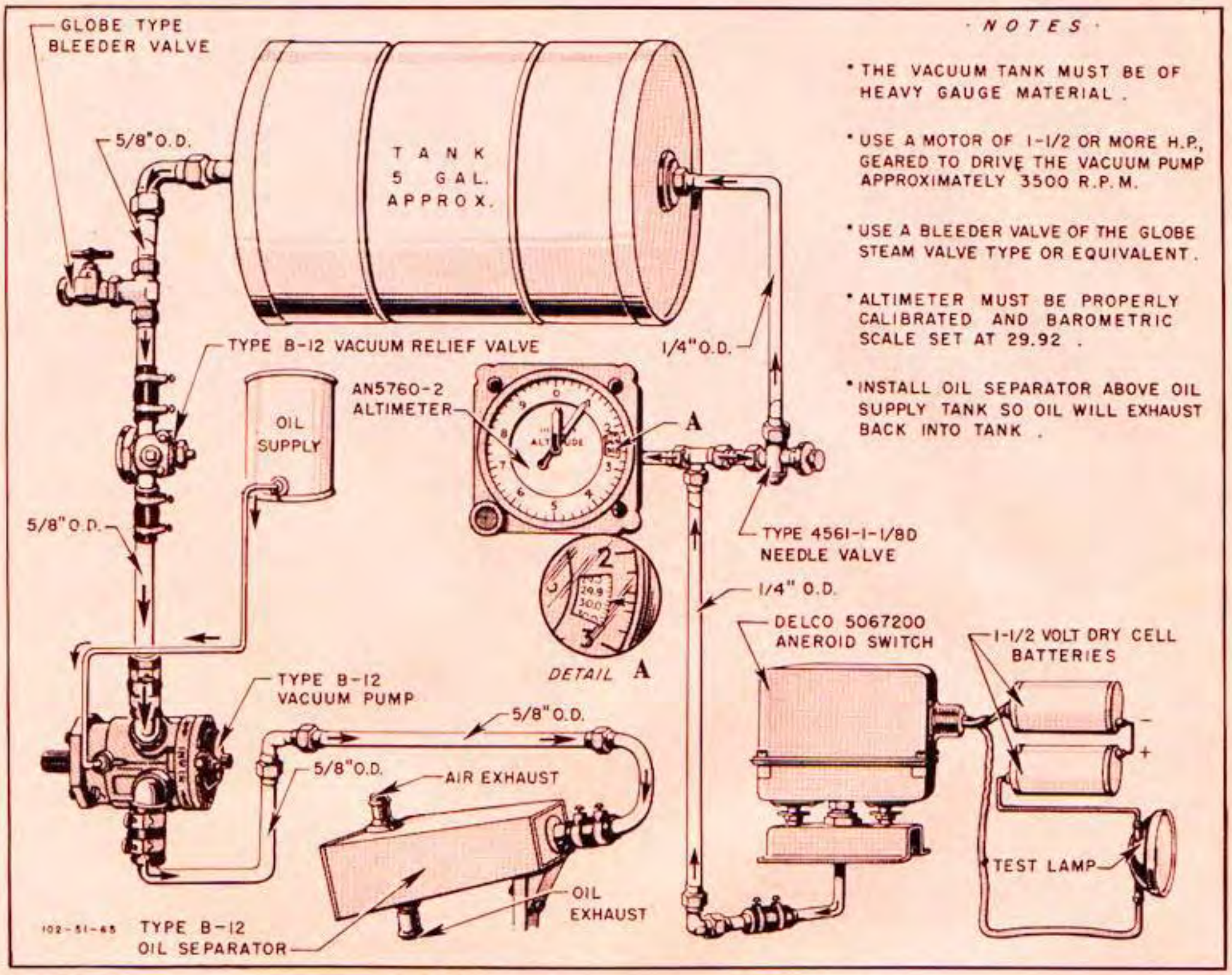


Figure 356—Supercharger Aneroid Test Stand

blower. The control switch, on the front switch panel, has three positions: "LOW," "AUTO," and "HIGH." The low position in either case is used to open the circuit to the supercharger solenoid for "LOW" blower operation in the event of aneroid switch failure. The spring-loaded guard holds the switch in "AUTO" position for normal operation.

(2) REMOVING SUPERCHARGER ANEROID SWITCH.

(a) Remove the electrical connector.

(b) Loosen the hose on the aneroid intake tube.

(c) Remove the screws securing the aneroid switch bracket to the cockpit floor. Do not remove the aneroid switch unit from the bracket.

(3) INSTALLING SUPERCHARGER ANEROID SWITCH.

(a) Position the unit with bracket attached and secure to the floor.

(b) Connect hose to the aneroid switch intake tube and secure the clamp.

(c) Connect the electrical connector to the unit.

(4) CALIBRATING SUPERCHARGER ANEROID SWITCH.—If laboratory equipment or replacement switches are not available, a simple test stand *(figure 356)*, made from standard aircraft parts, can be used to calibrate supercharger aneroid switches.

CAUTION

It is extremely important that only the parts specified, or their close equivalents, be used in constructing the test stand. Otherwise, the altimeter and the aneroid may be damaged beyond repair.

(a) Set up a test stand. *(See figure 356.)*

(b) Remove the mounting bracket and stop nuts from the aneroid switch assembly, and insert an AN8013-1 washer between the flexible mounting pad and each locknut *(figure 357)* to prevent the rubber shock mounts from being drawn in too far when the aneroid switch is evacuated. Reinstall the bracket, leaving the washers permanently installed.

(c) Remove the aneroid switch box cover, and reseal the mounting screw heads with sealing compound, Specification No. AN-C-54. Reinstall the cover.

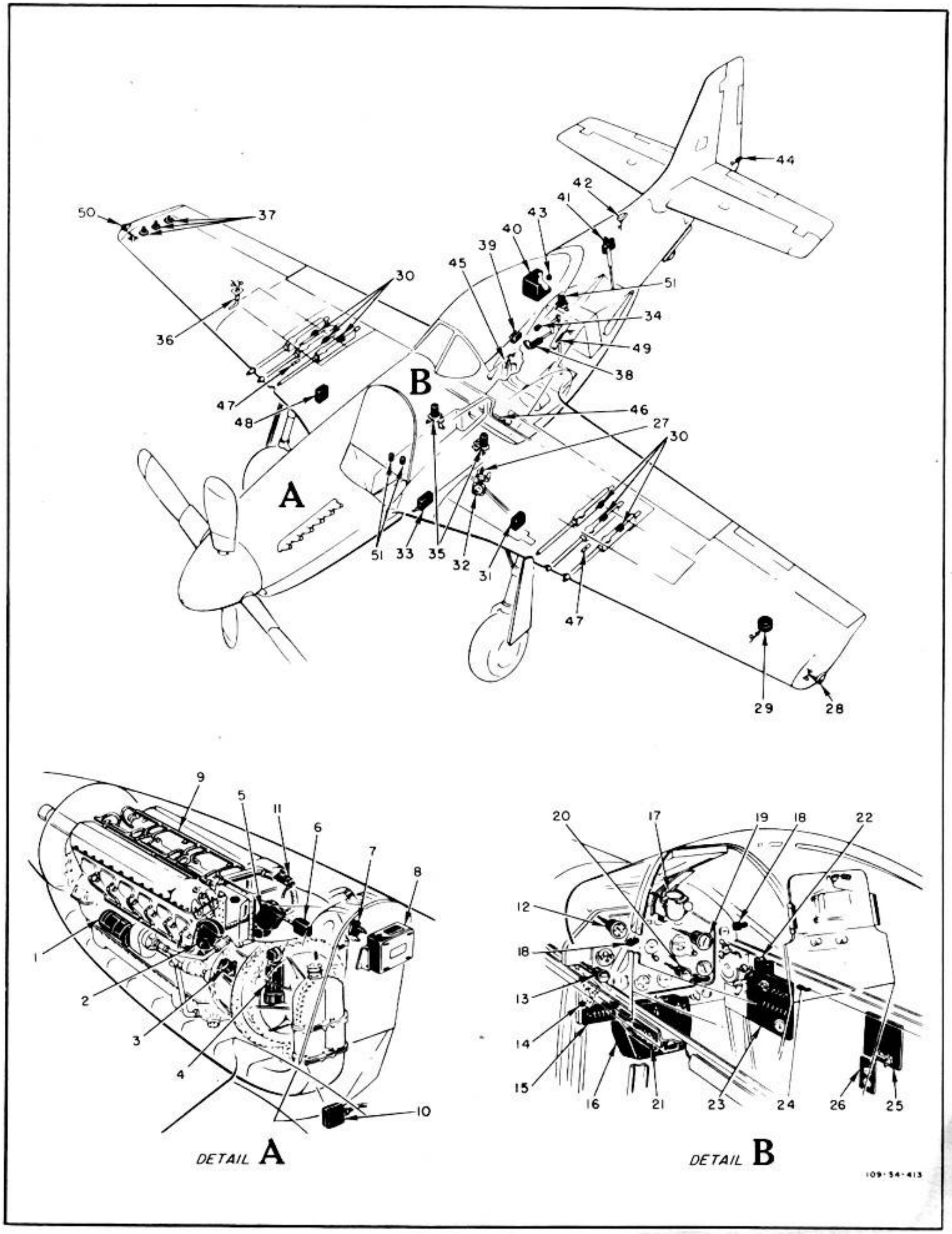


Figure 340—Location of Electrical Equipment

Figure 357—Installation of Washers on Delco Aneroid Switch Bracket

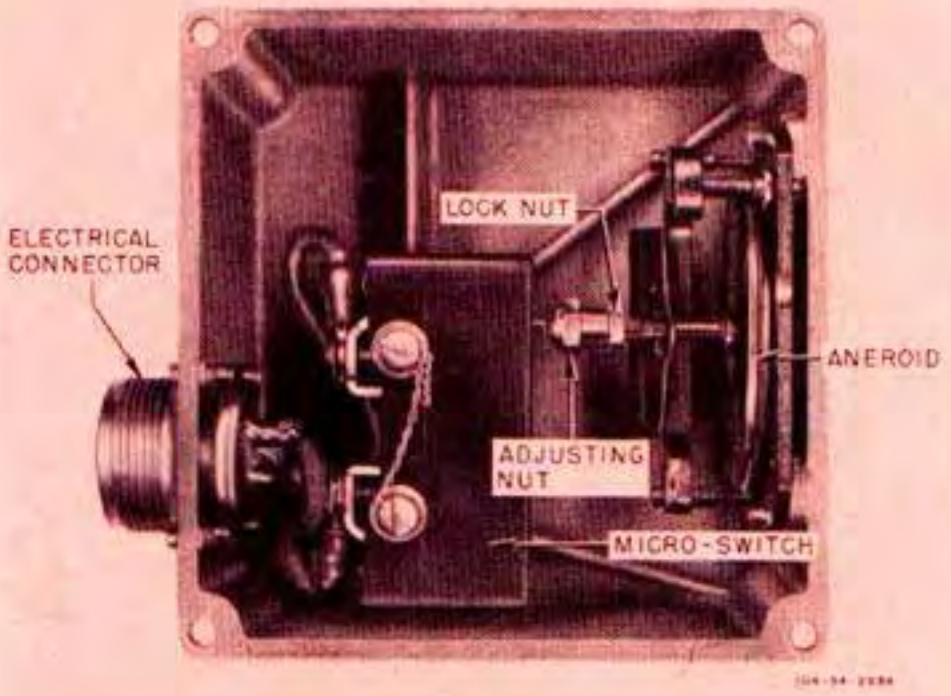


Figure 358—Delco Supercharger Aneroid Switch Adjustment

(d) Connect the aneroid switch to the test stand, and set the barometric pressure scale on the altimeter to 29.92 in. Hg.

(e) Set the relief valve to open at 17,500 feet altitude (for the Packard V-1650-7 engine).

(f) Start the vacuum pump, open the bleeder valve, and adjust the bleeder valve for an altimeter reading of 14,500 (±250) feet; the test light must burn. Bleed off to atmosphere so that pointer is stable.

CAUTION

Before opening an aneroid switch assembly or removing it from the test stand, outside pressure must be bled into the switch *very slowly* or serious damage to the altimeter and aneroid will result.

(g) If the test lamp burns beyond the tolerance range, the aneroid switch must be adjusted. Slowly open the bleeder valve and allow the altimeter reading to gradually fall to approximately zero. Then remove the aneroid switch.

Note

One sixth of a turn is equivalent to approximately 1000 feet altitude, or 1/12 of a turn for 500 feet.

(h) Install the aneroid switch box cover and repeat procedures *(f)* and *(g)* to see that the proper adjustment has been made.

(i) To test the switch for low blower operation, *barely* open the bleeder valve so that the altimeter reading will fall approximately 2000 feet. If the test light fails to go out within the 2000-foot drop in altitude, replace the entire aneroid switch.

(j) Run the altimeter up to 15,000 feet and close the needle valve, located in the line between the altimeter and the vacuum tank, to check the aneroid switch for leaks. If there is an altitude drop of 1000 feet or more in one minute, the aneroid switch must be resealed. As a further test, remove the aneroid switch from the test stand, connect an air hose to it, and immerse the switch assembly in carbon tetrachloride. Apply a pressure of 5 pounds per square inch, and check for leaks.

(5) SUPERCHARGER SOLENOID.

(a) TESTING SUPERCHARGER SOLENOID.

1. Place the supercharger switch, on the front switch panel, in the "LOW" position.

2. Warm up engine as per pilot's check list.

3. Set propeller control to full increase rpm, and open throttle to obtain 2300 rpm.

4. Switch from "LOW" to "HIGH" blower. Satisfactory operation is noted by momentary change in engine performance; rpm will drop at least 50 rpm. Some automatic boost controls may increase the manifold pressure during the change, so it is advisable to throttle back to the manifold pressure observed before switching, noting the rpm drop.

5. If high blower operation is not satisfactory, either readjust solenoid points or replace the supercharger switch in "AUTO" position.

(b) ADJUSTING SUPERCHARGER SOLENOID. *(See figure 355.)*

(6) SUPERCHARGER ANEROID SWITCH DIAPHRAGM.

(a) REMOVING SUPERCHARGER ANEROID SWITCH DIAPHRAGM.

1. Remove the four screws that secure the two halves of the aneroid switch unit together for access to the diaphragm.

2. Remove the two screws, from the outside of the box, and remove the diaphragm from the unit.

(b) INSTALLING SUPERCHARGER ANEROID SWITCH DIAPHRAGM.

1. Position the diaphragm; then secure with two flat head screws. Apply sealing compound, Specification No. AN-C-54, around the screw heads.

CAUTION

Coat both surfaces of the aneroid switch assembly gasket with a permanently plastic, fuel, oil, and water resisting sealing compound.

2. Position the two parts of the aneroid switch assembly, and secure and safety in place with four fillister head screws.

(7) SUPERCHARGER ANEROID MICROSWITCH.

(a) REMOVING SUPERCHARGER ANEROID MICROSWITCH.

1. Remove the four fillister head screws that secure the two parts of the aneroid switch assembly together for access to the microswitch.

2. Remove the safety wire from the two microswitch mounting screws; then remove the screws.

3. Pull the switch out of the box for access to the terminal screws. Remove the two wires from switch; then remove the microswitch.

(b) INSTALLING SUPERCHARGER ANEROID MICROSWITCH.

1. Position the switch; install and safety the two mounting screws.

2. Connect the red wire to the terminal marked minus. Connect the black wire (with a red tracer) to the microswitch terminal marked plus.

3. Calibrate the supercharger aneroid switch assembly; close the unit and install the four screws. *(See paragraph* ***n.*** (4).*)*

(8) SUPERCHARGER ANEROID SWITCH SHOCK MOUNTS.

(a) REMOVING SUPERCHARGER ANEROID SWITCH SHOCK MOUNTS.

1. Remove the mounting bracket from the aneroid switch assembly.

2. Remove the three mounts.

(b) INSTALLING SUPERCHARGER ANEROID SWITCH SHOCK MOUNTS.

1. Position the shock mount so that the greater part of the shock mount bushing is on the outside, giving maximum protection against shock. Rivet the shock mount in place.

2. Insert a 7S4-8-16 screw through each shock mount bushing. The head of the screw must be on the inside of the assembly. Secure the screw with a 2WIF-11-10-32 washer and AN365-832 nut.

3. Install the aneroid switch assembly to the mounting bracket.

4. Apply sealing compound, Specification No. AN-C-54, around the screw heads and mounts.

5. Check the unit for leaks and for proper calibration. *(See paragraph* ***n.*** (4) *(j).)*

o. SUPERCHARGER ANEROID AND SOLENOID (Later Airplanes).

(1) DFSCRIPTION.—On later airplanes a Square "D" Class 9315, Type 1, supercharger aneroid switch assembly is installed on the aft center cowl former forward of the firewall. The electrical system and its function in shifting the supercharger on these airplanes is identical to that on early airplanes. *(See paragraph* 20. ***n.*** (1).*)* However, on later airplanes, a push-to-test signal light is used for checking the condition of the lamp.

(2) REMOVING SUPERCHARGER ANEROID SWITCH.

(a) Remove the windshield cowling, forward of the windshield, for access to the supercharger aneroid switch.

(b) Remove the electrical connector.

(c) Loosen the hose on the aneroid intake tube.

(d) Remove the aneroid switch from the bracket.

(3) INSTALLING SUPERCHARGER ANEROID SWITCH.

(a) Remove the windshield cowling forward of the windshield.

(b) Position the aneroid switch on the bracket and install the mounting screws.

(c) Connect the electrical connector to the aneroid switch.

(d) Install the hose on the aneroid intake tube.

(e) Install the windshield cowling.

(4) CALIBRATING SUPERCHARGER ANEROID SWITCH (Square "D" Class 9315, Type).—As previously mentioned, if laboratory equipment (bell jar, etc.) or replacement switches are not available, a simple test stand *(figure 356)* made from standard aircraft parts can be used to calibrate supercharger aneroid switches.

CAUTION

It is extremely important that only the parts specified, or equivalents, be used in constructing the test stand. Otherwise, the altimeter and the aneroid may be damaged beyond repair.

(a) Set up a test stand. *(See figure 356.)*

(b) Connect the aneroid switch to the test stand; set the barometric pressure scale on the altimeter to 29.92 in. Hg.

(c) Set the relief valve to open at 17,500 feet altitude.

(d) Start the vacuum pump, open the bleeder valve, and adjust it for an altimeter reading of between 13,400 and 12,950 feet altitude (a minimum of 1100 or a maximum of 1550 feet).

(e) To establish the cutout point of the lamp, remove the sealing compound covering the range adjustment and lockscrew. Loosen the lockscrew; turn the adjustment screw to the right to lower the cutout point of the test lamp, or to the left to raise it.

Note

One fourth of a turn is equivalent to approximately 1000 feet altitude.

(f) Adjust the bleeder valve for an altimeter reading of 14,500 (±150) feet; the test light must burn. Bleed off to atmosphere so the pointer on the altimeter reads zero.

(g) Remove the plug beside the electrical receptacle and turn the differential screw to the right to increase the cut-in point or to the left to decrease it.

CAUTION

Before opening an aneroid switch assembly or removing it from the test stand, outside pressure must be bled into the switch very slowly, or serious damage to the altimeter and aneroid will result.

(h) On units not provided with a cap screw, remove the switch cover and loosen the locknut before turning the differential adjustment screw. *(See figure 359.)* The differential housing must be held rigidly to prevent turning when loosening or tightening the locknut. Replace and tighten cover before rechecking altitude settings, as tightening cover changes calibration.

Note

Do not use sealing compound on the cover gasket.

(i) After the differential adjustment is corrected, check for cut-in and cutout points of the lamp.

(j) Apply rubber cement (Specification No. 5069) around the range adjustment and lockscrew. On switches incorporating the cap screw, apply sealing compound (metallic X-cement or equivalent) on the lock washer and cap screw before installing them.

(k) Connect the aneroid switch to the test stand and run the altimeter up to 15,000 feet. Check the aneroid switch for leaks by closing the needle valve in the line between the altimeter and the vacuum tank. If there is an altitude drop greater than 1000 feet per minute, reseal the spots as in procedure *(j)*. To test for small leaks, remove the aneroid switch from the test stand, connect an air pressure of 5 pounds per square inch to it, and immerse in carbon tetrachloride.

CAUTION

If over 5 pounds per square inch pressure is used, permanent damage to the sensitive aneroid bellows will result.

(5) SUPERCHARGER ANEROID SOLENOID.

(a) TESTING SUPERCHARGER SOLENOID. *(See paragraph 20. **n.** (5) (a).)*

(b) ADJUSTING SUPERCHARGER SOLENOID. *(See figure 355.)*

(6) SUPERCHARGER ANEROID SWITCH DIAPHRAGMS.

(a) REMOVING SUPERCHARGER ANEROID SWITCH DIAPHRAGMS.

1. Remove the aneroid switch box cover.

2. Remove the sealing compound from around the range screw and the range locking screw; remove the range screw.

3. Insert a screwdriver into the bellows support stud and turn counterclockwise until the stud is free of the aneroid diaphragm screw. Prevent the diaphragm from turning while removing the stud. Very carefully remove the diaphragms from the box.

Note

Do not remove the compensating pins *(figure 358A)* from the original position on the temperature compensator.

4. If a pin falls out, reinstall by checking the figure written in ink on the diaphragm to determine its correct position on the temperature compensator. This figure indicates the proper center-punched mark for the pin. There are four center-punched marks at the end of each bimetallic compensator. The punch mark closest to the end is No. 1. There is only one center-punched marking in the round post in the center of the diaphragm.

Note

If the temperature compensator becomes loose, the unit must be replaced.

(b) INSTALLING SUPERCHARGER ANEROID SWITCH DIAPHRAGMS.

1. Insert the lock washer and the guide plate with the smaller hole on the screw extension of the diaphragm.

Note

Never pick up a new diaphragm by the U-shaped temperature compensator.

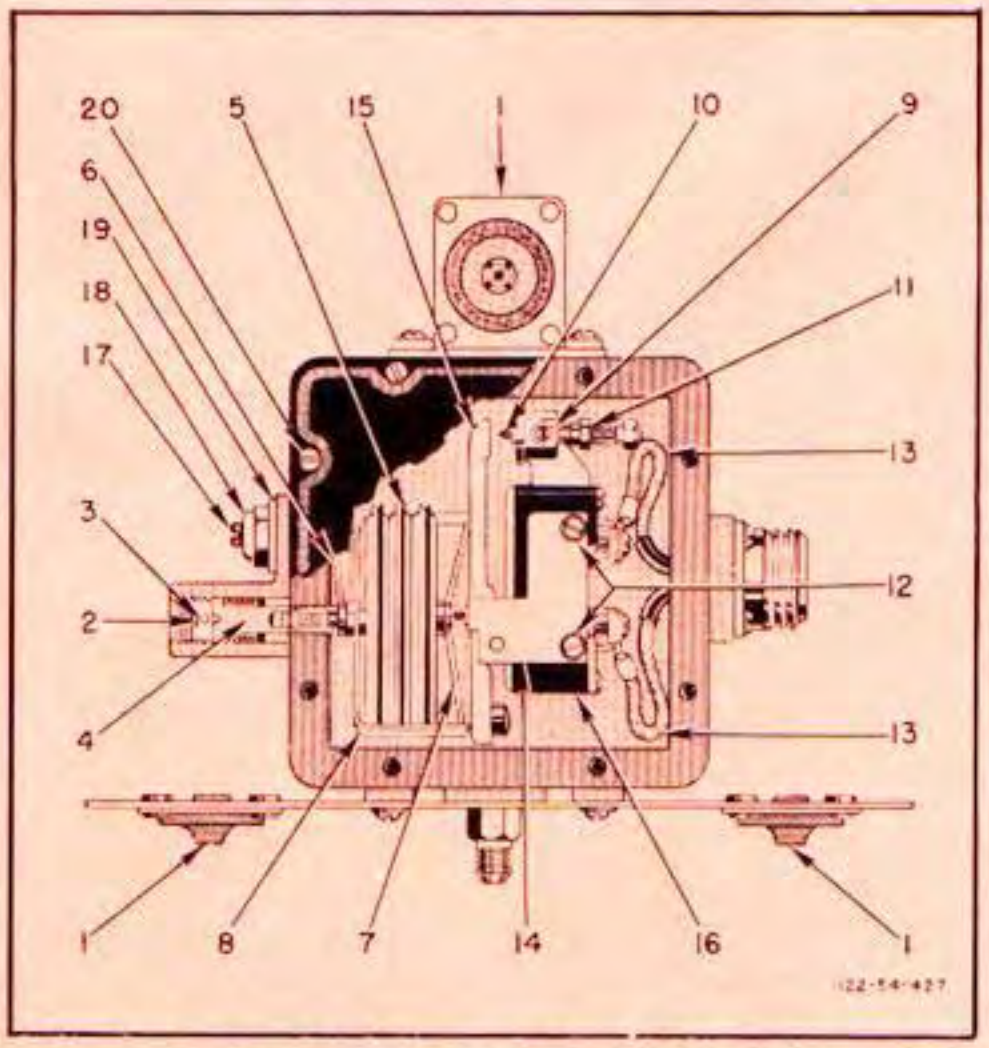


Figure 358A—Square "D" Aneroid Switch Details

(b) REMOVING BATTERY.

1. Remove the cockpit enclosure for access.

2. Turn wheel on quick-disconnect battery plug counterclockwise until the unit is disconnected from the battery; lay unit aside.

3. Disconnect battery vent hoses from battery.

4. Free tie-down rods from slots in battery cover.

5. Remove the battery. A second man should assist in this operation.

(c) INSTALLING BATTERY.

1. Make certain the battery is fully charged and that there is a 3/16-inch thick sponge rubber gasket between the battery lid and the battery; the gasket prevents any acid accumulated on top of the battery from leaking into the interior of the airplane.

2. Position the battery and install the tie-down rods in the slots in the battery cover. Snap down cam snaps and check for a tight fit. If necessary, release cam snaps and adjust for proper fit.

3. Connect wires to battery terminals and install the battery terminal box cover or, in the case of the quick-disconnect plug, position the plug and turn the wheel clockwise until it is snug.

4. Connect the battery vent lines to the battery vents.

(d) CHARGING BATTERY THROUGH EXTERNAL POWER SOCKET.—A battery with a specific gravity of 1.240 or lower must be removed and recharged. However, if the specific gravity is only a little low, it is possible to recharge the battery in the airplane through the external power socket as follows:

1. Connect a portable motor-driven generator with a 28 to 28.5 direct-current voltage output to the external power socket.

2. Turn "ON" the battery-disconnect switches. See that all other electrical switches are "OFF."

Note

As there is no individual switch for the inverter, it will run, without ill effects, while the battery is being recharged.

3. Start the motor generator and check its output for 28 volts. Take hydrometer readings at intervals.

(e) BATTERY VENTING AND DRAINING PROVISIONS.—The battery is vented by an intake rubber tube installed in the front scoop and connected to one battery vent. Another tube extends from the opposite battery vent to a small jar just aft of the battery, known as a sump, which contains a pad that has been treated with a solution of trisodium phosphate to neutralize any acid that spills over from the battery. From the jar, a tube carries the gases overboard through an opening on the right underside of the fuselage.

(f) REPLACING BATTERY SUMP PAD.

1. Remove the two wing nuts on plate holding the jar in place. Put the plate aside, and remove the jar.

2. Saturate a sponge or an inch-thick felt pad with a saturated solution of trisodium phosphate that has been boiled and allowed to cool.

CAUTION

Use only enough solution to saturate the pad. Any excess solution may flow into the vent line when the airplane is in a vertical or inverted position.

3. Place the sponge in the bottom of the jar.

4. Reinstall the jar and plate; tighten the wing bolts securely.

(2) GENERATOR SYSTEM.

(a) DESCRIPTION.—An engine-driven generator supplies the primary source of power for the electrical system when the engine is operating under normal conditions, and also charges the battery. Charging current is supplied through the reverse-current relay which is actuated by the generator-disconnect switch on the right switch panel. A voltage regulator keeps the charging potential between 27.5 and 28.5 volts. An ammeter mounted on the right switch panel indicates the current output of the generator.

(b) GENERATOR.

1. DESCRIPTION.—A Type O-4, 28.5-volt, 100-ampere left-hand rotation generator is mounted on the left side of the engine. Rammed air from the front of the engine is directed through a blast tube to the generator for cooling. A stud-type terminal block is mounted on the generator; a small boot tied around the block keeps out moisture.

2. REMOVING GENERATOR.

a. Remove the upper and lower left engine cowling for access to the generator.

b. Remove the three wires from the terminal block.

c. Remove the blast tube from the air spout on the generator.

d. Remove the nuts on the mounting studs and remove the generator.

3. MEASURING GENERATOR BRUSH TENSION.

a. Remove the front head cover for access to the brushes and brush springs.

b. Hook a spring scale underneath each spring, and lift the end of the spring 1/8 inch above the brush box. *(See figure 341.)* If the tension does not measure between 56 and 64 ounces, send the generator to the overhaul shop as this adjustment requires disassembly of the generator.

1. Shock Mount.
2. Range adjusting screw.
3. Range lock screw.
4. Bellows support stud.
5. Bellows.
6. Guide plate.
7. Temperature compensator pin.
8. Temperature compensator.
9. Cap screw.
10. Differential pin.
11. Differential lock nut.
12. Microswitch mounting screws.
13. Electrical wiring.
14. Switch bracket assembly.
15. Lever assembly.
16. Microswitch.
17. Guide pin.
18. Lock nut.
19. Lock washer.
20. Cover mounting screws.

KEY TO FIGURE 358A

2. Position the diaphragms so one leg of the temperature compensator measures between 3/32 and 5/32 inch from the flange surface of the case to the top end of the temperature compensating leg on the air inlet side. Turn the diaphragm support stud clockwise until the diaphragms are securely in place. Make sure the other end of the guide plate is connected to the guide pin.

3. Install the range adjustment screw.

4. Calibrate the aneroid switch assembly. *(See paragraph 20. o. (3).)*

(7) SUPERCHARGER ANEROID MICROSWITCH.

(a) REMOVING SUPERCHARGER ANEROID MICROSWITCH.

Note

The microswitch is a special unit developed for the aneroid switch and can only be replaced by one of the same type.

1. Remove the two microswitch mounting screws *(figure 358A)* and lift the unit out of the case.

2. Disconnect the wires from the switch and slide the switch out of the frame.

CAUTION

Do not change the shape of the switch frame by forcing the bracket together as this will destroy free movement of the lever.

(b) INSTALLING SUPERCHARGER MICROSWITCH.

1. Slide the new switch unit (Part No. 1555-D16-G1) into the frame (Part No. 1555-D14-G1) and connect.

2. Position the unit on the mounting and tighten the mounting screw next to the differential adjustment slightly; leave the other screw loose.

3. Shift the microswitch in the frame so it will operate with the lever approximately in the horizontal position. To determine the cut-in and cutout point, observe the click of the switch or connect a test light across the switch. Tighten both mounting screws.

Note

If the microswitch is shifted too far in the direction of the diaphragm, the switch will not cut out and the lever will extend too far above the differential adjustment; if the microswitch is too far down the result is the opposite and the lever will hit the frame. Therefore step 3. is important.

(8) ADJUSTING DIFFERENTIAL PICKUP.—If the holding screws of the microswitch have been loosened, the differential pickup should be checked and, if necessary, readjusted as follows:

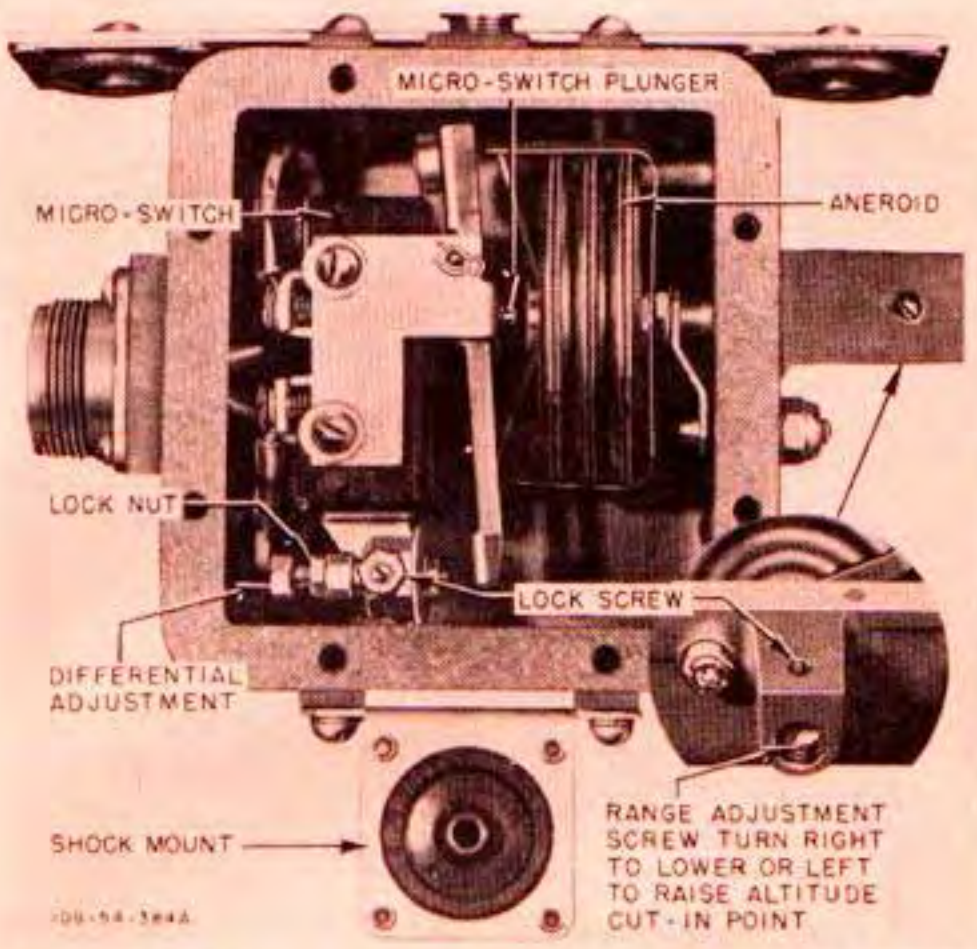


Figure 359—Square "D" Supercharger Aneroid Switch Adjustment

(a) Loosen the differential hexagon nut and setscrew.

(b) Operate the lever by hand or by using the range adjusting screw. The lever must engage the differential pickup pin, and push it in slightly before the microswitch clicks to the on position. When the lever is returned to the off position, it must leave the pickup pin and show a small air gap between the two parts before the microswitch opens. To bring the pickup pin in the right position, turn the differential housing in or out. The movement of the pickup pin must be approximately the same distance as the width of the air gap before the microswitch opens.

Note

Unless this adjustment is made correctly, it will be impossible to change the differential of the switch.

(c) After the adjustment is made, tighten the differential hexagon nut and setscrew securely. The unit is ready for calibration.

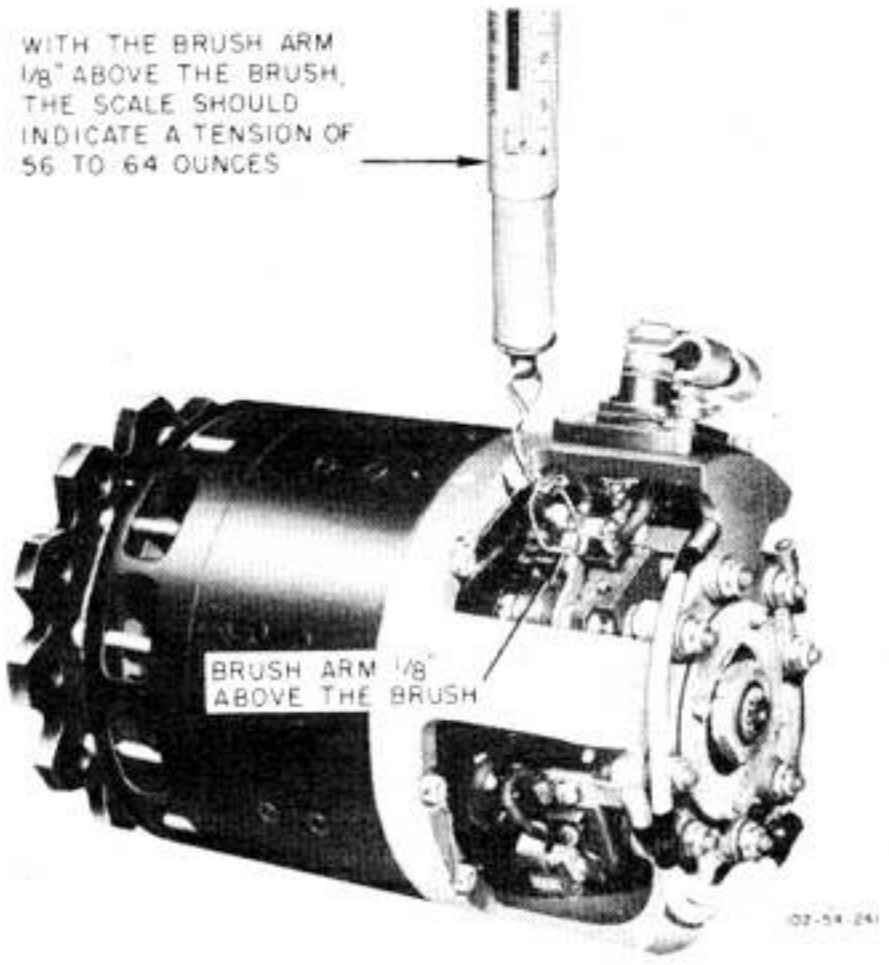


Figure 341—Measuring Generator Brush Tension

Note

The brush spring should bear centrally on the top of the brushes to ensure full brush contact with the face of the commutator.

4. CLEANING GENERATOR BRUSH BOXES.—If the brushes are not less than ½ inch in length but are binding in the brush boxes, remove and clean the brushes and brush boxes with a cloth moistened with unleaded gasoline or any other suitable solvent. *Do not use carbon tetrachloride, since its use will result in rapid brush wear.* The brushes should fit freely with no excessive side play.

5. REPLACING GENERATOR BRUSHES. *(See figure 342.)*

a. Remove the front head cover for access to the brushes.

b. If the brushes are ½ inch or less in length, replace them, making sure that the brush leads are not twisted and that all connections are clean and tight.

c. Reinstall the front head cover. Install generator on the airplane.

d. The new brushes must be seated to at least 75 percent of the contact surface by running the generator without load (with the generator-disconnect switch "OFF") for at least 15 minutes during the engine warm-up period

CAUTION

Do not use abrasives of any kind in seating the brushes.

6. INSTALLING GENERATOR.

a. Make sure the engine pad and the generator flange are free from oil and dirt, and that the gasket or seal is dry and in good condition.

b. Position the generator on the mounting studs and tighten the nuts securely.

c. Connect the air blast tube to the air spout on the generator.

d. Install the wires to the terminal block on the generator.

7. FLASHING GENERATOR FIELD.

a. Make sure the battery-disconnect switch is "OFF," and that no external power is connected to the airplane.

b. Remove the cover on the generator control panel for access to regulator and reverse-current relay.

c. Remove the voltage regulator from the mounting base.

d. Connect a piece of No. 14 or heavier wire between the "BAT" terminal on the reverse-current relay and terminal "A" on the voltage regulator mounting base.

e. Connect a test voltmeter between the "B" terminal on the voltage regulator and ground.

f. Turn "OFF" the generator-disconnect switch and run the engine at 1800 rpm.

g. With the engine running, open and close the battery-disconnect switch a few times and note if a voltage is obtained on the voltmeter. If no voltage is obtained, the generator is faulty and should be replaced. Stop engine.

h. Be sure battery-disconnect switch is "OFF"; then remove the jumper wire.

i. Replace the voltage regulator, and check if voltage is still indicated on the voltmeter.

j. If a generator repeatedly loses its residual magnetism, replace with a new generator.

CAUTION

Do not, under any conditions, flash the generator by manually closing the relay contacts.

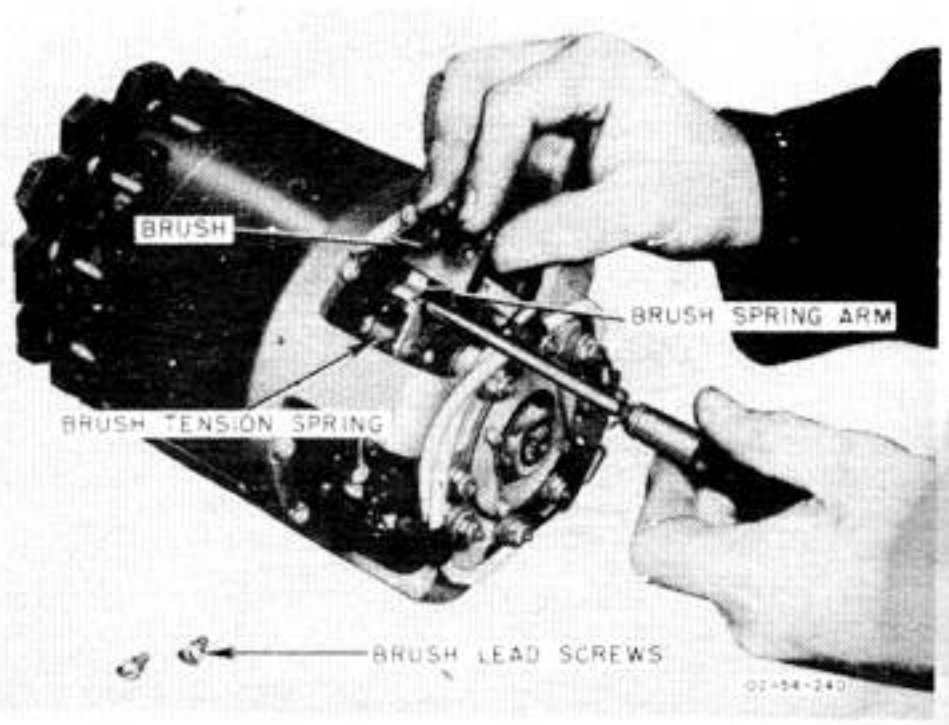


Figure 342—Replacing Generator Brushes

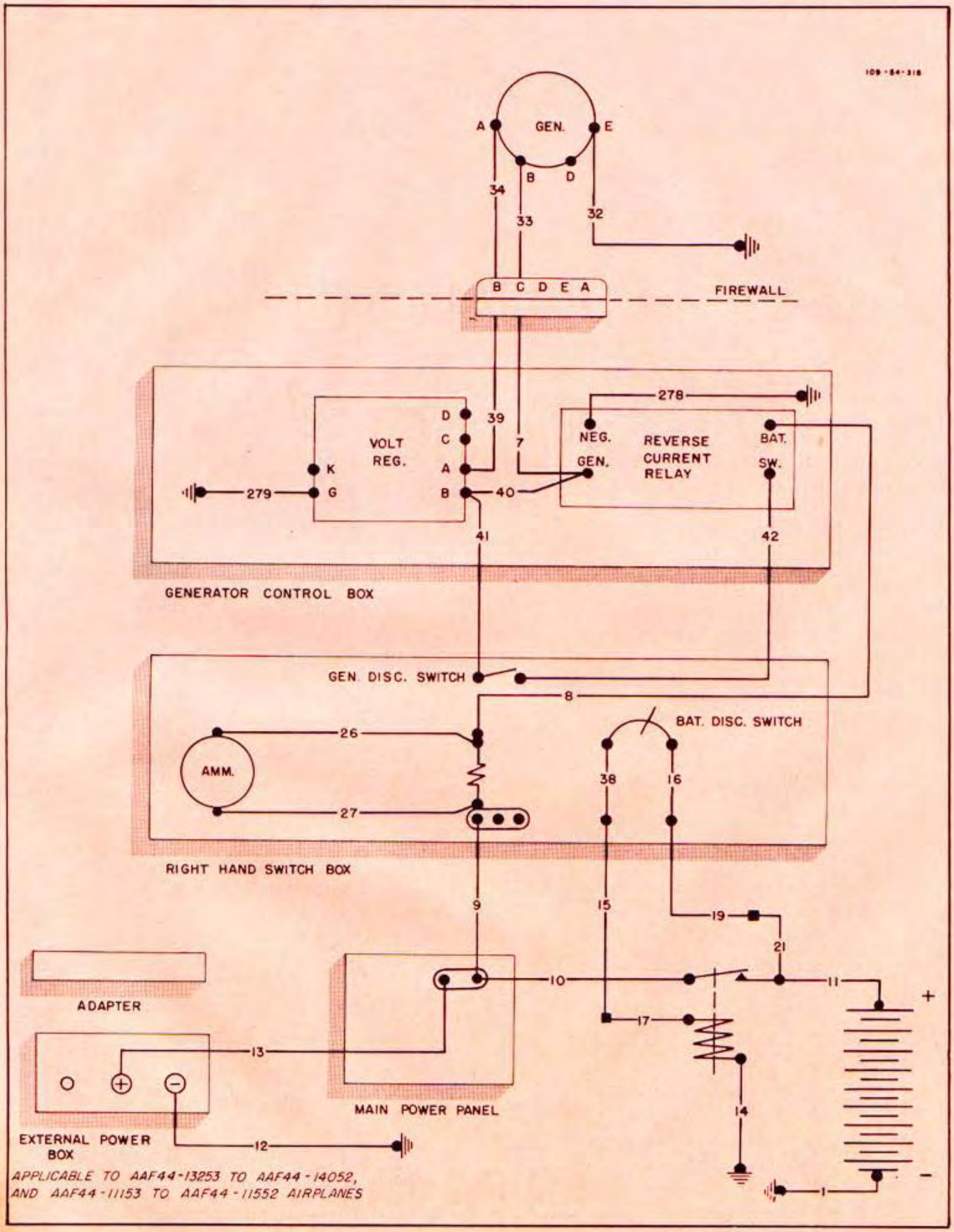


Figure 360—Battery and Generator Control and External Power Receptacle Wiring Diagram—Early Airplanes

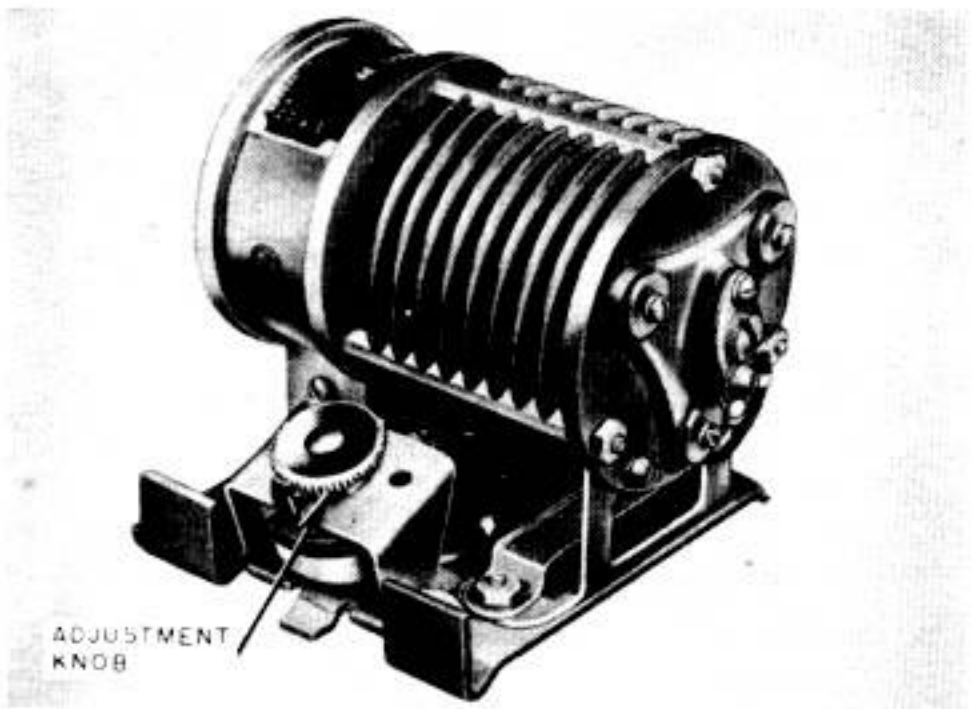


Figure 343—Voltage Regulator Adjustment

(c) VOLTAGE REGULATOR.

1. DESCRIPTION.—A voltage regulator, of either the contact finger or carbon pile type, is mounted in the generator control box. The regulator automatically maintains the electrical system at between 27.5 and 28.5 volts regardless of variations in the speed of the generator and conditions of varying electrical loads, by controlling the amount of resistance inserted into the field circuit of the generator.

2. REMOVING VOLTAGE REGULATOR.

a. Remove the cover of the generator control box.

b. Lift out the regulator while pulling the hold-down springs away from the base plate.

CAUTION

Handle voltage regulator with care.

3. INSTALLING VOLTAGE REGULATOR.

a. Inspect the voltage regulator for general condition and make sure there are no broken wires. *Handle the voltage regulator with care.*

b. Remove the lid of the generator control box.

c. Place the regulator on the mounting, and slip the hold-down ear on the unit into the slotted lugs on the base.

d. Snap the hold-down springs over the base plate of the regulator.

e. Replace the cover on the generator control box.

4. ADJUSTING VOLTAGE REGULATOR.—The precision-type voltmeter used for this adjustment must be handled carefully. If a precision-type voltmeter is not available, a Type B-1 meter may be used, but only after it has been checked with a precision meter. Satisfactory temporary operation may be had by checking the meter at 28 volts. Proceed as follows:

a. Remove the regulator, inspect for general condition, and see that there are no broken wires.

b. Turn "OFF" generator switch.

c. Connect negative side of voltmeter to ground or structure of the airplane, and the positive side to the "B" terminal of the voltage regulator.

d. Start engine and permit it to reach proper operating temperature; then gradually increase rpm to 1800. Voltmeter should then read 28 volts. If it does not, adjust voltage regulator by turning the adjusting screw or knob *(figure 343)* to the right to increase voltage, or to the left to decrease voltage.

WARNING

Throttle the engine to 650 or 700 rpm when making the adjustment; then be sure to step away when engine is run up to 1800 rpm so as to avoid injury by the propeller.

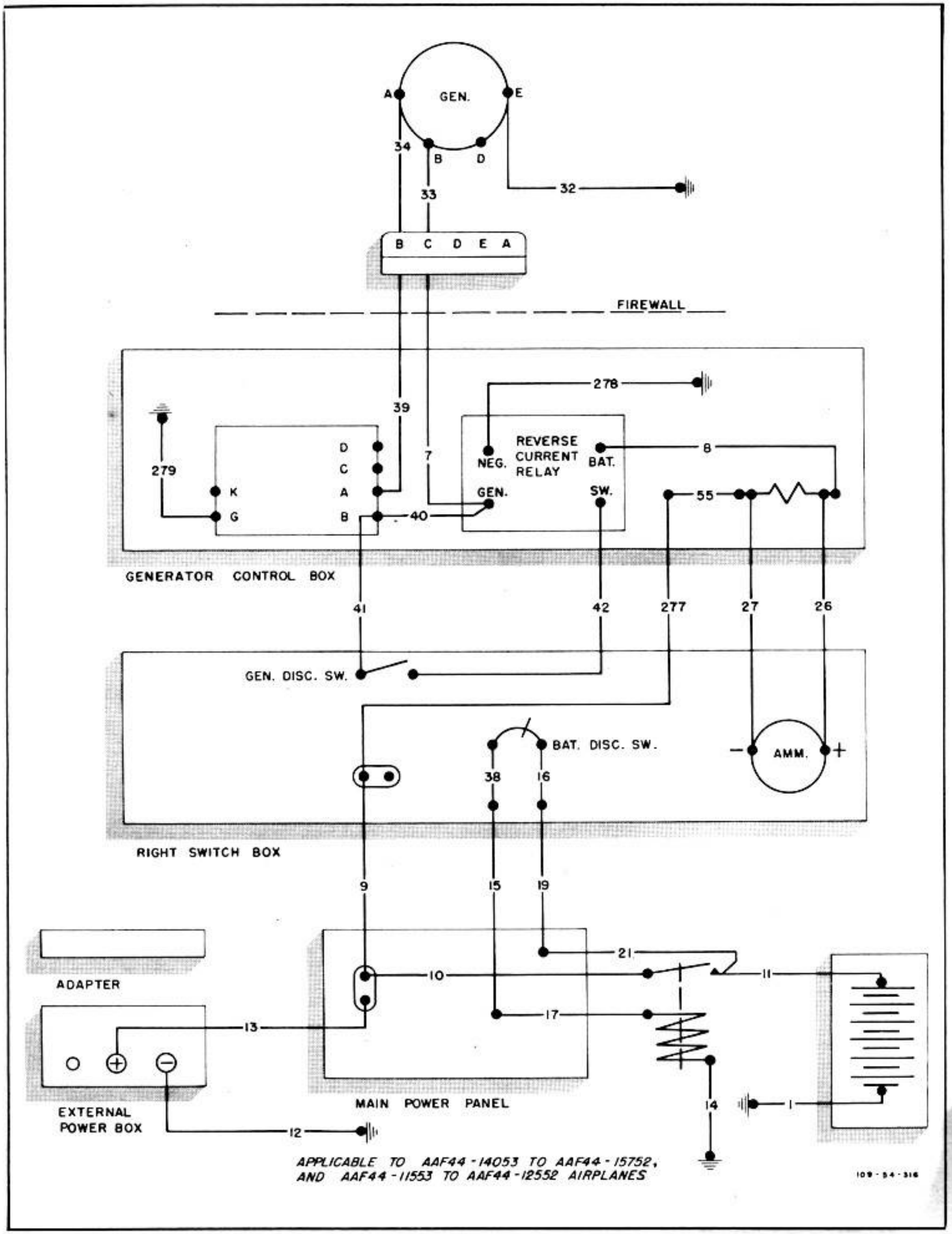


Figure 361—Battery and Generator Control and External Power Receptacle Wiring Diagram—Later Airplanes

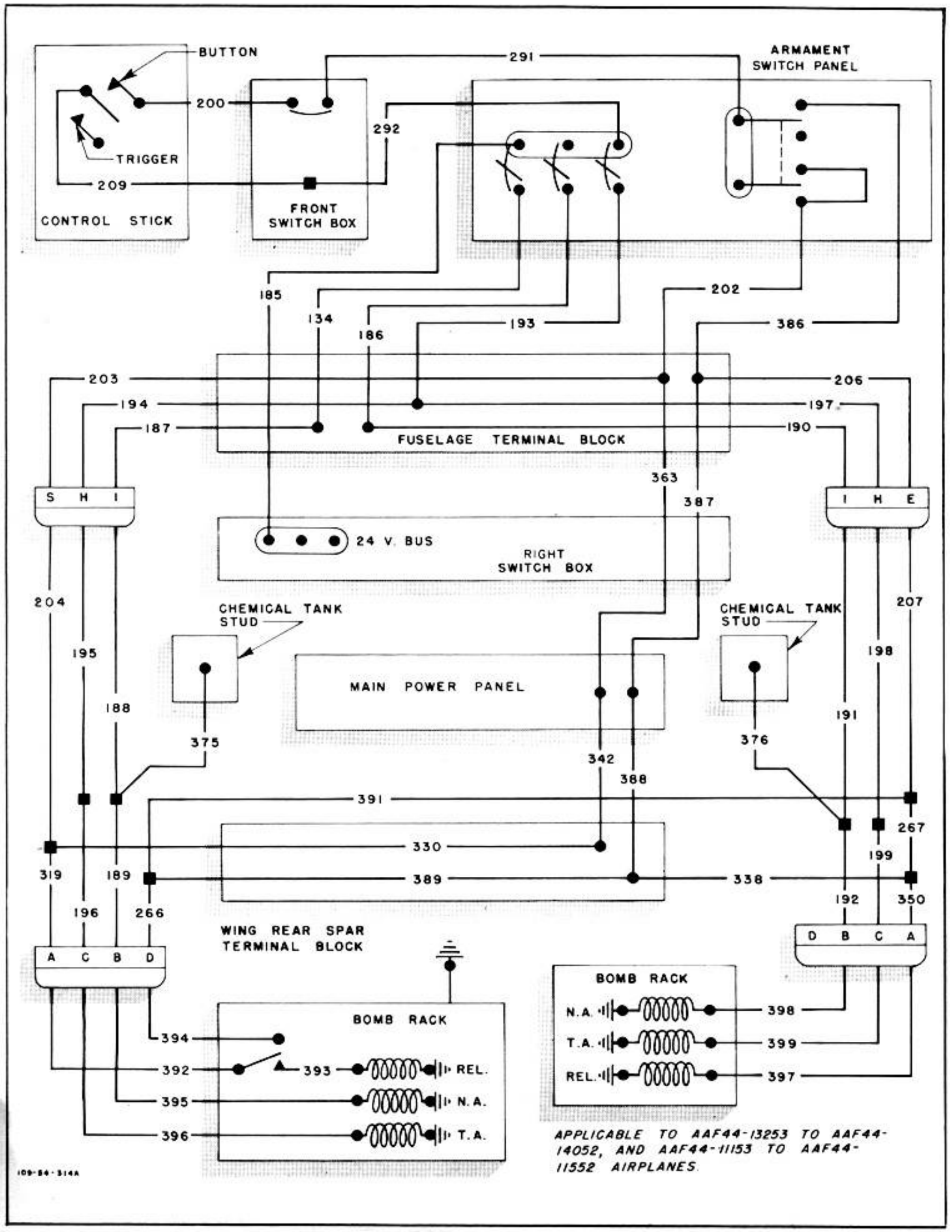


Figure 362—Bomb Control Wiring Diagram—Early Airplanes

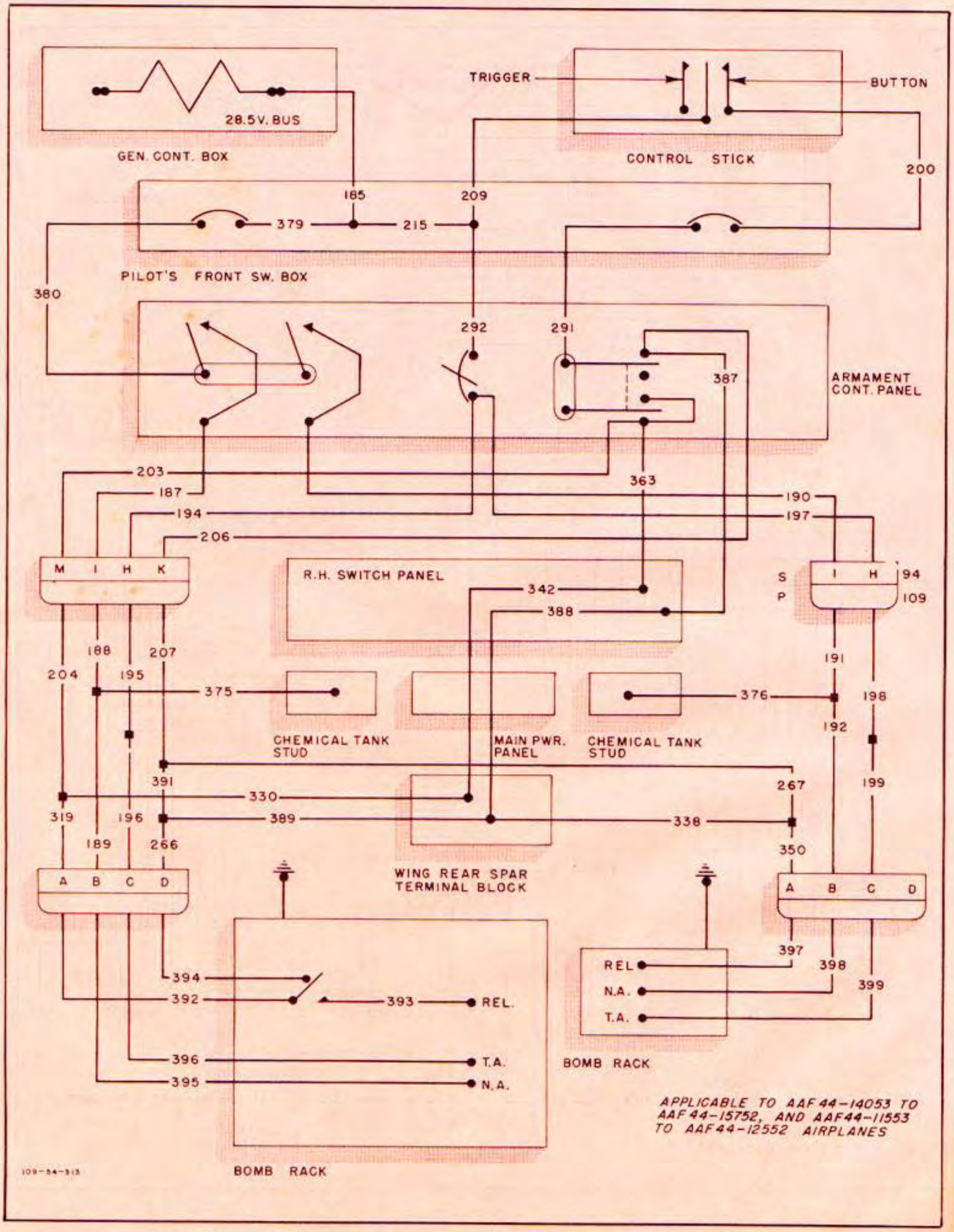


Figure 363—Bomb Control Wiring Diagram—Later Airplanes

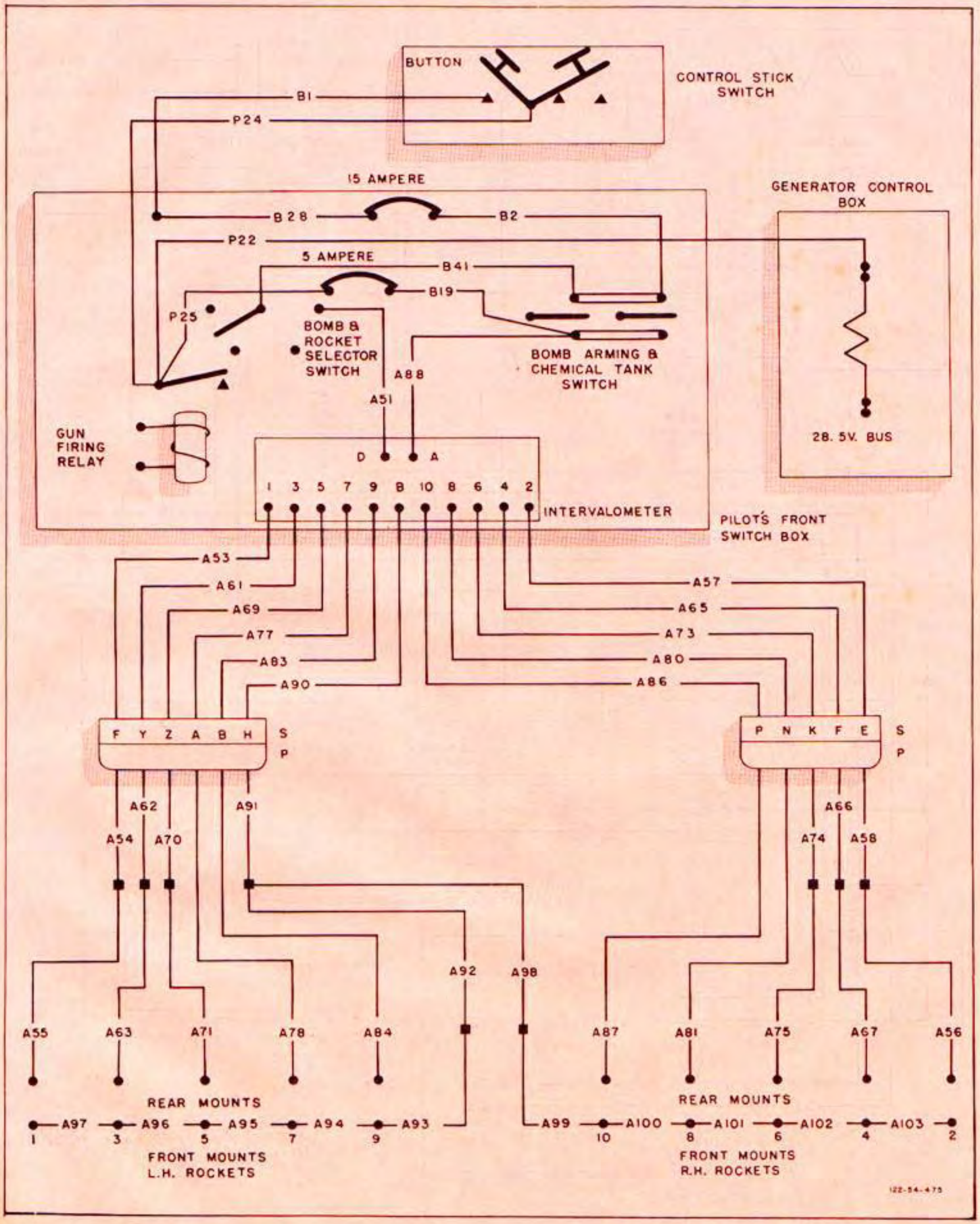


Figure 363A — Rocket Control Wiring Diagram

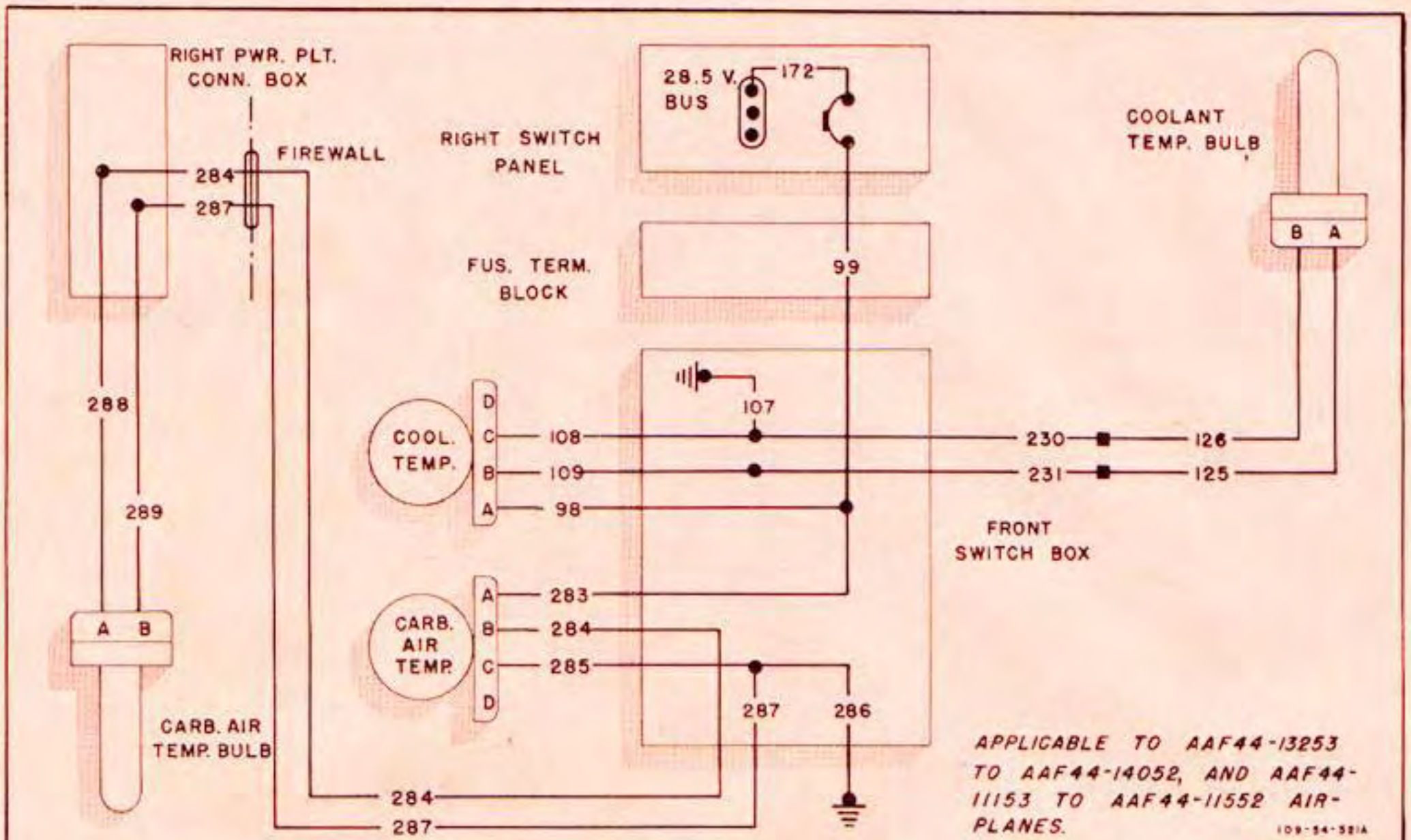


Figure 364—Coolant and Carburetor Air Temperature Indicators Wiring Diagram—Early Airplanes

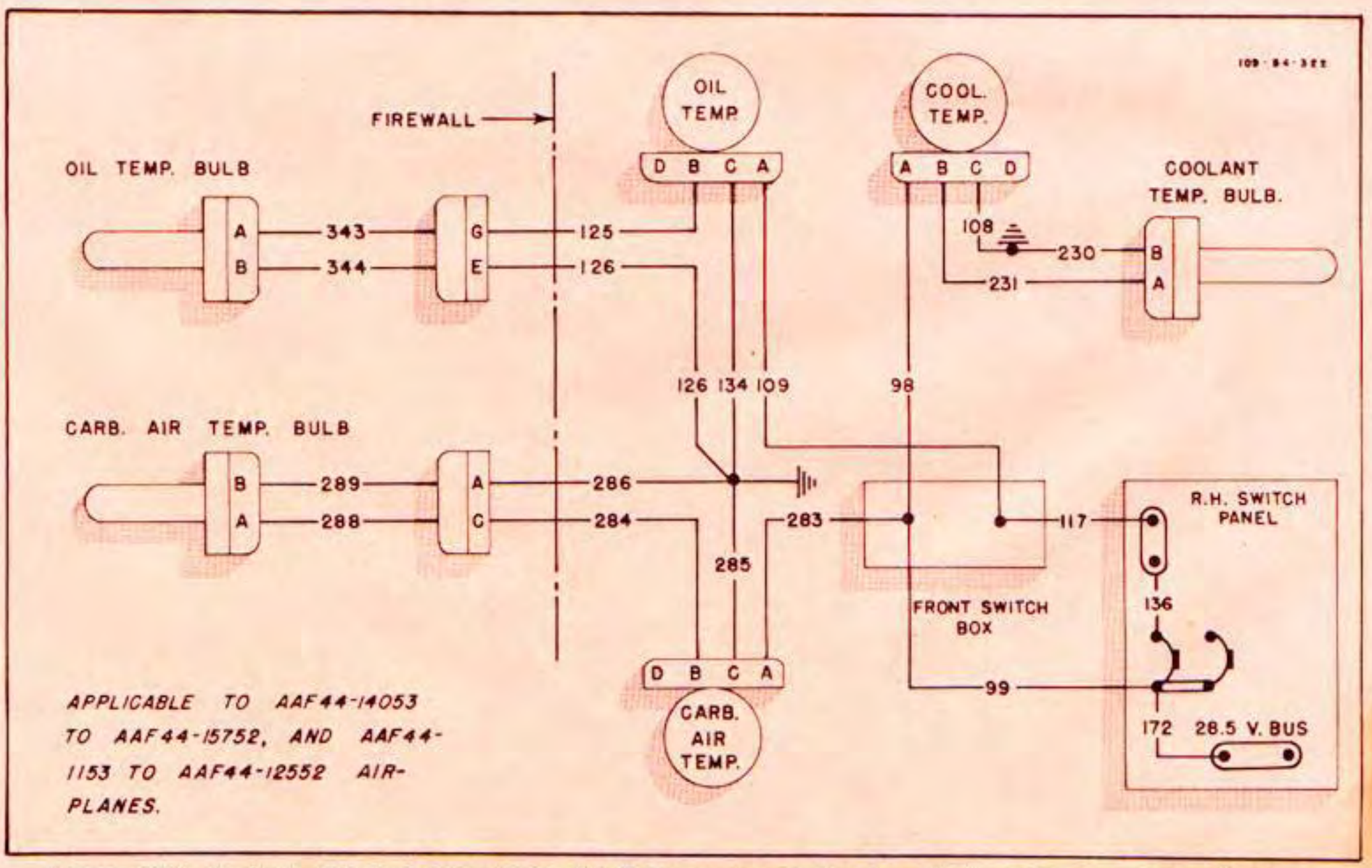


Figure 365—Coolant, Oil and Carburetor Air Temperature Indicators Wiring Diagram—Later Airplanes

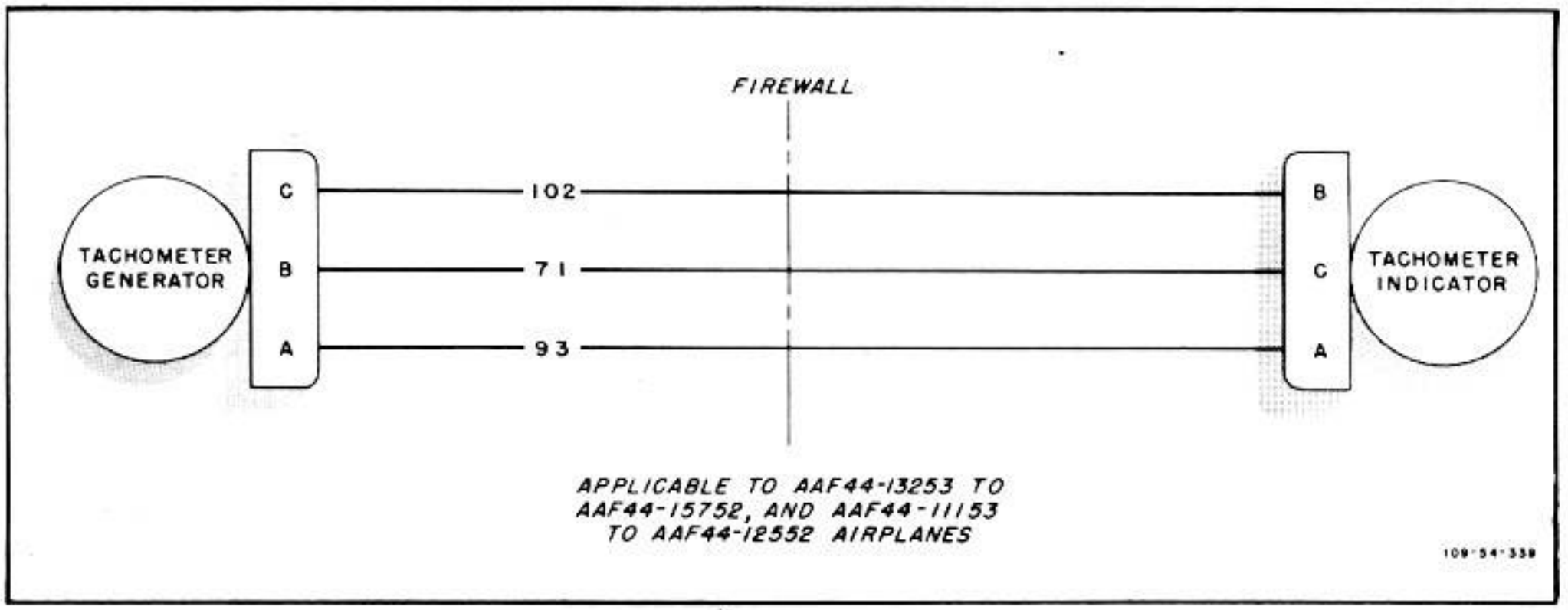


Figure 366—Tachometer Wiring Diagram

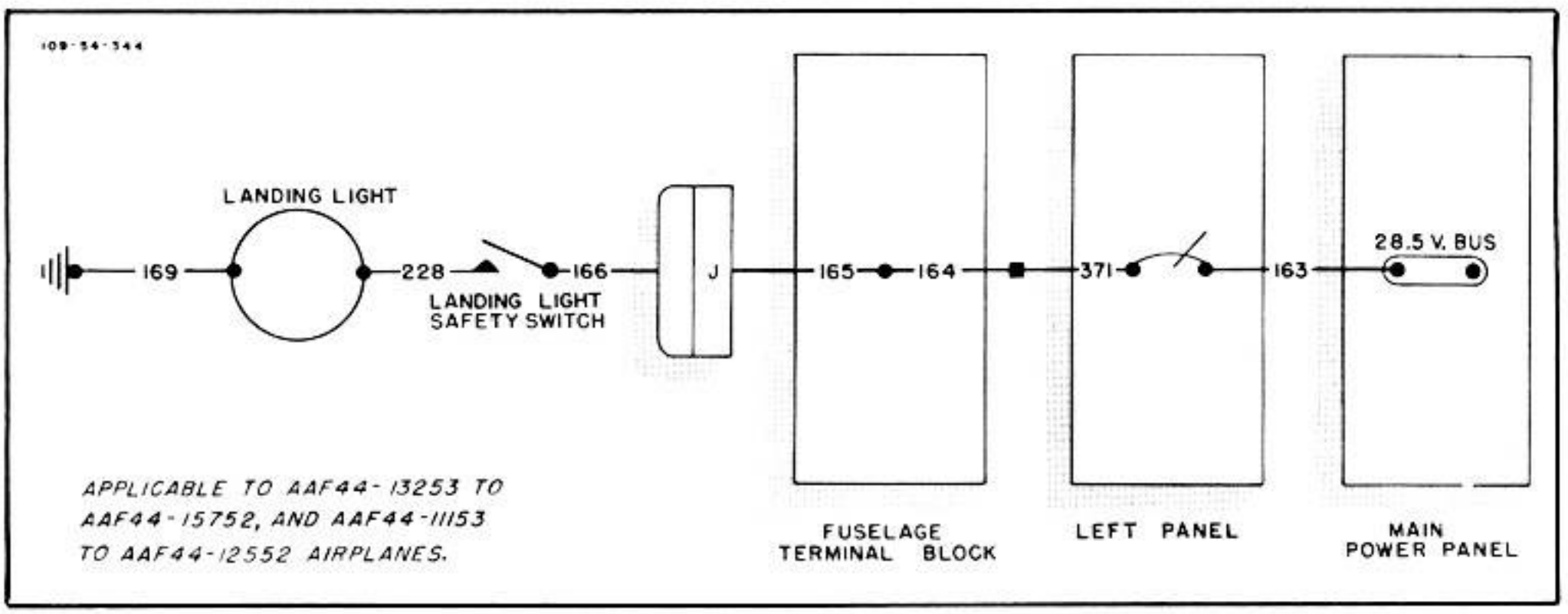


Figure 367—Landing Light Wiring Diagram

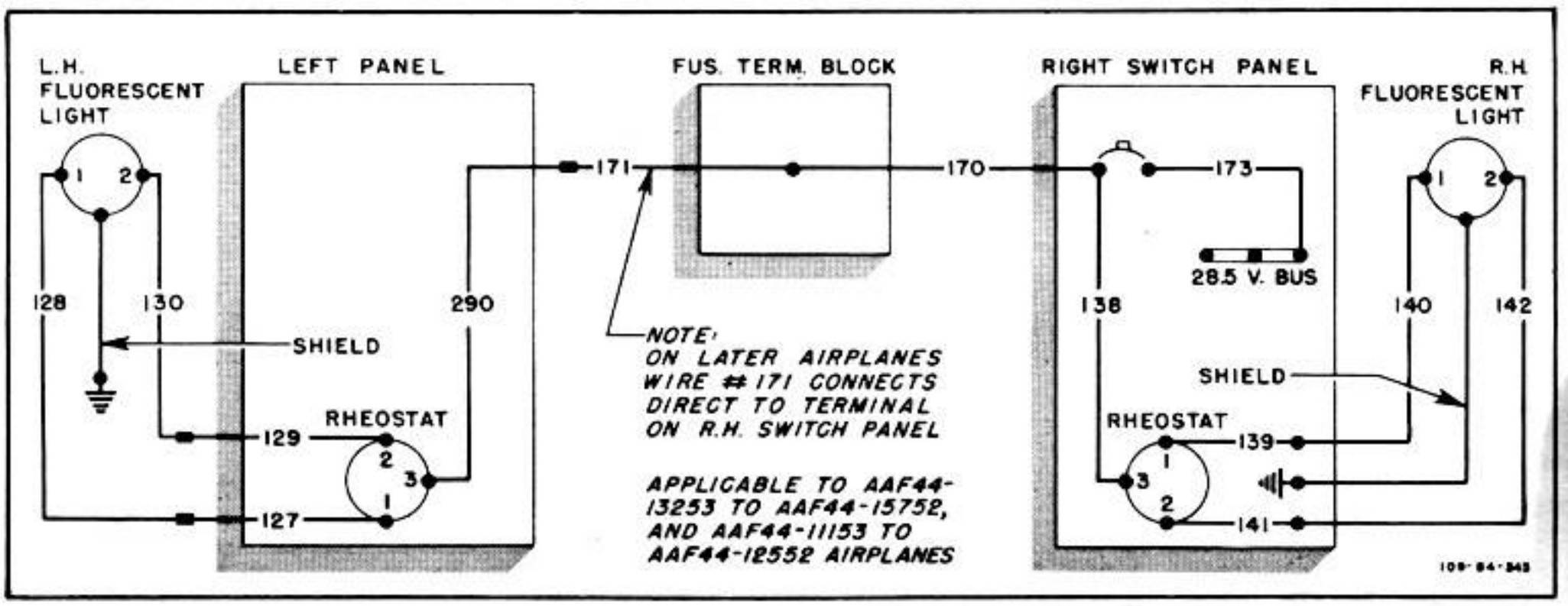


Figure 368—Fluorescent Light Wiring Diagram

TROUBLE	PROBABLE CAUSE	REMEDY
Temperature range increases.	Too much clearance between thermostat switch points.	Replace unit.
Temperature range slightly too high or too low.	Slight misadjustment of thermostat position.	Readjust temperature adjustment screw by means of access hole in actuator dust cover.
Temperature range much too high or too low.	Misalignment of follow-up screw.	Replace unit.
Actuator responds to manual control, but with switch in "AUTOMATIC," radiator flap stays closed.	Leak in diastat.	Drain coolant or oil system and replace diastat (temperature-sensitive) assembly.
Noisy gear operation.	Screws holding gear box housing not safetied, and working loose.	Tighten and safety screws; check unit for proper operation.
Actuator fails at low outside temperatures (high altitude), but works properly in ground operation.	Binding due to unequal shrinkage of housing and internal parts.	Replace unit and overhaul.

c. ELECTRICAL POWER SOURCES

(1) BATTERY.

(a) DESCRIPTION.—A 24-volt, 34 ampere-hour, AN3150 battery is mounted on the radio shelf aft of the command radio equipment. *(See figure 340.)* The battery powers the electrical system when the generator is not operating or when the generator output is insufficient to close the reverse-current relay. A Type B-4 solenoid switch, mounted on the right side of the fuselage alongside of the battery, is connected between the battery and the electrical system. This solenoid switch is controlled by a battery-disconnect switch on the right switch panel and is not safetied through the ignition switch.

1. Type O-4 Generator
2. Left-hand Magneto
3. Supercharger Solenoid
4. Type 840 Eclipse Starter
5. Right-hand Magneto
6. Booster Coil Junction Box
7. Oil Dilution Solenoid
8. Generator Control Panel
9. Ignition Harness
10. Supercharger Aneroid
11. Tachometer Generator (Type AN5531-1)
12. AN5730-6 Remote-reading Compass
13. Carburetor Air Temperature Indicator
14. Throttle Switch
15. Armament Control Panel
16. Pilot's Front Switch Box
17. K-14 Gun Sight Lamp
18. Type C-5 Fluorescent Light
19. AN5530-1 Tachometer
20. AN5790-6 Coolant Gage
21. Left Switch Panel
22. Recognition Light Keying Switch
23. Right Switch Panel
24. Cockpit Light
25. Main Power Panel
26. Signal Light Power Receptacle
27. Landing Light Safety Switch
28. Left Wing Position Lights
29. Remote-reading Compass (Transmitter)
30. Gun Solenoid
31. Left Landing Gear Switch Box
32. Landing Light
33. GSAP Camera
34. Battery-disconnect Solenoid
35. Fuel Booster Pumps
36. Pitot Head Heater
37. Recognition Lights
38. R-4310 Oil Scoop Actuator
39. External Power Socket
40. Battery
41. R-4250 Coolant Scoop Actuator
42. Recognition Light
43. Battery Sump
44. Rudder Light or Tail Position Light
45. Oil Temperature Bulb
46. Terminal Strip
47. Bomb Rack Disconnect
48. Right Landing Gear Switch Box
49. Coolant Temperature Bulb
50. Right Wing Position Light
51. Wing Disconnect Plugs

KEY TO FIGURE 340

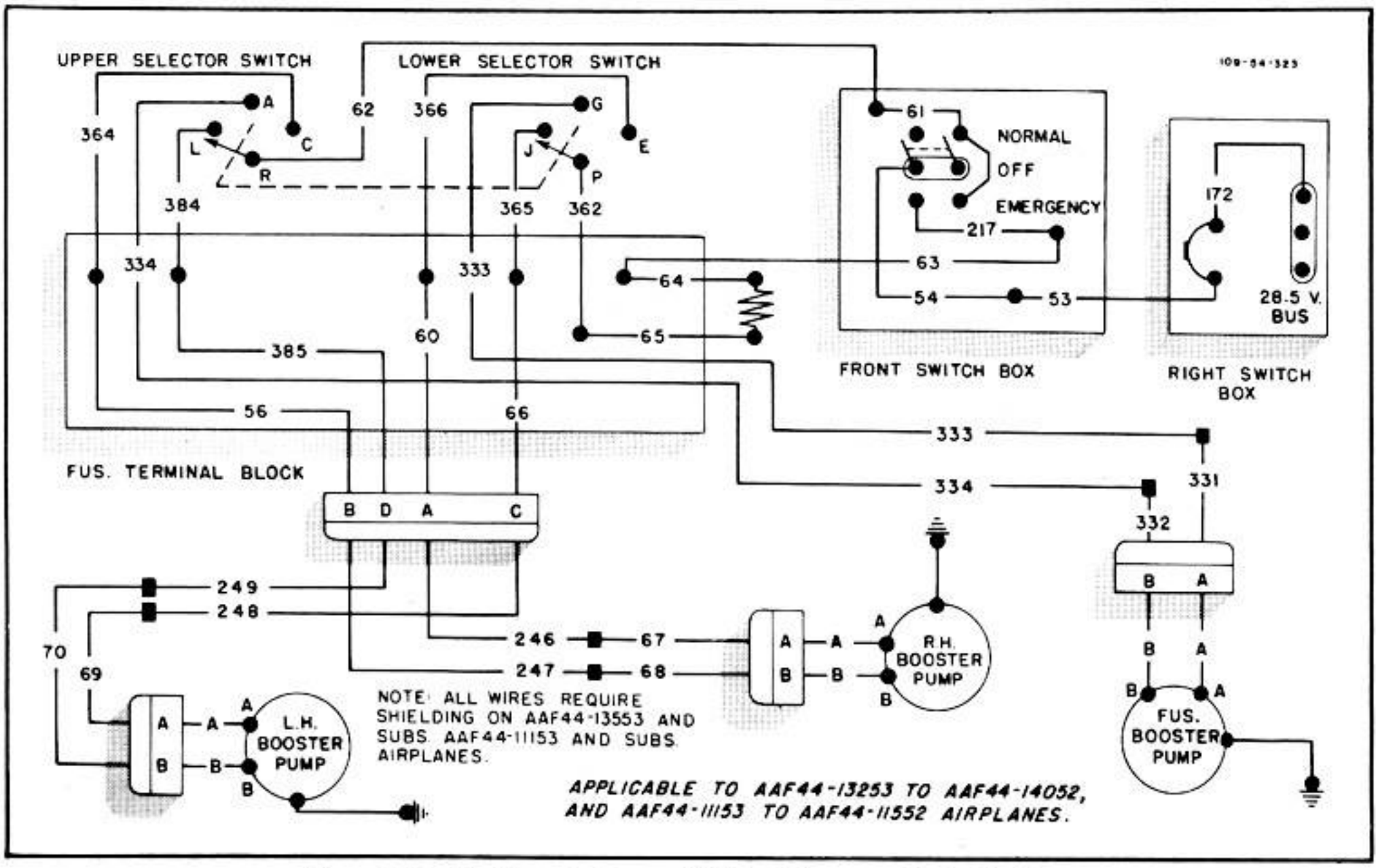


Figure 369—Fuel Booster Pumps Wiring Diagram—Early Airplanes

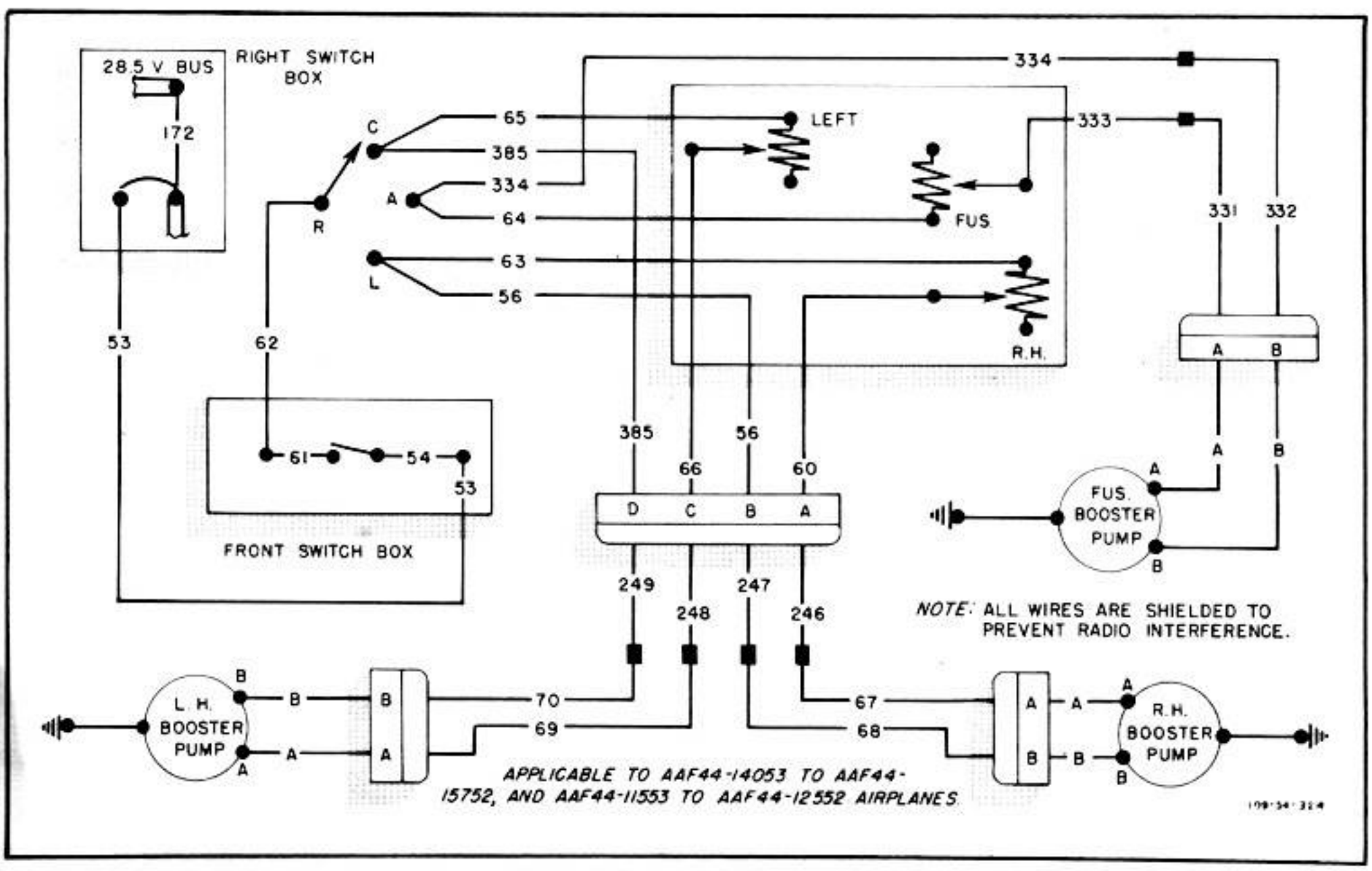


Figure 370—Fuel Booster Pumps Wiring Diagram—Later Airplanes

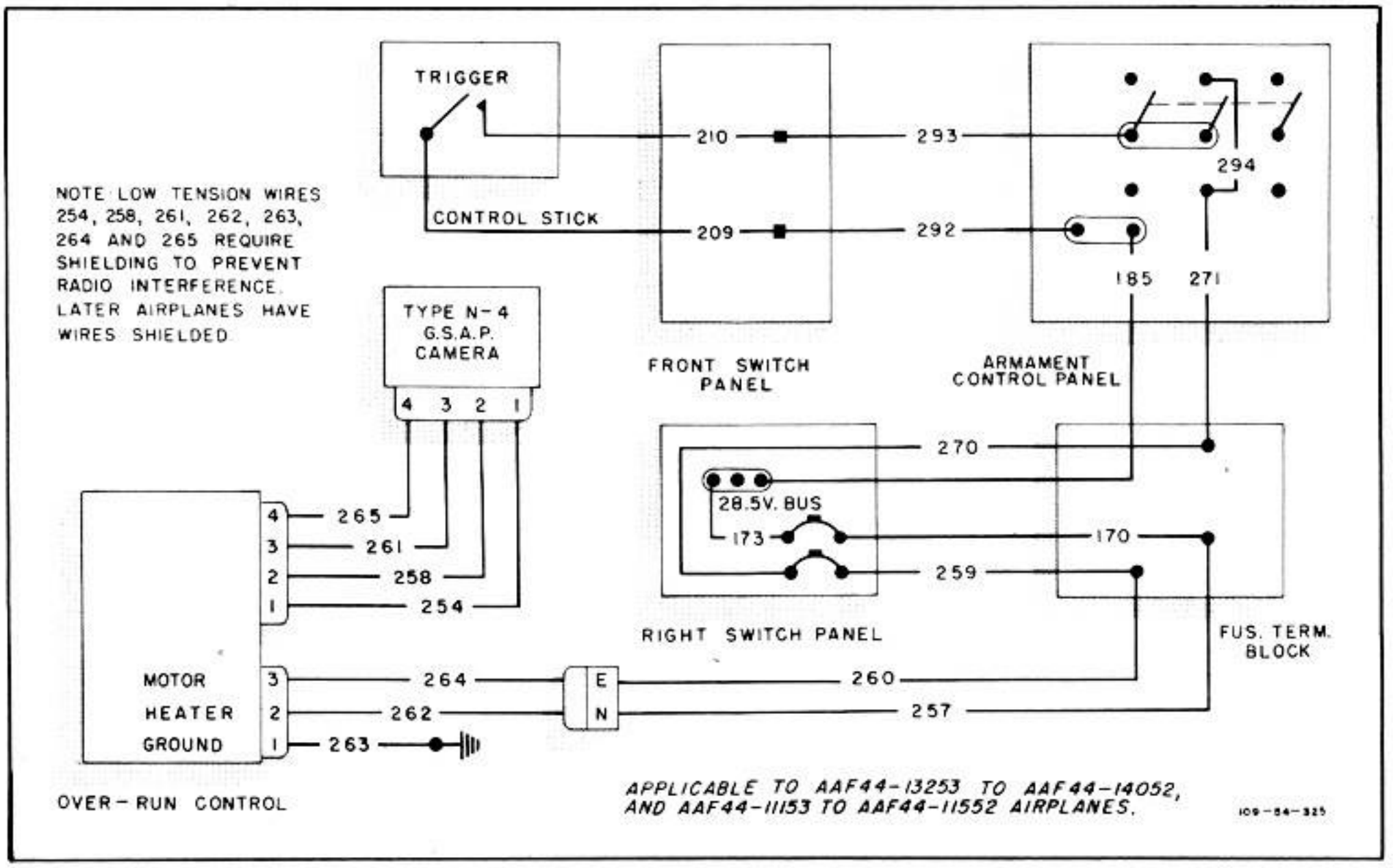


Figure 371—Gun Camera Wiring Diagram—Early Airplanes

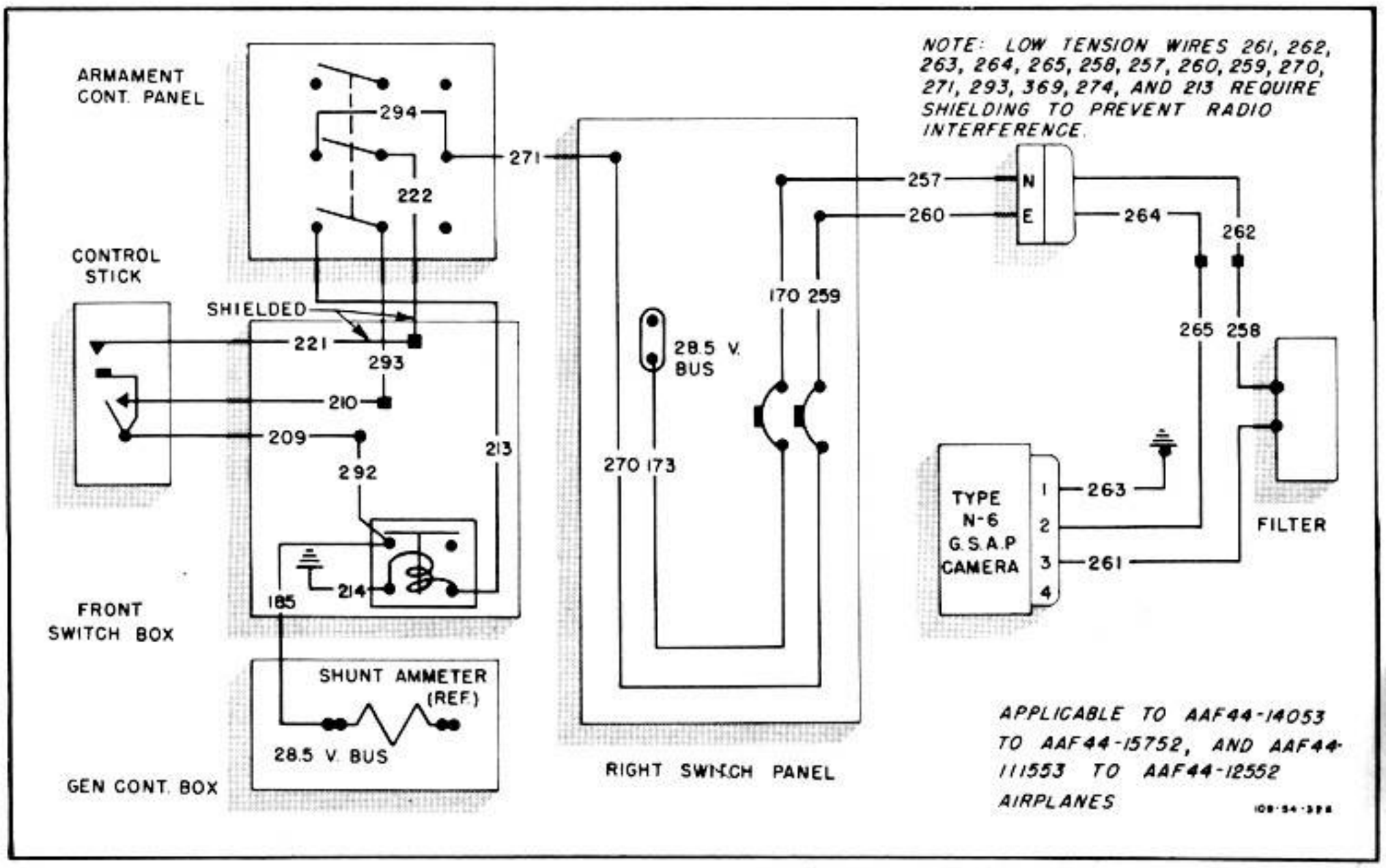


Figure 372—Gun Camera Wiring Diagram—Later Airplanes

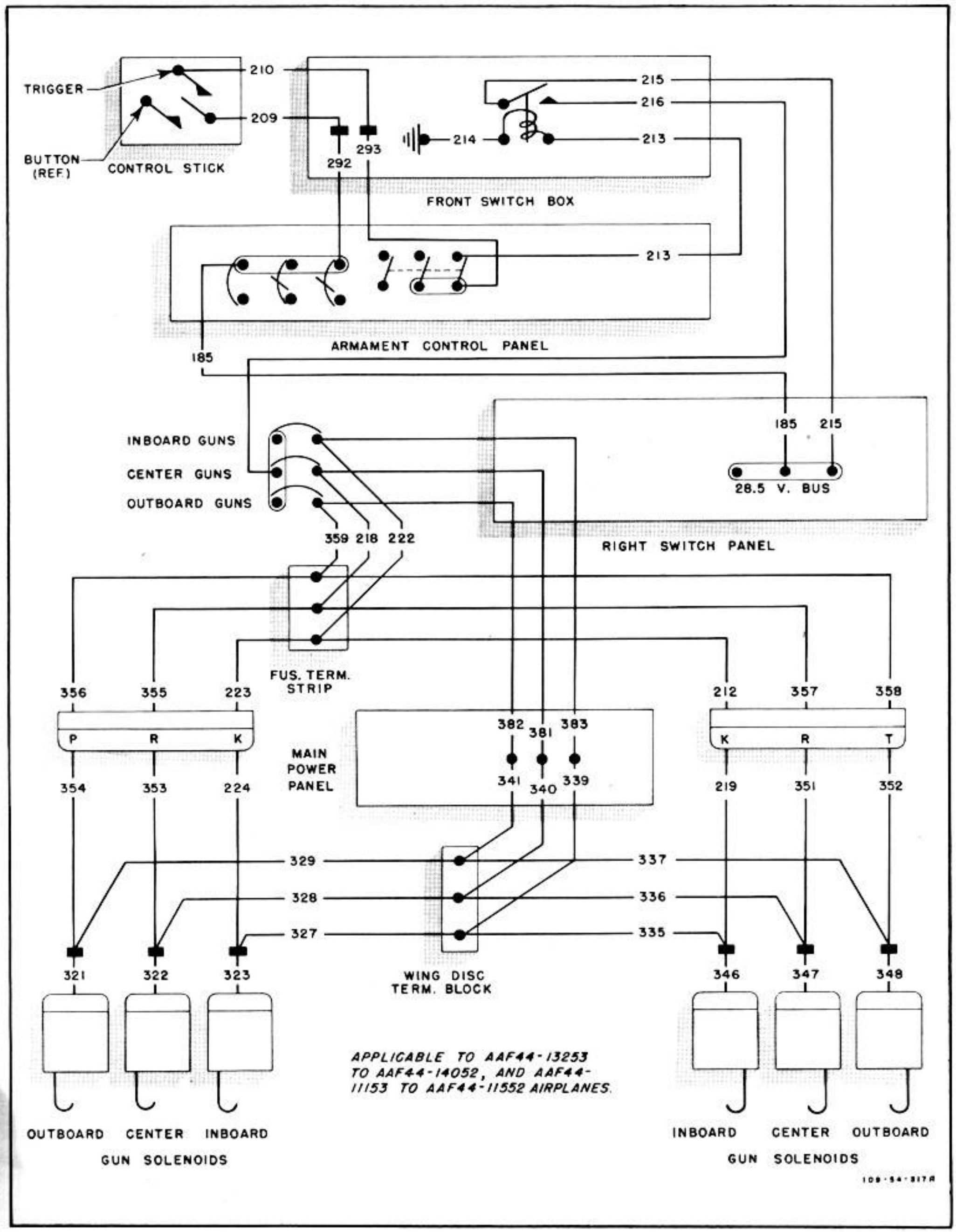


Figure 373—Gun Control Wiring Diagram—Early Airplanes

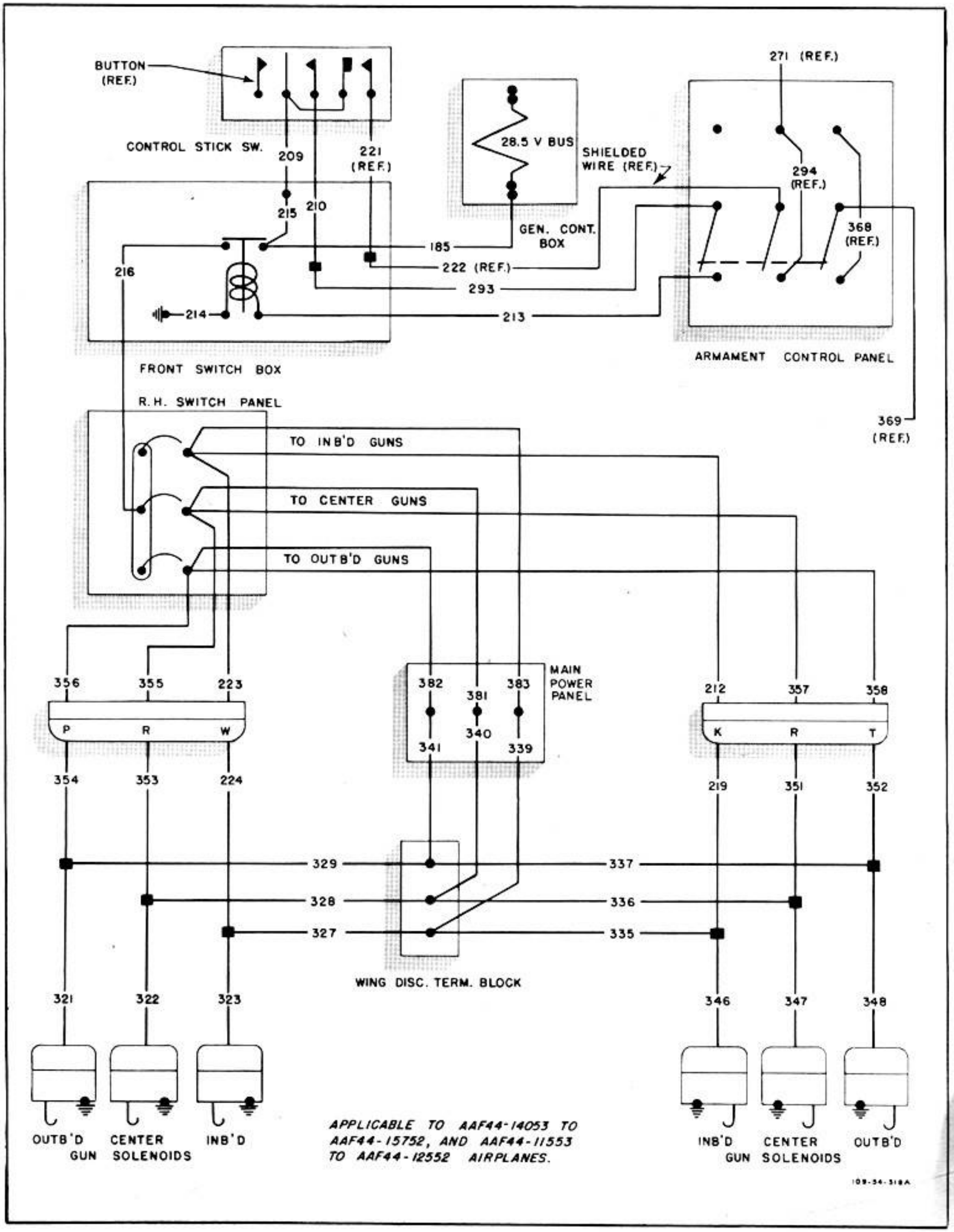


Figure 374—Gun Control Wiring Diagram—Later Airplanes

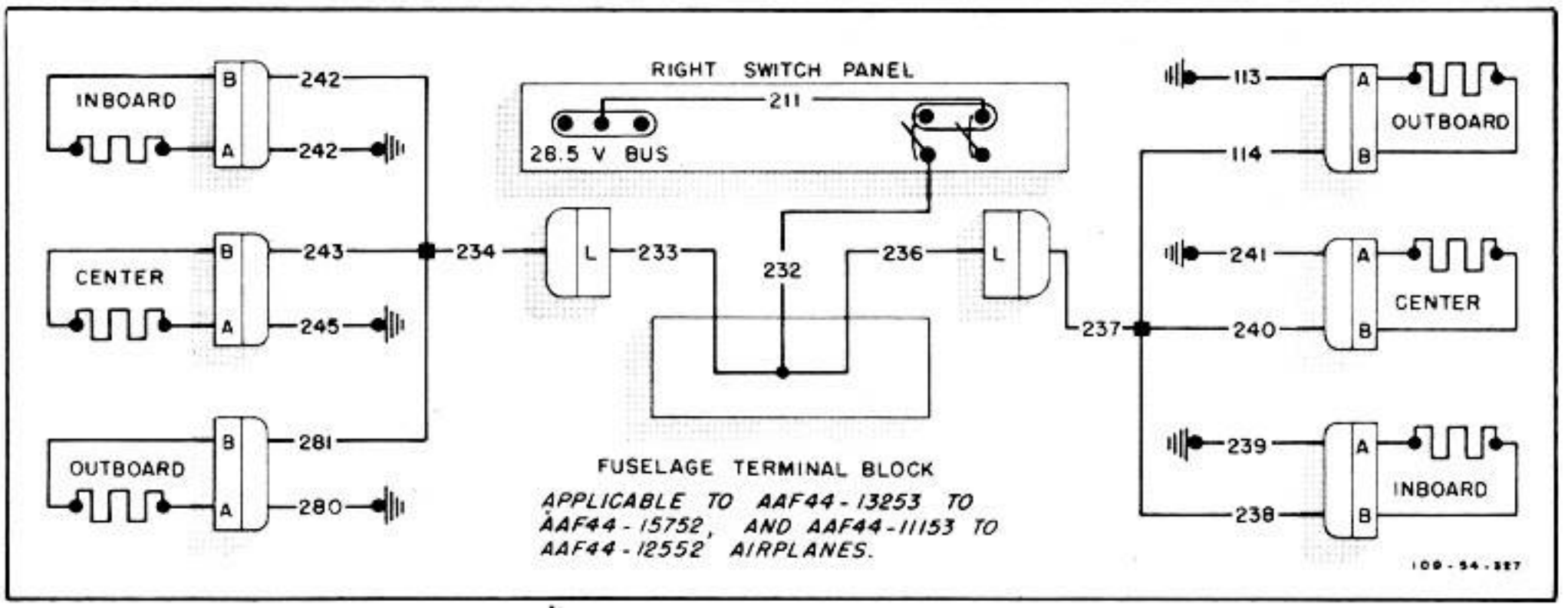


Figure 375—Gun Heaters Wiring Diagram

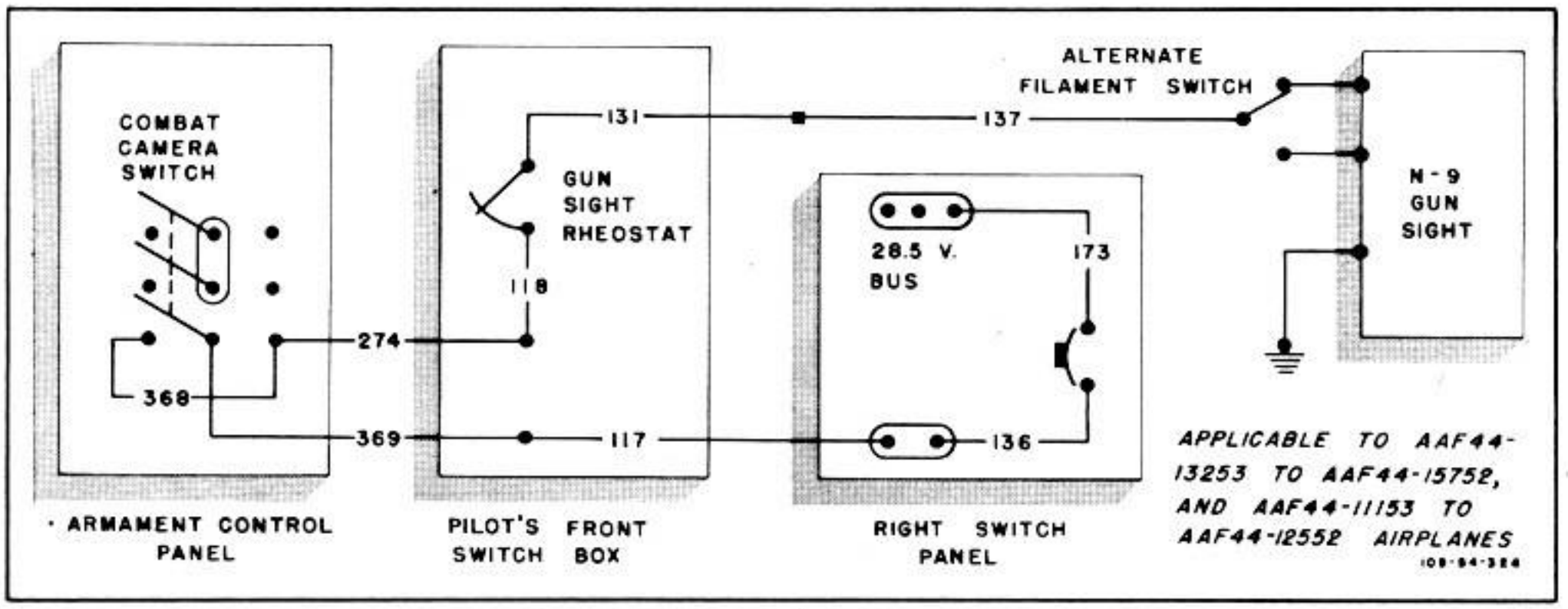


Figure 376—Gun Sight Wiring Diagram

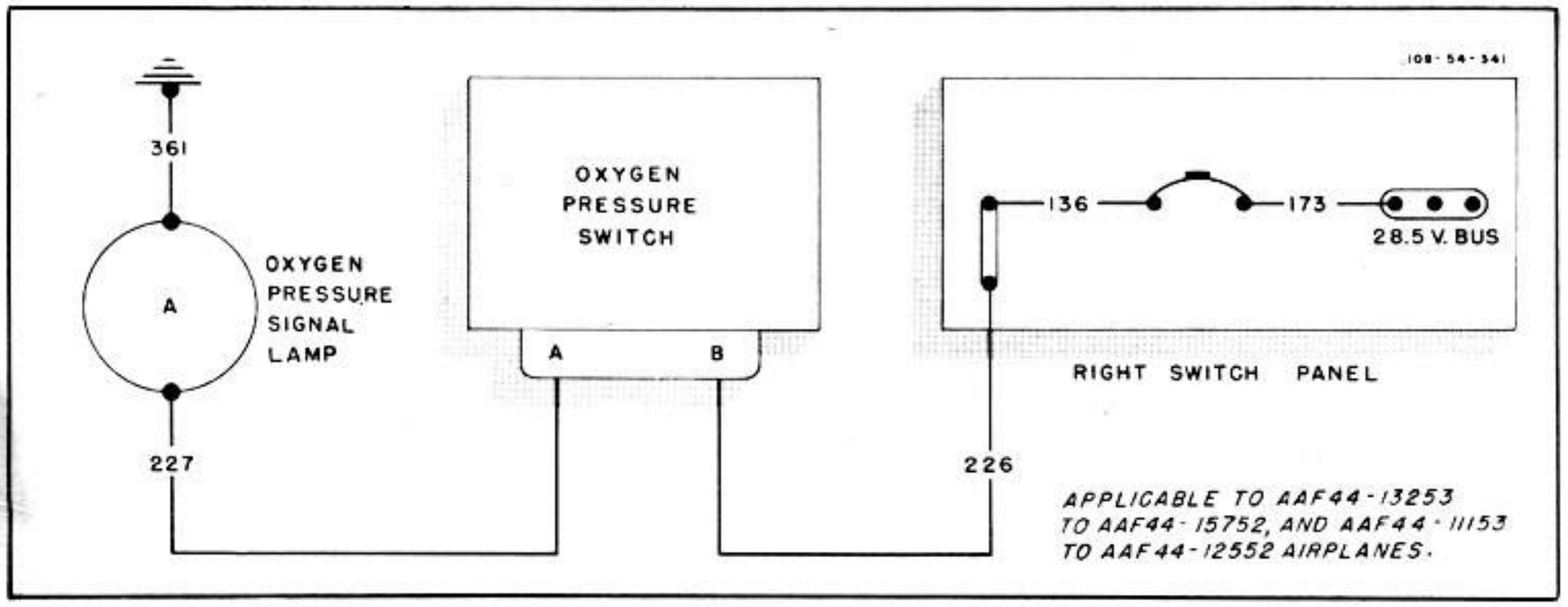


Figure 377—Oxygen Pressure Warning Wiring Diagram

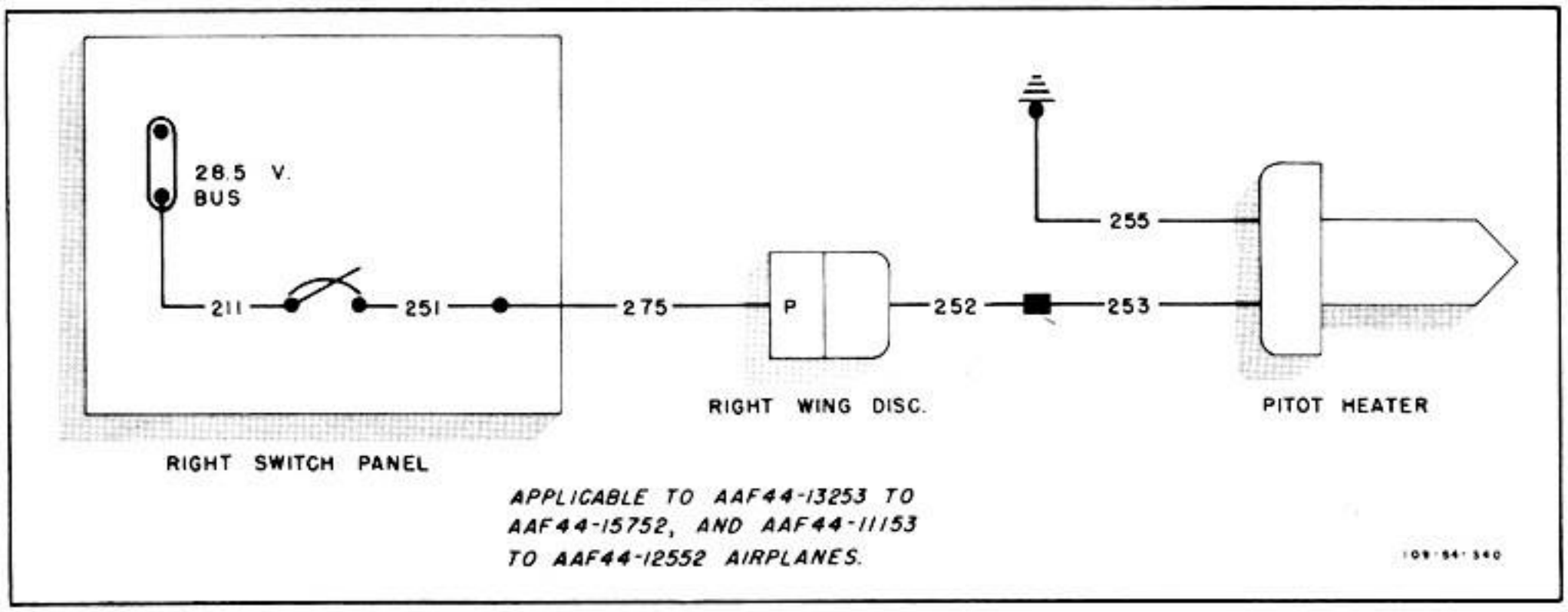


Figure 378—Pitot Heater Wiring Diagram

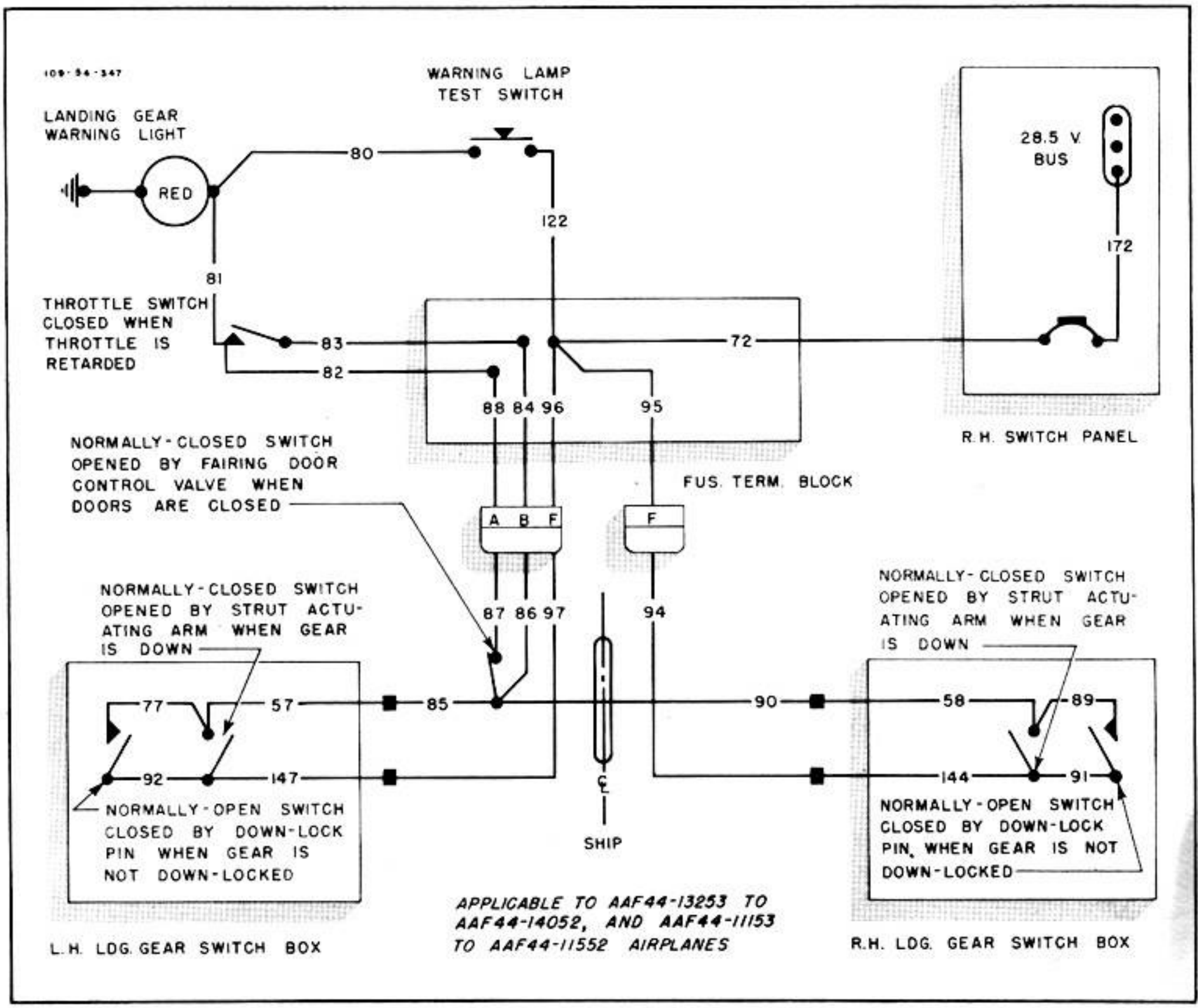


Figure 379—Landing Gear Warning Lights Wiring Diagram—Early Airplanes

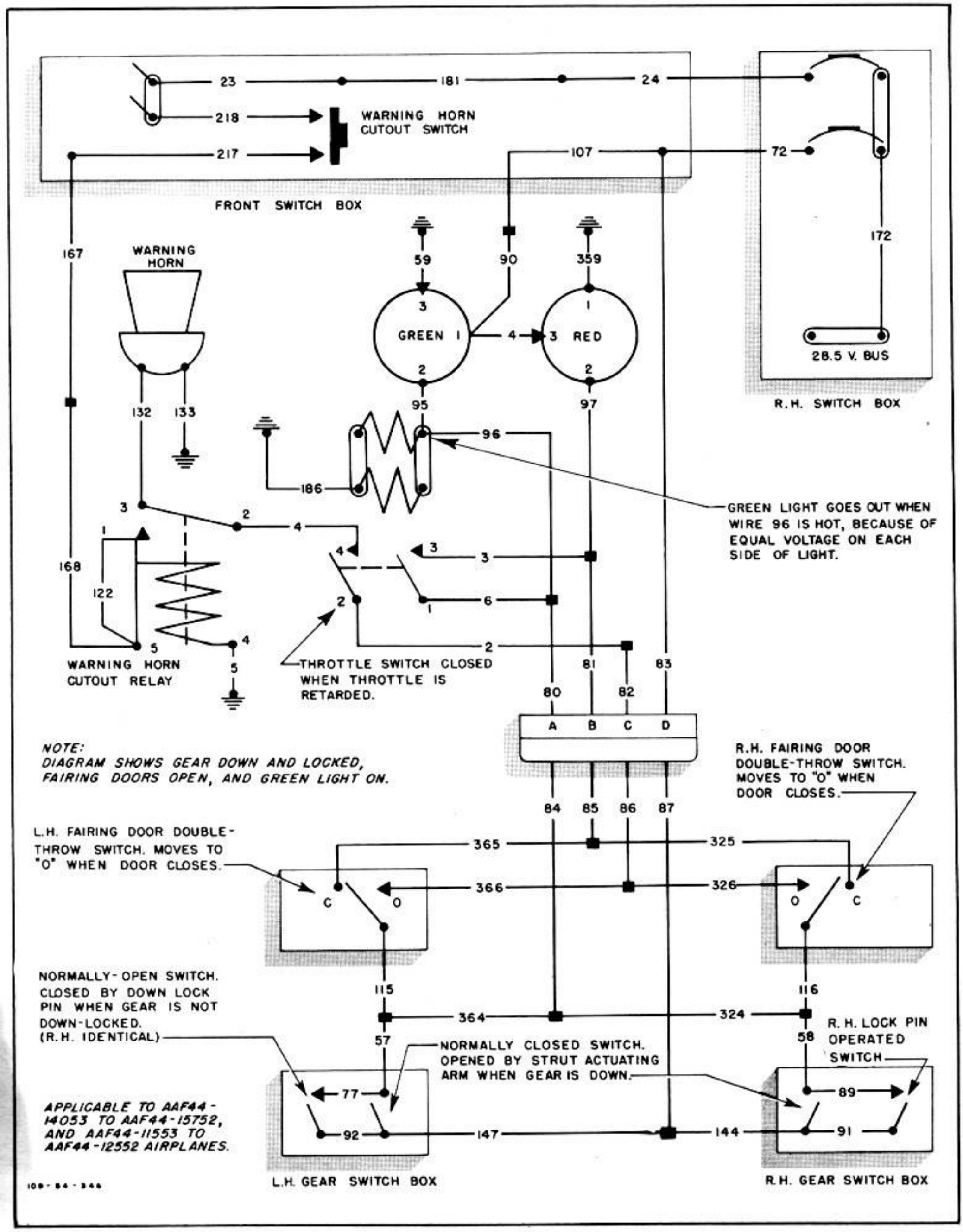


Figure 380—Landing Gear Warning System Wiring Diagram—Later Airplanes

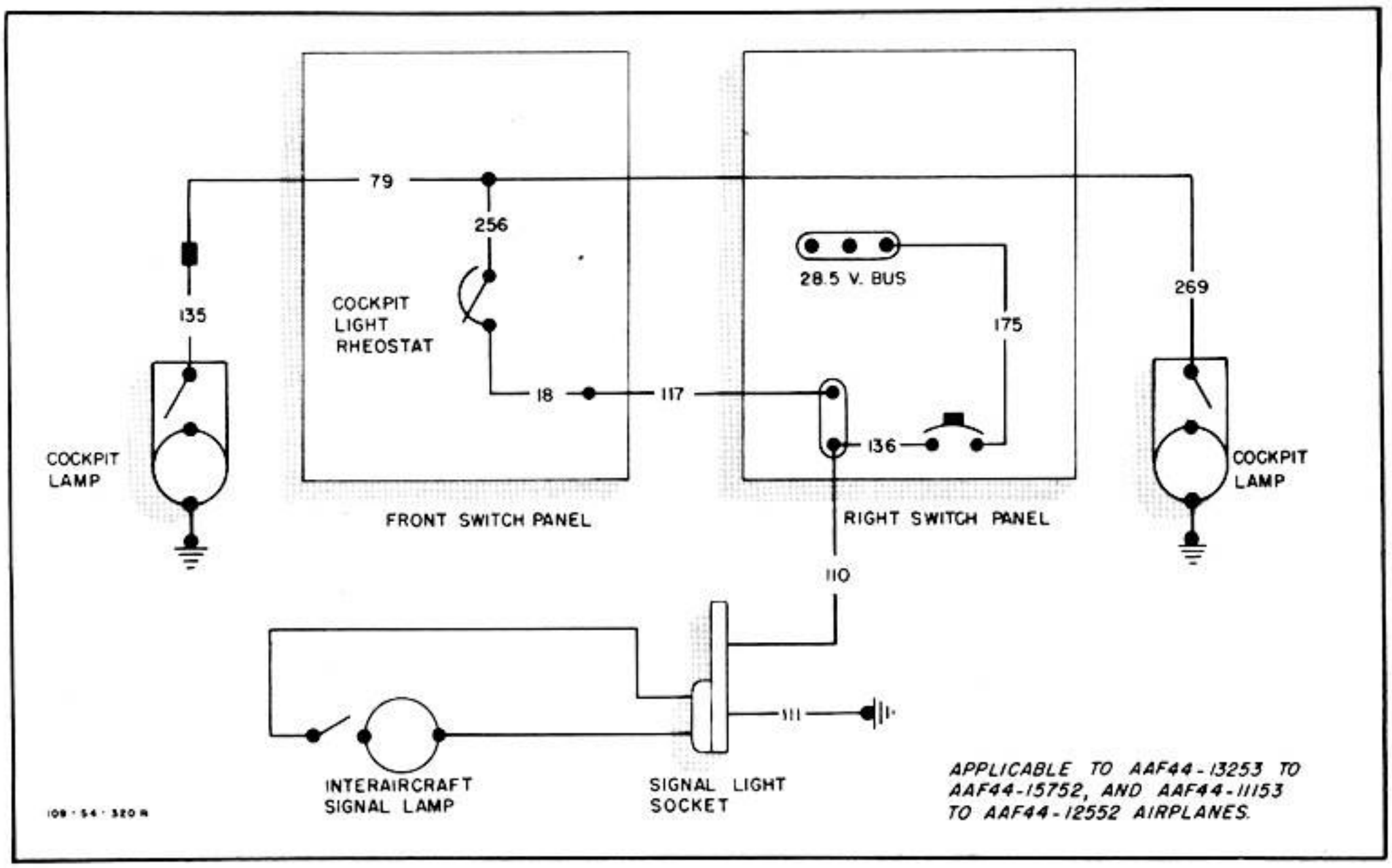


Figure 381—Cockpit Lights and Interaircraft Signal Light Wiring Diagram

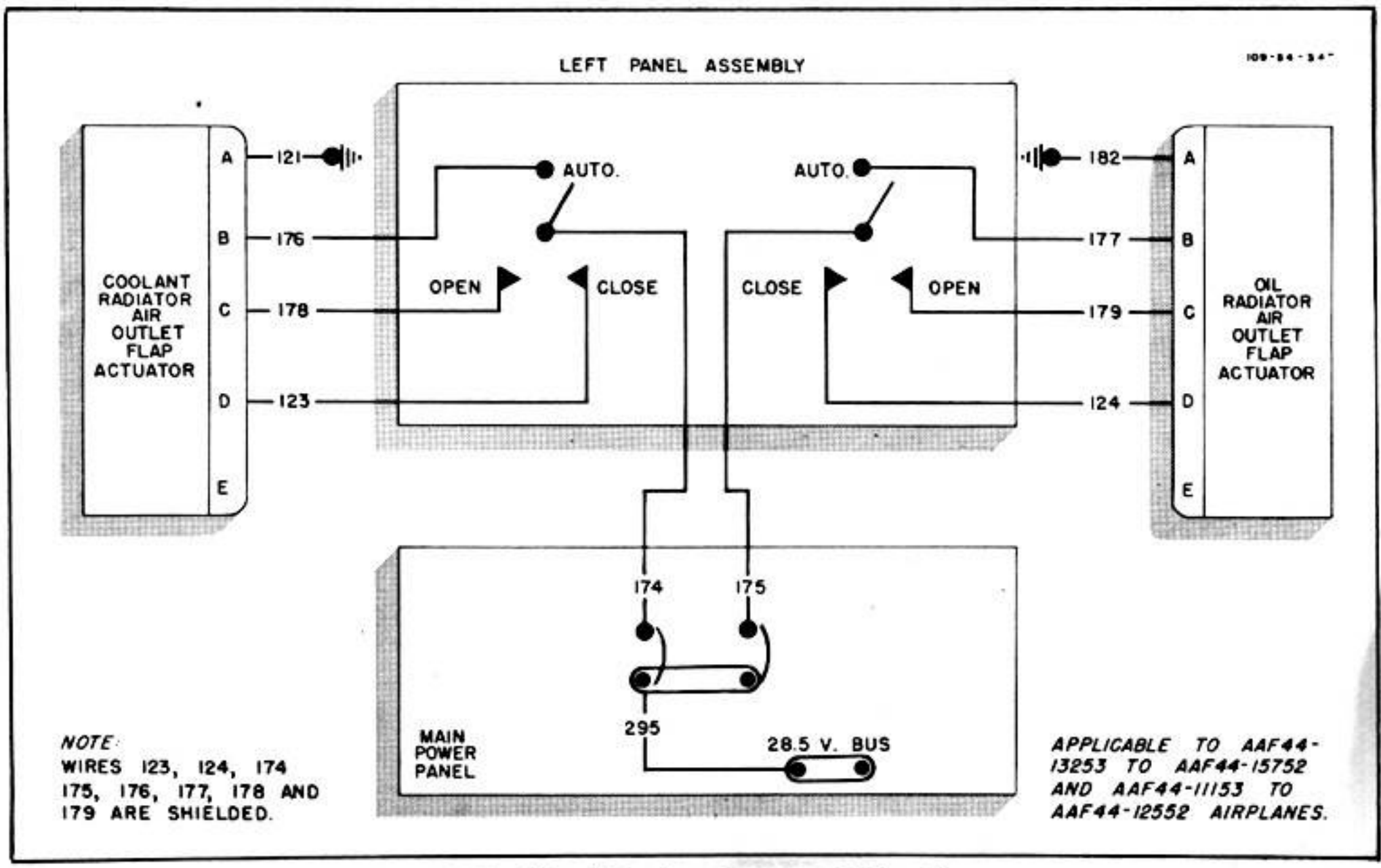


Figure 382—Oil and Coolant Actuators Wiring Diagram

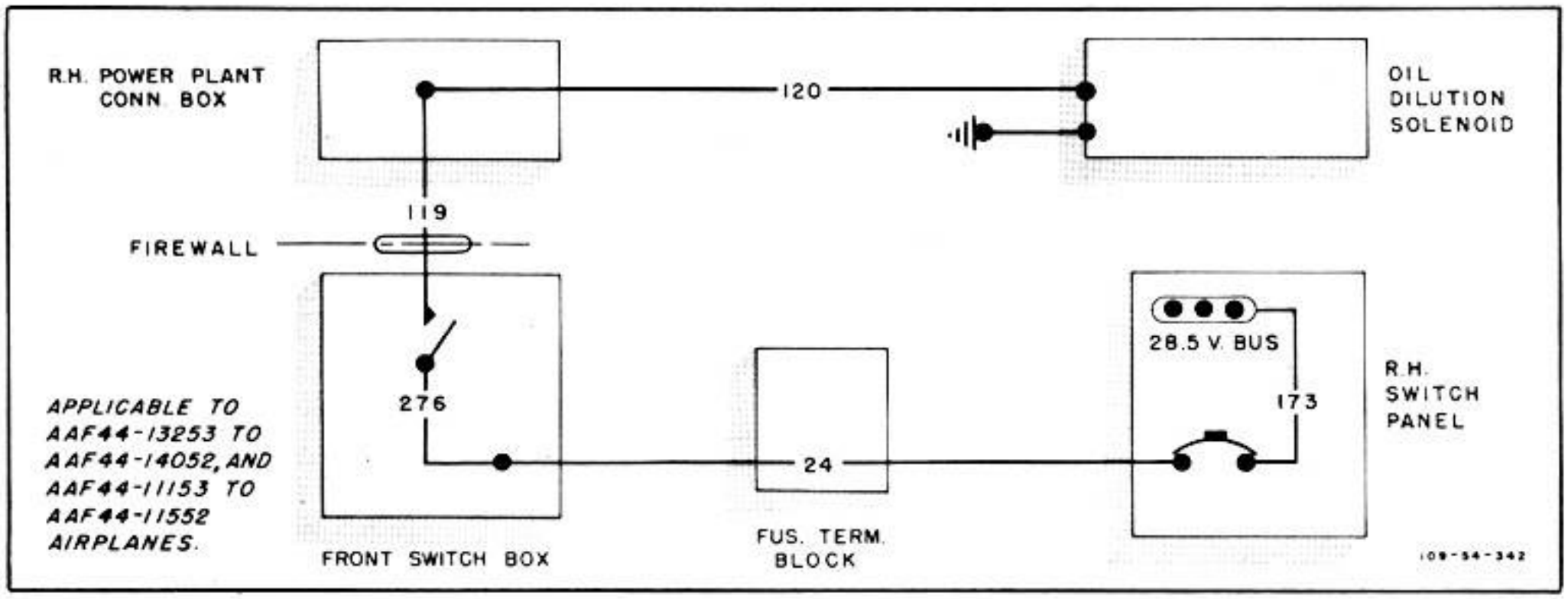


Figure 383—Oil Dilution Wiring Diagram—Early Airplanes

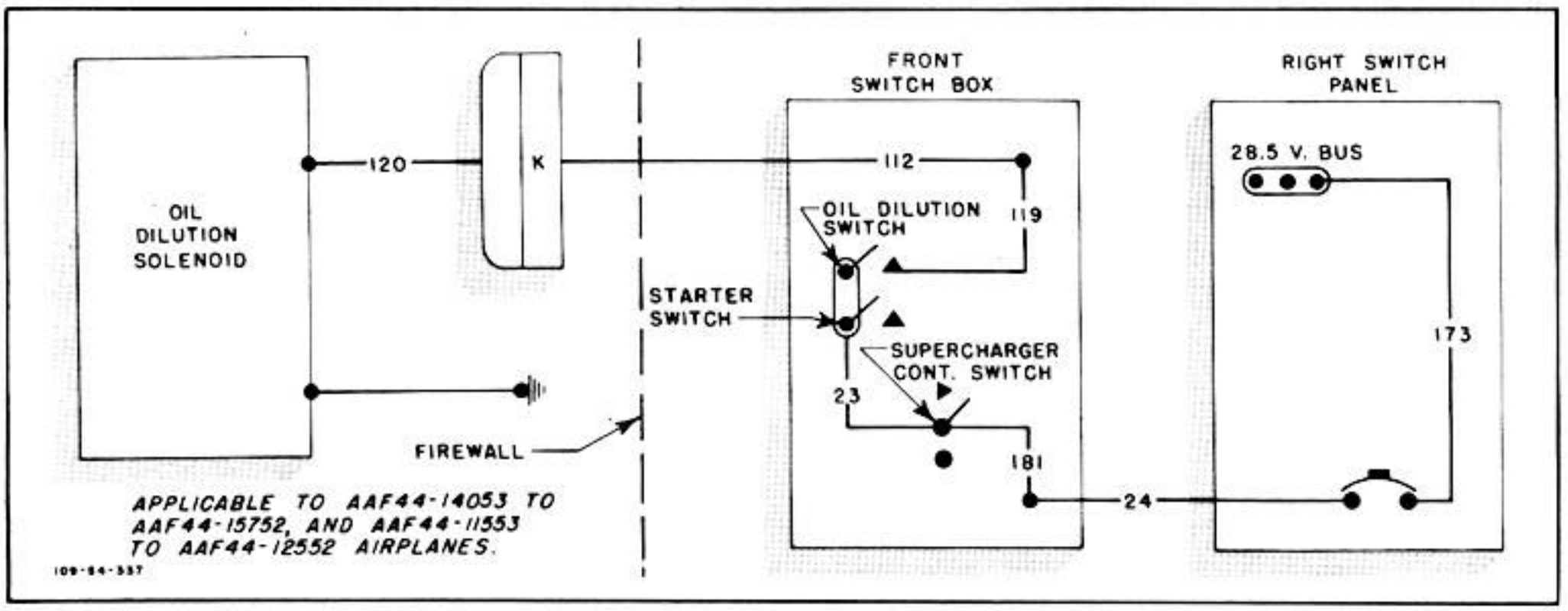


Figure 384—Oil Dilution Wiring Diagram—Later Airplanes

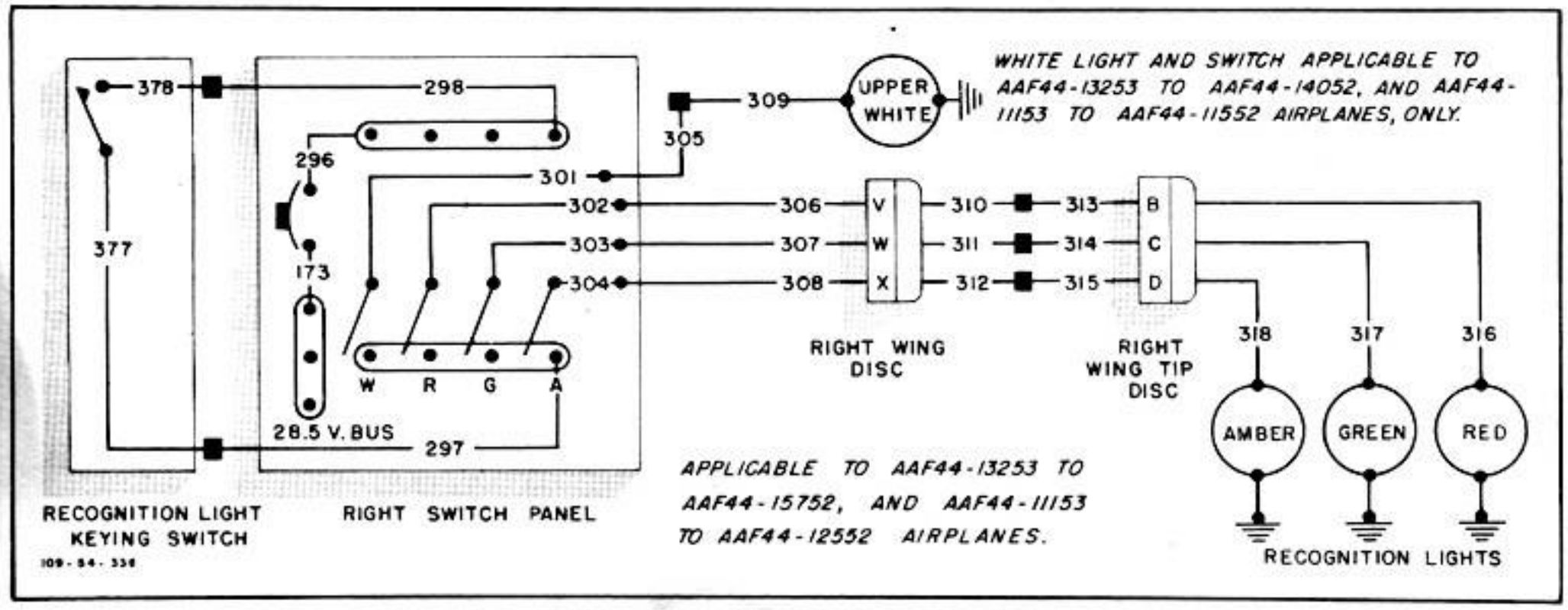


Figure 385—Recognition Lights Wiring Diagram

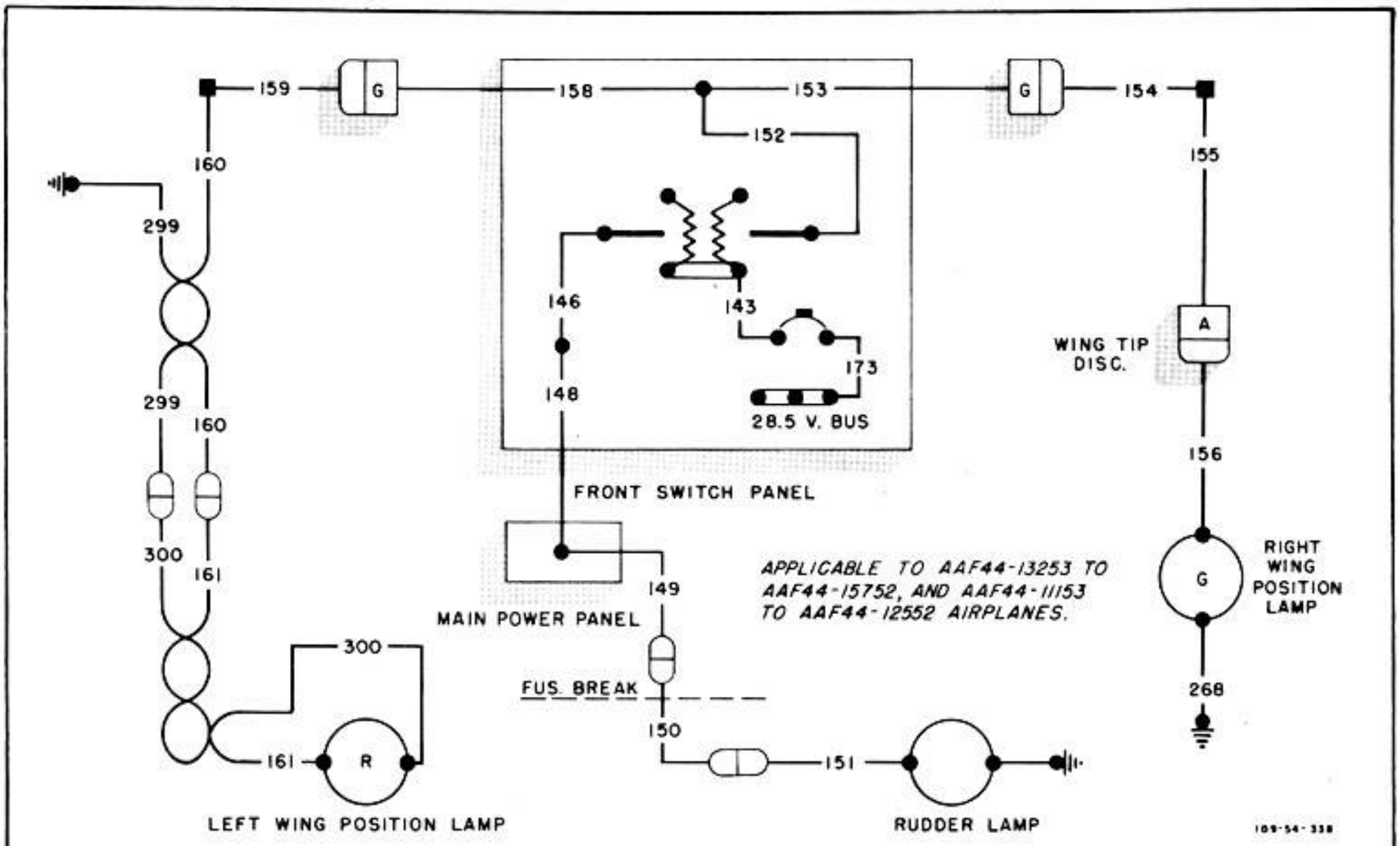


Figure 386—Position Lights Wiring Diagram

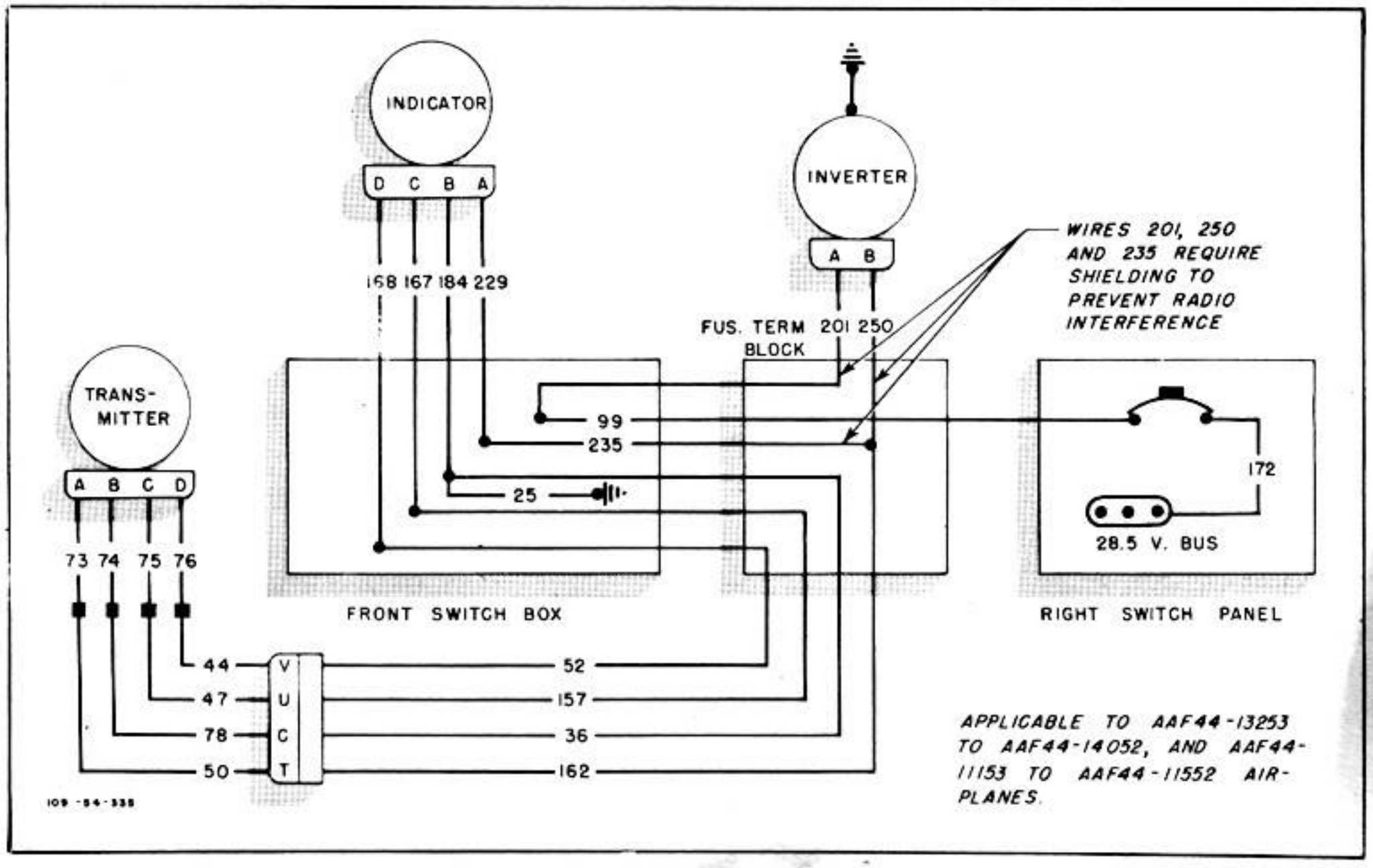


Figure 387—Remote Compass Wiring Diagram—Early Airplanes

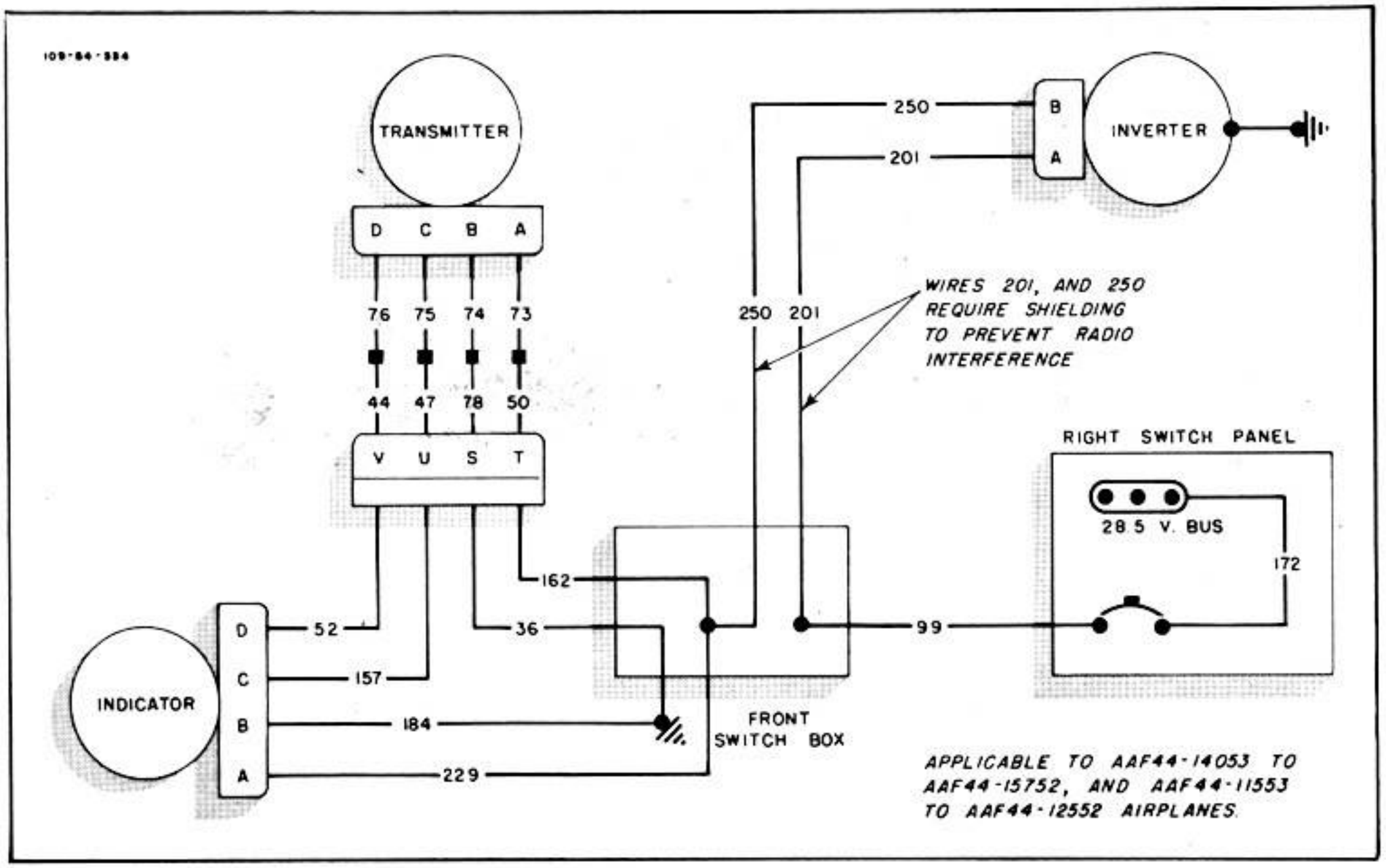


Figure 388—Remote Compass Wiring Diagram—Later Airplanes

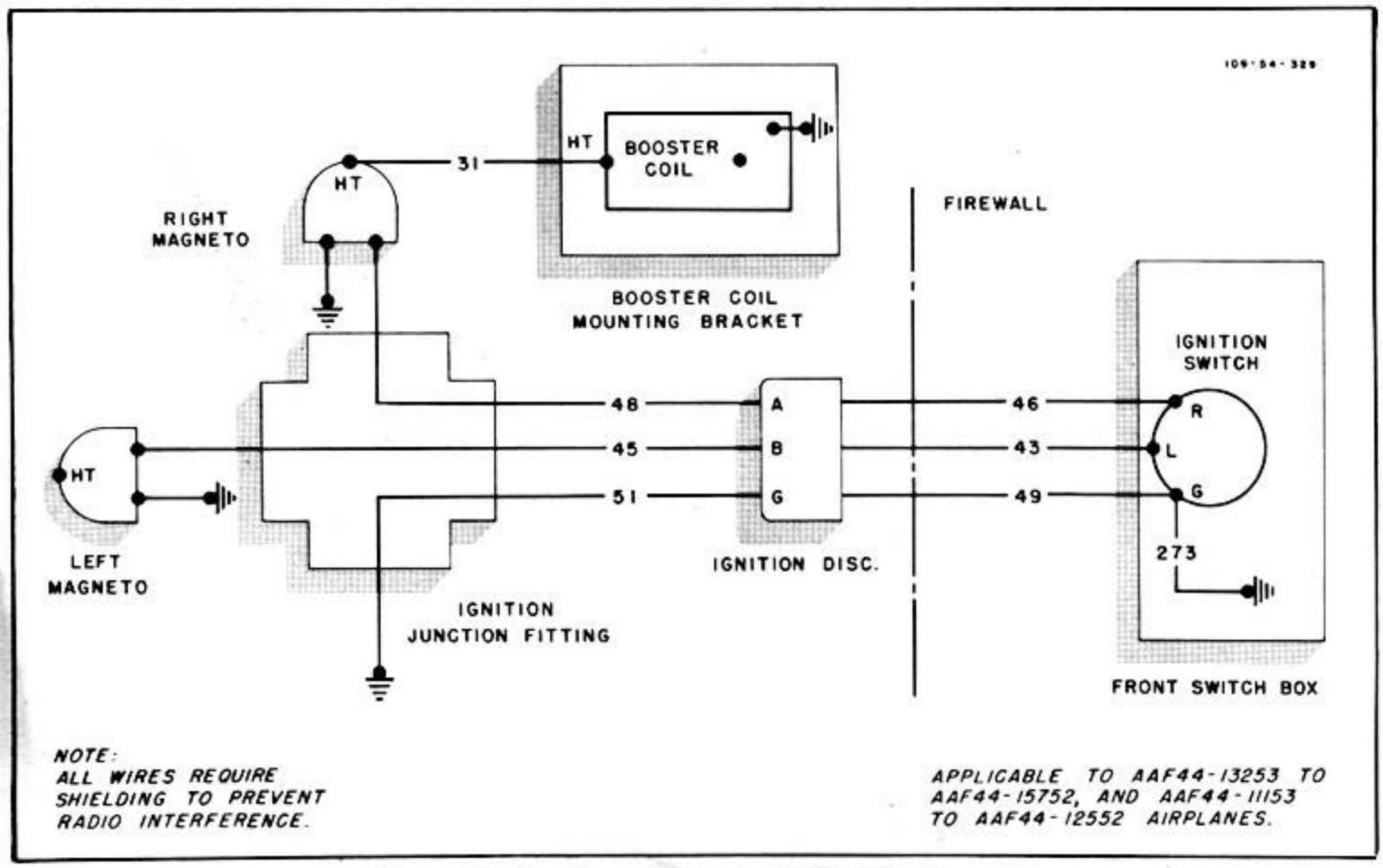


Figure 389—Ignition and Booster Coil Wiring Diagram

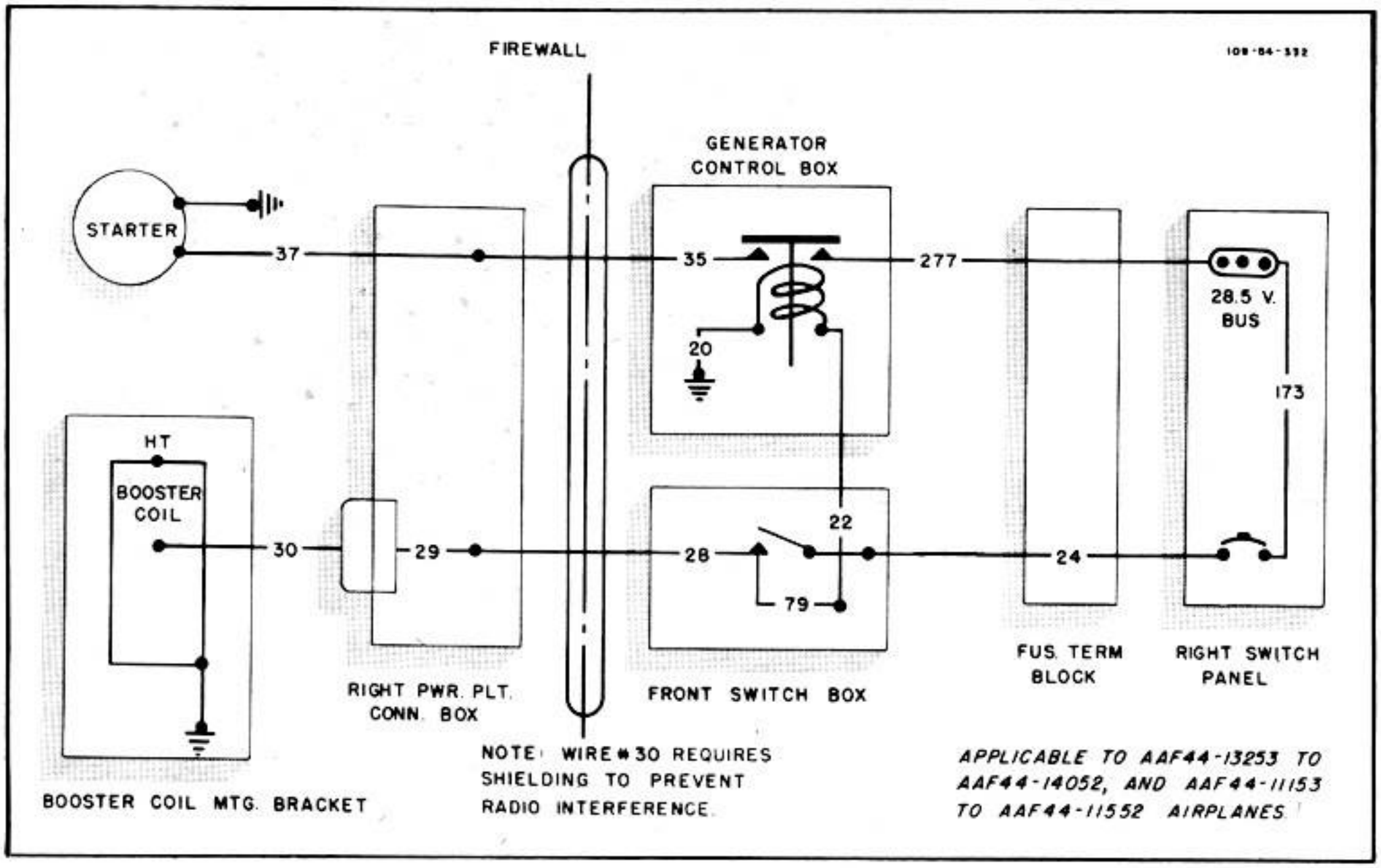


Figure 390—Starter and Booster Coil Wiring Diagram—Early Airplanes

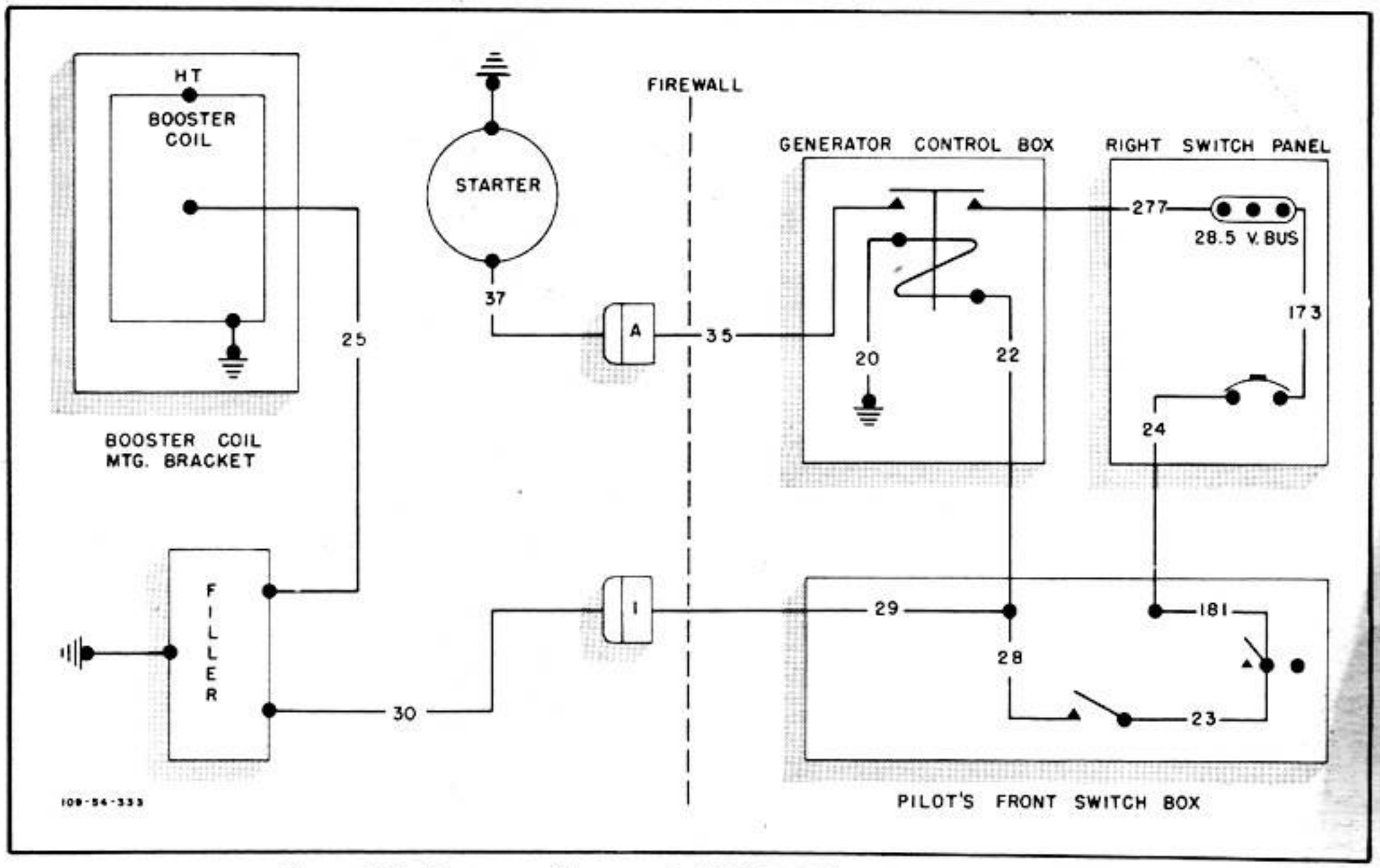


Figure 391—Starter and Booster Coil Wiring Diagram—Later Airplanes

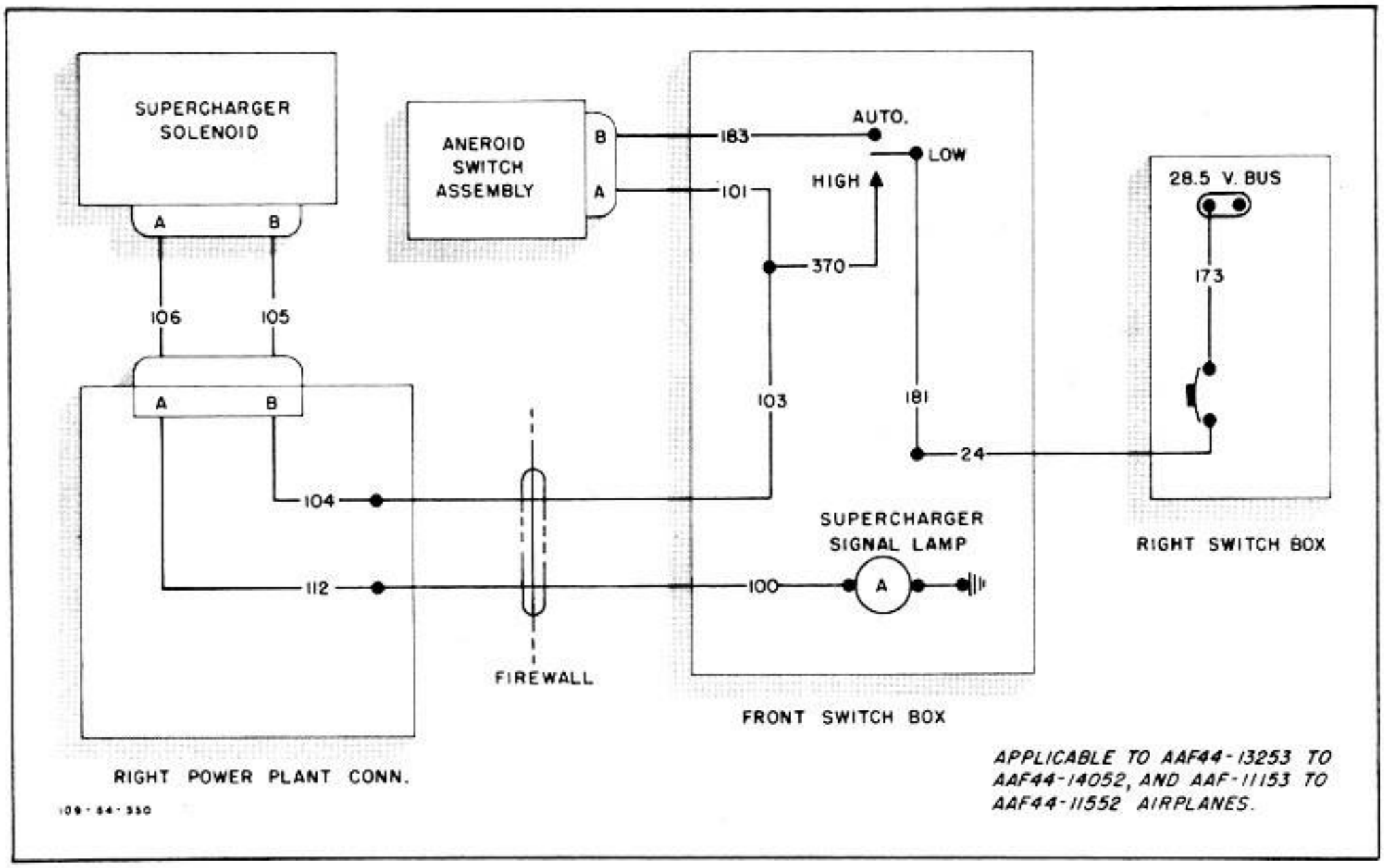


Figure 392—Supercharger Control Wiring Diagram—Early Airplanes

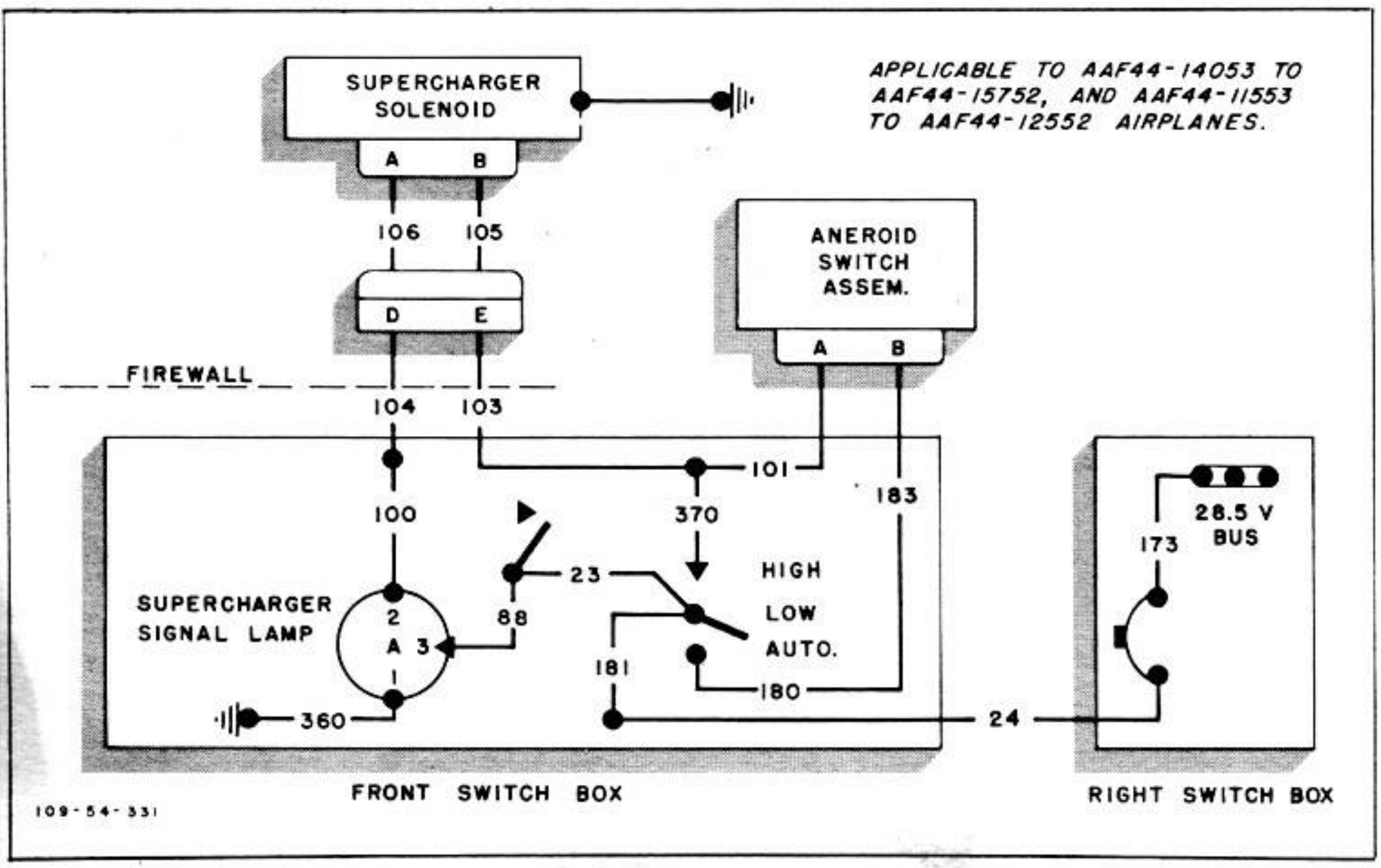


Figure 393—Supercharger Control Wiring Diagram—Later Airplanes

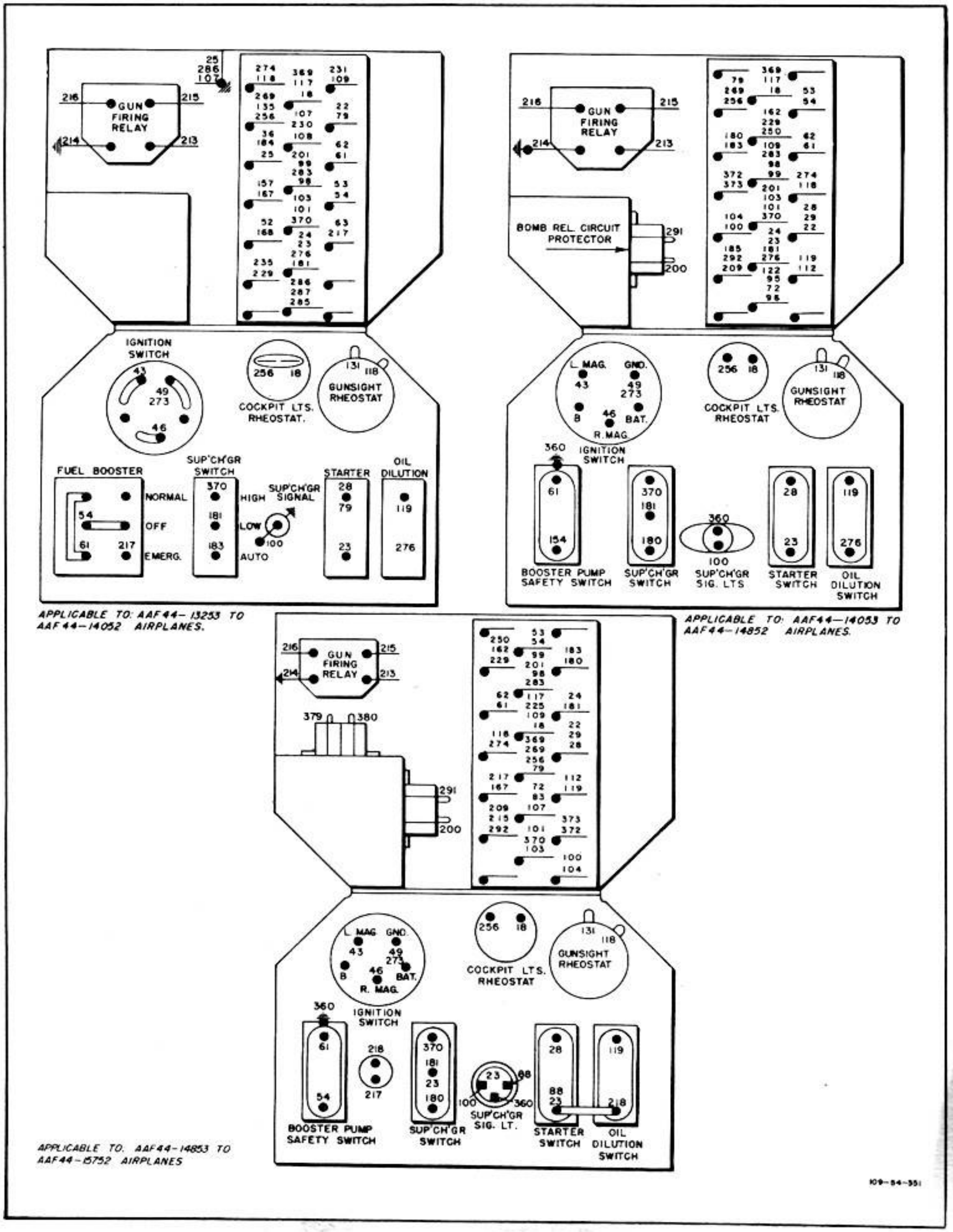


Figure 394—Front Switch Box Wiring Diagram

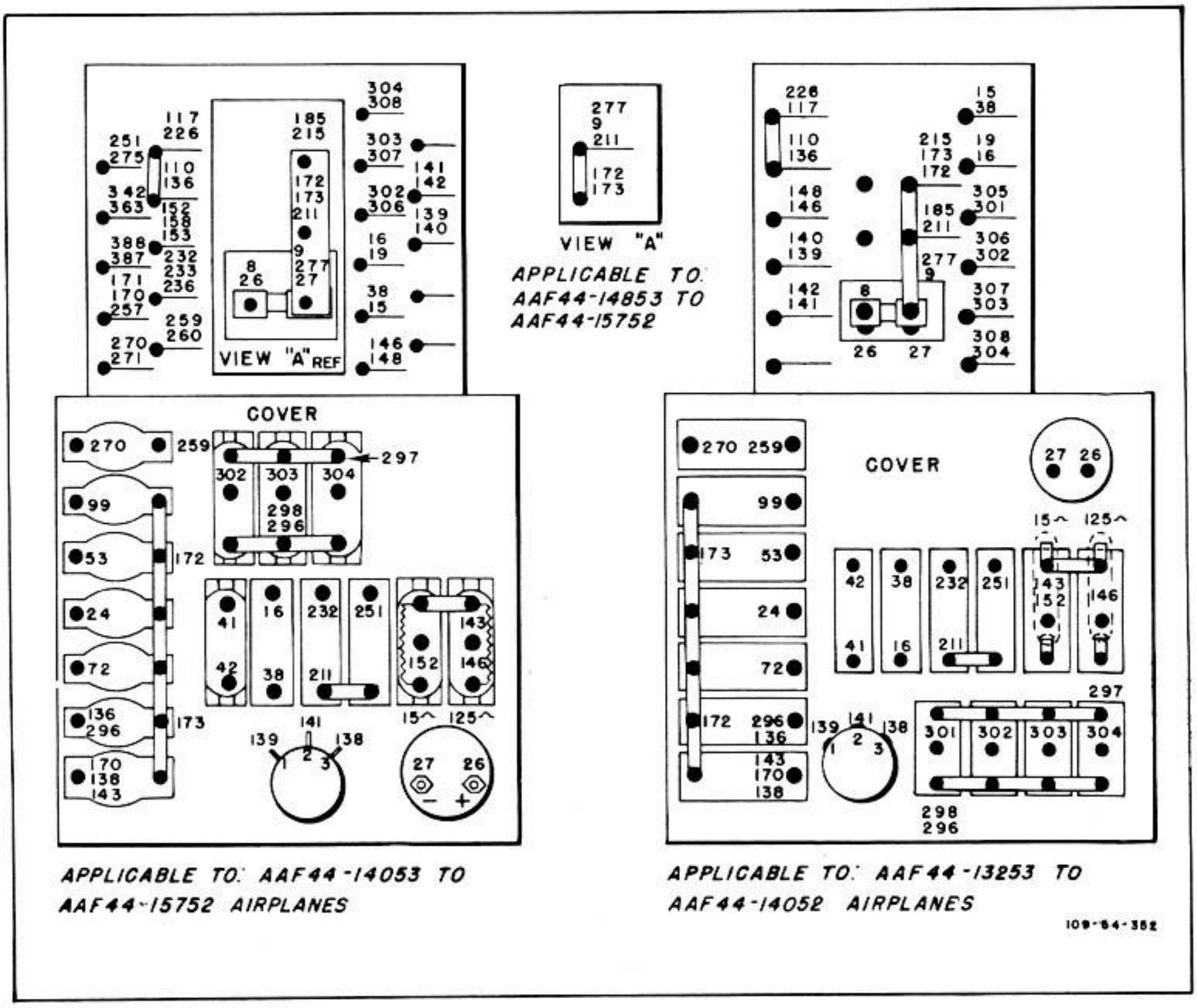


Figure 395—Right Switch Panel Wiring Diagram

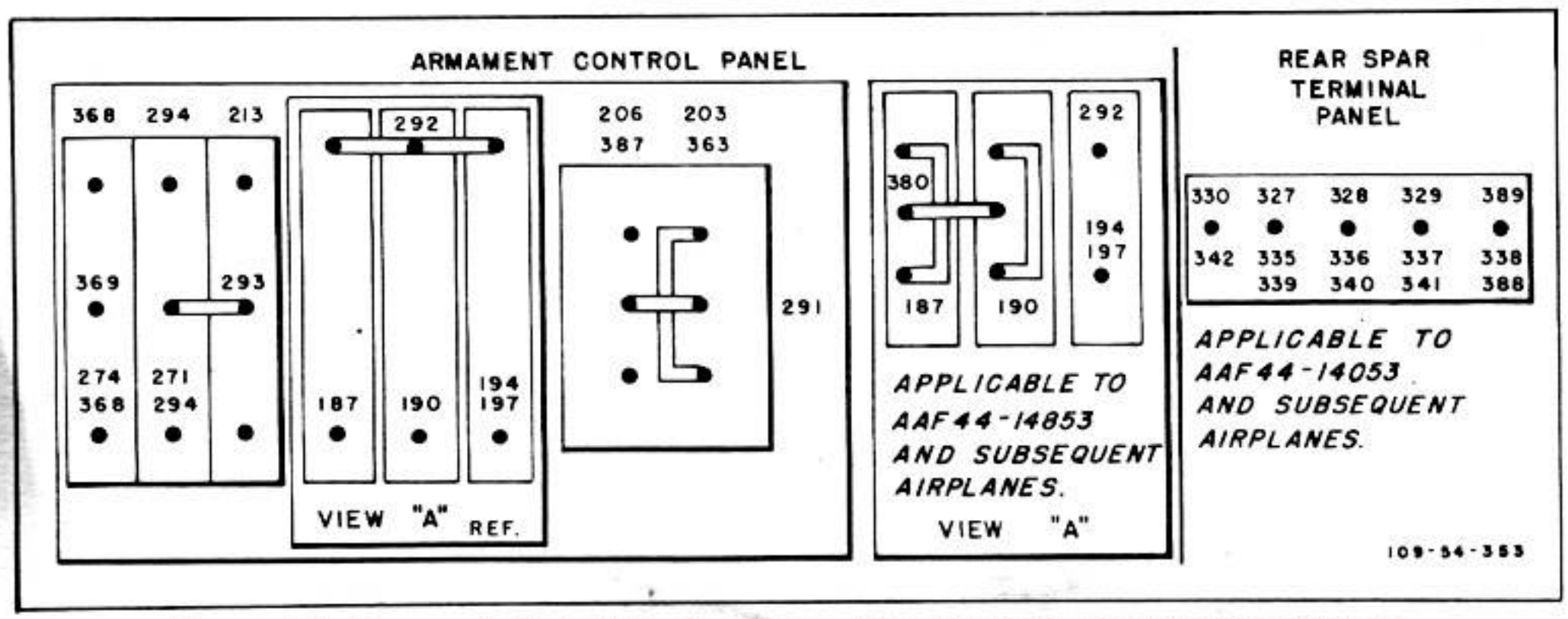


Figure 396—Armament Control Panel and Rear Spar Terminal Panel Wiring Diagram

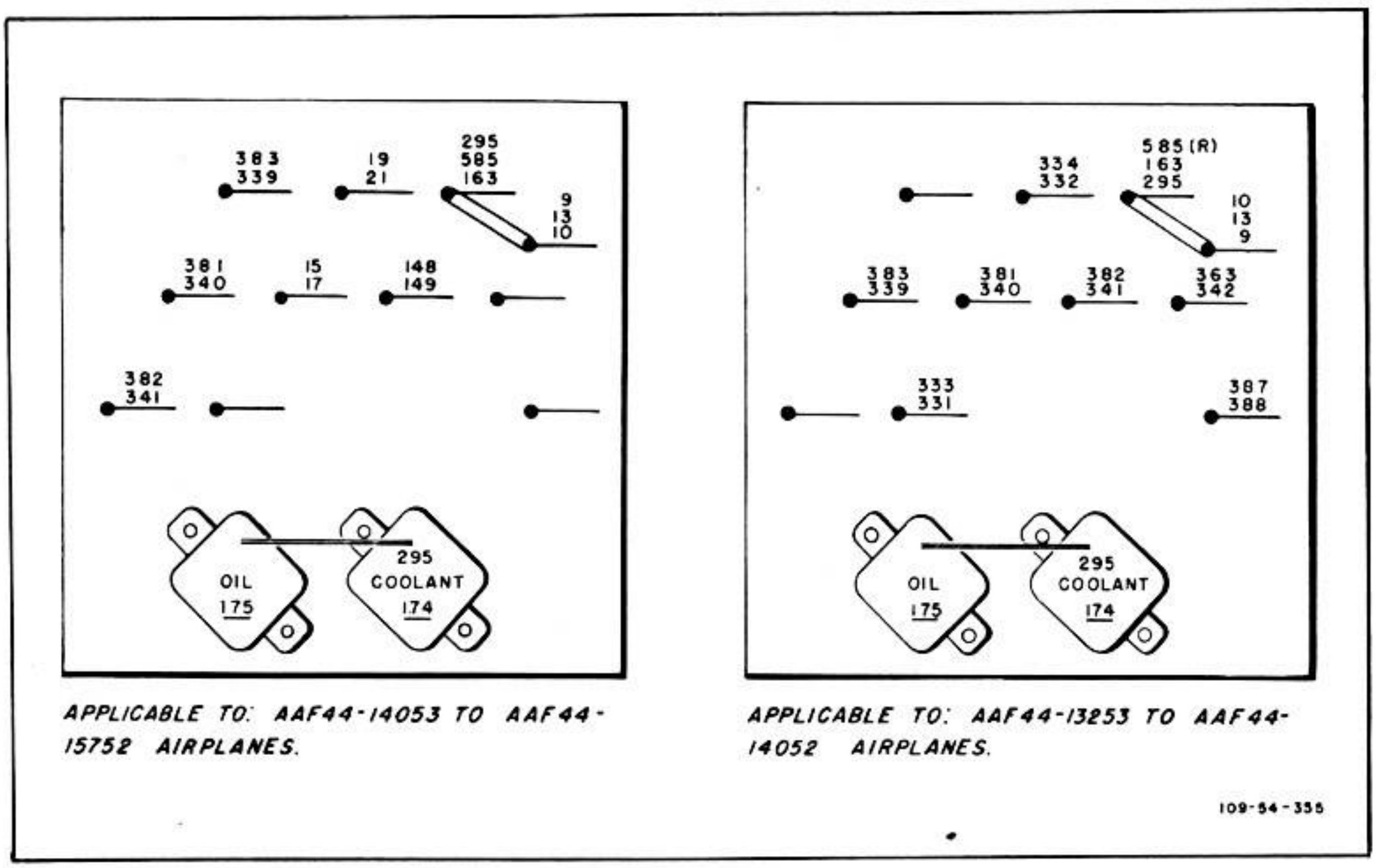


Figure 397—Main Power Panel Wiring Diagram

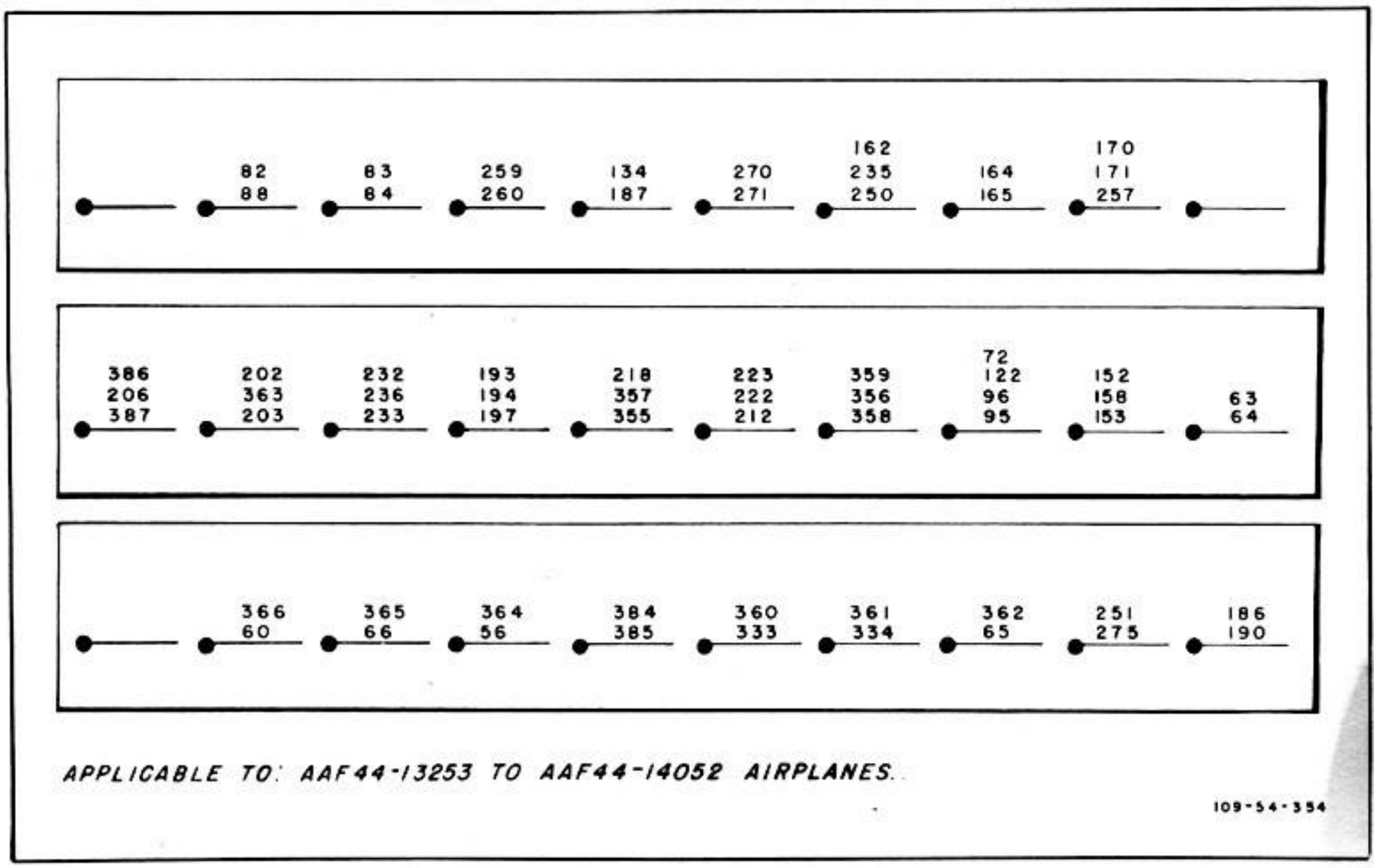


Figure 398—Fuselage Terminal Panel Wiring Diagram

21. RADIO EQUIPMENT.

a. GENERAL DESCRIPTION.—Five radio sets may be installed in these airplanes: the SCR-522-A and SCR-274-N *command equipment* for communication with other aircraft or ground station, and the SCR-695-A, SCR-515, or AN/APS-13 *radio equipment,* which is strictly confidential. On later airplanes, provisions are made only for the installation of SCR-522-A and AN/APS-13 radio equipment. The radio controls are on the right side of the cockpit. With the fuselage tank installed, the command equipment only may be carried; on early airplanes not carrying the tank, command and identification radio sets may be installed in the airplane at the same time. Detachable channels, furnished as loose equipment, are used to install either type command radio set on upper radio support. A BC-1206 radio range receiver, mounted on the cockpit floor at the right of the control stick, is for reception of beacon signals, weather broadcasts, and airport communication during ferrying operations when the SCR-522-A radio set is installed. The antenna system is shown in figure 408. All of the radio wiring is in open bundles supported by clips. Wiring diagrams will be found at the end of this paragraph.

b. MAINTAINING RADIO EQUIPMENT.—No maintenance should be required beyond checking the battery voltage, replacing the dynamotor brushes occasionally and testing the tubes periodically. No attempt at either the mechanical or electrical maintenance of any item of the radio equipment should be made unless suitable shop and testing facilities are available and authority to repair has been granted by the corps area officer in charge.

CAUTION

Some of the tubes in the SCR-522-A radio set are of special "baseless" construction and require special care in removal and installation. No side pressure is to be exerted on any of the prongs of these tubes.

c. DYNAMOTORS.

(1) DESCRIPTION.—All radio sets are powered by dynamotors which step the 24 volts up to the desired amount needed to maintain proper operation of the particular receiver or transmitter affected. Each dynamotor is either built into, or mounted adjacent to, the radio set it powers.

(2) REPLACING DYNAMOTOR BRUSHES.—Any brush which has worn down to a length of less than ⅜ inch should be replaced with a new one. When installing new brushes, "sanding in" is usually necessary, and can be done with a strip of No. 000 sandpaper wrapped around the surface of the commutator with the sand surface out. Install new brush and rotate armature back and forth until width of the brush face is making contact against the sandpaper, as indicated by sanding marks or scratches on the contact surface of the brush. If necessary, sand the sides of the brush for a free fit in the holder. Never apply oil or grease to the brush holder, or commutator.

CAUTION

Opening up the tube covers on the transmitters and modulator will expose the high voltage plate connections. The dynamotor output is sufficient to cause severe shock, or even death. Be sure that the dynamotor is not running before making any adjustment whatever, except when tuning up the transmitters. Do not depend alone on hearing the dynamotor run—feel it. *If the radio compartment has been exposed to gasoline vapor, make certain that it is aired out well before turning on the power to any radio unit.*

d. RADIO TROUBLE SHOOTING.

TROUBLE	PROBABLE CAUSE	REMEDY
SCR-274-N COMMAND TRANSMITTER		
Antenna current fails to rise.	Defective microphone circuit or microphone.	Repair wiring or replace microphone.
Transmitter carrier does not release.	Water in control box shorting out switch.	Dry out box with tetrachloride or lint-free cloth. Tape any crack in box.
No radiation indicated on R.F. meter on command antenna transmitter relay unit.	Faulty relay in command transmitter box. Not switching transmitters.	Replace command transmitter control box.
Transmitter does not operate.	Connections of the power wires reversed.	Connect properly.
Transmitter cuts in and out.	Jacks and microphone plugs corroded and burned.	Clean plugs with a rough rubber eraser. Clean jacks with a small piece of No. 0000 sandpaper wound on a dowel to fit jack.
Transmitter will not load up properly.	"Flat" tube in transmitter.	Replace defective tube.

TROUBLE	PROBABLE CAUSE	REMEDY
No sidetone.	Defective command transmitter control, command transmitter rack, or VT-135 tone oscillator tube. No. 11 pin in receptacle on transmitter rack not making good contact.	Change parts with a duplicate unit known to be good until defective part is located; then replace. Spread the spring contacts apart to establish proper contact.
Transmitter fails to operate. Dynamotor dead.	Defective 20-ampere fuse at right rear of modulator unit.	Replace fuse.
Dynamotor operates, but tube filaments do not light.	Defective 20-ampere fuse at right rear of modulator.	Replace fuse.
Erratic readings on R.F. ammeter.	Antenna cut loose from insulator and shorting to the fuselage of the airplane.	If in flight, turn "OFF" equipment. On ground, repair antenna.
	SCR-274-N COMMAND RECEIVER	
Noisy reception.	Phone plugs and jacks corroded. Faulty connection in antenna relay. Either ground wire from receiver rack to airplane has broken loose, or receiver is loose in the rack.	Clean plugs and jacks. Replace the unit. Restore ground contact.
Receiver operates, but no output to the headphones.	Output tube (VT-134) defective.	Replace defective tube and check for other weak tubes.
Operation in all receivers but one.	Fuse in low voltage input to command receiver rack is defective.	Replace fuse.
	SCR-522-A TRANSMITTER	
No meter reading on meter position 1.	Crystal not oscillating. Filament of VT-198 or VT-199 diode indicator burned out.	Replace crystal. Replace defective tube.
No meter reading on meter position 2.	Second harmonic amplifier VT-118 burned out.	Replace with a new tube.
No meter reading on meter position 3.	Power amplifier VT-118 burned out.	Replace with a new tube.
Antenna does not load properly.	Transmitter out of adjustment. Antenna coupling coil arcing. Dirt in antenna relay points or incomplete closing.	Recheck tuning of the transmitter. Remove foreign matter causing arcing. Clean and adjust the points.
Set remains in the receive position.	Shorted control box 602A or cable, or points of locking relay 411-1 shorted or stuck together.	Replace the control box, if necessary. Check the relay points.
Transmitter channel "D" control box 602 has no effect.	Terminal 6 on Jones plug 123-1 shorted to ground. Contactor cable shorted.	Correct. Repair or replace.

TROUBLE	PROBABLE CAUSE	REMEDY
Transmitter operates, but tone is heard in headset.	Relay 131 points closed in "pip squeak" position.	Clean points on relay.
	Solenoid shorted to ground.	Replace solenoid.
No modulation when set in the transmit position.	Speech amplifier VT-199 or modulator VT-134 burned out.	Check the tubes and replace, if defective.

SCR-522-A RECEIVER

Receiver sounds as if it is working, but no signals can be heard.	Any of the following tubes may be defective: VT-207. harmonic generator VT-202, or amplifier VT-203.	Check tubes and replace, if defective.
	Crystal not oscillating.	Clean or replace crystal.
Crystal good but no signal is heard.	R.F. tube VT-203 or mixer tube VT-203 burned out. **Note** These are peanut tubes and when defective appear cloudy or milky.	Replace defective tube or tubes.
No sidetone.	First audio VT-169 or VT-135 burned out.	Check and replace.
Receiver output low or distorted.	Headsets not matched with output transformer in receiver.	Check that headset connections are matched with terminals 4 and 6 on transformer for HS-33 headset.
Audio squelch does not operate.	VT-207 defective.	Replace tube.
	Audio squelch relay not working properly.	Adjust.

SCR-522-A RACK

Channel release button does not release.	Cams operate channel slides too fast.	Move the entire assembly, or spring the slides that are causing the trouble.
Channel motor erratic.	Interrupter switch points do not have proper gap.	Completely open gap .005 inch or about the thickness of a sheet of writing paper.

DYNAMOTOR PE-94

Voltage and dynamotor speed varies.	Dynamotor requires adjusting.	Loosen set and adjust carbon pile for 13.5 volts on low voltage output and steady dynamotor speed.
Noisy dynamotor.	Dirty commutator, faulty brushes, and brushes binding in their holders.	Clean commutator or replace brushes.

TROUBLE	PROBABLE CAUSE	REMEDY
	RADIO INTERFERENCE	
Ignition noise in the VHF radio equipment.	Nonmetallic gaskets installed between the magnetos and the engine.	Shine the gasket mating surfaces of the magneto and engine, and install a metallic gasket.
	Distributor bowl assemblies not properly grounded due to insulating gasket compound between these assemblies and their mounting pads on ends of the cylinder blocks.	Remove the gasket material and shine the machined surfaces to original condition. This is important in the elimination of ignition noise.
	Broken distributor crossover tube between the magnetos.	Replace tube.
	Loose gland nuts on the magneto, distributors, harness, and spark plugs.	Tighten connections.
	High tension booster wire connected to the left-hand distributor.	Connect high tension booster wire to the right-hand distributor.
	Dirty mating surfaces on the distributor covers and mounting screws.	Clean surfaces with crocus cloth, and reinstall.
	Glass strands in the T-44 microphone cord broken (when T-44 microphone used).	Replace cord. •

e. SCR-522-A RADIO EQUIPMENT.

(1) DESCRIPTION.—The radio set SCR-522-A consists essentially of a transmitter and receiver housed in one box, a power supply (Type PE-94-B dynamotor), a control box, an automatic switch (remote contactor), and a radio junction box. This equipment operates on a band between 100 mc and 156 mc, and no separate coils, crystals, etc., are necessary for either transmitter or receiver. This equipment is mounted on two fixed beams above the fuselage tank. *(See figure 402.)* The transmitter-receiver is equipped with a removable cover permitting internal adjustment of frequency and antenna coupling. The transmitter carrier may be turned on by either the throttle switch or from the control box; however, the switch on the control box is safetied in the "REM" position so that the carrier can only be turned on by using the throttle switch. An HS-33 headset, and a T-30P (or later) throat microphone with an M-299 microphone adapter are used with this radio equipment.

(2) REMOVING SCR-522-A RADIO SET.

(a) Remove the cockpit enclosure. *(See paragraph* 4. *c.* (3) *(c)* 2.*)*

(b) Remove the three plugs from the top of the radio set.

(c) Unfasten the four dzus fasteners holding the SCR-522-A radio set supports to the crossbeams; then lift the radio set and supports out of the airplane.

(3) REMOVING PE-94-B DYNAMOTOR.

(a) Remove the two bolts that attach the pilot's seat to the armor plate; then remove the seat from the airplane.

(b) Remove the four bolts that attach the armor plate to the support, and remove the armor plate.

Note

The armor plate is heavy and its removal will require two men.

(c) Remove the two screws at the top of dynamotor supporting bracket and the two screws beneath the dynamotor which attach the bracket to the cross-member. *(See figure 401.)* Remove the two plugs from the dynamotor; then remove dynamotor and bracket assembly.

Note

To facilitate dynamotor removal, later airplanes are provided with dzus fasteners in lieu of the two lower mounting screws.

(4) REMOVING PE-94-B DYNAMOTOR BRUSHES.—The dynamotor unit must be removed from the airplane before brushes can be installed. *(See paragraph* (3) *(a), (b), and (c) preceding.)* Proceed as follows:

(a) Remove the 18 cover screws and remove the cover.

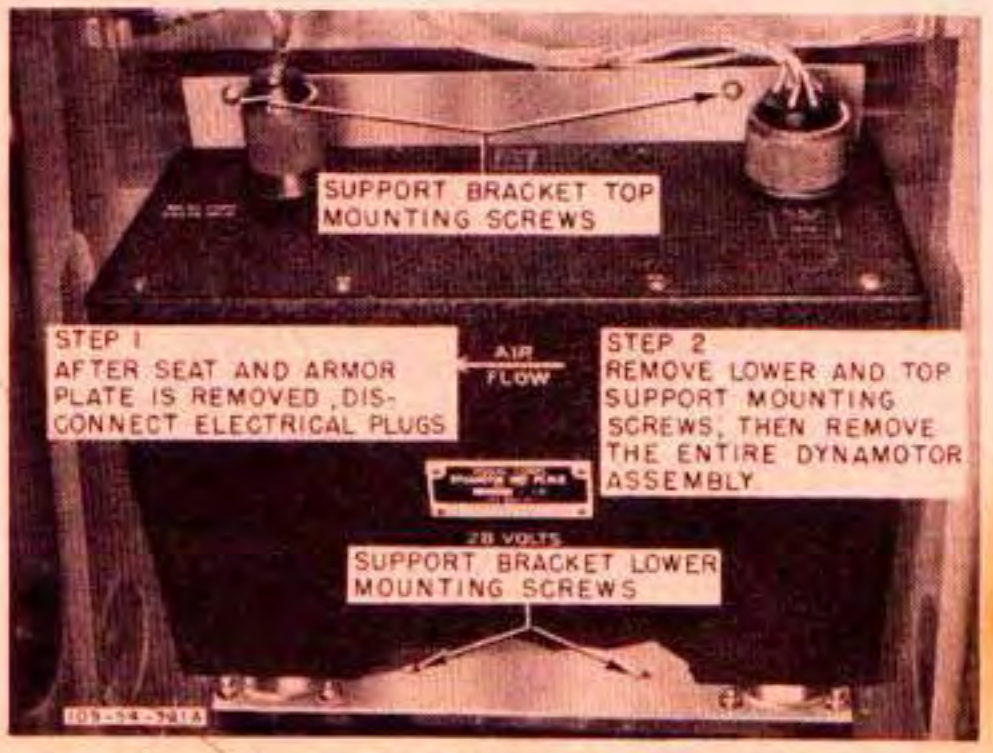
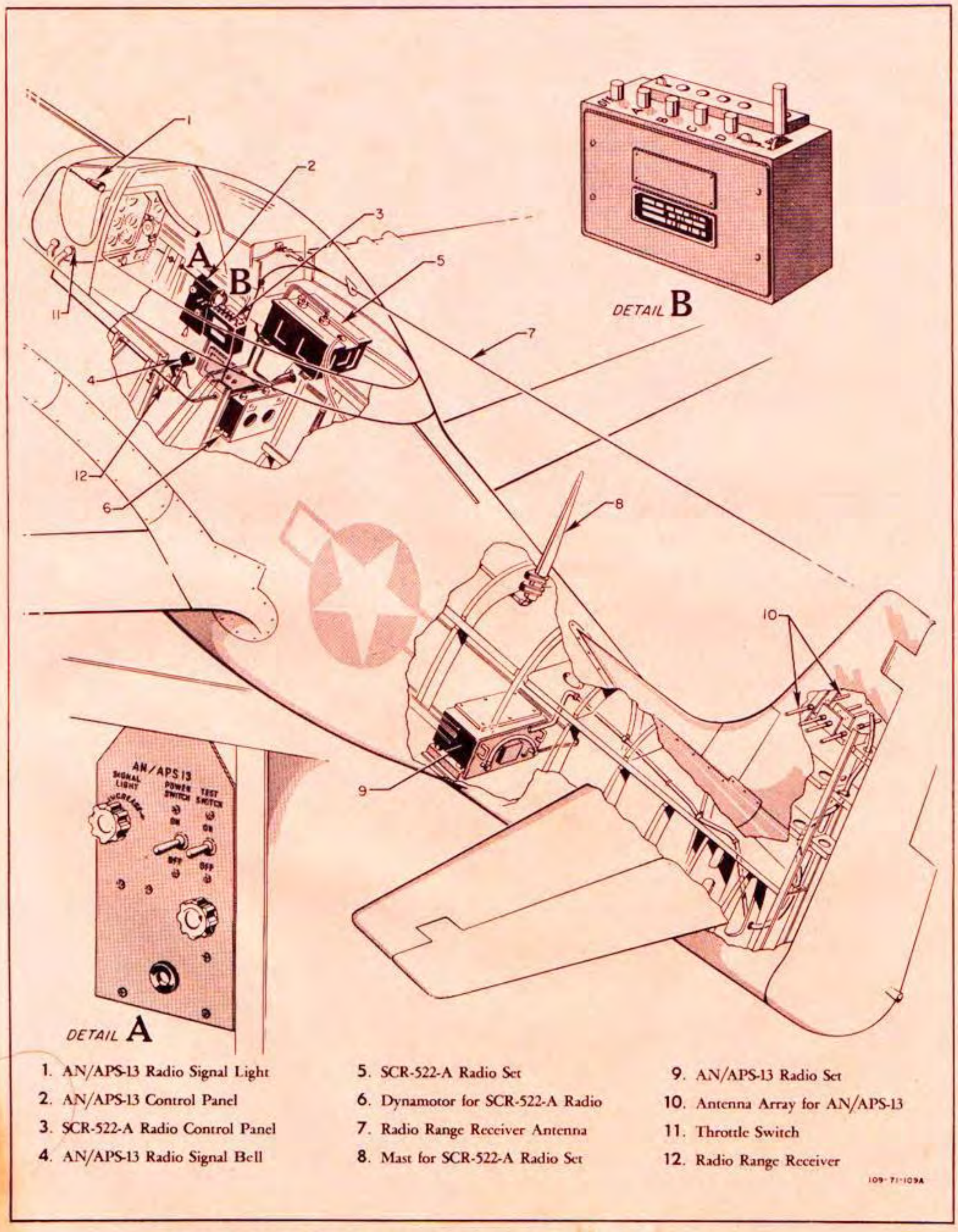


Figure 401—Removing PE-94-B Dynamotor



1. AN/APS-13 Radio Signal Light
2. AN/APS-13 Control Panel
3. SCR-522-A Radio Control Panel
4. AN/APS-13 Radio Signal Bell
5. SCR-522-A Radio Set
6. Dynamotor for SCR-522-A Radio
7. Radio Range Receiver Antenna
8. Mast for SCR-522-A Radio Set
9. AN/APS-13 Radio Set
10. Antenna Array for AN/APS-13
11. Throttle Switch
12. Radio Range Receiver

109-71-109A

Figure 402—SCR-522-A and AN/APS-13 Radio Installation—Later Airplanes

(b) Disconnect the dynamotor interconnecting leads.

(c) Loosen the captive screw which connects the ends of the dynamotor retaining strap. Carefully pull the dynamotor out of its compartment.

(d) Remove the screw fastening the flexible lead to the brush holder and move the brush spring away from the brush.

(e) Remove the old brush and replace with a new one. *(See c. (2) of this paragraph.)*

(5) INSTALLING PE-94-B DYNAMOTOR BRUSHES.

(a) Fasten the flexible lead to the brush screw after replacing the brush.

(b) Slip the dynamotor back into its compartment and reconnect the wires to it. Secure the retaining strap.

(c) Reinstall the dynamotor cover.

(d) Place the unit back in the airplane by installing the four bolts through the shock mounts into the unit. Connect the plugs to the unit.

(6) ADJUSTING SCR-522-A RADIO TRANSMITTER.—When tuning the transmitter, use test set IE-12-A. If this equipment is not available, use a zero to one milliammeter, whose resistance, including the meter's internal resistance and added external resistance, is exactly 75 ohms. Insert crystals in crystal sockets.

Note

The crystal frequencies are confidential, and information concerning their numerical value is to be transmitted only to persons authorized to receive it.

(a) Attach the test set IE-12-A or the zero to one milliammeter to the socket adjacent to the meter switch in the set. *(See figure 403.)*

(b) Plug one end of cord (CD-477) into socket (SO-153) on the right side of rack (FT-244-A) and plug the other end into the signal generator receptacle marked "PHANTOM ANTENNA," located to the right of the direct-current meter socket.

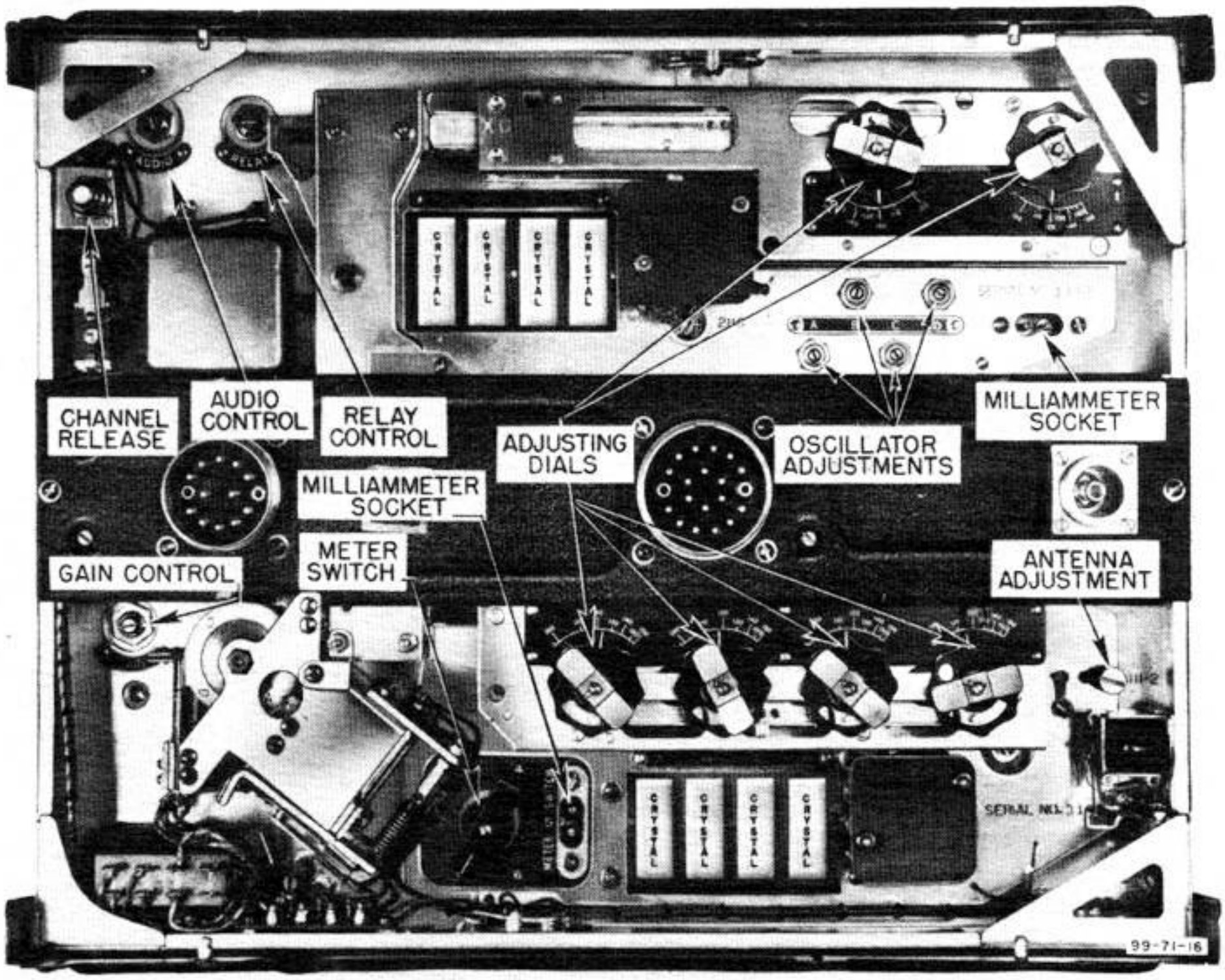


Figure 403—SCR-522-A Adjustment

(c) Throw the tuning crystal resonance switch to "TRANS. REC." position.

(d) Press the channel D button on the radio control box. Then press the channel release button and loosen the four transmitter tuning control locknuts by turning them counterclockwise. Press the channel A button on the radio control box. Allow one minute for the set to warm up. Place the meter switch in position 1 and adjust the first tuning control dial on the left for a maximum deflection of the test milliammeter.

CAUTION

Guard against tuning to undesired harmonics by making certain that the scale indication as shown on the transmitter tuning dial scale is approximately equal to the output frequency being tuned.

(e) Place the meter switch in position 2 and adjust the second tuning dial from the left for a maximum indication on the milliammeter. Place the meter switch in position 3 and adjust the third tuning dial from the left for a maximum indication on the milliammeter.

Note

The test milliammeter reading on switch position 3 is the best indication of the over-all operation of the transmitter. A record of the reading taken on the lowest frequency channel should be kept and checked daily.

(f) Adjust the fourth dial from the left (No. 1 on the right) for a minimum indication on the milliammeter. Place the meter switch in position 3 and adjust the third tuning dial from the left for a maximum indication on the milliammeter.

(g) Place the meter switch on position 4 and adjust the fourth dial from the left for a maximum indication of the milliammeter.

(h) Place the meter switch on position 5 and readjust all transmitter tuning control dials for a maximum test milliammeter reading. This procedure completes the tuning of transmitter channel A.

(i) To tune channel B, press B on the panel of the radio control box and follow the same tuning procedure outline for channel A, preceding.

(j) Tune channels C and D in a like manner; then press the channel release button and tighten all transmitter tuning control thumbscrews or locknuts by turning them in a clockwise direction.

(k) Adjust the antenna coupling, by placing the meter switch in position 3 and barely loosening the antenna coupling control thumbscrew located to the right of the transmitter tuning dials.

(l) Check and recheck each channel while sliding the antenna coupling control screw from side to side, using a screwdriver for a lever, to obtain an average current of approximately 63 milliamperes for all channels. When this adjustment is made, tighten the antenna coupling control thumbscrew by turning it clockwise. A sustained note in the microphone should now result in modulation of the carrier wave. This completes tuning of the transmitter.

(7) ADJUSTING SCR-522-A RADIO RECEIVER.— The test set IE-12-A and a headset are required for tuning the receiver, the frequency of which is confidential. Finding the correct receiver crystal for a particular receiver channel is the same as finding the correct fundamental frequency (f) of the crystal to be used. The fundamental crystal frequency (f) may be determined from the expression $f = \frac{fr - 12}{H}$, where fr equals the frequency to which the receiver is to be tuned and H equals the receiver crystal harmonic used.

Frequency (fr)	*Receiver Crystal* Harmonic (H)
100-108	11
108-116	12
116-124	13
124-132	14
132-140	15
140-148	16
148-156	17
156	18

When using the signal generator, insert a transmitter crystal into the crystal socket of the generator. This crystal should have a fundamental frequency 1/18 the magnitude of the receiver frequency to be tuned. If receiver channel A is being tuned, this should be the same crystal used for transmitter channel A. The same applies to all other channels. If the signal generator is not available, the set may be tuned by using similar radio equipment in nearby aircraft or ground stations, tuning the receiver with the transmitter of the other equipment. Connect the test milliammeter to the receiver at the plug adjacent to the oscillator tuning the receiver with the transmitter of the other equipment. Connect the test milliammeter to the receiver at the plug adjacent to the oscillator tuning screws. The following adjustments are to be made for channel A:

(a) Install the proper crystal in the socket for receiver channel A.

(b) Press channel D button on the radio control. Press the channel release button.

(c) Loosen the two receiver adjusting dial locknuts by turning them counterclockwise.

(d) Press the channel A button on the radio control box.

(e) After allowing approximately one minute for the receiver tubes to warm up, throw the T-R-REM switch on the radio control box to the "R", or center, position. Turn the receiver tuning controls to approximately the desired frequency. Starting from the extreme clockwise position, slowly turn the crystal oscillator plate coil tuning screw for channel A clockwise with a screwdriver until there is a sudden dip in the test meter. Several dips will be noted on

the test milliammeter; however, the dip with the broadest peak is the one to tune for and is the one giving the most stable operation of the receiver.

(f) Adjust the receiver tuning dials for a minimum milliammeter reading. These two adjustments may require repeated readjustment.

(g) To adjust the remaining channels, press the channel B button and remaining channels, and follow the same procedure as outlined for channel A.

Note

The tuning instructions for channel A will apply to channel B only if the letter B is substituted for A wherever the crystal, channel, or oscillator plate coil tuning screw is mentioned. This likewise applies when tuning channels C and D. Tune channels C and D; then press the channel release button and tighten the two receiver locknuts by turning them clockwise.

(8) INSTALLING SCR-522-A RADIO SET.

(a) Remove the cockpit enclosure. *(See paragraph 4. c. (3) (c) 2.)*

(b) If the channel supports are not attached to the radio set, install them on the set before installing set in the airplane. Make certain that channels are installed as marked, forward and aft.

(c) Place the radio set on the upper radio supports and secure channel supports to the radio supports by means of the dzus fasteners.

(d) Connect the three electrical plugs to the radio set.

(9) COMMAND SET CONTROL BOX.—The radio control box is provided with four push buttons for starting the radio set. The T-R-REM toggle switch at the bottom of the control box serves to switch the radio set to either transmit or receive conditions. The switch is safety wired in the "REM" position. A lamp on the right side of each channel selector button indicates which channel is being used. Dimmer masks for the lamps prevent glare.

(10) REMOTE CONTACTOR.—On early airplanes only, provisions are made on the instrument panel for installation of the remote contactor which automatically controls the special band D of the transmitter. There are two switches on the instrument; one starts or stops the clock and the other serves to cut the contactor into or out of the radio transmitting circuit. The pointer indicates the time of the special transmission period which is 14 seconds of every minute, and indicates when this special transmission period is approaching or ending. The clock has an 8-day movement.

f. RADIO SET SCR-274-N (Early Airplanes).

(1) DESCRIPTION.—Provisions for the SCR-274-N radio set are provided only on early airplanes. The radio set SCR-274-N consists of two transmitters, three receivers, and operating accessories such as the combined dynamotor and modulator, antenna switch relay, and junction box. When the fuselage tank is installed, only one transmitter and two receivers may be installed on the upper radio support. With the tank removed, an additional receiver and transmitter may be installed on the fixed radio shelf. *(See figure 404.)* The modulator is mounted just behind the pilot's armor plate at the forward end of the fixed radio shelf. Any two of the four command transmitters may be installed. No spare coils are required for either transmitters or receivers. The receivers are capable of continuous wave (cw) or amplitude modulated (mcw) reception. The use of an MC-385 headphone adapter is required with this radio set when using HS-33 headsets; however, no microphone adapter is required.

(2) REMOVING SCR-274-N RADIO COMMAND SET.

(a) Break the safety wire on the snapslides of the set being removed.

(b) Disconnect the antenna from the binding post of transmitter or receiver being removed.

(c) Remove the radio set from the airplane.

(3) ADJUSTING SCR-274-N TRANSMITTERS.—Transmitter adjustment, which chiefly concerns frequency calibration, is accomplished as follows:

(a) Open hinged cover at top rear of transmitter to such an angle that the reflection of the entire resonance indicator screen may be seen.

(b) Tune transmitter to the lowest frequency which will open the shadow on the resonance indicator. Spurious responses will sometimes be observed but they are always higher than the nominal frequency of the crystal.

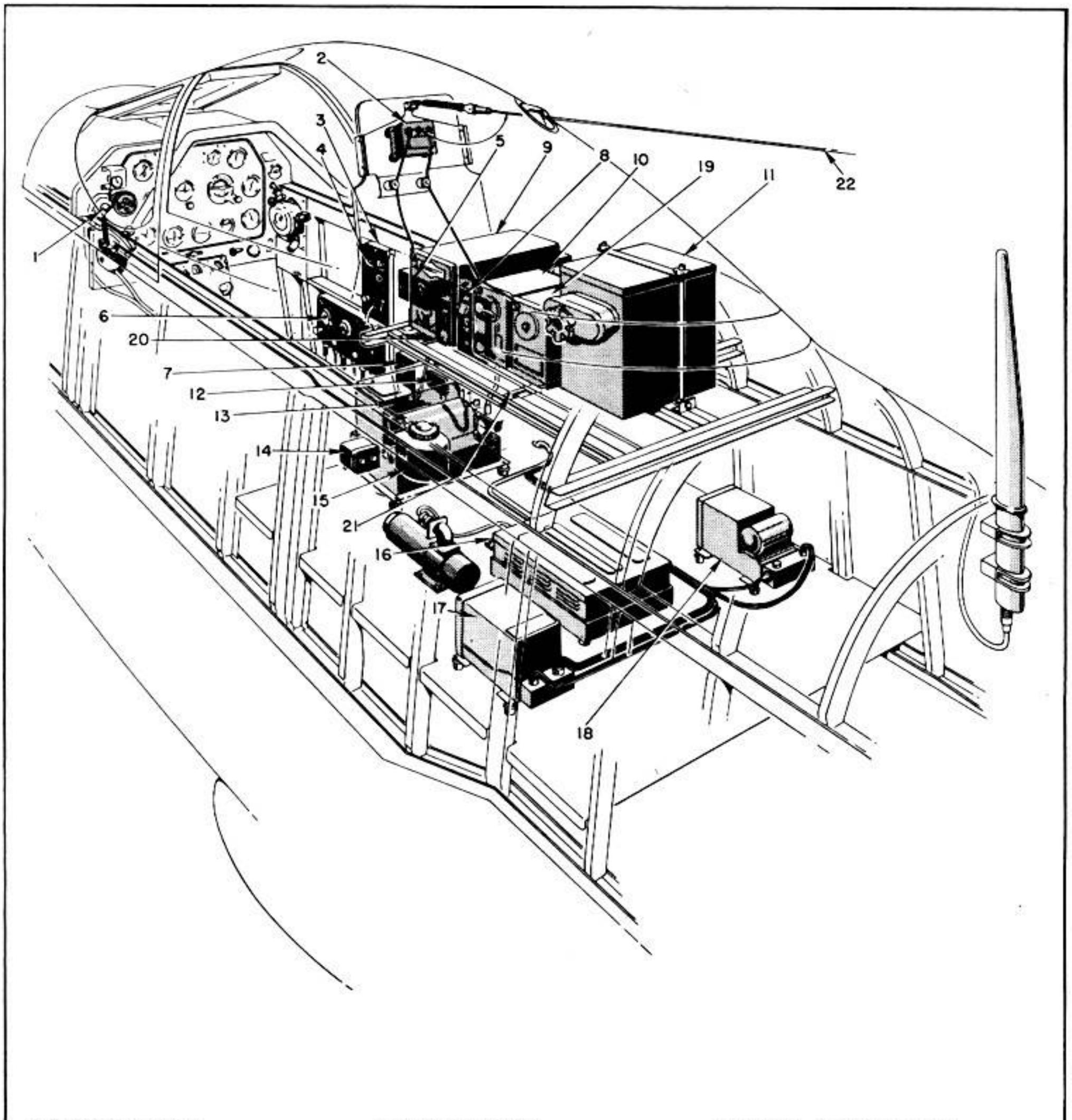
(c) The indicated dial frequency should now correspond with that of the crystal. If it does not, set the dial exactly on the frequency of the crystal and trim the master oscillator capacitor to make it do so. This trimmer may be adjusted with a small metal screwdriver inserted through the hole (covered with a metal slide) in the top of the transmitter. *(See figure 405.)* A clockwise rotation of this trimming control lowers the transmitter frequency.

(d) Adjust the frequency control again to make certain that the crystal is resonating at its lowest frequency, being sure that no opening of the resonance indicator is observed for any dial frequency below that corresponding to the value shown on the crystal holder. The calibration engraved on the frequency dial of the transmitter will then be correct at any point on the dial.

Note

The crystal alignment frequencies are:

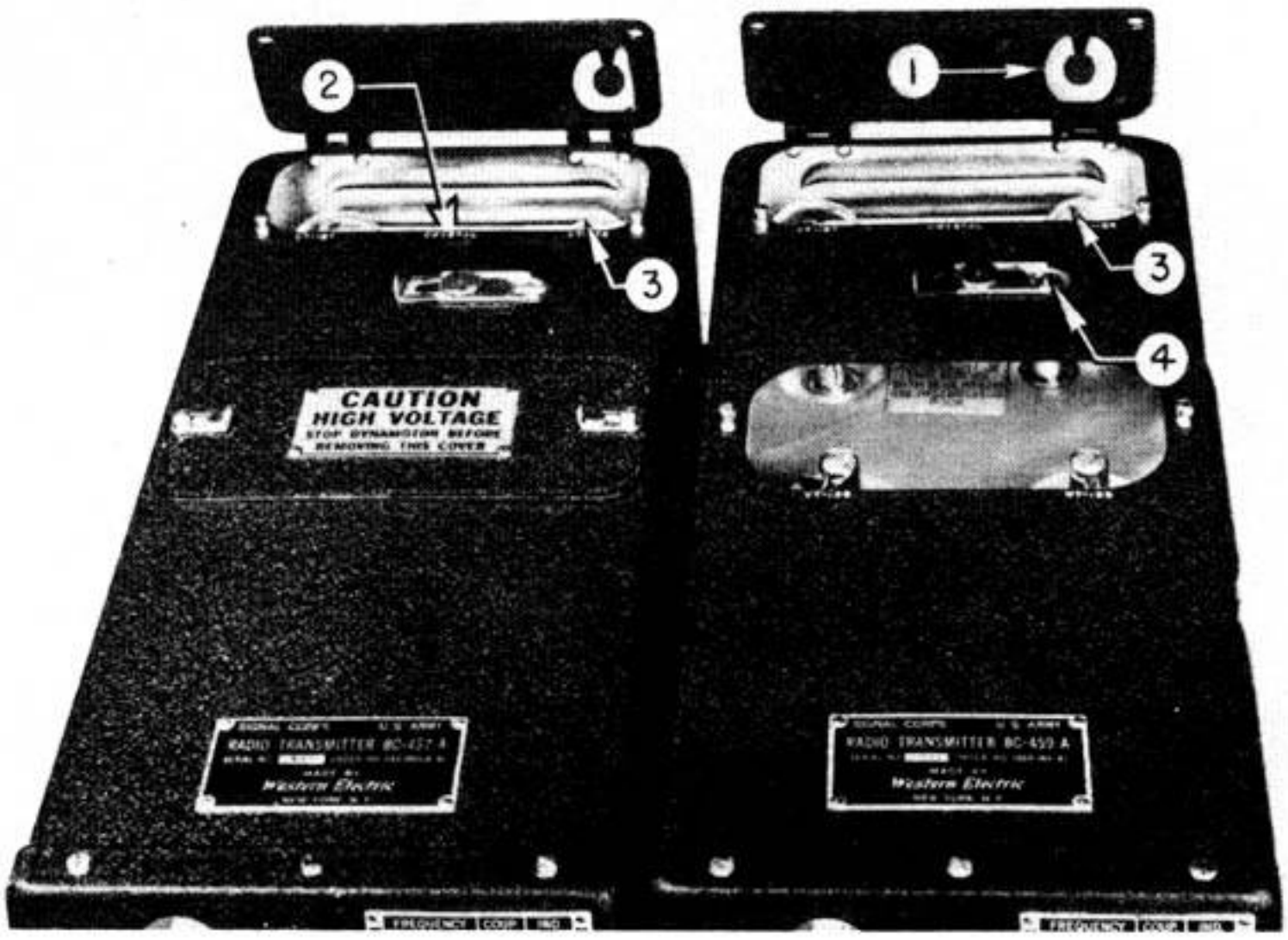
BC-459-A Transmitter	Crystal frequency 8.0 mc
BC-457-A Transmitter	Crystal frequency 4.6 mc
BC-458-A Transmitter	Crystal frequency 6.2 mc
BC-696-A Transmitter	Crystal frequency 3.5 mc



1. THROTTLE SWITCH
2. BC-442 ANTENNA RELAY
3. 106-71154 PANEL ASSEMBLY
4. SCR-515-A DETONATOR BUTTONS
5. BC-451-A TRANSMITTER CONTROL BOX
6. BC-450-A RECEIVER CONTROL BOX
7. FL-8 FILTER BOX
8. SCR-515-A CONTROL BOX
9. BC-457 TRANSMITTER
10. BC-453 RECEIVER
11. BATTERY
12. MC-385 MICROPHONE ADAPTOR
13. BC-456 MODULATOR UNIT
14. INDICATOR LIGHTS SCR-515
15. INERTIA SWITCH SCR-515
16. SCR-515-A RADIO SET
17. BC-458 TRANSMITTER
18. BC-455 RECEIVER
19. BC-454 RECEIVER
20. 106-71131 CHANNEL SUPPORT
21. 109-71132 CHANNEL SUPPORT
22. SCR-274-N ANTENNA

109-71-65A

Figure 404—SCR-274-N and SCR-515 Radio Installation—Early Airplanes



1. Resonance Indicator Mirror
2. Plug-in Crystal Unit
3. Resonance Indicator Tube
4. Recessed Trim Adjustment Screw

Figure 405—SCR-274-N Transmitter Adjustment

(4) ADJUSTING SCR-274-N RECEIVERS.—The only adjustment required on the receivers is that of antenna circuit alignment, as follows:

(a) Set the "CW-OFF-MCW" power switch to "CW."

(b) Connect a headset to the receiver.

(c) Set "INCREASE OUTPUT" switch to its maximum position.

(d) Tune receiver to the highest frequency shown on dial.

(e) Trim antenna input circuit for maximum background noise, using the "ALIGN INPUT" knob on front of receiver.

(f) Repeat the preceding instructions for each receiver, adjusting only one receiver at a time to avoid misinterpretation of background noise.

(g) Turn receivers "OFF."

(5) INSTALLING SCR-274-N RADIO SET.—Remove the enclosure and install the equipment as follows when fuselage tank is installed.

(a) If the radio channel supports have been removed, install the 109-71132 and 106-71131 channel supports between the upper radio support beams by means of the four dzus fasteners. It is particularly important that these channel supports be installed as marked (forward and aft).

(b) Install the 109-71078 and 109-71079 channel supports, running fore and aft, on top of the channel supports just installed. Use the nut plates to mount these supports together. Make sure the supports are installed as marked (left-hand and right-hand).

Note

When the channel supports are properly installed, the markings on the channel supports can be read from the left side of the airplane.

(c) Install the transmitter and receiver mountings to the channel supports running fore and aft; then install transmitter and receiver racks.

(d) Slide the transmitter and two receivers into their respective racks and secure in position with snapslides.

(e) With fuselage tank removed, an additional receiver and transmitter can be mounted on the fixed radio shelf between stations 168 and 184. *(See figure 404.)* These units are installed with the transmitter on the left and the receiver on the right side of the airplane.

(6) COMMAND SET SCR-274-N CONTROL BOXES.

(a) DESCRIPTION.—Both the mechanical and electrical controls are installed on the right side of the cockpit. The receiver control box, below the right-hand switch panel, is divided into three sections, each controlling an individual receiver. Each section has a crank-controlled dial on which is shown the frequency setting of the respective receiver. The desired receiver is turned on and off by a switch in the upper left-hand corner of the control section used. This switch, in addition to having an "OFF" position, has two

selective positions marked "CW" and "MCW," each of which is an "ON" position and indicates the type of signal which is to be received. The A-B selector switch in the upper left-hand corner of the control box used determines the phone jack used for the headset. The transmitter control box BC-451-A, located aft and above the receiver control box, contains three controls marked as follows: "TRANS POWER" with "ON" and "OFF" positions, "TONE-CW-VOICE," and "TRANSMITTER SELECTION." The latter has four selective positions; two are used and two are reserved for possible addition of other transmitters.

g. IFF RADIO EQUIPMENT.

(1) DESCRIPTION.—On early airplanes, either the SCR-515 or the SCR-695-A IFF radio set may be installed. On later airplanes, there are no provisions for these radio sets and an AN/APS-13 radio set is installed. Controls for these sets are mounted on the aft right side of the cockpit. Permanent associated equipment consists of the inertia switch, detonator buttons, two G-band switches (used with SCR-695-A radio set), and two indicator lights located as shown in figure 404.

CAUTION

The detonator buttons are to be pressed only when destruction of the IFF equipment is desired. When testing the detonator circuit or destruction of IFF set is contemplated, both switches must be pressed simultaneously.

(2) ADJUSTING INERTIA SWITCH.—To trip the BC-767 inertia switch, remove the transparent cap at the top and displace the pendulum arm until a sharp snap indicates that the switch is tripped; the indicator lamps located adjacent to the switch should then light. Reset the inertia switch by inserting a screwdriver in the right-hand side of the switch casing and turning the screw in a counterclockwise direction to the stop. Then slowly release the screwdriver. The pendulum will now be centered. Replace the transparent cap.

CAUTION

The preceding test should be made with the PL-117 destructor plug disconnected.

(3) RADIO SET SCR-695-A (Early Airplanes).

(a) DESCRIPTION.—Radio set SCR-695-A, installed on early airplanes, consists essentially of a receiver BC-966, control boxes BC-958 and BC-965, an antenna AN-95A, and permanent associated equipment. The receiver can be installed on the floor behind the pilot's armor plate at station 148½ only when the fuselage fuel tank is removed. *(See figure 406.)* The control box, which consists of two separate units mounted on one bracket, is installed on the right side of the cockpit. The two G-band switches are mounted immediately forward of the SCR-522-A control panel. One switch is used as an "ON-OFF" switch for the G-band operating mechanism. The other switch, push-button type, controls the length of time of G-band operation. The detonator buttons are also mounted on this same panel.

(b) REMOVING SCR-695-A RADIO SET.

1. Remove the pilot's seat and armor plate for access.

2. Remove either the modulator or dynamotor, depending on which command set is installed.

3. Remove the safety wire from the two thumbscrews on the left side of the set. Loosen the thumbscrews until the set is free to be removed from the mounting.

4. Remove the plugs from the set.

5. Should it be necessary to remove the FT-247-A rack which mounts the SCR-695-A set, remove the eight 7S4-10-8 screws.

Note

If SCR-695-A radio set is being removed for the fuselage fuel tank installation, it will be necessary to remove the BC-706 destroyer and BC-767 indicator lamps.

(c) INSTALLING SCR-695-A RADIO SET.—The following installation instructions are applicable to early airplanes:

1. Remove the fuselage fuel tank.

2. Remove the pilot's seat and armor plate for access.

3. Remove either the modulator or dynamotor depending on which command set is installed.

4. Install the FT-247-A rack. Position the set on the rack and tighten the two thumbscrews on the lower right side of the set. Safety each thumbscrew.

5. Connect the PL-177, 181, 182, and 183 plugs to the set.

(4) RADIO SET SCR-515.

(a) DESCRIPTION.—Only early airplanes are equipped with mounting and antenna provisions for SCR-515 radio equipment. The equipment will be installed at tactical station. The receiver and dynamotor provisions are made on the floor of the compartment behind the pilot's seat approximately the same as for the SCR-695-A equipment. *(See figure 404.)* Controls are on the right side of the cockpit.

(b) REMOVING SCR-515 RADIO SET.

1. Remove the fuselage fuel tank.

2. Remove the pilot's seat and armor plate for access.

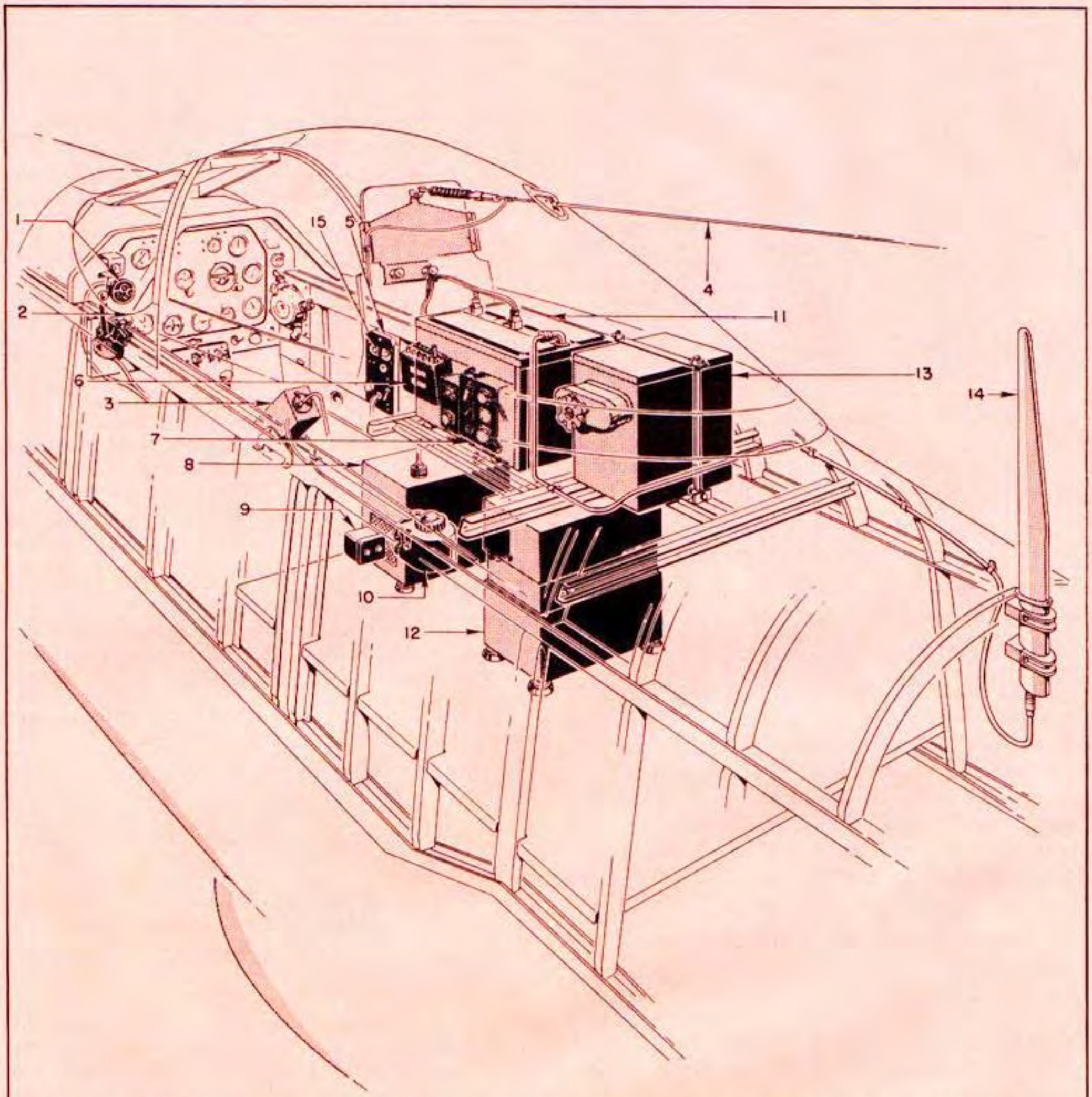
3. Remove either the modulator or dynamotor, depending on which command set is installed.

4. Remove plugs PL-184, 185, 187, 188, 191, and 196 from the set. Remove plug PL-188 from the dyna-coder.

5. Slide the snapslides to one side; then remove the unit.

(c) INSTALLING SCR-515 RADIO SET.

1. Remove the pilot's seat and armor plate for access.



1. REMOTE CONTACTOR
2. THROTTLE SWITCH
3. DETROLA RECEIVER MODEL-438
4. DETROLA & SCR-274-N ANTENNA
5. 106-71154 PANEL ASSEMBLY
6. CONTROL BOX FOR SCR-522-A
7. CONTROL BOX FOR SCR-695-A
8. DYNAMOTOR FOR SCR-522-A
9. INDICATOR LAMPS SCR-695
10. INERTIA SWITCH SCR-695
11. TRANSMITTER RECEIVER SCR-522-A
12. RADIO SET SCR-695-A
13. BATTERY
14. ANTENNA FOR SCR-522-A
15. SCR-695-A DETONATOR BUTTONS

109-71-62A

Figure 406—SCR-695-A and SCR-522-A Radio Installation—Early Airplanes

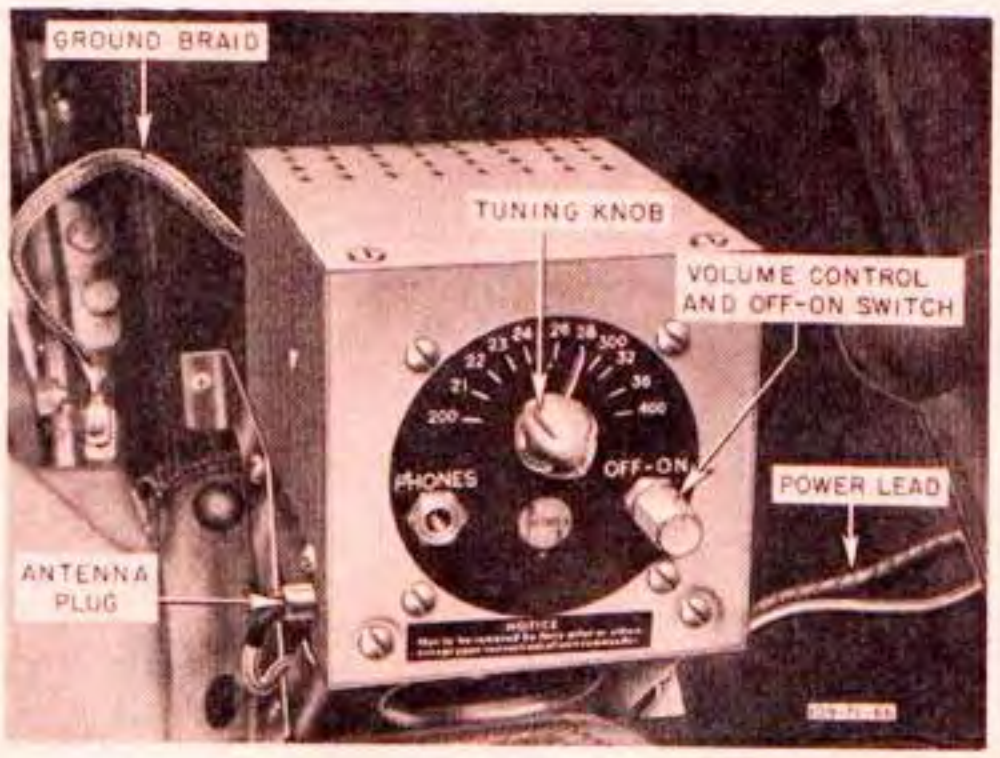


Figure 407—Radio Range Receiver Installed

2. Install the mounting to the shelf; then place the radio set on it and fasten in place with the snapslides.

3. Install the FT-251-A dyna-coder mounting; then fasten the dyna-coder in place with the snapslides.

4. Connect plugs PL-184, 185, 187, 188, 191, and 196 to the radio set. Connect plug PL-188 to the dyna-coder.

(5) AN/APS-13 RADIO SET.

(a) DESCRIPTION.—AN/APS-13 radio set consists of a signal light, warning bell, radio set, and two antenna masts. *(See figure 402.)* The signal light is mounted on the instrument shroud to the left of the centerline. The warning bell is on the left side of the cockpit adjacent to the pilot's seat. The radio set is mounted on the access door just aft of the rear scoop. An antenna array is installed on each side of the vertical stabilizer. Controls are on a panel just forward of SCR-522-A control box.

(b) REMOVING AN/APS-13 RADIO SET

1. Remove the access door aft of the scoop.

2. Reach up through the access holes and disconnect the power receptacle and antenna plug.

3. Unfasten the six dzus fasteners and gently slide the receiver out of the airplane.

(c) INSTALLING AN/APS-13 RADIO SET.

1. Remove the access door aft of the scoop.

2. Position the radio set in the airplane; then fasten the six dzus fasteners.

3. Connect the power receptacle and antenna plug to the receiver.

4. Install the access door.

b. BC-1206 RADIO RANGE RECEIVER.

(1) DESCRIPTION.—Since the SCR-522-A radio command set installed in the airplane is of the ultra-high-frequency type, a BC-1206 radio range receiver is used during ferrying operations for the reception of beacon signals, weather broadcasts, and airport communication. This receiver, installed on the floor of the cockpit, obtains its power for filaments and plates directly from the airplane electrical system, there being no high-voltage supply used. An antenna extending from the top of the vertical stabilizer to an insulator attached to the upper part of the armor plate behind the pilot's seat is used for this equipment. *(See figure 407.)*

(2) REMOVING THE BC-1206 RADIO RANGE RECEIVER.

(a) Place battery-disconnect switch in the "OFF" position, or disconnect the external source of power from the airplane.

(b) On early airplanes, disconnect the "hot" wire No. 680 which routes from the back side of the receiver to the detonator buttons. This wire connects to the same point on the buttons where wire No. 573 connects. On later airplanes, disconnect wire No. 661 where it connects in the 109-71151 or 122-71151 radio plate on right side of the cockpit.

(c) Disconnect the antenna lead-in and headphone cord from the receiver, and stow them so they will not foul the controls. Also disconnect the receiver ground strap where it connects to the airplane.

(d) Remove the four screws fastening the receiver to the airplane and remove it from the airplane.

(3) INSTALLING THE BC-1206 RADIO RANGE RECEIVER.

(a) Fasten the receiver to the cockpit floor with four AC530-10-8 screws.

(b) Connect the receiver ground strap to the metal structure of the airplane just forward of the receiver.

(c) Connect the antenna lead-in wire and the headphone cord to the receiver.

(d) On early airplanes, remove the cover from the radio junction box and connect wire No. 680 from the receiver to the destroyer switch terminal along with wire No. 573. On later airplanes, connect wire No. 661 to the fuse terminal along with wires No. 658 and 617, on the 109-71151 radio plate.

i. ANTENNA SYSTEM. *(See figure 408.)*

(1) DESCRIPTION.—On early airplanes, the antenna system consists of three antennas and provisions only for the two AN-40 antenna masts used with the SCR-515 radio set. On later airplanes, the system consists of four antennas. The AN-104-A mast used with the SCR-522-A radio set is insulated completely from the fuselage. The antenna extending from the vertical stabilizer is used for the SCR-274-N and radio range receiver on early airplanes. On later airplanes, the antenna is used only for the radio range receiver.

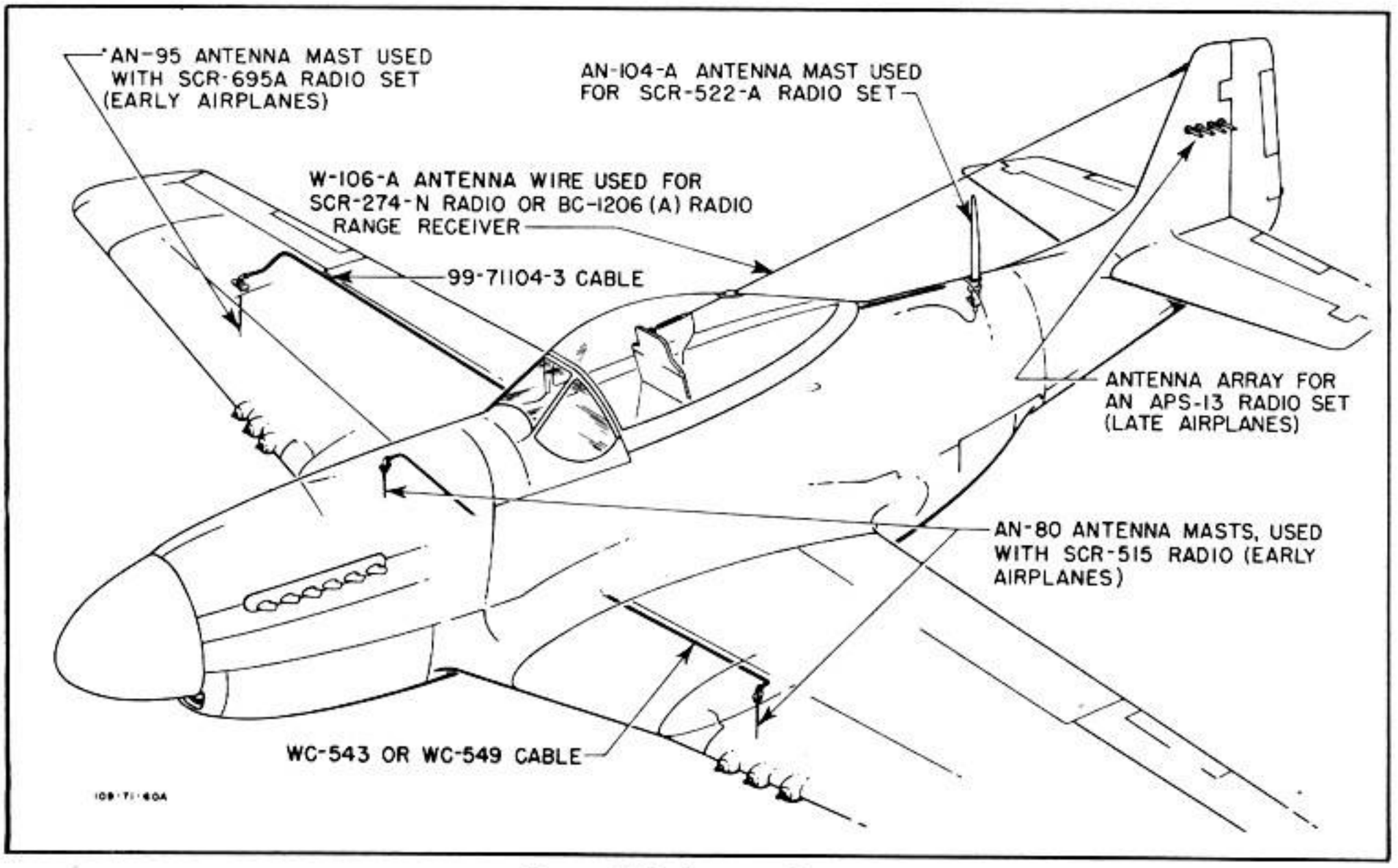


Figure 408—Antenna System

(2) REMOVING THE AN-104-A RADIO MAST.

(a) Remove the antenna cable from the bottom of the mast.

(b) Remove the four attaching bolts on the clamps holding the antenna mast rigid, and remove ground strap.

(c) Remove the mast out through the bottom or underside of the top fuselage. To remove the mast through the top of the airplane, it is necessary to remove the bonding braid screw from the mast.

(d) Remove the remaining half of the antenna mast clamps by removing the four bolts securing the clamps to the bracket.

(3) INSTALLING THE AN-104-A RADIO MAST.

(a) Install the two AN3-14A clamp bolts on the upper radio mast support and bolt the support to the overturn strut with the two AN3-14-A bolts and AN365-1032 nuts.

(b) Install the lower mast support in the same manner, using AN3-11A antenna mast clamp bolts.

(c) From within the airplane, slip the antenna mast through the opening on top of the fuselage.

(d) Install the antenna mast clamps with four AN365-1032 nuts, and install ground strap.

(e) Connect the antenna cable to the bottom of the antenna mast.

(f) Seal the opening in the skin around the base of the mast with NA 2-0305 sealing compound.

j. RADIO CALL LETTERS.—A small black panel with the radio call letters etched in white is mounted in the center of the instrument panel. These numbers correspond to the serial numbers painted on each side of the fuselage just forward of the empennage.

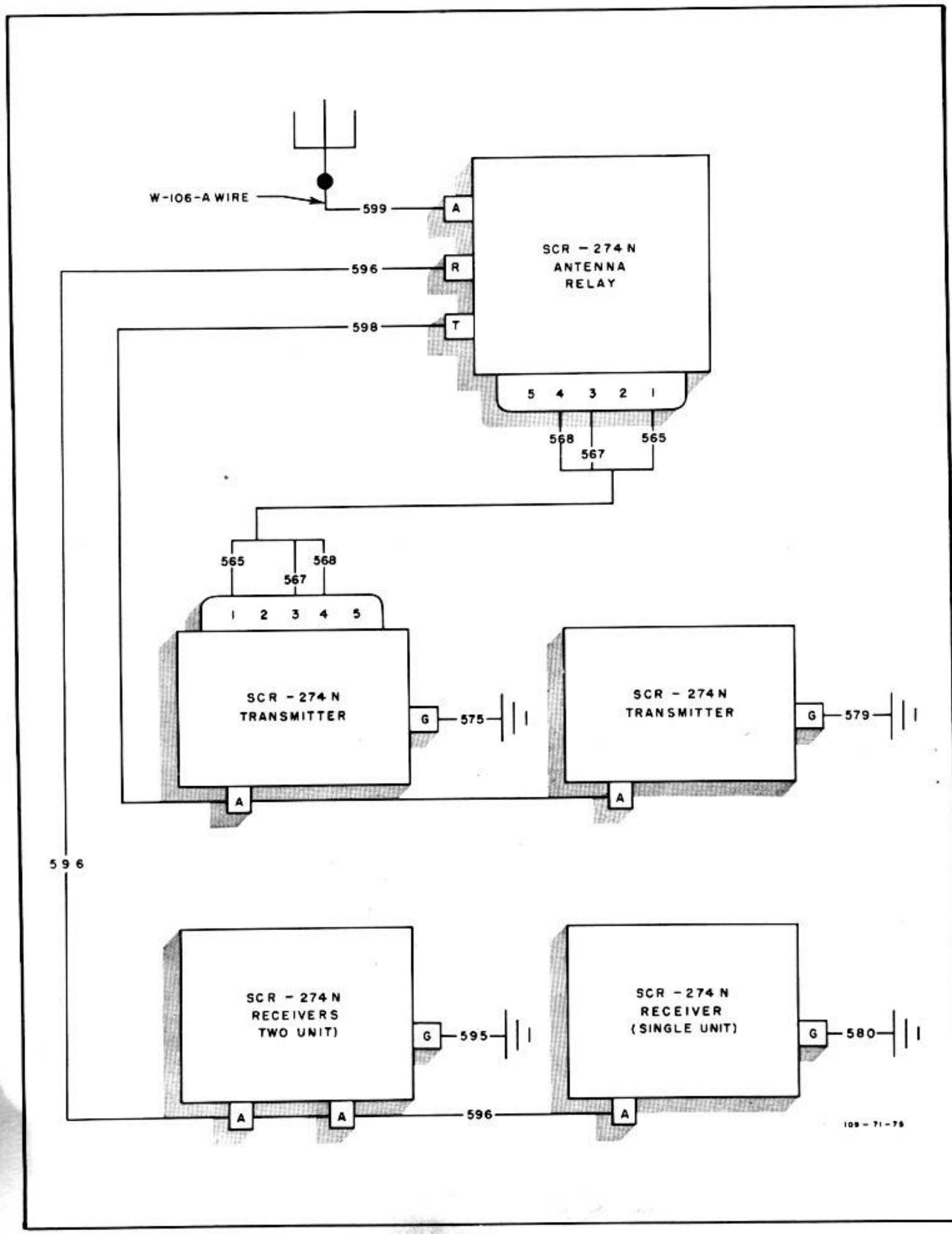


Figure 409—SCR-274-N Antenna Wiring Diagram

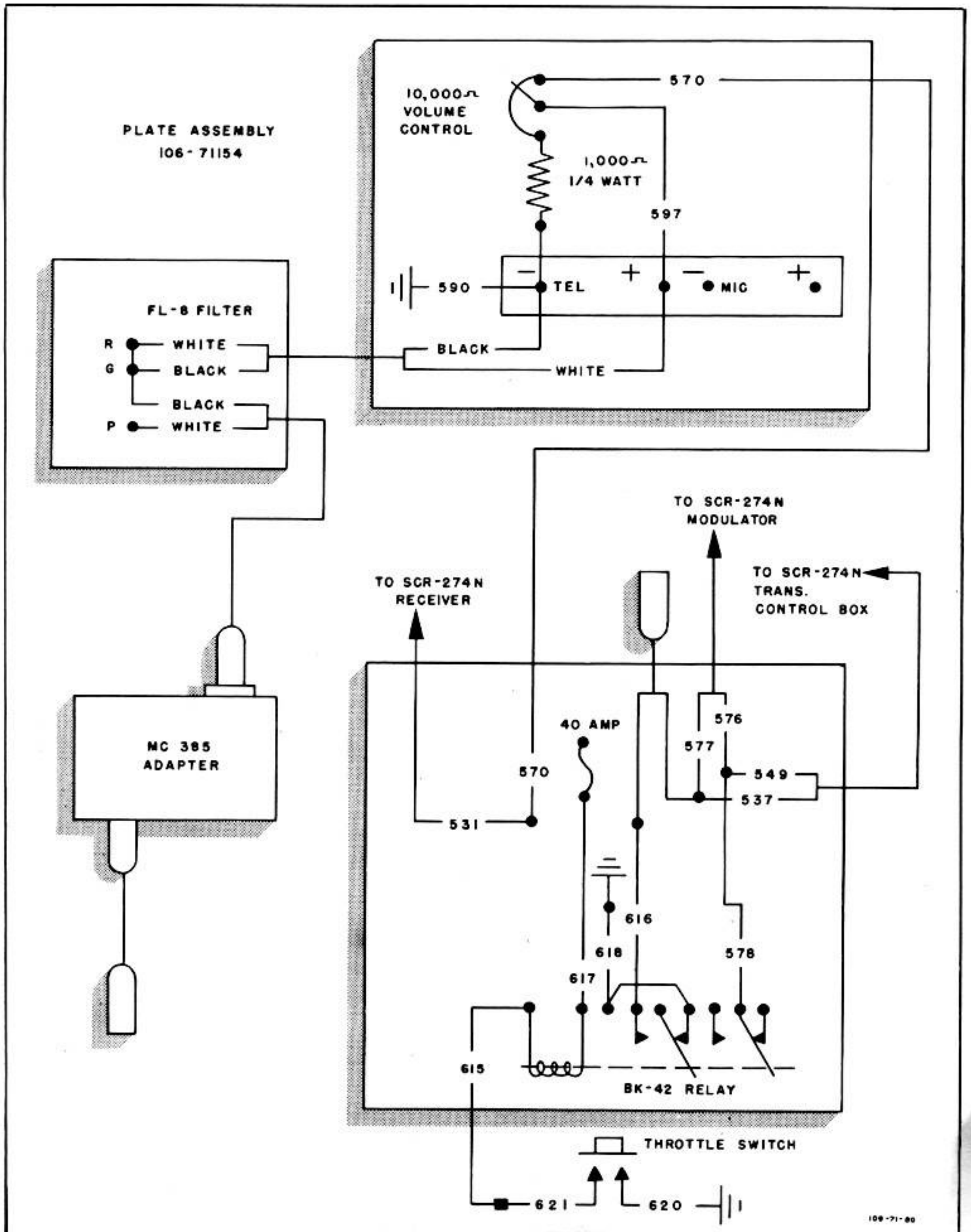


Figure 410—SCR-274-N Microphone and Headset Wiring Diagram

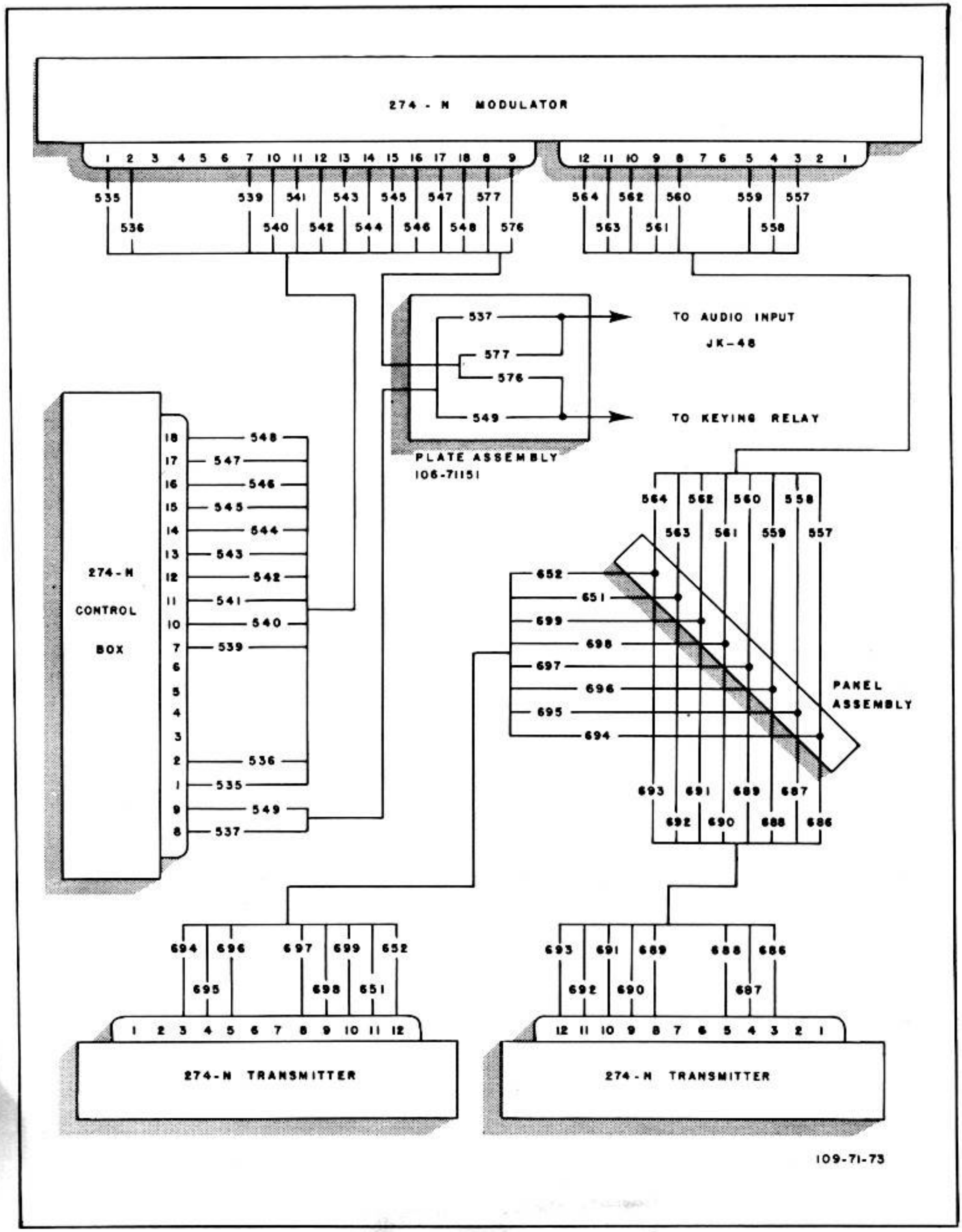


Figure 411—SCR-274-N Transmitter Wiring Diagram

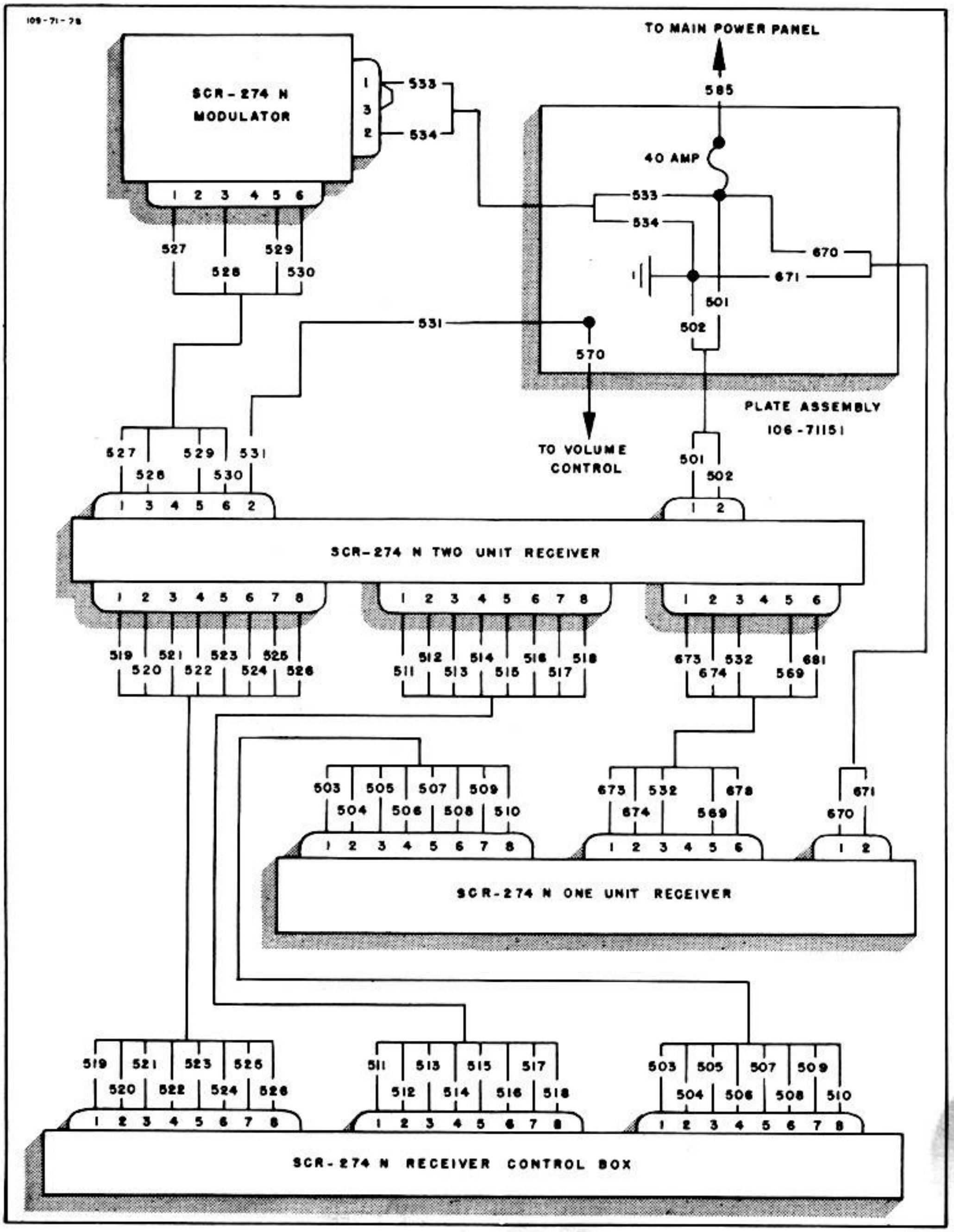


Figure 412—SCR-274-N Receiver Control Box Wiring Diagram

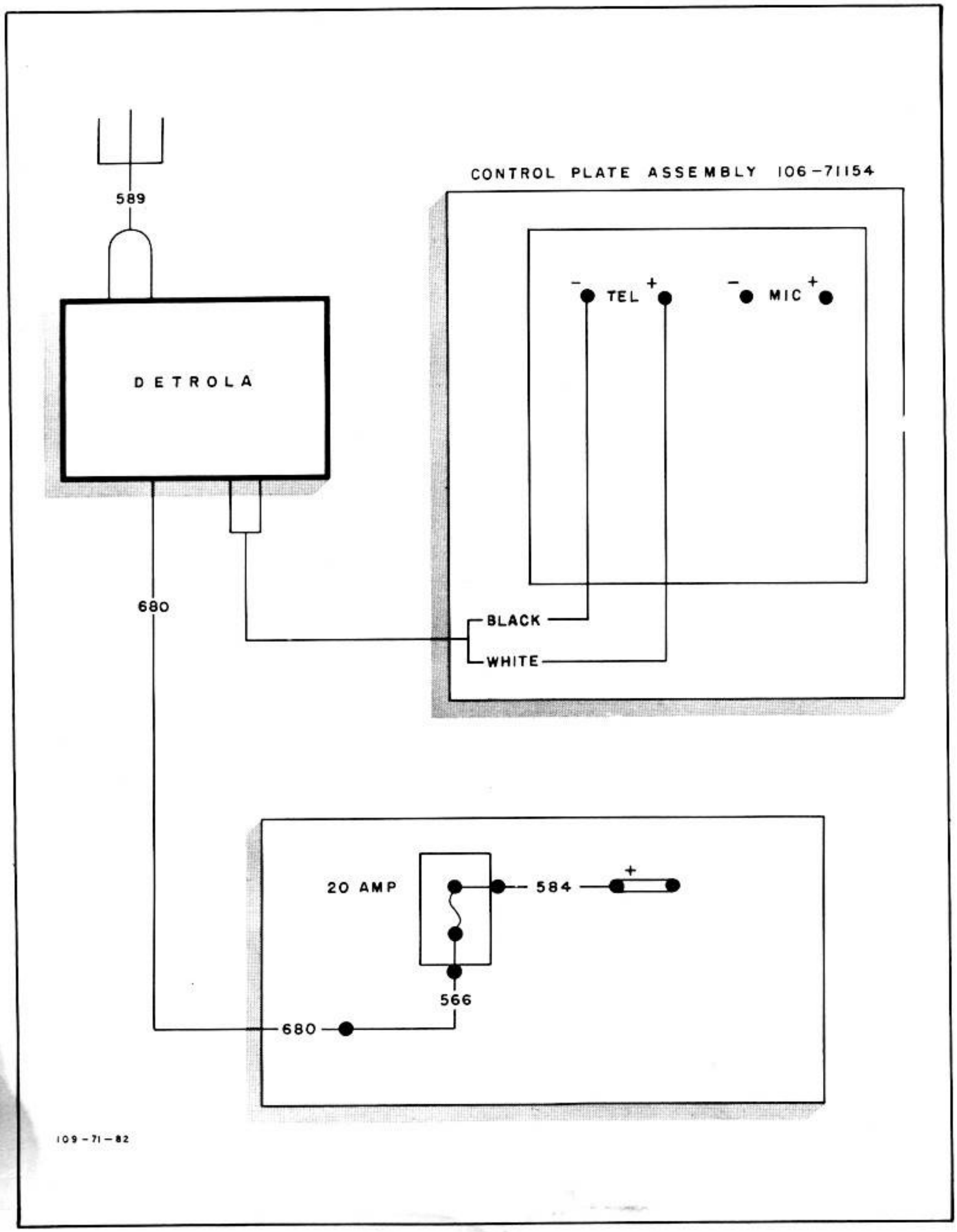


Figure 413—Detrola Radio Range Receiver Wiring Diagram—Early Airplanes

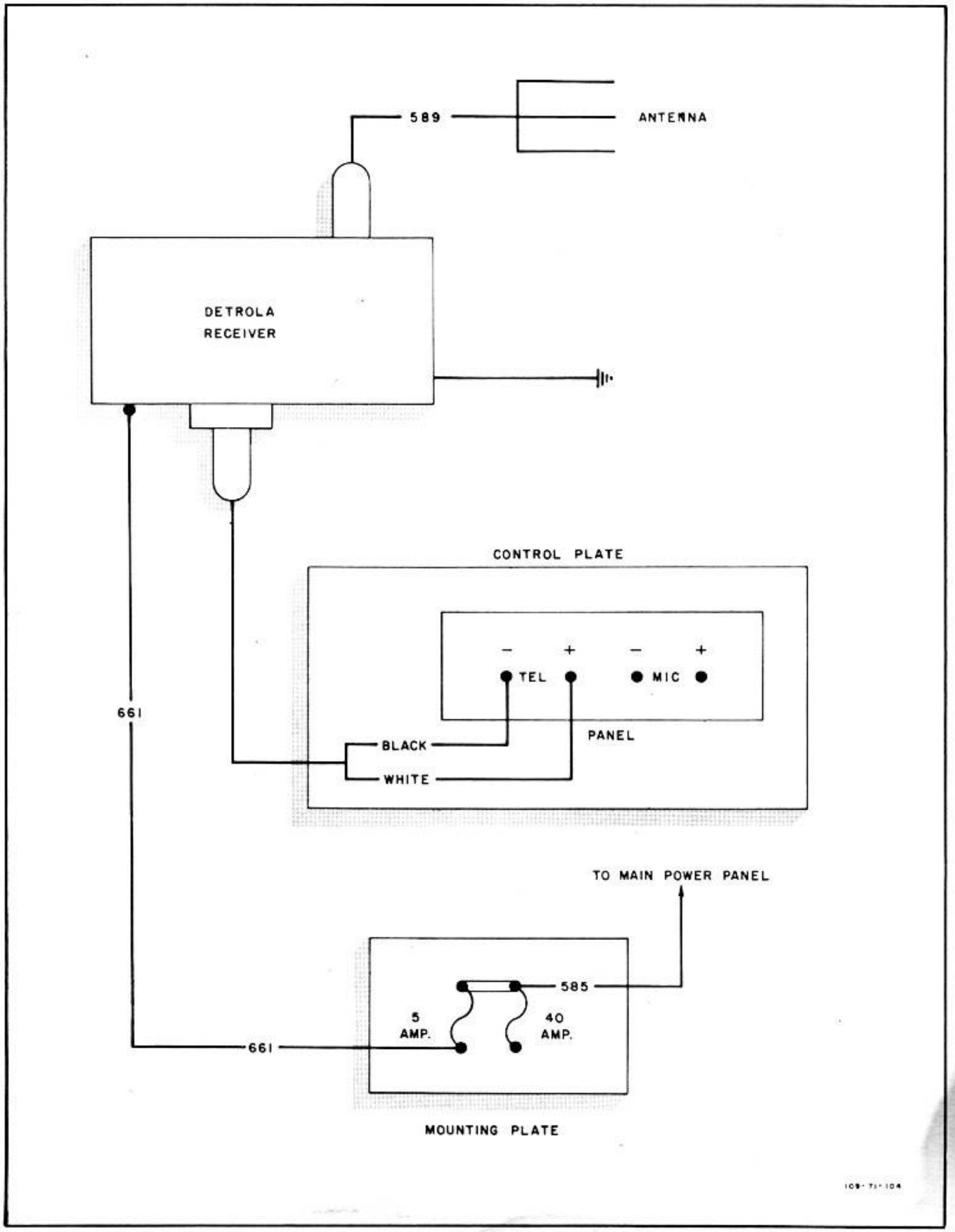


Figure 414—Detrola Radio Range Receiver Wiring Diagram—Later Airplanes

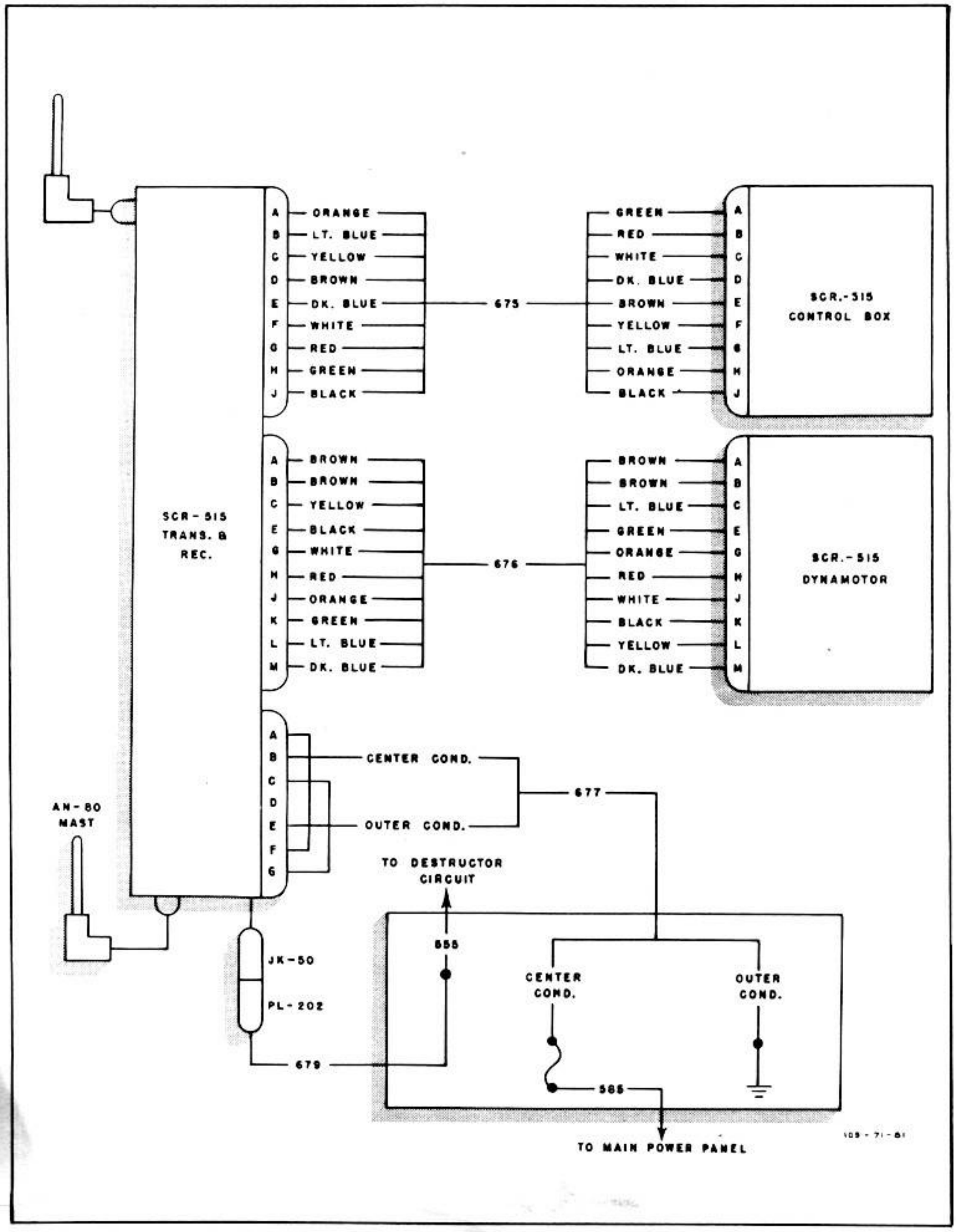


Figure 415—SCR-515 Transmitter and Receiver Wiring Diagram

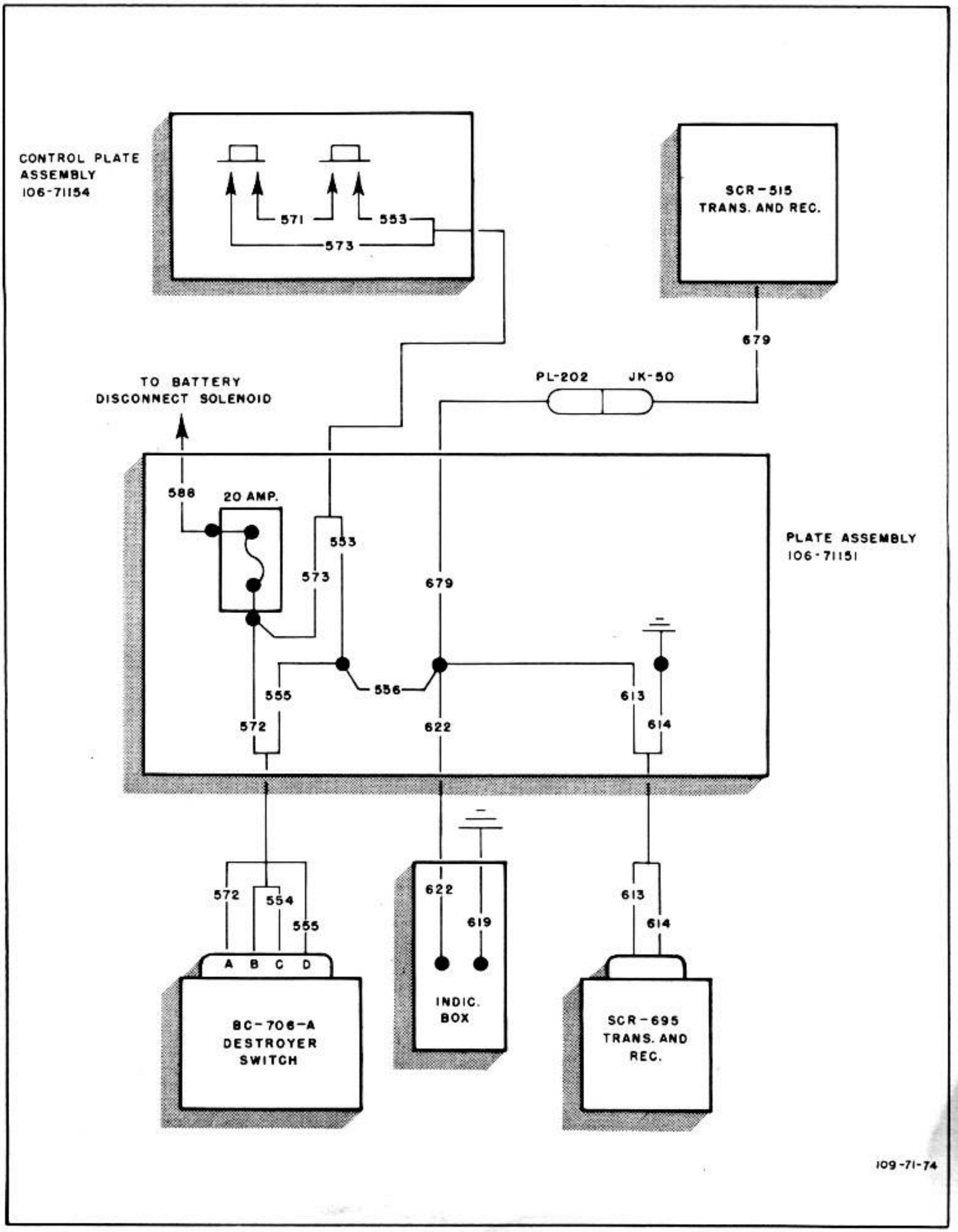


Figure 416—SCR-695-A and SCR-515 Destroyer Wiring Diagram

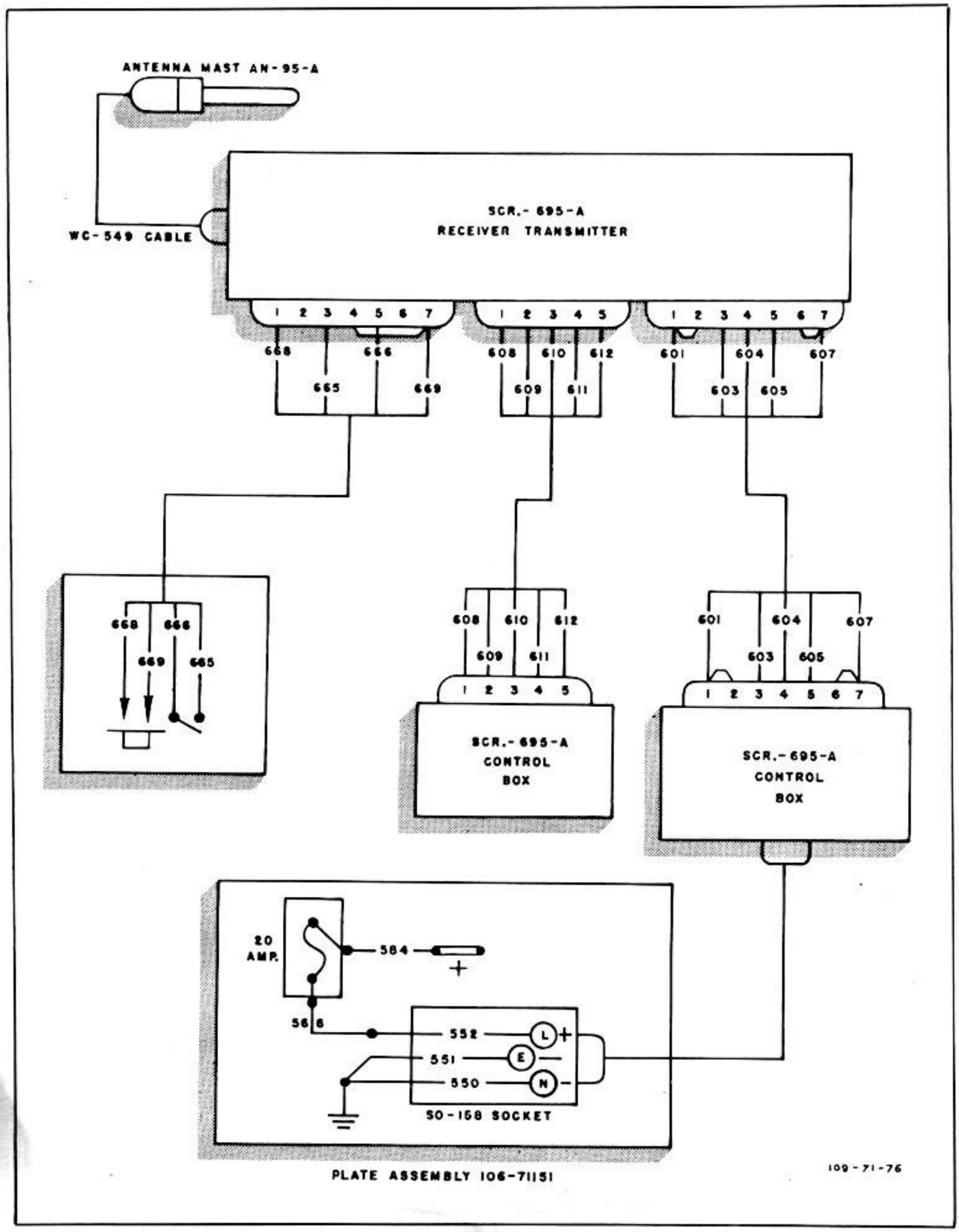


Figure 417—SCR-695-A Receiver and Transmitter Wiring Diagram

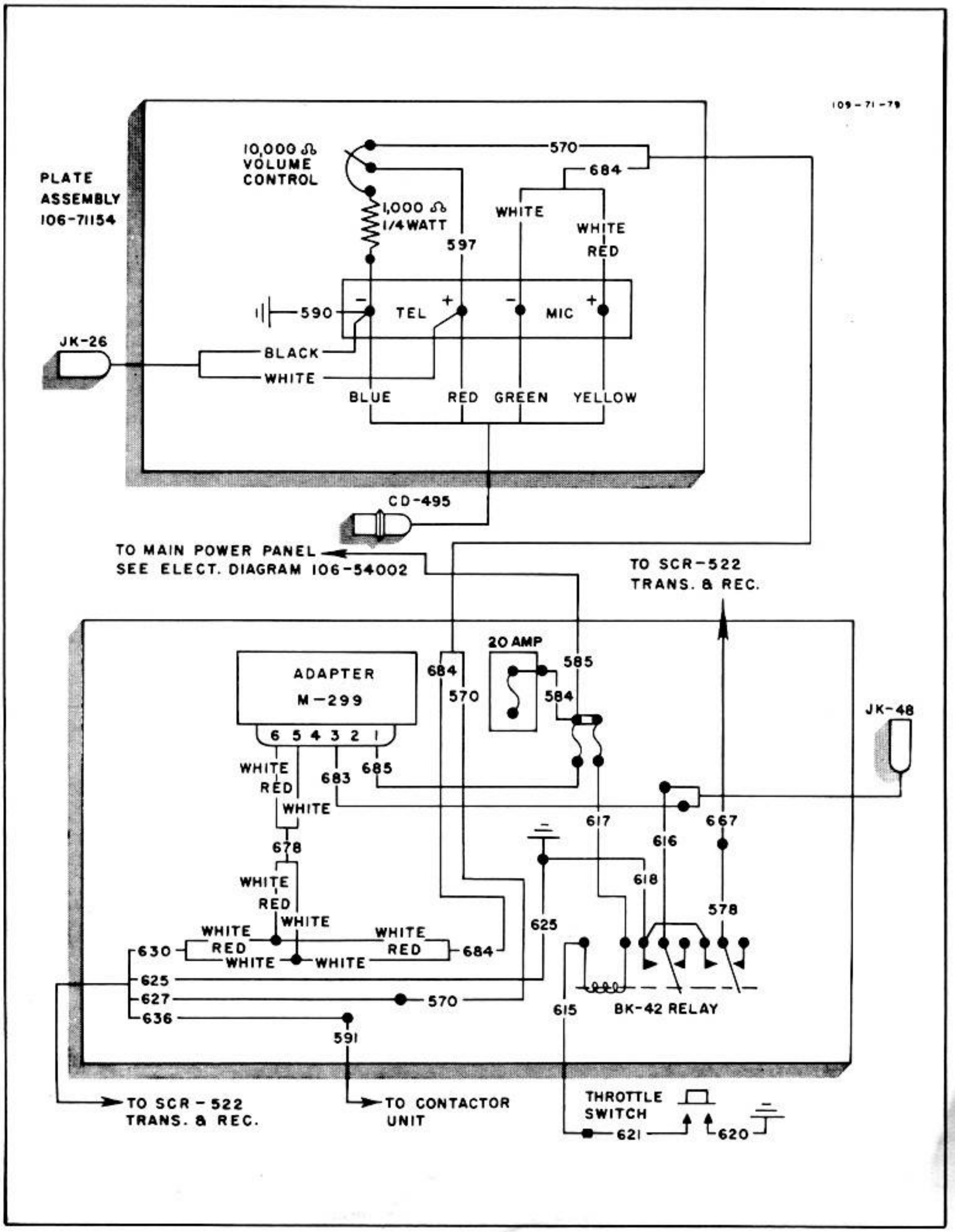


Figure 418—SCR-522-A Microphone and Headset Wiring Diagram—Early Airplanes

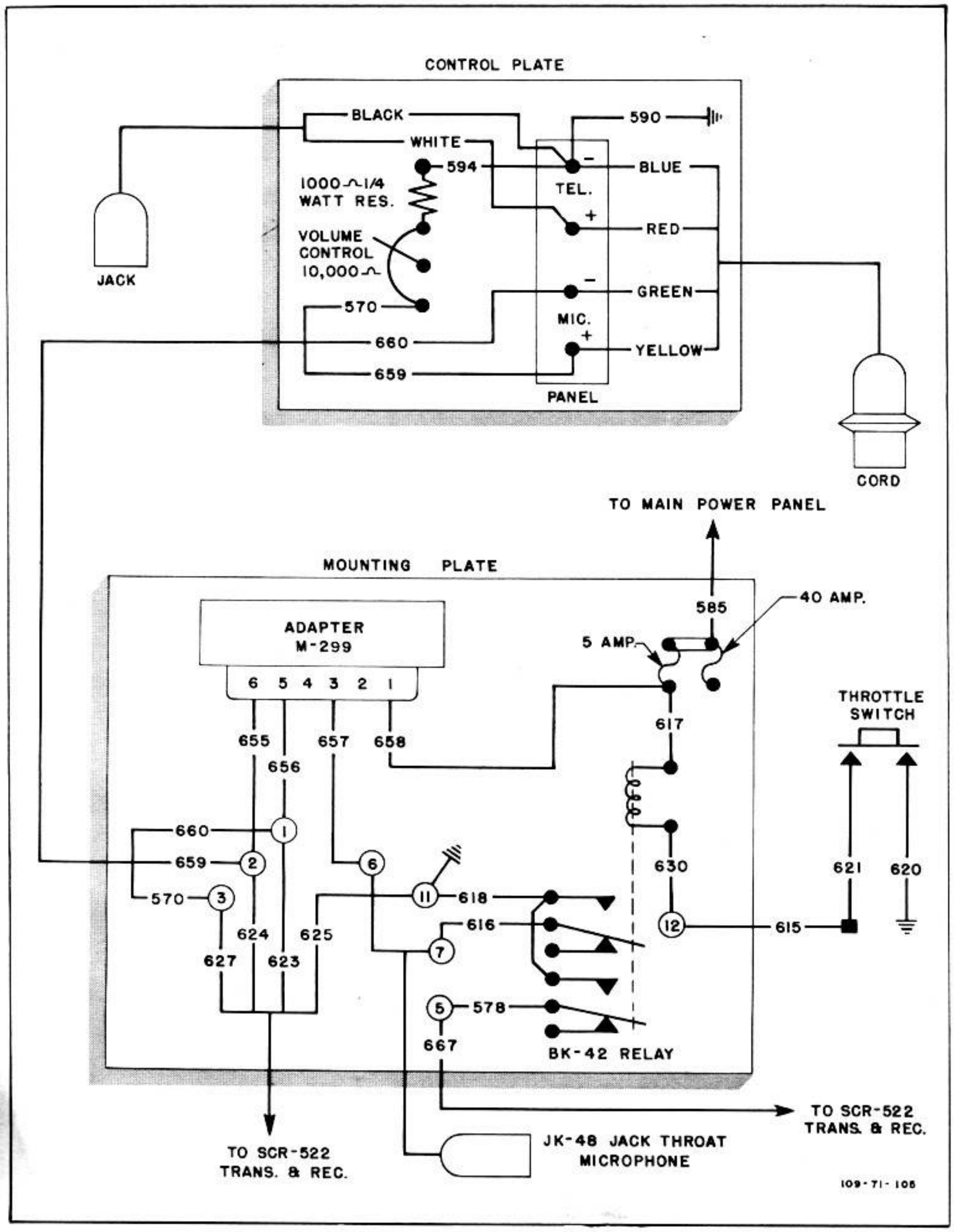


Figure 419—SCR-522-A Microphone and Headset Wiring Diagram—Later Airplanes

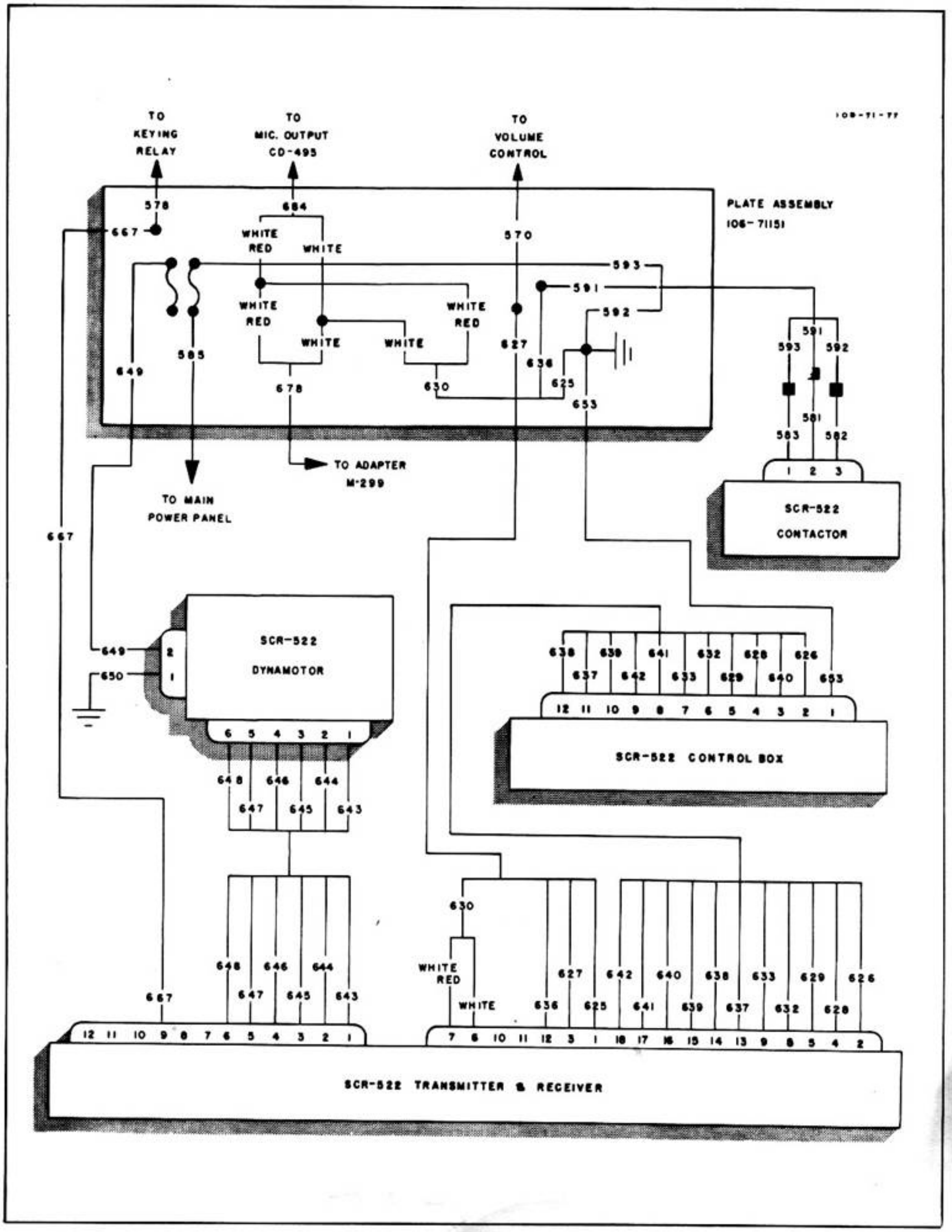


Figure 420—SCR-522-A Transmitter and Receiver Wiring Diagram—Early Airplanes

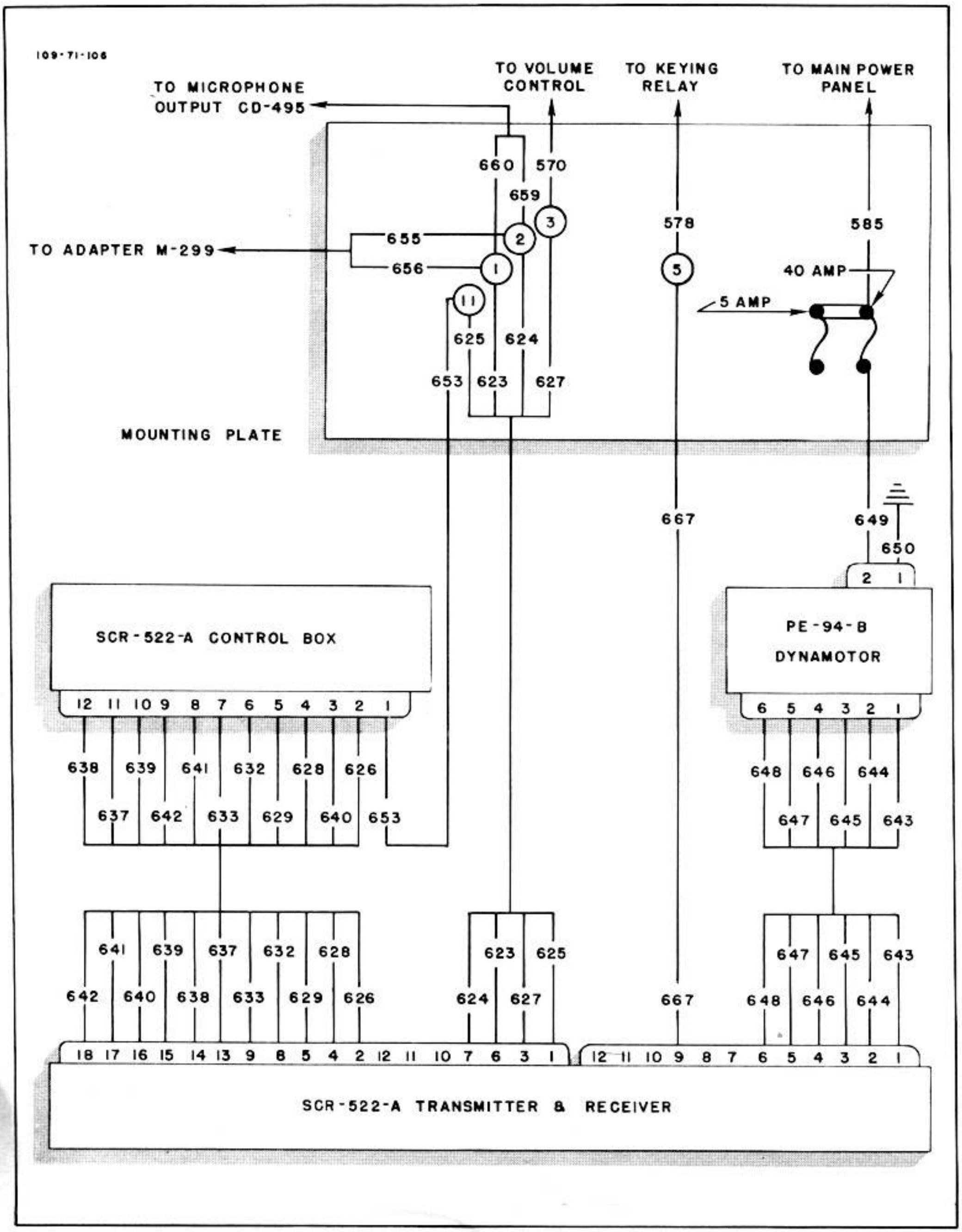


Figure 421—SCR-522-A Transmitter and Receiver Wiring Diagram—Later Airplanes

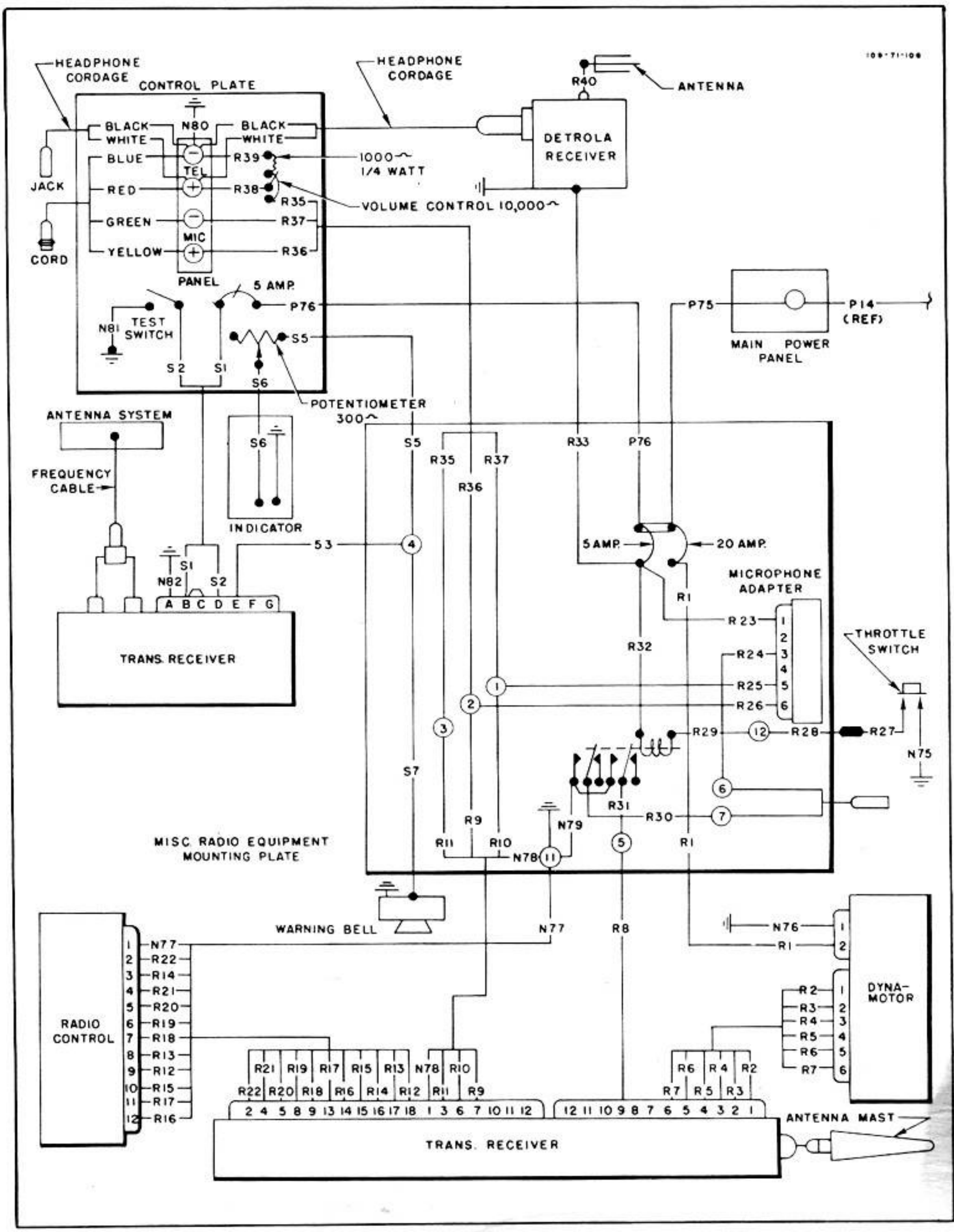


Figure 422—SCR-522-A and AN/APS-13 Wiring Diagram—Later Airplanes

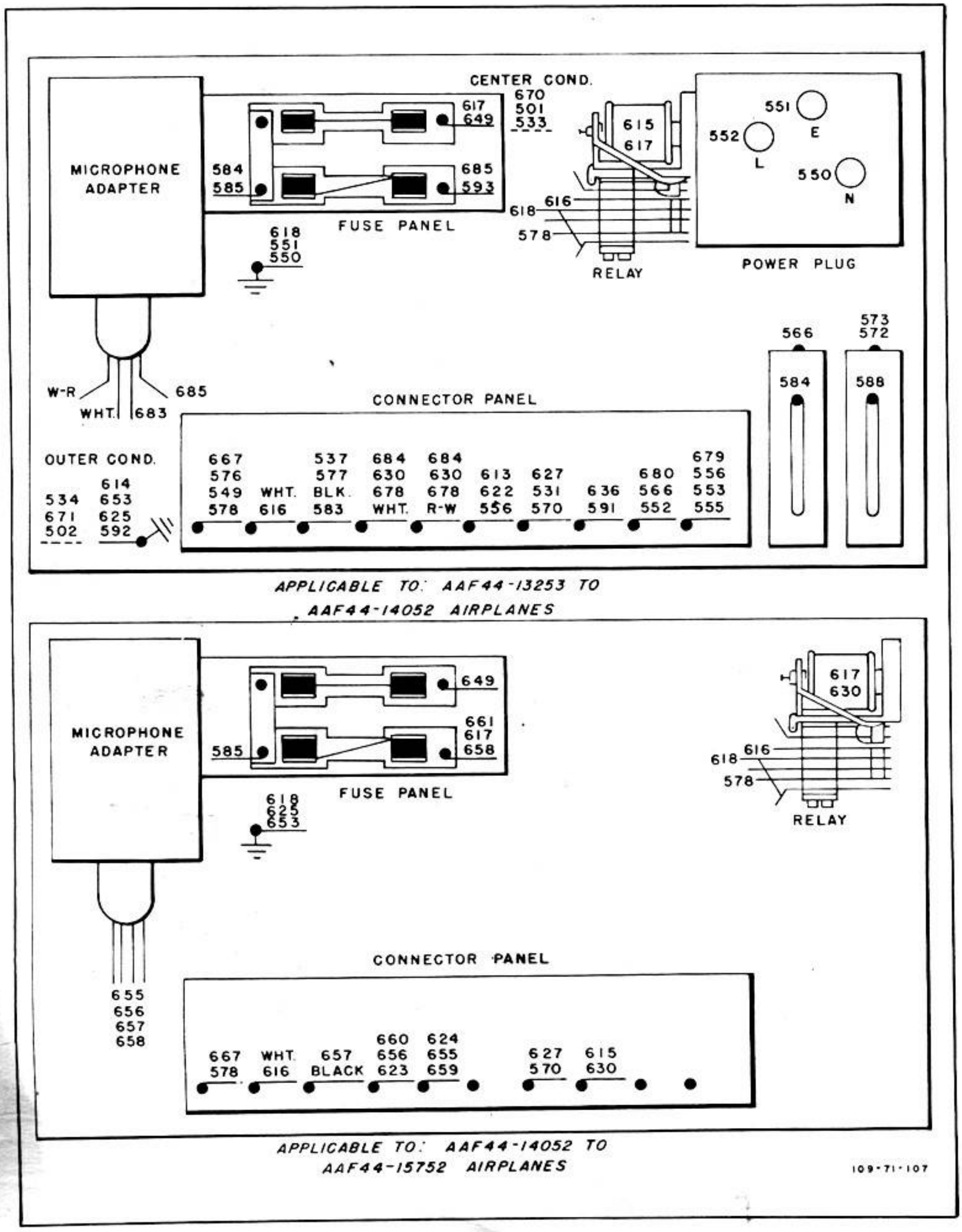


Figure 423—Radio Junction Panel Wiring Diagram

22. BOMBING EQUIPMENT.

a. GENERAL.—An external, removable, low-drag type bomb rack *(figure 429)* is installed on the lower outer panel of each wing. In normal operation, the bombs are electrically released. Emergency release of bombs is accomplished mechanically. When bombs are not carried, an AN-M10 chemical tank or a 75-gallon capacity combat fuel tank may be installed on each bomb rack and dropped by either normal or emergency operation of the bomb control system. For detailed information on the fuel tank installations, see paragraph 15. *d.* of this section.

Note

No lubrication or special periodic maintenance of bombing equipment is required.

b. TROUBLE SHOOTING.

TROUBLE	REMEDY	PROBABLE CAUSE
Rack mechanism does not release electrically.	Bomb safety switch not turned on.	Turn switch on.
	Connector plug not tight.	Tighten plug.
	No voltage at rack.	Repair defective wiring.
	Low voltage at rack causing faulty operation of solenoid.	Repair defective wiring.
	Prongs broken in wing connector plug.	Replace connector plug.
	Damaged release linkage within the rack.	Replace damaged linkage.
	Faulty solenoid assembly.	Replace solenoid.
	Burrs in bearings or camming surfaces of rack.	Remove burrs and smooth out defective surfaces.
	Plating galls between moving surfaces.	Smooth out defective surfaces.
Rack does not release mechanically.	Debris, rust, corrosion in rack.	Clean all of the rack, but the solenoids, with kerosene. Dry with dry high-pressure air. Polish camming surfaces.
	Salvo arm does not reach a full release position.	Rerig controls.
	Burrs in bearings or camming surfaces of rack.	Remove burrs and smooth out defective surfaces.
	Rack release linkage defective.	Replace defective parts.
	Plating galls between moving surfaces.	Smooth out defective surfaces.
Rack mechanism does not lock.	Burred solenoid rocker stop arm.	Remove burrs.
	Rocker return spring weak or broken.	Replace defective spring.
	Trip arm return spring weak or broken (trip arm-catch type rack only).	Replace defective spring.
	Burred trip arm or rocker bushings.	Recondition or replace bushings.
Arming latch does not hold a 3-pound load or holds more than a 4-pound load.	Defective torsion spring.	Replace spring.
Arming latch does not lock.	Connector plug not tight.	Tighten plug.
	No voltage at rack.	Repair defective wiring.
	Low voltage at rack causing faulty operation of solenoids.	Repair defective wiring.
	Broken wiring in rack.	Repair defective wiring.
	Arming solenoid inoperative.	Replace arming solenoid.

TROUBLE	PROBABLE CAUSE	REMEDY
Only one rack releases in train.	Defective wiring.	Repair wiring.
	Transfer switch not properly adjusted.	Adjust transfer switch.
	Defective transfer switch.	Replace switch.

c. ELECTRICAL BOMB RELEASE SYSTEM.—The electrical system is used for the selection of nose and tail arming of bombs and for the normal release of bombs, or for ignition and release of chemical tanks when they are installed. *(See figure 424.)* When the bomb release switch is pressed with the racks cocked and the safe-selector switch on "TRAIN" ("SEL" on early airplanes), the left bomb rack release solenoid is energized and trips the rack lock mechanism through interconnecting linkage. When the bomb release switch is released, the solenoid is de-energized, permitting the transfer switch to close. When the bomb release switch is pressed again, current is routed through the transfer switch to the right bomb rack release solenoid. Cocking the left rack resets the transfer switch. When the bomb release switch is pressed with the safe-selector switch on "BOTH," the racks release simultaneously. Refer to paragraph 20 of this section for detailed wiring diagrams.

d. MECHANICAL BOMB RELEASE SYSTEM.
(See figure 425.)

(1) DESCRIPTION.—The mechanical release system consists of two bomb salvo handles, on the left side of the cockpit just aft of the instrument panel, a salvo arm actuator assembly in each wing, and cable assemblies interconnecting the two. The salvo handles *(figure 426)* provide a selective mechanical release of bombs or combat tanks.

(2) REMOVING AND INSTALLING MECHANICAL BOMB RELEASE SYSTEM. *(See figure 425.)*

(3) REMOVING AND INSTALLING BOMB SALVO HANDLE ASSEMBLY.
(See figure 427.)

(4) ADJUSTING MECHANICAL BOMB RELEASE SYSTEM. *(See figure 425.)*

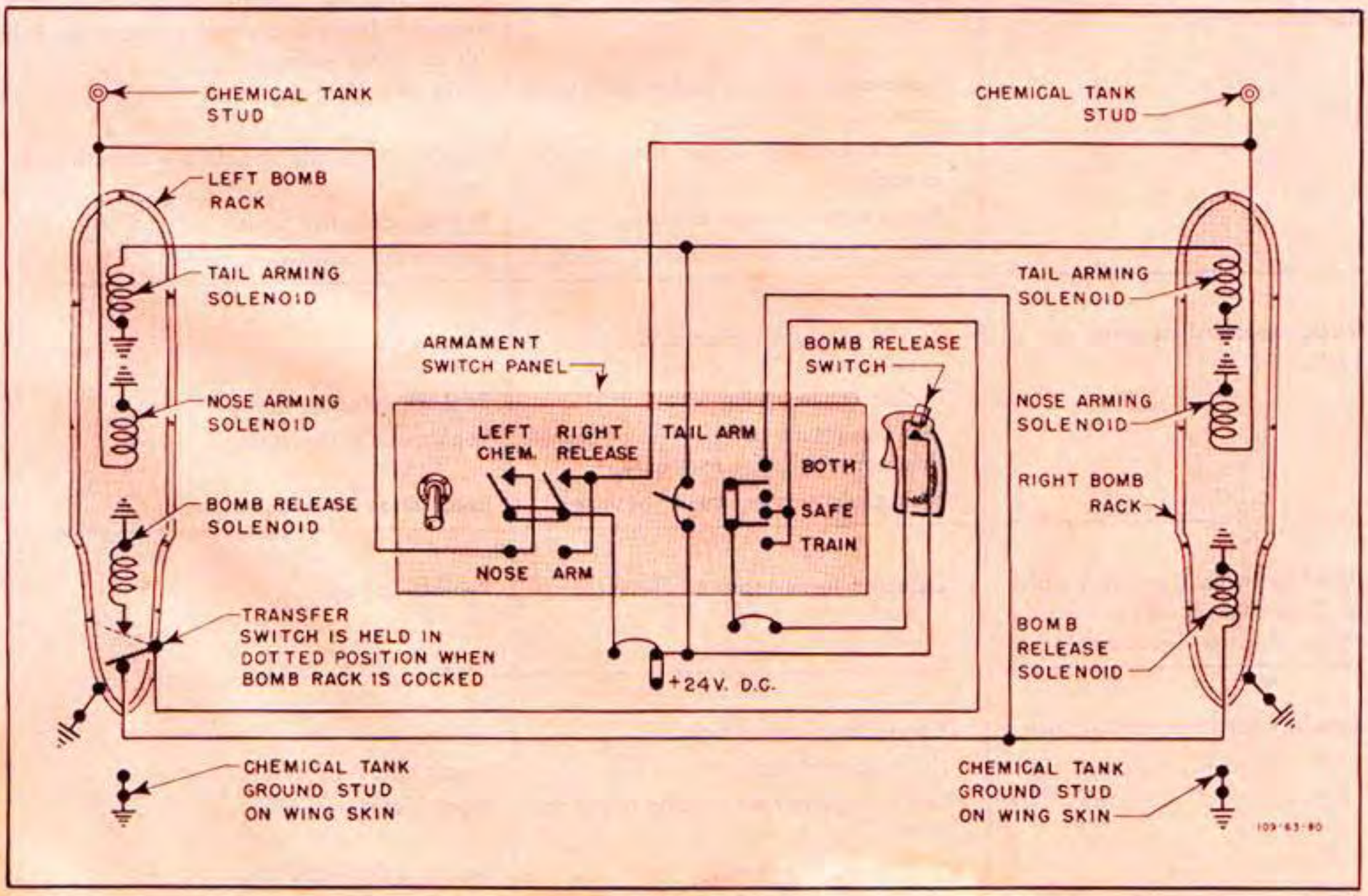


Figure 424—Electrical Bomb Release System—Early Airplanes

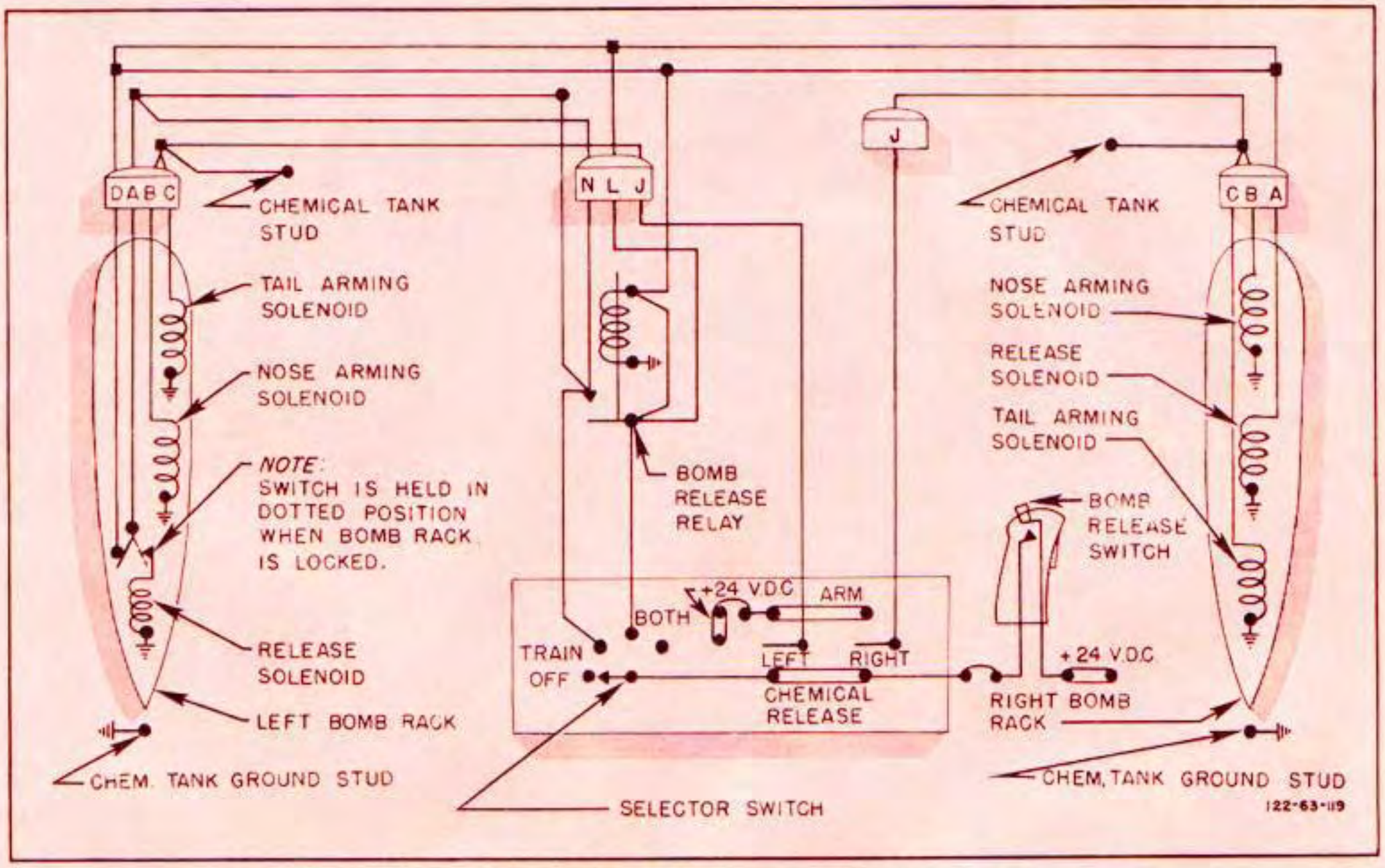


Figure 424A—Electrical Bomb Release System—Late Airplanes

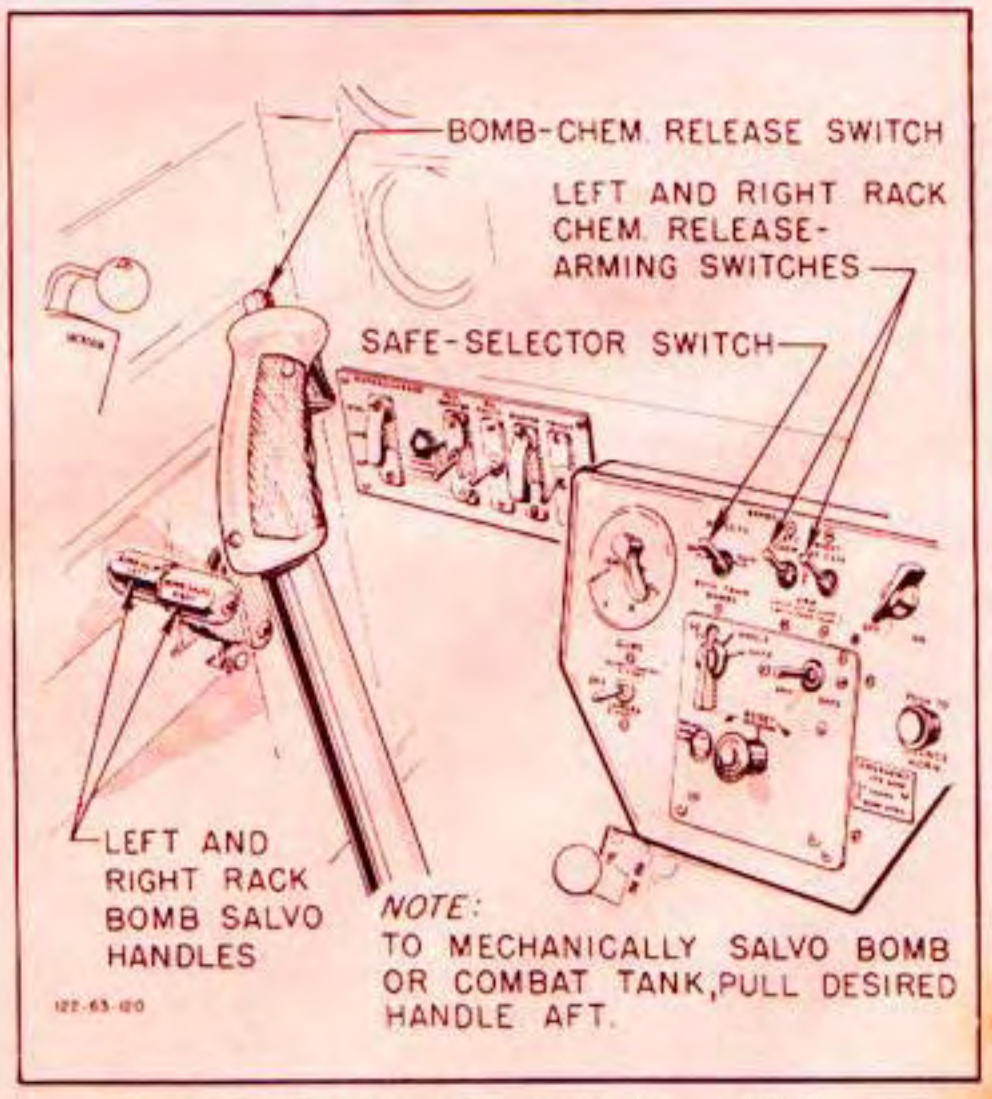
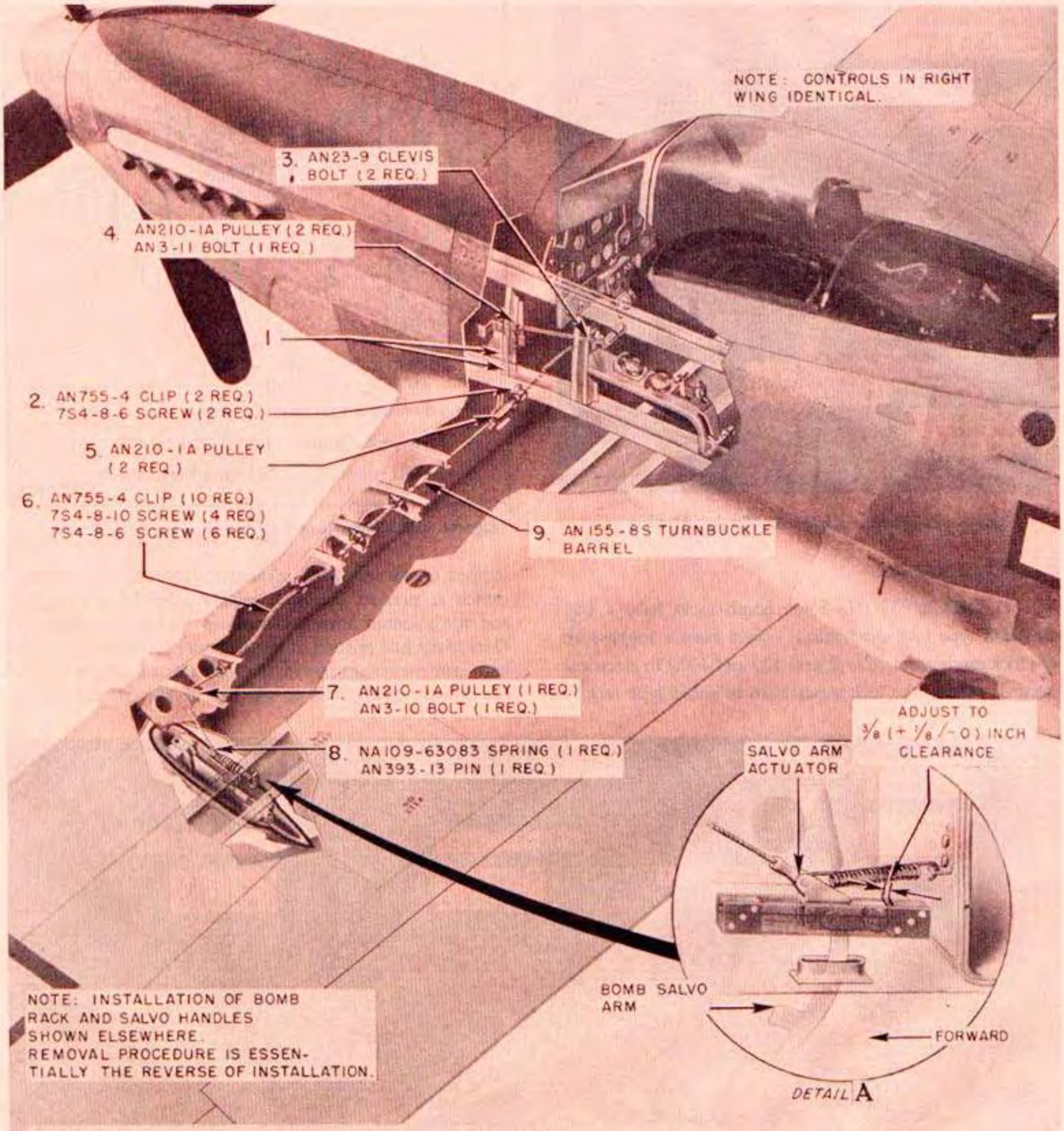


Figure 424B—Bomb Controls—Late Airplanes



1,2. STRING CABLES; SECURE RIGHT-HAND CABLE HOUSING.
3. CONNECT CABLES TO SALVO HANDLES
4,5. INSTALL PULLEYS.
6. STRING CABLE AND SECURE.
7. INSTALL PULLEY.
8. INSTALL SPRING AND CONNECT CABLE.
9. CONNECT CABLE ASSEMBLIES.
10. ADJUST CABLE LENGTH UNTIL SALVO ARM ACTUATOR IS POSITIONED PROPERLY; SAFETY TURNBUCKLE. SEE DETAIL "A".

NOTE: INSTALL CABLE HOUSINGS FREE OF KINKS OR EXCESSIVE BENDS, AND WITH A SLIGHT TENSION.

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Figure 425—Installing Mechanical Bomb Release System

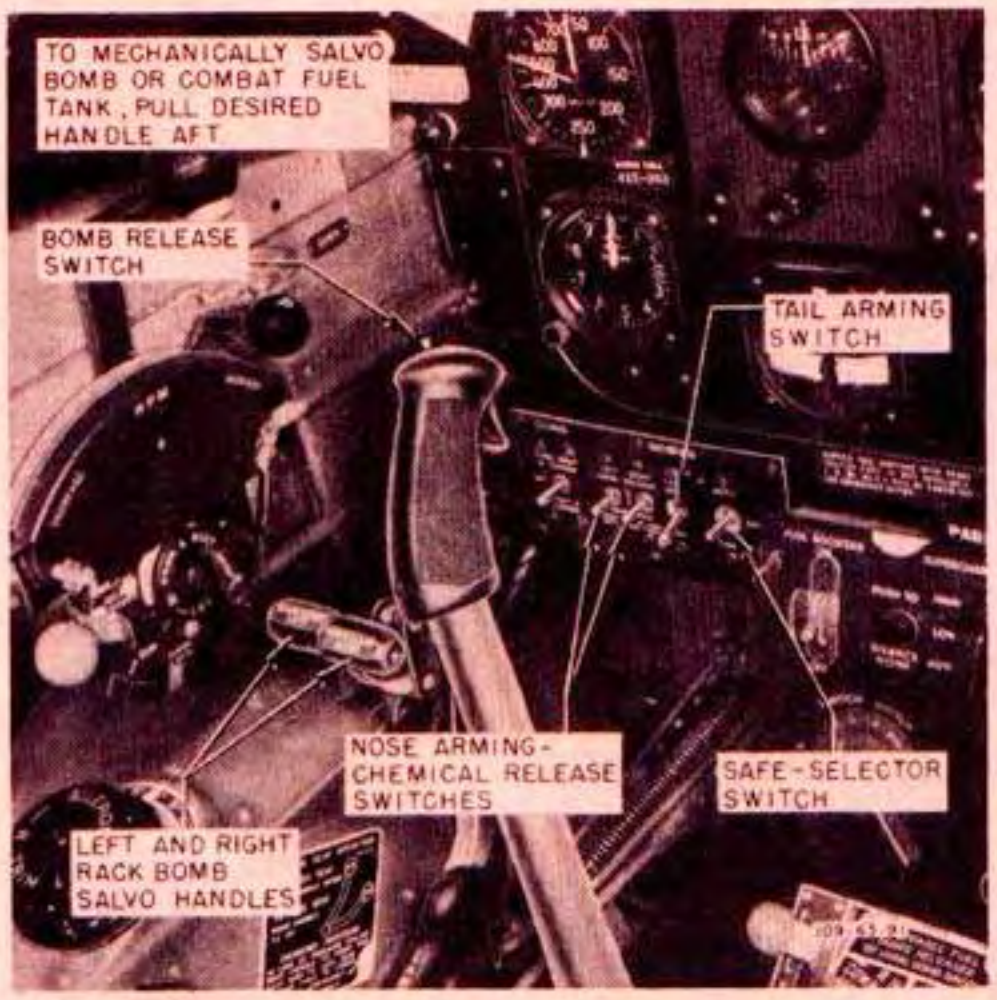


Figure 426—Bomb Controls—Early Airplanes

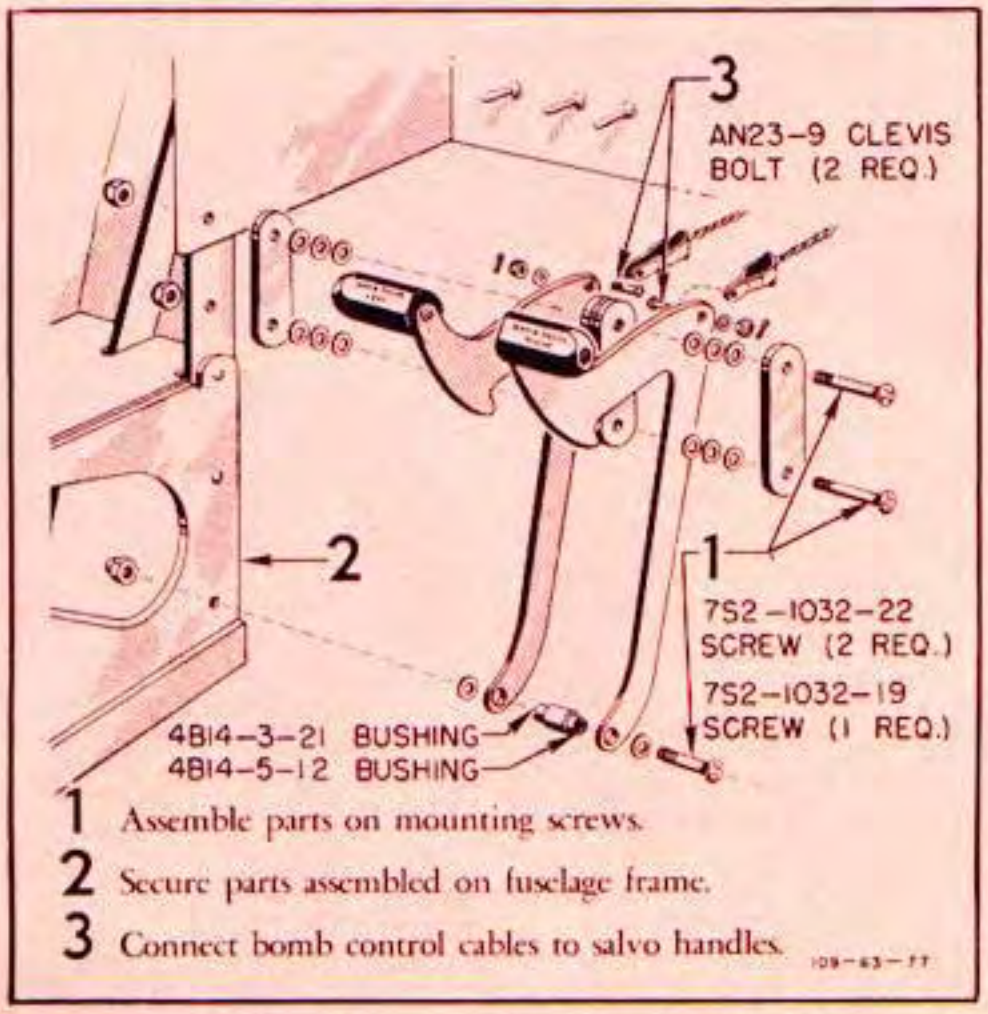


Figure 427—Installing Bomb Salvo Handle Assembly

e. BOMB RACKS.

(1) DESCRIPTION.—Some bomb racks have a trip arm-catch type lock mechanism; others have a toggle-link type lock mechanism. *(See figures 429 and 430.)* In electrical (normal) release, the lock mechanism in either type rack is tripped in the following manner: When the bomb release switch is pressed, the rack release solenoid is energized and the solenoid armature turns in a clockwise direction. During the first portion of the armature travel, the armature lock arm rotates up out of the lock seat of the rocker and the armature pin picks up the link in the overriding slot.

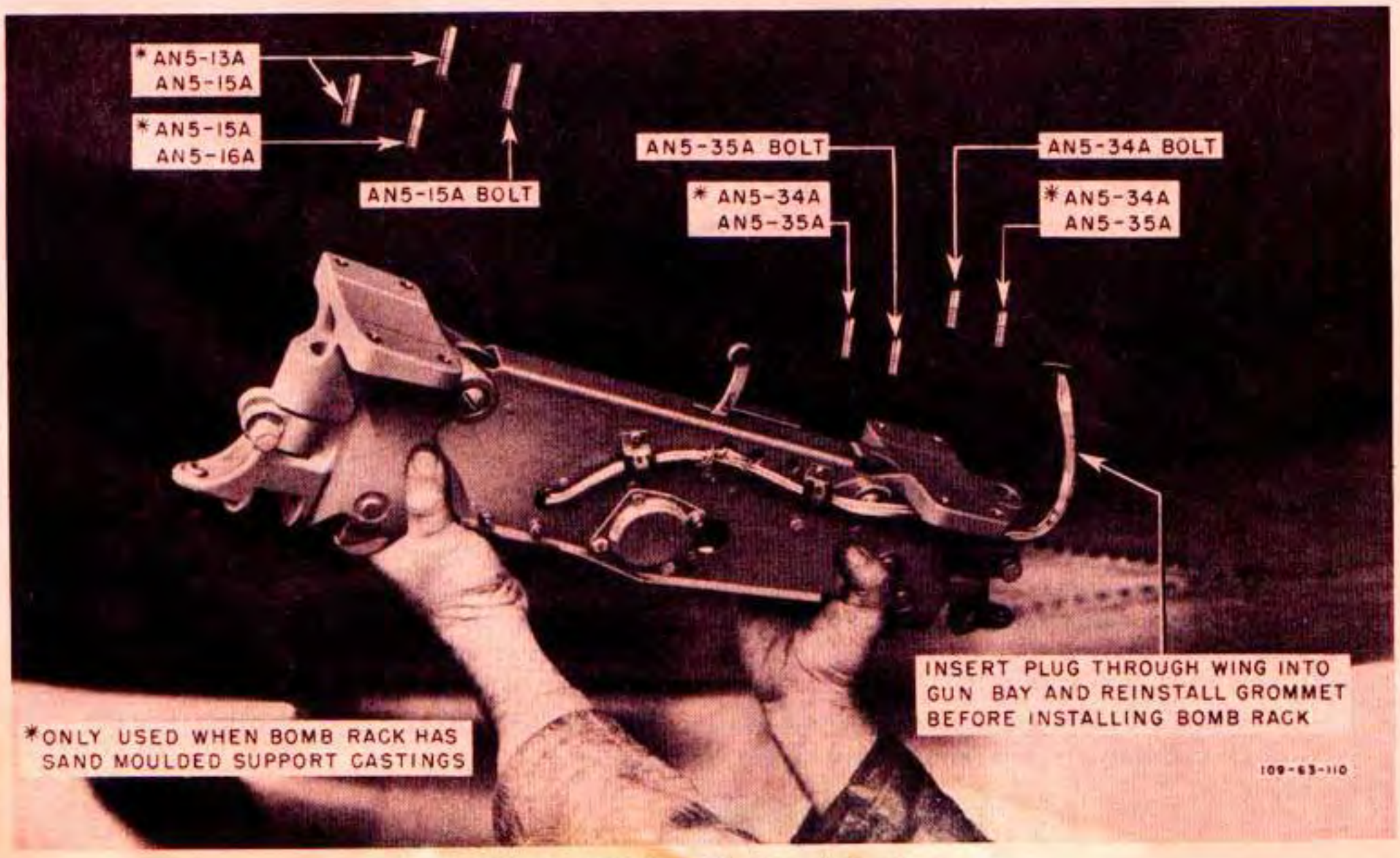


Figure 428—Installing Bomb Rack

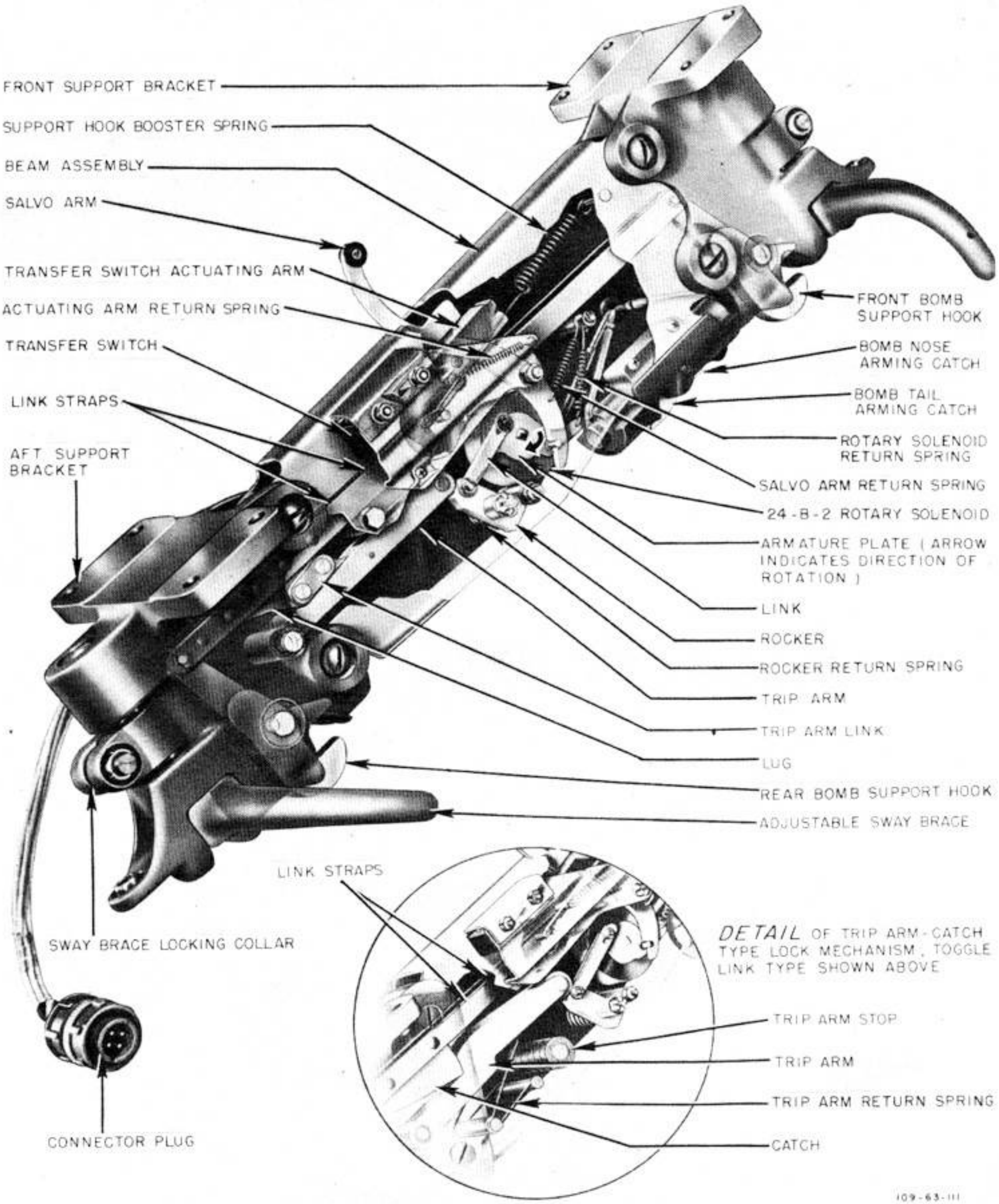


Figure 429—Bomb Rack

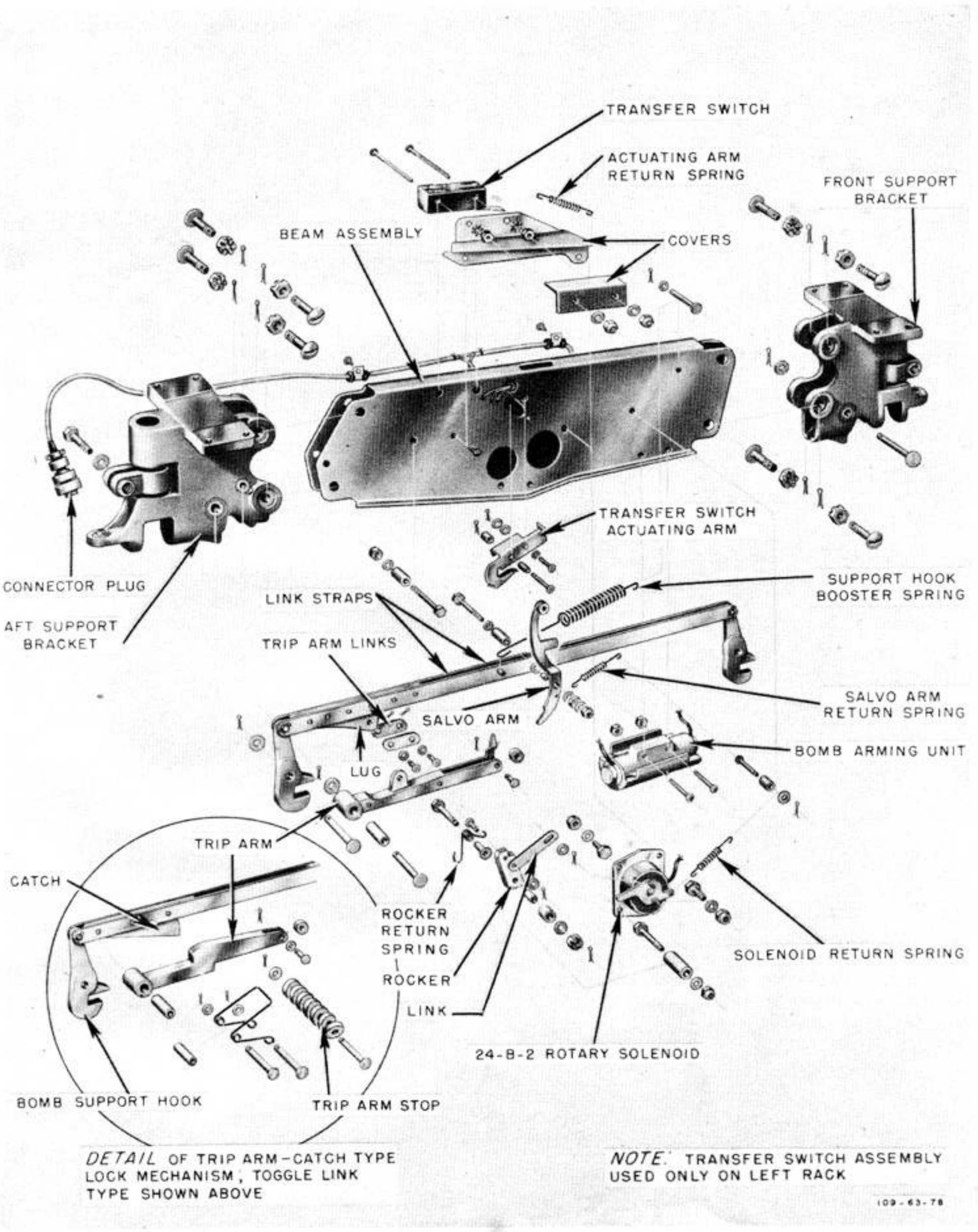


Figure 430—Bomb Rack Mechanism—Exploded

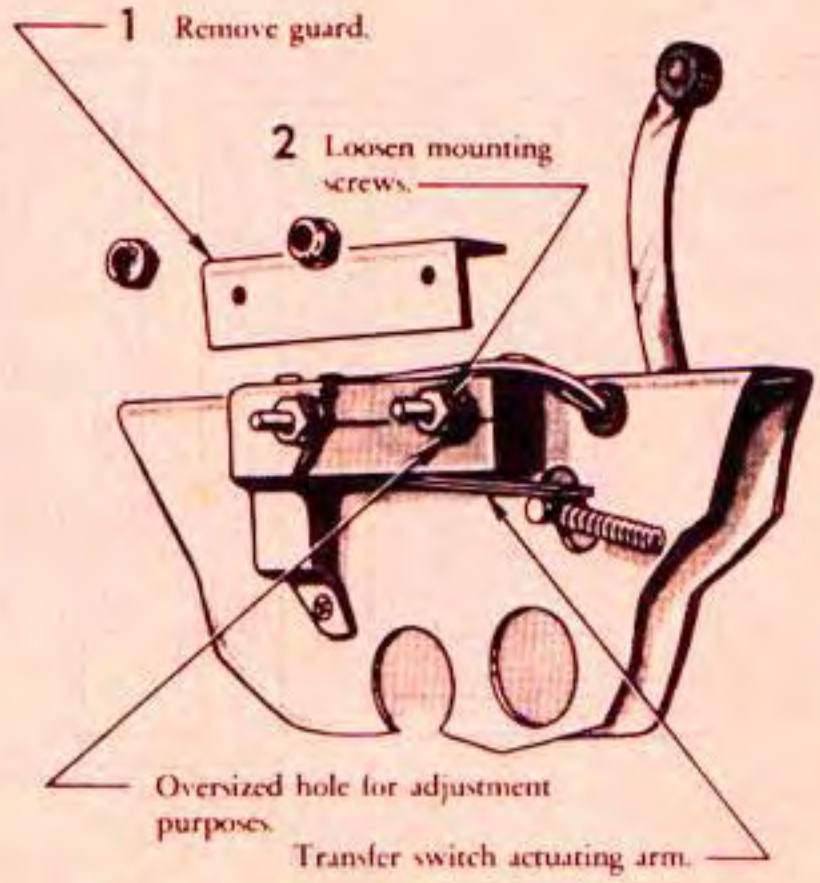


Figure 431—Adjusting Bomb Rack Transfer Switch

Further travel draws the rocker to the right, freeing the trip arm so that the tension of the bomb support hook booster spring and the weight of the bomb can rotate the hooks open to release the bomb. In mechanical (emergency) release, the lock mechanism is tripped as follows: When the salvo handle is pulled, the rack salvo arm is moved forward and rotates the solenoid armature, tripping the lock mechanism as in electrical release. To provide automatic cocking of the lock mechanism when the bomb is hoisted against the support hooks, the release solenoid is spring-loaded counterclockwise, the rocker is spring-loaded away from the release solenoid, and the trip arm is spring-loaded upward toward the catch on the trip arm-catch type rack, or is pulled upward by the toggle links on the toggle-link type rack. On the latter-type rack, a guard on the trip arm prevents the rocker from overtraveling. To prevent inadvertent bomb release, the salvo arm is spring-loaded toward the lock position. The support hooks are spring-loaded open to facilitate reloading of the rack and also to ensure that the transfer switch (left rack only) remains in proper position to transfer current to the right rack when the left rack lock mechanism is released. The sway brace assembly, housed in the support bracket on each end of the rack, is secured by a locking collar.

(2) REMOVING AND INSTALLING BOMB RACK. *(See figures 428 and 432.)*

(3) ADJUSTING TRANSFER SWITCH IN LEFT-HAND BOMB RACK. *(See figure 431.)*

(4) TESTING BOMB ARMING UNIT.—Make sure the bomb arming solenoids are de-energized; then test each latch as follows:

(a) Engage an arming wire swivel loop in arming latch.

(b) Exert a pull of 3 pounds on the arming wire; the swivel loop must not be released.

(c) Exert a pull of 4 pounds on the arming wire; the swivel loop must pull free of the latch.

(5) TEST BEFORE INSTALLING BOMB RACK.—Make sure the racks are clean and free from oil, dust, and corrosion; then test the rack as follows:

(a) When support hooks reach the closed position, the rack mechanism must lock.

(b) When salvo arm is pushed forward, the rack mechanism must release without hesitation, when a 20-pound weight is suspended from the hooks.

(c) Recock the rack and release the rack mechanism electrically; the rack mechanism must release without hesitation, when a 20-pound weight is suspended from the hooks.

(d) Energize arming solenoids; arming latches must be locked.

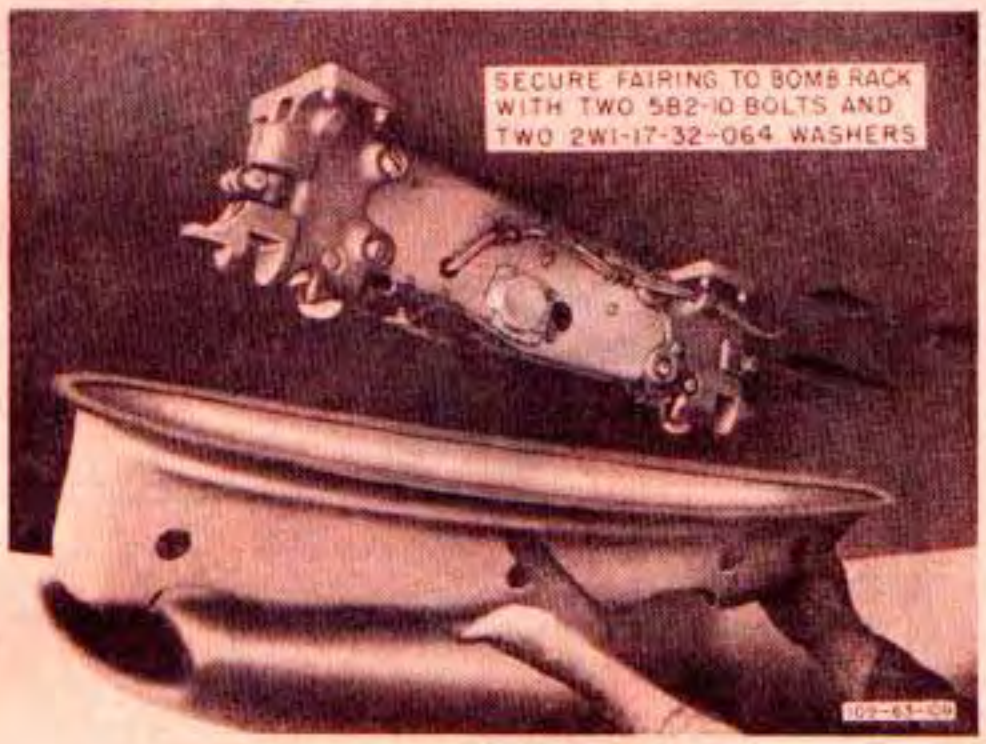


Figure 432—Installing Bomb Rack Fairing

23. GUNNERY EQUIPMENT.

a. GENERAL DESCRIPTION. *(See figure 433.)*—Either of two gun installations may be used: a maximum load of three fixed .50-caliber guns in each wing, or an alternate installation of two guns in each wing. For maximum load, 500 rounds of ammunition are provided for the inboard guns (400 rounds on late airplanes) and 270 rounds for each center and outboard gun. For the alternate installation, the center guns are removed and each outboard gun then has 500 rounds. Later airplanes are equipped with removable zero rail rocket launchers under each wing; the launchers can support a total of 10 rockets. To accommodate either the auxiliary droppable fuel tank or the 500-pound bomb,

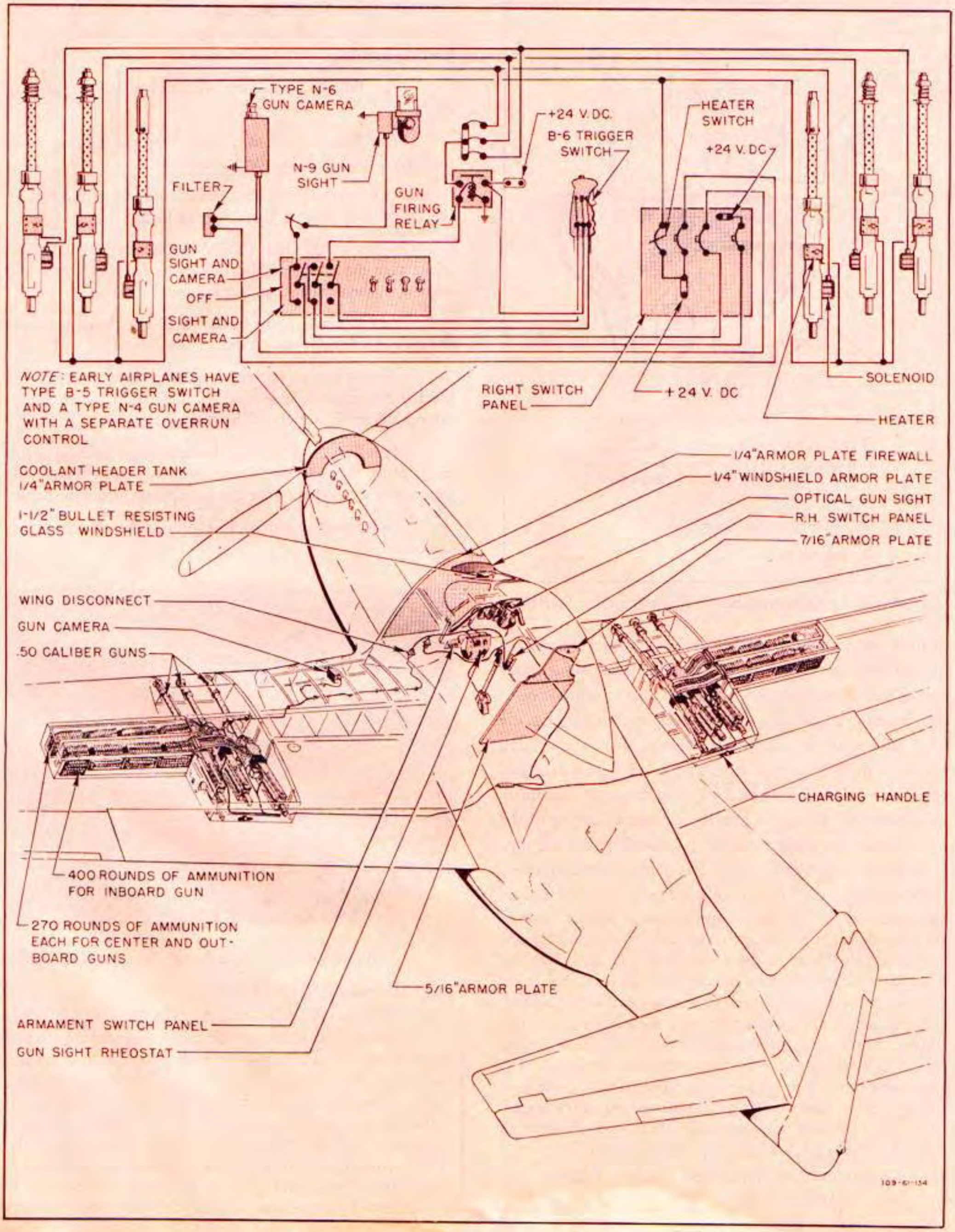


Figure 433—Gunnery Equipment

the two inboard launchers on each wing can be removed for installation of the bomb rack. The intervalometer on the front switch panel permits firing of the rockets singly or automatically in train. Armor plate protection is shown in figure 434. On early airplanes, a Type N-4 gun camera with separate overrun control unit is mounted in the leading edge of the left wing, forward of the wheel well. Later airplanes are equipped with a Type N-6 gun camera with a built-in overrun control. A gun charging handle is stowed in each gun bay for manual charging prior to flight. Gunnery operating switches are as follows: the three-position gun-and-camera safety-selector switch (on the armament switch panel), and a Type B-5 or B-6 trigger switch on the control stick.

(1) GUN SIGHT (Early Airplanes).—Early airplanes are equipped with a Type N-9 optical gun sight with a fixed head, mounted on the instrument shroud. Some of the airplanes in this category have an adjustable auxiliary bead sight mounted forward of the windshield, and an auxiliary ring sight mounted on the instrument shroud. A gun sight rheostat switch, on the pilot's switch panel, controls the intensity of the reticle image. *(See figures 439 and 446.)*

(2) GUN SIGHT (Later Airplanes).—Later airplanes have a Type K-14A compensating gun sight mounted on the instrument panel shroud. A gun sight selector-dimmer switch assembly, on the right side of the cockpit, has a rheostat for controlling the intensity of the reticle image; "FIXED," "FIXED AND GYRO," or "GYRO" positions can be selected. A twist grip for setting the range into the gun sight is on the throttle. *(See figure 439B.)*

Note

The K-14 and K-14A gun sights differ in that the K-14A sight has range lines on the fixed reticle for rocket aiming.

b. GUNNERY EQUIPMENT TROUBLE SHOOTING.

TROUBLE	PROBABLE CAUSE	REMEDY
Gun fails to fire.	Gun not loaded, charged, timed, or headspaced.	Correct.
	Defective gun.	Repair or replace defective part.
	Open circuit due to loose connections or the defective wiring, gun and camera safety-selector switch, trigger switch, or gun firing solenoid.	Repair or replace defective part.
	Faulty ammunition or links.	Inspect ammunition and links before loading.
Ammunition fails to feed.	Ammunition feed chute out of alignment with ammunition box.	Align feed chute support brackets.
	Feed chute out of alignment with gun feedway.	Align attaching lugs on inboard end of chute.
	Feed chute has projections such as rivets, dents or tears, or is damaged, causing insufficient clearance for ammunition belt.	Repair or replace chute.
	Feed chute mouth damaged or not flared sufficiently to allow free flow of belt.	Repair or replace.
	Feed chute hold-down strips on access door do not hold feed chute securely.	Repair or replace strips.
	Ammunition boxes overloaded, causing belts to bind against ammunition bay coverplate.	Remove some load.
	Defective gun.	Repair defective part.
	Faulty ammunition (split case, short round, etc.).	Inspect ammunition carefully before loading in ammunition boxes.

TROUBLE	PROBABLE CAUSE	REMEDY
Faulty link ejection.	Dented chute or bent lips at chute mouth.	Replace chute.
	Undersize chute.	Replace chute.
	Oversize chute allows links to rotate sidewise and bind.	Replace chute.
	Insufficient flare at ejection chute mouth causes small end of double loop to butt against edge of lip.	Replace chute.
	Aft inner surface of ejection chute mouth projects forward of link stripper, causing links to rotate sidewise and bind.	Replace chute.
Guns fail to hit target.	Guns and gun sight not harmonized.	Harmonize.
	Gun mounts loose.	Tighten and harmonize.
	Gun barrel worn or warped.	Replace barrel.
Gun camera not operating.	Connector plug loose or not connected.	Correct.
	Defective gun and camera safety-selector switch.	Repair or replace switch.
	Defective camera mechanism.	Replace camera.
Gun camera overrun control not operating.	Connector plug loose or not connected (early airplanes).	Correct.
	Defective mechanism.	Replace.
	Switch on overrun control not turned "ON" (early airplanes).	Turn "ON" before flight.
Gun camera mount adapter cracked.	Setscrew in bottom of adapter too tight.	Replace adapter. Setscrew to be finger-tight only (approximately 3 inch-pounds).
	TYPE N-9 GUN SIGHT	
Gun sight reticle image not visible.	Burned-out lamp filament.	Replace lamp.
	Gun sight circuit defective.	Repair.
	Gun sight rheostat faulty.	Replace.
	Gun and camera safety-selector switch not "ON."	Turn "ON" switch.

TROUBLE	PROBABLE CAUSE	REMEDY
Double gun sight reticle image.	Too great light intensity.	Regulate rheostat.
	Reticle assembly out of position.	Replace sight.
	Lens not focused.	Replace sight.
	Faces of reflector glass not parallel.	Replace reflector.

TYPE K-14A GUN SIGHT

Note

A standard volt-ohm meter with a 30-volt direct-current range is required for trouble shooting this sight. In an emergency, a continuity test light can be made by using one of the gun sight lamps and the airplane battery.

Sight does not operate with selector-dimmer (circuit breaker type) switch "ON" and selector at "FIXED AND GYRO."	No power supply.	Check battery circuit.
	Overload throws circuit breaker "OFF."	Reset switch to "ON." If switch does not remain in "ON" position, the electrical system should be checked to determine reason for overload.
	Circuit breaker defective.	Replace "ON-OFF" switch.
	Continuity broken in blue wire.	Replace cable, or repair cable attached to sighting head if it can be done without taking the unit apart.
	Voltage regulator defective.	Replace.
No fixed reticle image with "ON-OFF" switch "ON" and selector at "FIXED."	Lamp bulb defective.	Replace lamp bulb.
	Sighting head spring contacts not making electrical contact to lamp socket.	Clean, or bend contacts into position.
	Dimmer rheostat winding dirty or open.	Clean, or replace unit.
	No switch contact between maroon-white and green wires in selector switch.	Replace selector switch.
	No continuity in green wire from selector dimmer to sighting head.	Replace cable, or repair cable attached to sighting head if it can be done without taking the unit apart.
No fixed reticle image with "ON-OFF" switch "ON" and selector at "FIXED AND GYRO."	No switch contact between maroon-white and green wires.	Replace selector switch.
No movable reticle image with "ON-OFF" switch "ON" and selector at "FIXED AND GYRO."	Lamp bulb defective.	Replace lamp bulb.
	Sighting head spring contacts not making electrical contact to lamp socket.	Clean, or bend contacts into position.
	Dimmer rheostat winding dirty or open.	Clean or replace unit.
	No switch contact between maroon-white and yellow wires in selector switch.	Replace selector switch.
	No continuity in yellow wire from selector dimmer to sighting head.	Replace cable, or repair cable attached to sighting head if it can be done without taking the unit apart.

TROUBLE	PROBABLE CAUSE	REMEDY
No movable reticle image with "ON-OFF" switch "ON" and selector at "GYRO."	No switch contact between maroon-white and yellow wires in selector switch.	Replace selector.
Motor does not start with "ON-OFF" switch "ON" and selector at "GYRO" or "FIXED AND GYRO."	No switch contact between green-white and yellow-green wires in selector switch.	Replace selector.
	No continuity in red wire from selector dimmer to sighting head.	Replace cable, or repair cable attached to sighting head if it can be done without taking the unit apart.
	Motor defective.	Replace sighting head.
Gyro topples in turn.	Range rheostat open or dirty.	Replace sighting head.
	No continuity in white wire from selector-dimmer to sighting head.	Replace cable, or repair cable attached to sighting head if it can be done without taking the unit apart.
	No continuity between pins Nos. 1 and 10 in sighting head harness.	Replace sighting head.
Blocked or distorted images of sighting reticles.	Reticle slots dirty.	Replace sighting head.
Diamond-shaped images of gyro reticle appear round and enlarged.	Gyro mirror out of balance.	Replace sighting head.
Gyro reticle image jumps around in field with no tendency to center.	Drive belt broken.	Replace sighting head.
Cracking or fracture of gel cell.	Improper clearance.	Replace cell. Install new cell with .003 clearance between the gyro motor housing and gel cell.
Interior of lens clouds with moisture.	Silica gel exhausted.	Replace silica gel.
	Gel cell cracked.	Check that there is .003 clearance between housing and cell.
	Air leaks in sight case.	Replace sighting head.
Reticle images appear to change relationship to target when observer's head is moved over the field of vision of the sight.	Lenses out of focus.	Replace sighting head.

ROCKET INSTALLATION

Rockets fail to fire.	Defective wiring.	Make continuity check and replace defective wiring.
	Faulty rocket.	Replace.
	Intervalometer malfunctioning.	Replace.
Improper firing sequence of rockets.	Defective wiring.	Check and replace.
	Intervalometer malfunctioning.	Replace.

TROUBLE	PROBABLE CAUSE	REMEDY
Shear wire difficult to install.	Old wire left in arming latch.	Remove old wire.
	Latch pivot damaged causing misalignment of shear wire holes.	Replace latch.
Rocket does not fit mount.	Damaged mount.	Replace mount.
	Damaged mounting lugs on rocket.	Replace rocket.
	Lugs on rocket not made to proper dimensions.	Replace rocket.
Firing wire not shearing properly.	Cutting knife dull.	Sharpen.
	Wire not in knife.	Insert.

c. HARMONIZING GUNS, GUN SIGHT, AND GUN CAMERA.

(1) Construct a bore sight target board and a suitable support. *(See figure 435 for target board dimensions.)*

(2) Position airplane on level ground. Jack up the airplane, using the jacking point under each wing and a jack supporting bar inserted through the lift tube. Jacks are necessary to take the weight off the landing gear and so prevent deflection of the airplane during bore sighting. Use screw-type jacks when possible, since hydraulic jacks tend to creep and require checking during the operation.

Note

When lifting tail with lifting bar to install the tail jack, enough men should be available to prevent damage to the airplane. (Weight may vary from 1600 to 2000 lbs.) After tail jack is installed, suspend a 100-pound weight from each end of bar inserted through the lift tube to prevent airplane from nosing over.

(3) Level the airplane laterally by placing a leveling bar and bubble level across the leveling lugs on each upper fuselage longeron aft of the firewall *(figure 436)*, and then raising or lowering one wing until the bubble is centered. Level the airplane longitudinally, using the two lugs on the left cockpit trim panel. *(See figure 436.)*

(4) Attach plumb bobs to two No. 10-32 screws and insert the screws into the red-circled datum points. *(See figure 435.)* Suspend the plumb bobs about one inch above the ground.

(5) Place the bore sight target 1000 inches (83 feet 4 inches) forward of the gun sight reticle, aligning the vertical centerline of the target with the plumb bob cords. See that the target is leveled laterally or the guns will not be bore-sighted accurately.

(6) From the Gun Sighting Chart *(figure 438)*, obtain the flight attitude of the airplane (angle of attack of the fuselage reference line) for the desired attacking speed, weight and G acceleration. See example on chart.

(7) If mil adjustment is used, leave the airplane leveled and adjust the target board to the airplane in the following manner:

(a) N-9 GUN SIGHT (Early Airplanes).—Turn on gun sight lamp. Loosen reflector assembly lockscrew *(figure 446)* and rotate assembly to align the reticle dot with the vertical line through the sight alignment mark on the target board. Tighten lockscrew. Install a Type A-2 sight line level indicator (AAF41D3689) and adjust target. *(See figure 437.)*

(b) K-14A GUN SIGHT (Later Airplanes). *(See figures 439A and 439B.)*—Turn on gun sight lamp and set the selector switch to "FIXED." Then align the reticle cross with the K-14A vertical line through the sight aligning mark on the target board by loosening the center bolt on the

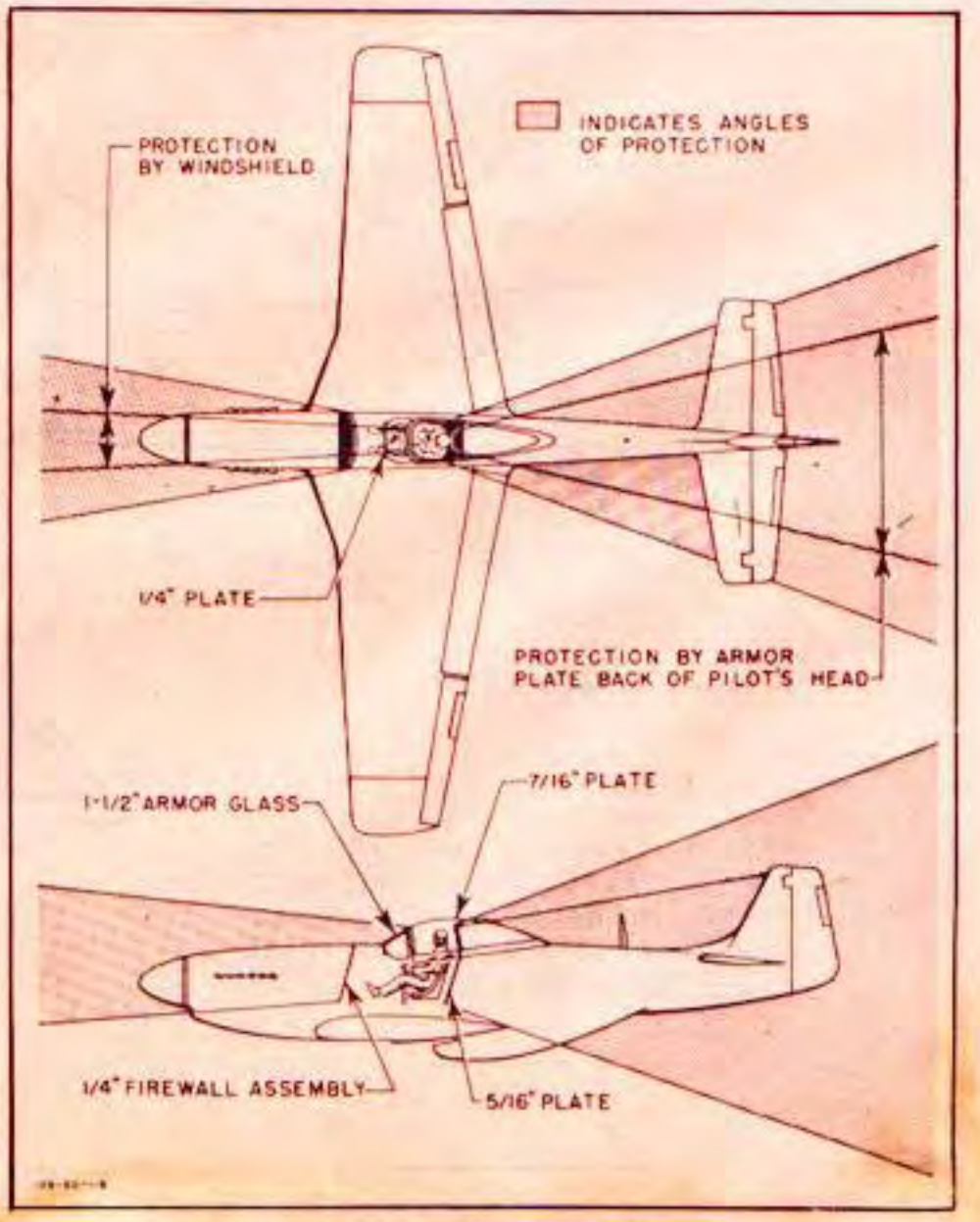


Figure 434—Angles of Armor Plate Protection

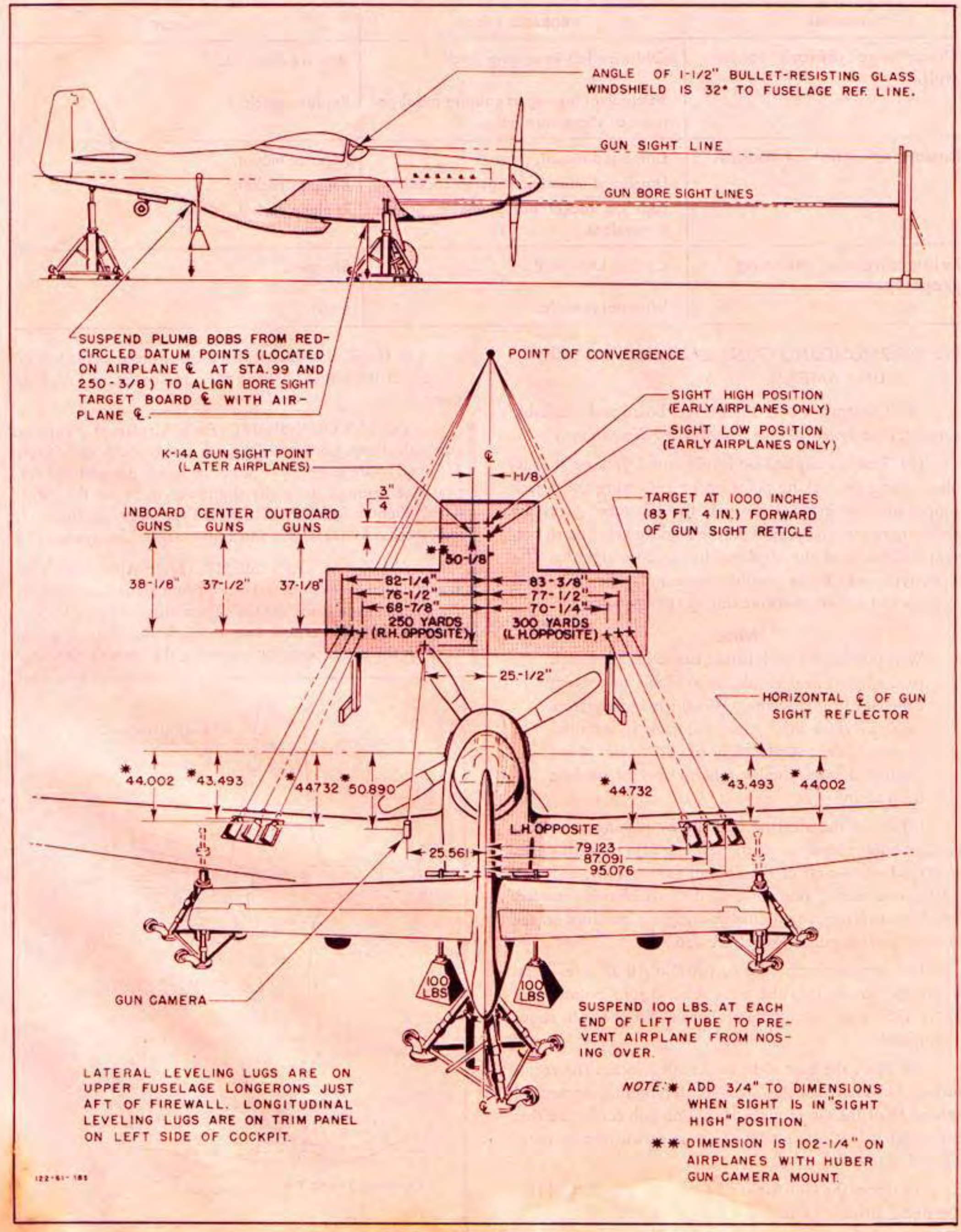


Figure 435—Bore Sighting Diagram

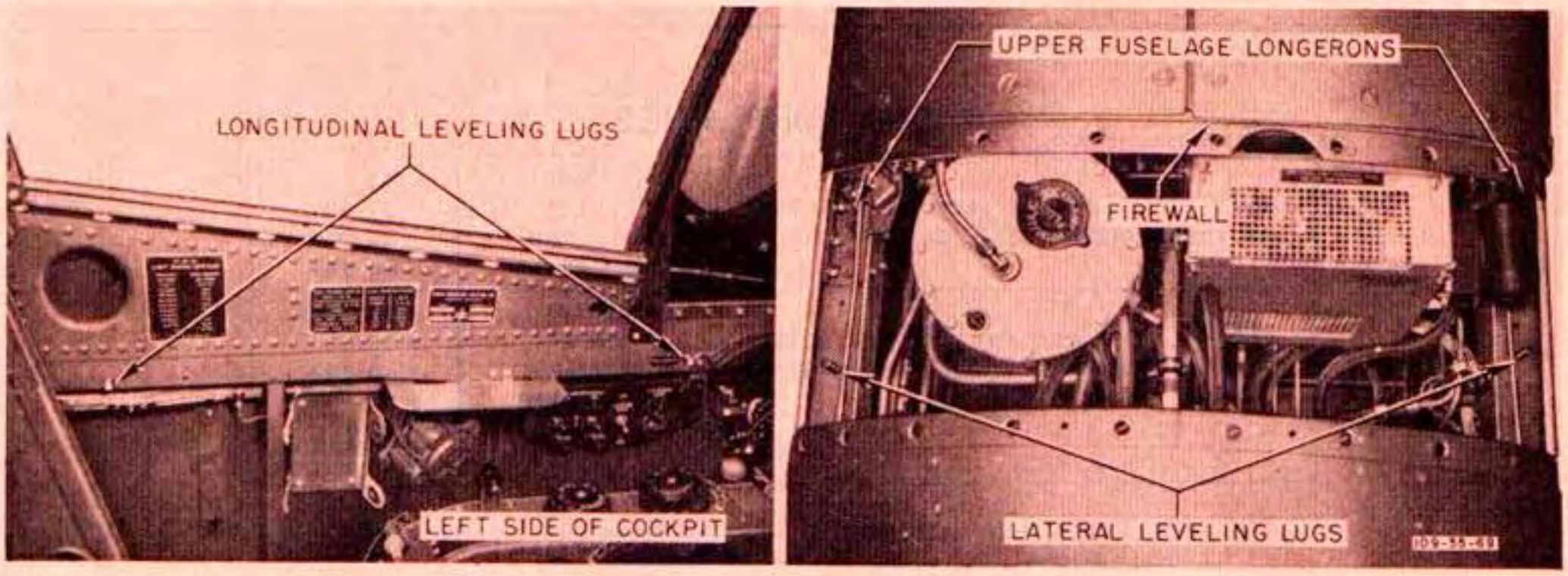


Figure 436—Airplane Leveling Lugs

sight bracket and adjusting the sight in azimuth. The adjusting ring permits azimuth adjustment to within 1.8 mil. For example: rotating the sighting head and adjusting ring together one large tooth (10 degrees), and then rotating the sighting head along three small teeth (9.9 degrees) in the opposite direction, gives a net movement of .1 degree or 1.8 mil.

(c) If the airplane has a K-14A gun sight or if an indicator is not available, hold a flat object (board, bar, or similar object) against the side of the reflector glass and at the same height as the reticle dot, and level the object with a bubble level. Turn off gun sight lamp. Then move target board until the horizontal line of the sight aligning mark is aligned with the flat surface. See that the target board vertical centerline remains in line with the plumb bob cords.

(d) For nose-up angle of attack, lower the target board the mil adjustment in inches (one mil equals one inch at 1000 inches); for nose-down angle of attack, raise the target board.

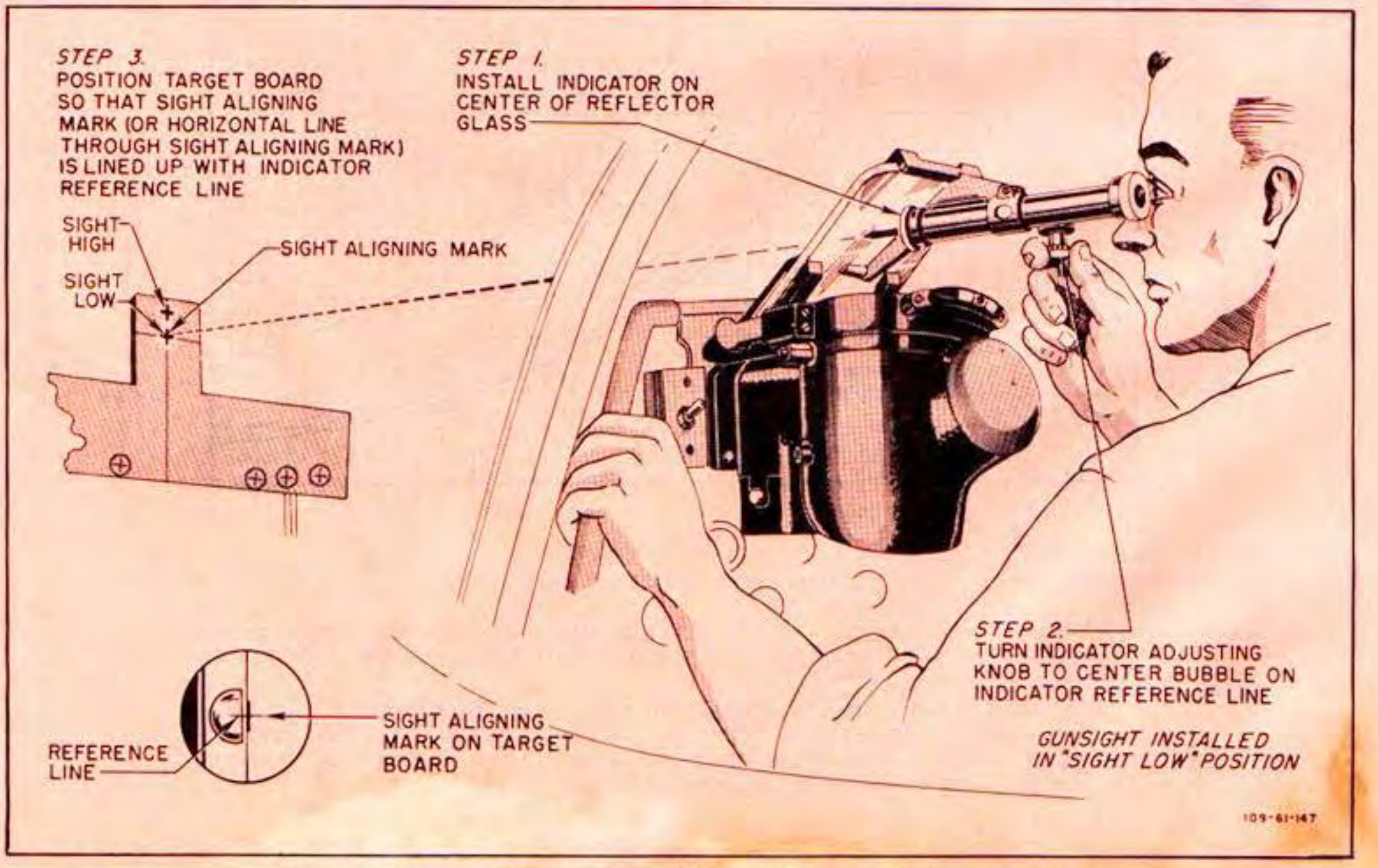
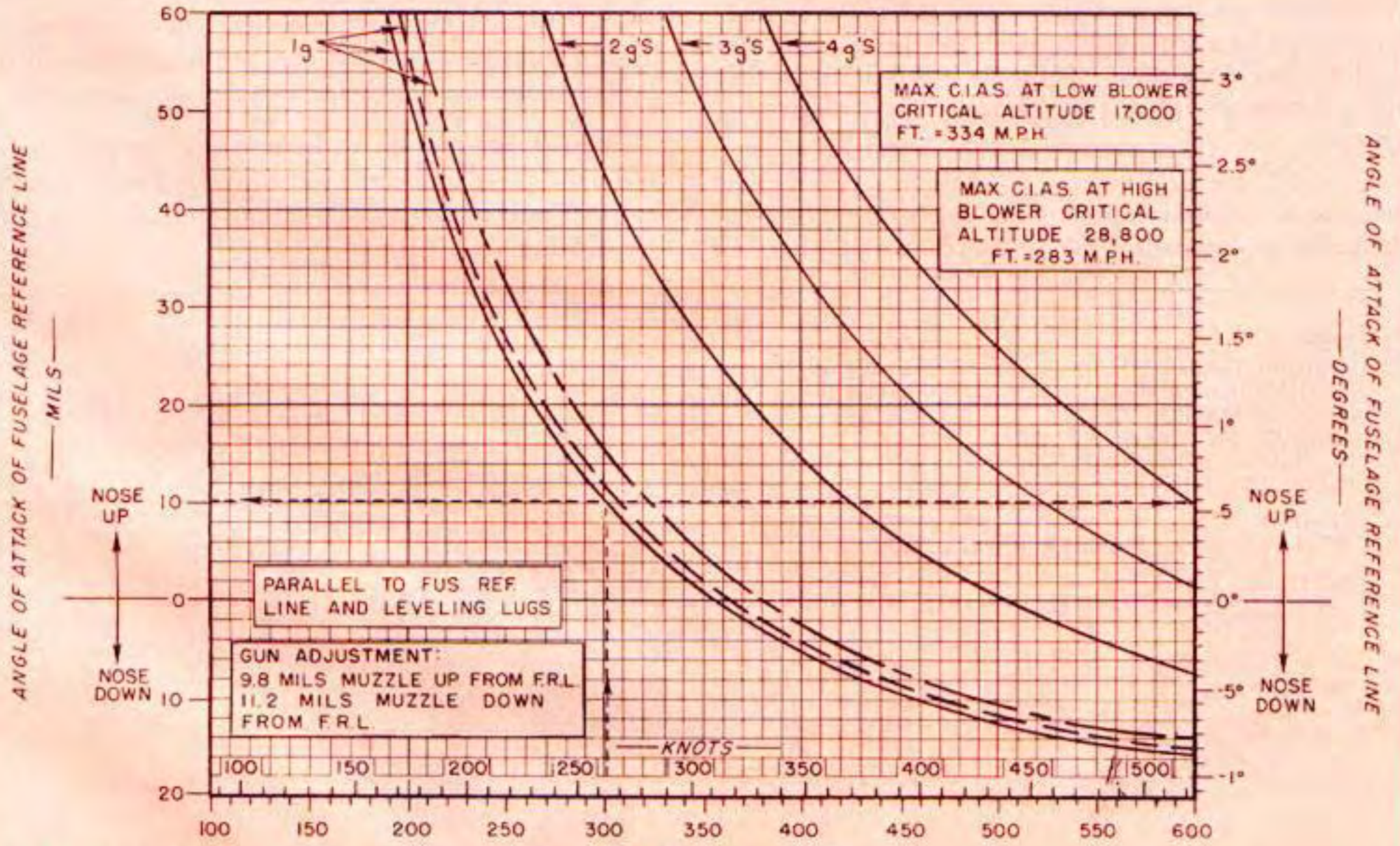


Figure 437—Using Sight Line Level Indicator—Type N-9 Gun Sight

P-51D AIRPLANES

HORIZONTAL DISTANCE FROM ℄ GUN BORE (AT FRONT MOUNT) TO ℄ OF AIRPLANE	INBOARD CENTER OUTBOARD GUN CAMERA	79.123 87.091 95.076 25.561
VERTICAL DISTANCE FROM ℄ GUN BORE (AT FRONT MOUNT) TO ℄ GUN SIGHT REFLECTOR	INBOARD CENTER OUTBOARD GUN CAMERA	*44.732 *44.003 *43.493 *50.890 * ADD .750 WITH SIGHT IN HIGH POSITION

LEGEND
——— FULL AMMUNITION, LESS 1/2 FUEL, WITHOUT BOMBS (=9065 LBS.) UNDER POSITIVE ACCELERATIONS OF 1g, 2g, 3g, OR 4g'S.
——— — MAXIMUM OVERLOAD GROSS WEIGHT, LESS 1/4 FUEL, WITH BOMBS (=10,358 LBS.) UNDER POSITIVE ACCELERATION OF 1g.
— — — — MAXIMUM OVERLOAD GROSS WEIGHT, LESS 1/4 FUEL, WITHOUT BOMBS (=9354 LBS.) UNDER POSITIVE ACCELERATION OF 1g.



1 DEGREE = 17.8 MILS
1 KNOT = 1.15 MILES PER HOUR

EXAMPLE: FIND ANGLE OF ATTACK FOR 301 M.P.H. (90% OF MAX. C.I.A.S. AT LOW BLOWER CRITICAL ALTITUDE) WITH FULL AMMUNITION, LESS 1/2 FUEL, WITHOUT BOMBS, AND POSITIVE ACCELERATION OF 1g.

FROM AIRSPEED SCALE, MOVE VERTICALLY TO THE 1g CURVE REPRESENTING THE ABOVE WEIGHT CONDITION (SEE LEGEND). FROM THIS INTERSECTION, MOVE HORIZONTALLY TO SCALE AT LEFT FOR NOSE UP ANGLE OF 10.04 MILS, OR MOVE HORIZONTALLY TO SCALE AT RIGHT FOR NOSE UP ANGLE OF .58 DEGREES OR 35 MINUTES.

109-93-121

Figure 438—Gun Sighting Chart

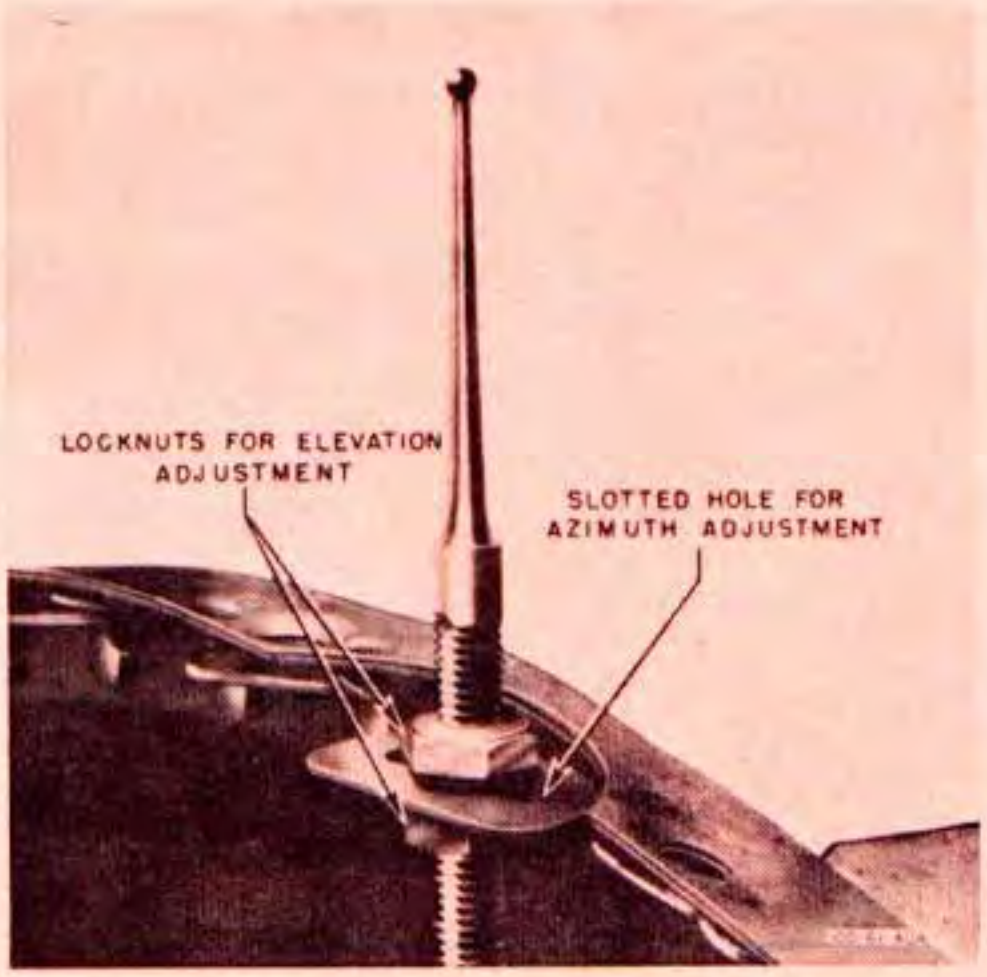


Figure 439—Bead Sight Adjustment

(8) If degree adjustment is used, place the airplane in flight attitude, using a leveling bar and protractor level on the longitudinal level lugs and lowering or raising the tail for the required nose-up or nose-down angle. Then align the gun sight in azimuth, and position the target board relative to the airplane as explained in paragraph (7) *(a)*, *(b)*, or *(c)*.

(9) ELEVATION ADJUSTMENT (N-9 Gun Sight).—Turn on gun sight lamp. Adjust the sight line in elevation by means of the two adjustment screws on the side of sight *(figure 446)* so that the reticle dot is on the sight aligning mark.

Note

A few airplanes of this category incorporated an auxiliary ring-and-bead sight. Elevation and azimuth adjustment to the sight aligning mark is attained by means of the bead sight adjustment. *(See figure 439.)*

(10) ELEVATION ADJUSTMENT (K-14A Gun Sight).—Turn on gun sight and set selector switch to "FIXED." Adjust the sight line in elevation by means of the adjustment screw on the forward lower portion of the gun sight mount, under the windshield shroud. Adjust this screw so that the reticle is on the sight aligning mark. *(See figure 439B.)*

(11) Install the gun camera aligning indicator in gun camera and adjust the gun camera to its mark on the target. On airplanes with the Type C-1 (Huber) gun camera mount, replace the lockwire in the elevation and azimuth adjustment screws. *(See figures 449 and 451.)*

(12) Install bore sight tool in each gun and adjust the gun at the rear mount to bore sight on its respective target. *(See figures 440 and 441.)*

(13) The preceding adjustments align the gun bores on their respective targets on the target board. However, during firing, gun barrel rifling and tolerances in the gun mechanisms and mounts cause the guns to shoot off the bore sight line to which they are adjusted. To further increase the accuracy of gunfire, make the following additional alignment:

(a) Fire a single shot from each gun. If all previous adjustments have been accurate and have not been disturbed, each bullet will pass through its respective target on the target board. If one of the guns does not shoot on its target, the gun barrel is warped, the gun mounts are loose, or the gun is not boresighted accurately. Replace the gun barrel or tighten the mounts, and bore sight the gun.

(b) If all the guns fire off their targets, the relationship of the target board to the airplane has been disturbed. For instance, the airplane may not be level, due to hydraulic jacks creeping, the jacks settling into the ground, or the target board having been accidentally moved. Repeat the previous harmonizing adjustments as necessary.

(c) Fire a burst of approximately 20 rounds simultaneously from both inboard guns, from both outboard guns, and from both center guns. If the guns are fired individually, the wing may deflect sufficiently to cause the burst pattern to be inaccurate.

(d) Correct the bore sight targets. *(See figure 442.)*

(e) Readjust each gun to its corrected bore sight target.

(f) Fire another burst to check the adjustment.

Note

If range is available, proof-fire the guns on a standard Type C target. If this is done, the ground fire may not necessarily converge with the sight line, since the guns are bore sighted for aerial fire. However, when the sight reticle dot is trained on the target and the bullet pattern is grouped, the guns may be considered properly harmonized.

d. GUNS.

(1) DESCRIPTION.—The guns and ammunition boxes, shown installed in figure 443, are entirely enclosed within the wing. Each gun is vertically mounted on a Type A-1 front mount and adjustable rear mount (NA 106-61026) and equipped with a Type G-9 gun firing solenoid, and a Type J-1 or a Type J-6 electric gun heater.

(2) REMOVING GUNS.—Disconnect feed chute and the solenoid and heater wires. Remove link ejection chute. Loosen rear mount clamp lockscrew, loosen front mount pin, and remove gun. Do not rest or slide guns on wing structure aft of gun bay.

(3) EQUIPPING GUNS. *(See figure 444, and paragraphs* ***e.*** (3) *and* (4).)—Assemble left wing guns for left-hand feed and right wing guns for right-hand feed.

(4) ADJUSTING GUN HEADSPACE.—The guns must be adjusted for headspace each time after the parts have been assembled. The only approved method is the following:

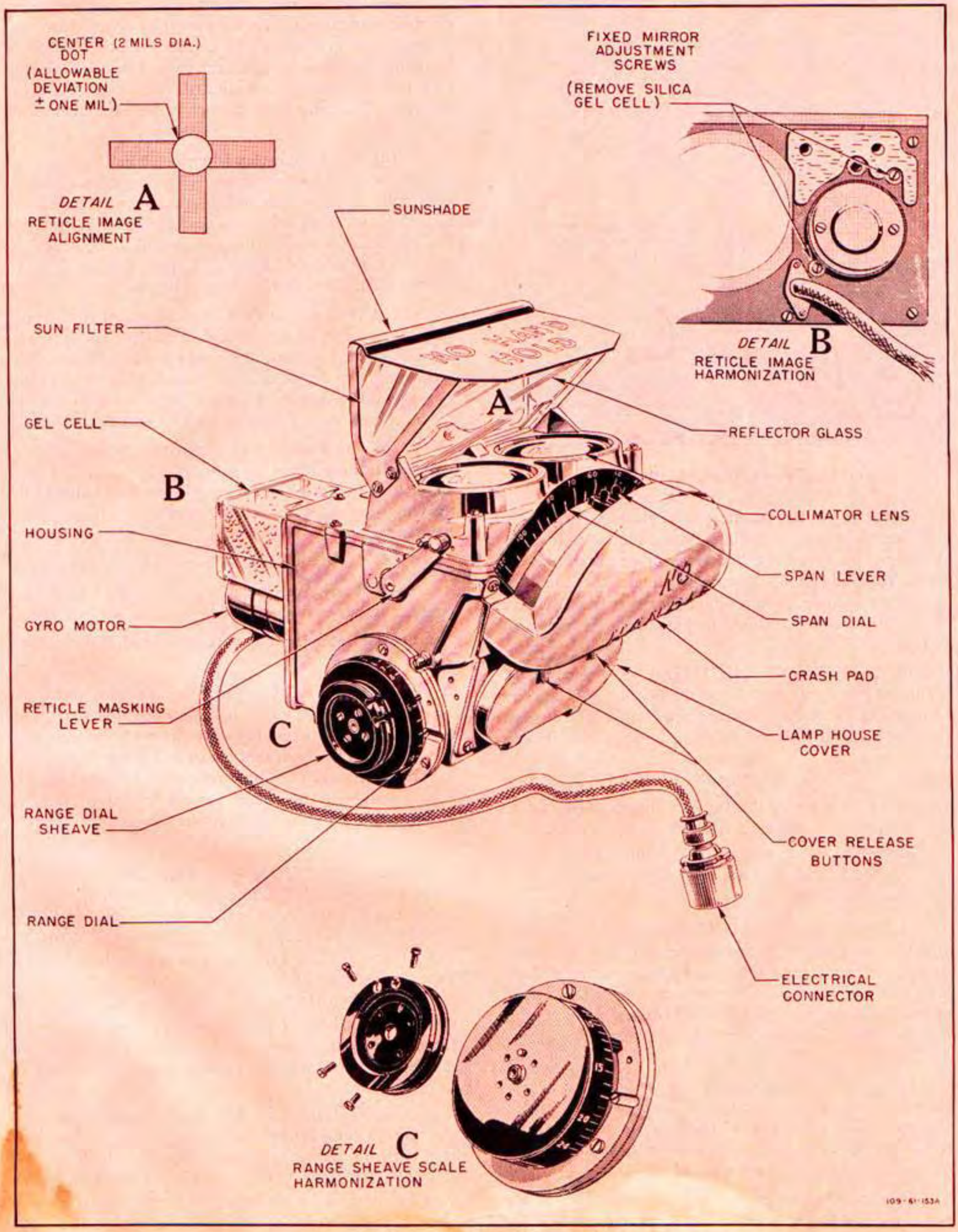


Figure 439A—K-14A Gun Sight

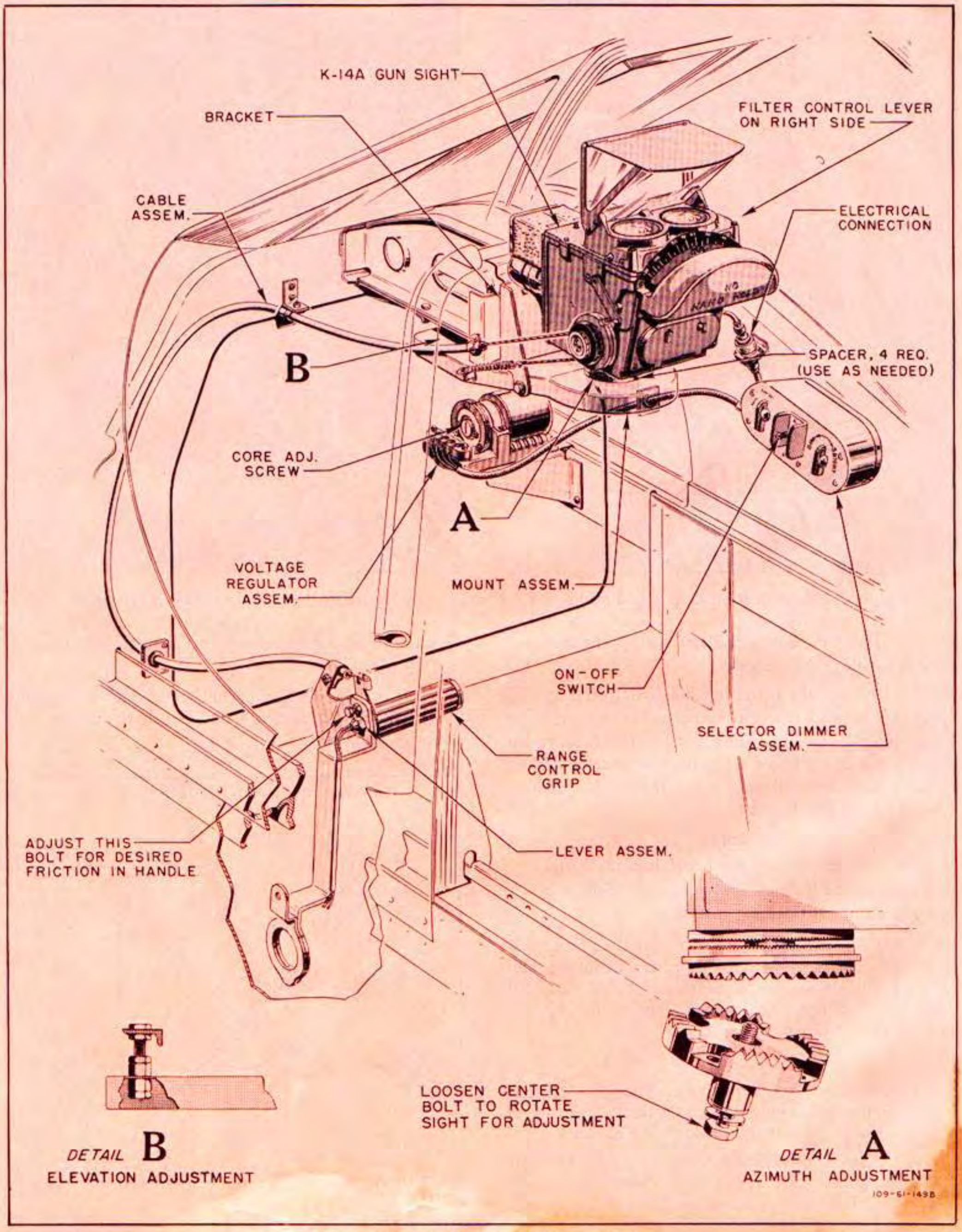


Figure 439B—K-14A Gun Sight Installation

Figure 440—Adjusting Gun in Azimuth

Figure 441—Adjusting Gun in Elevation

(a) Pull the bolt back about one inch by means of the bolt handle or the extractor.

(b) Screw the barrel into the barrel extension, by applying a screwdriver to the notches on the rear end of the barrel, until the recoiling parts will not go into battery position without being forced when the bolt is released. The recoiling parts are in battery when the barrel extension touches the trunnion block.

Note

For ease in screwing the barrel into the barrel extension on left-hand feed guns, remove the rear right-hand cartridge stop assembly.

(c) Screw the barrel out of the barrel extension one notch at a time until the recoiling parts will just go into battery position when the bolt is released, but is not forced forward. When this point is found, retract the bolt and unscrew the barrel two more notches.

Note

Do not retract the bolt more than one inch when determining the point at which the recoiling parts will just go into battery without being forced.

(5) CHECKING HEADSPACE ADJUSTMENT.—If a headspace gage, A351211, is available, check the headspace each time it is adjusted, prior to test firing on the ground, after installation of the gun in the airplane, prior to each take-off of the airplane, and at any other time that the correctness of the headspace is doubted. Check headspace adjustment as follows:

(a) Cock the gun by fully retracting the recoiling parts and allowing them to return to battery position. This cocks the firing pin.

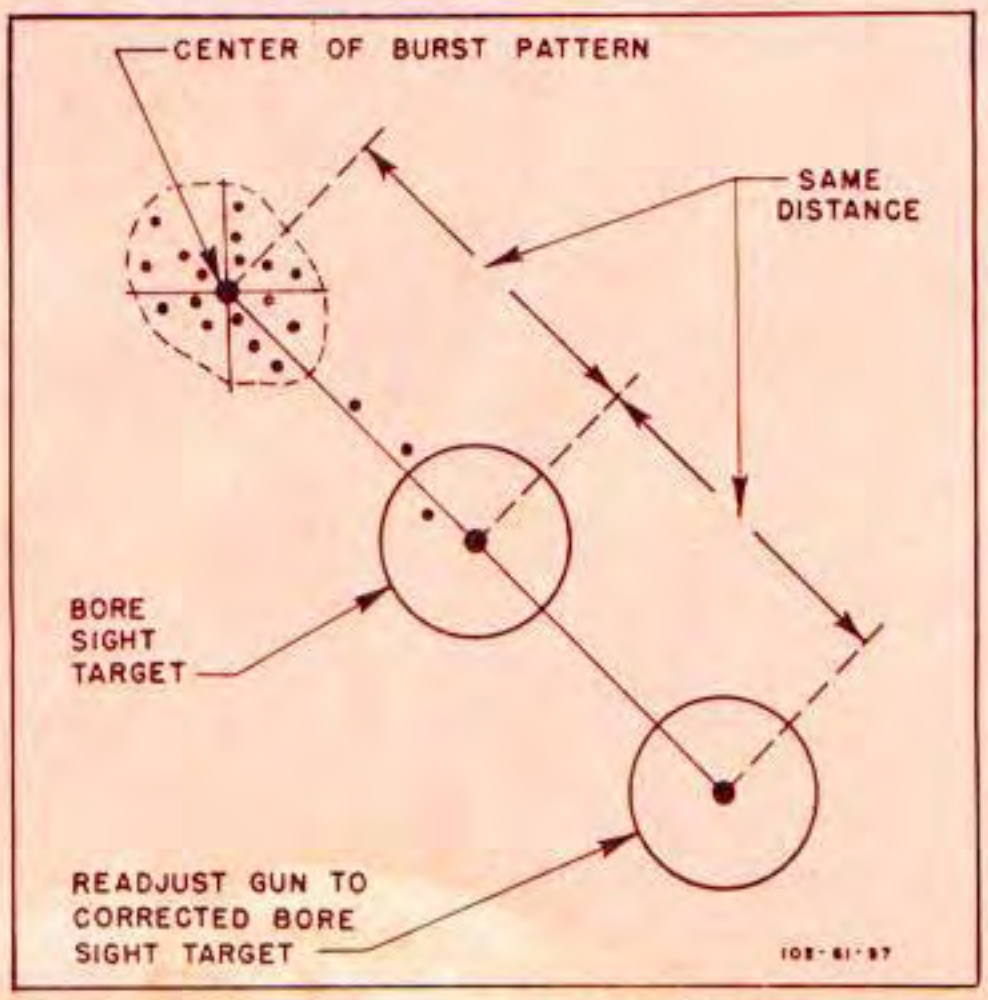


Figure 442—Correcting Gun Bore Sight Target

g. GUN CAMERA INSTALLATION.

(1) GUN CAMERA.—A 24-volt Type N-4 or N-6 gun camera *(figures 449 and 451)* is in the left wing on the inboard side of station 29.25 rib. The camera body contains shutter, motor, drive mechanism, a reset film footage indicator, a Type A-6 film magazine, and on the Type N-6 camera, a built-in overrun control. The Type N-4 camera has a separate overrun control. *(See figure 451.)* The camera can be set for speeds of 16, 32, or 64 frames per second. The plain lens assembly consists of a 35 mm f/3.5 telephoto lens, a sunshade, and a No. 12 minus-blue interchangeable glass filter. The diaphragm stops are marked "BRIGHT," "HAZY," and "DULL."

(2) GUN CAMERA MOUNTS.—Two types of gun camera mounts are used. *(See figures 449 and 451.)*

(3) ADJUSTING GUN CAMERA.—See harmonizing procedure. *(See paragraph c.* (11) *and figures 449 and 451.)*

(4) GUN CAMERA LENS PROTECTOR.—On early airplanes, the opening in the leading edge of the wing for the gun camera is covered by glass. On late airplanes, this opening is sealed by a spring-loaded metal plate which is actuated by a cable attached to the left main landing gear. *(See figure 449.)* The cable closes the plate against the spring when the landing gear is lowered. Retraction of the gear allows the spring to open the plate.

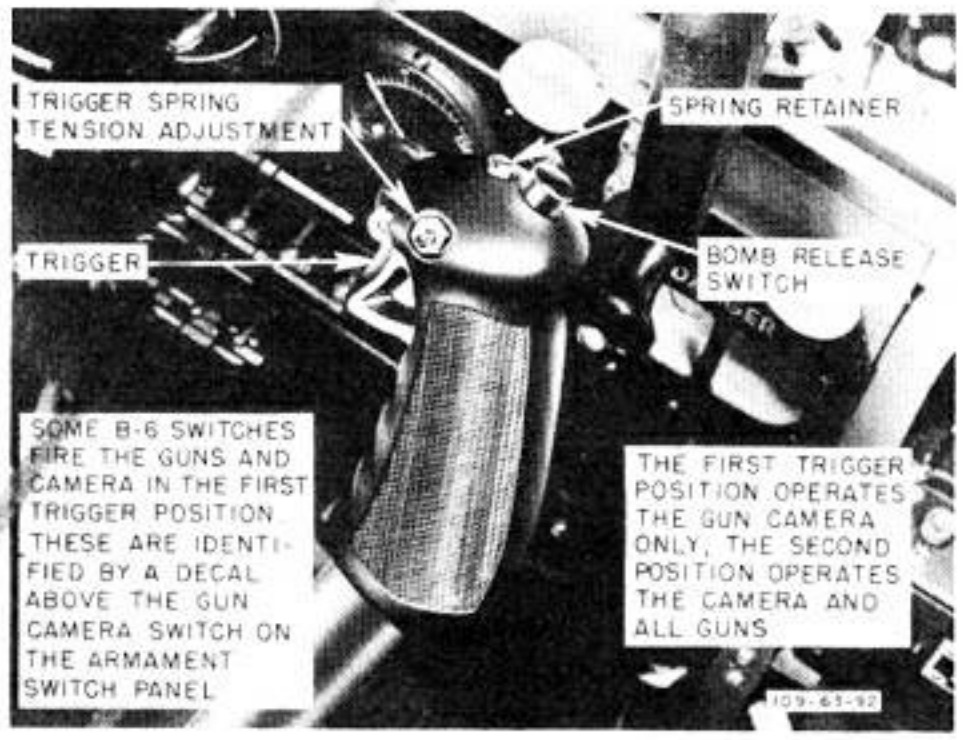


Figure 450—Control Stick Switch—Type B-6

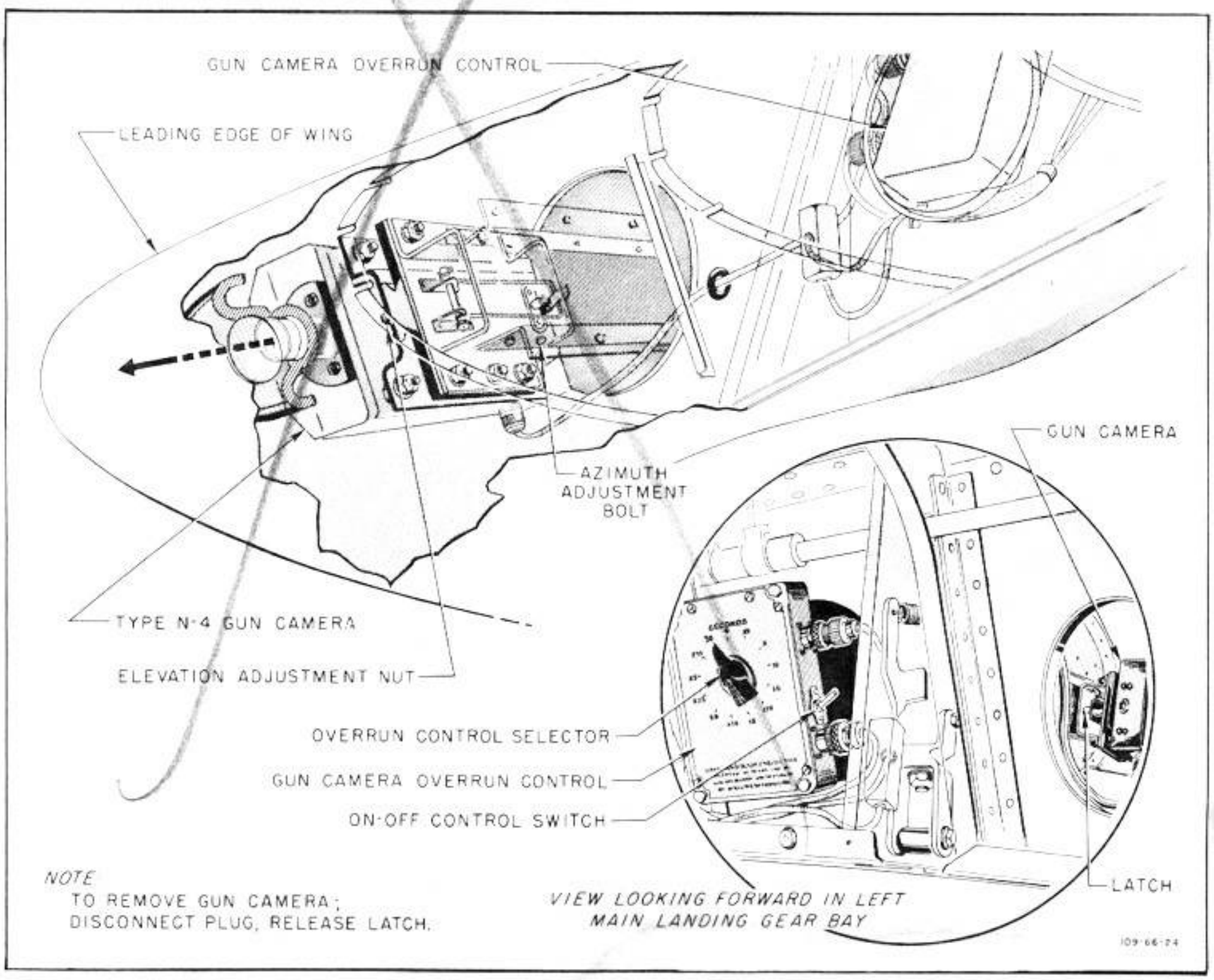


Figure 451—Gun Camera Installation—Early Airplanes

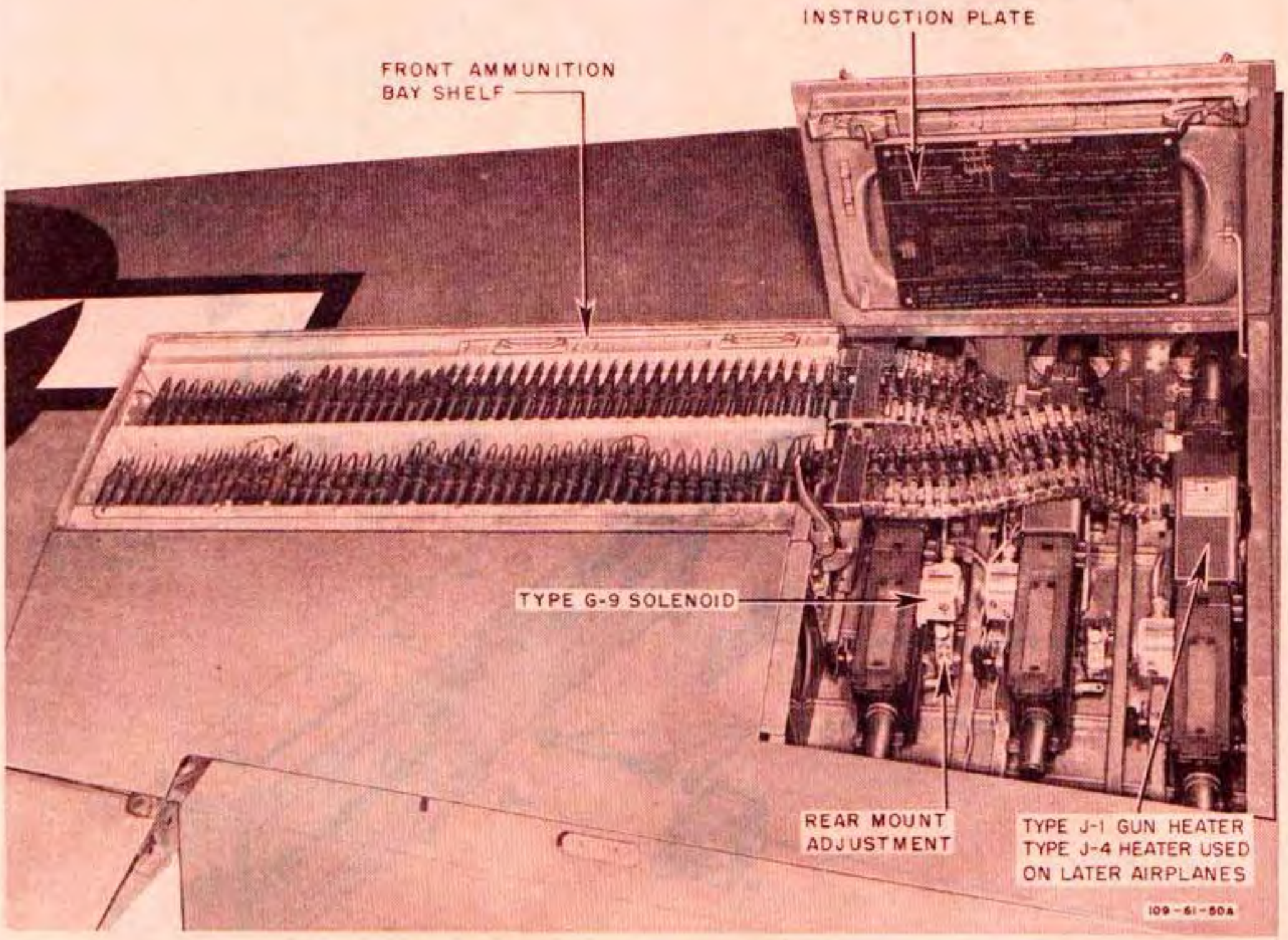


Figure 443—Left Wing Guns Installed

(b) Retract the bolt until the barrel extension and trunnion block are separated approximately 1/16 inch. This puts the locking surfaces of the breech lock and bolt in contact, which is the position they will assume when a cartridge is chambered.

(c) Insert the "GO" end of gage A351211 in the T-slot between the face of the bolt and the end of the barrel. If the gage does not go in, the headspace is too tight; correct the adjustment by unscrewing the barrel one notch at a time, checking with the gage each time, until the gage enters.

(d) Attempt to insert the "NO-GO" end of gage A351211 in the T-slot between the face of the bolt and the end of the barrel. If the gage goes in, the headspace is too loose; correct the adjustment by screwing the barrel into the barrel extension one notch at a time, checking with the gage each time until the "NO-GO" end of the gage will not enter. If the gage does not go in, and the check for tightness explained in *(c)* is satisfactory, the headspace is correct.

(e) If the headspace obtained by the method given in paragraph *d.* (5) *(c)* is not between "GO" and "NO-GO" limits of the gage, change the headspace to suit the gage.

(f) Remove the gage and release the firing pin.

CAUTION

Never release the firing pin with the gage in place, as the firing pin will be damaged.

(6) TIMING GUN WITH TYPE G-9 SOLENOID.

(a) Check headspace as outlined in paragraph *d.* (5).

CAUTION

Do not attempt to check timing unless the headspace has been checked and properly adjusted first.

(b) Cock the gun by means of the charging handle.

(c) Insert the "FIRE" timing gage A351214 between the barrel extension and the trunnion block.

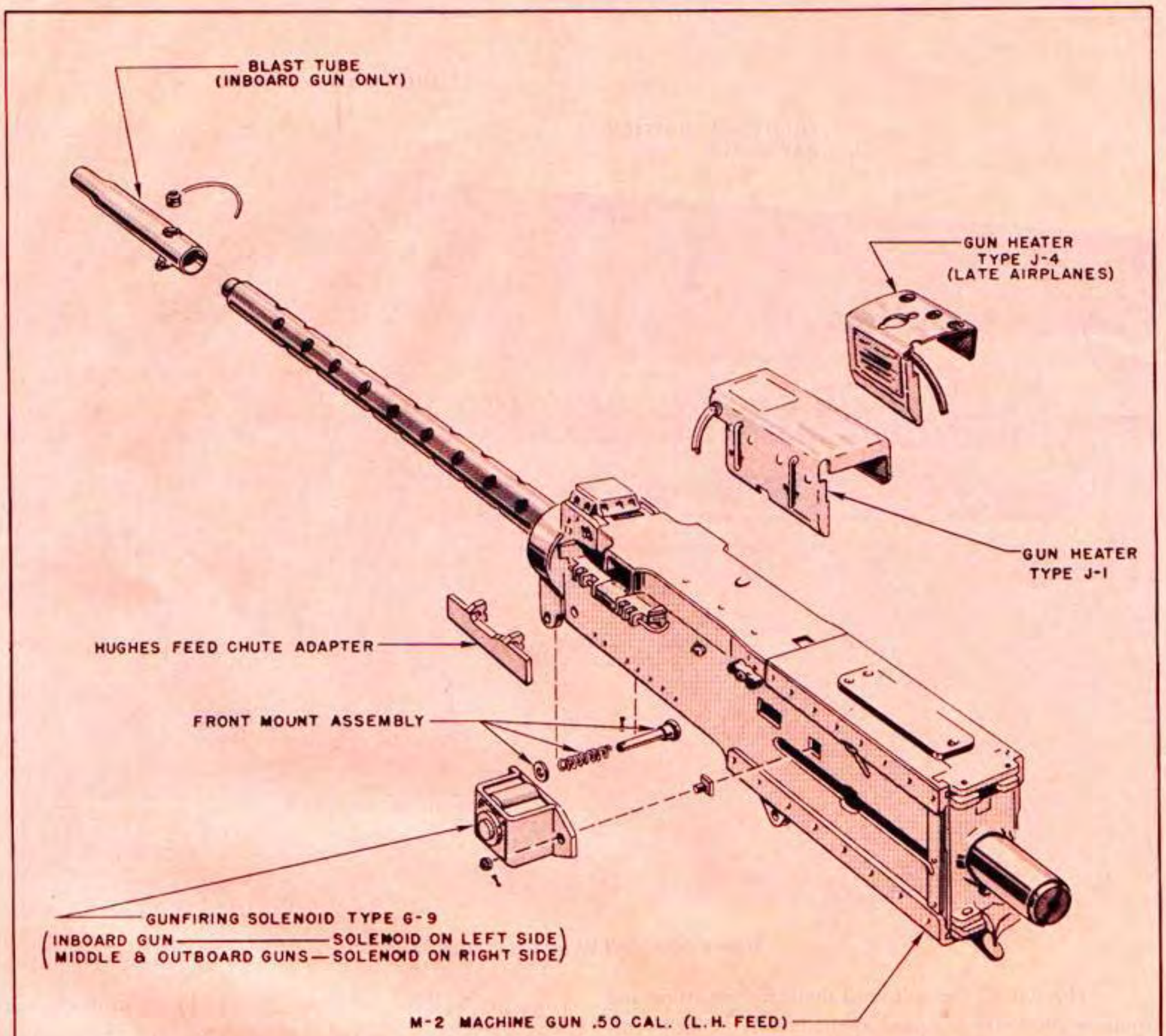


Figure 444—Equipping Guns

(d) Allow the barrel extension to close slowly on the gage.

(e) Release the firing mechanism by operating the solenoid. The firing pin should release smartly. If the firing pin is not released, turn the solenoid adjustment cap as necessary.

(f) Remove the "FIRE" gage, cock the gun and insert the "NO FIRE" gage A351213 between the barrel extension and the trunnion block.

(g) Allow the barrel extension to close slowly on the gage.

(h) Release the firing mechanism once. The firing pin should not be released. If the firing pin is released, turn the solenoid adjustment cap as necessary.

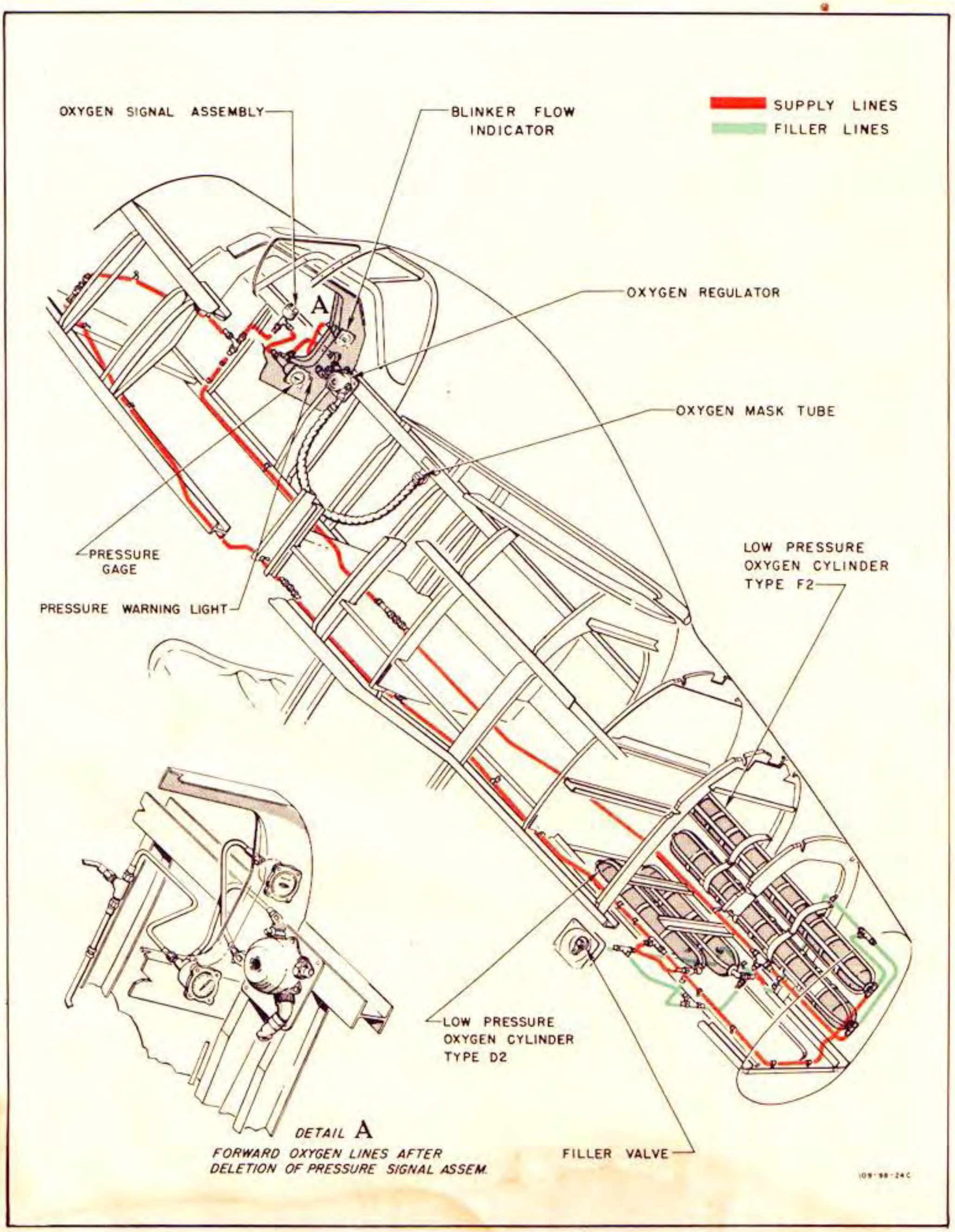


Figure 452—Oxygen System Diagram

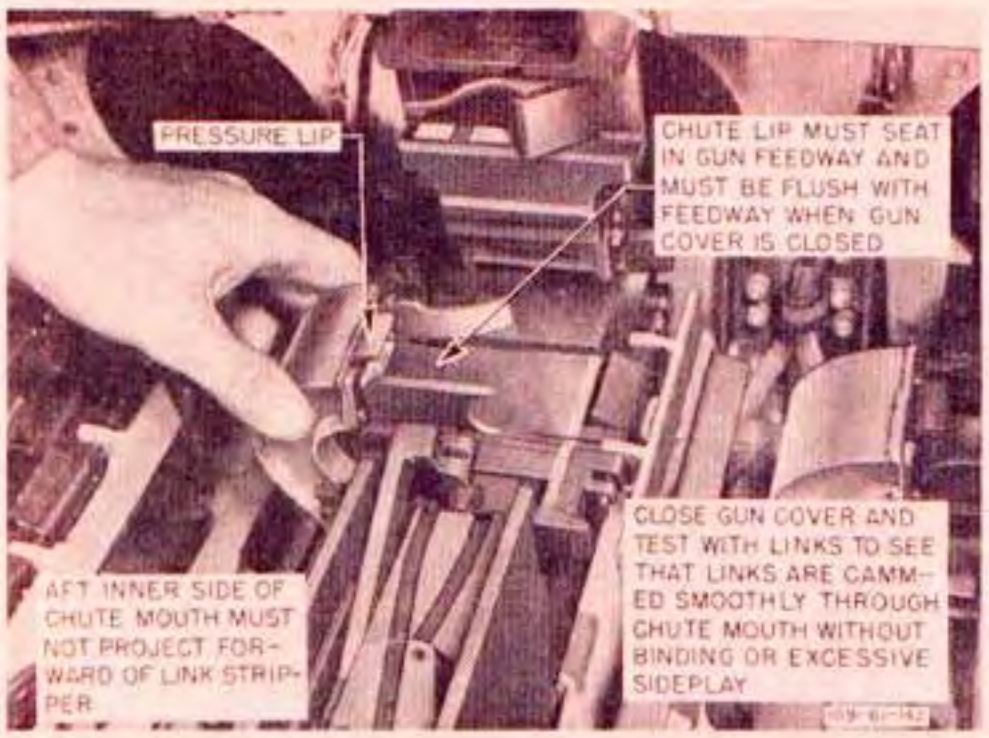
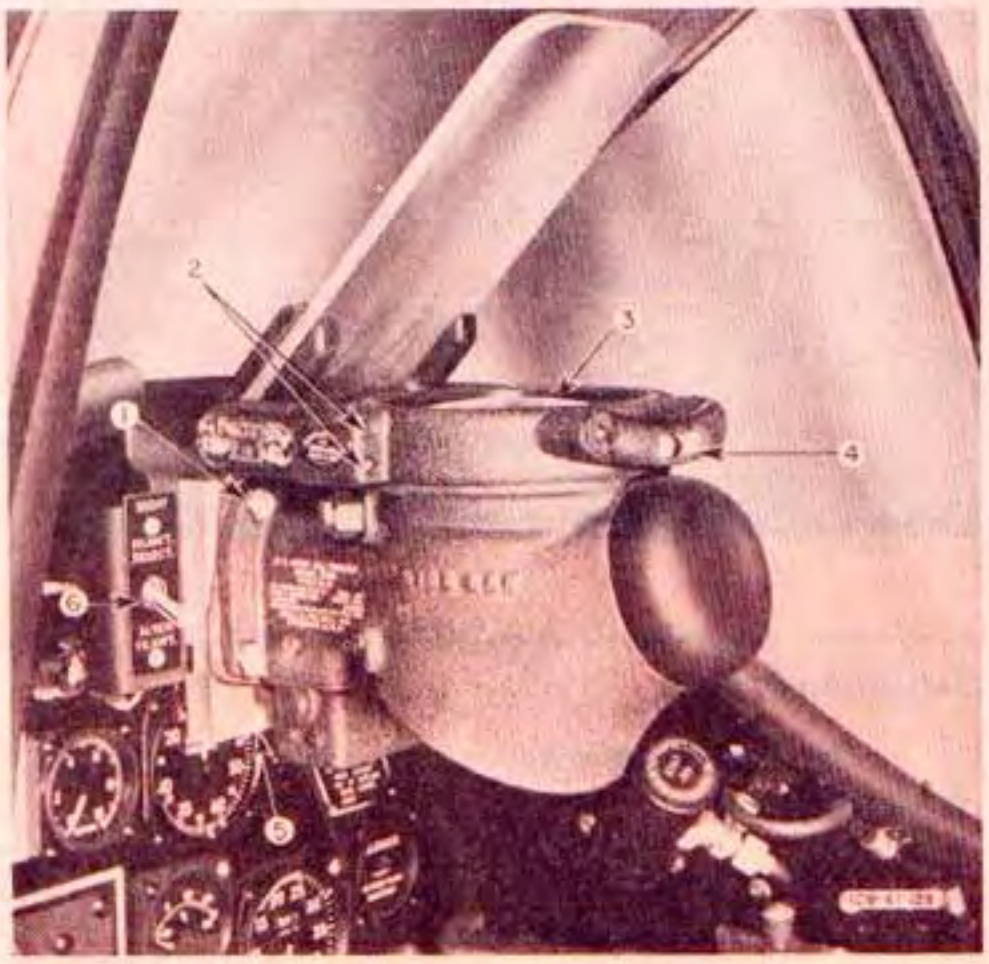


Figure 445—Checking Link Ejection Chute



1. AN4-14A Bolts, 4 Req.
   AN365-428 Nuts, 4 Req.
   AN960-416 Washers, 6 Req.
2. To adjust sight line in elevation, back out one screw while turning in the other screw.
3. To adjust sight line in azimuth, loosen setscrew and rotate head on gun sight.
4. Auxiliary bank-and-turn indicator. Loosen mounting bolts and adjust sight so indicator coincides with bank-and-turn indicator.
5. Adapter for alternate sight position.
6. Sight lamp alternate filament switch.

Figure 446—Type N-9 Gun Sight Installation

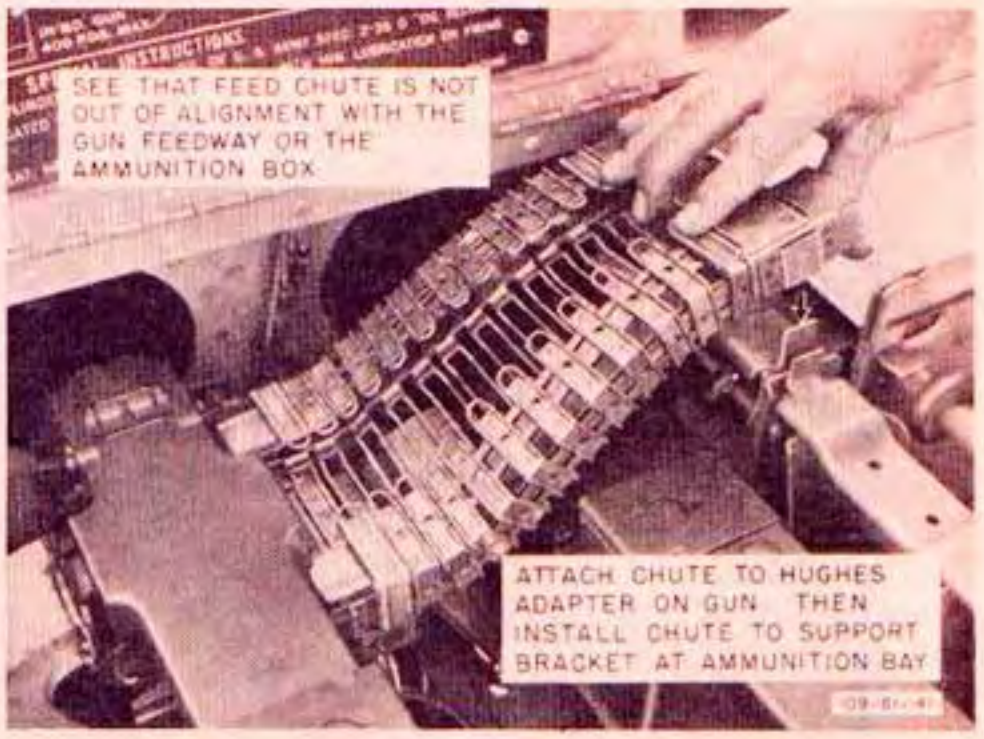


Figure 447—Installing Feed Chute

(7) ADJUSTING OIL BUFFER FOR SPEED OF FIRING.

(a) Remove the gun backplate and rotate the oil buffer tube counterclockwise (toward O) until it ceases to click.

(b) Turn the oil buffer tube clockwise to the first click. Then turn the tube clockwise two additional clicks. This setting gives the best operating condition at highest rate of fire.

Note

Turning the tube clockwise so the arrow moves toward C (closed) lessens the speed of firing, and turning it counterclockwise toward O (open) increases the speed of firing. The tube should not be turned so far that the arrow goes beyond the lines coinciding with C and O.

(8) INSTALLING GUNS.

Note

Do not rest or slide guns on wing structure aft of gun bay.

(a) Insert gun barrel into ball socket located forward of gun bay in leading edge of wing; then lower gun and engage front mount pin and rear mount clamp. Finger-tighten rear mount clamp lockscrew.

(b) Connect solenoid and heater wires.

Note

To prevent failure of gun solenoid connector plugs, do not use pliers to tighten them; tighten them with fingers and safety with tape.

(c) Raise gun cover and install applicable link ejection chute *(figure 445)*; then carefully close gun cover to hold chute into position.

(d) Install feed chute. *(See figure 447.)*

e. GUN HEATERS.

(1) DESCRIPTION.—A Type J-1 or a Type J-4 electric gun heater is installed on the coverplate of each gun *(figures 443 and 444)* and is controlled by a switch on the right switch panel.

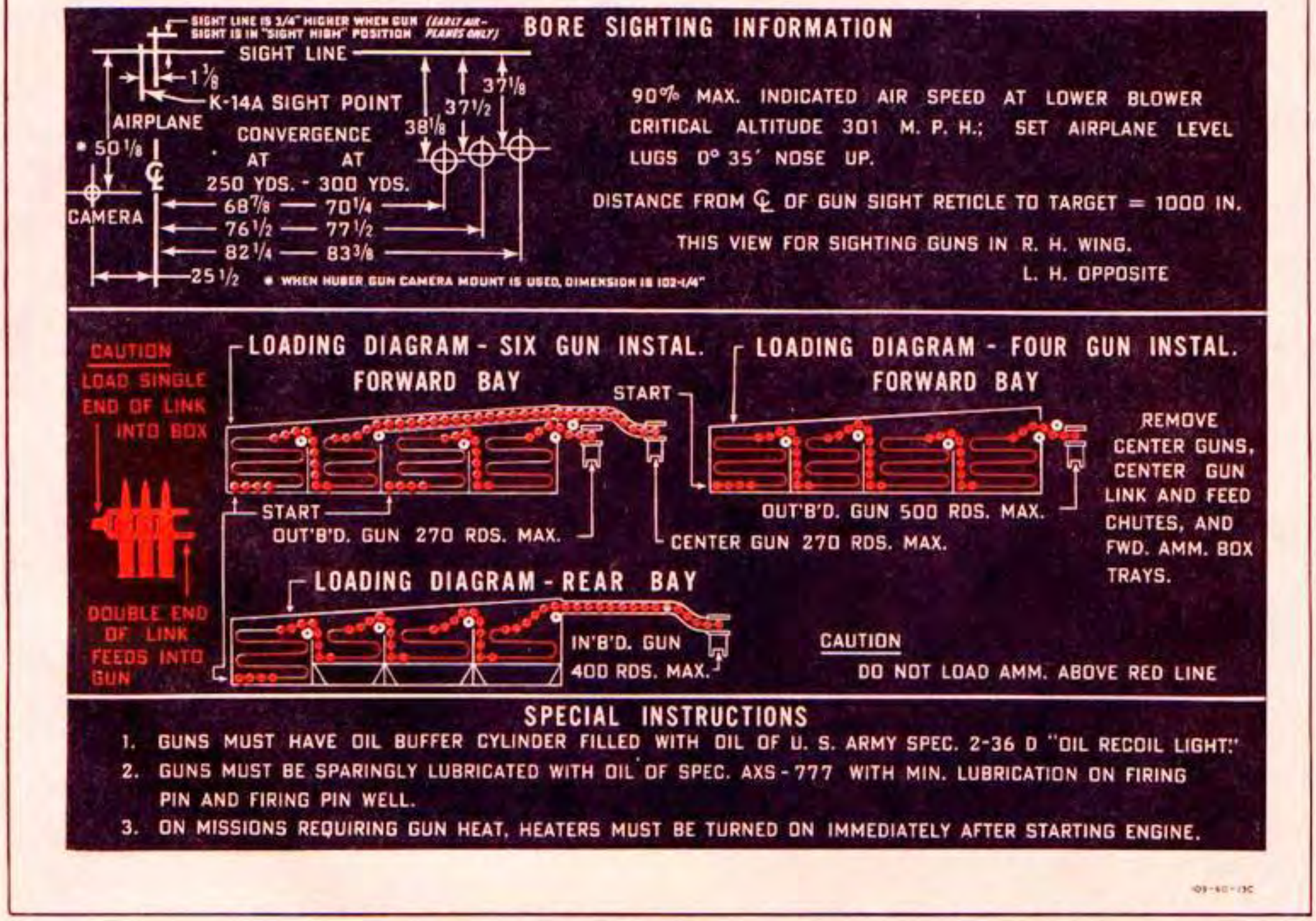


Figure 448—Gun Bay Instruction Plate

(2) REMOVING GUN HEATER.

(a) Disconnect the plug.

(b) Raise gun cover.

(c) On Type J-1 heater, press the sides of heater slightly inward and swing bars clear of the heater body.

(d) Spread sides of the heater slightly outward to clear the edges of gun cover, and remove heater.

(3) INSTALLING TYPE J-1 GUN HEATER.

(a) Raise gun cover.

(b) Swing bar of heater clear of heater body; spread heater slightly and with arrow pointing forward, place firmly upon top of gun cover, being sure underside of heater seats on cover.

(c) Swing clamp bars into latches.

(d) Lower cover taking care that copper pad passes side of gun cover smoothly.

(e) Install connector plug.

(4) INSTALLING TYPE J-4 GUN HEATER.

(a) Raise gun cover.

(b) Mount gun cover as shown on instruction plate on side of heater.

(c) Close gun cover.

(d) Install connector plug.

f. GUN SIGHT.

(1) TYPE N-9 GUN SIGHT (Early Airplanes).

(a) DESCRIPTION.—A Type N-9 gun sight, equipped with a fixed reflector, is installed on the center of the instrument panel shroud. *(See figure 446.)* A Type O-1C rheostat, on the front switch panel, turns on a double filament gun sight lamp (Mazda 844), and controls the light intensity of the reticle image on the reflector. A switch, on the left of the gun sight, directs current from one filament to another in case of necessity. On some of these airplanes, the gun sight can be mounted either in a "SIGHT LOW" or "SIGHT HIGH" position, depending upon the natural sighting position of the pilot. Spare gun sight lamps are mounted on the left underside of the instrument panel shroud.

(b) REMOVING AND INSTALLING TYPE N-9 GUN SIGHT. *(See figure 446.)*

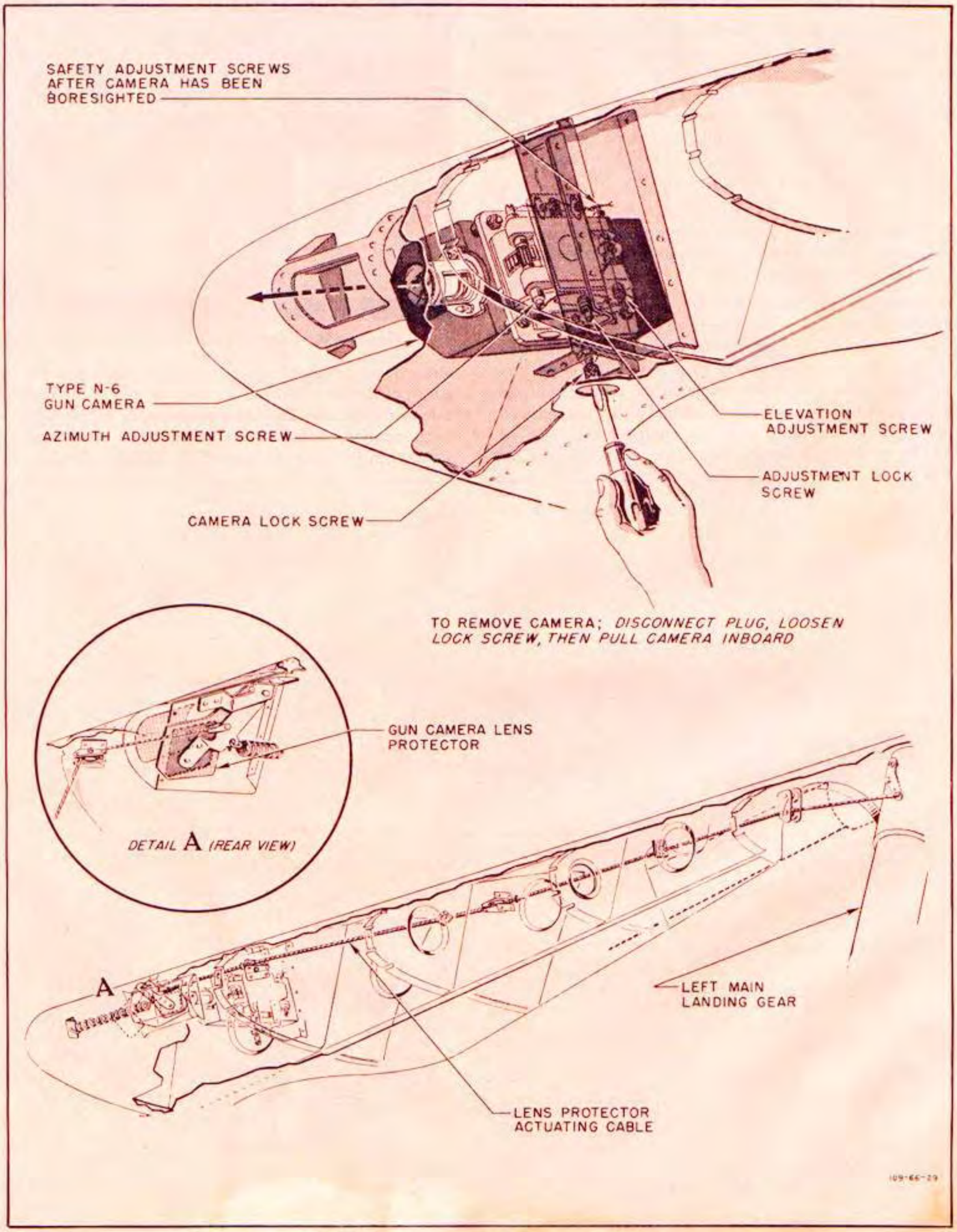


Figure 449—Gun Camera Installation—Late Airplanes

(2) TYPE K-14A GUN SIGHT (Later Airplanes).

(a) DESCRIPTION.—The Type K-14A gun sight *(figures 439A and 439B)* is a precision gyroscopic type which automatically computes the proper lead on the target airplane. The gyro is operated by a pulley on the governor end of the armature in the series-wound, direct-current motor. Elevation and range coils are fastened to the gyro housing and arranged around the gyro dome to obtain the desired electrical compensating effects.

CAUTION

Make no attempt to adjust the position of the coil pole pieces in the field, as this will destroy the calibration of the gyro.

A carbon pile type voltage regulator, on the right side of the cockpit, maintains a constant voltage of 22 (±.5) volts. The sight has two reticle images: a fixed image on the left side of the reflector consisting of a cross and 71-mil circle, and a compensating gyro reticle image on the right side of the reflector consisting of a center bead and a ring of diamond-shaped dots. The fixed reticle image circle can be blanked out by the lever on the left side of the sight. Selection of either fixed or compensating image, or both, is made by means of the selector-dimmer switch assembly, on the right side of the cockpit. The fixed reticle image is provided for harmonization, maintenance checks, and as an emergency sight when the compensating reticle fails. The fixed reticle

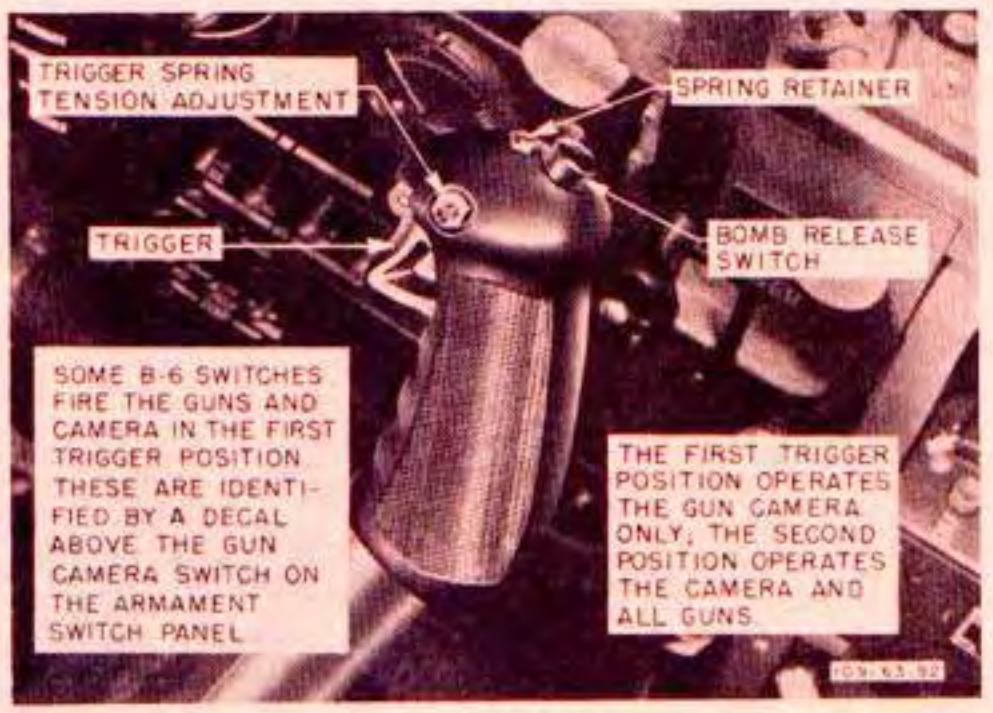


Figure 450—Control Stick Switch—Type B-6

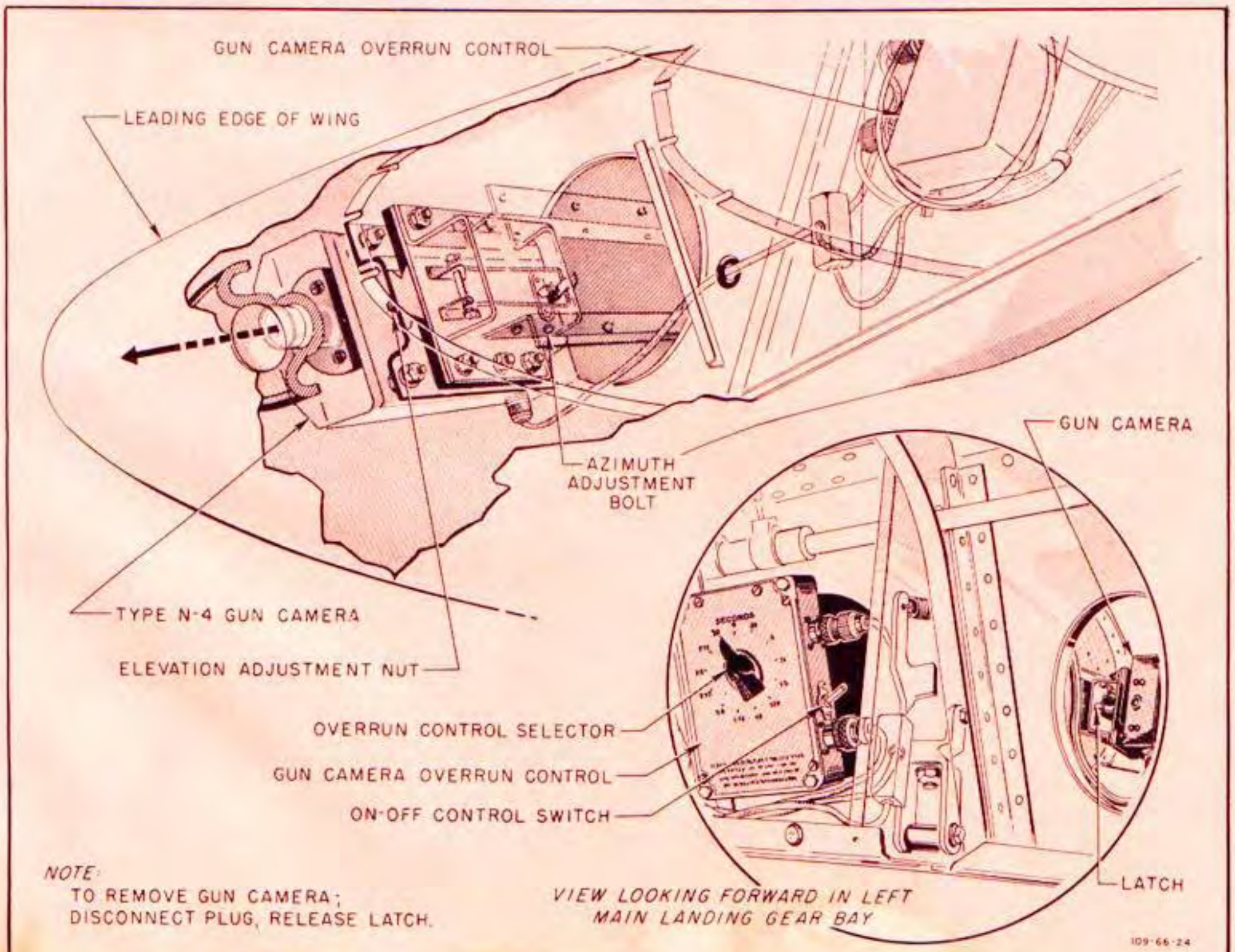


Figure 451—Gun Camera Installation—Early Airplanes

also has range lines for rocket aiming. The diameter of the compensating reticle ring is varied either by changing the setting of the span knob on the front of the sight, or by rotating the range twist grip on the throttle.

CAUTION

Keep protective cover on sighting head whenever the sight head is not in operation.

(b) REMOVING AND INSTALLING K-14A GUN SIGHT. *(See figures 439A and 439B.)*

g. GUN CAMERA INSTALLATION.

(1) GUN CAMERA.—A 24-volt Type N-4 or N-6 gun camera *(figures 449 and 451)* is in the left wing on the inboard side of station 29.25 rib. The camera body contains shutter, motor, drive mechanism, a reset film footage indicator, a Type A-6 film magazine, and on the Type N-6 camera, a built-in overrun control. The Type N-4 camera has a separate overrun control. *(See figure 451.)* The camera can be set for speeds of 16, 32, or 64 frames per second. The plain lens assembly consists of a 35 mm f/3.5 telephoto lens, a sunshade, and a No. 12 minus-blue interchangeable glass filter. The diaphragm stops are marked "BRIGHT," "HAZY," and "DULL."

Note

The camera knurled-head lockscrew should be tightened finger-tight only (approximately 3 inch-pounds).

(2) GUN CAMERA MOUNTS.—Two types of gun camera mounts are used. The NAA type mount *(figure 451)* is used on early airplanes. The Type C-1 (Huber) mount *(figure 449)*, with additional servicing access provisions, is used on later airplanes.

(3) ADJUSTING GUN CAMERA.—See harmonizing procedure. *(See paragraph c.* (11) *and figures 449 and 451.)*

(4) GUN CAMERA LENS PROTECTOR.—On early airplanes, the opening in the leading edge of the wing for the gun camera is covered by glass. On late airplanes, this opening is sealed by a spring-loaded metal plate which is actuated by a cable attached to the left main landing gear. *(See figure 449.)* The cable closes the plate against the spring when the landing gear is lowered. Retraction of the gear allows the spring to open the plate.

h. ZERO RAIL ROCKET LAUNCHERS. *See figures 451A and 451B.)*—Three removable zero rail launchers are installed under each wing for supporting T64 (5-inch

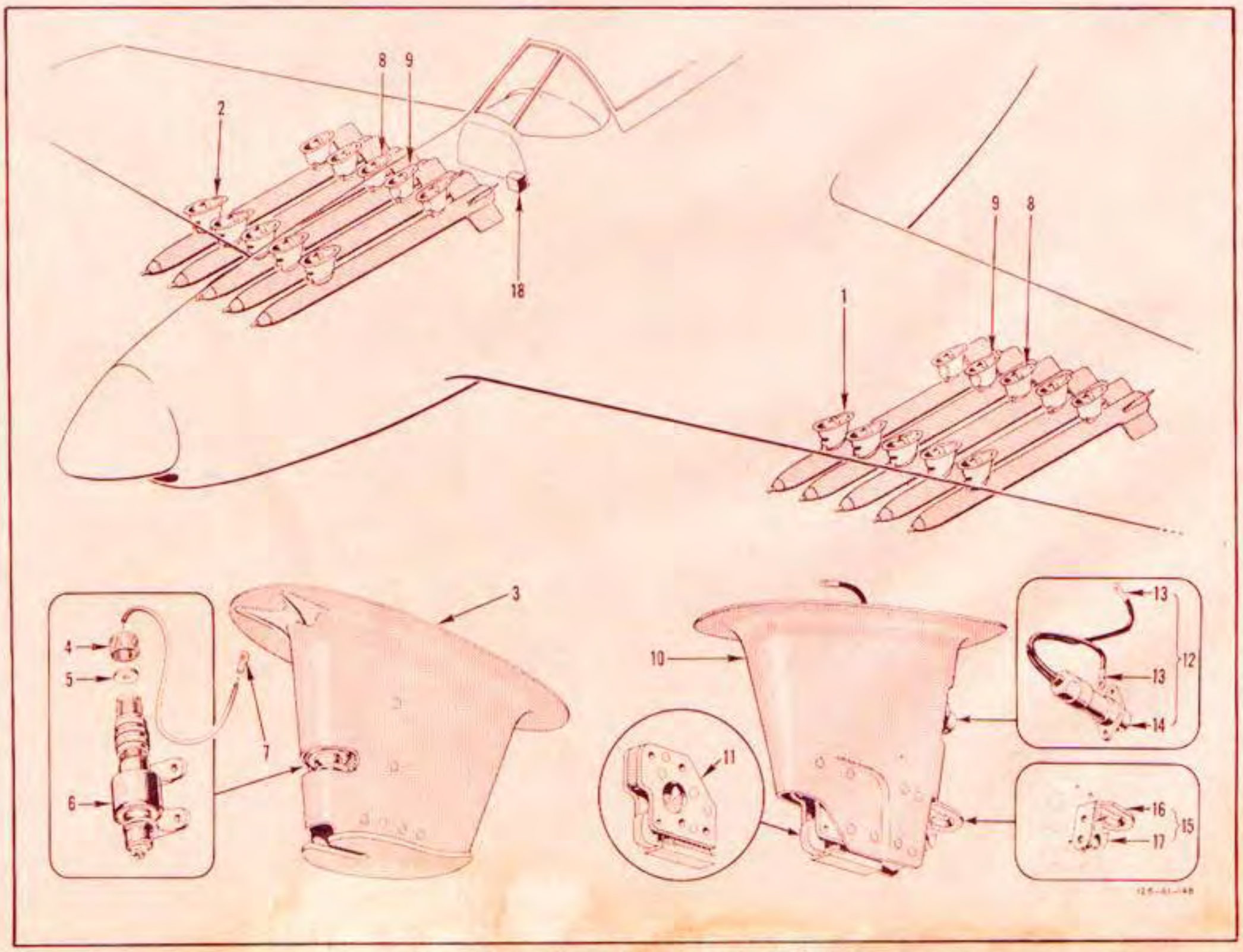


Figure 451A—Zero Rail Rocket Installation

H.V.A.R.) rockets. The launchers support the rockets parallel to the fuselage reference line. Two additional launchers for each wing are stowed in the ammunition bays, and can be installed when the bomb racks are not being carried. Each launcher consists of a front mount which contains the arming solenoid, and a rear mount which has a rocket igniter plug receptacle and a supporting latch. The rear mount also incorporates a cutting knife for shearing the rocket igniter wire. A rocket control box incorporating an intervalometer and switches is mounted on the front switch panel. Range lines on the fixed reticle of the K-14A gun sight are provided for rocket aiming. The screws securing the rocket mounts are all of the same length. When the mounts are removed, it is necessary to replace the screws only in those holes designated on lower surface of wing. The second outboard mount on each wing must be removed before the airplane can be jacked.

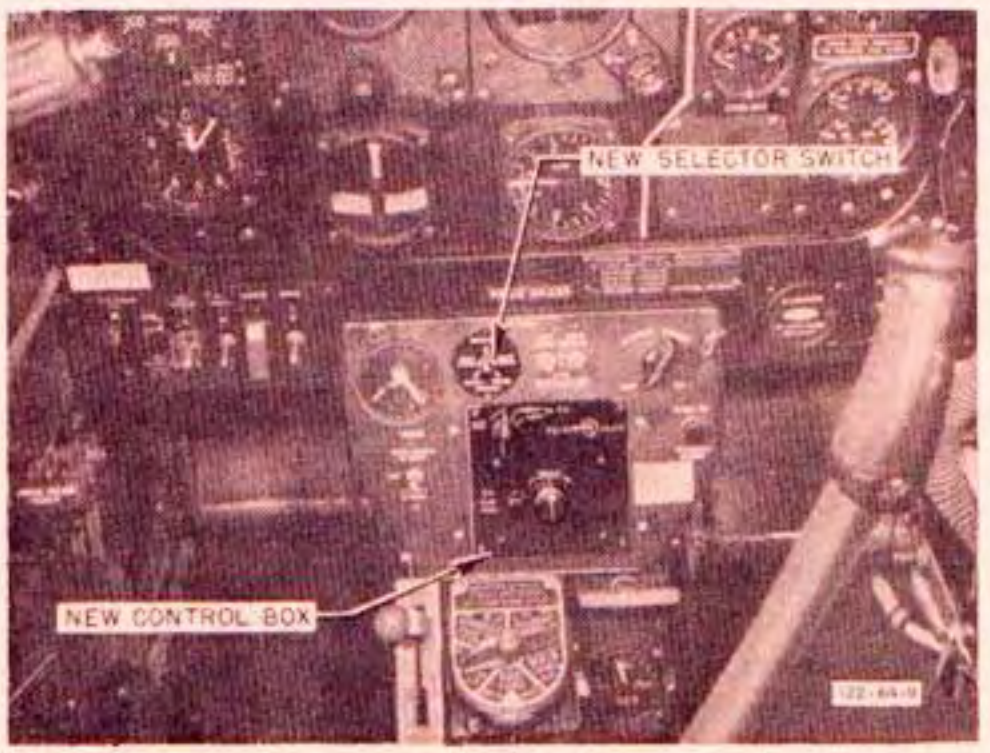


Figure 451B—Rocket Controls

	NO. REQ.
1. Left Front Mount Assembly	5
2. Right Front Mount Assembly	5
3. Front Mount	10
4. AN3054-3 Nut	10
5. Washer	10
6. 43B9887 Control Assembly (GFE)	10
7. AN659-2	10
8. Rear Mount Assembly (3 Outboard on Each Wing)	6
9. Rear Mount Assembly (2 Inboard on Each Wing)	4
10. Rear Mount	10
11. Rear Mount Latch Assembly (45B4656—GFE)	10
12. Rear Mount Receptacle Assembly	10
13. Terminal	20
14. Q237 Plug Jack (GFE)	10
15. Rear Mount Knife Support	10
16. Firing Wire Knife	10
17. Firing Wire Clip	10
18. Specification No. 24867, Release-type A-1 (GFE)—Control Box on Instrument Panel	1

Key to Figure 451A

24. OXYGEN SYSTEM.

a. GENERAL DESCRIPTION OF OXYGEN EQUIPMENT.—The low-pressure oxygen system consists of two D-2 and two F-2 type built-in oxygen cylinders, a pressure gage to indicate oxygen pressure within the cylinders, a demand-type regulator for automatic oxygen flow control, a blinker flow indicator which warns the pilot if the oxygen flow becomes irregular, a warning light which goes on when the pressure drops below 100 pounds per square inch, and a Type A-9, A-9A, A-10, or A-14 mask. The units are connected by standard lines and fittings, which include a filler valve and check valves. A mask tube and fitting are connected to the adjustable elbow on the regulator. *(See figure 452.)*

CAUTION

Oil in oxygen system will cause explosion. Handle oxygen equipment carefully, and keep free from dirt, moisture, oil, and grease. *(See section III, paragraph 2. b. (4) for recharging instructions.)*

b. TESTING OXYGEN SYSTEM.

(1) Fill system to 400 pounds pressure.

(2) Test for leaks by painting all joints with soap solution, and eliminate all such leaks.

Note

All parts tested with soap solution shall be carefully wiped clean and dry immediately after test.

(3) Allow system to cool to outside temperature.

(4) Mark position of pressure gage pointer on the gage coverglass, and allow system to remain undisturbed for 4 hours.

(5) If the pointer has not moved from position at the end of 4 hours, the system shall be considered acceptable.

(6) Make sure that shipping plug has been removed from the regulator outlet elbow.

(7) Turn the emergency valve of the regulator fully on for approximately 30 seconds. There should be a free continuous flow of oxygen with no evidence of line blockage. Turn the emergency valve to "OFF."

(8) Tighten the demand regulator outlet elbow as follows:

(a) Turn the knurled nut of the elbow assembly until it just begins to engage the shoulder of the elbow.

(b) Starting with the elbow ½ turn from the desired final position, turn both the nut and elbow for ½ turn.

(9) Turn the auto-mix lever on the regulator to the "OFF" position. Apply a slight suction at the regulator outlet elbow. The blinker flow indicator should function freely with each application of suction. Turn auto-mix lever back to "ON" position after testing blinker.

Note

Do not tap or handle the diaphragm knob.

(10) Securely clamp the mask-to-regulator tubing to the outlet elbow.

c. OXYGEN SYSTEM TROUBLE SHOOTING.

TROUBLE	PROBABLE CAUSE	REMEDY
Oxygen pressure drop.	Normal loss due to cooling of oxygen after filling system.	Add oxygen.
	Leak in system.	Check for leaks.
Regulator fails to deliver oxygen.	Clogged connection line.	Disconnect the regulator and blow oxygen from the cylinders through the connection tubing to remove the obstructions.
	Clogged screens.	Replace regulator.
	Failure of demand valve stem to operate.	Replace regulator.
	Dirt in oxygen inlet orifice.	Replace regulator.
Regulator delivers only pure oxygen or improper mixture.	Broken aneroid assembly. Maladjustment of aneroid and throttling plate assembly.	Replace regulator.

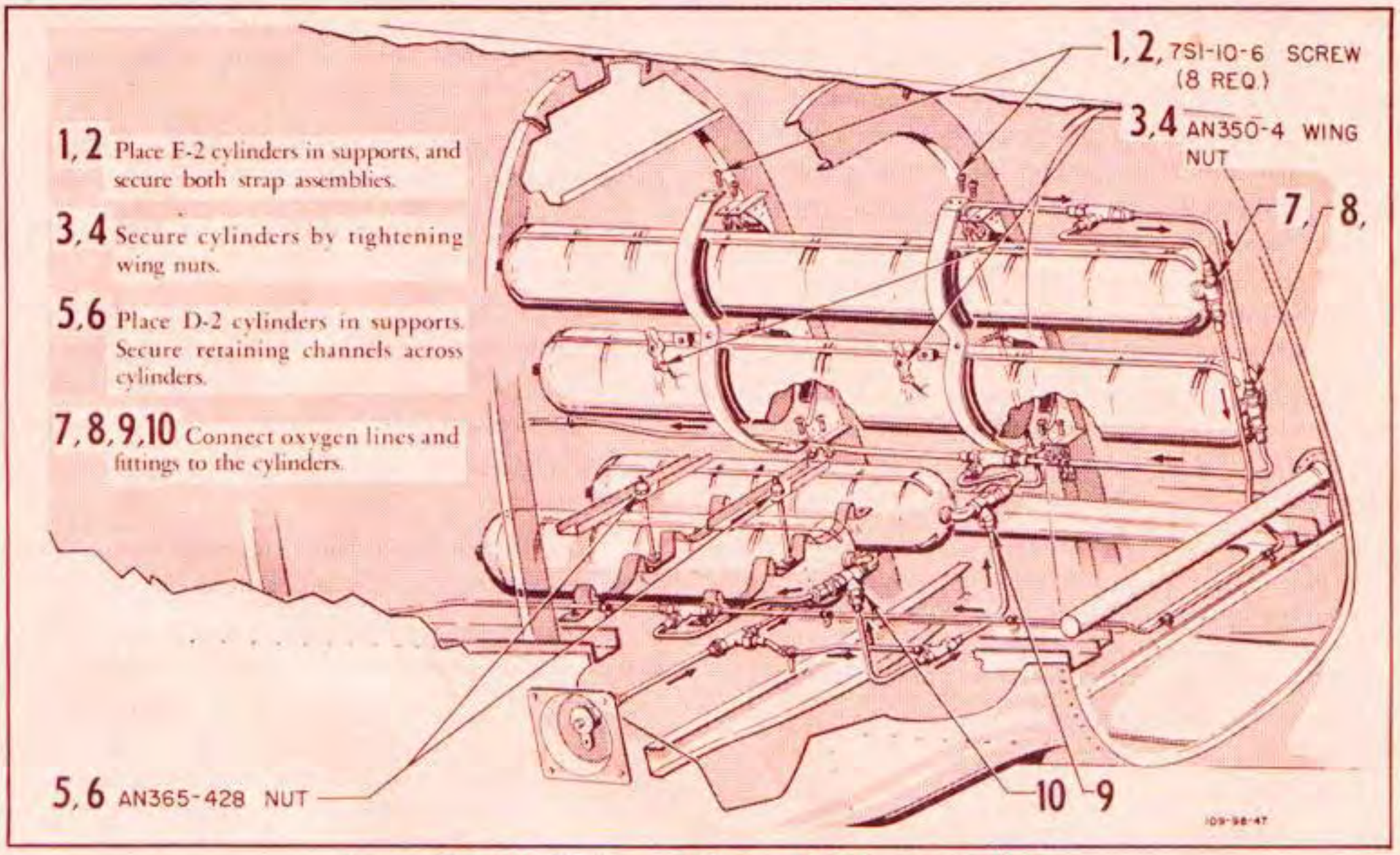


Figure 453—Installation and Removal of Oxygen Cylinder

d. OXYGEN CYLINDERS.

(1) DESCRIPTION.—The oxygen system uses two D-2 and two F-2 type low-pressure cylinders. Each D-2 cylinder has an internal volume of 500 cubic inches and an effective capacity of 6.9 cubic feet. Each F-2 cylinder has an internal volume of 1000 cubic inches, and an effective capacity of 13.8 cubic feet. The cylinders are installed inside of the fuselage, just aft of the fuselage tank. *(See figure 452.)* The filler valve is accessible through a dzus-fastened door on the left side of the fuselage.

(2) MAINTAINING OXYGEN CYLINDERS.

(a) Check cylinders for cleanliness.

(b) Clean spud threads with a stiff, dry brush.

(c) If the insides of the cylinders need cleaning, tumble them with shot, then wash with carbon tetrachloride, and allow to dry.

(d) Rinse with isopropyl alcohol (AAF Specification No. 14082A), and dry thoroughly by blowing oxygen through the cylinders.

WARNING

Do not use compressed air, since it may contain moisture which will freeze and clog lines, at high altitudes.

(3) FINAL CHECK BEFORE INSTALLATION.—Examine cylinders for chipped, scarred, or corroded areas. If necessary, refinish with zinc chromate primer, Specification No. AN-TT-P-656. Replace all weakened and dented cylinders.

(4) INSTALLING AND REMOVING OXYGEN CYLINDERS. *(See figure 453.)*

e. OXYGEN REGULATOR VALVE.

(1) DESCRIPTION.—The oxygen system employs a Type AN6004 demand regulator which automatically controls the flow and dilution of the oxygen. *(See figure 454.)* The regulator is installed on the right side of the cockpit, just aft of the instrument panel. A diaphragm actuates a valve which permits oxygen to flow through the regulator, where it mixes with free air in varying amounts in accordance with barometric pressure. A control permits the user to close the air intake, thus causing pure oxygen to flow to the mask. A red knob actuates an emergency valve which causes pure oxygen to by-pass the entire regulator mechanism. Another valve automatically shunts oxygen into the blinker flow indicator as the demand valve operates.

Note

On later airplanes the Type A-14, demand-diluter regulator is installed. This regulator operates as a demand regulator to an altitude of 32,000 feet. Above 32,000 feet the control knob may be turned to a higher altitude indication to cause the regulator to deliver pure oxygen under pressure, regardless of the position of the automatic mixture lever. If the automatic mixture lever is at "100 percent oxygen," pure oxygen is delivered at any altitude.

(2) FINAL TEST BEFORE INSTALLATION.—Before installing a new or different regulator, be sure it is

the proper type (AN6004) and has been inspected and approved for use. See that the control valve works freely and that the diaphragm is undamaged. The regulator is a delicate instrument and must be handled carefully.

f. OXYGEN MASK AND MASK TUBE.

(1) DESCRIPTION.—The oxygen system is designed for use with an A-9, A-10, A-10A, or A-14 mask. A low-pressure tube assembly (AN6003-4) conducts oxygen from the regulator to the mask intake tube. One end is clamped to the regulator adjustable elbow, and the mask end has a jaw-type stowage clamp.

(2) INSTALLING MASK TUBE.—Loosen the knurled coupling and turn the elbow fitting to desired position; then tighten coupling. Slip the rubber end of mask tube over elbow, and clamp tightly.

(3) CARE OF OXYGEN MASK AND MASK TUBE.—At the end of each day of use, wash the oxygen mask with a mild soap and water solution, rinse in clean water, and dry. Keep both the mask and mask tube out of direct sunlight as much as possible, to prevent deterioration.

Note

On later airplanes the blinker is located adjacent to the oxygen pressure gage.

g. OXYGEN PRESSURE GAGE.

(1) DESCRIPTION.—An AN6021 gage, installed in the lower right section of the instrument panel, indicates the amount of oxygen in the cylinders. The dial is calibrated in 50-pound graduations from 0 to 500, and a spring-loaded needle, linked to a curved bourdon tube, indicates pounds per square inch pressure.

(2) FINAL TEST AND ADJUSTMENT BEFORE INSTALLATION. *(See figure 455.)*

h. OXYGEN PRESSURE WARNING SIGNAL AND SWITCH.

(1) DESCRIPTION.—The warning signal light in the lower right corner of the instrument panel is automatically turned on and off by a Type G-1 pressure signal switch. The switch is located forward of the instrument panel, on the right side of the oxygen supply line. The warning light and signal switch are fully described in section IV, paragraph 18. *h.* (1) *(a).*

Note

The oxygen pressure warning signal and the switch have been deleted on later airplanes. *(See figure 452, detail A.)*

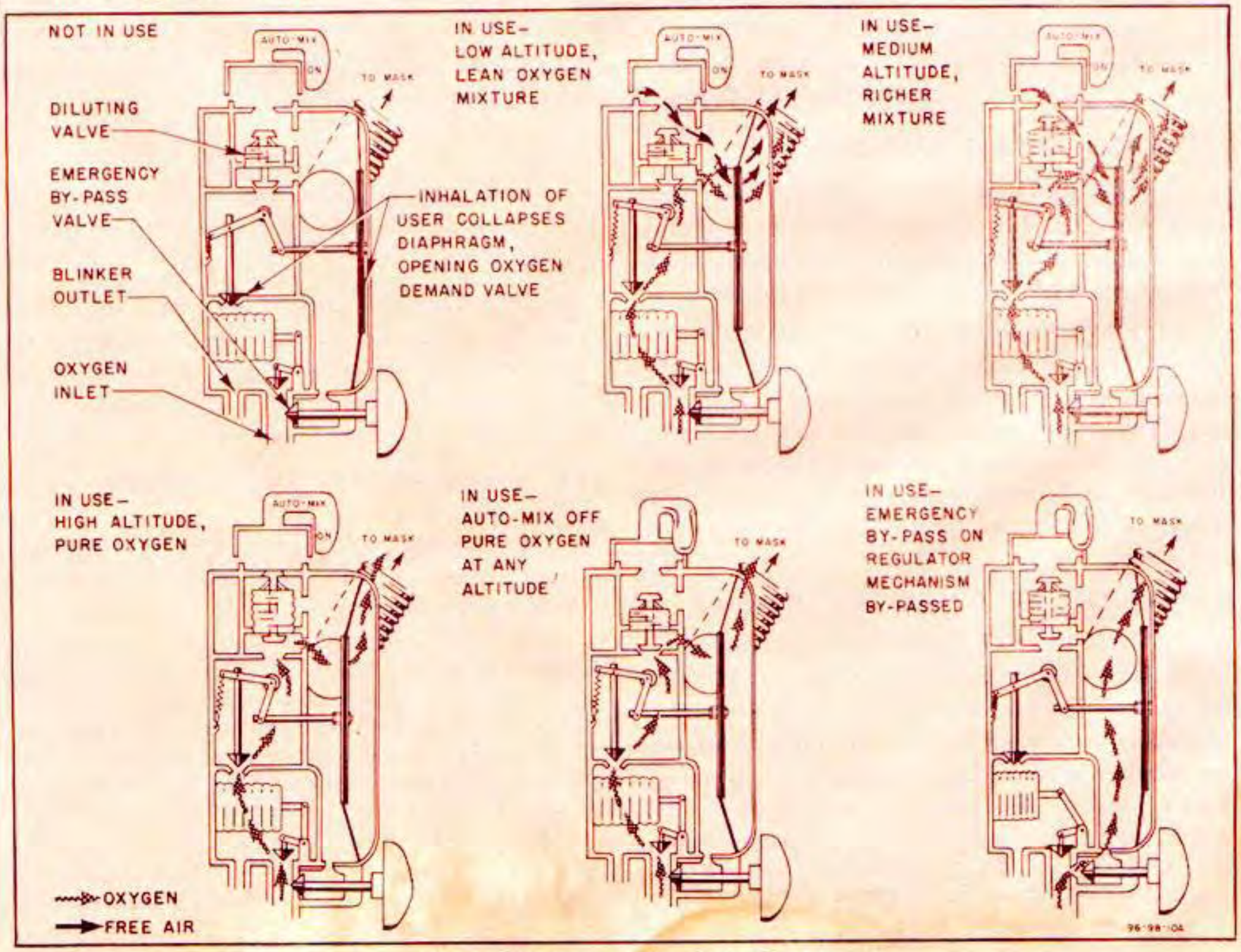
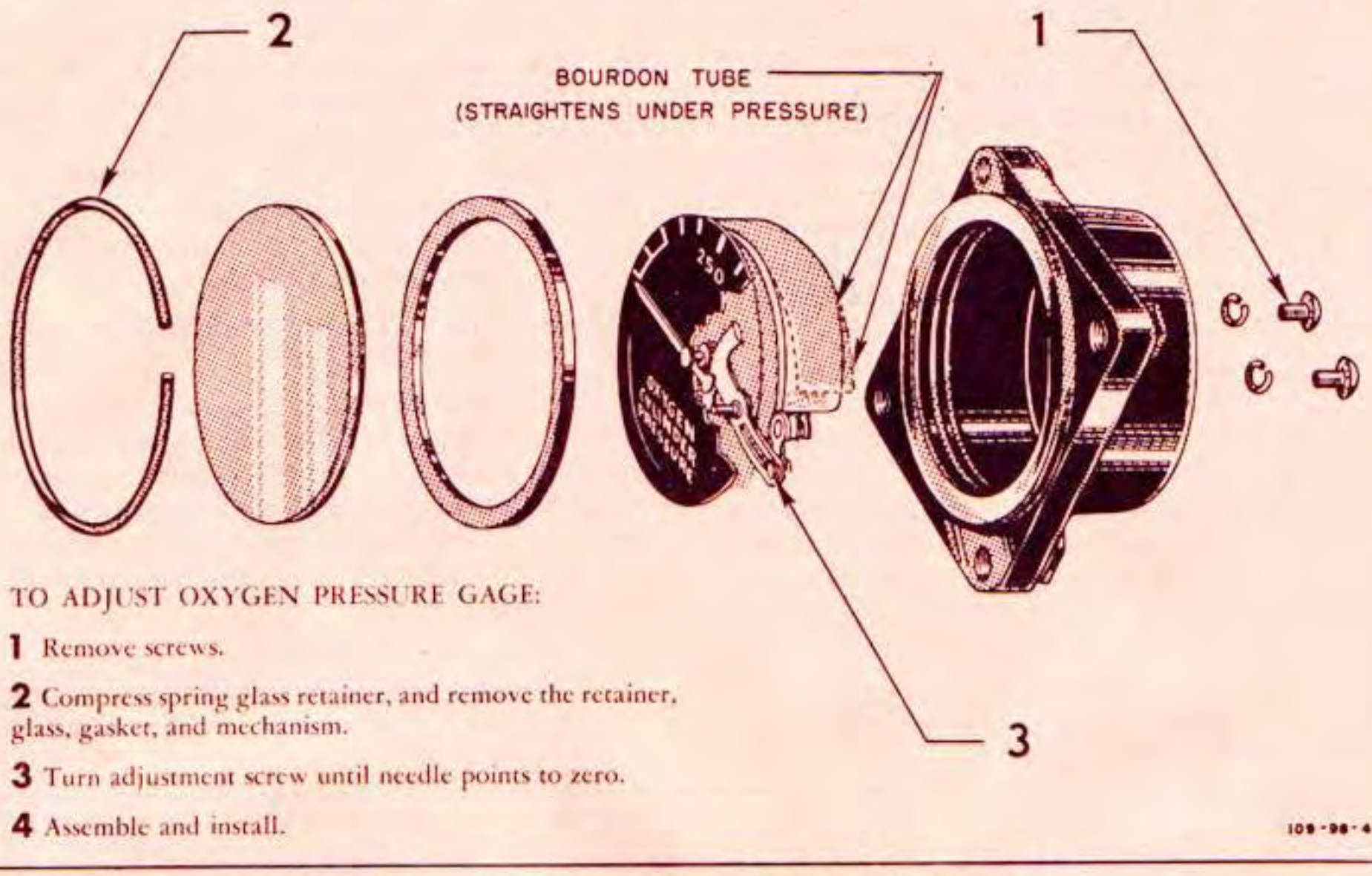


Figure 454—Oxygen Regulator Diagram



TO ADJUST OXYGEN PRESSURE GAGE:

1 Remove screws.

2 Compress spring glass retainer, and remove the retainer, glass, gasket, and mechanism.

3 Turn adjustment screw until needle points to zero.

4 Assemble and install.

109-98-48

Figure 455—Oxygen Pressure Gage Adjustment

i. OXYGEN BLINKER FLOW INDICATOR.

(1) DESCRIPTION.—A Type AN6029 blinker flow indicator is mounted in the upper right section of the instrument panel. A bellows assembly, actuated by the user's breathing, opens and closes a shutter in the indicator face.

(2) FINAL TEST BEFORE INSTALLATION.—Before installing a new or different blinker flow indicator, be sure it is approved for use. To test against leakage, connect the unit to an oxygen supply line, raise pressure to 10 pounds per square inch, and shut off supply. If after 10 minutes the shutters have not begun to close, there is no leakage. If the unit does leak, replace it; do not attempt field repairs.

j. OXYGEN LINES, VALVES, AND FITTINGS.

(1) DESCRIPTION.—Standard lines and fittings connect the units of the system. A Type AN6024-3 filler valve prevents loss of oxygen through the recharging attachment. (An adapter is furnished for use with British recharging equipment.) A check valve at the supply line junction forward of the instrument panel, one at the spud of each of the four cylinders, and one at each junction of supply lines from each cylinder prevent loss of entire oxygen supply in event of leakage in one line or cylinder.

(2) INSTALLATION OF LINES, VALVES, AND FITTINGS.

Note

A tubing assembly diagram and chart for the oxygen system will be found in section VIII of this Handbook.

The check valves have arrows on the arms which indicate proper installation. Always connect the oxygen lines to the check valve with the arrow pointing in the direction of normal oxygen flow. All threads must be treated with approved antiseize and sealing compound.

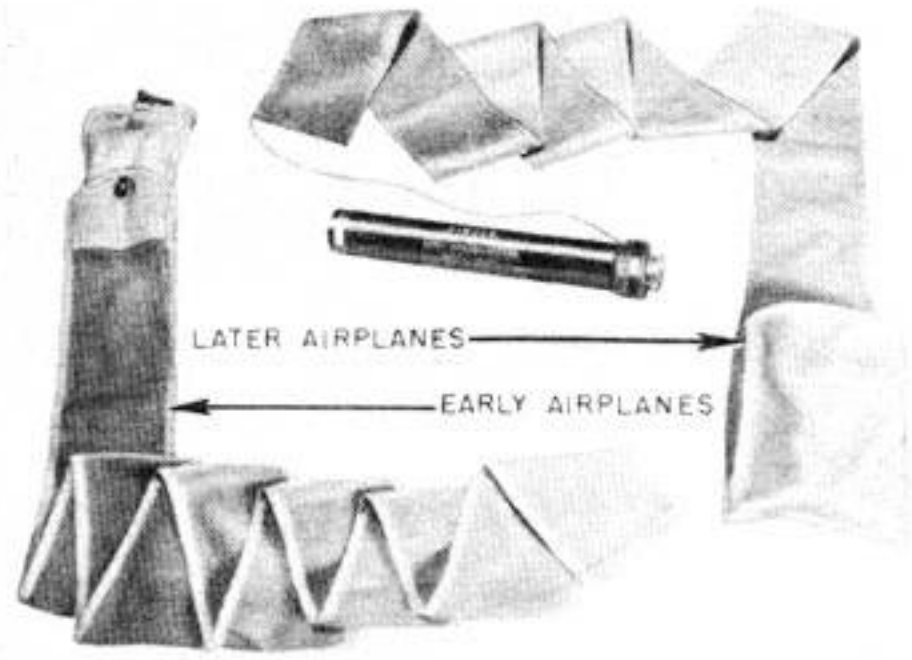
25. FURNISHINGS AND MISCELLANEOUS EQUIPMENT.

a. MISCELLANEOUS EQUIPMENT.—The P-51D Airplanes are supplied with the following miscellaneous and emergency equipment:

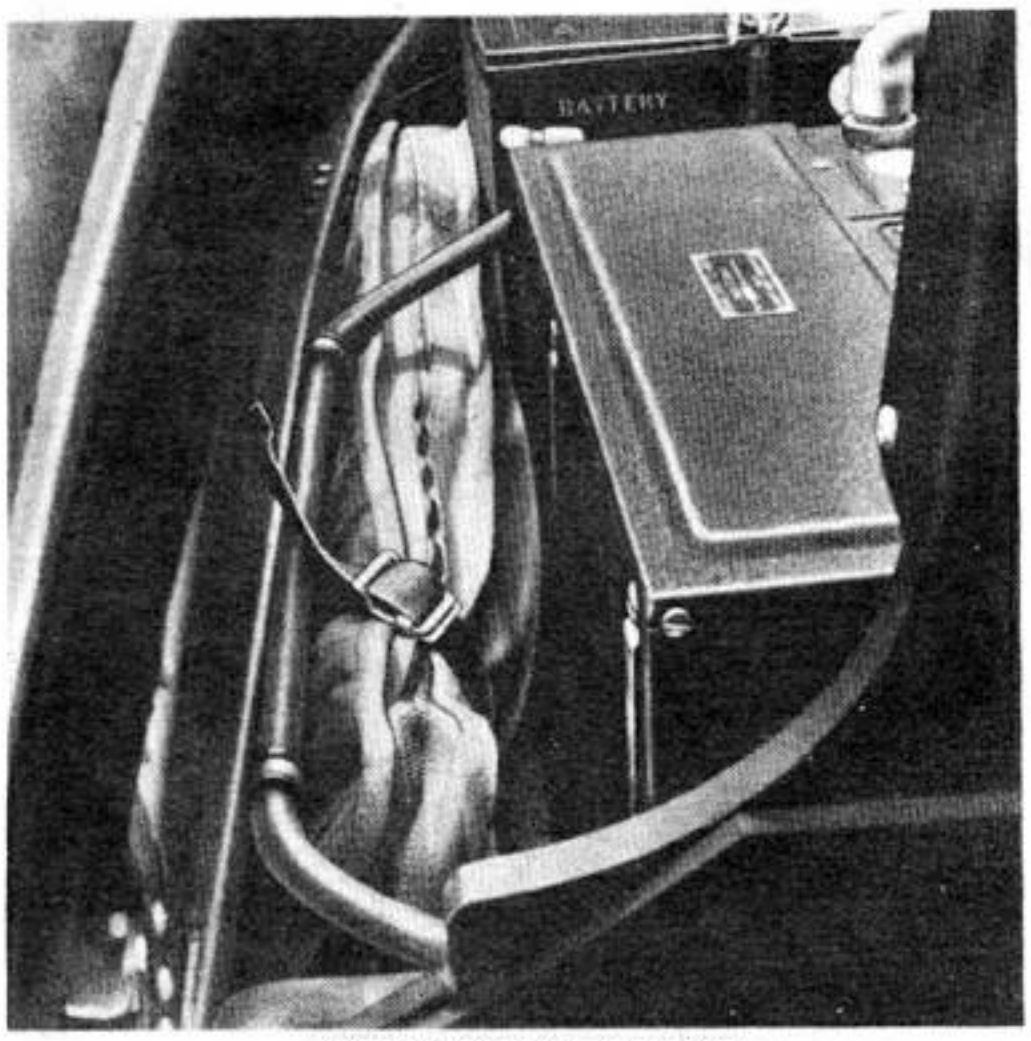
(1) PILOT'S SEAT.—The pilot's seat is adjustable vertically. Two spring-loaded pins, actuated by a lever at the lower right side, snap into holes in the seat post and secure the seat at any one of nine height levels. The pilot's parachute is used as a seat cushion, and the kapok-filled back cushion may be used as a life preserver. Shoulder straps and a safety belt are attached to the seat and are joined by a quick-release safety buckle.

(2) PILOT'S RELIEF TUBE.—The relief horn is stowed on a bracket on the floor left of the pilot's seat.

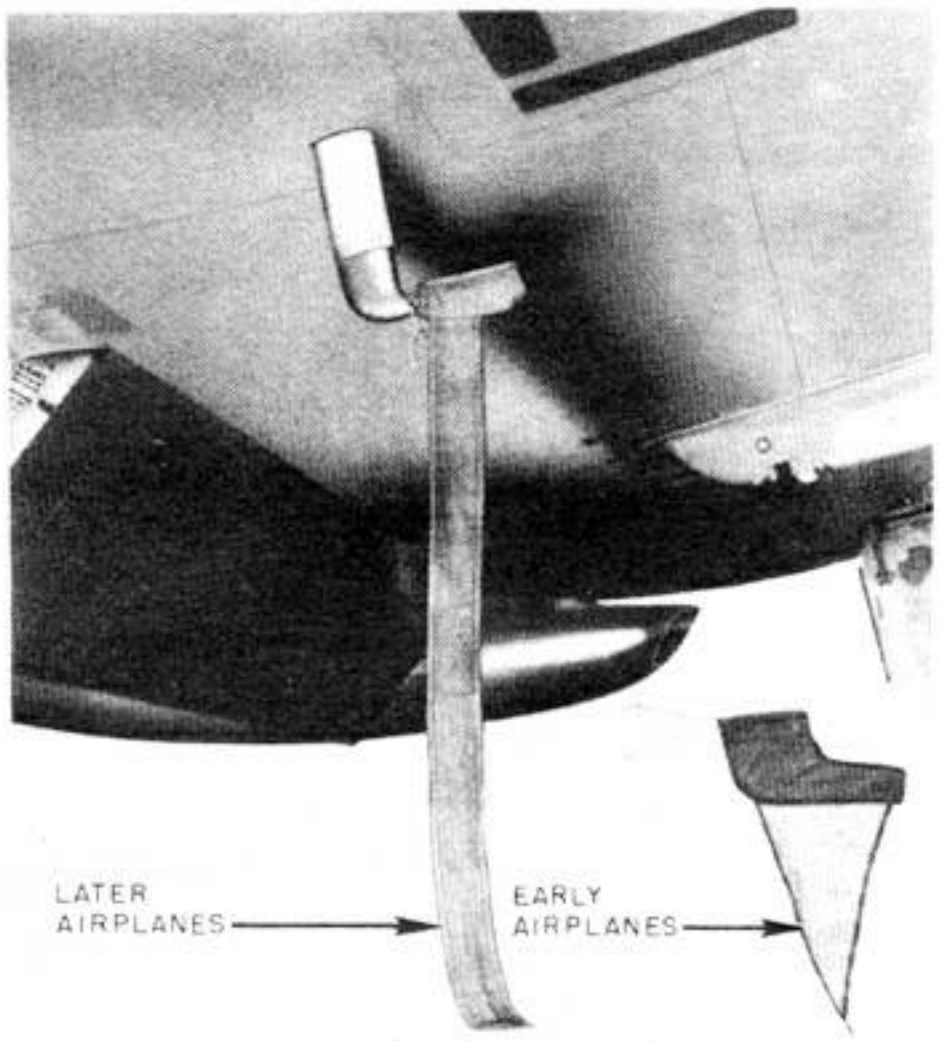
(3) ENGINE STARTING CRANK AND EXTENSION. *(See figure 456.)*—On early airplanes, the engine



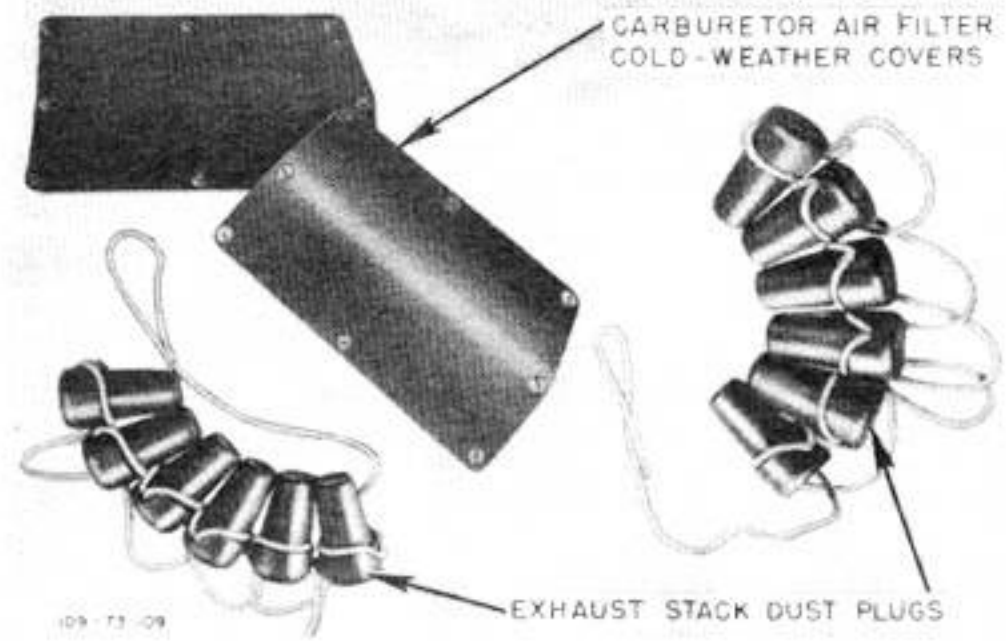
DROP MESSAGE BAG

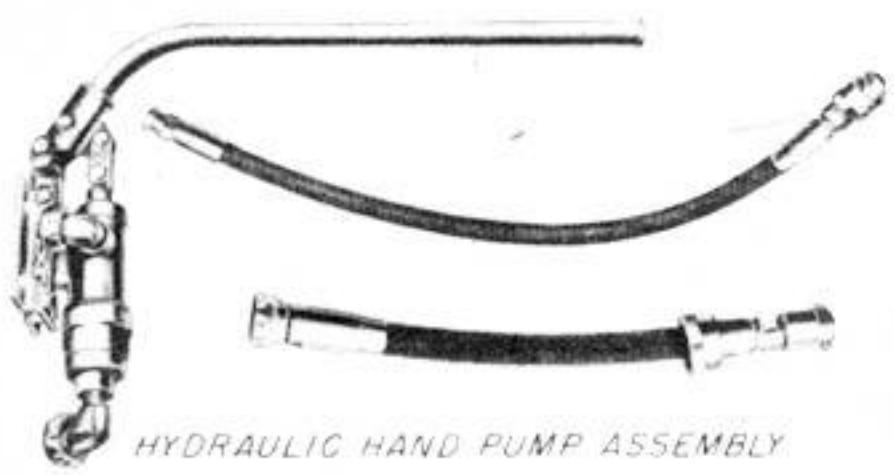


MOORING KIT STOWED



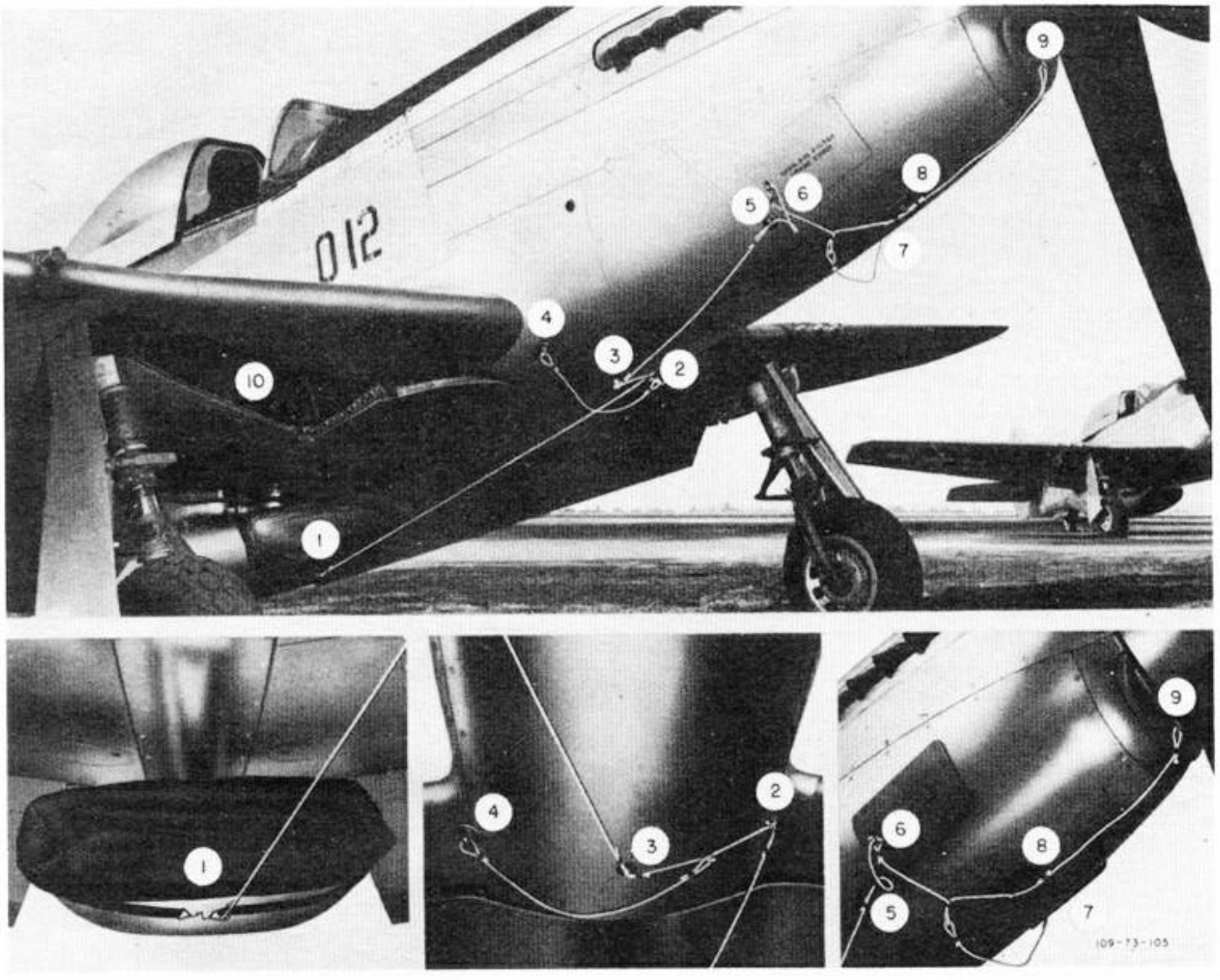
PITOT TUBE COVERS





HYDRAULIC HAND PUMP ASSEMBLY

Figure 456—Miscellaneous Equipment



1 Radiator Air Scoop
2 Oil Overflow Outlet
3 Carburetor Duct Elbow Outlet
4 Drain Box Vapor Outlet
5 Oil Overflow Drain Line
6 Carburetor Filter Air Intake RH
7 Carburetor Filter Air Intake LH
8 Sand Outlet
9 Carburetor Air Intake
10 Inside Wheel Well Covers

Figure 457—Dust Excluder Assembly and Wheel Well Covers Installed

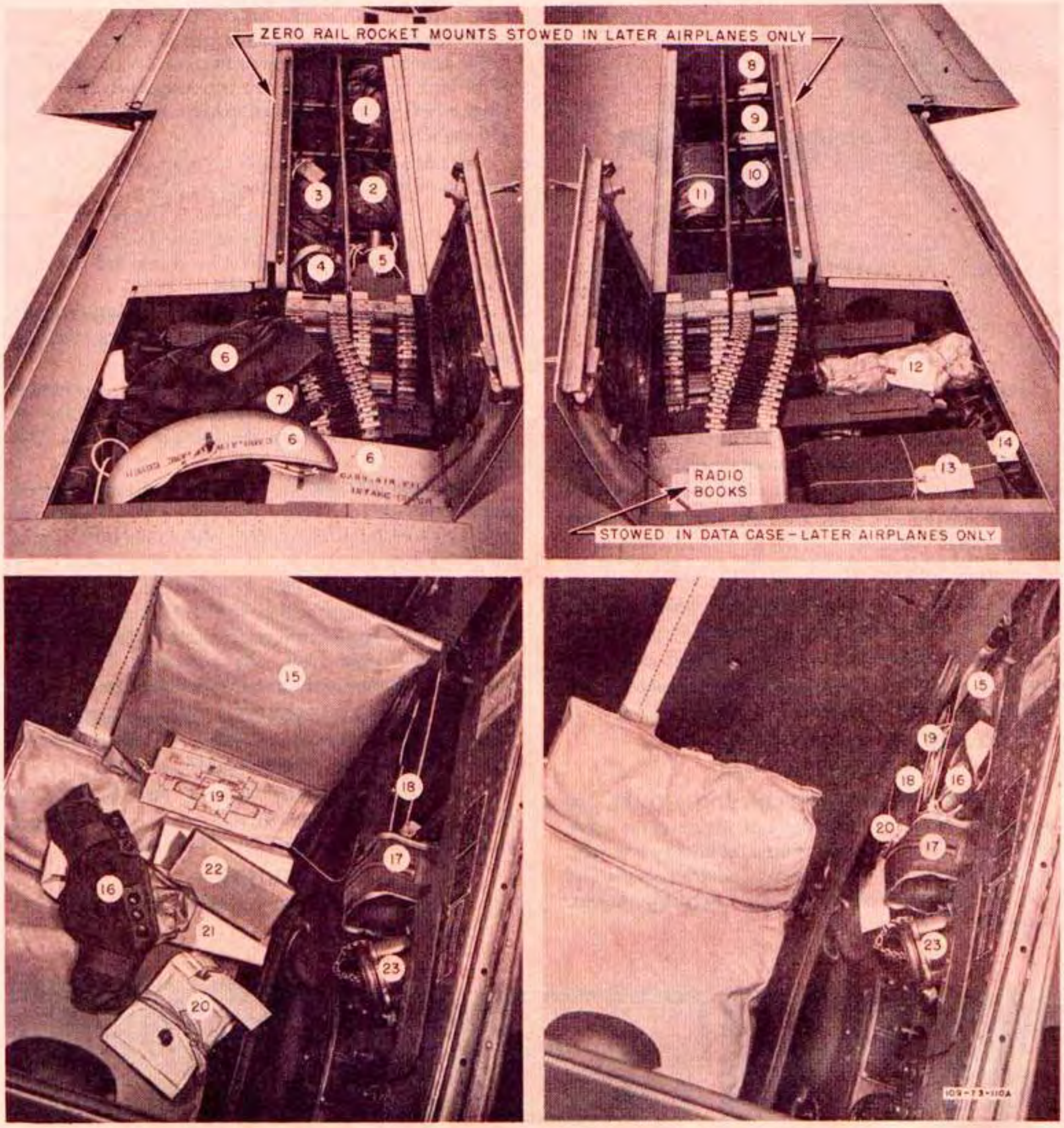
starting crank and extension are stowed in the right landing gear wheel well. A separate bracket holds the extension.

(4) WEATHERPROOF COVERS.—The following weatherproof dust covers and plugs are provided:

(a) DUST EXCLUDER ASSEMBLY.—Nine weather-excluding units are fastened together by sash cord. The length of the cord permits installation as an assembly. *(See figures 457 and 458.)* The dust excluder units include the following:

Radiator air scoop cover—a weatherproof cloth cover
Oil overflow outlet cover—a felt-covered plug
Carburetor air duct elbow outlet cover—a felt-covered plug
Drain box vapor outlet cover—a felt-covered plug
Oil overflow drain line cover—a felt-covered plug
Carburetor filter R.H. air intake cover—a felt-lined metal plate
Carburetor filter L.H. air intake cover—a felt-lined metal plate
Sand outlet cover—a felt-lined metal plate
Carburetor air intake cover—a felt-lined metal plate

(b) ENGINE AND COCKPIT COVER ASSEMBLY. *(See figures 458, 459, and 460.)*



1 Engine Cover (Front Section)
2 Wheel Well Covers (Outside)
3 Pitot Tube Dust Cover
4 Combat Sway Brace Kit
5 Exhaust Stack Cover Plugs
6 Dust Excluder Assembly
7 Propeller Combination Wrench*
8 Dome Handle and Cam Shaft Puller*
9 Propeller Socket Wrench*
10 Jacking and Hoisting Tool Kit
11 Cockpit Cover (Rear Section)
12 Armorer's Tool Roll
13 Carburetor Air Filter Intake Covers
14 Hydraulic Hand-pump Assembly
15 Pilot's Delivery Envelope
16 Flare Pistol
17 Container for Flares
18 Map Case
19 Check List Holder
20 Message Bag
21 HS-33 Headset
22 T-30 Microphone
23 Flare Pistol Mount
*Early Airplanes Only

Figure 458—Miscellaneous Equipment Stowage

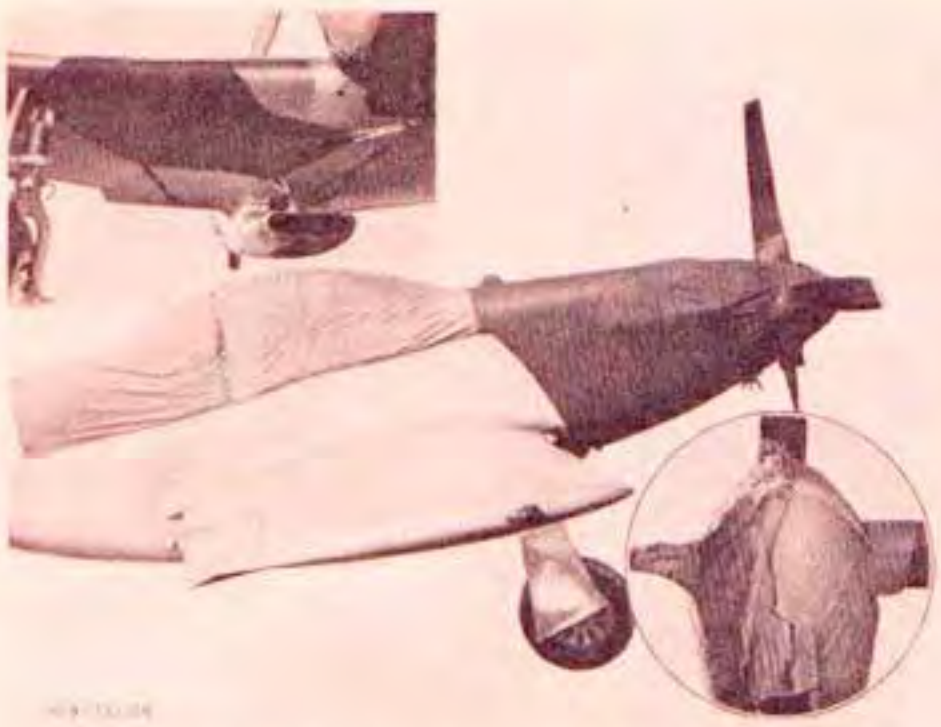


Figure 459—Weatherproof Covers Installed

(c) LANDING GEAR WHEEL WELL OUTER DUST COVERS.—Left and right weatherproof cloth covers are furnished for the landing gear wheel wells, to prevent dust from entering the wing when the airplane is parked. *(See figures 458 and 459.)*

(d) LANDING GEAR WHEEL WELL INNER DUST COVERS.—The main landing gear wheel wells are lined with waterproof cloth dust covers held in position by snap fasteners. These covers are not removed except for access to parts, within the wing, inaccessible through the two zipper-type openings in the cover. *(See figure 457.)*

(e) PITOT TUBE DUST COVER.
(See figures 456 and 458.)

(f) TAIL WHEEL WELL DUST COVER.—A weatherproof fabric dust cover designed to protect the upper part of the tail wheel assembly is installed in the wheel well. This cover is fastened to the fuselage by drive screws and snaps, and is removed only to make inspections, adjustments, and repairs.

(g) EXHAUST STACK DUST COVERS.—For early airplanes, two metal dust covers are provided. These covers fasten to the right and left rows of exhaust stacks by spring clamps. They are stowed in the radio compartment. With later airplanes, there are two assemblies of wooden plugs which fit the individual exhaust stacks. *(See figures 456 and 458.)*

(5) MAP CASE.—A map case is attached to the fuselage, left of the pilot's seat. *(See figure 458.)*

(6) DATA CASE.—A data case is attached to the access door directly forward of the tail wheel well. *(See figure 460.)* On later airplanes, the data case is installed inside the fuselage aft of the oxygen cylinders.

(7) CHECK LIST HOLDER.—A transparent plastic check list cover is attached to the map case by a cord. *(See figure 458.)*

(8) MOORING KIT CASE.—A fabric, aluminum-stiffened mooring kit case is installed on the right side of the rear fuselage section above the fuselage fuel tank. *(See figure 456.)*

(9) FLOORBOARDS.—Wooden floorboards, secured with screws, are installed in the airplane from a point immediately forward of the rudder pedals to the front edge of the pilot's seat.

(10) FLOOR COVER.—An olive-drab duck cover is furnished to complete the floor surface of the cockpit under the pilot's seat. The forward center curved edge of the cover is attached by four studs. The balance of the cover is anchored by buttons and sockets around the edge.

(11) DROP MESSAGE BAG.—A drop message bag is stowed on the left side of the cockpit, in a fiber holder attached to the map case. *(See figures 456 and 458.)*

(12) PYROTECHNIC SIGNAL PISTOL.—A pyrotechnic signal pistol is stowed in a canvas holster strapped on the left side of the cockpit. *(See figure 458.)*

CAUTION

The pistol is cocked while breech is closed, so do not stow loaded.

Figure 460—Stowage of Data Case, Engine Cover, and Gun Camera

1. SUPPORT ASSEMBLY
2. AN-M-1 MOUNT
3. RECOIL SPRINGS
4. COVER CAP
5. MOUNTING SLOTS
6. MOUNT RELEASE TRIGGER
7. BREECH LOCK LEVER
8. 7S2-1032-7 SCREWS (4 REQ.)

CAUTION
PISTOL MUST NOT BE STOWED IN CANVAS HOLSTER WHILE LOADED, AS IT IS COCKED WHEN BREECH IS CLOSED.

Figure 461—Pyrotechnic Pistol and Mount

1 & 2 CONTAINER AND DIRECTIONS
3 EYE DRESSING
4 FIELD DRESSING
5 TOURNIQUET
6. BANDAGE SCISSORS
7. SULFANILAMIDE CRYSTALS
8. SULFANILAMIDE TABLETS
9 MORPHINE SYRETTE
10. WATER PURIFICATION TABLETS
11. IODINE SWABS
12. BORIC ACID AND APPLICATOR
13. BANDAGE COMPRESS

Figure 462—First-aid Kit (Installed in Early Airplanes Only)

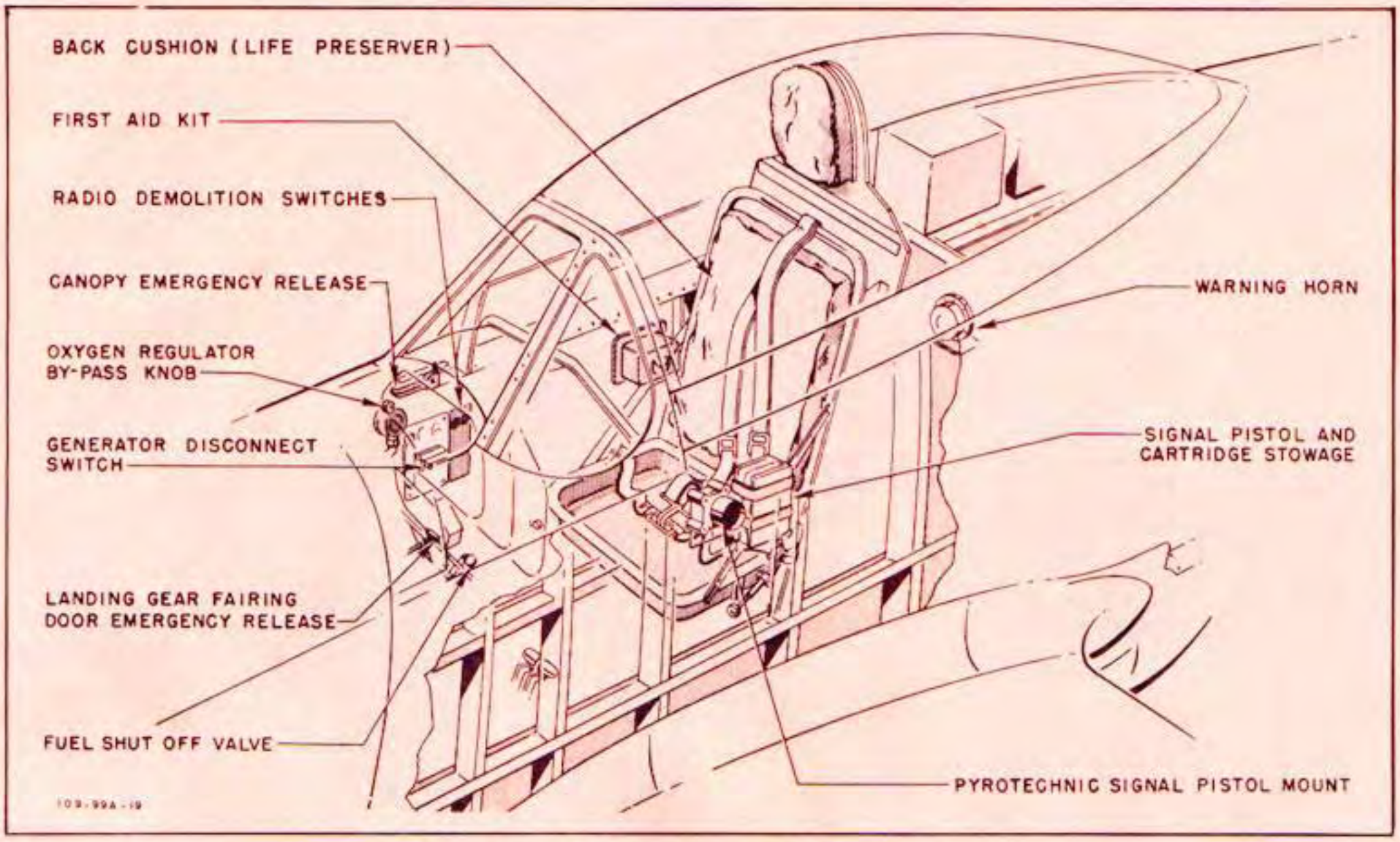


Figure 463—Emergency Equipment

A spring-recoil pistol mount is attached to a support just under the window at left of pilot's seat. This support consists of two flanges and a tube through which pistol is fired. The tube is capped when not in use, and is aimed outward, upward, and aft. *(See figure 461.)*

(13) HYDRAULIC HAND-PUMP ASSEMBLY.—A hydraulic hand-pump and the necessary tubing for attachment to the airplane are supplied with each airplane. *(See figures 456 and 458.)* For installation instructions, refer to paragraph 19 of this section.

(14) CARBURETOR AIR FILTER INTAKE COVERPLATES.—Each airplane is supplied with two aluminum carburetor air filter coverplates for cold weather operation. These covers are provided with dzus fasteners for attachment to the right-hand and left-hand engine cowling. *(See figures 456 and 458.)*

b. EMERGENCY EQUIPMENT.

(1) IFF RADIO DESTRUCTION EQUIPMENT.—A switch for the demolition of the IFF radio equipment is located on the right side of the cockpit, opposite the pilot's seat. *(See figure 463.)* When both switch buttons are depressed simultaneously, a charge is set off inside the radio equipment.

(2) FIRST-AID KIT.—In early airplanes only, a first-aid kit, with directions for use, is located on the right side of the cockpit beside the pilot's seat. *(See figures 462 and 463.)*

CAUTION

Before each flight, the first-aid kit must be checked for security and general condition. If the seal has been broken, check the contents of the kit with the items listed in figure 462.

(3) COCKPIT SLIDING CANOPY RELEASE.—The sliding section of the cockpit enclosure may be quickly released in an emergency by means of a handle on the forward right side of the cockpit. *(See figure 463.)* A single movement of the handle releases the entire sliding canopy. An outside emergency release handle is located on the right side of the windshield assembly, just below the windshield side panel.

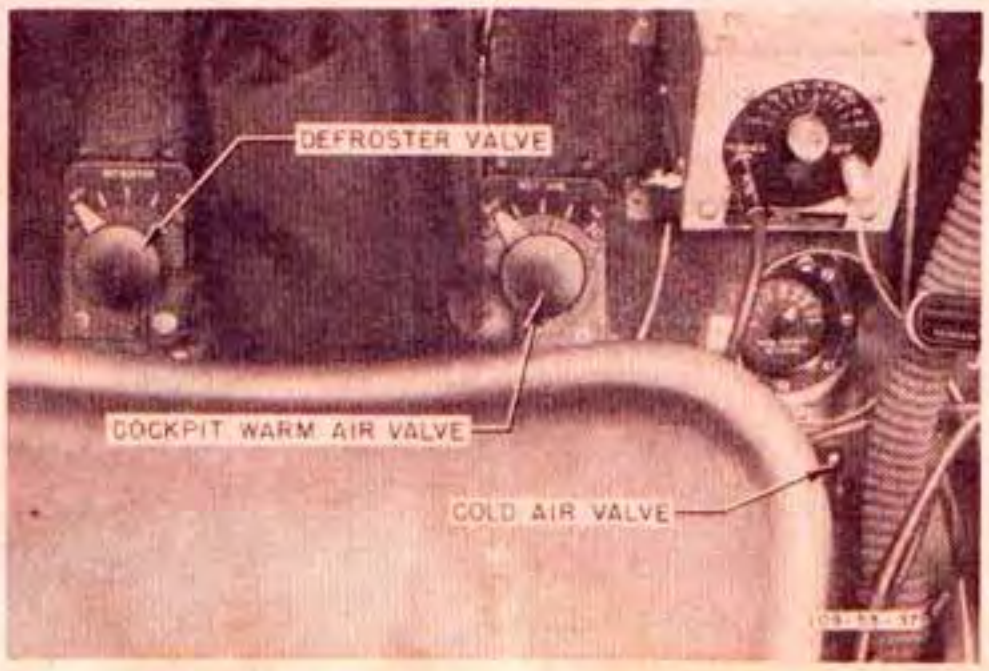


Figure 464—Heating, Venting, and Defrosting Controls

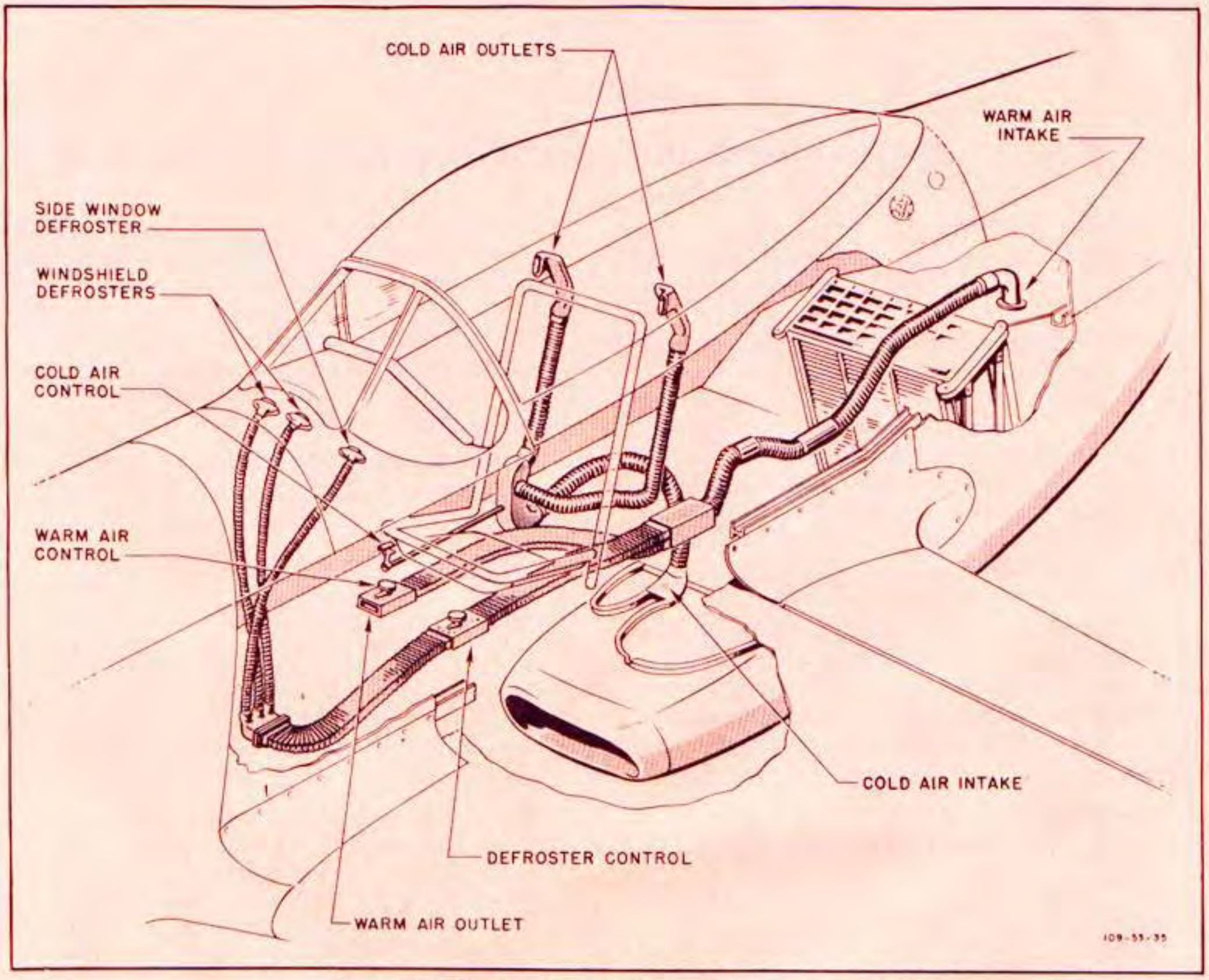


Figure 465—Heating, Ventilating, and Defrosting Systems

26. HEATING, VENTILATING, AND DEFROSTING SYSTEMS.

a. HEATING AND DEFROSTING SYSTEMS.—Warm air for heating the cockpit and defrosting the windshield and side windows is diverted through a port in the dome aft of the coolant radiator. *(See figure 465.)* The warm air passes through a flexible duct to a point behind the pilot's seat, from which the system branches out to the cockpit hot air outlet valve on the right side of the cockpit, and to the defroster valve forward and left of the pilot's seat. From the defroster valve, the warm air is conducted to a distributor fitting to which are attached the three defroster tubes. The cockpit warm air valve and the defroster valve *(figure 464)* are both of the gate type, the pointer attached to the valve handle indicating the position of the gate. The spring metal pointer drags on a calibrated shoulder on the valve, preventing the valve setting from being changed by vibration or by force of air.

b. VENTILATING SYSTEM. *(See figure 465.)*—Air for cooling and ventilating the cockpit is diverted by a scoop within the forward part of the radiator air inlet scoop and is conducted through a flexible tube to a valve behind the pilot's seat. Two smaller flexible tubes then carry the cool air to the outlet assemblies, one of which is located on each side of the pilot's seat just below the window. A handle on the floor at the left of the pilot's seat controls the cool air valve. *(See figure 464.)*

Section V

USEFUL OR MILITARY LOAD INSTALLATION, WEIGHT AND BALANCE

1. LOADING AMMUNITION.

Refer to the gun bay door instruction plate (*figure 448 of section IV, paragraph 23*). Observe the following precautions:

a. Before loading ammunition, check each gun for headspace, solenoid timing, and security of mounting.

b. Do not load ammunition bays too full or the top belt layers will bind against the ammunition bay coverplate. Leave space for the top row to flow freely.

c. Make sure that feed chutes are aligned with ammunition bays and with the gun feedways. Slide belts back and forth in the chutes to make sure ammunition flows freely.

d. Make sure that the link ejection chutes are properly installed.

e. Install ammunition bay coverplate securely; then charge several rounds through each gun to test functioning, proper feeding, and proper ejection. Stow charging handle.

f. Use the trouble shooting chart in section IV, paragraph 23, as a check list to prevent any possible stoppages.

g. Make sure that gun bay doors are closed and locked.

2. LOADING GUN CAMERA.

a. Open magazine access cover at aft end of camera.

b. Move magazine latch out of the way; this positively retracts the magazine driving spline.

c. Insert film magazine into camera with aperture toward camera lens and the footage indicator on the magazine toward the mount side of the camera. Note the footage of film in the magazine for setting the camera film footage indicator.

d. Move magazine latch over the end of the magazine as far as it will go.

e. Close magazine access cover.

f. Push in and turn the footage indicator knob to the number of feet of film contained in the magazine.

g. Set the shutter speed (16, 32, or 64 exposures per second) by turning the shutter speed knob.

CAUTION

Never change shutter speed when camera is running, and always have the index marks on the shutter speed knob and on the top cover in exact alignment.

h. Set the shutter speed mark on the index ring against the index mark on the lens barrel.

Note

The shutter speed knob on the camera body and the index ring on the lens barrel *must* always be set at the same shutter speed.

i. Set the diaphragm ring so that its index mark is set against the proper stop as indicated on the index ring. The letters B, H, and D stand for *bright*, *hazy*, and *dull*, respectively.

j. On early airplanes having separate overrun control, turn the knob to the desired time and turn "ON" the switch on the side of the control. On later airplanes having Type N-6 camera, the overrun control is permanently set at 2 seconds.

3. LOADING BOMBS OR CHEMICAL TANKS.

a. GENERAL.—The bomb rack on the lower outer panel of each wing can carry one of the following:

100-lb.	Practice bomb	M38-A2
100-lb.	General purpose bomb	AN-M30
250-lb.	General purpose bomb	AN-M57
325-lb.	Depth charge	AN-MK17
500-lb.	General purpose bomb	AN-M64
500-lb.	Semi-armor-piercing bomb	AN-M58A1
588-lb.	Chemical tank (filled)	AN-M10

When neither bombs nor chemical tanks are carried, a 75-gallon capacity combat fuel tank may be installed.

Note

It is not recommended that the 1000-pound bombs or the 110-gallon combat tanks be used, as neither the wing nor the bomb rack was designed for their installation. However, if certain missions require their use, see section IV, paragraph 15. *d.*, for combat tank installation, and paragraph 3. *c.* in this section for 1000-pound bomb installation.

b. PRELOADING INSPECTION.—Prior to loading bombs, inspect the bomb racks and control systems for safetying, secure installation, and proper rigging. Make certain system operates without binding.

(1) SALVO (MECHANICAL) TEST.

(a) Load a test weight on each bomb rack by pushing the weight support lugs up against the upper portion of both open bomb support hooks at the same time. (Each test weight should be at least 20 pounds.)

(b) Pull both handles together; both test weights should release.

(2) ELECTRICAL TEST.

(a) Load test weights.

(b) Turn battery-disconnect switch "ON," if airplane's battery is used. If external power source is used, turn battery-disconnect switch "OFF."

(c) With the nose and tail arming switches "OFF," the arming units should be unlocked; with the arming switches "ON," the arming units should be locked.

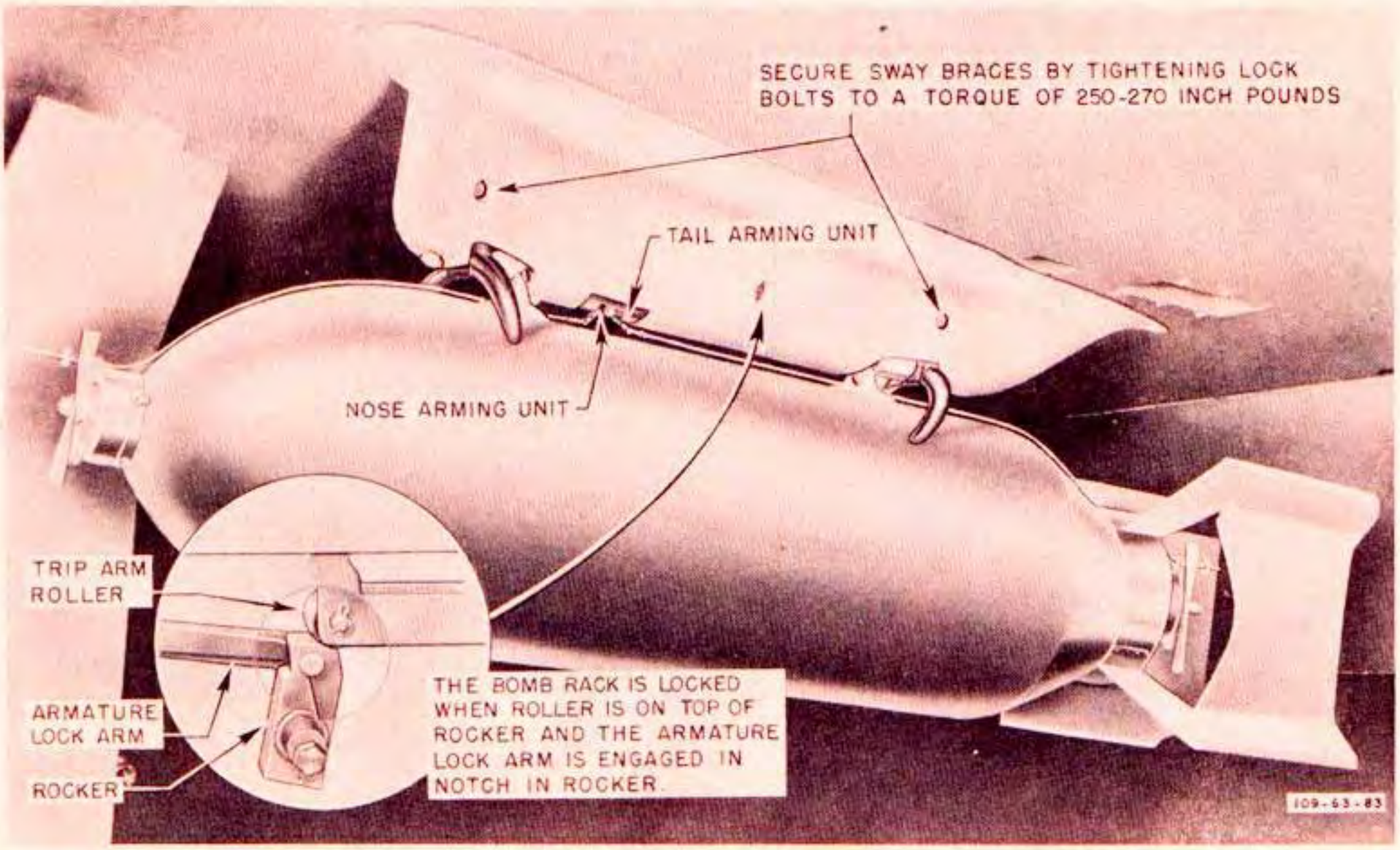


Figure 466—Bomb Installed

(d) With safe-selector switch on "SAFE," press the bomb release switch; the test weights should not release.

(e) With the safe-selector switch on "BOTH," press the bomb release switch; both test weights should release simultaneously.

(f) Load test weights.

(g) With the safe-selector switch on "TRAIN," ("SEL" on early airplanes), press the bomb release switch; only the left test weight should release. Press the bomb release switch again; the right test weight should release.

(h) At the completion of this test, turn bomb arming switches "OFF," and move safe-selector switch to "SAFE."

c. LOADING ALL TYPES OF BOMBS. *(See figure 466.)* —Because of their small diameter, 100-pound bombs require the installation of two AN3-13 bolts in the front sway brace.

(1) Open bomb support hooks.

(2) Place safe-selector switch on "SAFE," arming switches "OFF."

(3) Install sway braces up as far as possible on each rack to allow space for loading. Make sure sway braces are installed with arms toward the center of rack.

(4) Lift the bomb until both support lugs have entered the two slots in the rack, and then bump the lugs against the upper portion of the bomb rack support hooks to snap the hooks shut and lock the rack.

(5) Inspect each bomb rack through inspection window in fairing to make sure the bomb rack is locked. *(See detail on figure 466.)*

(6) Extend the sway braces until the bomb is held tightly against the sway pads; tighten each sway brace lock bolt (torque bolt from 250 to 270 inch-pounds).

(7) Install nose arming wire in nose arming (forward) unit; then connect the other end of the wire to the nose fuse of the bomb.

(8) Install the tail arming wire in the tail arming (aft) unit; then connect the other end of the wire to the tail fuse of the bomb.

d. LOADING CHEMICAL TANKS.—A chemical tank may be installed on each bomb rack. Several men are required to lift the tank into place, as each tank weighs 588 pounds. *(See figure 467.)* Before loading the tanks, make the preloading inspection outlined in paragraph ***b.***

(1) Open bomb support hooks.

(2) Place safe-selector switch on "SAFE," arming switches "OFF."

(3) Install sway braces up as far as possible on each rack to allow ample space for loading. Make sure braces are installed with arms toward center of rack.

(4) Lift the chemical tank until its support lugs have entered the two slots in the rack, and then bump the lugs against the upper portion of the bomb rack support hooks to snap the hooks shut and lock the rack.

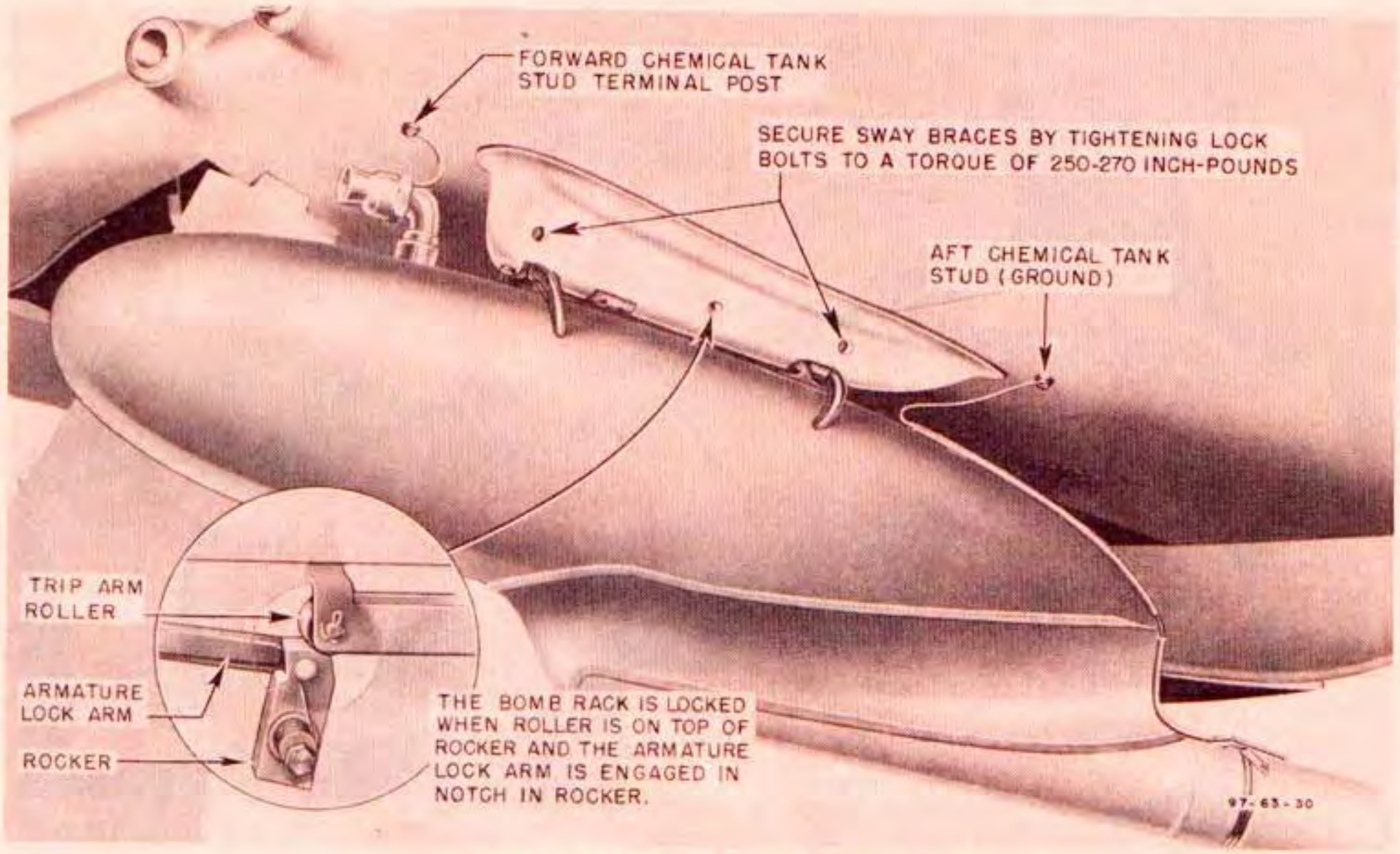


Figure 467—Chemical Tank Installed

(5) Inspect the bomb racks to make sure the bomb racks are locked. *(See detail on figure 467.)*

(6) Extend the sway braces until the chemical tank is held tightly against the sway pads; tighten each sway brace lock bolt (torque bolt from 250 to 270 inch-pounds).

(7) Insert front chemical tank igniter wire on insulated chemical tank post on the wing skin ahead of the rack. Pull wire snug and tighten the screw.

(8) Attach rear chemical tank igniter wire on the ground post on the wing skin. Pull wire snug and tighten the screw.

CAUTION

Do not move the nose arming switches from the "OFF" position, as chemicals will be released.

4. LOADING ROCKETS.

a. GENERAL.—Three removable zero rail launchers are installed under each wing for supporting T64 (5-inch H.V.A.R.) rockets. Two additional launchers for each wing are stowed in the ammunition bays, and can be installed when the bomb racks are not in use.

b. PRELOADING INSTRUCTIONS.—Prior to installing rockets on launchers, inspect the front and rear mount assemblies for cracks and damages. Make sure the mounts are secure, that the launching slots in the front mounts are not obstructed, and that the release latches operate freely.

(1) Plug the leads of a Type B-2 circuit tester (or equivalent) into the socket in each rear mount assembly.

(2) Turn battery-disconnect switch "ON," rocket-bomb selector switch to "ROCKETS," and set projector release switch to "SINGLE." Position reset knob to "1."

(3) Press rocket-bomb release switch on the pilot's control stick repeatedly. The test lamps must illuminate in the correct firing order (from outboard to inboard). See applicable wiring diagram in section IV, paragraph 20.

(4) Repeat operations (1) to (3) preceding, with the projector release switch in "AUTO." The test lamps must illuminate in the correct firing order (from outboard to inboard) at 1/10-second intervals.

(5) With the rocket fuse arming switch on "DELAY," test the fuse arming solenoid in each front mount assembly by inserting an arming wire swivel-loop into the unit and checking the pull-out force. The solenoid must retain the loop with a 3-pound pull and release the loop with a 4-pound pull.

(6) Turn the fuse arming switch to "INST" and try to insert the arming wire swivel-loop in each of the fuse arming units; each unit must be locked.

(7) Turn battery-disconnect, rocket-bomb selector, and projected release switches "OFF."

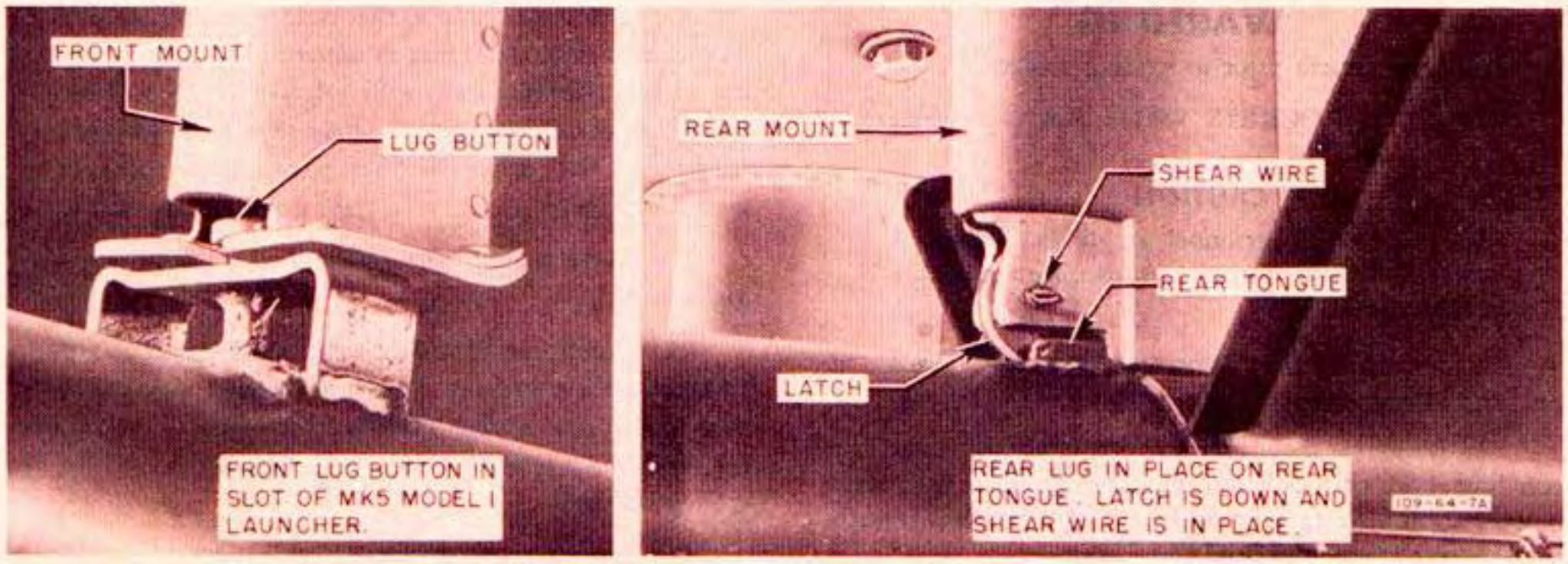


Figure 467A—Rocket Launcher Mounts With Rocket Installed

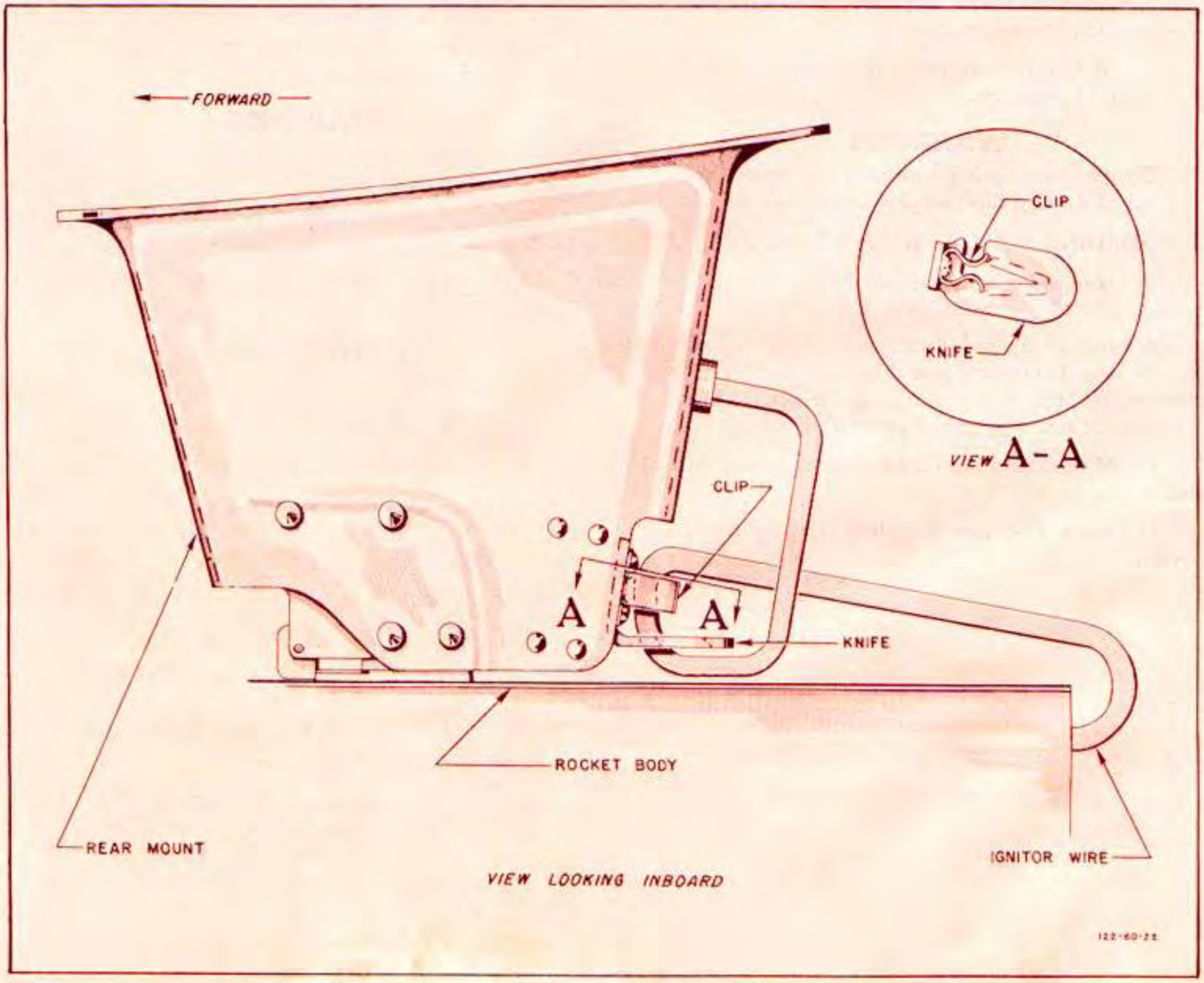


Figure 467B—Method of Installing Rocket Igniter Wire

WARNING

Load gun camera prior to loading rockets.

c. LOADING ROCKETS WITH SOLID NOSE. *(See figure 467A.)*

CAUTION

Only authorized personnel are to be permitted near the airplane during or subsequent to rocket loading operations.

(1) Turn battery-disconnect, rocket-bomb selector, and projector release switches "OFF."

(2) Raise rear mount latch and fit front lug button and rear tunnel lug of rocket into mounts simultaneously; then insert a shear wire (minimum length of 2 inches) through latch on rear mount and bend ends down.

CAUTION

Use only low brass (.064) standard bomb arming wire, as heavier wire may cause damage to the launchers or wing structure.

(3) Make certain rocket is held firmly by trying to move rocket fore and aft.

WARNING

Do not insert igniter wire plug nor remove attached shorting clips; let plug hang loose.

d. LOADING ROCKETS WITH MK149 NOSE FUSE.

(1) Load rocket as directed in procedures *c.* (1) to (3) preceding.

(2) Inspect cap and clamp assembly on nose of fuse for corrosion. Do not use fuse if cap and clamp are badly corroded. If corrosion is slight, grasp the clamp and rotate it around the fuse body until it slides freely.

(3) Make certain auxiliary booster is in fuse liner of shell.

(4) Screw fuse into fuse liner ring with spanner wrench.

(5) Turn fuse clamp so that clamp pin and bushing are on the same side of the fuse as the arming wire. Insert arming wire in the hole next to the safety wire. *Do not reverse this order, and do not remove safety wire until arming wire is installed.* Save safety wire for re-use if the rocket is returned to storage.

(6) Insert arming wire swivel-loop into the fuse arming solenoid.

(7) Install one Fahnestock clip on free end of arming wire and slide it down to the clamp bushing. Adjust clip on wire so that just enough slack is in the wire to ensure that the swivel-loop is not partially pulled from the catch of the arming solenoid.

(8) Cut off excess arming wire, leaving 3 to 4 inches in front of the fuse.

e. BEFORE TAKE-OFF.

(1) Turn battery-disconnect, rocket-bomb selector, and projector release switches "OFF"; remove rocket shorting clips and save for future use.

WARNING

Use test lamp to ensure the circuits are dead before inserting igniter plugs.

(2) Working consecutively from inboard to outboard, first one wing then the other, insert igniter wire plug of each rocket in rear mount. Loop the igniter wire as shown in figure 467B.

WARNING

Always stand to one side of any loaded rocket.

(3) If gun camera is used, turn camera switch on.

(4) Remove safety wire from fuse.

f. UNLOADING ROCKETS.—The unloading procedure is essentially the reverse of loading except that the electrical circuit check is omitted.

Section VI
MATERIALS OF CONSTRUCTION

1. GENERAL.

The following list of heat-treated parts includes only heat-treated castings, forgings, and steel members used in the construction of the airplane. Generally, the repair of these parts is not recommended, and any extent of damage necessitates complete replacement of the damaged member. However, it is to be noted that in the event of an improvised replacement, the heat-treatment of the fabricated member must produce the tensile strength given on the subsequent pages in the "Heat Treat" column.

2. MATERIAL CODE.

The following code used in the heat-treated parts list simplifies the identification of materials and their physical properties.

AA-B	Aluminum alloy bar
AA-C	Aluminum alloy casting
AA-E	Aluminum alloy extrusion
AA-P	Aluminum alloy plate
AA-DF	Aluminum alloy drop forging
AA-RF	Aluminum alloy rough forging
AA-T	Aluminum alloy tube
MA-C	Magnesium alloy casting
CM-ST	Chrome-moly steel tube
CM-SF	Chrome-moly steel forging
CM-SS	Chrome-moly steel sheet
CM-SB	Chrome-moly steel bar
MC-SS	Mild-carbon steel sheet
MC-B	Mild-carbon bar
ALC-S	Alclad sheet

PART NO.	TITLE	MATERIAL CODE	HEAT-TREAT TO TENSILE STRENGTH IN LBS./SQ. IN.
73-14006	Fitting—Wing Rear Spar Attachment	AA-DF	65,000
73-14144	Bracket—Aileron Inboard Hinge	AA-C	32,000
73-14193	Bracket—Wing Flap Inboard Hinge	MA-C	32,000
73-14194	Bracket—Wing Flap Center Hinge	AA-C	32,000
73-14195	Bracket—Wing Flap Outboard Hinge	MA-C	32,000
102-14206	Angle—Wing Rear Spar to Fuselage Attachment Fitting Stabilizer	AA-E	60,000
73-14224	Fitting—Wing Station 75 Rear Spar Center Flap Support	AA-E	60,000
106-14246	Fitting—Nose to Fuselage Attachment	MA-C	32,000
106-14263	Fitting—Wing Center Bulkhead to Fuselage Upper Center	MA-C	32,000
106-14354	Angle—Wing Station 0 Jack Fitting Support	AA-E	60,000
104-16015	Fitting—Aileron Inboard Hinge	MA-C	32,000
104-16016	Fitting—Aileron Center Hinge	AA-C	32,000
104-16017	Fitting—Aileron Outboard Hinge	AA-C	32,000
73-21009	Bracket—Elevator Center Hinge	MA-C	32,000
73-21032	Fitting—Horizontal Stabilizer Rear Beam to Fuselage Attachment	CM-SF	90,000
73-22011	Fitting—Elevator Trim Tab End Hinge	AA-C	33,000
73-22012	Fitting—Elevator Trim Tab Intermediate Hinge	AA-C	33,000
73-22014	Fitting—Elevator and Rudder Intermediate Hinge	AA-E	57,000
73-22015	Fitting—Elevator Outboard and Rudder Upper Hinge	AA-E	57,000
97-22022	Horn—Elevator Trim Tab	MC-SS	55,000
73-22028	Tube—Elevator Torque	AA-T	62,000
73-23011	Fitting—Rudder Lower Hinge	MA-C	32,000
73-24009	Fitting—Rudder Trim Tab Intermediate Hinge	AA-E	57,000
73-24010	Fitting—Rudder Trim Tab Lower Hinge	AA-E	57,000
73-24014	Fitting—Rudder Trim Tab Upper Hinge	AA-E	57,000
73-24019	Fitting—Rudder Horn and Lower Hinge	MA-C	32,000
99-24050	Bracket—Rudder Static Balance Lower Weight	ALC-S	62,000
73-31067	Support—Tail Wheel Door Operating Link	AA-E	62,000
106-31526	Support—Engine Removable Cowling Firewall Upper Former Rear	MC-SS	55,000

PART NO.	TITLE	MATERIAL CODE	HEAT-TREAT TO TENSILE STRENGTH IN LBS./SQ. IN.
102-310275	Support—Engine Removable Cowling Side Former Rear Upper	MC-SS	55,000
102-310288	Support—Engine Removable Cowling Side Former Rear Lower	MC-SS	55,000
102-31413	Angle—Fuselage Firewall-to-Wing Center Bulkhead Attachment	AA-E	60,000
102-31910	Bolt—Engine Mount Firewall Lower Attaching	CM-SB	160-180,000
102-31911	Bolt—Engine Mount Firewall Upper Attaching	CM-SB	160-180,000
73-31912	Nut—Engine Mount Fuselage Attaching	CM-SB	125-140,000
102-31950	Bracket—Engine Mount Lord Bushing Housing Front	AA-E	
102-31975	Brace—Engine Mount Jury	24ST-E	57,000
73-33312	Link—Landing Gear Fairing Attachment Rear	AA-C	32,000
106-33318	Bracket—Landing Gear Fairing Door Rear Hinge Support	AA-C	32,000
106-33352	Arm—Landing Gear Fairing Door Lock Support Actuating	CM-SS	90,000
106-33366	Yoke—Landing Gear Fairing Door Lock Support	CM-SS	90,000
106-33367	Support—Landing Gear Fairing Door Lock Rear	AA-C	32,000
73-34160	Fork—Tail Wheel Steering Turnbuckle	CM-SB	125-140,000
73-34163	Pin—Tail Wheel Down Position Strut Stop	CM-SB	125-140,000
73-34164	Retainer—Tail Wheel Lock Spring	MA-C	32,000
97-34168	Bellcrank—Tail Wheel Declutching	ALC-S	62,000
73-34189	Bellcrank—Tail Wheel Steering Pulley	AA-C	32,000
104-34505	Retainer—Tail Wheel Lock Spring	MA-C	32,000
73-34508	Fitting—Tail Wheel Bellcrank Support	MA-C	32,000
73-34164	Retainer—Tail Wheel Door Operating Bellcrank Support		
102-44032	Bellcrank—Propeller Control Front	CM-SS	90,000
73-52107	Stop—Control Stick Aileron Torque Tube	MA-C	32,000
106-52129	Arm—Aileron and Elevator Control Lock	AA-C	32,000
106-52146	Tube—Elevator Control Stick Connecting	CM-ST	90,000
73-52148	Clevis—Elevator Control Stick Tube Adjustment	CM-SB	125-140,000
106-52155	Arm—Surface Control Locking	AA-C	32,000
73-52217	Bellcrank—Elevator Control	MA-C	32,000
73-52223	Horn—Elevator Left	AA-P	62,000
73-52224	Horn—Elevator Right	AA-P	62,000
102-52316	Wheel—Aileron Fork Actuating Pulley	MA-C	32,000
73-52317	Fork—Aileron Control	AA-RF	65,000
102-52351	Sector—Aileron Control Cable	MA-C	32,000
73-52404	Fork—Rudder Pedal	AA-C	33,000
73-52406	Bellcrank—Rudder and Steerable Tail Wheel Control	MA-C	32,000
73-52425	Bracket—Rudder Control Lock	MA-C	34,000
73-52445	Lever—Rudder Control Locking	CM-S	90,000
106-52572	Housing—Aileron Trim Tab	MA-C	32,000
106-52583	Support—Aileron Trim Tab Drum	MA-C	32,000
97-52611	Handle—Flap Cockpit Control	MA-C	32,000
73-52612	Support—Flap Torque Tube	AA-DF	65,000
73-52613	Support—Flap Torque Tube Left	AA-DF	65,000
102-52619	Link—Flap Actuating Cylinder to Arm Connecting	CM-ST	90,000
73-52625	Support—Flap Torque Tube Right	AA-DF	65,000
73-52636	End—Flap Control Rod	CM-SB	125,000 to 140,000
97-58705	Rod—Hydraulic Wing Flap Control Valve	MC-B	55,000
62-58944	Lever—Hydraulic Auxiliary Landing Gear Up-lock Timing Valve	AA-B	62,000

Section VII

FINISH

1. This specification designates the finishes and processes to be employed by the contractor in applying protective treatment and finish colors to contractor-furnished parts and equipment used in the fabrication and assembly of Model P-51D Airplanes.
2. All standard parts are to be given protective treatment in accordance with standard drawings and are not governed by the detail sections of Chart "A." The finish color coat on standard parts shall be in accordance with Chart "B."
3. The detail sections of Chart "A" do not list finish colors. Consult Chart "B" for the finish color coat required by any given area. All areas not mentioned in Chart "B" require only the treatment called out in the detail section by Chart "A."
4. Whenever the peculiarity of a part or assembly, or the particular use made of that part or assembly prohibits the use of the finish specified, the part shall be given as high a degree of protection as is consistent with its intended use.
5. Specification primer tinted to match the interior green color of ANA bulletin No. 157 may be substituted for untinted primer at the discretion of the contractor.

CHART A
PROTECTIVE TREATMENT CHART

DETAIL SECTION	REQUIREMENTS	SPECIFICATIONS	NOTES
ALUMINUM & ALUMINUM ALLOYS			
FA-0 General	Do not anodize		
FA-20 Interior of closed members	1. Do not anodize 2. No treatment required		
FA-21 Interior surfaces, parts & open members FA-23 Engine compartment surfaces, parts & members	1. Do not anodize		Exceptions: 1. Anodize (Spec. AN-QQ-A-696) interior of all coolant lines and header tank. 2. Anodizing of exteriors of coolant lines and header tank is optional. A. All parts to be painted must be cleaned as per process Specification No. 98-20007 (Chronodize or Phosphoric etch). Exception: Anodized parts require no further cleaning treatment if painted immediately. B. All surfaces of all aluminum alloys (including alclad) shall receive a minimum of one coat of zinc chromate primer. Priming must be done in detail to protect contacting surfaces. Exceptions: 1. Exterior surfaces of alclad, 2S, 3S, 52S, and 53S, require no primer except in wing areas finished for aerodynamic smoothness. 2. Carburetor air scoop interior shall not be primed. 3. Interiors of all lines and assemblies carrying fluids shall not be primed. 4. Tubing of 2S, 3S, 52S, or 53S and all conduit require no primer unless subsequently covered with an insulation material. 5. Prime spot-welded assemblies after spot-welding. Wheel well and armament bay doors, radiator air scoop, and wing tips spot-welded to the extent that some areas are inaccessible for spray priming, require no priming in those inaccessible areas. 6. Touch-up of minor scratches, rivet heads, screws, and similar fasteners is required only in the cockpit. 7. Butt-jointed sheet edges, rivet and drain holes, and cut countersinks require no primer. C. Where priming is normally required but the location or function of the part prohibits priming, the parts shall be anodized as per process Specification No. AN-QQ-A-696. Exception: 1. Thread areas on threaded parts do not require anodizing when assembled with a suitable antiseize compound.
FA-25 Exterior surfaces, parts & members Wing surfaces FA-28 Instrument panels FA-29 Electrical & radio junction boxes and conduit	2. One coat zinc chromate primer	AN-TT-P-656	

DETAIL SECTION	REQUIREMENTS	SPECIFICATIONS	NOTES
COPPER AND COPPER ALLOYS			
FC-0 General	Cadmium or zinc plate	AN-QQ-P-421 or AN-P-32	Exception: The following brass or bronze parts are not to be plated: nuts and screws in vicinity of compass; parts contacting hydraulic or anti-icing fluid; electrical contacts; turnbuckles, safety lockwire, and bearing surfaces.
FC-20 Copper lines	No treatment required		
FC-23 Dissimilar metals	1. Cadmium or zinc plate 2. See notes	AN-QQ-P-421 or AN-P-32	Dissimilar metal contacts shall be protected after plating as specified in Section FG-5.
GENERAL FINISHES			
FG-0 Chromium plate	See notes	AN-P-39	Chromium plate. Parts to be chrome plated; internal steel parts contacting hydraulic fluid & communicating to the exterior. Exception: Corrosion-resistant steel parts shall not be plated.
FG-2 Control cables			
Tinned or galvanized steel cables	See notes		Treat for corrosion prevention with one coat Spec. AN-C-52 Type 1 corrosion-preventive compound.
Corrosion-resistant steel	No treatment required		
Carbon and low alloy terminals	Parkerize and oil	57 0 2	Parkerize and oil prior to swaging. After swaging, oil with Specification AN-C-52 Type 1. When Parkerizing facilities are not available terminals may be either cadmium or zinc plated. Plating to be done prior to swaging.
FG-5 Dissimilar metals	See notes	AN TT P 656	1. Insulate from mutual contact by one coat zinc chromate primer applied to either of the contacting surfaces. On later airplanes, a minimum of one coat of primer shall be applied on each contacting surface. Exceptions: 1. When magnesium or its alloy is one of the contacting metals, each contacting metal shall be given the complete protective treatment required for that metal by Chart "A" prior to assembly. 2. Bearing surfaces and electrical bonding contacts are not to be primed. 3. Bolts, nuts, screws and similar fasteners, and cadmium or zinc-plated nut plates require no dissimilar metal protection other than that normally required for the metal they contact. 2. Contacting surfaces where tolerances are too small to permit a paint coat between, but where dissimilar metal protection is normally required, shall be assembled with a wet coat of primer applied to either of the contacting surfaces.
FG-8 Walkways	See notes		Upper wing surfaces adjacent to fuselage from fairings outboard 17 inches shall receive two coats of airfoil smoother.
FG-10 Coil springs, and FG-11 Flat springs	One coat zinc chromate primer	AN-TT-P-656	Exception: Spring in contact with hydraulic or anti-icing fluid shall not be primed or otherwise finished.
FG-13 Armament protection	See notes		Weather seal all ejection chutes, blast tubes, etc., communicating with the exterior by covering openings with suitable waterproof tape.
FG-20 Tanks and tank compartments			
Droppable steel tanks			
Interior of tank	See notes		One slosh coat of a suitable aromatic fuel resistant material.
Exterior of tank	Finish in accordance with Sect. FS-30		
Tank compartments	Two coats zinc chromate primer	AN-TT-P-656 & 20023	Primer to be thinned in ratio of 1:1 with Spec. AN-T-8B.
FG-21 Markings: Piping lines	Refer to Drawings 106-00010 and 10375		
FG-22 Markings: Cables, cranks and horns	Not required		
FG-23 Markings: Miscellaneous	Refer to Drawing 106-00010		
FG-24 Markings: Engine disconnect points	Refer to Drawing 106-00010		Each disconnect point (both sides) to be marked with a 1/4" daub of International orange lacquer meeting Spec. AN-TT-L51.

DETAIL SECTION	REQUIREMENTS	SPECIFICATIONS	NOTES
MAGNESIUM AND MAGNESIUM ALLOYS			
FM-0 General FM-20 Exterior surfaces, parts, and members FM-23 Engine compartment surfaces, parts & members FM-25 Interior surfaces, parts and members	1. Protective treatment 2. Two coats zinc chromate primer	98-20010 AN-TT-P-656	Second prime coat to be tinted interior green.
STEEL			
FS-0 General	Cadmium or zinc plate	AN-QQ-P-421 or AN-P-32	Exception: Corrosion-resistant steel, armor plate, and parts contacting hydraulic or anti-icing fluid shall not be cadmium or zinc plated.
FS-20 Exterior surfaces, parts and open members that can be plated	Cadmium or zinc plate No primer required	AN-QQ-P-421 or AN-P-32	Exception: Dissimilar metal contacts shall be protected as specified in Section FG-5.
FS-21 Exterior closed members that can be plated Interior of members	Hot oil treatment	JJJ-O-336 or AN-C-52	Method of treatment to be as outlined, Spec. 3-1001, Sec. E-9. Exception: Flash-welded parts require no oil treatment.
Exterior of members	1. Cadmium or zinc plate 2. No primer required	AN-QQ-P-421 or AN-P-32	Exception: Corrosion-resistant steel shall not be plated. Exception: Dissimilar metal contacts shall be protected as specified in Section FG-5.
*FS-22 Exterior closed members that cannot be plated Interior of members	Hot oil treatment	JJJ-O-336 or AN-C-52	Method of treatment to be as outlined, Spec. 3-1001, Sec. E-9. Exception: Flash-welded parts require no oil treatment.
Exterior of members	One coat zinc chromate primer	AN-TT-P-656	Exception: Corrosion-resistant steel requires no primer.
FS-23 Engine compartment surfaces, parts & members Interior of closed members	Hot oil treatment	JJJ-O-336 or AN-C-52	Method of treatment to be as outlined, Spec. 3-1001, Sec. E-9. Exception: Flash-welded parts require no oil treatment.
Interior of open members	One coat zinc chromate primer	AN-TT-P-656	
Exterior of all members	1. Cadmium or zinc plate 2. No primer required	AN-QQ-P-421 or AN-P-32	Exception: Corrosion-resistant steel and armor plate shall not be plated. Exceptions: 1. Armor plate shall be given one coat primer. 2. Dissimilar metal contacts shall be protected as specified in Section FG-5.
FS-26 Interior surfaces, parts and open members that can be plated	1. Cadmium or zinc plate 2. No primer required	AN-QQ-P-421 or AN-P-32	Exception: Corrosion-resistant steel and armor plate shall not be plated. Exceptions: 1. Armor plate and parts subsequently to be finished with lacquer shall be given one coat primer. 2. Dissimilar metal contacts shall be protected as specified in Section FG-5.
*FS-27 Interior closed members that cannot be plated Interior of members	Hot oil treatment	JJJ-O-336 or AN-C-52	Method of treatment to be as outlined, Spec. 3-1001, Sec. E-9. Exception: Flash-welded parts require no oil treatment.
Exterior of members	One coat zinc chromate primer	AN-TT-P-656	
FS-28 Interior closed members that can be plated Interior of members	Hot oil treatment	JJJ-O-336 or AN-C-52	Method of treatment to be as outlined, Spec. 3-1001, Sec. E-9. Exception: Flash-welded parts require no oil treatment.
Exterior of members	1. Cadmium or zinc plate 2. Do not prime	AN-QQ-P-421 or AN-P-32	Exception: Corrosion-resistant steel and armor plate shall not be plated. Exceptions: 1. Armor plate and parts subsequently to be finished with lacquer require one coat primer. 2. Dissimilar metal contacts shall be protected as per Section FG-5.
*FS-29 Interior open members that cannot be plated	One coat zinc chromate primer	AN-TT-P-656	
*FS-30 Exterior open members that cannot be plated	One coat zinc chromate primer	AN-TT-P-656	Exceptions: 1. Corrosion-resistant steel requires no finish. 2. Armor plate requires priming only. 3. Interior surfaces of steel members closed by fusion welding shall be treated with hot oil as per Specification No. 3-100.

*Later Airplanes: All steel parts which cannot be plated require Parkerizing and priming, as per Specification No. 57-0-2C, Type II, Class B.

DETAIL SECTION	REQUIREMENTS	SPECIFICATIONS	NOTES
TEXTILES			
FT-21 Tail group, and FT-23 Rudder	1. 3 brush coats clear dope	AN-TT-D-514	All fabric control surfaces to be finished as per Spec. 98-24100.
	2. 2 spray coats clear dope	AN-TT-D-514	
FT-25 Cotton webbing	No treatment required		
WOOD			
FW-21 Interior surfaces, parts and members	Two coats sealer	AN-S-17	Method of finishing to be as per Spec. AN-C-83. Exceptions: 1. Balsa wood parts shall be given one coat of spirit varnish. 2. Fast drying wood sealer may be substituted for AN-S-17 sealer on floorboards, bulkheads, and filler blocks when such parts are in areas requiring no finish color coat.
FW-23 Exterior surfaces, parts and members	1. Two coats sealer	AN-S-17	Method of finishing to be as per Spec. AN-C-83.
	2. One coat pigmented sealer	AN-S-17 Amend. # 1	
FW-24 Interior of closed members	Two coats sealer	AN-S-17	Method of finishing to be as per Spec. AN-C-83.

CHART B

ARMY FINISH COLOR SCHEME

1. In all cases the finishes specified herein are in addition to the requirements of Chart "A", and are to be applied after the requirements of Chart "A" have been met.
2. In this chart, where finish colors only are specified, the number of finish coats shall be such as to give complete hiding.

SURFACE	FINISH COLOR	NOTES
INTERIOR SURFACES		
Anti reflection	Flat black	Spec. AN-L-21 lacquer to be used or Spec. AN-E-7 (Color No. 604).
Instrument panel (front side only)	Instrument black	Spec. AN-L-21 lacquer to be used or Spec. AN-E-7 (Color No. 604).
Pilot's compartment		
Metal floor areas	No finish coat required	
Wood floor areas	See notes	One coat of Spec. NA 2-1301 non-skid surfacer.
Pilot's seat	Dull dark green	Metal fittings on wooden seats require no finish coat.
Control handles	See notes	Corrosion-resistant steel and cadmium or zinc-plated control handles require no finish coat, except for the knobs which shall be finished in accordance with the applicable drawing.
All other areas from Station 101 to Station 184	Interior green	Spec. AN-E-7 flat black to be used.
All other areas	No finish coat required	Exception: Areas not normally visible require no finish coat.
*EXTERIOR SURFACES		
Landing gear	Aluminum	Clear lacquer (Spec. AN-TT-L-51) or clear varnish (Spec. AN-E-7), containing 12 ounces aluminum paste (Spec. AN-TT-A-461) per unthinned gallon to be used. Exception: Corrosion-resistant steel parts or parts that are cadmium, zinc, or chromium plated require no finish coat.
Propeller blades	Instrument black	Parts received unfinished shall be primed and given one coat instrument black lacquer (Spec. AN-TT-L-51).
Propeller blade tips	Identification yellow	Parts received unfinished shall be given one coat Spec. AN-E-7 identification yellow enamel from tip to 4 inches from tip.
All fabric control surfaces	Aluminum	Two coats aluminized, Spec. AN-TT-D-551 nitrate dope to be used.
All other areas	Aluminum	Primed surfaces, wood, plastic, and any areas not bare metal shall be finished with aluminized clear lacquer or aluminized varnish.
Insignia	See notes	Spec. AN-E-7 camouflage enamel to be used, colors and location to be as per Drawing 106-00010. Surfaces to be sanded with # 400 paper, removing only the minimum amount of finish necessary to obtain the desired smoothness.
Antiglare finish	Dark olive drab	The top of the engine cowling in all areas covered by the forward vision of the pilot shall be finished with dark olive drab, Spec. AN-E-7 camouflage enamel.

*See figure 468 for British camouflage color scheme.

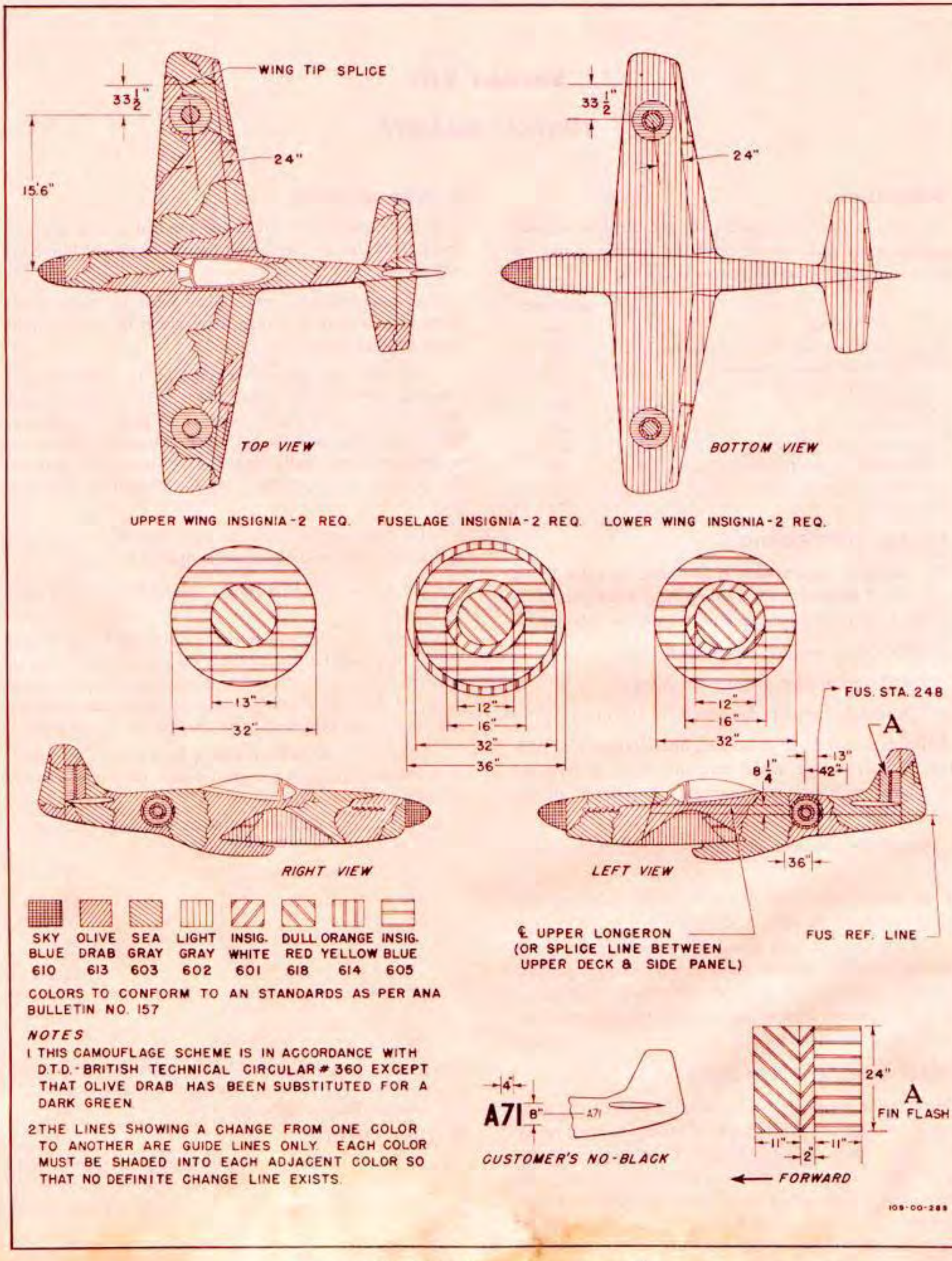


Figure 468—British Camouflage Color Scheme

Section VIII

TUBING CHARTS

1. GENERAL.

The various operating systems of the airplane employ numerous types and sizes of rigid and flexible tubing, as indicated on the applicable system diagrams.

SYSTEM	REFERENCE FIG.
Hydraulic Power and Wing Flap System	470
Landing Gear Hydraulic System	471
Brake System	472
Fuel System	473
Oil System	474
Cooling System	475
Vacuum and Engine Instrument System	476
Airspeed Instrument System	477
Oxygen System	478

2. TUBING IDENTIFICATION.

The tubing of each system is identified by color bands at the end of each tube. *(See figure 469.)* Place identification tape in a conspicuous place on the tube as follows:

a. Select a clean and dry surface on the tube.

b. Install tape on tube; overlap tape ¼ turn.

(Deleted in revision dated Feb. 2, 1945.)

d. Brush a coat of clear lacquer, Specification No. AN-TT-L-51, on the tape. Make sure the edges of tape are well covered with lacquer to prevent deterioration of the tape.

e. Store tape in a cool, dry place—away from dampness and heat.

f. If identification tape is not available, paint suitable colored stripes on the tube to designate system. When the paint is dry, cover it with a coat of shellac. If paint is not available, mark the tube in the best way possible, perhaps by gluing a piece of white paper, on which the name of the line is printed clearly, around the tube. Protect the paper with a coat of shellac.

3. TUBE SIZES AND LENGTHS.

In replacing a damaged tube, select a tube of the same material and size. Cut the piece of tubing approximately 10 percent longer than the length of the tube to be replaced. After required bends have been made, the new tube will be ½ to 2 inches longer than the old tube. Allowances should be made for the flaring operation to follow. The amount of tubing in excess of these required dimensions should be cut off.

4. TUBE TEMPLATE.

a. If the old tube is intact and the bends have not been changed, use it as a template or pattern from which to bend a new tube.

b. If a new model or template must be made, select a soft iron wire or a ⅛-inch tube; either of these may be easily bent by hand.

(1) Place the material selected for use as a template into one of the fittings where the tube is to be connected. Form the necessary bends in order to place the opposite end of the template into the other connection. When the template is satisfactorily formed to span the area between the two fittings, remove and use the pattern to bend new tube.

(2) Select a path with the least total degrees of bend, as this reduces the flow loss and simplifies bending.

(3) Use a path, if possible, with all bends in the same plane.

(4) Never select a path that requires no bends. A tube cannot be cut or flared accurately enough so that it can be installed without bends and still avoid initial mechanical strain on the tube. Bends are also necessary for expansion and contraction resulting from changes in temperature.

(5) Lay out a path providing for supports by clamps or brackets at intervals not greater than those given in the following:

TUBE O.D. (INCHES)	DISTANCE BETWEEN SUPPORTS (INCHES) ALUMINUM ALLOY	STEEL
⅛	9½	11½
3/16	12	14
¼	13½	16
5/16	15	18
⅜	16½	20
½	19	23
⅝	22	25½
¾	24	27½
1	26½	30

Note

Place supports as close to bends as possible to minimize the amount of overhang of the tube from a straight line between supports.

5. TUBE CUTTING.

a. With a standard cutting tool, cut the tube at right angles to the surface. Do not force tube out of round. A hack saw may be used if a standard cutting tool is not available.

b. After the tube has been cut off, file the end square, using a fine-toothed flat file while holding the tube in a

tube vise or flaring block. If a hack saw was used for cutting, the tube ends must be filed until all saw marks are removed.

c. After filing, remove all burrs from the inside and outside of the tubes with a burnishing spoon.

6. TUBE BENDING

Tube bending can be done with any one of a variety of hand bending tools or power production bending tools. Avoid bending in smaller radius than the limits of the tube will allow, or forming flattened, kinked, or wrinkled bends.

RADIUS OF BEND FOR RIGID TUBING

TUBE O.D. (INCHES)	NOMINAL BEND RADIUS MEASURED TO THE TUBE CENTERLINE (INCHES)
1/8	3/8
3/16	7/16
1/4	9/16
5/16	11/16
3/8	15/16
1/2	1 1/4
5/8	1 1/2
3/4	1 3/4
1	3
1 1/4	3 3/4
1 1/2	5
1 3/4	7

Bending tube without the aid of tools can be accomplished by carefully forming the desired radius by hand. This method is crude, but can be employed in an emergency. It is suggested that tubing ½-inch O.D. or larger be packed with very fine dry sand, unless Cerrobend is available, and both ends of the tube be plugged before bending. This will aid in preventing cracked or wrinkled bends and form a more acceptable radius. In bending, form a large radius in the tube and gradually work it down to the radius desired. When the bend is completed, remove the plugs and sand; then thoroughly cleanse the tube before installation.

7. FLARING TUBE ENDS.

a. Select the proper flaring tool and vise for the tube to be worked. With a hammer-type tool, tap the pin lightly first; then use more force. Avoid cracking tube ends and overflaring. If a flaring pin and block are not available, a ball-peen hammer can be used. Secure the tube and form the flange with the round end of the hammer by tapping the opposite end of the hammer lightly.

b. Check the flare by placing a "T" sleeve over the tube; the outside diameter of the flare should extend beyond the toe of the sleeve, but not beyond the outside diameter of the sleeve. Tubes flared too long will stick and jam on the threads when being assembled and are likely to seat on the bottom of the coupling rather than on the tapered seat. Flares too short may be squeezed thin on installation and prevent full utilization of the clamping area.

8. INSTALLING A TUBE.

a. Take a piece of clean cloth as large as can be pulled through the tube; attach a wire to the cloth six inches longer than the tube. Thread the wire through the tube and pull the cloth through as many times as is necessary to free the inside of the oil, grease, or other foreign matter.

b. See that the inside of the flare is clean.

c. Lubricate the exposed external tube machined threads with a thin film of lubricant (selected from the following thread compound chart) on the first two threads.

THREAD COMPOUNDS

The following thread compounds are approved for use in the indicated installations. No other thread compounds shall be used.

Installation	Straight Threads	Pipe Threads
Airspeed	AN-VV-P-236	AN-C-53
Hydraulic system		AN-C-53
Fuel system	AN-VV-P-236	Parker Sealube
Oil system	AN-VV-P-236	Parker Sealube
Coolant system	Threadlube	Threadlube
Instrument system	AN-VV-P-236	AN-C-53
Oxygen system	Not used	*AN-C-86 Type B Rector Seal #15

*Approved for use on low-pressure system (400 lbs./sq. in.) only.

Proper tinning of brass pipe threads is also acceptable for sealing purposes in the oxygen system.

d. Position the tube in place and tighten the nut finger-tight.

e. With an end or crescent wrench, hold the fitting in position while the nut is tightened to the proper torque with a torque wrench. *(See paragraph b. for maximum torque.)*

f. Use of a torque wrench is strongly recommended to avoid overtightening and consequent system failure.

g. Test the installation for tightness by applying the system pressure.

h. MAXIMUM WRENCH TORQUES IN INCH-POUNDS FOR DIFFERENT MATERIAL AND SIZES OF TUBING.

Fitting size	3	4	5	6	8	10	12	16
Tubing O.D.	3/16	1/4	5/16	3/8	1/2	5/8	3/4	1
Copper tube	40	70	100	125	200	325	450	600
Al alloy 52SO	40	70	80	125	250	350	500	750
Steel tube	50	150	200	250	400	575	775	

9. TUBE LEAKS AND FAILURES: CAUSES, REMEDIES, AND PREVENTION.

a. GENERAL.—Trouble in a tubing system may be broadly classified into two groups: namely, leaks and failures.

b. LOCATING LEAKS.—Liquid leaks are sometimes hard to locate. Wipe the system clean and trace the leak to its source. Leaks generally occur at joints, around shafts or seals, and infrequently at pinholes in the unit bodies.

c. CAUSES FOR LEAKS AT FLARE JOINTS.

(1) Poor flares, rough surface, cracks, and splits.

(2) Insufficient wrench torque.

(3) Too much wrench torque.

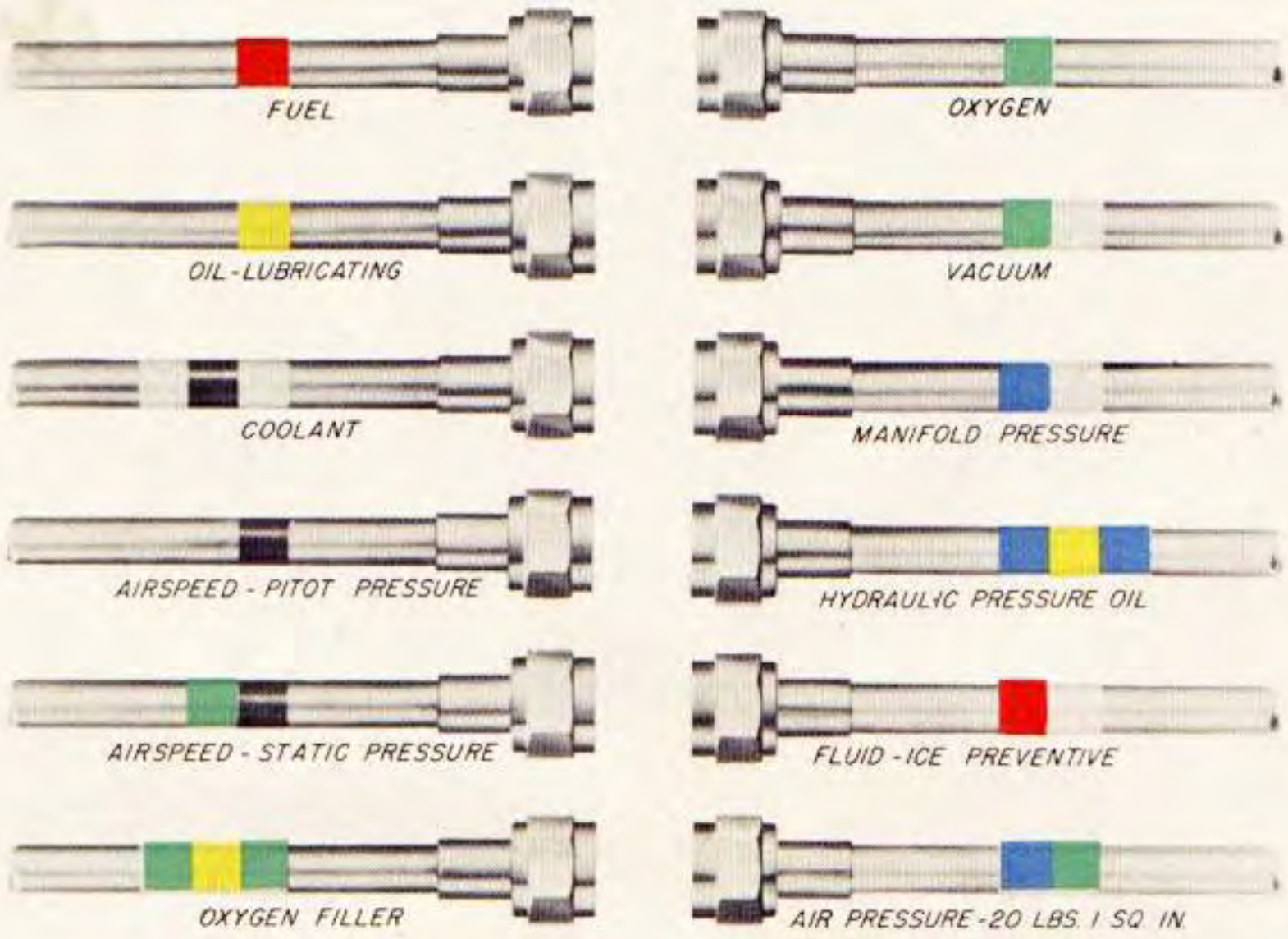


Figure 469—Tubing Color Identification

(4) Damage to flares.

(5) Foreign material under flares.

(6) Bad fitting or mismating parts.

(7) Careless assembly, such as cross-threading.

(8) Thread seized or galled.

d. CAUSES FOR LEAKS AT PIPE THREAD JOINTS.

(1) Sealing compound washed out or not properly used.

(2) Insufficient wrench torque.

(3) Poor threads, either badly machined or damaged.

(4) Galling or seizing of threads.

(5) Careless assembly, such as cross-threading.

e. CAUSES FOR LEAKS AT STRAIGHT THREAD JOINTS USING FLAT METAL GASKETS WITH SERRATIONS.

(1) Seizing or galling of threads.

(2) Too much or too little wrench torque.

(3) Mismated parts, damaged or improper serrations.

(4) Wrong size gaskets, wrong type gaskets, or no gasket.

(5) Re-use of gasket or careless assembly.

f. CAUSES FOR LEAKS AT STRAIGHT THREADED JOINTS USING SYNTHETIC RUBBER TYPE GASKET.

(1) Improper positioning of gasket on the fitting.

(2) Fitting on boss not properly positioned.

(3) Not enough wrench torque to squeeze the gasket and make the seal.

(4) Wrong size or defective gasket.

(5) Seizing or galling threads, mismated parts.

(6) Careless assembly.

g. FAILURES.—Bursting of a tube is generally due to faulty material, since the tubing is designed to withstand several times the operating pressure to which it is subjected. Vibration resulting from chattering or insufficient support is also a common cause for tube failure.

HYDRAULIC POWER AND WING FLAP SYSTEM UNITS

REF.	NAME	NO. REQ.
A	Strut Assembly—Hydraulic Wing Flap Operating Complete	1
B	Valve Assembly—Hydraulic Wing Flap Control Complete	1
C	Valve Assembly—Hydraulic System Engine Pump Unloading Complete	1
D	Gage—Single 1⅞ Dial—Pressure	2
E	Accumulator Assembly—Hydraulic Complete	1
F	Valve—Check	1
G	Reservoir Assembly—Hydraulic Complete (P-51D-5)	1
H	Reservoir Assembly—Hydraulic Complete (P-51D-10 and Subsequent)	1
I	Pump Assembly—Hydraulic Engine Complete	1

HYDRAULIC POWER AND WING FLAP SYSTEM LINES

REF. NO.	LOCATION	NO. REQ.	DIA.	GAGE	MATERIAL	MAX. LENGTH	FITTING	NO. FITTINGS REQ.
1	Line Assembly—Hydraulic Fuselage Flap Control Valve to Strut Down	1	5/16" OD	.042	52SO	39"	811BT5	2
							811T5CS	2
2	Line Assembly—Fuselage Flap Control Valve to Strut Up	1	5/16" OD	.042	52SO	32¾"	811BT5	2
							811T5CS	2
3	Line Assembly—Hydraulic Fuselage Station 126 Union to Flap Control Valve Pressure	1	5/16" OD	.042	52SO	34"	811BT5	2
							811T5CS	2
4	Line Assembly—Hydraulic Fuselage Station 131 Union to Flap Control Valve Return	1	5/16" OD	.042	52SO	30"	811BT5	2
							811T5CS	2
5	Line Assembly—Hydraulic Fuselage Stations 85 to 90 Check Valve to Station 126 Union Pressure	1	5/16" OD	.042	52SO	40⅜"	811BT5	2
							811T5CS	2
6	Line Assembly—Hydraulic Fuselage Stations 85 to 90 Check Valve to Station 129 Union Return	1	5/16" OD	.042	52SO	43"	811BT5	2
							811T5CS	2
7	Line Assembly—Hydraulic Wing Station 0 Pressure Unloader Valve to Tee Return	1	½" OD	.042	52SO	18⅞"	811BT8	2
							811T8CS	2
8	Line Assembly—Hydraulic Wing Station 0 Pressure Unloader Valve to Bulkhead Tee System Pressure	1	⅜" OD	.042	52SO	22⅜"	811BT6	2
							811T6CS	2
9	Line Assembly—Hydraulic Wing Station 0 Pressure Unloader Valve to Accumulator Pressure	1	⅜" OD	.042	52SO	20⅝"	811BT6	2
							811T6CS	2
10	Line Assembly—Hydraulic Wing Station 0 Accumulator to Gage Air Pressure	1	¼" OD	.035	52SO	13⅜"	811BT4	2
							811T4CS	2
11	Line Assembly—Hydraulic Wing Station 0 Pressure Unloader Valve to Firewall Engine Pump Pressure	1	½" OD	.042	52SO	30½"	811BT8	2
							811T8CS	2

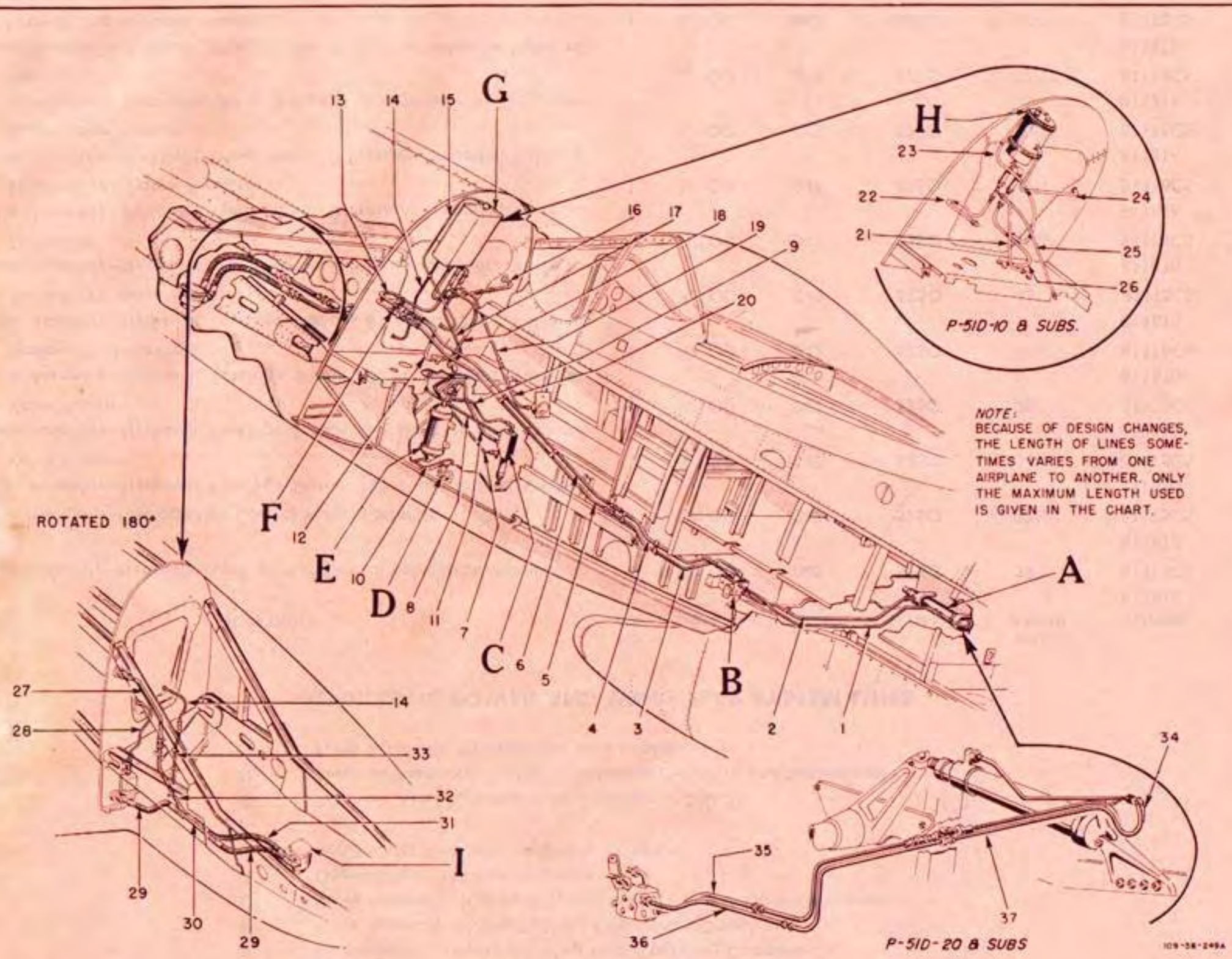


Figure 470—Hydraulic Power and Wing Flap System

HYDRAULIC POWER AND WING FLAP SYSTEM LINES (Cont.)

REF. NO.	LOCATION	NO. REQ.	DIA.	GAGE	MATERIAL	MAX. LENGTH	FITTING	NO. FITTINGS REQ.
12	Line Assembly—Hydraulic Fuselage Station 80 Bulkhead Tee to Stations 85 to 90 Check Valve Pressure	1	3/8" OD	.042	52SO	28½"	811BT6 811T6CS	2 2
13	Line Assembly—Hydraulic Fuselage Stations 85 to 90 Check Valve to Reservoir Return	1	3/8" OD	.042	52SO	18¼"	811BT6 811T6CS	2 2
14	Line Assembly—Hydraulic Fuselage Reservoir to Union Drain	1	5/16" OD	.042	52SO	23"	811BT5 811T5CS	2 2
15	Line Assembly—Hydraulic Fuselage Reservoir to Firewall Vent	1	¼" OD	.035	52SO	45⅜"	811BT4 811T4CS	2 2
16	Line Assembly—Hydraulic Fuselage Firewall to Reservoir Engine Pump Suction	1	5/8" OD	.042	52SO	25⅜"	811BT10 811T10CS	2 2
17	Line Assembly—Hydraulic Fuselage Station 80 Bulkhead Tee to Reservoir Pressure	1	3/8" OD	.042	52SO	21⅜"	811BT6 811T6CS	2 2
18	Line Assembly—Hydraulic Fuselage Station 80 Bulkhead Union Reservoir Return	1	½" OD	.042	52SO	23"	811BT8 AN819-8Z	2 2
19	Line Assembly—Hydraulic Fuselage Station 85 Tee to Snubber Pressure	1	5/16" OD	.042	52SO	11¼"	811BT5 811T5CS	2 2
20	Line Assembly—Hydraulic Fuselage Snubber to Gage Pressure	1	¼" OD	.035	52SO	7⅛"	811BT4 811T4CS	2 2
21	Line Assembly—Hydraulic Fuselage Station 80 Bulkhead Elbow Reservoir Return	1	½" OD	.042	52SO	22¾"	811BT8 811T8CS	2 2
22	Line Assembly—Hydraulic Fuselage Station 85 Check Valve to Reservoir Return	1	3/8" OD	.042	52SO	15¼"	811BT6 811T6CS	2 2
23	Line Assembly—Hydraulic Fuselage Reservoir to Firewall Vent	1	¼" OD	.035	52SO	43"	811BT4 811T4CS	2 2
24	Line Assembly—Hydraulic Fuselage Firewall to Reservoir Engine Pump Suction	1	5/8" OD	.042	52SO	24⅛"	811BT10 811T10CS	2 2
25	Line Assembly—Hydraulic Fuselage Station 85 Tee to Snubber Pressure	1	5/16" OD	.042	52SO	12½"	811BT5 811T5CS	2 2
26	Line Assembly—Hydraulic Fuselage Station 80 Bulkhead Tee to Reservoir Pressure	1	3/8" OD	.042	52SO	22⅝"	811BT6 811T6CS	2 2
27	Line Assembly—Hydraulic Engine Section Nose Connection to Disconnect Coupling Engine Pump Suction	1	5/8" OD	.042	52SO	18¾"	811BT10 811T10CS 811BT4	1 1 1
28	Line Assembly—Hydraulic Engine Section Firewall Hose to Drain Box Vent	1	¼" OD	.035	52SO	17¾"	811T4CS	1
29	Hose—Hydraulic Flexible	2	½" ID	Flexible		16¼"	43B2485-8D	4

HYDRAULIC POWER AND WING FLAP SYSTEM LINES (Cont.)

REF. NO.	LOCATION	NO. REQ.	DIA.	GAGE	MATERIAL	MAX. LENGTH	FITTING	NO. FITTINGS REQ.
30	Line Assembly—Hydraulic Engine Section Hose to Hose Engine Pump Pressure	1	½" OD	.042	52SO	12⅞"	811BT8	2
							811T8CS	2
							43B2483-10D	1
31	Hose—Hydraulic Flexible	1	⅜" ID	Flexible		18¼"	43B2485-10D	1
32	Line Assembly—Hydraulic Engine Section Flexible Hose to Hose Connection Engine Pump Suction	1	⅜" OD	.042	52SO	22½"	811BT10	1
							811T10CS	1
							811BT5	1
33	Line Assembly—Hydraulic Engine Section Union to Overboard Drain	1	3/16" OD	.042	52SO	17½"	811T5CS	1
							811BT5	2
34	Line Assembly—Hydraulic Fuselage Flap Restrictor to Strut Down	1	3/16" OD	.042	52SO	29⅜"	811T5CS	2
							811BT5	2
35	Line Assembly—Hydraulic Fuselage Flap Control Valve to Restrictor Down	1	3/16" OD	.042	52SO	17½"	811T5CS	2
							811BT5	2
36	Line Assembly—Fuselage Flap Control Valve to Union	1	3/16" OD	.042	52SO	14⅞"	811T5CS	2
							811BT5	2
37	Line Assembly—Hydraulic Fuselage Flap Union to Strut Up	1	3/16" OD	.042	52SO	44⅞"	811T5CS	2

LANDING GEAR HYDRAULIC SYSTEM UNITS

REF.	NAME	NO. REQ.
A	Strut Assembly—Hydraulic Landing Gear Down-lock Actuating Complete Left and Right	2
B	Strut Assembly—Hydraulic Landing Gear Operating Complete	2
C	Valve Assembly—Hydraulic Landing Gear Fairing Door Emergency Lowering Complete	1
D	Valve Assembly—Hydraulic Landing Gear Selector Complete	1
E	Valve Assembly—Hydraulic Landing Gear Fairing Door Control Complete	1
F	Strut Assembly—Hydraulic Tail Wheel Operating Complete	1
G	Strut Assembly—Hydraulic Landing Gear Fairing Door Operating Complete Left and Right	2
H	Valve Assembly—Hydraulic Landing Gear Up Controllable Check Complete	1
I	Valve Assembly—Hydraulic System Engine Pump Unloading Complete (See Hydraulic Power and Wing Flap System)	1

NOTE:
BECAUSE OF DESIGN CHANGES, THE LENGTH OF LINES SOMETIMES VARIES FROM ONE AIRPLANE TO ANOTHER. ONLY THE MAXIMUM LENGTH USED IS GIVEN IN THE CHART.

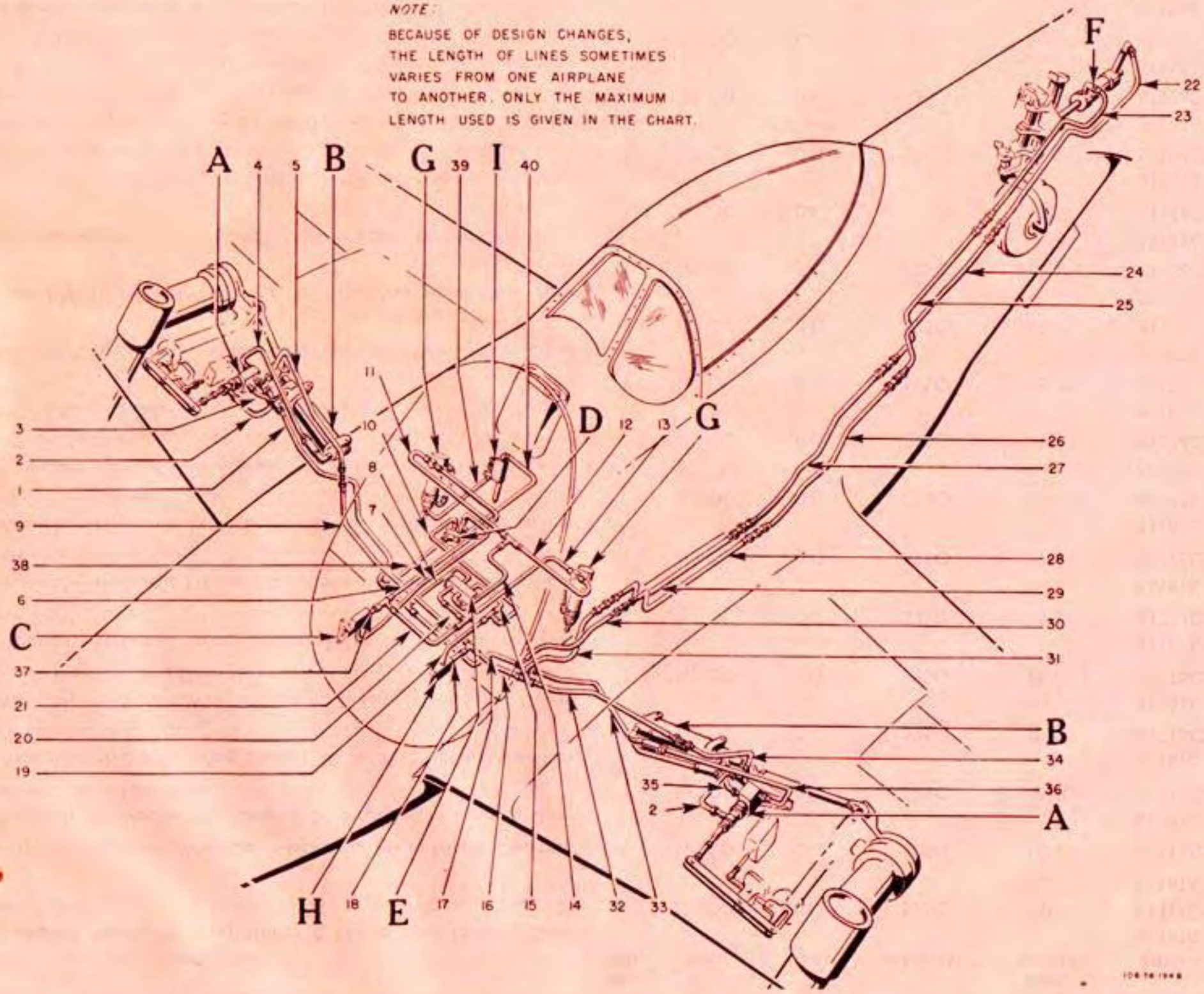


Figure 471—Landing Gear Hydraulic System

LANDING GEAR HYDRAULIC SYSTEM LINES

REF. NO.	LOCATION	NO. REQ.	DIA.	GAGE	MATERIAL	MAX. LENGTH	FITTING	NO. FITTINGS REQ.
1	Line Assembly—Hydraulic Wing Station 0 Tee to Strut Landing Gear Down Right	1	3/8" OD	.042	52SO	54¾"	811BT6 811T6CS 811BT6	2 2 4
2	Line Assembly—Hydraulic Wing Down-lock Strut Tee to Nipple Open	2	3/8" OD	.042	52SO	10¼"	811T6CS	4
3	Line Assembly—Hydraulic Wing Station 50 Strut Tee to Landing Gear Down-lock Strut Lock Right	1	3/8" OD	.042	52SO	8⅜"	811BT5 811T5CS	2 2
4	Line Assembly—Hydraulic Wing Station 40 to 58 Strut to Down-lock Right Landing Gear Up	1	3/8" OD	.042	52SO	18½"	811BT6 811T6CS	2 2
5	Line Assembly—Hydraulic Wing Station 42 Union to Station 54 Down-lock Tee Right Landing Gear Up	1	3/8" OD	.042	52SO	15¾"	811BT6 811T6CS	2 2
6	Line Assembly—Hydraulic Wing Station 0 Tee to Strut Fairing Door Close Right	1	3/8" OD	.042	52SO	25½"	811BT6 811T6CS	2 2
7	Line Assembly—Hydraulic Fairing Door Control Valve to Fairing Door Emergency Release Valve	1	3/8" OD	.042	52SO	29¼"	811BT6 811T6CS	2 2
8	Line Assembly—Hydraulic Wing Station 0 Fairing Door Valve to Tee Landing Gear Down	1	3/8" OD	.042	52SO	22⅛"	811BT6 811T6CS	2 2
9	Line Assembly—Hydraulic Wing Station 0 Tee to Station 42 Union Landing Gear Up Right	1	3/8" OD	.042	52SO	49"	811BT6 811T6CS	2 2
10	Line Assembly—Hydraulic Wing Station 0 Selector Valve to Tee Landing Gear Up	1	3/8" OD	.042	52SO	18¼"	811BT6 811T6CS	2 2
11	Line Assembly—Hydraulic Wing Station 0 Tee to Strut Fairing Door Open Right	1	3/8" OD	.042	52SO	19⅛"	811BT6 811T6CS	2 2
12	Line Assembly—Hydraulic Wing Station 0 Tee to Strut Fairing Door Open Left	1	3/8" OD	.042	52SO	18⅞"	811BT6 811T6CS	2 2
13	Line Assembly—Hydraulic Wing Station 0 Tee to Strut Fairing Door Close Left	1	3/8" OD	.042	52SO	13¾"	811BT6 811T6CS	2 2
14	Line Assembly—Hydraulic Wing Station 0 Tee to Fairing Door Valve Doors Open	1	3/8" OD	.042	52SO	15⅝"	811BT6 811T6CS	2 2
15	Line Assembly—Hydraulic Wing Station 0 Fairing Door Valve to Check Valve Landing Gear Up	1	3/8" OD	.042	52SO	6"	811BT6 811T6CS	2 2
16	Line Assembly—Hydraulic Wing Station 0 Tee to Station 13 Tee Landing Gear Up Left	1	3/8" OD	.042	52SO	14⅞"	811BT6 811T6CS	2 2
17	Line Assembly—Hydraulic Wing Station 0 to Station 14 Tee Landing Gear Down Left	1	3/8" OD	.042	52SO	16⅜"	811BT6 811T6CS	2 2

18	Line Assembly—Hydraulic Wing Station 0 Check Valve to Tee Landing Gear Up	1	3/8" OD	.042	52SO	13 7/8"	811BT6 811T6CS	2 2
19	Line Assembly—Hydraulic Wing Station 0 Controllable Check to Tee Landing Gear Up	1	3/8" OD	.042	52SO	2 1/4"	811BT6 811T6CS	2 2
20	Line Assembly—Hydraulic Wing Station 0 Fairing Door Valve to Tee Closed	1	3/8" OD	.042	52SO	5 3/8"	811BT6 811T6CS	2 2
21	Line Assembly—Hydraulic Fairing Door Up Tee to Tee	1	3/8" OD	.042	52SO	21 1/4"	811BT6 811T6CS	2 2
22	Line Assembly—Hydraulic Fuselage Station 248 Disconnect Coupling to Strut Tail Wheel Down	1	5/16" OD	.042	52SO	62 1/4"	811BT5 811T5CS	2 2
23	Line Assembly—Hydraulic Fuselage Station 248 Disconnect Coupling to Strut Tail Wheel Up	1	5/16" OD	.042	52SO	54 1/2"	811BT5 8115CS	2 2
24	Line Assembly—Fuselage Station 200 Union to Fuselage Station 248 Disconnect Coupling Tail Wheel Down	1	5/16" OD	.042	52SO	56"	811BT5 811T5CS	2 2
25	Line Assembly—Fuselage Station 200 Union to Fuselage Station 248 Disconnect Coupling Tail Wheel Up	1	5/16" OD	.042	52SO	58"	811BT5 811T5CS	2 2
26	Line Assembly—Hydraulic Fuselage Station 160 Union to Station 200 Union Tail Wheel Down	1	5/16" OD	.042	52SO	38 1/2"	811BT5 811T5CS	2 2
27	Line Assembly—Hydraulic Fuselage Station 164 Union to Station 200 Union Tail Wheel Up	1	5/16" OD	.042	52SO	36 1/2"	811BT5 811T5CS	2 2
28	Line Assembly—Hydraulic Fuselage Station 130 Union to Station 160 Union Tail Wheel Down	1	5/16" OD	.042	52SO	34 1/2"	811BT5 811T5CS	2 2
29	Line Assembly—Hydraulic Fuselage Station 120 Union to Station 160 Union Tail Wheel Up	1	5/16" OD	.042	52SO	34 1/2"	811BT5 811T5CS	2 2
30	Line Assembly—Hydraulic Fuselage Station 94 Elbow to Station 126 Union Tail Wheel Down	1	5/16" OD	.042	52SO	36 1/4"	811BT5 811T5CS	2 2
31	Line Assembly—Hydraulic Fuselage Station 94 Elbow to Station 120 Union Tail Wheel Up	1	5/16" OD	.042	52SO	36 3/8"	811BT5 811T5CS	2 2
32	Line Assembly—Hydraulic Wing Station 13 Tee to Station 42 Union Landing Gear Up Left	1	3/8" OD	.042	52SO	28 1/4"	811BT6 811T6CS	2 2
33	Line Assembly—Hydraulic Wing Station 14 Tee to Strut Landing Gear Down Left	1	3/8" OD	.042	52SO	35 3/8"	811BT6 811T6CS	2 2
34	Line Assembly—Hydraulic Wing Station 42 Union to Station 54 Down-lock Tee Left Landing Gear Up	1	3/8" OD	.042	52SO	21 1/8"	811BT6 811T6CS	2 2

LANDING GEAR HYDRAULIC SYSTEM LINES (Cont.)

REF. NO.	LOCATION	NO. REQ.	DIA.	GAGE	MATERIAL	MAX. LENGTH	FITTING	NO. FITTINGS REQ.
35	Line Assembly—Hydraulic Wing Station 50 Strut Tee to Landing Gear Down-lock Strut Lock Left	1	3/16" OD	.042	52SO	8 7/8"	811BT5 811T5CS	2 2
36	Line Assembly—Hydraulic Wing Station 40 to 58 Strut to Down-lock Left Landing Gear Up	1	3/8" OD	.042	52SO	18 3/4"	811BT6 811T6CS	2 2
37	Line Assembly—Hydraulic Wing Station 0 Emergency Fairing Door Release Valve to Tee	1	3/8" OD	.042	52SO	2 1/2"	811BT6 811T6CS	2 2
38	Line Assembly—Hydraulic Wing Station 0 Selector Valve to Tee Landing Gear Down	1	3/8" OD	.042	52SO	17 1/2"	811BT6 811T6CS	2 2
39	Line Assembly—Hydraulic Wing Station 0 Pressure Unloader Valve to Landing Gear Selector Valve Return	1	3/8" OD	.042	52SO	9 7/8"	811BT6 811T6CS	2 2
40	Line Assembly—Hydraulic Wing Landing Gear Selector Valve to Pressure Unloader Valve Pressure	1	3/8" OD	.042	52SO	15 3/8"	811BT6 811T6CS	2 2

BRAKE SYSTEM UNITS

REF.	NAME	NO. REQ.
A	Swivel Assembly—Hydraulic Brake Main Landing Gear Fitting	2
B	Cylinder Assembly—Brake	2
C	Cylinder Assembly—Brake Master	2
D	Compensator Assembly—Parking Brake	1
E	Reservoir Assembly—Hydraulic Complete	1

BRAKE SYSTEM LINES

REF. NO.	LOCATION	NO. REQ.	DIA.	GAGE	MATERIAL	MAX. LENGTH	FITTING	NO. FITTINGS REQ.
1	Line Assembly—Hydraulic Main Landing Gear Hose to Wheel Cylinder Brake	2	3/16" OD	.042	52SO	13 3/8"	811BT5 AN819-5Z	2 2
2	Hose—Hydraulic (AN-H-6-5-146)	2		Flexible				
	Nipple Assembly—Hydraulic Hose Male 811 Type	2						
	Nipple Assembly—Hydraulic Hose Bulkhead 811 Type	2						
3	Line Assembly—Hydraulic Main Landing Gear Swivel Fitting to Hose Left Brake	1	3/16" OD	.042	52SO	23"	811BT5 811T5CS	2 2
4	Line Assembly—Hydraulic Main Landing Gear Swivel Fitting to Hose Right Brake	1	3/16" OD	.042	52SO	23"	811BT5 811T5CS	2 2

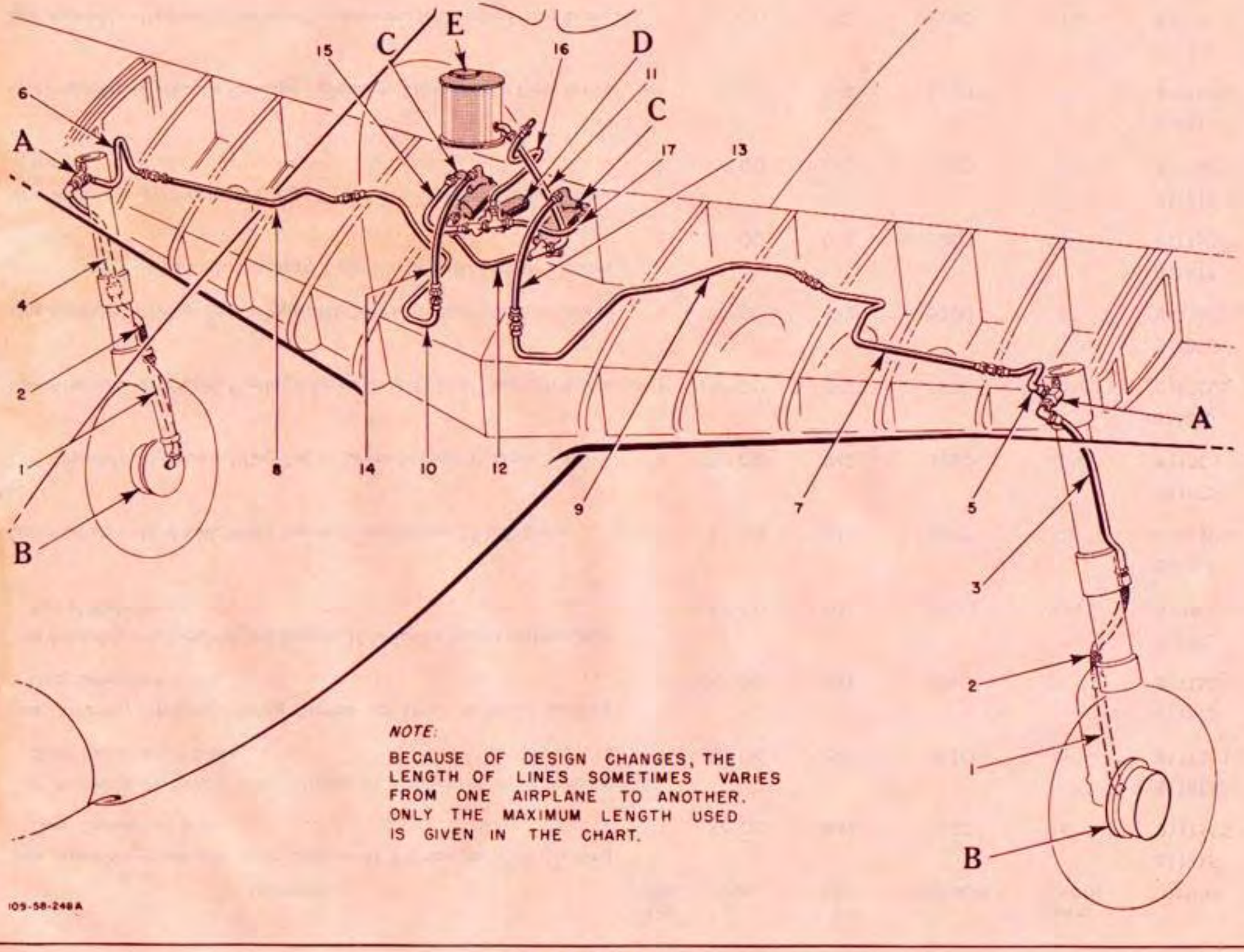


Figure 472—Brake System

BRAKE SYSTEM LINES (Cont.)

REF. NO.	LOCATION	NO. REQ.	DIA.	GAGE	MATERIAL	MAX. LENGTH	FITTING	NO. FITTINGS REQ.
5	Line Assembly—Hydraulic Wing Station 61.5 Union to Main Landing Gear Swivel Left Brake	1	3/16" OD	.042	52SO	16"	811BT5 811T5CS	2 2
6	Line Assembly—Hydraulic Wing Station 61.5 Union to Main Landing Gear Swivel Right Brake	1	3/16" OD	.042	52SO	16"	811BT5 811T5CS	2 2
7	Line Assembly—Hydraulic Wing Station 35 Union to Main Landing Gear Swivel Left Brake	1	3/16" OD	.042	52SO	31 1/16"	811BT5 811T5CS	2 2
8	Line Assembly—Hydraulic Wing Station 35 Union to Main Landing Gear Swivel Right Brake	1	3/16" OD	.042	52SO	30 3/4"	811BT5 8115CS	2 2
9	Line Assembly—Hydraulic Wing Tee to Union Station 35 Left Brake	1	3/16" OD	.042	52SO	42 3/16"	811BT5 811T5CS	2 2
10	Line Assembly—Hydraulic Wing Tee to Union Station 35 Right Brake	1	3/16" OD	.042	52SO	45 3/16"	811BT5 8115CS	2 2
11	Line Assembly—Hydraulic Fuselage Reservoir to Cylinder Tee Left Brake	1	3/8" OD	.042	52SO	10 3/4"	811BT6 811T6CS	2 2
12	Line Assembly—Hydraulic Fuselage Left Cylinder to Right Cylinder Brake	1	3/8" OD	.042	52SO	5"	811BT6 811T6CS	2 2
13	Line Assembly—Hydraulic Fuselage Cylinder to Bulkhead Union Left Brake	1	3/16" OD	.042	52SO	24 1/2"	811BT5 811T5CS	2 2
14	Line Assembly—Hydraulic Fuselage Cylinder to Bulkhead Union Right Brake	1	3/16" OD	.042	52SO	25 3/16"	811BT5 811T5CS	2 2
15	Line Assembly—Hydraulic Fuselage Cylinder to Compensator Right Brake	1	3/16" OD	.042	52SO	11 5/16"	811BT5 811T5CS	2 2
16	Line Assembly—Hydraulic Fuselage Compensator to Bleeder Fitting Brake	1	3/16" OD	.042	52SO	22 7/16"	811BT5 811T5CS	2 2
17	Line Assembly—Hydraulic Fuselage Cylinder to Compensator Left Brake	1	3/16" OD	.042	52SO	6 5/16"	811BT5 811T5CS	2 2

FUEL SYSTEM UNITS

REF.	NAME	NO. REQ.
A	Cell Assembly—Fuselage Fuel Self-sealing	1
B	Cell Assembly—Self-sealing Fuel Complete—Left-hand	1
	Cell Assembly—Self-sealing Fuel Complete—Right-hand	1
C	Cup Assembly—Main Fuel Cell Pressure Accumulater—Left-hand	1
	Cup Assembly—Main Fuel Cell Pressure Accumulator—Right-hand	1
D	Valve Assembly—Fuel Shut-off	1
E	Box Assembly—Engine Drain	1
F	Valve Assembly—Fuel Selector	1
G	Separator—Oil (Type B-12)	1
H	Pump Assembly—Fuel (Type G-9)	1
I	Strainer Assembly—Fuel (Type C-5)	1

FUEL SYSTEM LINES

REF. NO.	LOCATION	NO. REQ.	DIA.	GAGE	MATERIAL	MAX. LENGTH	FITTING	NO. FITTINGS REQ.
1	Line—Fuselage Fuel Cell to Vent Cup—1st Section	1	¾" OD	.049	52SO	35⅜"		
2	Line—Fuselage Fuel Cell to Vent Cup—2nd Section	1	¾" OD	.049	52SO	46⅞"		
3	Line—Fuselage Fuel Cell to Vent Cup—3rd Section	1	¾" OD	.049	52SO	13¾"		
4	Line—Fuselage Fuel Cell Booster Pump Drain	1	¼" OD	.035	Copper	16¼"		
5	Line—Fuselage Fuel Cell Drain	1	¾" OD	.049	52SO	13¾"		
6	Hose—Fuselage Fuel Cell Drain	1	¾" ID	Self-sealing		13"		
7	Line Assembly—Main Fuel Cell Vent—3rd Section Left (Welded)	1	1" OD	.049	52SO	17"		
			1" OD	.049	52SO	5⅜"		
8	Line—Main Fuel Cell Vent—4th Section Left	1	1" OD	.049	52SO	9¾"		
9	Line Assembly—Fuel Tank to Vent Relief Valve—2nd Section Left	1	1" OD	.049	52SO	79"		
	(Welded)	1	1" OD	.049	52SO	8"		
10	Hose—Vent Line	2	1" ID	Self-sealing		20"		
11	*Line—Fuel Droppable Tank to Fuel Cock Left—1st Section	1	¾" OD	.049	52SO	21⅛"	811BT12	
	†Line—Fuel Droppable Tank to Fuel Cock Left—1st Section	1	¾" OD	.049	52SO	24¾"	811T12	
12	Line—Fuel Tank Vent Fitting to Line Connector	2	1" OD	.049	52SO	9½"		

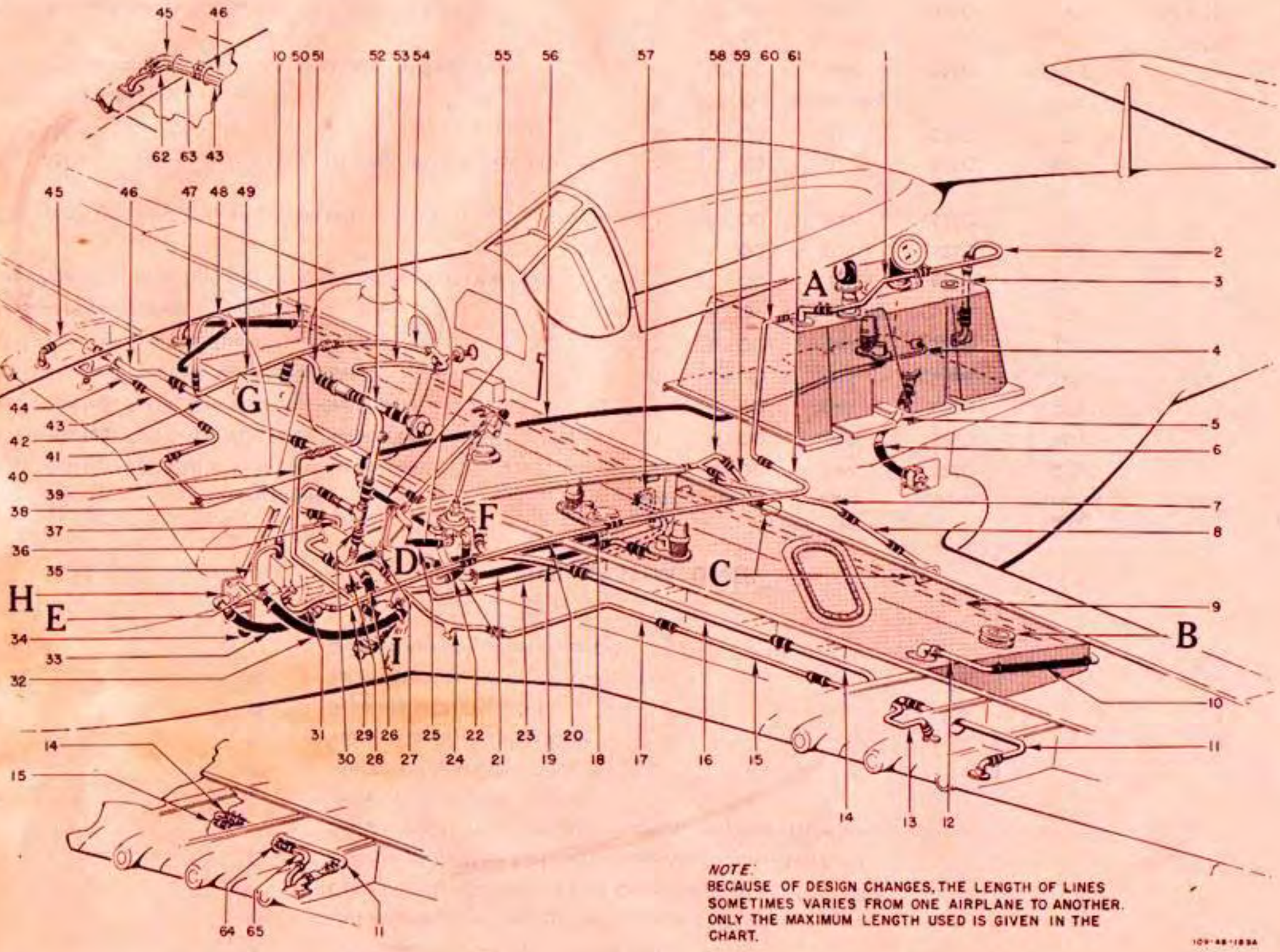


Figure 473—Fuel System

FUEL SYSTEM LINES (Cont.)

REF. NO.	LOCATION	NO. REQ.	DIA.	GAGE	MATERIAL	MAX. LENGTH	FITTING	NO. FITTINGS REQ.
13	Line—Combat Fuel Pressure System Left—5th Section	1	½" OD	.035	52SO	26"		
14	Line—Fuel Droppable Tank to Fuel Cock Left—2nd Section	1	¾" OD	.049	52SO	28¾"		
15	Line—Combat Fuel Pressure System Left—4th Section	1	½" OD	.035	52SO	14¼"		
16	Line—Fuel Droppable Tank to Fuel Cock Left—3rd Section	1	¾" OD	.049	52SO	25¾"		
17	Line—Combat Fuel Pressure System Left—3rd Section	1	½" OD	.035	52SO	34¾"		
18	Line—Fuel Vapor Return Carburetor to Fuselage Cell Vent—2nd Section	1	¼" OD	.035	52SO	30"		
19	Line—Fuel Droppable Tank to Fuel Cock Left—4th Section	1	¾" OD	.049	52SO	19⅜"		
20	Hose—Right-hand Fuel Pump to Selector Valve—1st Section	1	¾" ID	Self-sealing		31"		
21	Hose—Left-hand Fuel Pump to Selector Valve	1	¾" ID	Self-sealing		23¼"		
	Line—Fuel Left Wing Cell to Selector Valve	1	¾" OD	.049	52SO	12¾"		
22	Hose—Right-hand Fuel Booster Pump to Selector Valve—2nd Section	1	¾" ID	Self-sealing		9½"		
23	Tube Assembly—Drain Box Outlet Intermediate Section (Welded)	1	⅜" OD	.035	52SO	12"		
			⅝" OD	.035	52SO	58"		
24	Line Assembly—Combat Fuel Pressure System Left—2nd Section	1	½" OD	.035	52SO	27⅞"		
25	‡Hose—Selector Valve to Shut-off Valve	1	¾" ID	Self-sealing		14¾"		
	§Line—Fuel Selector Valve to Shut-off Valve	1	¾" OD	.049	52SO	11½"		
26	Hose—Firewall to Strainer	1	1" ID	Self-sealing		6¼"		
27	Hose—Shut-off Valve to Firewall	1	1" ID	Self-sealing		5"		
28	Line Assembly—Combat Fuel Pressure System Left—1st Section (Welded)	1	½" OD	.035	52SO	11⅛"		
			½" OD	.042	52SO	1¾"		
29	Line—Fuel Vapor Return Carburetor to Fuselage Cell Vent—1st Section	1	¼" OD	.035	52SO	18½"		
	Hose—Aromatic Synthetic Resistant	1	1" ID	Synthetic (AN884-4-48)		12"		
30	Line—Combat Fuel Pressure System Tee to Center Bulkhead	1	⅜" OD	.035	52SO	7"		
31	Line—Engine Compartment Drain—1st Section	1	⅝" OD	.035	52SO	22⅜"		
32	Hose—Strainer to G-9 Pump	1	1" ID	Self-sealing		30½"		
33	Hose—G-9 Pump to Carburetor Inlet	1	1" ID	Self-sealing		18¾"		
34	Hose—Aromatic Synthetic Resistant	1	¼" ID	Synthetic (AN884-4-52)		13"		

FUEL SYSTEM LINES (Cont.)

REF. NO.	LOCATION	NO. REQ.	DIA.	GAGE	MATERIAL	MAX. LENGTH	FITTING	NO. FITTINGS REQ.
35	Line—Fuel G-9 Pump Drain	1	¼" OD	.035	52SO	30¾"		
36	Line—Combat Fuel Pressure System Right—1st Section	1	½" OD	.035	52SO	12⅛"		
37	Line—Combat Fuel Pressure Relief Valve to Drain Box	1	⅜" OD	.035	52SO	14"		
38	Line—Fuel Droppable Tank to Fuel Cock Right—4th Section	1	¾" OD	.049	52SO	27"		
							811BT4	2
39	Line Assembly—Fuel Primer System Firewall to Fuel Strainer	1	¼" OD	.035	52SO	29¼"	811T4CS	2
40	Line Assembly—Combat Fuel Pressure System Right—2nd Section	1	½" OD	.035	52SO	41¼"		
41	Line—Combat Fuel Pressure System Right—3rd Section	1	½" OD	.035	52SO	25⅜"		
42	Line—Fuel Droppable Tank to Fuel Cock Right—3rd Section	1	¾" OD	.049	52SO	26"		
43	Line—Combat Fuel Pressure System Right—4th Section	1	½" OD	.035	52SO	22"		
44	Line—Combat Fuel Pressure System Right—5th Section	1	½" OD	.035	52SO	24⅜"		
45	*Line—Fuel Droppable Tank to Fuel Cock Right—1st Section	1	¾" OD	.049	52SO	21"		
							811BT12	1
	†Line—Fuel Droppable Tank to Fuel Cock Right—1st Section	1	¾" OD	.049	52SO	24¼"	811T12	1
46	Line—Fuel Droppable Tank to Fuel Cock Right—2nd Section	1	¾" OD	.049	52SO	28⅞"		
47	Hose—Aromatic Synthetic Resistant	1	1" ID	Synthetic (AN884-4-12)		3"		
48	Line—Fuel Primer System Firewall to Engine Connector—2nd Section	1	¼" OD	.035	52SO	27⅜"		
49	Line Assembly—Fuel Primer System Firewall to Engine Connector—1st Section	1	¼" OD	.035	52SO	39"	811BT4 811T4CS	1 1
50	Line Assembly—Fuel Tank Vent to Vent Relief Valve Right—2nd Section Welded	1	1" OD 1" OD	.049 .049	52SO 52SO	79" 7⅞"		
51	Line—Combat Fuel Pressure System Separator to Pressure Relief Valve		⅜" OD	.042	52SO	12⅜"		
52	Line Assembly—Combat Fuel Pressure System Check Valve to Tee (Welded)	1	⅜" OD ⅜" OD	.042 .042	52SO 52SO	23¼" 3¼"		
							811T4	2
53	Line Assembly—Fuel System Hand Primer to Firewall Suction	1	¼" OD	.035	52SO	33⅜"	811BT4	2
							811BT4	2
54	Line Assembly—Fuel System Hand Primer to Firewall Pressure	1	¼" OD	.035	52SO	20⅞"	811T4CS	2

55	Hose—Fuselage Fuel Cell Pump to Selector Valve—2nd Section	1	¾" ID	Self-sealing		14¾"		
56	Hose—Fuselage Fuel Cell Pump to Selector Valve—1st Section	1	¾" ID	Self-sealing		88½"		
57	Line—Drain Box Outlet—Rear Section	1	⅜" OD	.035	52SO	17¼"		
58	Line Assembly—Main Fuel Cell Vent Right—3rd Section (Welded)	1	1" OD	.049	52SO	13¼"		
			1" OD	.049	52SO	6"		
59	Line—Main Fuel Cell Vent Right—4th Section	1	1" OD	.049	52SO	20¼"		
60	Line—Fuel Vapor Return Carburetor to Fuselage Cell Vent—4th Section	1	¼" OD	.035	52SO	33¼"		
61	Line—Fuel Vapor Return Carburetor to Fuselage Cell Vent—3rd Section	1	¼" OD	.035	52SO	27⅜"		
62	Line—Combat Fuel Pressure System—6th Section Right	1	⅜" OD	.035	52SO	17¾"	811BT6	1
							811T6	1
63	Line—Combat Fuel Pressure System—5th Section Right	1	⅜" OD	.035	52SO	15½"		
64	Line—Combat Fuel Pressure System—5th Section Left	1	⅜" OD	.035	52SO	16⅜"		
65	Line—Combat Fuel Pressure System—6th Section Left	1	⅜" OD	.035	52SO	17⅝"	811BT6	1
							811T6	1

FUEL SYSTEM LINES CODE

*Used on P-51D-5-NA and NT through P-51D-20-NA and NT Airplanes.

†Used on P-51D-25-NA and NT and Subsequent Airplanes.

‡Used on P-51D-5-NA and 44-14053 Through 44-14253 of P-51D-10-NA Airplanes.
Also Used on P-51D-5-NT and 44-11553 Through 44-11752 of P-51D-10-NT Airplanes.

§Used on 44-14253 Through 44-14852 of P-51D-10-NA and Subsequent Airplanes.
Also Used on 44-11752 Through 44-11952 of P-51D-10-NT and Subsequent Airplanes.

OIL SYSTEM UNITS

REF.	NAME	NO. REQ.
A	Tank Assembly—Oil Complete	1
B	Separator—Oil	1
C	Valve—Solenoid	1
D	Radiator Assembly—Oil Complete	1
E	Box Assembly—Engine Drain	

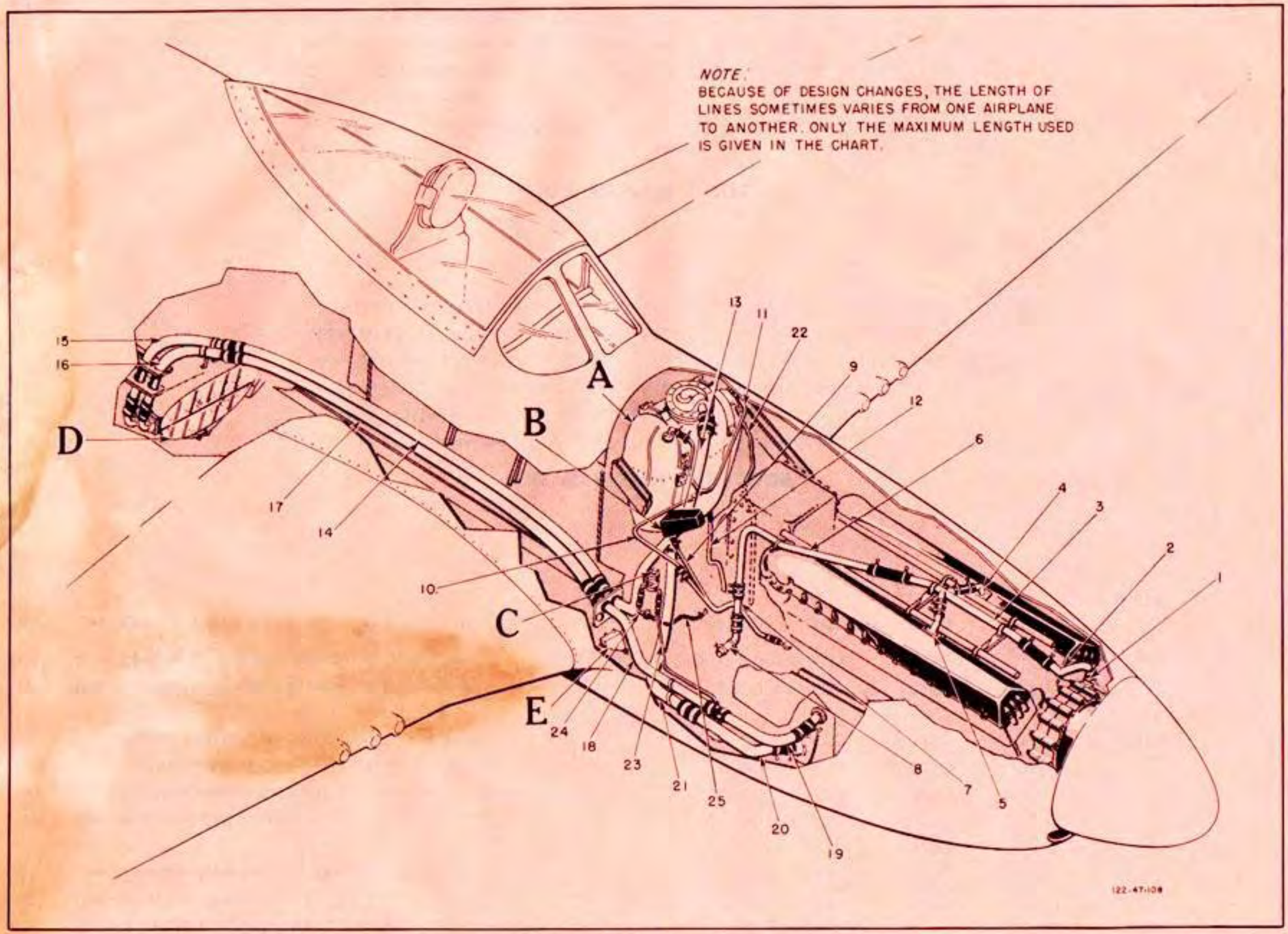


Figure 474—Oil System

OIL SYSTEM LINES

REF. NO.	LOCATION	NO. REQ.	DIA.	GAGE	MATERIAL	MAX. LENGTH	FITTING	NO. FITTINGS REQ.
1	Tube Assembly—Front Crankcase Breather—1st Section	1	1¼" OD	.049	52SO	3¼"		
			1½" OD	.049	52SO	13"		
2	Tube Assembly—Front Crankcase Breather Swage—2nd Section (Welded)	1	1½" OD	.049	52SO	3"		
			1¼" OD	.049	52SO	3⅛"		
			1½" OD	.049	52SO	26¼"		
3	Tube Assembly—Front Crankcase Breather—2nd Section (Welded)	1	1" OD	.049	52SO	4¼"		
			1" OD	.049	52SO	4¼"		
4	Tube Assembly—Rocker Box Breather Left (Welded)	1	1" OD	.049	52SO	2½"		
			1" OD	.049	52SO	2¼"		
5	Tube Assembly—Rocker Box Breather Right (Welded)	1	1" OD	.049	52SO	2½"		
			1" OD	.049	52SO	2¼"		
6	Line—Front Crankcase Breather—3rd Section	1	1½" OD	.049	52SO	31¾"		
7	Line—Front Crankcase Breather—4th Section	1	1½" OD	.049	52SO	12¾"		
			1½" OD	.049	52SO	5⅝"		
8	Elbow Assembly—Rear Breather (Welded)	1	1½" OD	.049	52SO	3"		
9	Line Assembly—Oil System Tank Vent—3rd Section (Welded)	1	½" OD	.042	52SO	17½"		
			¾" OD	.049	52SO	17¾"		
10	Line—Oil System Vent	1	¾" OD	.049	52SO	18½"		
11	Line Assembly—Oil System Tank Vent—1st Section (Welded)	1	½" OD	.042	52SO	41¼"		
			¾" OD	.049	52SO	4"		
							811BT6	2
12	Line Assembly—Oil Tank Sump Drain	1	⅜" OD	.035	52SO	34¾"	811T6CS	2
13	Line—Oil System—Cooler to Tank—3rd Section	1	1½" OD	.049	52SO	48¼"		
14	Line Assembly—Oil System—Cooler to Tank—2nd Section	1	1½" OD	.049	52SO	74⅛"		
15	Housing Assembly—Oil Cooler Door Control Thermometer Bulb (Welded)	1	1½" OD	.049	52SO	25"		
16	Line—Oil System Engine to Oil Cooler—4th Section	1	1½" OD	.049	52SO	28¾"		
17	Line Assembly—Oil System—Engine to Oil Cooler—3rd Section	1	1½" OD	.049	52SO	73"		
18	Line—Oil System—Engine to Oil Cooler—2nd Section	1	1½" OD	.049	52SO	37½"		
19	Line—Oil System—Engine to Oil Cooler—1st Section	1	1½" OD	.049	52SO	11⅛"		
20	Line Assembly—Oil System—Tank to Engine (Welded)	1	1½" OD	.049	52SO	9¼"		
			2" OD	.049	52SO	10¾"		
21	Line—Oil System—Oil Tank to Engine—1st Section	1	2" OD	.049	52SO	35⅝"		
22	Line—Oil Filter Overflow to Cowling Former	1	½" OD	.042	52SO	42½"		
23	Line—Oil Dilution Valve to Drain Casting	1	¼" OD	.035	52SO	16⅛"		
24	Hose—Oil and Coolant Synthetic	1	¼" ID		Synthetic	5"		
25	Hose—Aromatic Synthetic Resistant	1	⅜" ID		Synthetic	16½"		

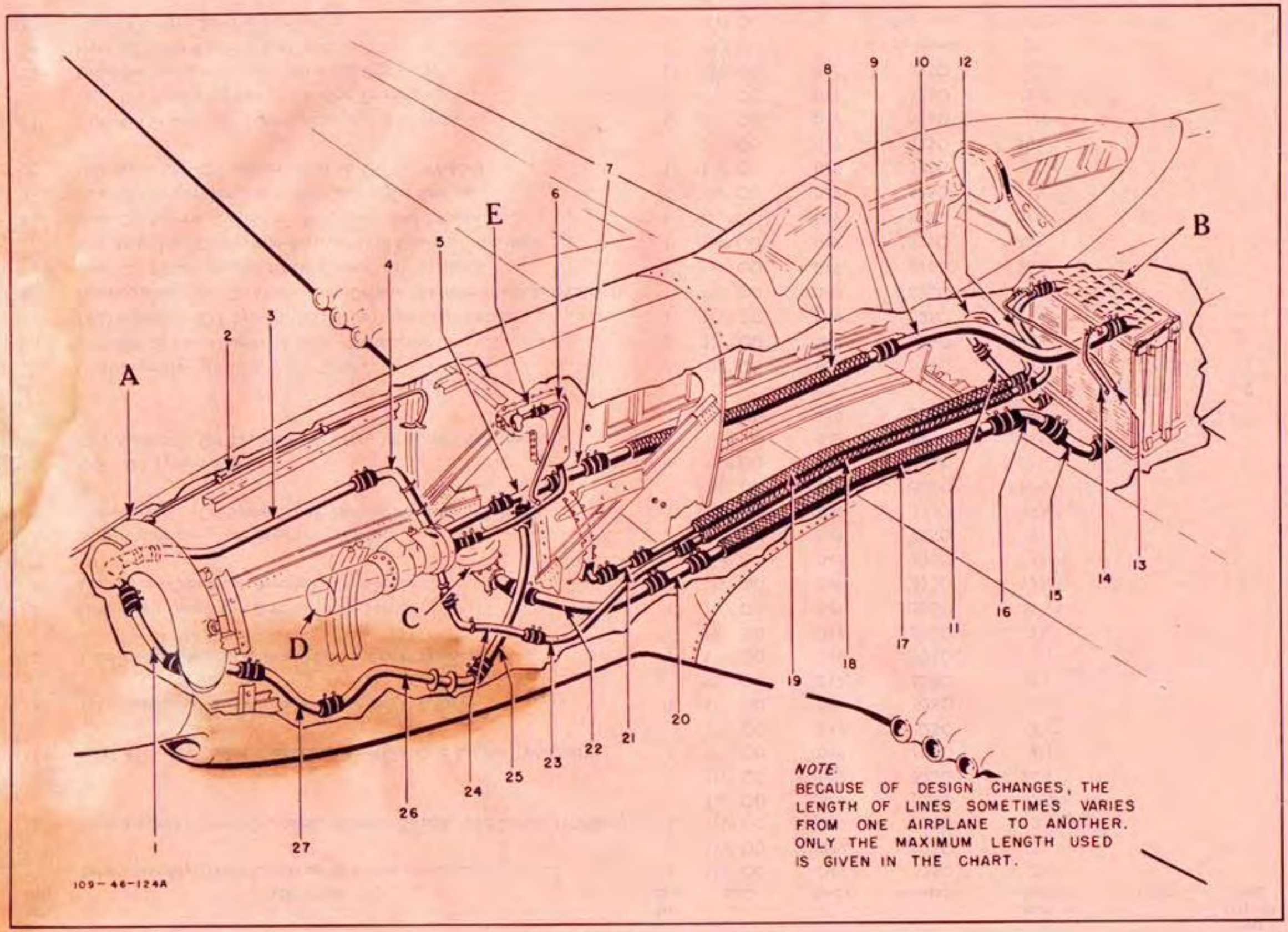


Figure 475—Cooling Systems

COOLANT SYSTEM UNITS

REF.	NAME	NO. REQ.
A	Tank Assembly—Twin Outlet Coolant Header Complete	1
B	Radiator Assembly—Aftercooling and Engine Coolant	1
C	Pump—Engine Coolant	1
D	Pump—Aftercooler	1
E	Tank—Expansion	1

COOLANT SYSTEM LINES

REF. NO.	LOCATION	NO. REQ.	DIA.	GAGE	MATERIAL	MAX. LENGTH	FITTING	NO. FITTINGS REQ.
1	Line—Coolant Header Tank Cross-flow	1	¾" OD	.035	52SO	17¼"		
2	Line—Coolant Relief Valve Vent	1	½" OD	.035	52SO	69"		
3	Line—Coolant Header Tank to Y Right—2nd Section	1	2" OD	.049	52SO	25⅞"		
4	Line—Coolant Header Tank to Y Right—3rd Section	1	2" OD	.049	52SO	35⅞"		
5	Line Assembly—Coolant Y (Welded)	1	2" OD	.049	52SO	8½"		
			2" OD	.049	52SO	10"		
			2½" OD	.049	52SO	13¾"		
6	Line—Aftercooling Relief Valve Vent	1	⅜" OD	.035	52SO	24⅜"		
7	Line Assembly—Coolant Thermometer Well (Welded)	1	2½" OD	.049	52SO	13½"		
8	Line Assembly—Coolant Y to Radiator Upper Inlet—2nd Section	1	2½" OD	.049	52SO	71¾"		
9	Line Assembly—Coolant Y to Radiator Upper Inlet—3rd Section (Welded)	1	2½" OD	.049	52SO	45"		
10	Line—Aftercooler Radiator Lower Outlet to Firewall—2nd Section	1	1¼" OD	.049	52SO	42⅛"		
11	Line—Aftercooler Radiator Lower Outlet to Firewall—1st Section	1	1¼" OD	.049	52SO	14"		
12	Line Assembly—Aftercooler Firewall to Radiator Upper Inlet—2nd Section (Welded)	1	1¼" OD	.049	52SO	45⅝"		
13	Line—Aftercooling Radiator to Vent	1	¼" OD	.032	Copper	27¾"		
14	Line—Coolant Radiator to Vent	1	¼" OD	.032	Copper	11¼"		
15	Line—Coolant Radiator Lower Outlet to Firewall—1st Section	1	2½" OD	.049	52SO	16⅝"		
16	Line—Coolant Radiator Lower Outlet to Firewall—2nd Section	1	2½" OD	.049	52SO	20⅞"		
17	Line Assembly—Coolant Radiator Lower Outlet to Firewall—3rd Section	1	2½" OD	.049	52SO	70½"		

COOLANT SYSTEM LINES (Cont.)

REF. NO.	LOCATION	NO. REQ.	DIA.	GAGE	MATERIAL	MAX. LENGTH	FITTING	NO. FITTINGS REQ.
18	Line Assembly—Aftercooler Firewall to Radiator Upper Inlet—1st Section	1	1¼" OD	.049	52SO	72¾"		
19	Line Assembly—Aftercooler Radiator Lower Outlet to Firewall—3rd Secton	1	1¼" OD	.049	52SO	75½"		
20	Line—Coolant Radiator Lower Outlet to Firewall—4th Section	1	2½" OD	.049	52SO	13⅞"		
21	Line—Aftercooler Firewall to Supercharger	1	1¼" OD	.049	52SO	19⅞"		
22	Line—Coolant Firewall to Pump Outlet	1	2½" OD	.049	52SO	25"		
23	Line—Aftercooler Pump to Firewall—3rd Section	1	1¼" OD	.049	52SO	38⅜"		
24	Line—Aftercooler Pump to Firewall—1st Section	1	1¼" OD	.049	52SO	17½"		
25	Line—Coolant Header Tank to Y Left—3rd Section	1	2" OD	.049	52SO	29⅜"		
26	Line—Coolant Header Tank to Y Left—2nd Section	1	2" OD	.049	52SO	29"		
27	Line—Coolant Header Tank to Y Left—1st Section	1	2" OD	.049	52SO	10"		

INSTRUMENT SYSTEM UNITS

REF.	NAME	NO. REQ.
A	Panel—Instrument Complete	1
B	Filter—Vacuum Air	1
C	Valve—Suction Relief (Spec. No. 95-28391)	1
D	Pump—Vacuum (Spec. No. 95-28391)	1
E	Separator—Oil (Spec. No. 95-28391)	1
F	Transmitter—Fuel Pressure (P-51D-15 and Subsequent)	1
G	Needle Valve (Parker)	1
H	Block—Vacuum and Filter Manifold	1

INSTRUMENT SYSTEM LINES

REF. NO.	LOCATION	NO. REQ.	DIA.	GAGE	MATERIAL	MAX. LENGTH	FITTING	NO. FITTINGS REQ.
							811BT8D	1
1	Line Assembly—Firewall to Manifold Block Vacuum	1	½" OD	.042	52SO	28⅛"	AN819-8Z	1
2	Line—Firewall to Vacuum Suction Relief Valve Vacuum	1	⅝" OD	.042	52SO	14⅛"		
3	Line—Vacuum Suction Relief Valve to Vacuum Pump—1st Section Vacuum	1	⅜" OD	.042	52SO	30¾"		
4	Line Assembly—Vacuum Suction Relief Valve to Vacuum Pump—2nd Section Vacuum	1	⅝" OD	.042	52SO	47⅛"	811BT10D AN819-10Z	1 1

NOTE:
BECAUSE OF DESIGN CHANGES, THE LENGTH OF LINES SOMETIMES VARIES FROM ONE AIRPLANE TO ANOTHER. ONLY THE MAXIMUM LENGTH USED IS GIVEN IN THE CHART.

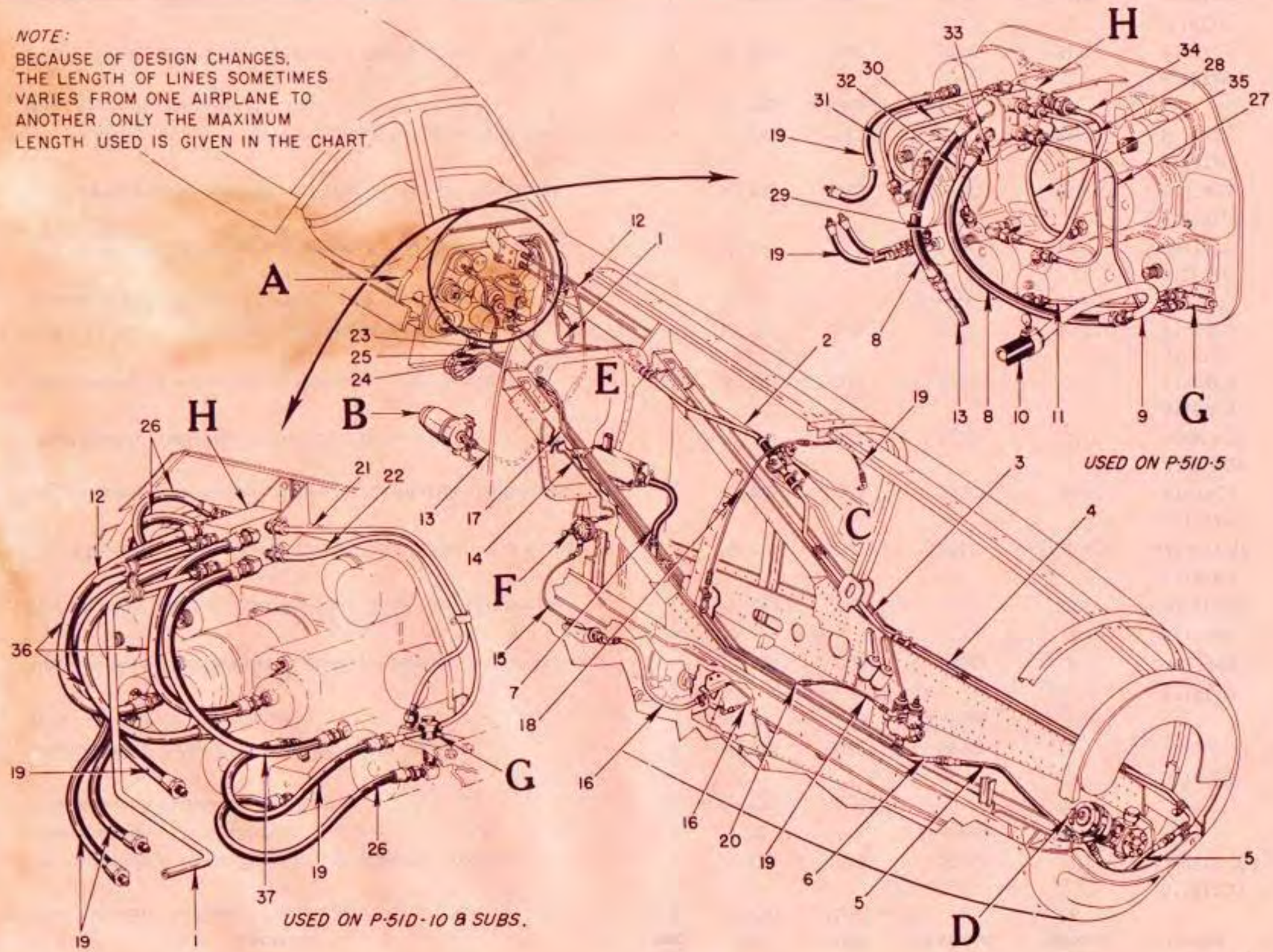


Figure 476—Vacuum and Engine Instrument System

INSTRUMENT SYSTEM LINES (Cont.)

REF. NO.	LOCATION	NO. REQ.	DIA.	GAGE	MATERIAL	MAX. LENGTH	FITTING	NO. FITTINGS REQ.
5	Hose Assembly—Instrument Flexible	2	5/8" OD	Flexible		16"		
							811BT10D	1
6	Line Assembly—Vacuum Pump to Oil Separator Vacuum	1	3/8" OD	.042	52SO	52 1/8"	AN819-10Z	1
7	Hose Assembly—Oil Separator	1	3/8" ID		Synthetic	10"		
8	Hose Assembly—Instrument Flexible	2	1/2" OD	Flexible		16"		
							811BT8D	1
9	Line Assembly—Firewall to Manifold Block Vacuum	1	3/8" OD	.042	52SO	15"	AN819-8Z	1
10	Hose—Oil and Coolant Synthetic	1	3/8" ID		Synthetic	5"		
							811BT4D	2
11	Line Assembly—Needle Valve to Bank-and-Turn Indicator—Vacuum	1	1/4" OD	.035	52SO	8 1/4"	181T4CS	2
							811BT8D	2
12	Line Assembly—Vacuum Manifold Block to Air Filter—1st Section	1	1/2" OD	.042	52SO	29 1/4"	AN819-8Z	2
							811BT8D	2
13	Line Assembly—Vacuum Manifold Block to Air Filter—2nd Section	1	1/2" OD	.042	52SO	20 3/8"	AN819-8Z	2
							811BT4D	2
14	*Line Assembly—Fuel Pressure Firewall to Carburetor—1st Section	1	1/4" OD	.035	52SO	26 3/4"	811T4CS	2
							AN818-2D	2
	†Line Assembly—Fuel Pressure Firewall to Transmitter	1	1/4" OD	.035	52SO	25 1/4"	AN819-2Z	2
							811BT4D	2
15	*Line Assembly—Fuel Pressure to Carburetor—2nd Section	1	1/4" OD	.035	52SO	7 1/4"	811T4CS	2
							811BT4D	2
	†Line Assembly—Fuel Pressure Transmitter to Carburetor	1	1/4" OD	.035	52SO	25 1/4"	811T4CS	2
16	Hose—Aromatic Synthetic Resistant	1	3/8" ID		Synthetic	16 1/2"		
							811BT4D	2
	Line Assembly—Fuel Pressure Transmitter to Engine	1	1/4" OD	.035	52SO	14"	811T4CS	2
							811BT4D	2
17	Line Assembly—Manifold Pressure Firewall to Engine—1st Section	1	1/4" OD	.035	52SO	41 3/4"	811T4CS	2
							811BT4D	2
18	Line Assembly—Manifold Pressure Firewall to Engine—2nd Section	1	1/4" OD	.035	52SO	23 3/8"	811T4CS	2
19	Hose Assembly—Instrument Flexible	5	1/4" OD	Flexible		14"		
							811BT4D	2
20	Line Assembly—Oil Pressure Firewall to Engine	1	1/4" OD	.035	52SO	51"	811T4CS	2
							811BT4D	2
21	Line Assembly—Manifold Block to Bank-and-Turn Indicator—Filter	1	1/4" OD	.035	52SO	19 3/8"	811T4CS	2

							811BT4D	2
22	Line Assembly—Bank-and-Turn Needle Valve to Manifold Block	1	¼" OD	.035	52SO	18⅜"	811T4CS	2
							811BT4D	2
23	Line Assembly—Manifold Pressure Gage to Firewall	1	¼" OD	.035	52SO	15⅛"	811T4CS	2
							811BT4D	2
24	*Line Assembly—Fuel Pressure—Engine Gage to Firewall	1	¼" OD	.035	52SO	14½"	811T4CS	2
	†Hose Assembly—Low-pressure—Swivel Connection	1	⅛" OD	Flexible		22"		
							811BT4D	2
25	*Line Assembly—Oil Pressure Engine Gage to Firewall	1	¼" OD	.035	52SO	13¹¹⁄₁₆"	811T4CS	2
	†Hose Assembly—Low-pressure—Swivel Connection	1	⅛" OD	Flexible		22"		
26	Hose Assembly—Instrument Flexible	3	¼" OD	Flexible		14"		
							811BT4D	2
27	Line Assembly—Needle Valve to Manifold Block—Vacuum	1	¼" OD	.035	52SO	13⅜"	811T4CS	2
							811BT4D	2
28	Line Assembly—Bank-and-Turn Indicator to Manifold Block	1	¼" OD	.035	52SO	14¼"	811T4CS	2
							AN818-2D	2
29	Line Assembly—Engine Gage to Bulkhead Disconnect	1	⅛" OD	.035	52SO	9½"	AN819-2Z	2
							811BT6D	2
30	Line Assembly—Flight Indicator to Manifold Block—Vacuum	1	⅜" OD	.035	52SO	10⅛"	AN819-6Z	2
							811BT6D	2
31	Line Assembly—Flight Indicator to Manifold Block—Filter	1	⅜" OD	.035	52SO	9⅜"	AN819-6Z	2
							811BT4D	2
32	Line Assembly—Suction Gage to Flight Indicator	1	¼" OD	.035	52SO	10"	811T4CS	2
							811BT4D	2
33	Line Assembly—Suction Gage to Manifold Block—Filter	1	¼" OD	.035	52SO	9½"	811T4CS	2
							811BT6D	2
34	Line Assembly—Turn Indicator to Manifold Block—Filter	1	⅜" OD	.035	52SO	10"	AN819-6Z	2
							811BT6D	2
35	Line Assembly—Turn Indicator to Manifold Block—Vacuum	1	⅜" OD	.035	52SO	12⅞"	811T6CS	2
36	Hose Assembly—Instrument Flexible	3	⅜" OD	Flexible		18"		
37	Hose Assembly—Instrument Flexible	1	⅜" OD	Flexible		20"		

INSTRUMENT SYSTEM LINES CODE

*Used on P-51D-5 and P-51D-10 Airplanes.

†Used on P-51D-15 and Subsequent Airplanes.

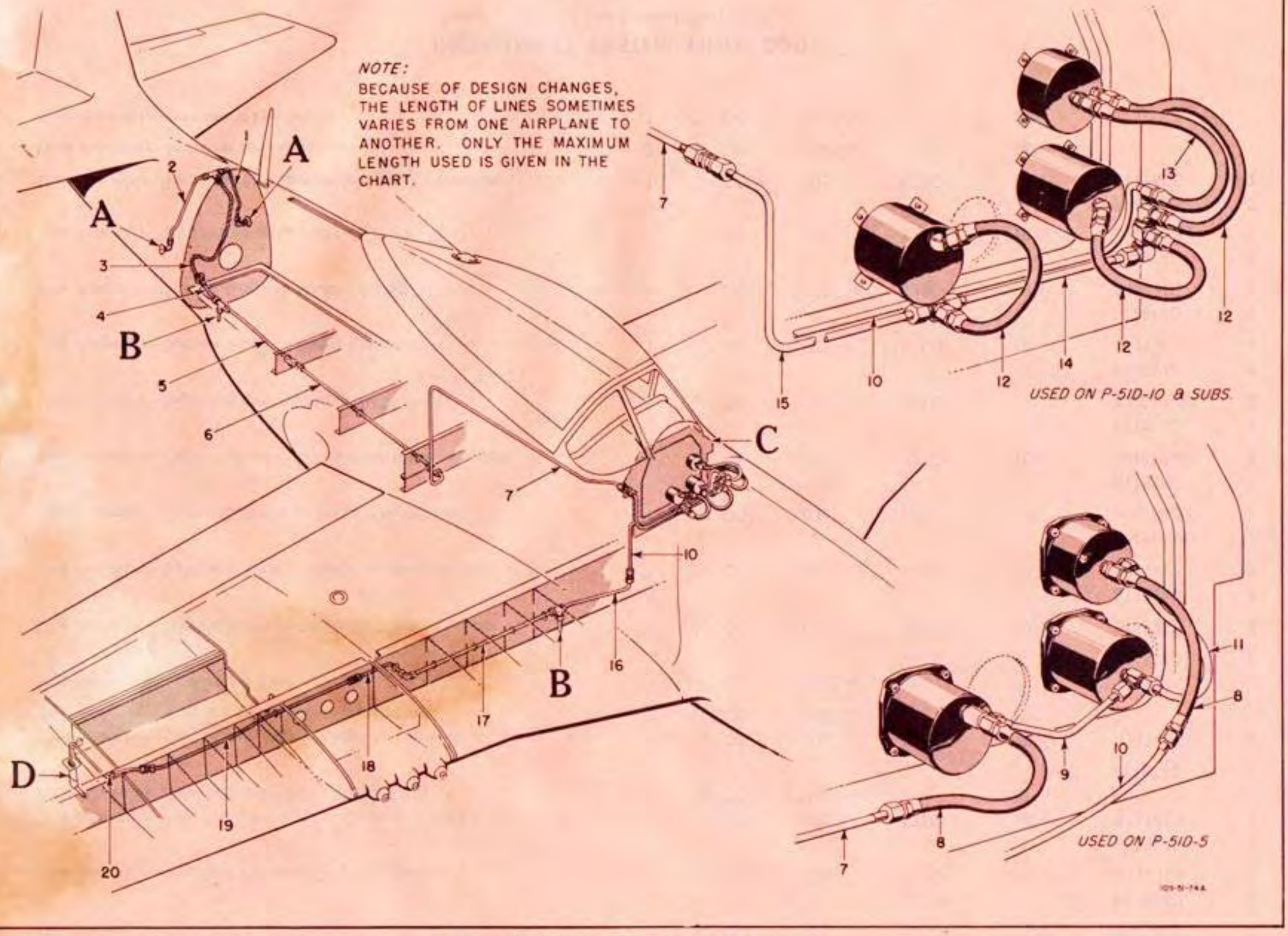


Figure 477—Airspeed Instrument System

AIRSPEED INSTRUMENT SYSTEM UNITS

REF.	NAME	NO. REQ.
A	Tube—Static Pressure	2
B	Sump—Airspeed Line	2
C	Panel Assembly—Instrument Complete	1
D	Pitot Head (Type G-2) and Head Support Tube	1

AIRSPEED INSTRUMENT SYSTEM LINES

REF. NO.	LOCATION	NO. REQ.	DIA.	GAGE	MATERIAL	MAX. LENGTH	FITTING	NO. FITTINGS REQ.
1	Line Assembly—Airspeed Tee to Static Port Right	1	¼" OD	.035	52SO	18¼"	811BT4D 811T4CS	2 2
2	Line Assembly—Airspeed Tee to Static Port Left	1	¼" OD	.035	52SO	18¼"	811BT4D 811T4CS	2 2
3	Line Assembly—Airspeed Station 248 to Tee	1	¼" OD	.035	52SO	29"	811BT4D 811T4CS	2 2
4	*Line Assembly—Airspeed Rate of Climb to Station 248—4th Section Static	1	¼" OD	.035	52SO	7⅜"	811BT4D 811T4CS	2 2
	†Line Assembly—Altimeter Tee to Station 248—5th Section Static	1	¼" OD	.035	52SO	7⅜"	811BT4D 811T4CS	2 2
5	*Line Assembly—Airspeed Rate of Climb to Station 248—3rd Section Static	1	¼" OD	.035	52SO	35"	811BT4D 811T4CS	2 2
	†Line Assembly—Airspeed Rate of Climb Tee to Station 248—4th Section Static	1	¼" OD	.035	52SO	35"	811BT4D 811T4CS	2 2
6	*Line Assembly—Airspeed Rate of Climb to Station 248—2nd Section Static	1	¼" OD	.035	52SO	56½"	811BT4D 811T4CS	2 2
	†Line Assembly—Airspeed Rate of Climb Tee to Station 248—3rd Section Static	1	¼" OD	.035	52SO	56½"	811BT4D 811T4CS	2 2
7	*Line Assembly—Airspeed Rate of Climb to Station 248—1st Section Static	1	¼" OD	.035	52SO	70⅞"	811BT4D 811T4CS	2 2

AIRSPEED INSTRUMENT SYSTEM LINES (Cont.)

REF. NO.	LOCATION	NO. REQ.	DIA.	GAGE	MATERIAL	MAX. LENGTH	FITTING	NO. FITTINGS REQ.
	†Line Assembly—Airspeed Rate of Climb Tee to Station 248—2nd Section Static	1	¼" OD	.035	52SO	64⅞"	811BT4D 811T4CS	2 2
8	Hose Assembly—Instrument Flexible	2	¼" OD	Flexible		14"		
9	Line Assembly—Rate-of-Climb Indicator to Altimeter—Static	1	¼" OD	.035	52SO	6⅜"	811BT4D 811T4CS	2 2
10	Line Assembly—Airspeed Indicator to Pitot Head—1st Section Pressure	1	¼" OD	.035	52SO	51⅜"	811BT4D 811T4CS	2 2
11	Line Assembly—Altimeter to Airspeed Indicator—Static	1	¼" OD	.035	52SO	8⅞"	811BT4D 811T4CS	2 2
12	Hose Assembly—Instrument Flexible	3	¼" OD	Flexible		14"		
13	Hose Assembly—Instrument Flexible	1	¼" OD	Flexible		14"		
14	Line Assembly—Airspeed Tee to Rate of Climb Tee—Static	1	¼" OD	.035	52SO	9⅝"	811BT4D B11T4CS	2 2
15	Line Assembly—Airspeed Rate of Climb Tee to Station 248—1st Section Static	1	¼" OD	.035	52SO	18"	811BT4D 811T4CS	2 2
16	Line Assembly—Airspeed Indicator to Pitot Head—2nd Section Pressure	1	¼" OD	.035	52SO	21½"	811BT4D 811T4CS	2 2
17	Line Assembly—Airspeed Indicator to Pitot Head—3rd Section Pressure	1	¼" OD	.035	52SO	45½"	811BT4D 811T4CS	2 2
18	Line Assembly—Airspeed Wing Pressure—4th Section	1	¼" OD	.035	52SO	10⅛"	811BT4D 811T4CS	2 2
19	Line Assembly—Airspeed Indicator to Pitot Head—5th Section Pressure	1	¼" OD	.035	52SO	57¼"	811BT4D 811T4CS	2 2
20	Line Assembly—Airspeed Indicator to Pitot Head—6th Section Pressure	1	¼" OD	.035	52SO	25"	811BT4D 811T4CS	2 2

AIRSPEED INSTRUMENT SYSTEM LINES CODE

*Used on P-51D-5 Airplanes.

†Used on P-51D-10 and Subsequent Airplanes.

OXYGEN SYSTEM UNITS

REF.	NAME	NO. REQ.
A	Switch—Oxygen Signal (G-1) (Early Airplanes)	1
B	Indicator—Flow	1
C	Regulator—Demand (Type A-12)	1
D	Gage—Pressure	1
E	Valve—Check (AN6033-1)	1
F	Tube Assembly—Oxygen Mask	1
G	Cylinder—Oxygen (Type F-2)	2
H	Cylinder—Oxygen (Type D-2)	2-4
I	Valve—Filler (AN6024-3)	1
J	Valve—Check (AN6031-1) (Style B)	1-4
K	Valve—Check (AN6032-1) (Style C)	2
L	Valve—Check (AN6033-1) (Style D)	1-2

OXYGEN SYSTEM LINES

REF. NO.	LOCATION	NO. REQ.	DIA.	GAGE	MATERIAL	MAX. LENGTH	FITTING	NO. FITTINGS REQ.
1	Line Assembly—Oxygen Regulator to Pressure Gage	1	3/16" OD	.035	52SO	10½"	8115CS	2
							811BT5D	2
							811T5CS	2
2	Line Assembly—Oxygen Regulator to Flow Indicator	1	3/16" OD	.035	52SO	11½"	811BT5D	2
							811T5CS	2
3	Line Assembly—Oxygen Pressure Gage to Signal Assembly	1	3/16" OD	.035	52SO	10"	811BT5D	2
							811T5CS	2
4	Line Assembly—Oxygen Check Valve to Signal Assembly	1	3/16" OD	.035	52SO	10¼"	811BT5D	2
							811T5CS	2
5	Line Assembly—Left Oxygen Bottles to Check Valve—4th Section	1	3/16" OD	.035	52SO	36⅜"	811BT5D	2
							811T5CS	2
6	Line Assembly—Oxygen Supply Check Tee to Pressure Gage	1	3/16" OD	.035	52SO	18⅜"	811BT5D	2
							811T5CS	2
7	Line Assembly—Left Oxygen Bottles to Check Valve—3rd Section	1	3/16" OD	.035	52SO	74⅜"	811BT5D	2
							811T5CS	2
8	Line Assembly—Right Oxygen Bottles to Check Valve—3rd Section	1	3/16" OD	.035	52SO	72½"	811BT5D	2
							811T5CS	2
9	Line Assembly—Left Oxygen Bottles to Check Valve—2nd Section	1	3/16" OD	.035	52SO	77¼"	811BT5D	2
							811T5CS	2
10	Line Assembly—Right Oxygen Bottles to Check Valve—2nd Section	1	3/16" OD	.035	52SO	78¼"	811BT5D	2

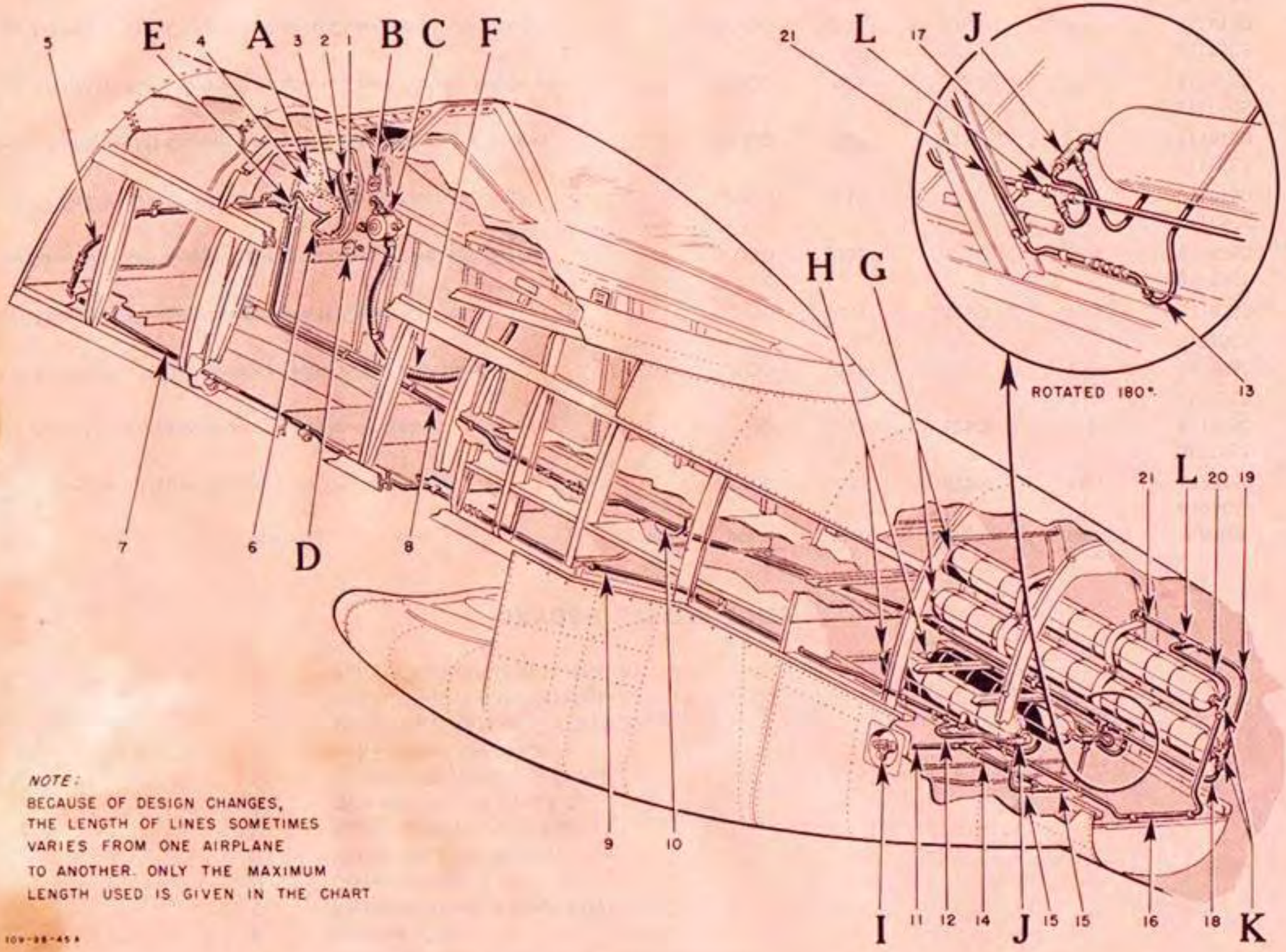


Figure 478—Oxygen System

OXYGEN SYSTEM LINES (Cont.)

REF. NO.	LOCATION	NO. REQ.	DIA.	GAGE	MATERIAL	MAX. LENGTH	FITTING	NO. FITTINGS REQ.
							811T5CS	2
11	Line Assembly—Oxygen Filler Valve to Tee	1	3/16" OD	.035	52SO	10¼"	811BT5D	2
							811T5CS	2
12	Line Assembly—Lower Left Oxygen Bottle to Check Tee	1	3/16" OD	.035	52SO	10⅜"	811BT5D	2
							811T5CS	2
13	Line Assembly—Oxygen Filler Valve Tee to Union	1	3/16" OD	.035	52SO	19⅛"	811BT5D	2
							811T5CS	2
14	Line Assembly—Oxygen Filler Valve Tee to Left Bottle Tee	1	3/16" OD	.035	52SO	12¼"	811BT5D	2
							811T5CS	2
15	Line Assembly—Oxygen Tee to Bottle Upper and Lower	2	3/16" OD	.035	52SO	6⅛"	811BT5D	2
							811T5CS	2
16	Line Assembly—Upper Right Oxygen Bottle to Check Tee	1	3/16" OD	.035	52SO	48½"	811BT5D	2
							811T5CS	2
17	Line Assembly—Upper Left Oxygen Bottle to Check Tee	1	3/16" OD	.035	52SO	5⅜"	811BT5D	2
							811T5CS	2
18	Line Assembly—Lower Right Oxygen Bottle to Check Tee	1	3/16" OD	.035	52SO	20¼"	811BT5D	2
							811T5CS	2
19	Line Assembly—Filler Line Tee to Right Lower Oxygen Bottle	1	3/16" OD	.035	52SO	16¼"	811BT5D	2
							811T5CS	2
20	Line Assembly—Filler Line Tee to Right Upper Oxygen Bottle	1	3/16" OD	.035	52SO	12¼"	811BT5D	2
							811T5CS	2
21	Line Assembly—Oxygen Filler Valve Tee to Right Bottle Tee	1	3/16" OD	.035	52SO	35⅜"	811BT5D	2

Section IX

CHARTS & TABLES

1. CABLE MANUFACTURING CHART.

This information is contained in figure 481.

2. BOLTS, SCREWS, AND NUTS.

a. TYPES.—Structural bolts and screws are made from steel alloys which comply with the strength requirements of Specification No. AN-B-3. Plain nuts are manufactured to conform with Specification No. AN-N-2, while self-locking nuts conform to Specification No. 25527. Dimension specifications meet AN and NA standards. Generally, only the AN3, 4, and 5 type bolts, the 7S6, 100-degree countersunk screw and the 7S2 button head screw are required for assembly of parts. The type of nuts used varies with the particular application, generally including the regular self-locking hexagonal, basket anchor, corner anchor, and gang channel. The self-locking hexagonal nut (elastic stop nut) can be used in oil or gasoline, but it should not be used in the control systems where the bolt would be subject to rotation. For temperatures up to 121°C (250°F), the standard (elastic type) self-locking nut may be used. Installations where temperatures are between 121°C (250°F) and 232°C (450°F) may utilize the Boots Mfg. Co. "Rol-Top" nut, while higher temperatures than 232°C (450°F) necessitate the use of the "Hy-Temp" type nut with metallic insert. The minimum hexagonal nut height is limited only by the strength requirements of the specification. Gang channels should not be used in tension applications. The Boots nuts in the gang channel may be spaced by means of punch marks placed in the channel, and may be readily snapped in or out of the channel. For blind anchoring, the basket anchor nut is useful because it eliminates accurate jigging of holes. The corner anchor nut has a tendency to bend thinner gage sheet stock below .040 inch. The standard two-lug anchor nuts should be used wherever possible.

b. STANDARD HOLES FOR BOLTS AND SCREWS.—The following chart specifies the hole sizes for the application of the various sizes of bolts.

TYPE	DIAM.	DRILL	REAM + .0005 −.001	COUNTERSINK FOR 756 SCREW
No. 6	.138	No. 27 (.144)		100° x 17/64-in.. diam.
No. 8	.164	No. 18 (.1695)		100° x 5/16-in. diam.
No. 10 or AN3	.189	No. 14 (.182)	.189	100° x 3/8-in. diam.
AN4	.250	C (.242)	.250	
AN5	.3125	N (.302)	.3125	

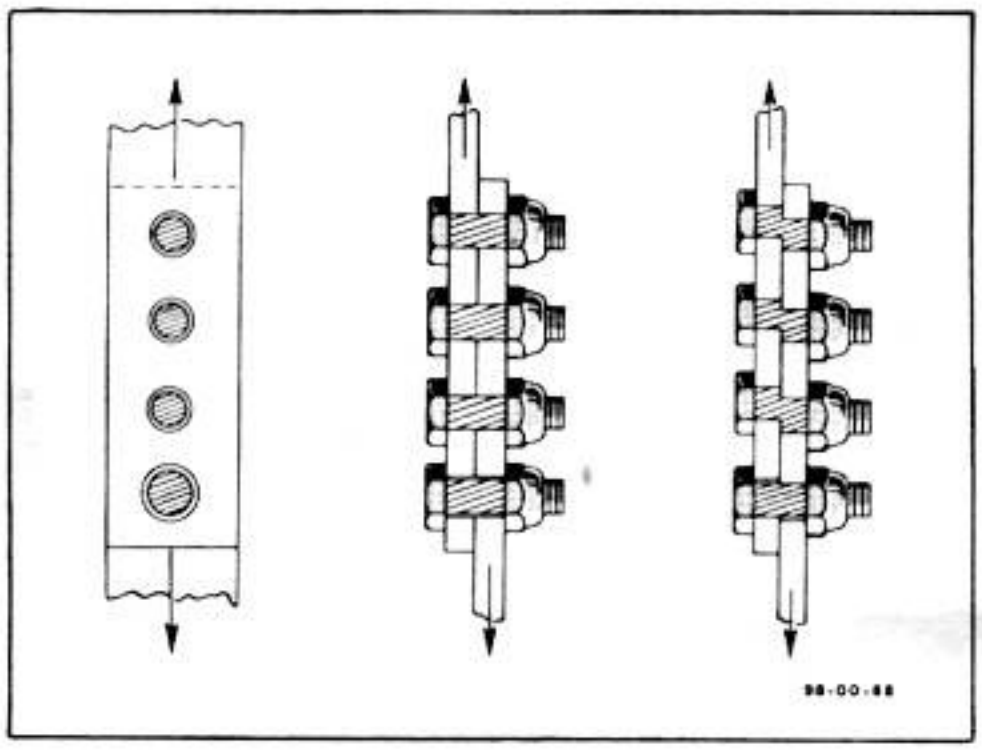


Figure 479—Bolted Joint With Oversize Hole

c. FITTING OF BOLTS AND SCREWS.—All bolt holes should be the smallest consistent with design, and all bolts must be suitably locked. It is advisable to drill the hole undersize and ream for a close fit. Bolt holes must not be oversized or elongated. A bolt in an oversized or an elongated hole takes none of the applied shear load until the metal it is holding in shear has slipped enough, and the remaining bolts sheared enough, to allow the bearing surface to come in contact with the bolt. (*See figure 479.*) The shearing action is a definite failure in these bolts and they are no longer capable of carrying their design loads. In some cases of oversized or elongated holes, it is permissible to drill or ream the hole until large enough to permit the insertion of the next size larger bolt. However, before resorting to this method, obtain permission from an authorized engineering officer. When in doubt, it is advisable to replace the fitting which contains the oversized hole with one in which the holes are the proper size. To make a bolt

installation structurally sound, bolt threads must never bear in any part of a fitting. All bolt holes must be normal to the surface involved and must provide complete bearing surface to the head and shank of the bolt. Also any bolt entering an anchor nut must be free enough to engage the threads in the nut by hand manipulation. Bolt threads must cut completely through the locking device of self-locking nuts. To meet this requirement, washers may be used under nuts, and shims may be added under nut plates. The bolts must be sufficiently tight, but too much twist on the wrench is to be avoided. The inch-pounds twist required should be within a certain range for the bolt diameter used. The following chart specifies the twist required. Inch-pounds is obtained by multiplying the pull by the wrench length or by the use of a torque wrench which is calibrated in inch-pounds. *(See figure 480.)*

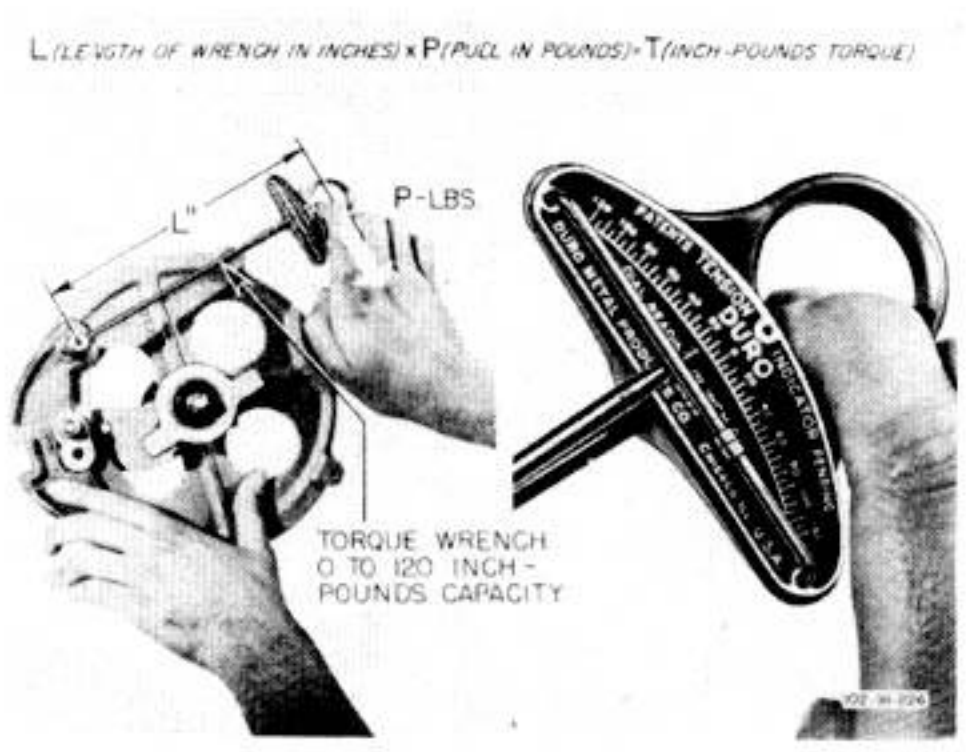


Figure 480—Use of Torque Wrench

d. TORQUE LIMITS FOR BOLTS AND NUTS.

BOLT SIZE	TORQUE LIMITS			
	Tension Type Nut AN365 and AN310		Shear Type Nut AN320	
	(In.-Lbs.)	(Ft.-Lbs.)	(In.-Lbs.)	(Ft.-Lbs.)
8-32	12-15	1-1¼	7-9	⅝-¾
10-32	20-25	1¾-2	12-15	1-1¼
¼-28	50-70	4¼-6	30-40	2½-3
5/16-24	100-140	8-12	60-85	5-7
⅜-24	160-190	13-16	95-110	8-9
7/16-20	450-500	37-41	270-300	20-25
½-20	480-690	40-57	290-410	30-35
9/16-18	800-1000	66-83	480-600	40-50
⅝-18	1100-1300	91-110	660-780	55-65
¾-16	2300-2500	190-208	1300-1500	110-125
⅞-14	2500-3000	208-250	1500-1800	125-150
1-14	3700-5500	308-483	•2200-3300	•183-283
1⅛-12	5000-7000	415-580	•3000-4200	•250-350
1¼-12	9000-11,000	750-910	•5400-6600	•450-550

•Values calculated by extrapolation.

e. PROCEDURE FOR TIGHTENING SCREWS.—For the proper tightening of aircraft screws, the limits given in chart *d.* must be observed.

(1) Excessive tightening will overstress the screw, causing distortion or stripping of the thread. Insufficient tightening results in insecure fastening.

(2) The torque to be applied with a hand screwdriver of proper size to fit the screw in question falls within the specified limits. However, when screws are applied by means of a speed wrench or power screwdriver, care should be taken that the tool is adjusted to slip at the minimum torque specified. When screws cannot be seated by a power screwdriver adjusted to the given minimum torque, the screw shall be driven home by a hand screwdriver. In the case of round or brazier head screws, when one side of the head fails to come flush with the adjoining material, a maximum tolerance of .004 inch can be permitted, provided the number of screws affected does not exceed 10 percent of the total and provided the screws are not adjacent to each other.

3. ARMY, NAVY, COMMERCIAL AND BRITISH EQUIVALENTS.

This information is contained in figure 482.

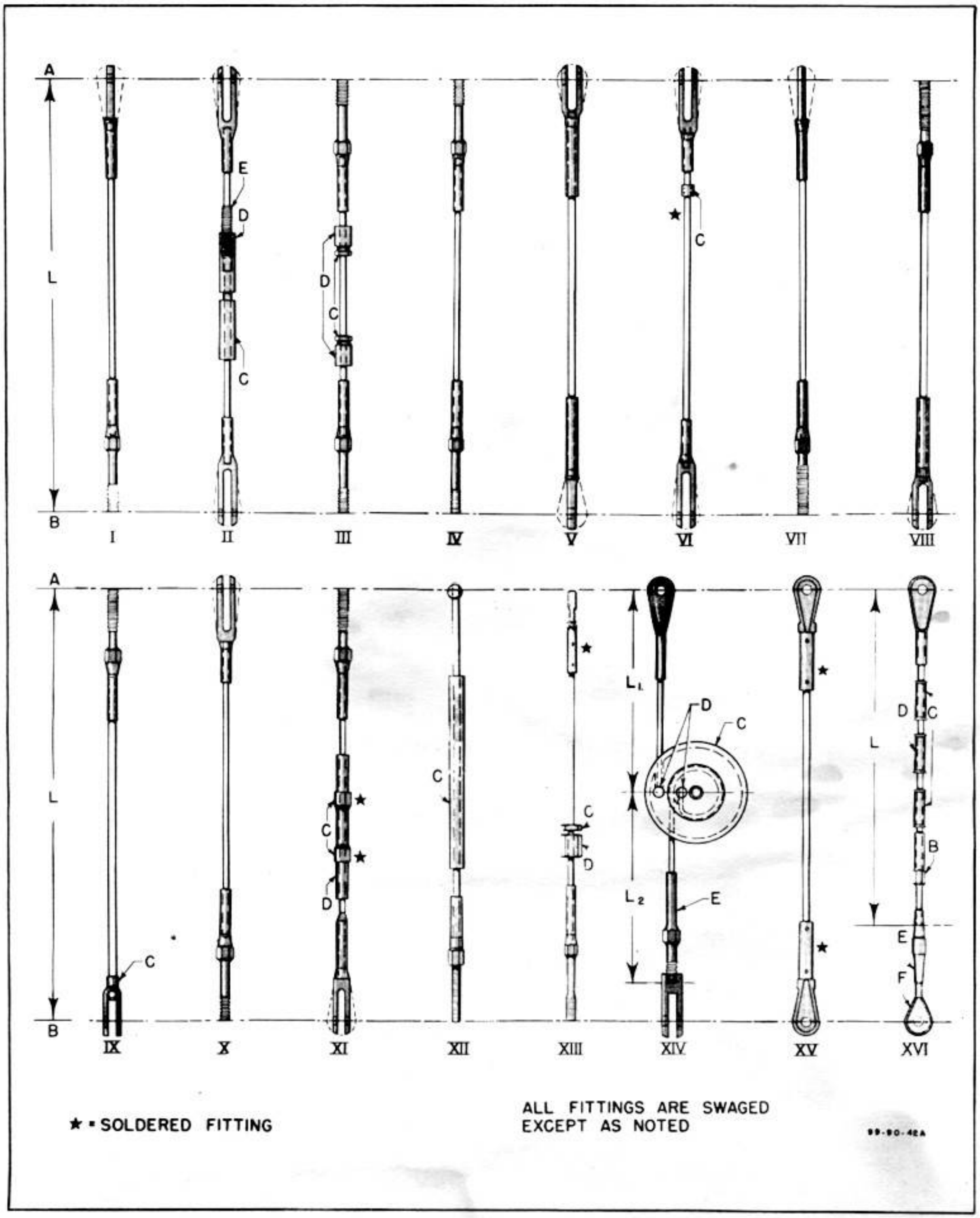


Figure 481 (Sheet 1 of 3 Sheets)—Cable Data Chart

CABLE LOCATION	NO. REQ.	NA DWG. NO.	TYPE	FITTING "A"	CABLE DIA. IN INCHES	FITTING "B"	LENGTH "L" IN INCHES	ADD. FITTINGS AS NOTED
Cockpit Enclosure Emergency Release	1	106-318217		RA1791A RA1802	3/32	AN666-3 LH		73-318133-2 & -3, -4
Cockpit Enclosure Canopy Actuating	2	106-318287	I	AN668-3	3/32	AN669-S3 RH		
Cockpit Enclosure Canopy Emer. Release	1	109-318240	X	AN667-3	3/32	AN669-S3 LH		RA1802
Cockpit Emer. Boost Control	1	102-43090	IX	AN666-2 RH	1/16	RA1862	38 5/16	(C) RA2134-A Yoke (1 Req.)
Landing Gear Strut to Timing Valve Cable Attach. Left	1	106-335172	X	AN667-2	1/16	AN669-2 RH		
Landing Gear Strut to Timing Valve Cable Attach. Right	1	106-335106	V	AN667-2	1/16	AN668-2		
Landing Gear Timing Valve Bellcrank Attach. Left	1	106-335139	I	AN668-2	1/16	AN669-2 LH		
Landing Gear Strut Cable to Torque Tube Attach.	1	106-335173	I	AN668-2	1/16	AN669-2 LH		
Landing Gear Timing Valve Bellcrank Attach. Right	1	106-335105	I	AN668-2	1/16	AN669-2 LH		
Tail Wheel Declutching Rear	1	99-34192		AN666-3 RH	3/32	AN667-3	69 3/16	(C) 4B14-4-12 (D) No. 3500 Shakespeare Casing
Tail Wheel Up-lock Control	1	106-34140	I	AN668-3	3/32	AN669-S3 RH		
Tail Wheel Down-lock Control	1	106-34139	I	AN668-3	3/32	AN669-S3 RH		
Tail Wheel Down-lock Control Rear	1	102-341013	X	AN667-3	3/32	AN669-S3 LH	52 5/16	
Tail Wheel Up-lock Control Rear	1	102-341012	X	AN667-3	3/32	AN669-S3 LH	71 15/16	
Tail Wheel Steering	2	73-34198		AN668-B-5	5/32	AN668-B-5	72 3/16	
Elevator Control Upper Rear	2	102-52209	I	AN668-5	5/32	AN669-L5 LH	68 15/16	
Elevator Control Lower Rear	2	102-52210	I	AN668-5	5/32	AN669-L5 LH	74 13/16	
Elevator Control Front	4	106-52211	I	AN668-5	5/32	AN669-L5 RH		
Aileron Control Inboard	2	102-52383-2	I	AN668-5	5/32	AN669-S5 RH	102	
Aileron Control Inboard	2	102-52383-3	I	AN668-5	5/32	AN669-S5 RH	104 9/16	
Aileron Control Outboard	2	102-52384	IV	AN669-S-5 LH	5/32	AN669-S-5 LH	64 1/2	
Rudder Pedal Return	1	73-52410	II	AN667-4	1/8	AN667-4	49 5/8	(C) 73-52431 (D) 73-52467 (E) 73-52468 1 Req. of Each
Rudder Control Front	2	102-52417	VIII	AN669-L5 RH	5/32	AN667-5	125 1/4	
Rudder Control Rear	2	102-52418	I	AN668-5	5/32	AN669-L5 LH	75 3/8	
Elevator Trim Tab Forward	1	106-525170	IV	AN669-2 RH	1/16	AN669 RH		
Elevator Trim Tab Left Rear	1	83-52534	XIII	25-318126-3	1/16	NAF310621-802	142 1/4	(C) 1T6-3 (D) 1L1 (E) 1L1-2
Elevator Trim Tab Right Rear	1	83-52547	XIII	1T6-2	1/16	NAF310621-802	139 1/16	(C) 1L1 (1 Req.) (D) 1L1-2 (1 Req.)
Elevator Trim Tab Intermediate	2	102-52523	IV	AN669-2 RH	1/16	AN669-2 LH	36	
Rudder Trim Tab Forward	1	106-525171	III	AN669-2 RH	1/16	AN669 RH		(C) 25-52542 (D) 23-52464 2 Req. of Each
Aileron Trim Tab Outboard	1	102-52550	IV	AN669-2 LH	1/16	AN669-2 LH	127 1/4	
Aileron Trim Tab Inboard	1	106-525169	III	AN669-2 RH	1/16	AN669-2 RH		(C) 25-52542 (D) 23-52464 2 Req. of Each
								(C) 5900

Figure 481 (Sheet 2 of 3 Sheets)—Cable Data Chart

CABLE LOCATION	NO. REQ.	NA DWG. NO.	TYPE	FITTING "A"	CABLE DIA. IN INCHES	FITTING "B"	LENGTH "L" IN INCHES	ADD. FITTINGS AS NOTED
Bomb Rack Release Control Outer Wing	2	106-63118	XII	RA970	1/16	AN666-2 LH		Shakespeare Casing
Bomb Rack Release Control Left Wing Inner	1	106-63066	VII	AN668-2	1/16	AN666-2 RH		(C) 5900
Bomb Rack Release Control Right Wing Inner	1	106-63067	XII	AN668-2	1/16	AN666-2 RH	63 1/2	Shakespeare Casing
Bomb Rack Release Control Fuselage	2	106-63064		RA2500	1/16	RA2482-1	12	(C) RA1862 (2 Req.)
Bomb Release Inner Left	1	109-63066	I	AN669-2	1/16		48 15/16	
Bomb Release Inner Right	1	109-63067	IX	AN669-2	1/16		76 1/16	RA2482-2
Bomb Release Outer	2	109-63118	IX	AN669-2	1/16		65 3/8	RA2500

Figure 481 (Sheet 3 of 3 Sheets)—Cable Data Chart

ARMY, NAVY, COMMERCIAL

and

BRITISH EQUIVALENTS

ITEM	U. S. SPEC.	COMMERCIAL EQUIVALENT	BRITISH SPEC.
Shock Strut Fluid	AAF 3580 or AN-VV-O-366	Intava Servo Fluid Socony Vacuum Mobilfluid H.F.	DTD 44C
Lubricating Grease	AN-G-3	Penola Beacon M285	DTD 577
Wheel Bearing Grease	AAF 3560 Medium	Intava Grease C Socony Vacuum PD433B	DTD 419 Medium
Hydraulic Fluid	AN-VV-O-366	Penola WS-491	DTD585
Fuel	AN-F-28, Grade 130	Esso Ethyl Aviation Gasoline, Grade 130	
Oil	AN-O-5, Grade 1100p	Intava Red Band Esso Aviation Oil, Grade 100	DTD 472B
Coolant	Ethylene Glycol (AN-E-2) with NaMBT added. See T.O. 24-25-1A	Carbide and Carbon Chemicals Corp.—Ethylene Glycol	Ethylene Glycol DTD 344A
Oxygen System Lubricant	AN-C-86	Rector Well Equipment Co.—Rectorseal No. 15	Proprietary Grade (AQUADAG)
Machine Gun Lubricant	AXS-777	Standard Oil of New Jersey WS-466	DTD 44D
Instrument Thread Compound	AN-C-53	Intava (U. S. AC3590)	DTD 392
Aircraft Instrument Oil	AN-O-6	Intava Utility Oil Intava Servo Fluid	DTD 44C

Figure 482—Army, Navy, Commercial, and British Equivalents for Commonly Used Materials

Section X

SERVICE INSPECTION

Introduction

The following inspection and maintenance requirements are minimum. If, because of local conditions, peculiarities of equipment, or abnormal usage, the described inspection and maintenance requirements are insufficient to secure satisfactory maintenance, local authority should not hesitate to increase the scope and frequency of inspections. The inspection periods are fully defined in the Visual Inspection Manual, T.O. No. 00-20A.

Inspection periods established for AAF and Navy service organizations are not identical. For that reason, inspection periods specified in this section in terms of hours consist of two figures, i.e., 25-30 Hour Inspections, the first figure of which indicates the AAF period, and the second figure of which indicates the comparable Navy period. The following index is provided for convenience in locating the inspections specified for the various components of the airplane.

PREFLIGHT INSPECTION

BEFORE STARTING ENGINE

Examine airplane flight report, Form 1A. Enter all information necessary to complete report. If routine inspections are due but cannot be made, enter the proper symbols to indicate the omission of the inspections.

Remove covers from engine, cockpit enclosure, and pitot head.

Check quantity of coolant, oil, and fuel. Enter on Form 1A.

With ignition switches "OFF," inspect propeller for nicks, scratches, and looseness.

Remove lower engine cowling and fuselage cowling in front of cockpit enclosure.

Inspect all readily accessible hydraulic lines and units for leakage.

Drain all fuel strainers.

Visually check all accessories and lines, and replace cowling.

On early airplanes, make sure that handcrank is in right wheel well.

Inspect landing gear for proper inflation; check for obvious damage and fluid leaks.

Check tires for correct inflation.

Circle entire ship to check upper and lower surfaces of skin for obvious damage, loose access doors, and loose cowling.

Examine wing flaps, ailerons, and trim tabs for freedom of movement and general condition.

Make sure that wing tie-down rings are retracted into wing, and that plugs are installed in hoisting sockets.

Examine upper surface of wing, particularly at leading edge, for dirt, fuel, oil, or frost.

Visually inspect all structure surrounding the self-sealing tanks for evidence of fuel leakage.

Make sure that canopy slides freely, and locks.

Clean entire windshield and sliding canopy, and examine glass for cracks and deep scratches.

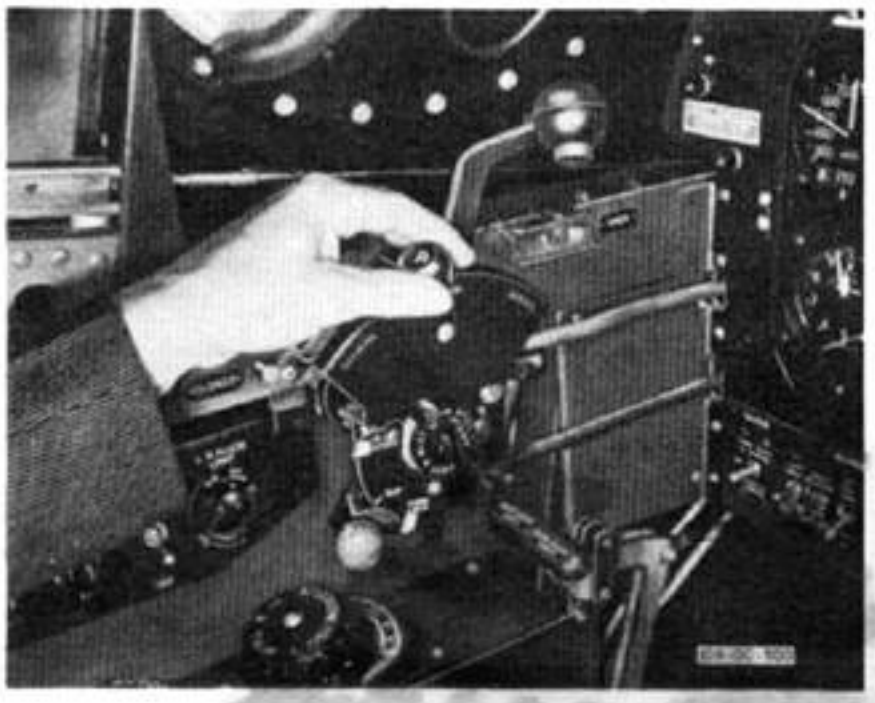
Make sure that cockpit enclosure emergency release handle and release mechanism are not released.

Check all flight control mechanism for freedom of movement, and range of operation.

Make sure that engine controls have sufficient spring-back and do not bind.

Make sure friction lock operates correctly.

Make sure that tag wires across throttle stop on longeron and mixture control "RUN" position stop have not been broken.

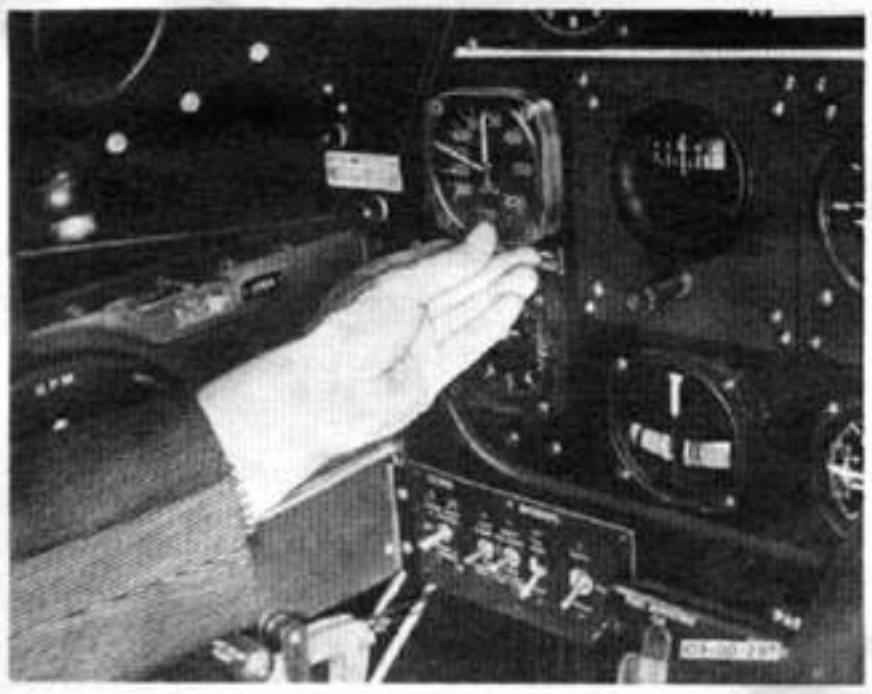


Set clock to operations office time and see that it is running.

Set altimeter to station altitude, or as directed by pilot.

Set rate-of-climb indicator to zero. Tap instrument to make sure pointer is not stuck.

Check all instruments for proper pointer position, loose or broken coverglasses, moisture in the case, chipped luminous or operating limit markings, loose dials and pointers, or other visible defects.



Clean all instrument coverglasses with clean, lint-free cloth.

Make a thorough visual check of the SCR-274-N radio antenna, bearing in mind that the slightest nick in the antenna wire may result in a break during operation.

Unpark and park brakes, checking system for evidence of air.

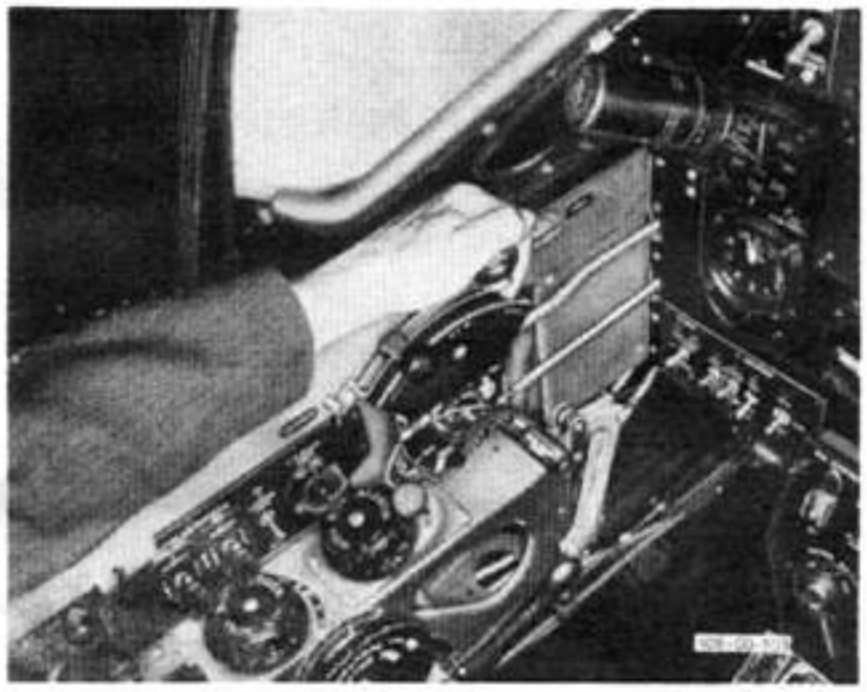
Turn fuel selector valve control handle one complete revolution, and note whether binding occurs at any point. If binding is indicated, check the connecting linkage for correct alignment.

Make sure landing gear control handle is in "DOWN" position.

Prior to every flight during which the use of oxygen is anticipated, check oxygen pressure and operation of oxygen system.

DURING ENGINE WARM-UP

Make engine run-up inspection. *(See "Engine and Accessories Ground Test" in Operation and Flight Manual, T.O. No. 01-60JE-1.)*



AUXILIARY EQUIPMENT—INSPECTED TODAY

BOMBING EQUIPMENT

If bombs are installed, determine the load carried.

Make sure sway braces hold bombs securely.

Check arming wires for proper installation.

Make sure safety pins are pulled from the bomb fuses.

Make sure that bomb rack mechanism is locked.

Bomb safe-selector switch must be in "SAFE" position.

Bomb arming switches must be in "OFF" position.

GUNNERY EQUIPMENT

Inspect left wing guns for left-hand feed and right wing guns for right-hand feed.

Check headspace, timing, and oil buffer adjustment of guns.

See that bore and chamber of guns are clean.

Check solenoids for proper installation and functioning.

Check gun camera circuit.

Check gun sight rheostat and lamp for proper functioning. Check both filaments selectively.

Check security of attachment, and alignment of feed and ejection chutes.

Make sure that ammunition belt is properly connected to feeder chute.

See that gun mounts are securely locked.

Check safetying of nuts, screws, and bolts.

Make sure gun covers are securely latched, and backplates are latched and locked.

Make sure guns are charged; then securely fasten access plates and doors.

COMMUNICATION EQUIPMENT

Check radio receiving equipment for proper adjustment by tuning in a station within the frequency range of the radio.

Make operational check of transmitters by calling airport tower and asking for frequency check.

Determine if output of transmitter is maximum.

Make sure transmitter is properly tuned to antenna.

Listen for engine interference in the receivers when engine is running.

PHOTOGRAPHIC EQUIPMENT

Clean camera thoroughly, taking particular care not to scratch haze filter.

Check camera mount for security of attachment.

Make sure electrical connections are tight.

Check shutter speed indicator dial for correct alignment with index mark on camera body.

Set lens adjustment to correspond with shutter speed, 16, 32, and 64.

Set lens adjustment marked "B.H.D." (bright, hazy, and dull), according to light conditions.

Make certain that lens assembly and haze filter are tight.

Make sure film magazine is properly loaded and door is securely latched.

Make sure overrun control is set to desired time.

On early airplanes, make certain that camera sighting window is securely attached and clean. On later airplanes, make sure lens protector plate covers lens.

AFTER FLIGHT INSPECTIONS

POWER PLANT

Note

Any defects noted during this inspection will be entered under appropriate column number on inspection form.

After each flight, inspect the emergency boost control lever, or in the case of later airplanes, check the tag wire on throttle stop. A broken lockwire seal, in either case, indicates that war emergency power has been used. If the seal is broken, make the following engine inspections before releasing the airplane for further flight.

Remove and inspect oil filter for metal particles.

Remove oil drain plugs, and check oil for metal particles.

Remove valve covers, and check valve clearances.

Check rocker arm bearing bracket studs. Check valve springs for breakage. Turn engine by hand to detect blow-by at the valves.

If war emergency power has been used for an extended period, replace spark plugs with a new or reconditioned set.

Visually inspect the engine and mount for cracked structures.

Check supercharger inlet for evidence of chafing by the supercharger impeller. This is usually indicated by peeled or scorched paint on the supercharger elbow.

Replace the engine if there is evidence of erratic operation or malfunctioning that ordinary maintenance cannot remedy.

Note

Close co-ordination between pilot, crew chief, and engineering officer will be required to keep an accurate record of the amount of time any engine has operated at War Emergency Rating conditions. When 5 hours of such operating time has accumulated, pull the engine for tear-down inspection and reconditioning.

AIRPLANE

Inspect airplane for general condition.

Check fuel, oil, coolant, and hydraulic quantities; replenish if necessary. See that filler caps and access doors are secure.

Check entire fuel, oil, coolant, and hydraulic systems for obvious leakage.

Check landing gear struts for cleanliness, and tires for condition and inflation.

Examine cockpit for cleanliness and general condition.

If oxygen has been used, check oxygen supply and recharge cylinders if necessary. Wash the oxygen mask.

Flush pilot's relief tube.

If the seal on the first-aid kit has been broken, check contents of kit and replace any missing items.

See that pyrotechnic pistol is unloaded and stowed in holster, and that the required signal cartridges are stowed.

Unless the airplane is to be used again immediately, install all weatherproof covers.

Auxiliary Equipment

BOMBING EQUIPMENT

Thoroughly inspect controls and racks to ensure proper functioning of all parts.

Clean controls and racks. Dry to prevent oxidation.

Each inspection shall include all parts of the control system.

CAUTION

At no time should oil or grease be used on the bombing equipment, as such agents accumulate dust and create a condition that can lead to malfunctioning of the system.

If it is determined that the bomb racks are not operating properly, remove the racks and clean them of all foreign substance with dry high-pressure air, carbon tetrachloride, or kerosene.

Note

Do not allow tetrachloride or kerosene to get into the bomb rack solenoids.

GUNNERY EQUIPMENT

Check the condition of feed and ejection chutes and ammunition boxes.

Check condition of front and rear gun mounts and adjacent structure.

While cleaning the guns, check for worn or defective parts, burrs, or other damage. Make necessary repairs; then oil the guns with special preservative lubricating oil, US Army Specification No. AXS 777.

Clean gun sight lens.

Clean reflector glass, and check it for cracks, chips, and other damage.

Make sure reflector mounting is secure.

Make sure gun sight body is held firmly in its mount.

Check electrical connection for solid contact, and check rheostat and lamp for proper operation. The lamp filaments should burn selectively.

Make sure reticle pattern is properly reflected by the sight reflector.

Check harmonization of the guns and gun sight.

Check condition and installation of auxiliary ring-and-bead gun sight.

Clean gun solenoid with gasoline-moistened cloth, and check for wear.

Replace solenoid plunger if cadmium plating has been worn away.

Replace solenoid sear pin if the milled sides or the beveled face is rough from wear.

Replace the return spring if it is distorted.

Check solenoid by connecting the terminal and frame to a 110-volt test lamp circuit. If lamp fails to light, the coil is open and the entire solenoid assembly should be replaced.

Check resistance of coil with a Wheatstone bridge, or equivalent. If resistance is less than 5 ohms at 20°C (68°F), shorted turns are indicated and solenoid should be replaced.

DAILY INSPECTION FOR POWER PLANT

Note

Any defects noted during this inspection will be entered under appropriate column number on inspection form.

ENGINE CONTROLS

Examine throttle linkage (from the cockpit to termination at the engine) for security and condition. Make sure that it strikes its respective stops at the engine before full travel at the cockpit quadrant is obtained. Control should have at least ⅛-inch spring-back.

Examine mixture control linkage for security and condition. Make sure the control at the carburetor falls into detents corresponding to the positions noted on the control quadrant name plate.

Examine propeller governor control linkage for security and condition. Make sure that control strikes stop on governor at full "INCREASE RPM," before lever on control quadrant strikes stop. In full "DECREASE RPM" position, control lever on quadrant should strike stop before control on governor strikes stop.

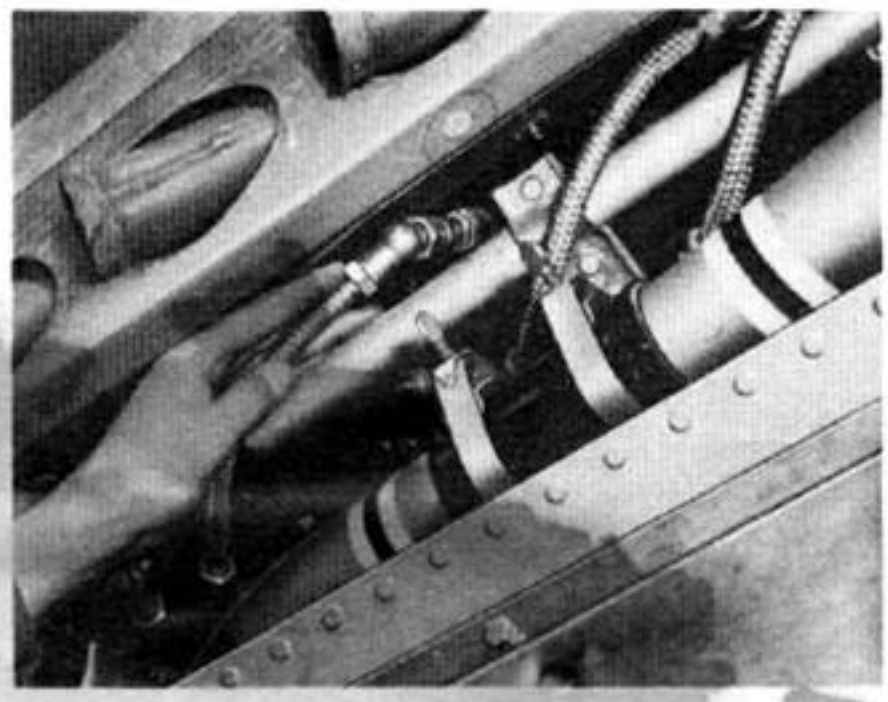
Check carburetor for security and safety of bellcranks, rods, and lines. With mixture control in "IDLE CUT OFF," start booster pump and check carburetor for pressure leaks.

Check carburetor air control for freedom of operation, and proper opening and closing of ram air gate, filtered air door, and hot air door.

Operate throttle, mixture control, and propeller control. Check friction disc for operation.

IGNITION AND ELECTRICAL

Inspect high-tension leads for evidence of burning as a result of leaks in the exhaust manifold. Inspect ignition harness.



Check left and right magneto connections.

Check booster coil housing for security of dzus fasteners and connections.

With ignition switch "OFF" and external power source removed, turn battery-disconnect switch "ON" and listen for the plainly audible tone of the compass inverter. If the inverter operates, the battery-disconnect solenoid is closed.

Make operational check of the position and recognition lights, and all other electrical equipment.

Check pitot tube heating unit for operation.

Inspect spark plugs for visual evidence of leakage.

Check tachometer generator mounting and lead for security.

Examine engine electrical junction box dzus fasteners and leads.

Check reverse-current relay and voltage regulator housing for security.

Check the scoop actuators, particularly the coolant scoop actuator, for leakage of grease around the screw shaft at lower bearing. If the unit is leaking in excess, replace it.

Examine all electrical wiring and mounting brackets for condition.

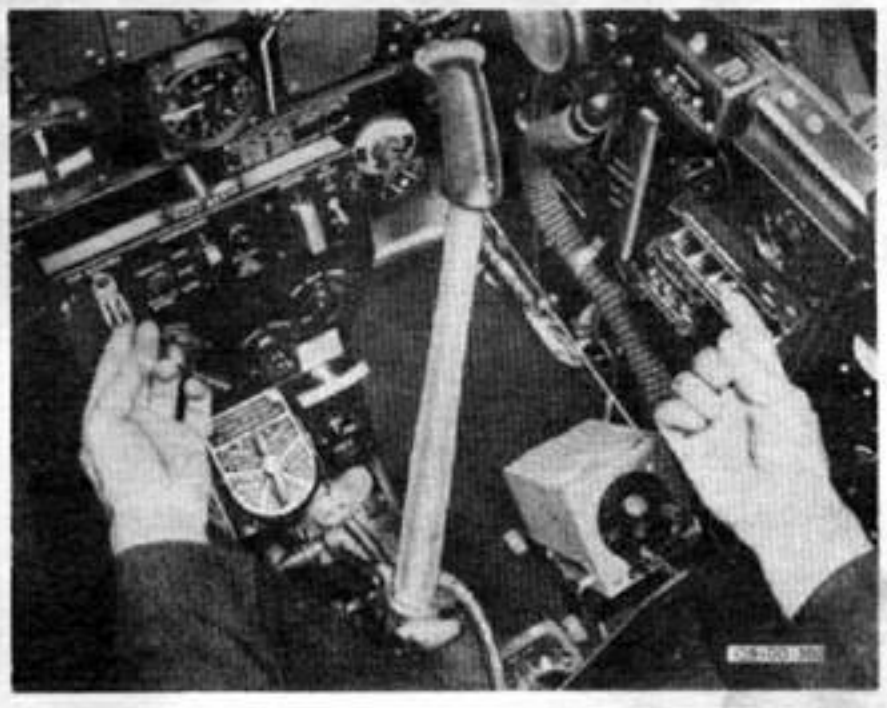
Check the oxygen signal assemblies for operation and check warning light by reducing low-pressure supply lines to below 100 pounds per square inch. Light should not go on until pressure is below 105 pounds per square inch. If instrument does not respond to above pressure values, remove and recalibrate.

CAUTION

No lubrication of any kind (oil or grease) should be used on any of the threads or internal switch parts (signal Type G-1) which may be exposed to oxygen under pressure.

When night flying is intended, inspect all lights in the airplane for operation.

Check all booster pumps for normal and emergency pressures (normal 8 to 12 pounds per square inch, emergency 14 to 19 pounds per square inch).



Check the manual scoop control "OPEN" and "CLOSE" for proper operation.

Inspect generator, starter, switches, coils, solenoids, and magnetos for cracked housings or flanges, security of mounting, tightness of housing bolts, and safetying.

Check booster coil operation.

Check operation of microswitches in the landing gear warning system.

FUEL SYSTEM

Drain and safety fuel strainer and all weatherheads (4). On early airplanes, check primer lines and connections. Inspect fuel lines for leaks, dents, cracks, or wear caused by vibration or chafing.

Make sure that lines are secure.

Make sure all vent lines are unobstructed.

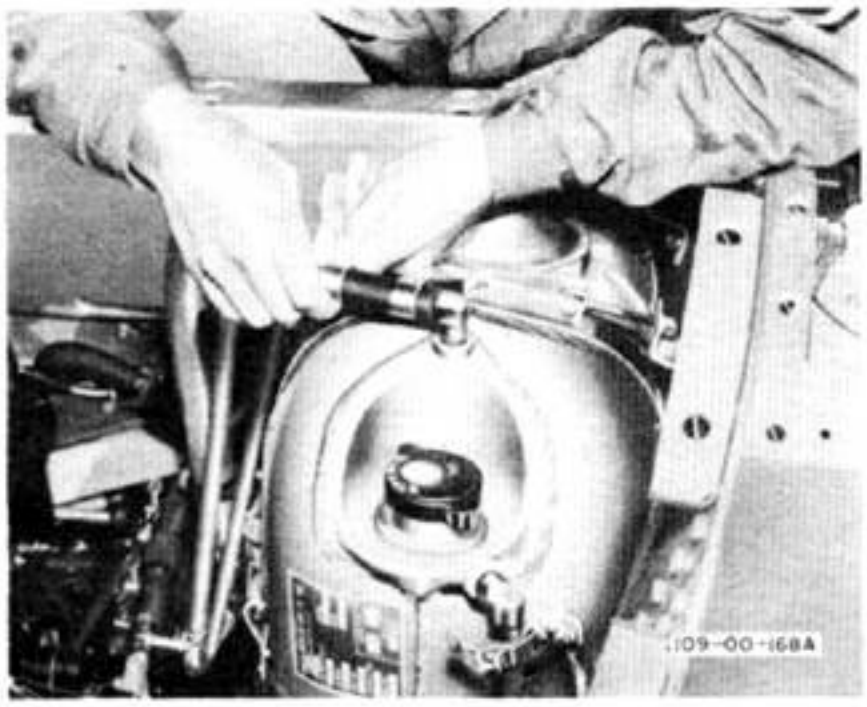
Inspect carburetor and fuel line connections for fuel leakage, giving particular attention to drain plugs, passage plugs, and parting surfaces between the regulator casting. Inspect safety wiring on carburetor.

Check fuel selector valve for backlash and security of mounting.

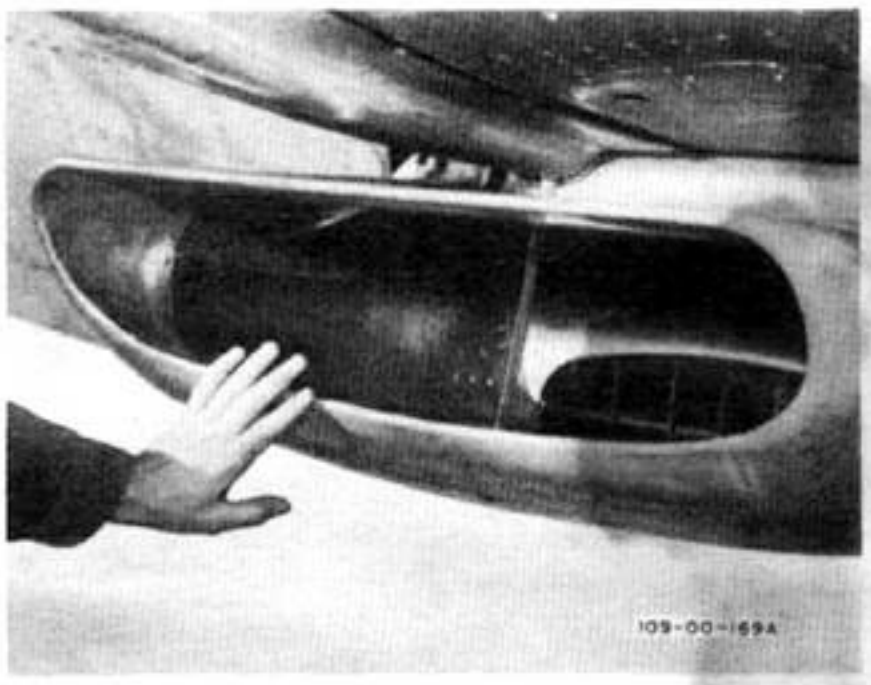
OIL SYSTEM

Operate oil radiator heat control in open, close, and automatic positions.

Make sure oil drain casting, oil tank sump drain cocks, and engine oil filter caps are properly installed, tightened, and safetied. Check oil level and safety cap.



Inspect oil cooler for security of installation. Make sure cooler case is not clogged.



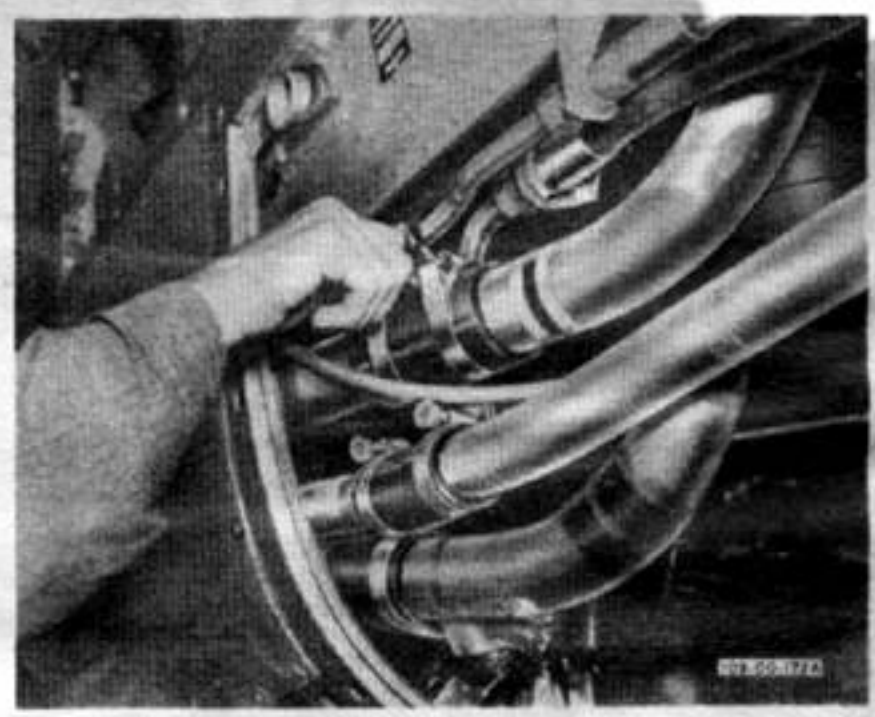
Check oil filter for correct safety.
Examine oil pressure relief valve assembly for security, safety, and evidence of leakage.

COOLING SYSTEM

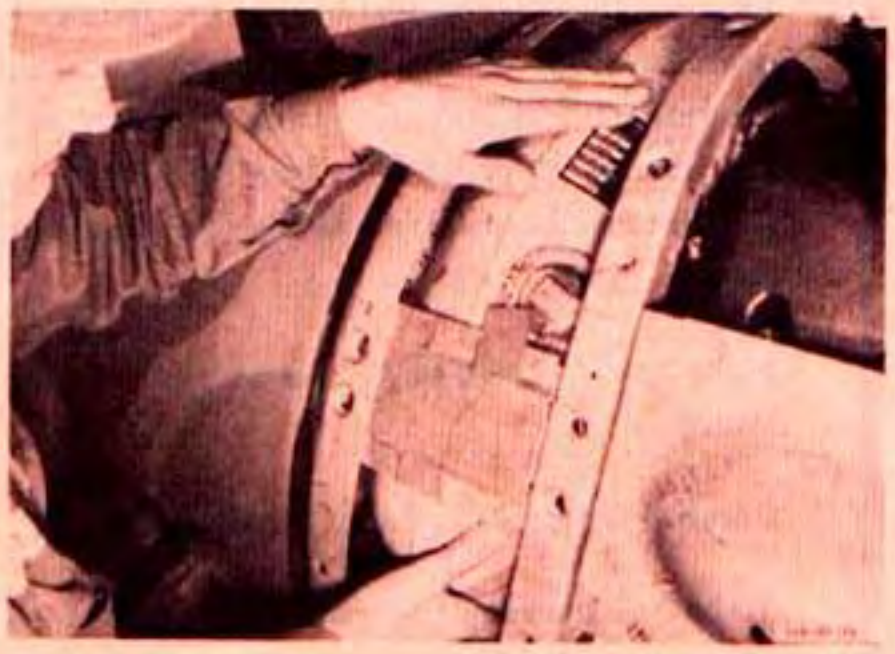
Examine front and rear scoops for cracks, dents, or abrasions.
Inspect all drain plugs and access doors for proper installation. Make sure plugs are properly safetied.
Check coolant level in main coolant system and aftercooler system, and resafety.

Check rubber grommets on main coolant line through engine crossbeam.
Inspect coolant radiator for security of attachment and examine for leakage. Make sure face of radiator is not clogged.

Inspect cylinder blocks and heads, coolant pump, aftercooler pump, lines, vents, and connections for condition and leakage.



Check coolant header tank, header tank relief valve, aftercooler tank, and relief valve for security, condition, and safety.



Check coolant temperature bulb for security and safety.

Operate coolant radiator flap control in open, close, and automatic positions.

MANIFOLDS AND SUPERCHARGERS

Make sure intake manifold pipes are secure, and inspect for leakage.

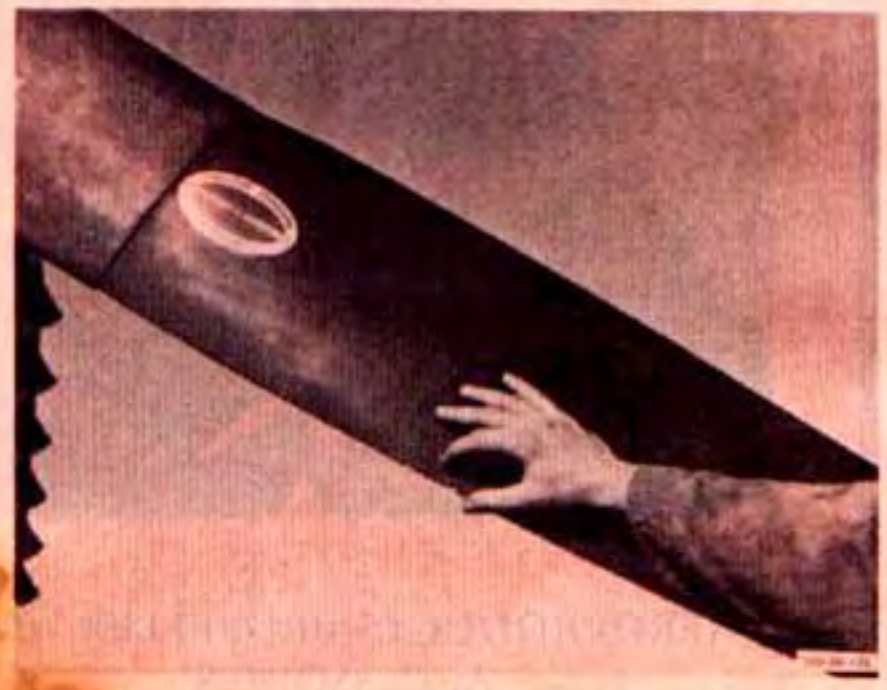
Make external inspection of supercharger and wheel case.

Make certain blower seal vent is unobstructed.

Inspect supercharger control, solenoid and connections.

HAMILTON STANDARD PROPELLER AND ACCESSORIES

Examine exterior of all parts of propeller for cracks, bends, nicks, and other damage. The entire leading edge, trailing edge, and tip portion of each blade should be carefully checked to guard against development of cracks. A magnifying glass will facilitate this work. When in doubt as to the extent of apparent cracks, give the blades a local etching. Watch for longitudinal cracks.



Inspect propeller governor linkage for security and safety.

Inspect propeller governor for secure mounting on pad, evidence of oil leakage, and full travel of the control.

Inspect propeller spinner for general condition and security of attachment.

AEROPRODUCTS PROPELLER AND ACCESSORIES

Check for excessive amount of grease on the shank of the blade to the outer side of the spinner shell.
Clean the blades with kerosene or other recommended solvent. Do not use carbon tetrachloride or other highly volatile fluids.

Examine the brazed joint between the camber sheet and the thrust member. This joint extends entirely around the profile of the blades. Check for longitudinal cracks on the camber side at approximately the 40 percent chord line.

Wipe the blades with clean engine oil at the end of each day. While oiling, check blades for nicks, scratches, or other damage.

If a crack or other flaw is suspected, carefully examine the entire surface of all blades with a magnifying glass. If further examination is necessary, remove and magnaflux blades.

Note

The brazed joint between camber sheet and thrust member will show up as a crack.

See that the spinner shell attaching screw and bolts are tight.

Check to see that the spinner shell is free of nicks, cracks, or other damage, paying particular attention to reinforcement former at each blade cutout.

Examine the cowling seal behind the spinner for evidence of oil. If oil is found, remove the cowling and determine if leak is coming from the engine reduction gear case or propeller. This may be done by painting adjacent members with a whiting solution and running engine.

Make sure the control rod clevis pin is properly installed.

Check the adapter stop block for safety.

Make sure the regulator assembly is free of oil leaks.

Note

Oil leaks must be corrected before flight.

POWER PLANT GENERAL

Check for evidence of engine throwing oil.

When it is definitely known that the airplane will be inoperative for more than one day, but will be operated within 7 days, rotate the propeller at least 4 complete revolutions by hand daily.

Check all connections at firewall for security and condition.

Make sure main and auxiliary lines and connections in the engine section are secure, and inspect for dents, cracks, and wear caused by chafing and vibration.

Make sure vacuum relief valve is secure and check the safety of the adjusting screw.

Examine engine mount to fuselage bolts and engine hoisting eyes for safety.

Examine manifold pressure regulator for security of mounting and safety, and check condition of attendant linkage.

Inspect induction system for condition and safety.

Inspect spark plug blast tube for security.

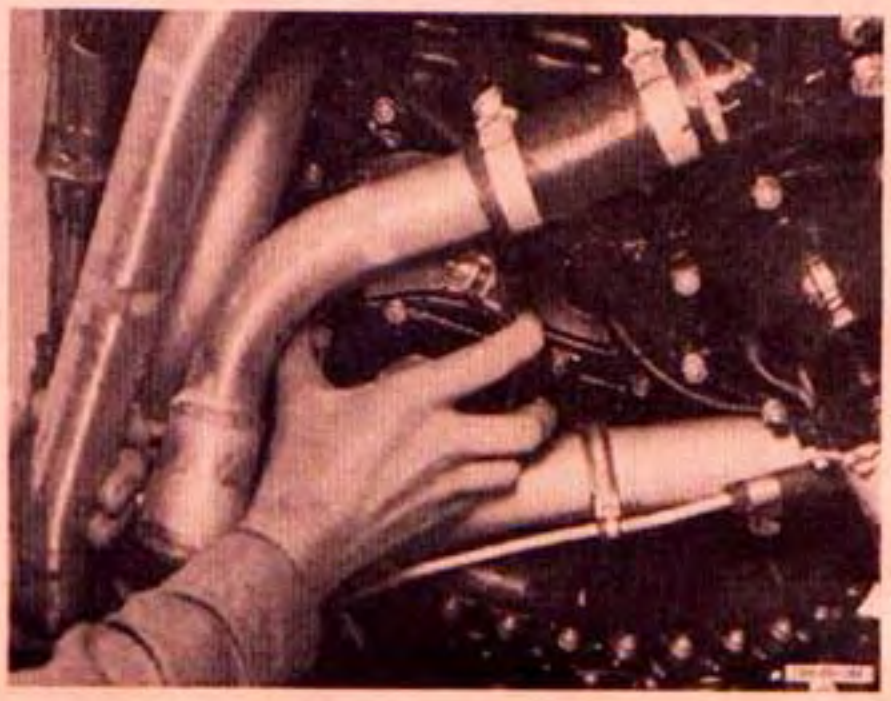
Inspect generator blast tube for security.

Remove shroud from exhaust stacks, and inspect condition of stacks; make sure they are not loose. Examine shroud and replace.

Inspect engine mounting bolts and Lord mounts for security and condition.

Inspect air filters for cleanliness and security.

Inspect suction relief valve for cleanliness of screen.



Inspect oil, coolant, hydraulic, vacuum, and fuel pumps, and engine starter for security of mounting.

Inspect drain box clamps and mounting.

Inspect all engine cowling and replace. Be sure all fasteners are properly secured.

DAILY INSPECTION FOR AIRPLANE

COCKPIT

Inspect entire cockpit enclosure canopy for evidence of damage.

Clean windshield thoroughly.

Check operation of sliding canopy and canopy lock. Inspect sliding canopy emergency release handle for safety.

Make sure flare pistol and cartridges are stowed.

Inspect flare pistol mount for security, and tightness of cap.

Inspect all instruments for cleanliness, loose or broken coverglasses, correct markings, and correct readings.

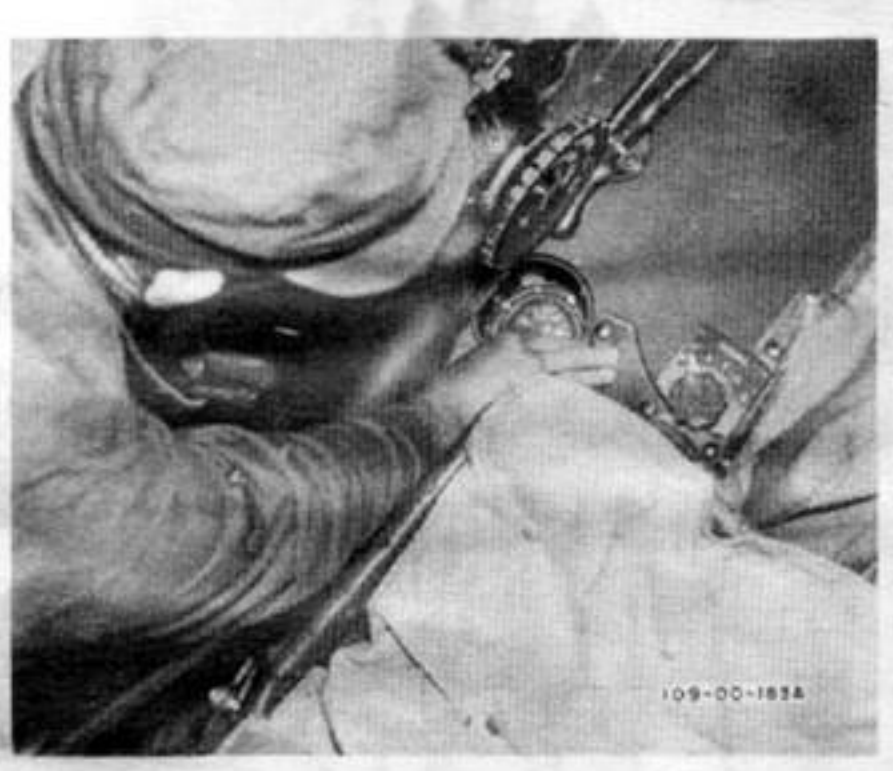
Inspect gun sight bulb for operation.

Check spare bulb container for spare bulbs.

Inspect flooring and canvas covers for security and condition. Clean floor thoroughly.

Inspect cockpit heat, defroster, and cold air controls.

Inspect fuel gage coverglasses for general condition.



Inspect seat slide for freedom of operation and locking in 9 positions.

Inspect seat, safety belt, and Sutton harness installation.

Make sure first-aid kit is stowed and sealed.

FLIGHT CONTROL MECHANISM

Inspect surface control lock for proper operation.

Operate all flight control mechanism, and inspect for full travel and free movement.

Inspect rudder pedals for proper adjustment.

Remove boot around control stick; inspect mechanism for condition, cleanliness, and safety.

Remove four inspection plates on aft end of the fuselage, and inspect the tail gear locking mechanism.

Inspect all flight control cables for security.

MOVABLE SURFACES

Inspect condition and security of metal covering of wing flaps and ailerons, particularly at hinge points.

Make sure flap rubbing strips clear trailing edge of wing. Check security of access doors on ailerons.

Examine trim tabs for general condition and security.

Examine elevators for general condition, security, and proper drainage.

Inspect balance weights for security and alignment.

Inspect rudder for condition, security, and proper drainage.

FIXED SURFACES

Inspect upper and lower surfaces of wing, horizontal stabilizer, and vertical stabilizer for general condition and cleanliness. Examine for cracks, dents, and abrasions.

Examine screws attaching wing tip to wing, and adjacent skin for general condition and security.

Make sure pitot tube assembly is secure and unobstructed.

If guns have been fired, examine gun compartments for general condition. Clean the compartments and inspect for loose fasteners.

Inspect position lights for condition, and seal.

Inspect identification lights for loose screws or damaged glass.

Inspect IFF antenna for security.

Examine fuel tank door attaching screws for security.

Make sure fuel cap is secure.

Inspect access covers for loose or missing screws.

Inspect wheel well cover for condition, and fasteners for proper installation.

FUEL TANKS

Inspect fuel tank access doors on the bottom of the wing to check against obvious leakage of fuel.

Inspect the fuselage fuel tank for condition.

Inspect fuel tank selector valve for security, and fuel lines for evidence of leakage.

Make sure fuel tank vents and relief valve are unobstructed.

TAIL GEAR

Operate tail wheel declutching mechanism to make sure that tail wheel locks and unlocks properly.

Clean shock strut piston with cloth soaked in hydraulic fluid or kerosene.

Examine tail wheel shock strut for proper inflation and proper installation of canvas cover.

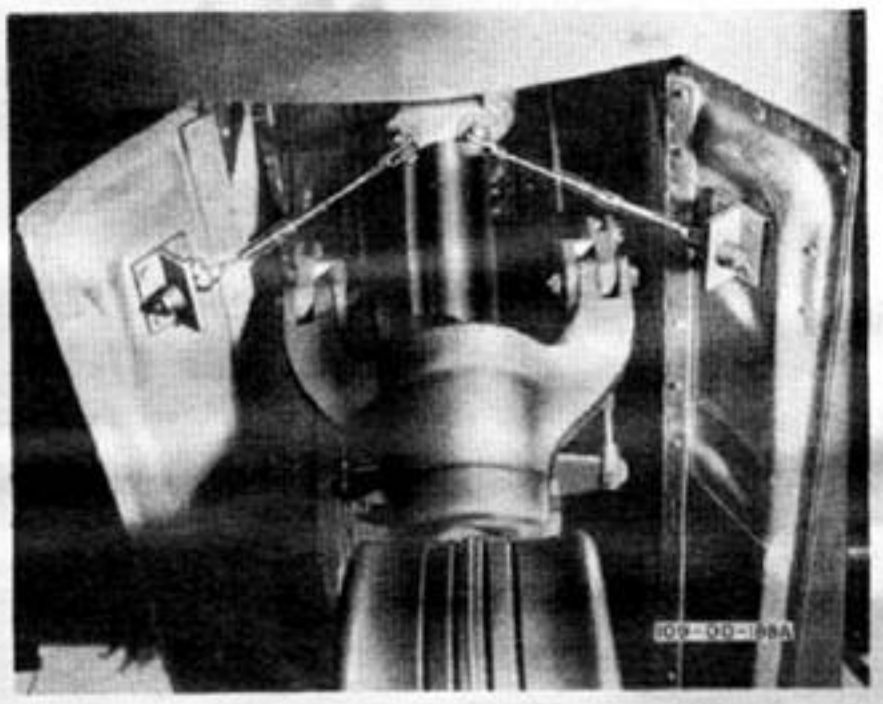
Inspect tail gear shock strut for evidence of leakage.

Examine tail wheel unit, lock mechanism, and entire wheel compartment for cleanliness.

Check inflation and condition of tail wheel tire.

Inspect tail wheel and rudder for correct alignment when both are in locked position.

Inspect tail gear fairing doors for cracks or looseness.



LANDING GEAR

Lower landing gear fairing doors. Inspect doors for condition, and hinges for safety. Inspect operating strut and linkage for safety and condition.

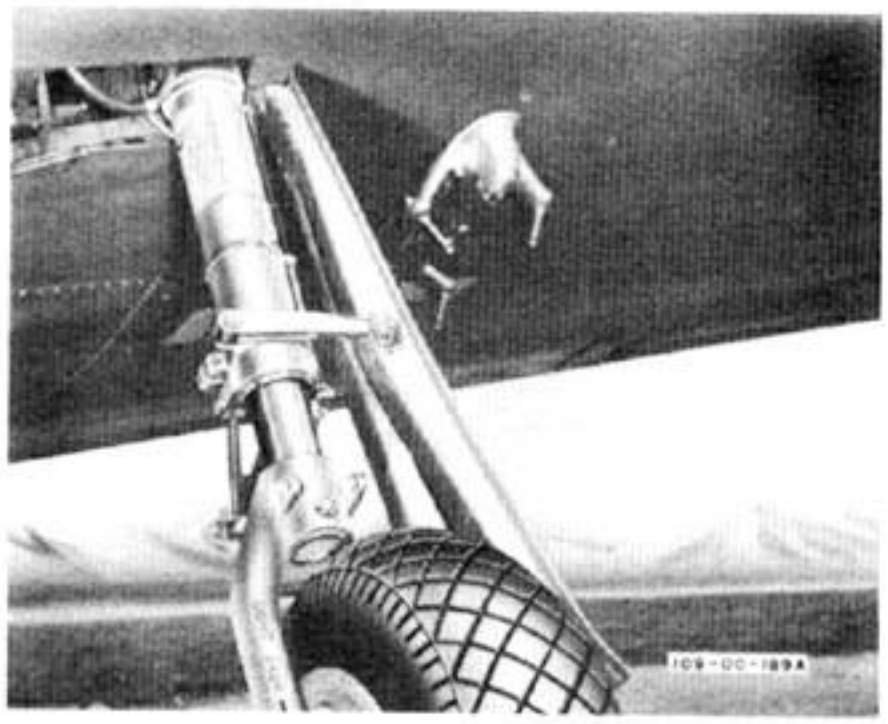
Inspect all landing gear mechanical linkage thoroughly for condition and safety.

Inspect main shock strut fairing for security.

Inspect torque link for looseness.

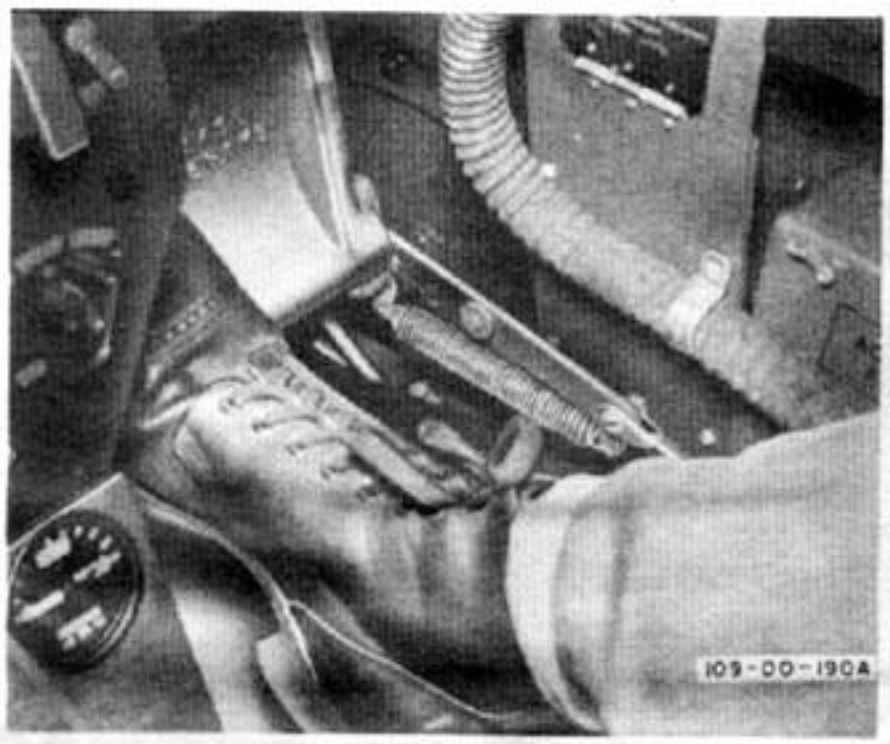
Clean shock strut pistons with cloth soaked in hydraulic fluid or kerosene.

Inspect main landing gear shock strut for proper inflation and obvious fluid leaks.



WHEELS AND BRAKES

Check brakes for proper operation. Make sure right and left pedal pressures are equal.



Inspect wheels and tires for visual evidence of damage. Inspect retaining nuts, bolts, and cotter pins for security.

Inspect tires for correct inflation.

Inspect brake master cylinders for condition and evidence of leakage.

Inspect brake lines for condition and evidence of leakage.

Park and unpark brakes. Inspect park brake handle for security.

HYDRAULIC SYSTEM

Check accumulator air pressure—400 plus or minus 25 pounds per square inch.

Inspect all hydraulic lines, valves, and struts for security of mounting and evidence of leakage.

Inspect unloader valve adjustment screw jam nut for security.

Check fluid in reservoir and replenish if necessary.

FUSELAGE

Inspect metal covering of entire fuselage for security of attachment, and for cracks, dents, loose rivets, or abrasions.

Make sure windshield and windshield cowling are secure.

Inspect antenna installation.

Make sure radiator air scoop and radiator are free from foreign matter.

Make sure fuel cap is secure.

Check all coverplates on bottom of fuselage for loose or missing screws.

Check all fairing around wing and tail for loose or missing screws.

Inspect outside external power source cover for condition and security.

On early airplanes, inspect recognition light for security.

Inspect dzus fasteners on all inspection plates for security.

OXYGEN EQUIPMENT

Inspect all line, valve, and fitting connections in the oxygen system for tightness, and freedom from oil, grease, or dirt.

Make sure oxygen cylinders are charged. Recharge if less than 400 pounds per square inch is indicated by pressure gage on instrument panel.

Turn the regulator emergency by-pass knob to "ON," and check for flow of oxygen at mask outlet. Turn knob to "OFF" after check.

Check operation of automatic mixture thumb lever.

Position auto-mix at "100% OXYGEN" and emergency knob at "OFF," depress diaphragm (accessible through hole in center of case), and check for oxygen flow at mask outlet.

Install mask; while breathing into it, check operation of shutters in blinker flow indicator.

Make sure the connection from the regulator to the tube is secure, and that the rubber gasket is in place.

NIGHT FLYING EQUIPMENT

Check cockpit and fluorescent lights for operation.

Check operation of position lights and the landing light.

Check recognition lights for keying and steady "ON" operation.

Check (with ultraviolet lens over fluorescent lamps) luminous markings on instrument dials.

AIRPLANE GENERAL

Inspect mooring kit for security.

Inspect scoop control panel and actuating mechanism for security.

Make sure weatherproof covers and dust excluders are properly stowed.

Make sure required maps, charts, lists, etc., are in place in the map and data cases.

Navigation Instruments

GYRO INSTRUMENTS

Make sure that all gyro instruments are uncaged.

Clean gyro air filter.

OTHER NAVIGATION INSTRUMENTS

Check for presence of compass card and make sure compass face is not discolored.

Wind clock and set to operations time.

With the compass power supply on, turn the ship through 360 degrees. If the indicator does not follow the transmitter on all headings, check the continuity of the wiring.

Make sure the holes in the static and pitot pressure head are not clogged with dirt or other foreign matter.

Inspect pitot tube for cleanliness.

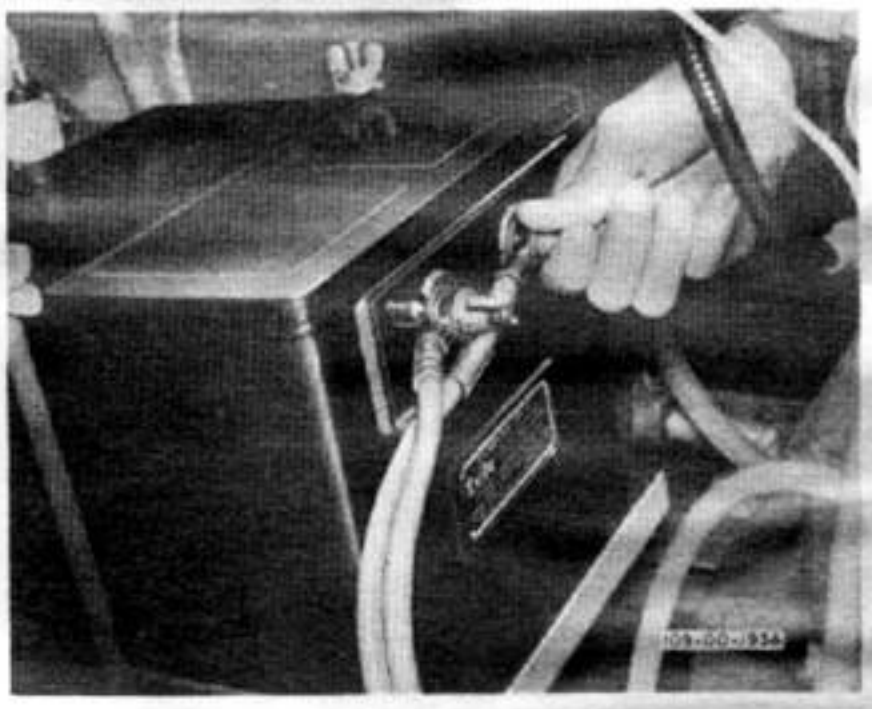
BATTERIES

Check battery cells with hydrometer.

Inspect battery for leakage of acid resulting from a broken case or defective sealing. If evidence of leakage is found, replace the battery. Safety the cover.

Make sure battery venting tubes are open and are secure. Inspect for breaks or kinks. Make sure inlet and outlet flanges are snug against outside skin.

Inspect terminals for condition and cleanliness.



PERIODIC INSPECTIONS

BOMBING EQUIPMENT

25-Hour Inspection

Inspect arming solenoid pins and latches, and bomb support hooks for general condition. Examine for wear, burrs, corrosion and other defects. Keep camming surfaces smooth and polished.

Inspect arming units for proper pull-out resistance; each unit should support a 3-pound load, but not a 4-pound load.

Inspect the bomb rack electrical connector plug for proper soldering of wires. Also see that the insulator tubing around the wires is securely held at the plug by the adapter clamp. Inspect for frayed insulation.

GUNNERY EQUIPMENT

25-Hour Inspection

Thoroughly inspect gun mounts, brackets, and adjacent structures for cracks, corrosion, and other defects or damage.

Make a thorough inspection of all the guns.

Inspect optical gun sight for cracks and other damage.

Test rheostat and lamp for proper functioning.

Check harmonization of the line of sight to the flight path of the airplane, and of the bore sight adjustment of the guns to the gun sight.

Inspect gun heaters and heater wiring circuit.

Inspect gun camera installation.

COMMUNICATION EQUIPMENT

25-Hour Inspection

Inspect all equipment for security of mounting and general condition.

Inspect wiring for frayed insulation.

50-Hour Inspection

Make thorough inspection of entire communication equipment system to make sure each metal part is adequately bonded, and that all electrical parts are properly shielded and bonded. Eliminate each rubbing or vibrating metal contact by insulation, shielding, or bonding, as required.

With an air hose or bellows, clean accumulated dust and dirt from all units.

Note

To wash radio equipment, use carbon tetrachloride only.

Test all tubes and check operating efficiency. Replace if necessary.

Examine all plugs for malformity, cleanliness, and security of attachment. Make sure all tubes are securely seated in sockets.

Inspect all fuses for clean contacts and security.

Inspect antennas for security of attachment and for proper tension.

Check frequency range of the transmitters, and inspect for proper operation.

With transmitter operating, check modulation by speaking into the microphone and observing the antenna RF indicator. The pointer will indicate a slight increase of current if the output is properly modulated (SCR-274-N).

Examine flexible tuning cables for kinking. For ease of operation, tuning cables (SCR-274-N) should be as straight as possible.

100-Hour Inspection

Check length of dynamotor brushes, and examine for broken pigtail leads. Replace if necessary.

Inspect dynamotor commutators for cleanliness, and examine for excessive wear.

500-Hour Inspection

Inspect bearings of dynamotors for proper lubrication.

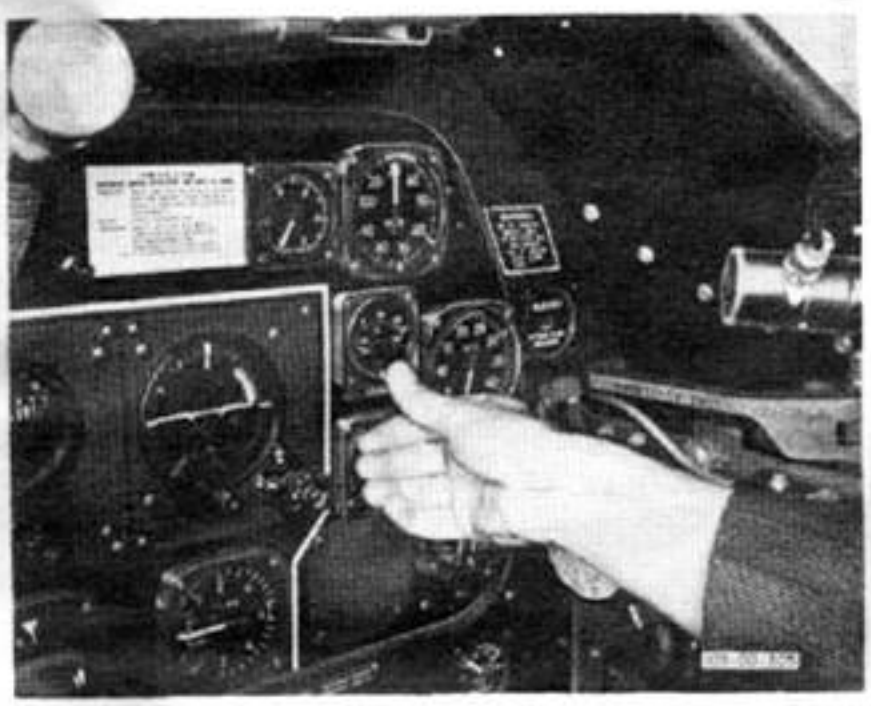
ENGINE INSTRUMENTS

50-Hour Inspection

Inspect tachometer generator for tightness of electrical connections and security of mounting.

Inspect all instruments, instrument lines, and capillaries for security, tightness of all connections (including electrical connections when used), and condition of all bonding. Check for wear due to vibration or chafing. Make certain that rubber grommets are installed where required, and that grommets are in good condition.

Inspect all engine instruments for discolored or chipped instrument limit markings. Make sure that engine instrument operating limit markings are correct.



IGNITION AND ELECTRICAL

25-Hour Inspection

Check elbow terminals and shielding nuts of shield spark plug installations for security. When tightening the elbow assembly of shielded plugs, the barrel must not be loosened. Do not rotate the barrel, as such action changes the gap setting.

Inspect the landing gear warning light assembly for security of mounting and security of electrical connections.

Inspect all electrical boxes for cleanliness and security.

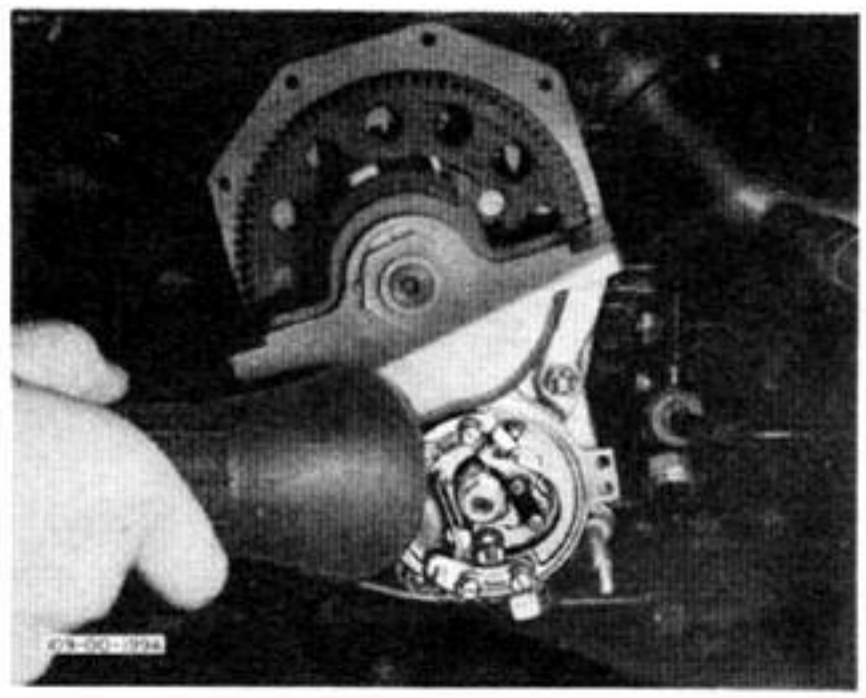
Make sure spare light bulbs are serviceable and are the correct type. Make sure all wiring connections are secured to plugs, switches, sockets, and terminal blocks.

Make sure all lamp coverglasses are clean, secure, and undamaged.

Inspect all ignition wire shielding for general condition and security.

Lubricate all external connections on magnetos, and linkage rod connections twice during 25-hour period —at 10 and 25 hours.

Clean bearing surface of contact breaker base, and lubricate lightly. Do not permit oil to touch contact points.



Inspect starters, magnetos, generator, and distributors, for security of mounting, tightness of housing bolts, and safetying of all attaching or connecting bolts.

Inspect for cracked housings or flanges.

Inspect for presence of engine oil in the starter gear case, which condition often results in starter failure, particularly during cold weather. In such cases, replace the starter.

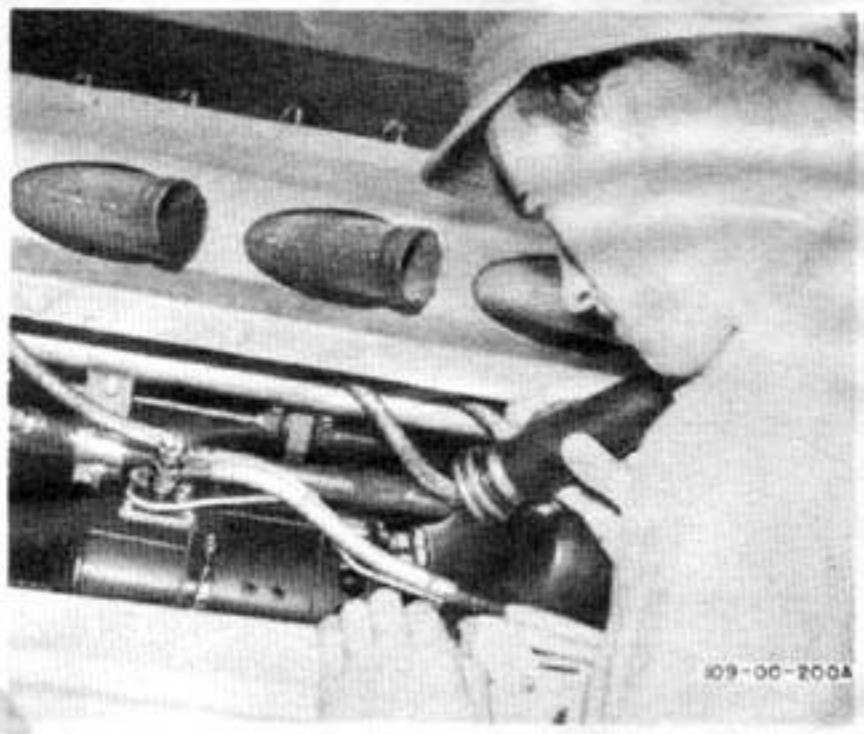
50-Hour Inspection

Inspect all electrical connections and leads for security of ground connections, anchorage of lines, tightness of connections, condition of insulation, safetying and security of plugs.

Inspect all switches, rheostats, position indicators, relays, and solenoids for condition, security of mounting and connections, and for proper operation. Examine for worn or pitted contacts.

Inspect generator for excessive arcing, dirty or loose connections, loose terminals, and worn or binding brushes. Examine generator for security of mounting.

Inspect booster coil. Examine for security of mounting



Inspect oil dilution solenoid for correct operation.

Examine for cleanliness, security, and general condition.

Clean and tighten all connections to the generator, and replace any defective wiring. Brushes should be replaced before maximum wear limit is reached to ensure proper operation until the next 50-hour inspection period. If the airplane is subject to high-altitude flying, the brushes should be given special attention. Inspect commutator for wear.

Should oil be found in the generator, remove the generator, clean it thoroughly, and check engine oil seal for leakage. Tighten and resafety all loose generator mounting screws.

Inspect all lamp bulbs for discoloration. Make sure filaments are intact.

Check pitot tube heater for correct operation. Inspect pitot head for security and general condition.

Inspect voltage regulator and reverse-current relay switch for security of mounting, cleanliness, and burned, welded, or pitted parts. Usually, dirt can be removed by inserting a piece of clean, hard paper between the contacts, pressing contacts together, and pulling paper out. Do not leave paper lint between the contacts, as it would reduce the voltage. Snapping contacts open and closed may help remove lint.

CAUTION

When inspecting or cleaning the contacts, the battery-disconnect switch must be in "OFF" position. If an external source of power is being used, remove the external power plug.

Check voltage regulator for a 28-volt setting with no load, and check reverse-current relay for a setting of 26 to 26.5 volts, closing voltage.

Remove window strap on the motor of the starter and inspect the motor for loose connections and worn or binding brushes. Replace worn brushes immediately, as burning of the commutator and insulation usually results from failure to make such replacement in time.

When installing the brushes, leave sufficient sleeving on the brush leads.

Check over-all length of starter brushes. Replace any brush which is 5/8 inch or less over-all length. If brushes wear rapidly, examine for rough or pitted commutator and excessive spring tension.

If starter commutator is rough or dirty, smooth and polish with No. 0000 sandpaper. Keep sand and metal particles from motor ball bearings. After sanding, thoroughly clean commutator to remove all sand and metal particles. If commutator is burned, rough, or scored to such an extent that it cannot be properly conditioned, replace the starter motor.

Check starter brush spring tension. Starter brush springs that are not under 24 to 28-ounce tension when raised 1/4 inch above top of brush box, should be replaced.

Check gap between the magneto contact points with wire-type spark plug gap measuring feeler. If less than .011 inch, or more than .014 inch, adjust to .012 inch by loosening locknut and turning adjustable contact point screw with flight tool wrench AT-8002, or equivalent.

Note

Check gap setting on the three other cam lobes and, if necessary, readjust the gap within the permitted limits to an average of the clearances obtained in all 4 cam positions.

Inspect scoop actuator motor brushes and commutator for wear. Replace brushes as necessary. Inspect actuator relay points, and redress if necessary.

CAUTION

Do not use sandpaper or emery cloth when dressing down the thermostat contacts. Use a fine burnishing tool. Do not dress down thermostat contacts, unless it is absolutely necessary to clean them.

100-Hour Inspection

Make sure that the contact breaker arm rubbing block in the magneto extends 1/8 inch beyond arm.

Install new cam lubricating pad and clip assembly and breaker point assembly in the magnetos. When installing, adjust clip so that pad just contacts the cam lobes.

Check operation of the booster coil. Excessive spark or a greenish tinge accompanied by smoke indicates a defective or improperly adjusted coil.

Remove all spark plugs and replace with new or reconditioned plugs of same type.

300-Hour Inspection

Remove generator from engine and turn generator rotor. If it is not possible to turn the rotor drive key with the fingers, the generator should be overhauled.

Note

No lubrication of generator is necessary, as the ball bearings are permanently lubricated and sealed before assembly.

FUEL SYSTEM

25-Hour Inspection

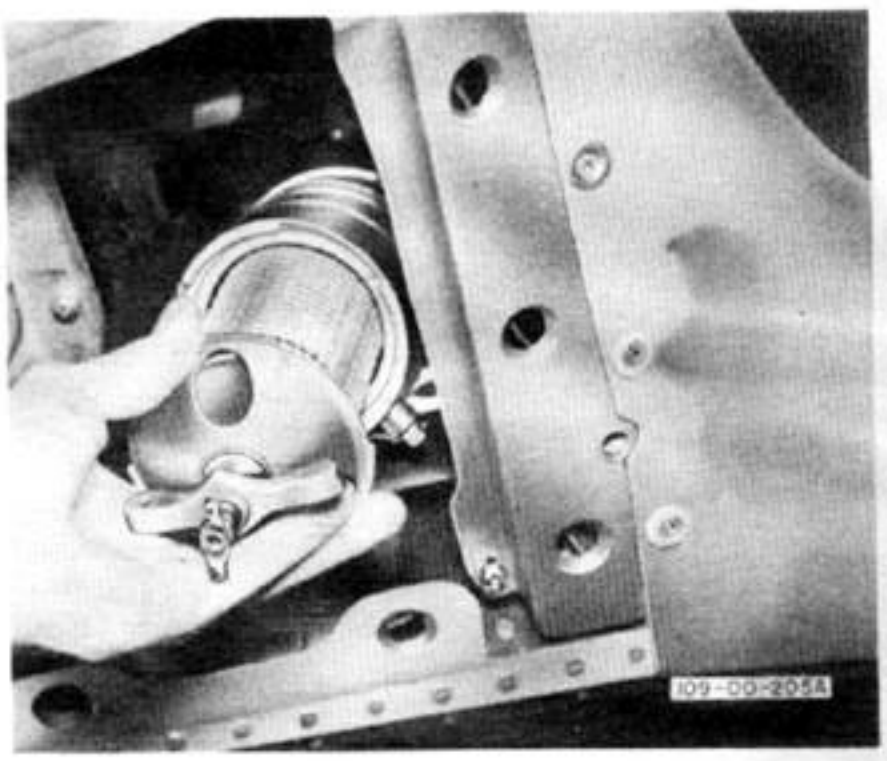
Inspect the engine-driven fuel pump for security of mounting and proper safetying.

Make sure that ends of drain lines are clean.

Check fuel pressure with engine running. Minimum 14 pounds per square inch; maximum 19 pounds per square inch. Desired setting is 17 (±1) pounds per square inch.

On early airplanes, make sure primer pump does not leak when pressure is applied by booster pump.

Remove screen from end of fuel strainer and clean with gasoline. Make sure interior of strainer is clean before reinstalling screen.



With engine compartment cowling and necessary access doors removed, and with fuel pressure up, inspect all fuel lines for leaks and cracks, particularly at sharp bends.

Note

Leaks are usually detected on fuel lines by presence of stains caused by the dye used in aviation gasoline.

Make sure connections are not leaking, wearing, chafing, or cutting lines. Examine for proper location of clamps and tightness of connections.

50-Hour Inspection

Inspect fuel selector valve controls for general condition and security. Inspect for excessive backlash or drag, and make sure connections to the tanks correspond to dial markings.

Inspect the fuel vent relief valves for general condition and for correct operation.

Remove and clean vent plug on engine-driven fuel pump relief valve housing.

Inspect fuel booster pump for condition and proper mounting.

100-Hour Inspection

Inspect lines, hoses, and clamps inside tank bays for general condition and security.

Remove fuel gages from tanks and inspect rods, gears, and drain cocks for damage or deterioration.

Remove booster pumps and clean the screens.

Inspect fuel booster pump motor brushes for excessive wear.

OIL SYSTEM

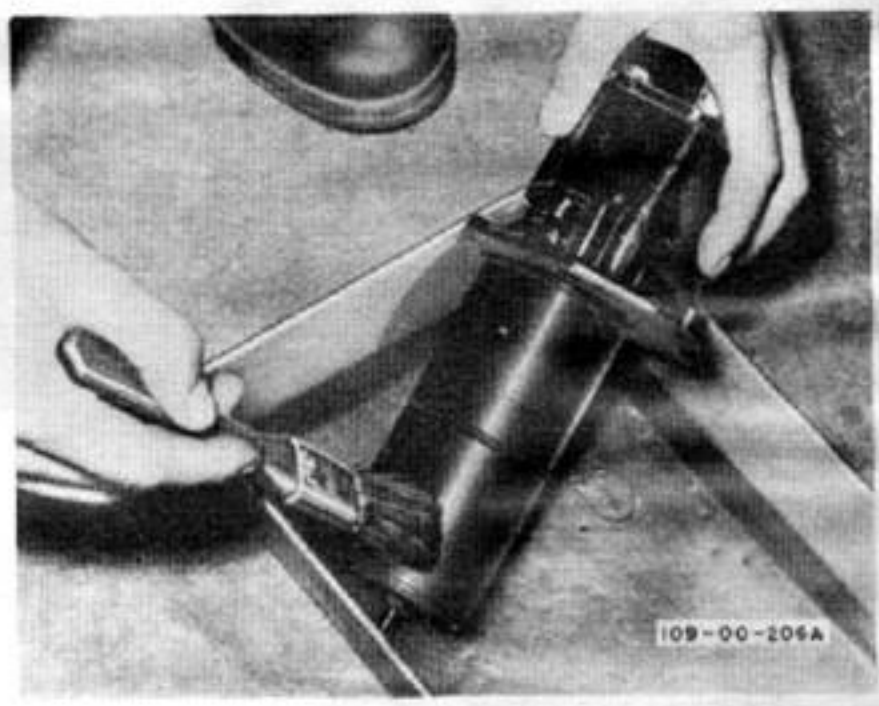
25-Hour Inspection

Inspect all lines for cracks, dents, kinks, and deterioration. Make sure lines are secure and not touching any part of the airplane in a manner likely to result in wear.

Inspect rubber hose connections for cracks or deterioration. Make sure hose clamps are properly spaced and adjusted.

Inspect oil tank for security of mounting and make sure there is no leakage.

Remove and clean oil filter. Clean interior of filter sediment chamber.



Note

An even distribution of dirt on the disc surfaces indicates that the filter blades have not been turning.

Remove and clean scavenge pump screen.

Inspect, for attachment and evidence of leakage, all fittings, valves, flanges, strainers, and the oil pumps.

ENGINE CHANGE

Drain oil system.

Disconnect lines, remove hose connections, and inspect for debris. Flush and clean system thoroughly with kerosene, Specification No. VV-K-211.

Because of oil tank baffling, a complete inspection of the tank is impossible. Therefore, during the flushing operation, disconnect the oil outlet at bottom of tank and circulate kerosene through the tank until all traces of dirt and debris have been eliminated.

If, because of engine failure, metal particles have been released into the oil system, remove the tank and clean it thoroughly. Replace the oil cooler.

Remove and overhaul oil filter. Clean filter again after after first 5 hours of flying after engine change.

COOLING SYSTEM

25-Hour Inspection

Inspect header tank for leakage, and security of mounting.

Inspect lines for wear and deterioration. Make sure lines are secure and not touching any part of the airplane in a manner that might result in wear.

Inspect scoop for cleanliness and security of attachment. Examine bolts and make sure there is no play in the scoop hinge bushings.

Inspect all hose connections for deterioration. Examine hose clamps for tightness and proper edge distance.

Make sure scoop actuating linkage is properly attached and adjusted for full operation.

50-Hour Inspection

Inspect radiator support straps for security, and examine the four attaching bolts for proper tension and safety.

Inspect pumps for security of attachment. If there is excessive leakage, replace packing.

Inspect capillary bulb in inlet port of radiator for security. Make sure there are no sharp kinks in the line from the capillary bulb to the thermostatic control valve.

Test coolant for correct percentage of water and glycol treated with NaMBT.

100-Hour Inspection

Drain and flush cooling systems.

VALVES

100-Hour Inspection

Completely inspect and adjust the valve mechanism. Examine for broken springs. Inspect for leaky, burned,

or warped valves by removing plug from each cylinder, turning propeller by hand, and listening for leak. Adjust valve clearances if necessary.

25 Hours After Engine Change

Make a complete detailed inspection and adjustment of the valve mechanism, checking condition of valve springs and cylinder head cover gasket.

MANIFOLDS AND SUPERCHARGERS

25-Hour Inspection

Make sure induction manifolds are secure; inspect for cracks and "blown" gaskets.

Inspect supercharger castings and elbow for cracks and evidence of failure.

Inspect pressure regulator (boost) control for security of attachment.

100-Hour Inspection

Remove, clean, and inspect the priming jets on the side induction manifolds and the jet and filter in the supercharger elbow. Check the flow of the fuel from the primer pump. After reconnecting the piping, inspect the priming system for leaks.

Remove the side and center induction manifolds.

Remove flame traps and clean thoroughly with carbon-removing compound, AAF Specification No. 20025.

Inspect for condition, evidence of burning, and security of cores in frames.

HAMILTON STANDARD PROPELLER AND ACCESSORIES

25-Hour Inspection

Inspect propeller hub and retaining nut for looseness on shaft. If repeated tightening of retaining nut is necessary to maintain proper tightness, remove propeller and investigate.

Lubricate propeller dome trunnion and spinner front section centering ring bushing.

25 Hours After Engine Change

Inspect propeller shaft thrust bearing nut. Subsequent tightening shall be at the discretion of the engineering officer in charge, or at any time that the nuts are found to be loose.

AEROPRODUCTS PROPELLER AND ACCESSORIES

25-Hour Inspection

Check to see that the regulator has the proper oil level. Oil should be at the level of the filler plug hole when the filler plug hole is in the horizontal position and on the left-hand side of the airplane.

Remove oil pump filter plug and check filter for foreign matter. Clean and reinstall filter, being sure to safety plug. This should be done on first 25-hour inspection and only at 100-hour inspection periods thereafter.

50-Hour Inspection

Check to see that the propeller retainer nut is tight and safetied.

See that there are identification markings on all blades and the hub; re-mark if necessary.

Check hub for sufficient grease and regulator for proper oil level.

Inspect spinner assembly attaching screw holes for elongation.

Check to see that the spinner is free from dents, nicks, loose rivets, and loose dowels. Remove all dents.

Check each blade retaining nut for security of mounting.

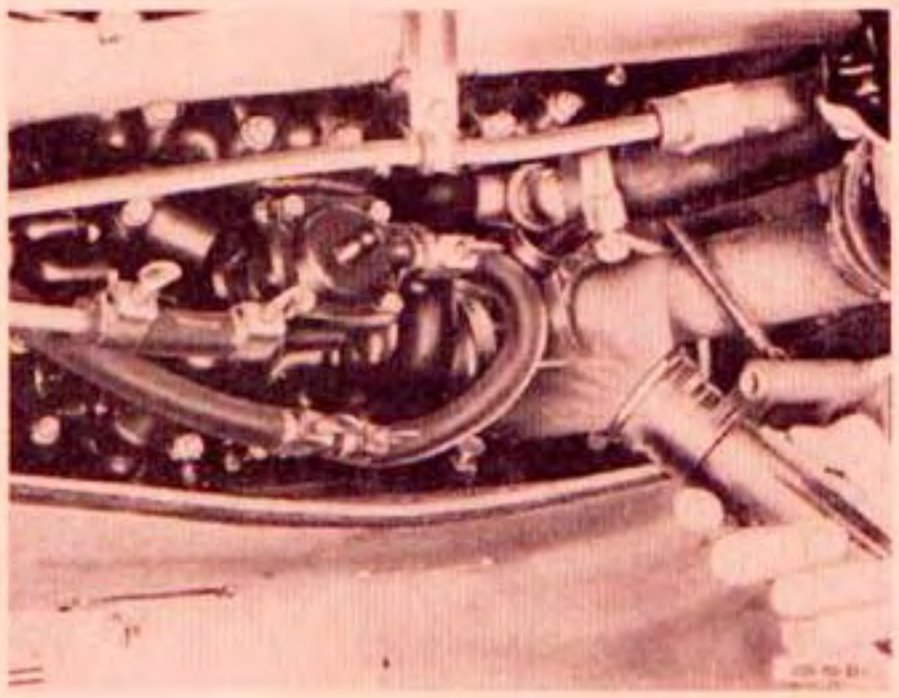
GENERAL—POWER PLANT

25-Hour Inspection

Inspect spark plug elbow terminals and shielded plugs for security. Do not loosen the barrel when tightening elbow assembly. Elbows should be tightened finger-tight plus one-half turn with wrench.

Wash engine completely. Do not allow any cleaning fluid to enter the generator, starter, or any other electrical equipment.

Inspect reduction gear housing, supercharger housing, and all accessory housings of the engine for general condition and security.



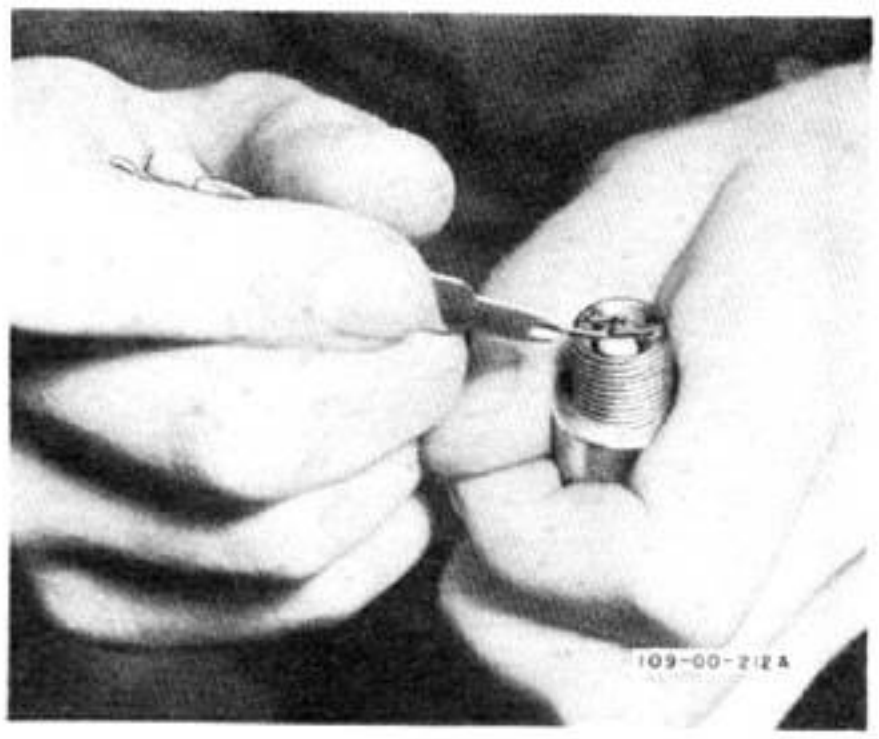
Clean carburetor fuel strainer. The fuel supply line does not have to be disconnected.

After replacing carburetor strainer, and while strainer is filled with air, disconnect the vapor vent line at carburetor. Then, with the booster pump, apply fuel pressure at approximately 14 pounds per square inch and observe the action of the vapor eliminator. It should be possible to notice the rush of air being expelled and then ceasing when the fuel level raises the float and shuts off the vent passage. There should be no fuel flow from the vent line other than a few drops, which is normal seepage.

Inspect carburetor attachment bolts and carburetor air scoop elbow nuts for security.

Inspect ignition ground and booster connections.

Check spark plug gaps. Recommended gap settings, .012 inch. Reset gaps if less than .011 inch or more than .014 inch.



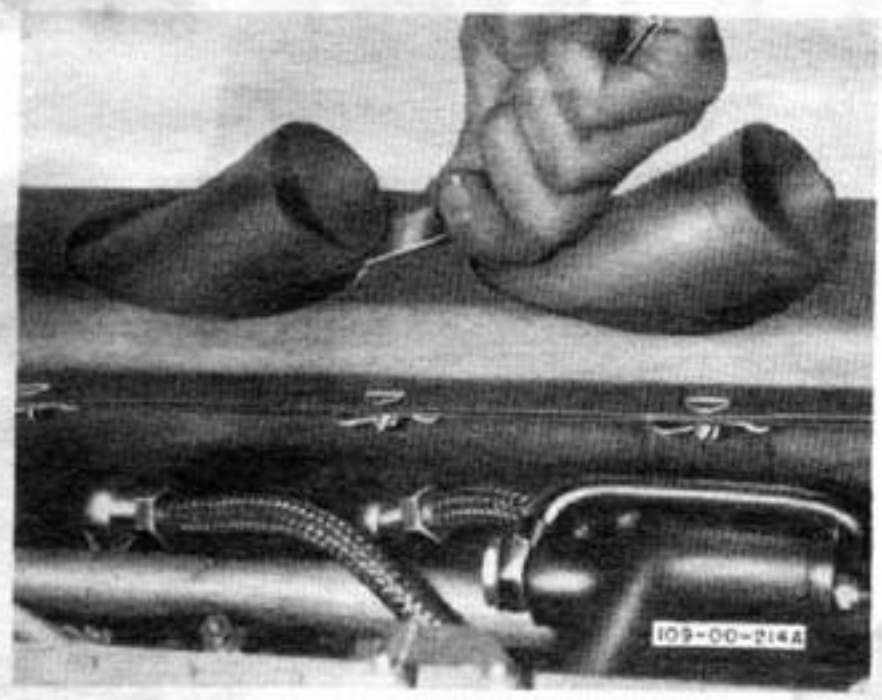
Inspect automatic boost control for security of attachment.

Check engine idling.

Inspect engine breather system for free venting.

Inspect outboard face of exhaust shroud fairing for airflow.

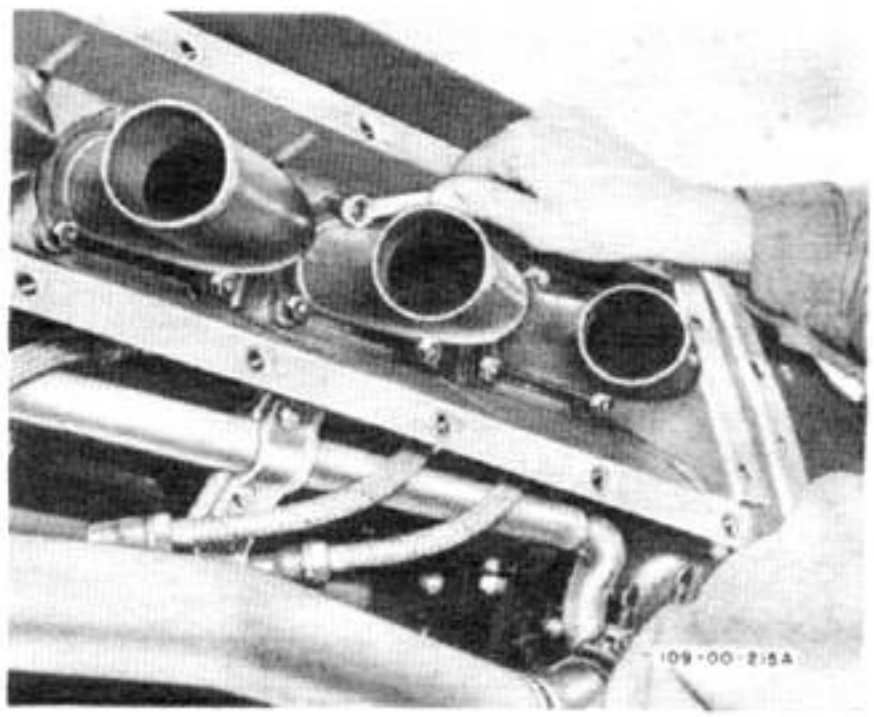
Inspect generator and spark plug blast tubes for free



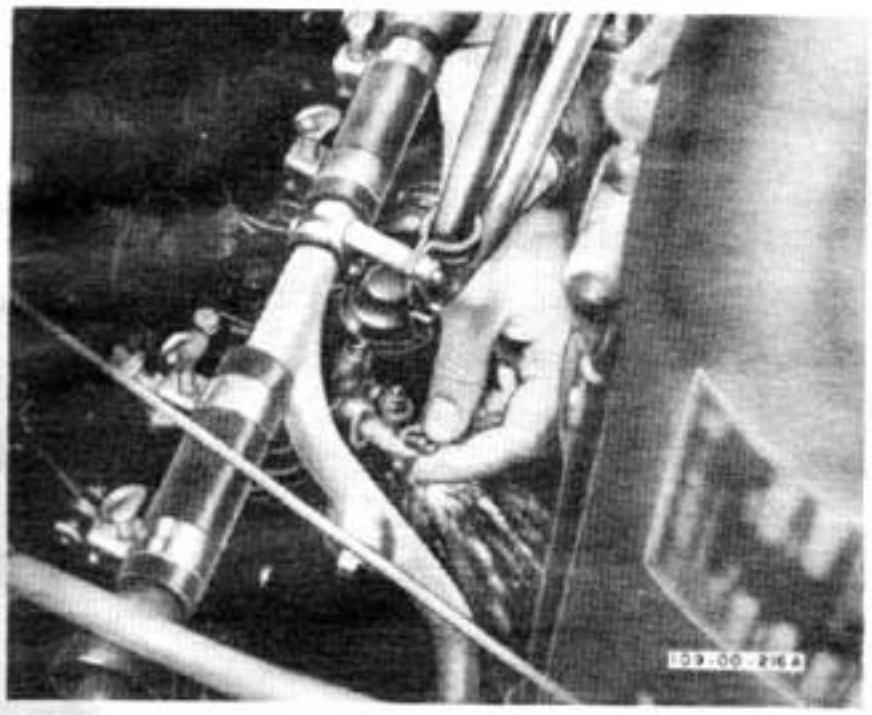
clearance from flange on cowling, and clearance between stacks and shroud.

50-Hour Inspection

Inspect ignition shielding for proper anchorage and the union nuts and tube brackets for security. Check exhaust stacks and studs for looseness. (Use wrench.)



Drain carburetor regulator unit and fuel control unit through plugs in bottom.



Examine engine cowling formers and frames for general condition and security.

Remove and clean carburetor air scoop sections. Clean carburetor air impact tubes and internal surface of throttle body, particularly the small boost venturi. Soak caked dust, oil, or grime with a fine gasoline spray and remove with a cloth or a soft brush.

Inspect magnetos for damaged cam followers, damaged breaker felts, weak or broken breaker-arm springs, worn or loose cams, or cam bearings. Inspect for security of mounting. Examine for excessive lubrication, but lubricate if necessary.

Inspect magneto distributor for sticking or broken brush, and signs of arcing. Check tightness of mounting screws with screwdriver.

Inspect magneto breaker contacts and adjust if necessary.

100-Hour Inspection

Replace all spark plugs with new or reconditioned plugs of an approved type.

Inspect magneto breaker points for pitting.

Check magneto timing.

Inspect high-tension leads in magneto.

Inspect ignition booster for operation by disconnecting wire No. 79 in the pilot's switch box, turning battery-disconnect switch to "ON" position, and engaging starter, noting booster coil operation. After test, turn battery-disconnect switch to "OFF" position, and connect wire.

Examine rubber elbow on carburetor air scoop for evidence of deterioration.

Engine Change

Engine change shall be made after a specific number of hours *(see latest engine T.O.)* unless malfunction or failure of an engine part occurs prior to this time. Comply with all special instructions and accomplish all maintenance work prescribed by technical instructions for engine change.

Inspect the ten Lord mounts for general condition and security.

When replacement pumps are available, replace all accessory pumps except those with less than 100 hours operation since last overhaul.

When a new or recently overhauled engine is installed, ground test the installation for approximately 30 minutes and thoroughly check the operation of the engine, engine instruments, and related accessories.

At the completion of the ground test, clean all removable screens. Make a flight test for one hour at reduced power and full mixture. After the flight test, inspect the engine for evidence of failure or malfunctioning. Make a second flight test of approximately 2 hours at reduced power. At the end of the second flight test, clean all removable oil screens.

At the end of the first 5-hour flying time of a new or overhauled engine, inspect the cylinder hold-down nuts for tightness. Usually, the nuts will be loosened because of settling of the cylinder blocks, and compression of gasket paste on the cylinder barrel bearing plates or shims.

COCKPIT

25-Hour Inspection

Close sliding cockpit enclosure canopy and pull emergency release handle. Apply force to ceiling of enclosure to make sure that canopy will release properly.

When reinstalling canopy, make sure that it is correctly locked in position. Safety emergency release handle with .025-gage safety wire. Lubricate all working parts.

Inspect weather stripping around windshield and curved side panels for general condition and security.

Inspect windshield and curved side panels for condition of frame and security. Examine all glass and plastic sheets for cracks or breaks.

Inspect pilot's seat for security of attachment, condition and operation of adjusting mechanism, breaks or cracks in the seat back which could foul parachute or clothing. Examine supports and brackets. Lubricate seat adjustments.

Inspect safety belt and shoulder harness attachments.

Examine fabric and leather parts for cuts or fraying, and the latching devices for condition and operation.

Inspect fittings and attachment parts for condition and security of fastening. Check safety belt for date of last weight test. (All belts to be tested semiannually except Type B-11, which are to be tested annually.)

Inspect ventilators for condition and proper operation.

Inspect contents of map case and data case for completeness.

FLIGHT CONTROL MECHANISM

25-Hour Inspection

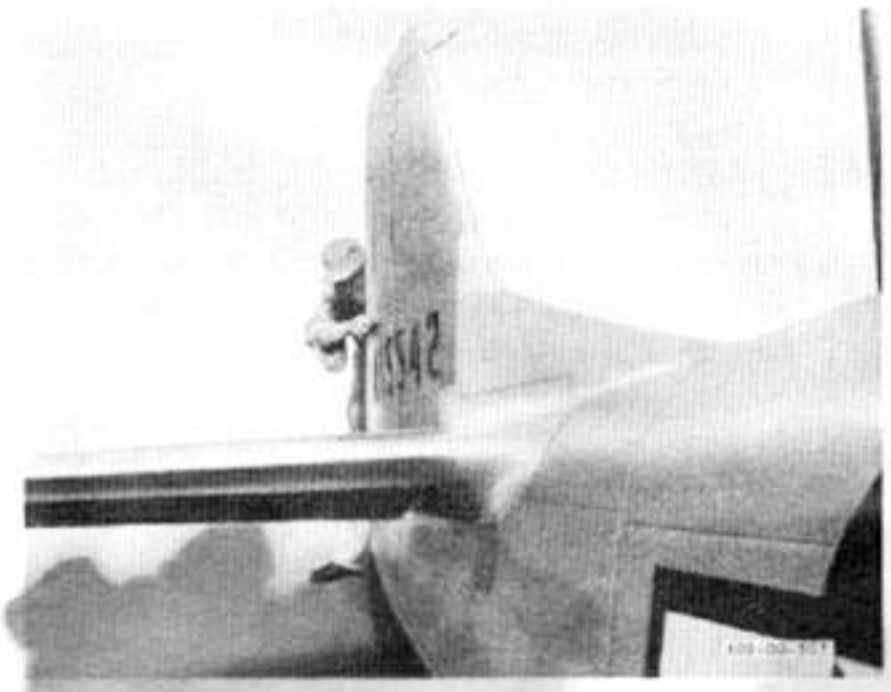
Examine the control stick, push-pull rod, and attachments for general condition and security.

Check all control surfaces for proper ranges of movement.

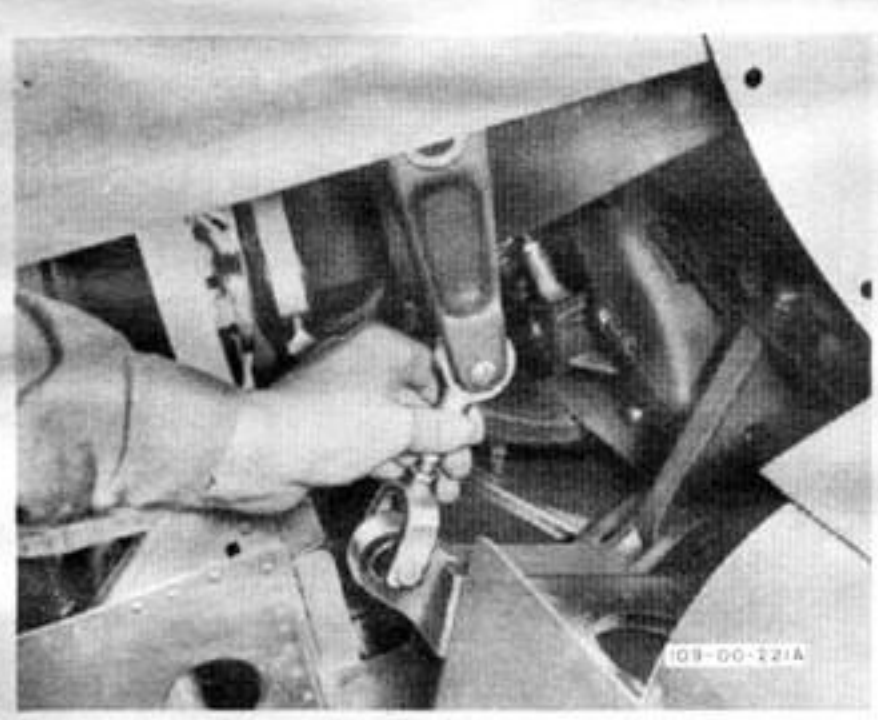
With surface controls in locked position, and trim tab position indicators on pedestal at neutral, inspect trim tabs for correct alignment with rudder, elevators, and ailerons.

Inspect surface control lock and link mechanism for general condition and security. Make sure the surface control lock engages properly. Lubricate the plunger if necessary.

With controls in locked position, inspect rudder for correct alignment with vertical stabilizer.



Inspect flap actuating linkage for security. Make sure all locknuts are tight.



Inspect aileron control system torque tube attachment bearings and attachments to control stick for general condition and security. Inspect torque tube bearings for excessive play.

Inspect the two links from aileron torque tube to aileron cable sector for security, and make sure locknuts are tight.

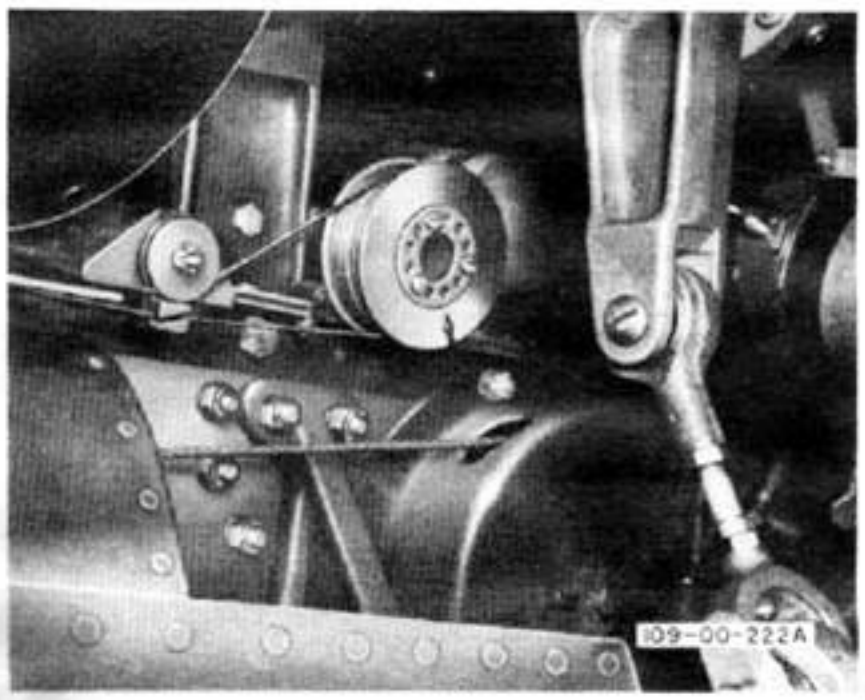
Examine inboard and outboard cable sector of each aileron for general condition and security.

Inspect aileron control cables for security of attachment to sectors, and determine that connecting turnbuckles are safetied.

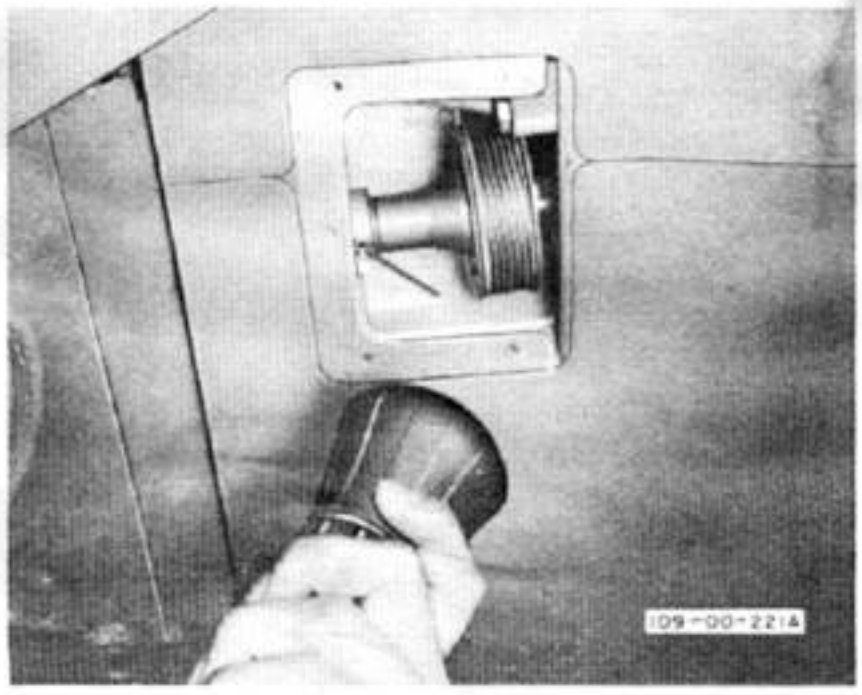
Inspect the two aileron actuating fork assemblies for general condition and security.

Examine right aileron tab rod, arm assembly, and attachments for general condition and security. Make sure the locknut is tight.

Examine left outboard aileron trim tab control drum, linkage, and attachments for general condition and security. Make sure the lockscrew is tight.



Examine inboard aileron trim tab control drum and the chain to the pedestal control, for general condition and security.



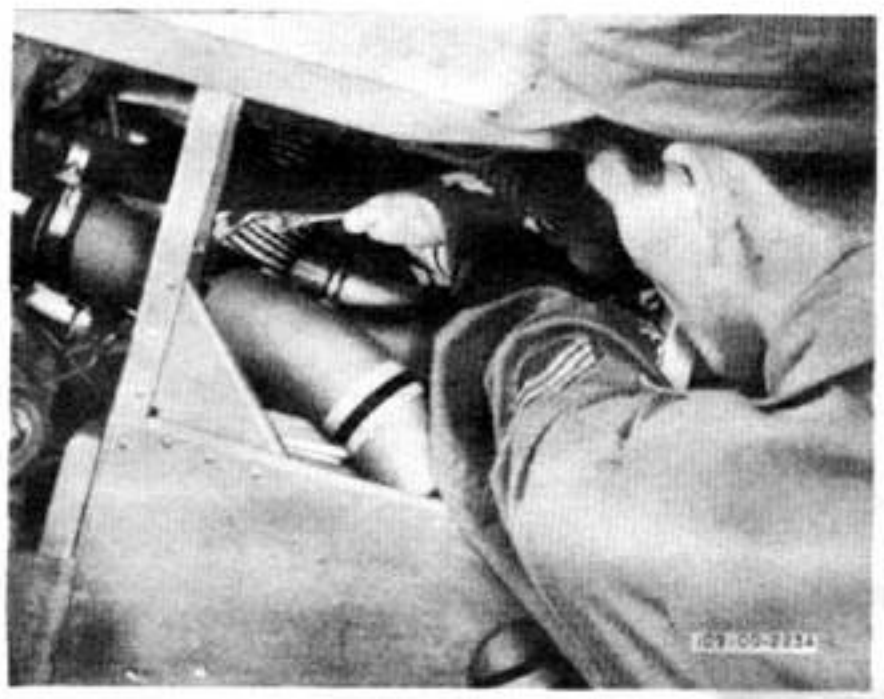
Inspect the two aileron trim tab cables for general condition and security of attachment to the drum assemblies. See that attaching turnbuckles are safetied.

Inspect elevator push-pull control rod connection to forward elevator bellcrank for security, and inspect the bellcrank for general condition. Examine locknut on push-pull rod to make sure it is tight.

Inspect elevator actuating horn assembly and cable attachment links in rear section for general condition and security.

Inspect elevator trim tab drum and control in the pedestal for general condition and security.

Examine elevator control cables for security of attachment, general condition, and correct routing. Make sure the turnbuckles are secure and safetied.



Inspect the two elevator trim tab drums in horizontal stabilizer, and linkage to tabs, for general condition and security. Make sure locknuts are tight.

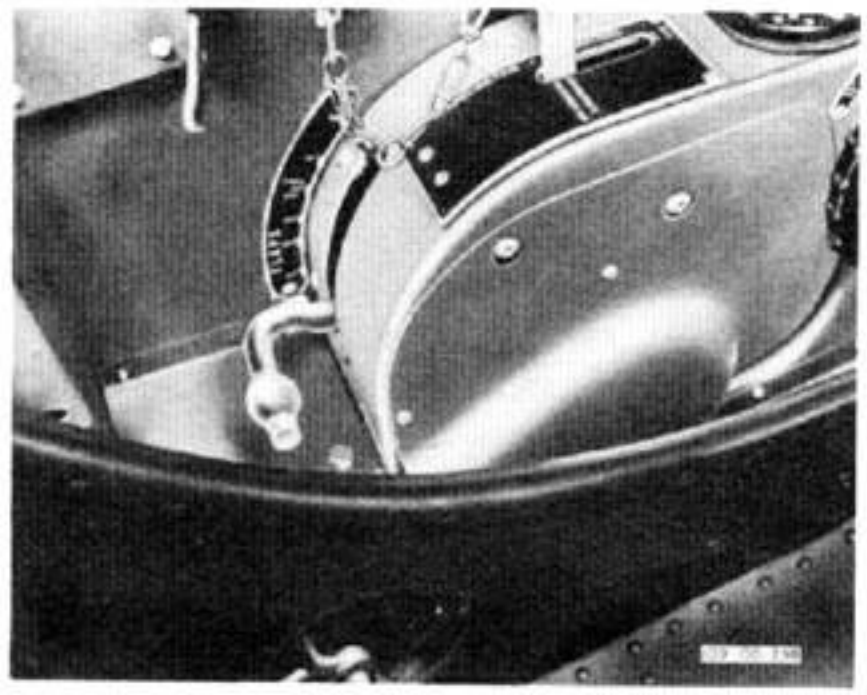
Examine the two elevator trim tab control cables for general condition and security. Inspect all turnbuckles and cable linkage for security.

Inspect rudder pedals, attachment blocks, and attachment bolts for general condition and security. Make sure locknuts on brake adjustment rods are tight.

Adjust rudder pedals to the different leg lengths, and make sure the pins engage correctly at all positions.

Examine rudder-operating bellcrank in rear section, and rudder actuating rod, for general condition and security. Inspect locknut on rod assembly to make sure it is tight.

Inspect the two rudder control cables for correct routing, general condition, and security.



Inspect rudder trim tab drum and control in the pedestal for general condition and security.

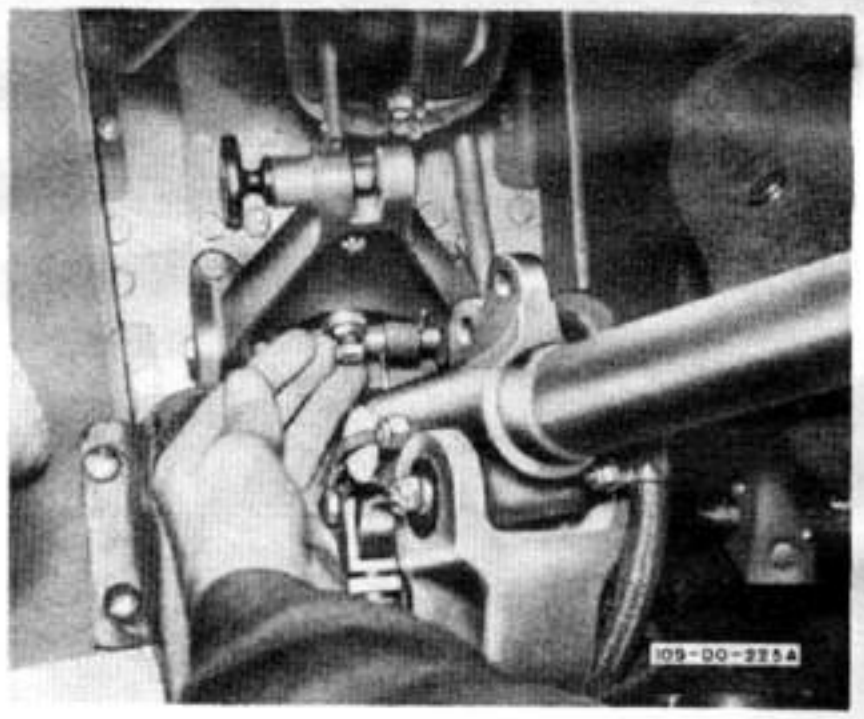
Inspect rudder balance cable, lock mechanisms, and attachments for general condition and security. Make sure pulleys move freely.

Inspect rudder trim tab drum in vertical stabilizer, and linkage to rudder trim tab, for general condition and security. Make sure locknut is tight.

Examine the two rudder trim tab control cables for general condition and security of attachment. Make sure both turnbuckles are safetied.

Make sure the two aileron stops on the aileron control system torque tube and the two stops on each aileron outboard cable sector are secure.

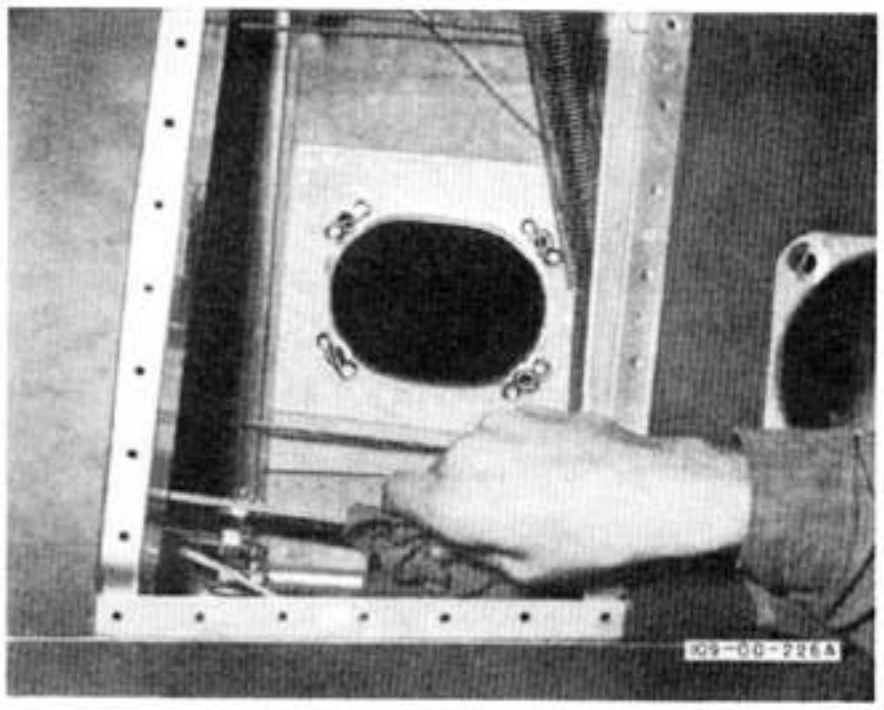
Make sure the rudder stops on the rudder bellcrank and the elevator stops at the base of the control stick are secure.



Check cable tensions.

Lubricate control mechanisms.

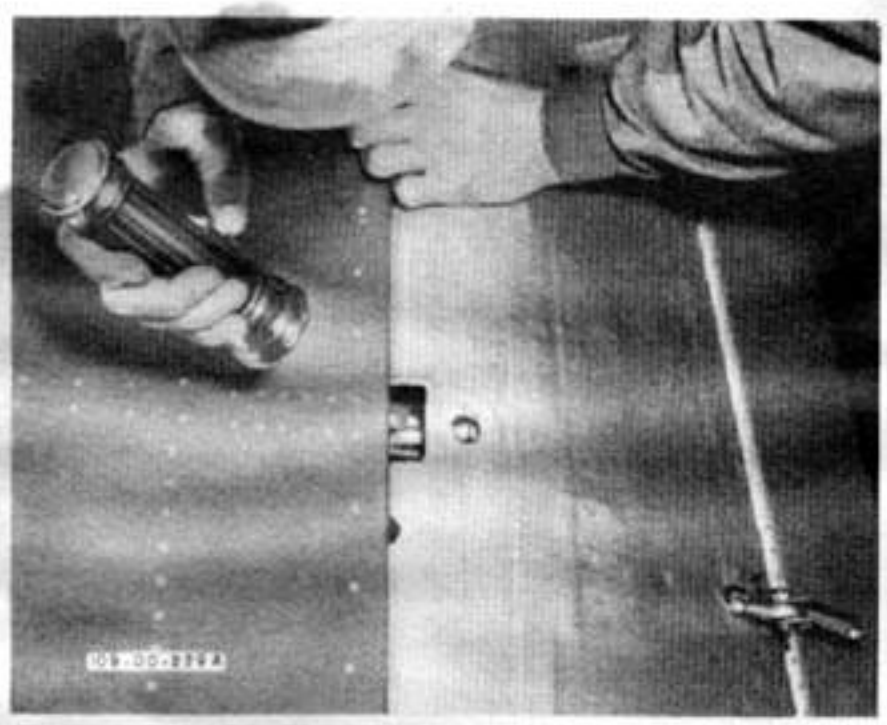
Inspect all control cables for frayed wires, particularly around pulleys and fairleads.



MOVABLE SURFACES

25-Hour Inspection

Inspect aileron and elevator attachment fittings, bearings, and attachment bolts for general condition and security.



50-Hour Inspection

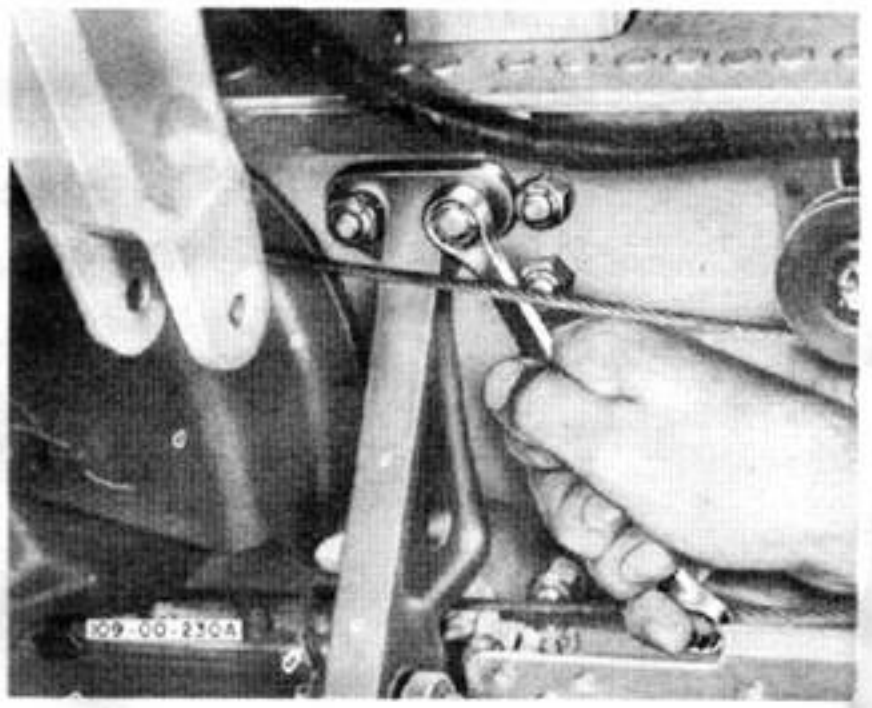
Examine for excessive play in aileron actuating fork. A maximum of ⅛-inch play at trailing edge of aileron is permissible.

Remove bolt attaching wing flap to wing flap operating link at fuselage, and allow wing flap to drop.

Remove rudder cap and examine rudder attachment fittings, bearings, and attachment bolts for general condition and security.

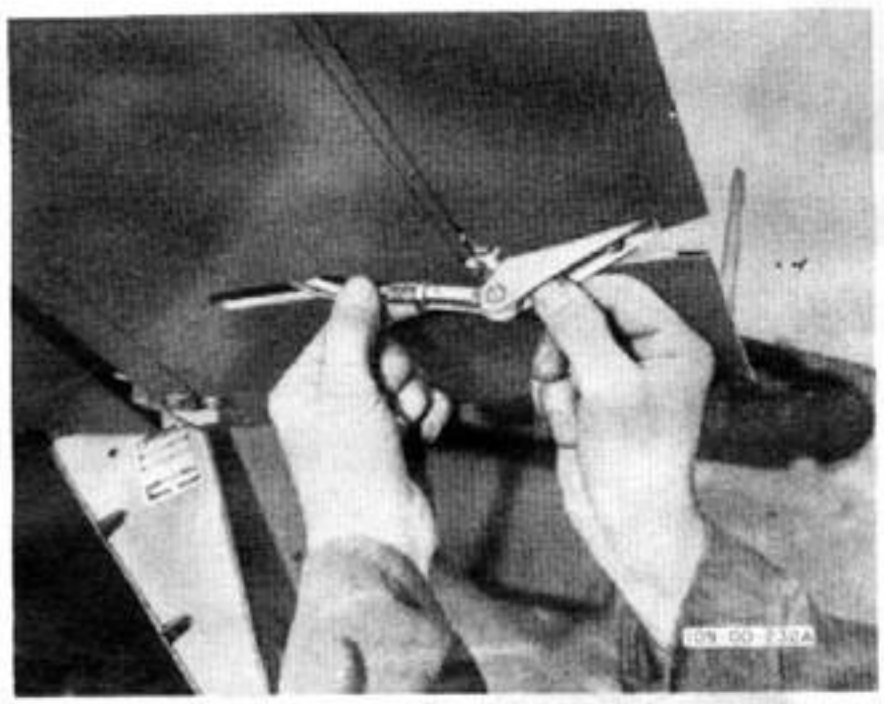
Remove fairing adjacent to elevators and examine elevator attachment fittings, bearings, and attachment bolts for general condition and security.

Inspect wing flap attachment fittings, bearings, and attachment bolts for proper condition and security.



Inspect trim tabs and tab hinges for general condition and security.

Examine gaps between all fixed surfaces and all movable surfaces to see that no foreign matter is present.

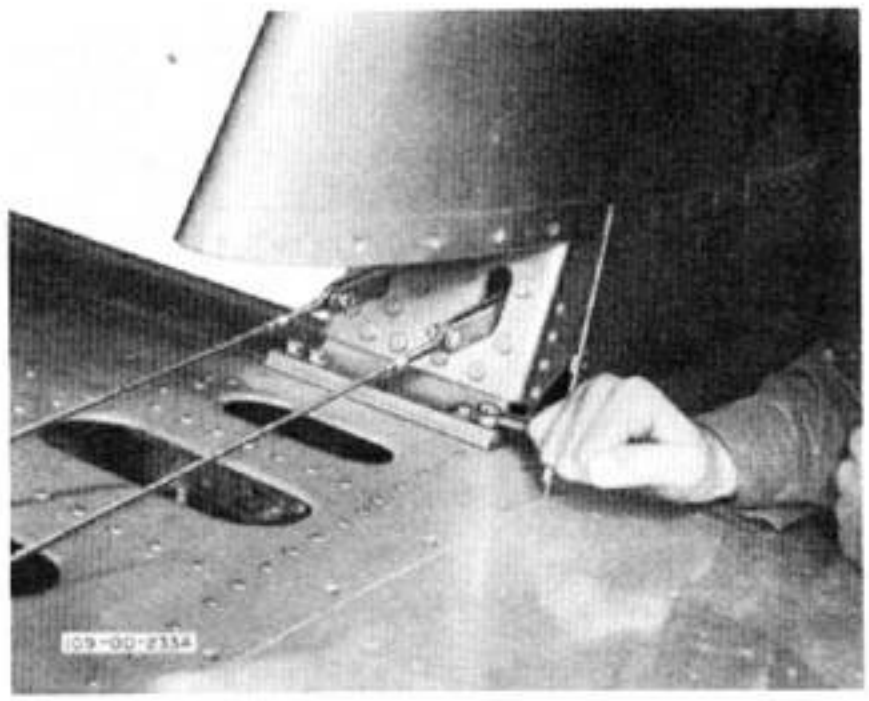


Examine drain holes in elevators, and rudder cap section at bottom of rudder to make sure holes are open.

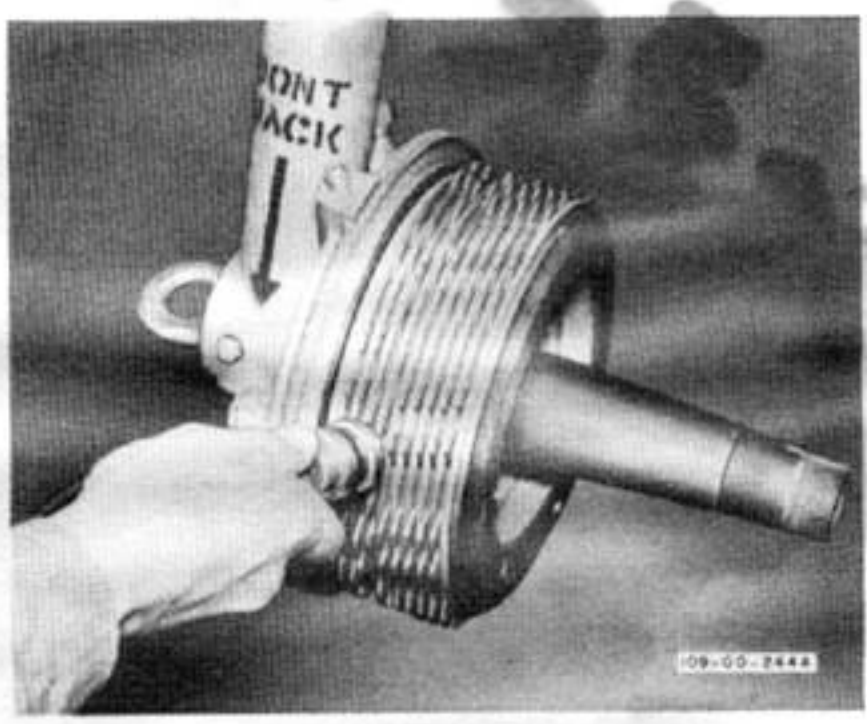
FIXED SURFACES

25-Hour Inspection

Inspect, for general condition and security, the attachment fittings and attachment bolts joining the vertical stabilizer and horizontal stabilizer to fuselage.



Inspect wings, horizontal stabilizer, vertical stabilizer and fairings for cracks, loose rivets, loose screws, corrosion, and general condition.



Examine wing-to-fuselage attachment fittings, and attachment bolts for general condition and security.

50-Hour Inspection

Remove all dzus-fastened inspection doors on wing; then lower wing flaps and landing gear doors, and inspect wing for loose or pulled rivets, distorted, cracked or broken ribs and structural members, security of wing attachment bolts, and cracks in bolting strip or adjacent skin. Remove several bolts and inspect for elongated bolt holes.

Remove all inspection hole covers, access doors, and fairings. Examine the structural members of horizontal stabilizer and vertical stabilizer for cracks, corrosion, or other damage.

Inspect flaps for condition of hinges and absence of binding.

100-Hour Inspection

Remove wing access covers and clean wing interior.

Inspect for loose rivets, distorted, cracked or broken ribs, deterioration and general condition.

When fuel tanks have been removed for 100-hour inspection, examine wing centerline attachment angles, adjacent skin, and attachment bolts within fuel tank compartment for general condition and security.

FUEL TANKS

25-Hour Inspection

Inspect area around fuel tank doors for evidence of fuel leakage.

50-Hour Inspection

Completely drain the self-sealing main fuel tanks and the fuselage auxiliary tank. Refill tanks and compare the quantity of fuel required to fill each tank to level of the filler neck, with the original capacity of the cell as reported on the filler cap. If the capacity of the tank is less than 95 percent of the original capacity, remove the cell and inspect to determine the cause of the reduced capacity.

100-Hour Inspection

Remove the fuel tanks and inspect them thoroughly.

Visually inspect the tanks through fitting openings and access doors, using a safety light and mirror. If no raised or blistered areas, loose seams, or any other apparent defects are noted, the tanks may be returned to service.

300-Hour Inspection

Inspect tanks for evidence of deterioration. Use a round wooden stick of sufficient length to probe the bottom of the tank. If tanks are soft and spongy, remove for more complete inspection. If tanks are solid and springy, they are fit for further service.

Inspect general condition of the fuel tank compartment liner.

TAIL GEAR

25-Hour Inspection

Examine the tail wheel declutching cable for security and general condition. Make sure turnbuckle is properly secured and safetied. Inspect the cable casing and attachments, for general condition, adjustment, and security. Lubricate if necessary.

Inspect tail wheel up-lock cable and tail wheel down-lock cable for security of attachment and general condition. Make sure turnbuckles are properly secured and safetied.

Inspect the two tail wheel steering cables for general condition, adjustment, and security. Make sure the two

retaining springs are secure. Check cables for 60 pounds tension ± 5 pounds.

Examine tail wheel up-lock mechanism for general condition, freedom of movement, and security of attachment.

Examine tail wheel down-lock mechanism and actuating arm for general condition and security.

Lubricate tail wheel down-lock mechanism (instructions on plate), check for freedom of movement, and inspect contacting surfaces for cleanliness.

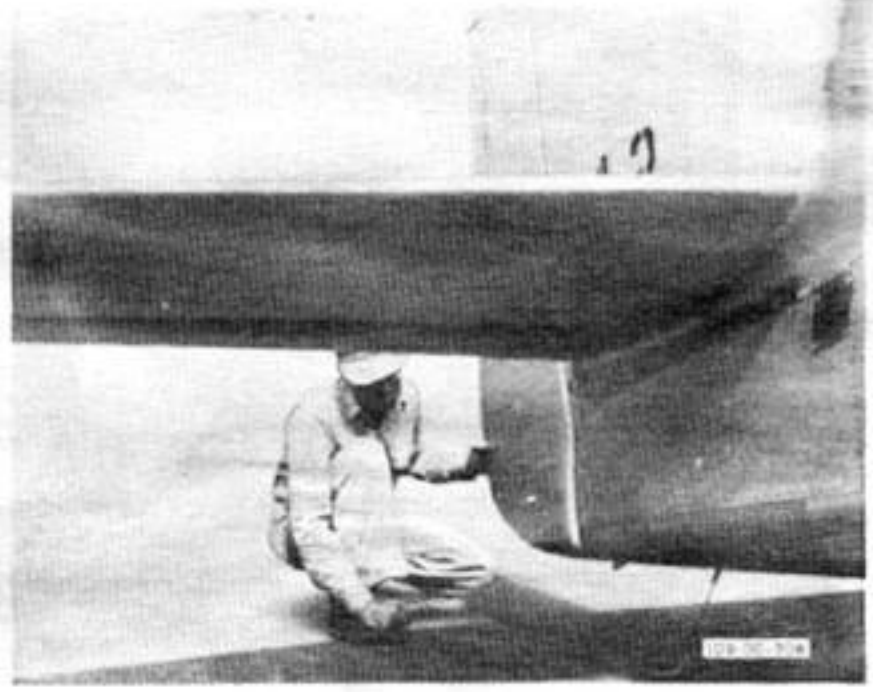
Inspect up-latch roller on tail wheel for free movement and security. Lubricate as necessary.

Examine entire tail wheel unit for general condition and cleanliness.

Lubricate tail wheel unit at the four zerks.

Examine tail wheel unit pivot bolts and attachment fittings for general condition and security.

Check relationship of movement of rudder and tail wheel. With full rudder applied 30 degrees, the tail wheel should be turned 6 degrees. Check movement in both directions.



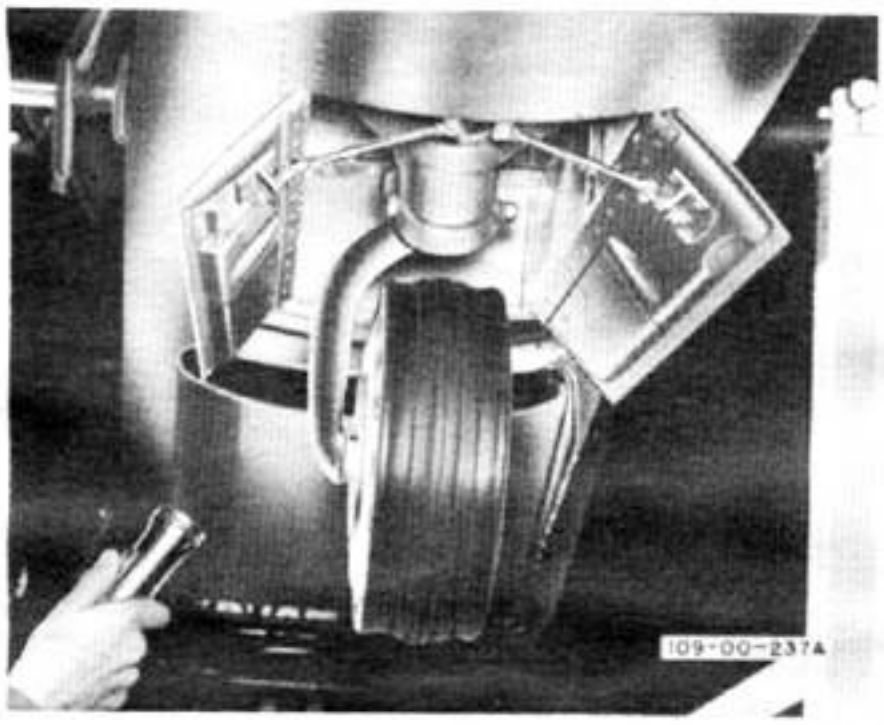
Inspect tail wheel retracting linkage for security of attachment.

Inspect tail wheel doors and operating linkage for general condition and security.

50-Hour Inspection

Check tail gear shock struts for correct fluid level.

With airplane jacked, inspect tail wheel for operation. Make sure up-lock and down-lock operate efficiently and hold tail wheel unit securely. Make any necessary cable length adjustments to assure full and correct movement of the locks.



When tail wheel is in operation, inspect tail wheel doors. Make sure turnbuckles are adjusted so doors close completely, but not too firmly. Doors should open enough to allow tail wheel to clear both doors by at least 3/8 inch when wheel is at the right angle to fuselage and shock strut is deflated. Make sure turnbuckles are secure and safetied.

Inspect the tail wheel locking cable fairleads, pulleys, and attachments from the pedestal to the tail wheel, for general condition and security. Make sure cables are routed correctly.

With airplane in jacked position, declutch tail wheel and inspect for free movement and full-swiveling action.

MAIN LANDING GEAR

25-Hour Inspection

Clean down-lockpins and apply light oil to locking surfaces.

Inspect fairing door lock linkage for general condition.

Check for correct adjustment of linkage and cables, and for proper clearance between torque tube bellcranks, pads, and between safety stop, and inboard bellcrank.

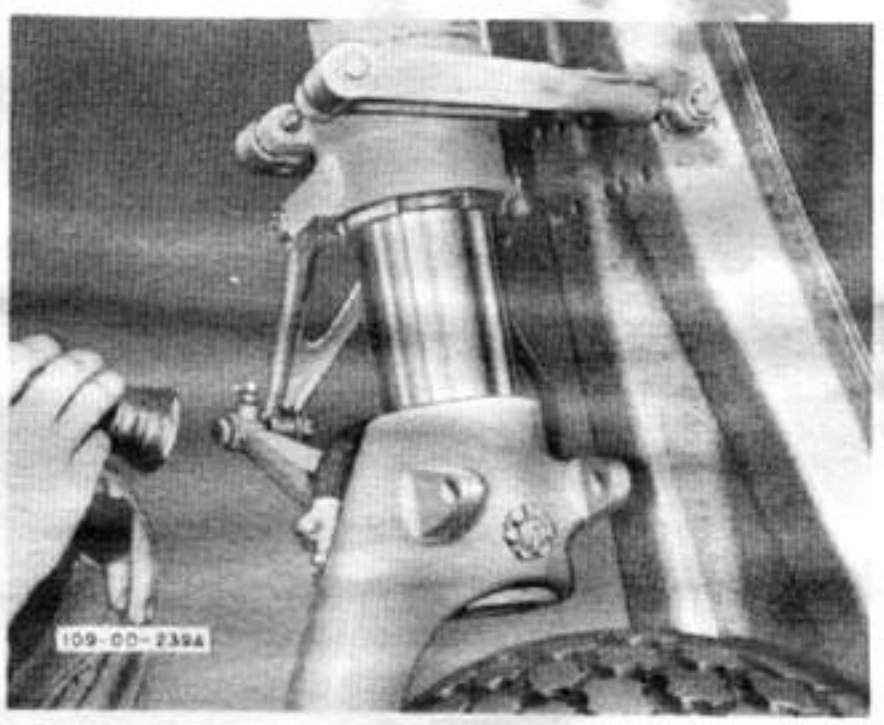
Check door up-latch hooks for proper clearances and overlap in relation to up-latch rollers.

Inspect latch hook links for past dead center position when hooks are extended.

Check main gear up-latches for minimum clearances and linkage adjustment.

Check operation of emergency down release. Inspect timing valve linkage for general condition, security of attachment, and correct adjustment. Make sure locknuts are tight on linkage, and on striker pins.

Lubricate the four zerk fittings on each main landing gear torque link.



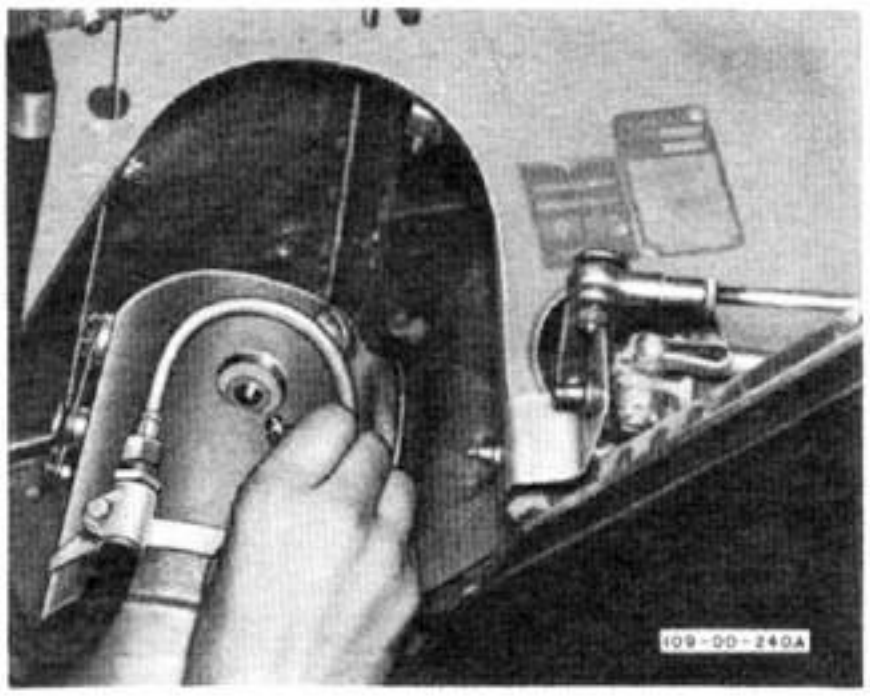
Lubricate each main landing gear pivot shaft at the zerk fitting in the landing gear support casting.

50-Hour Inspection

Jack airplane and check landing gear operation. Make sure that landing gear fairing doors have sufficient clearance when gear retracts, and up-latches engage properly when a 125-pound weight is suspended from outboard edge of doors.

Lubricate landing gear selector control handle at the pedestal.

Check main landing gear shock struts for correct fluid level.



Check main gear down-locks for full and free movement.

Inspect landing gear fairing and fairing doors for proper fit when gear is retracted.

WHEELS AND BRAKES

25-Hour Inspection

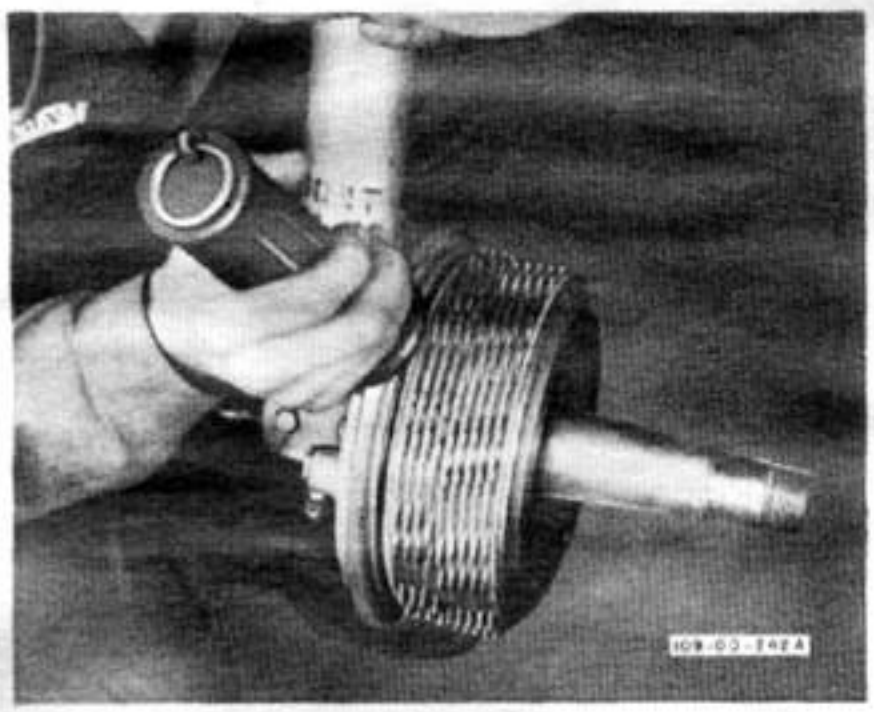
Inspect the brake master cylinders for leaks, and external damage.

Inspect connections of parking brake control linkage, and pedal brake linkage.

Examine entire brake system for leakage.

Make sure that all brake lines are secure and free from chafing, scratches, or cuts.

Inspect brake discs for cleanliness.



Make sure brakes are adjusted to .053 to .056-inch clearance.

Lubricate anchor nut threads with anti-seize compound, Specification No. AN-C-53.

Examine the tires thoroughly, if there are cuts, breaks, blisters, or other damage, remove the casing. Examine tire and tube carefully, and repair or replace in accordance with applicable technical orders.

Make sure wheel and wheel rim are in good condition. If rim is corroded, bent, or otherwise damaged, replace or repair it.

200-Hour Inspection

Remove wheels and inspect condition of bearing cups.

Inspect inboard bearing felt grease retainer. Replace, if grease-soaked.

Remove wheel bearings and wash clean with solvent; then blow out foreign matter with air. Inspect both sides of bearings for lateral and radial roughness.

Lubricate wheel bearings.

Inspect wheels when mounted, for true and free operation.

500-Hour Inspection

Remove wheels and completely disassemble brake units for inspection.

Examine brake discs. Replace all discs that are dished, warped, or worn.

Make sure brake return springs are in good condition.

Inspect brake seals for shrinkage, damage or wear.

Clean brake cylinder and piston; replace if damaged or worn excessively.

HYDRAULIC SYSTEM

25-Hour Inspection

Thoroughly inspect all hydraulic lines and operating units for security of attachment. Examine for leaks, wear, dents, cracks, or damaged nuts.

Investigate excessive leakage of fluid from the operating cylinders or valves. Replace packings, if necessary. Examine the flexible hoses and hose connections used in the engine pump pressure line for kinks or deterioration.

ENGINE CHANGE

Remove hydraulic pump for overhaul at each engine overhaul. This applies even though the pump has been replaced between engine overhauls.

FUSELAGE

25-Hour Inspection

Inspect fuselage for general condition, corrosion, pulled rivets, rupture or distortion indicating failure, or other damage.

50-Hour Inspection

Remove all access doors, coverplates, and fairings. Inspect internal structure of fuselage for cracks, corrosion, or other damage.

Examine the front fuselage to rear fuselage attachment angles, adjacent skin, and attachment bolts for general condition and security.

Inspect the four engine mount fittings in fuselage just aft of firewall for security of attachment.

Examine firewall for general condition. Inspect firewall splice plates and attachment bolts for general condition and security.

Inspect firewall-to-fuselage attachment screws, bolts, and adjacent skin for general condition and security.

OXYGEN EQUIPMENT

25-Hour Inspection

Recharge the oxygen cylinders if necessary. Then paint the lines and fitting connections with soapy water, and examine for leaks.

Inspect all lines for wear caused by chafing. If chafing cannot be prevented, wrap lines at contact points with several layers of friction tape, and apply shellac.

100-Hour Inspection

Check the pressure gage, using standard bourdon tube type gage procedure.

500-Hour Inspection

Replace oxygen regulator and send to depot for overhaul.

NAVIGATION INSTRUMENTS
GYRO INSTRUMENTS

50-Hour Inspection

Remove and clean the vacuum instruments air filter.

Note

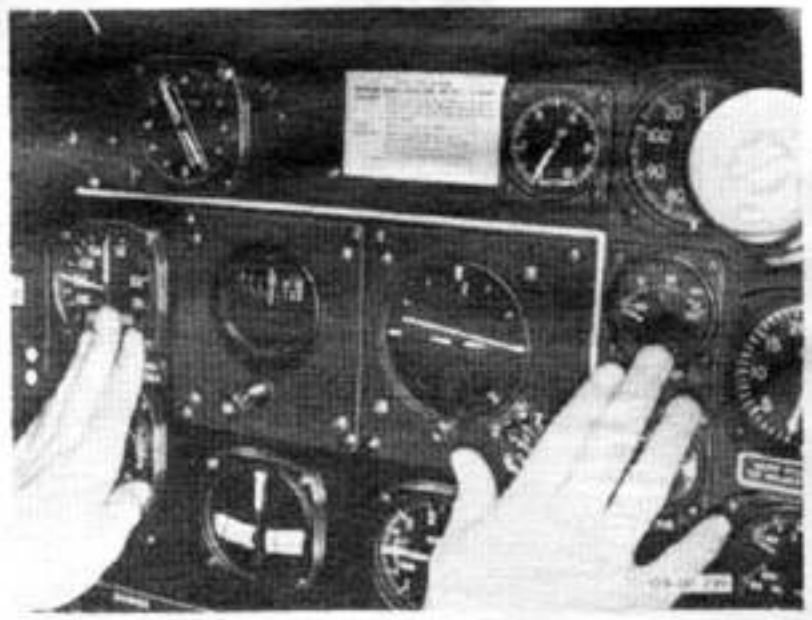
If airplane is operating in extremely dusty locale, the filter will require more frequent cleaning.

OTHER NAVIGATION INSTRUMENTS

50-Hour Inspection

Inspect all instruments and instrument panels for condition and security. Inspect instrument lines and connections (including electrical connections when used) for tightness, condition, bonding, and wear due to vibration or chafing.

Make sure rubber grommets are installed on instrument lines where required and are in good condition. Inspect shock mounting of pilot's instrument panel for general condition, flexibility, and security.



Inspect airspeed indicator operating limit marking. Make sure marking is legible. If necessary, remove the old marking and install decal on coverglass.

100-Hour Inspection

Inspect vacuum pump for security of mounting.

Clean oil separator with a suitable cleaning fluid. After inspecting the restriction holes, replace the fittings and examine for security.

With the compass units properly connected, the inverter on, and the engines running, head the airplane successively Magnetic North, East, South, and West. The indicator units must read the indications noted on the correction card. If they do not, check the applied voltage and frequency, which must be 26 volts, 400 cycles. If the power supply is functioning properly, recompensate the compass.

300-Hour Inspection

Connect a suction gage to the suction relief valve. With the engine operating at 1600 rpm, adjust the valve to indicate 4.2 in. Hg.

Disassemble the vacuum relief valve and clean it with gasoline. Inspect valve seats and spring tension, and replace excessively worn parts.

BATTERIES

Weekly Inspection

Take hydrometer readings of batteries. If any cell is too high or too low, turn battery in for check. After reading, return electrolyte to cell from which it was drawn. Add drinking water as necessary. Inspect the battery leads for frayed insulation and general condition.

CAUTION

Do not spill electrolyte from hydrometer when taking battery readings. Ascertain proper level with a self-leveling syringe. Should any electrolyte be accidentally spilled, wipe it away immediately, and wash the area with a sodium bicarbonate solution.

Whenever the battery is removed, clean the casing of all corrosion. If necessary, recoat casing with acidproof lacquer, US Specification No. 3-168.

When the airplane is to remain idle for more than one week, the battery should be removed and stored.

Remove any dirt or corrosion from terminals with a solution of baking soda (bicarbonate of soda) or diluted ammonia.