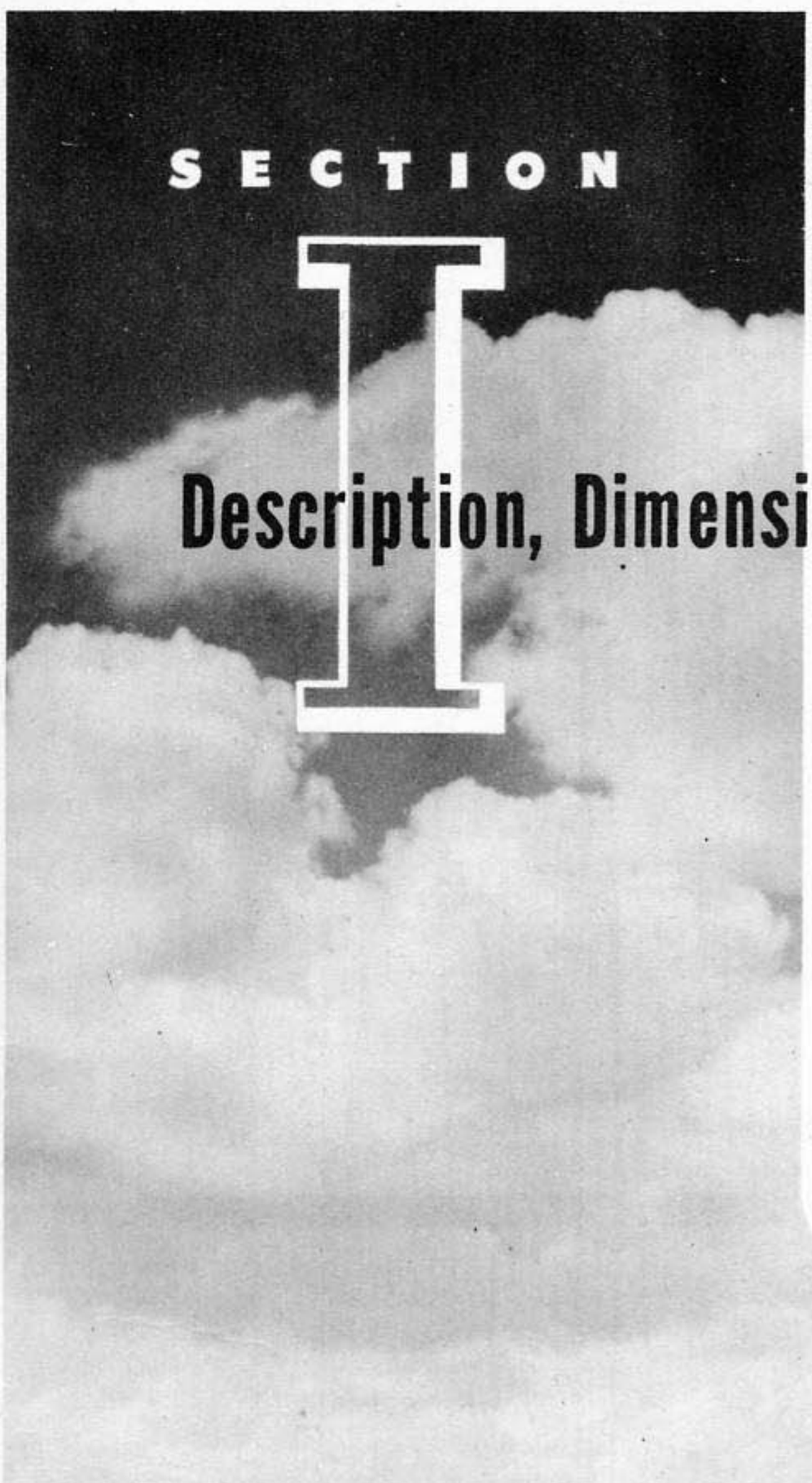
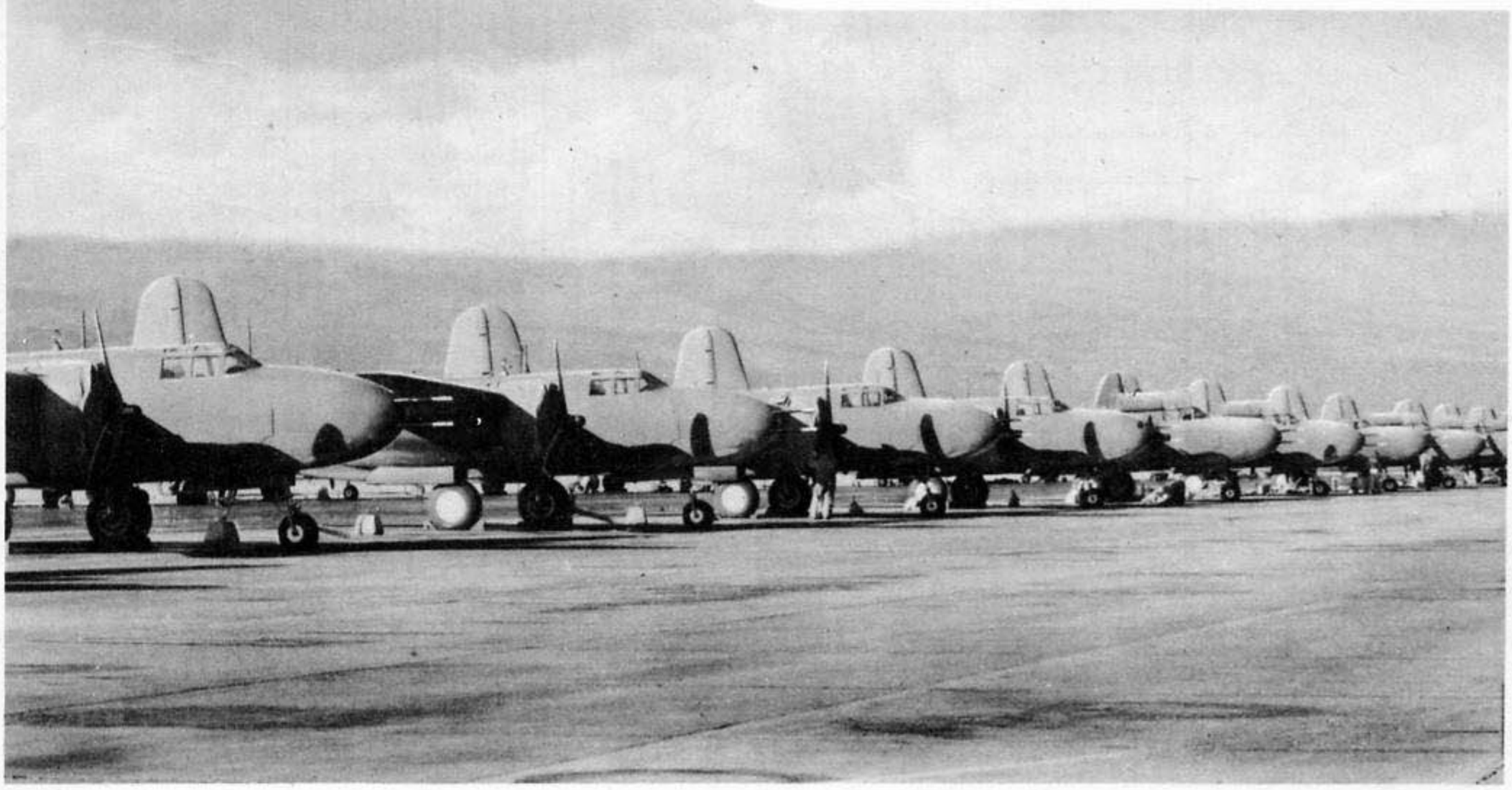


Description, Dimensions and Leading Particulars

1. DESCRIPTION.

a. The Douglas model A-20G attack bomber is a twin-engined, all-metal, midwing monoplane, incorporating a tricycle landing gear. The airplane has an over-all span of 61 feet 4 inches, an over-all length of 47 feet 4 inches, and an over-all height at rest of 18 feet 1 inch. It is designed as an attack bomber, and provisions are made for a crew of three: pilot, upper rear gunner, and lower rear gunner.



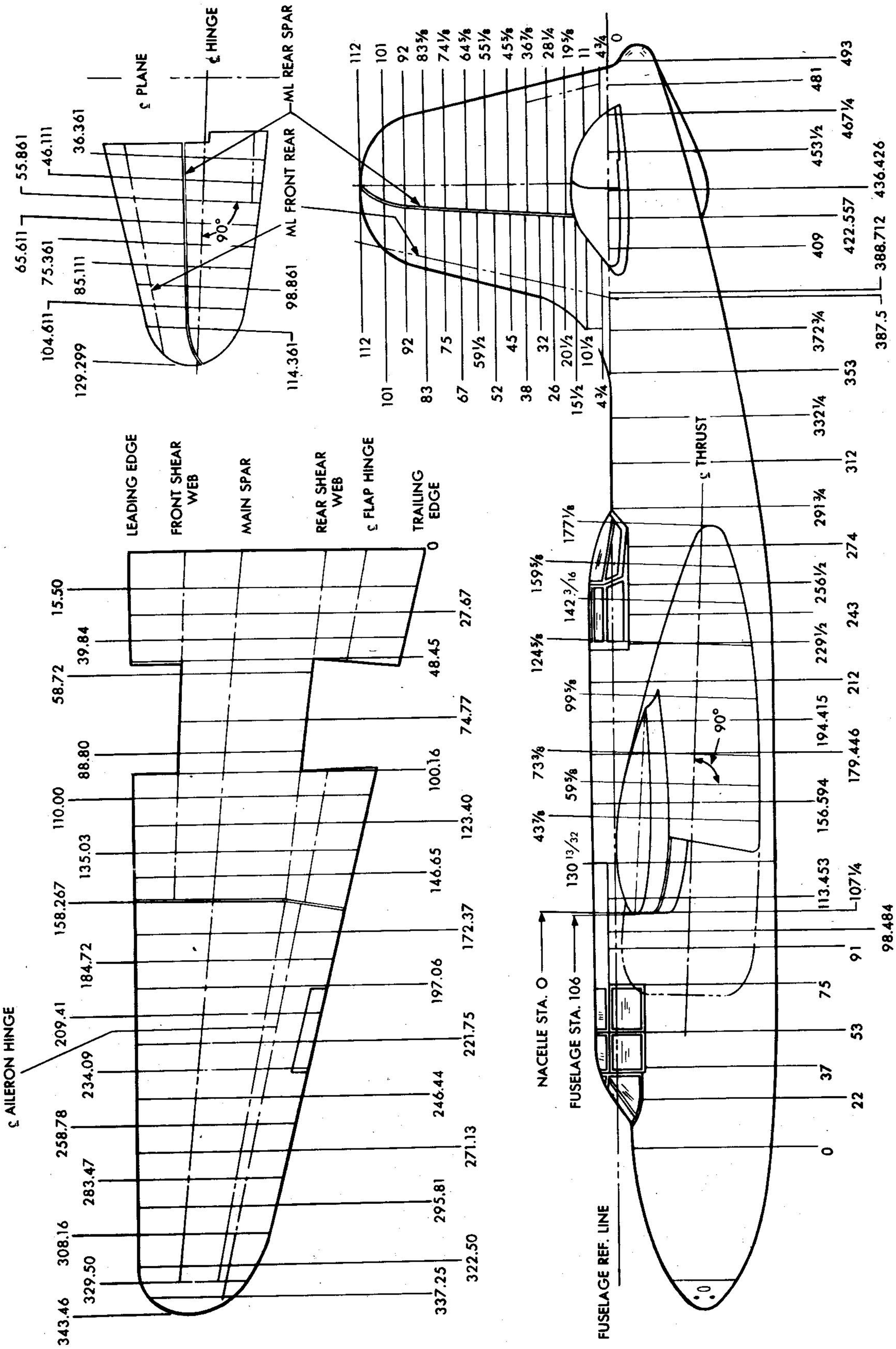


Figure 7 - STATION DIAGRAM

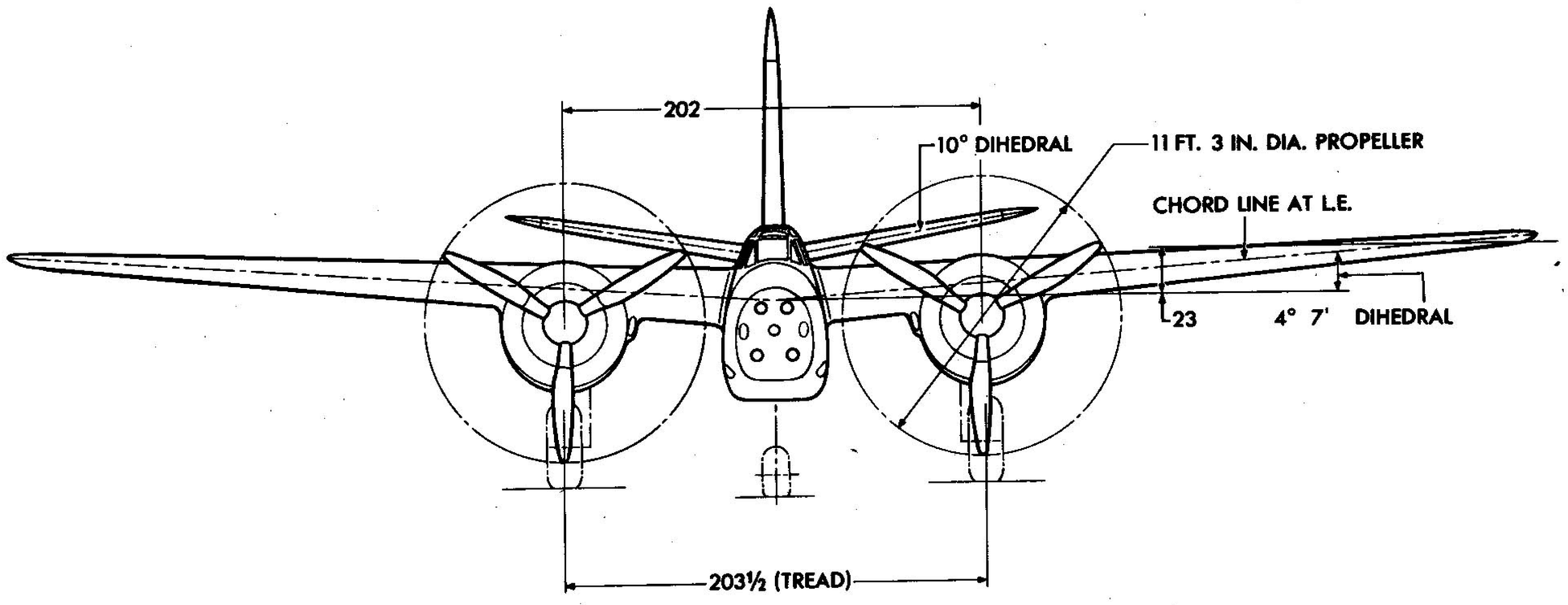


Figure 8 - FRONT VIEW, SHOWING PRINCIPAL DIMENSIONS

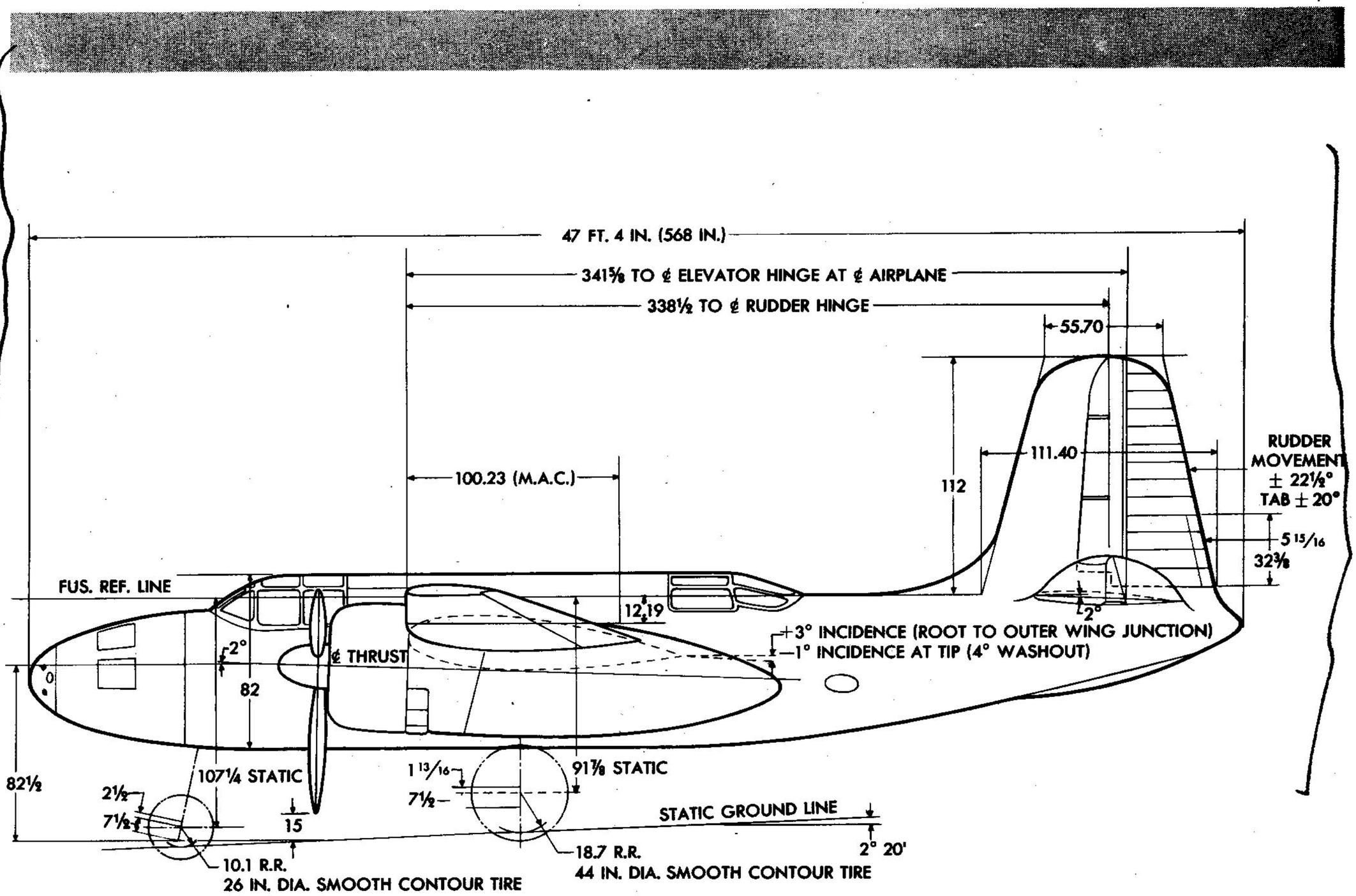


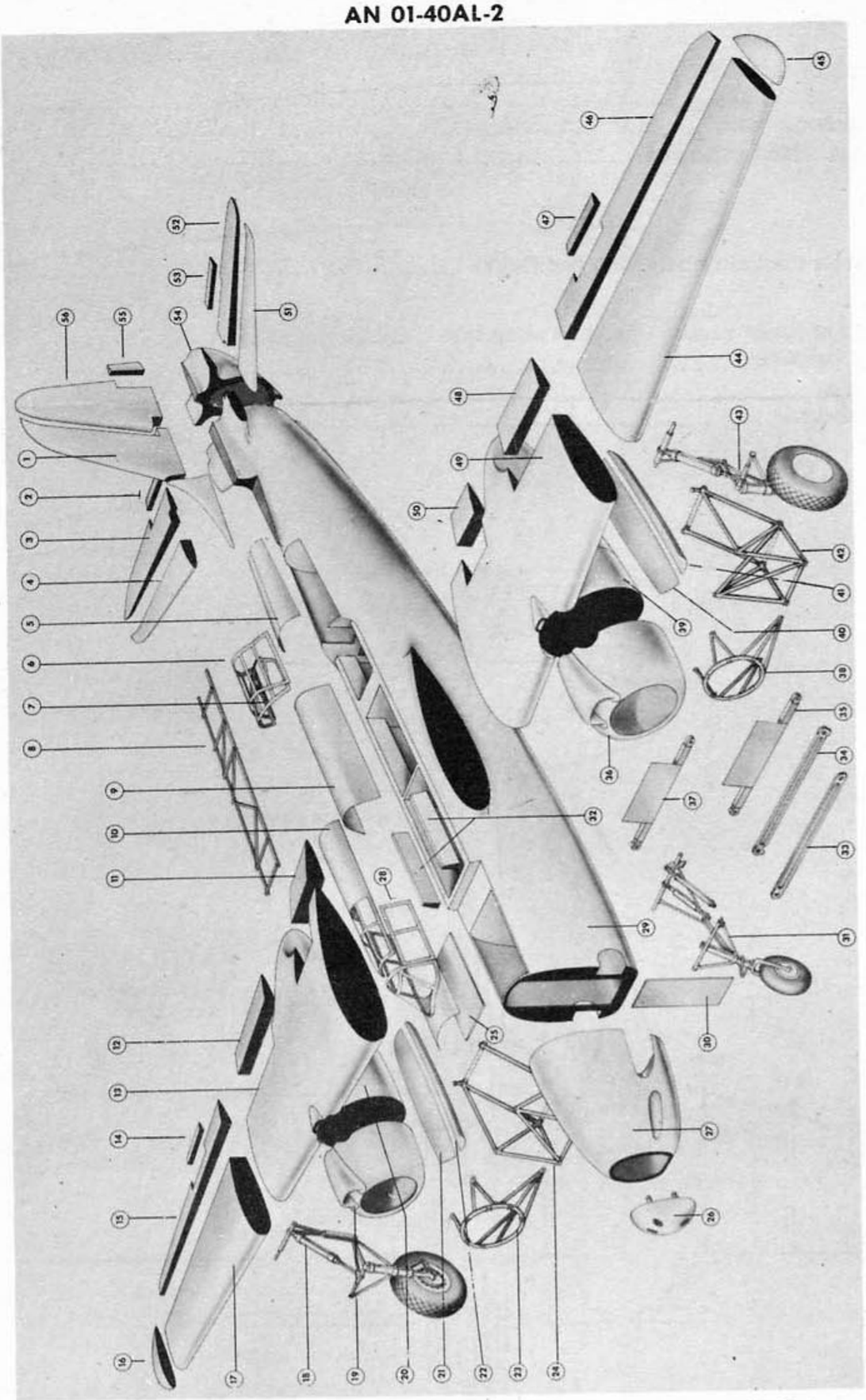
Figure 9 - SIDE VIEW, SHOWING PRINCIPAL DIMENSIONS

Vertical stabilizer (fin)	
Span	9 ft 4 in.
Chord (maximum)	9 ft 3 in.
Incidence (fixed setting)	0^{o}

b. AREAS.

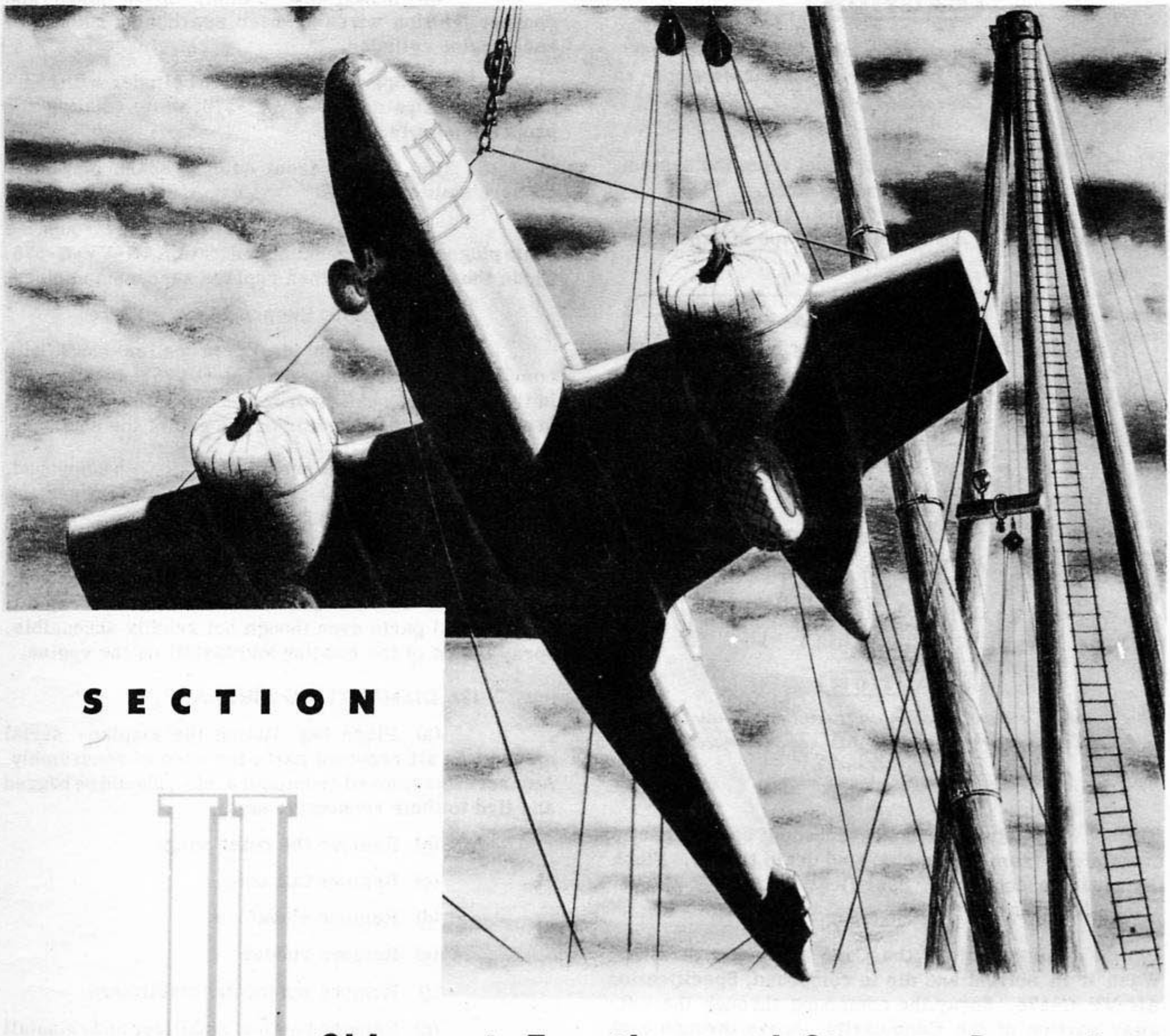
Wing	
Total area (including ailerons and flaps)	464.8 sq ft
Ailerons	
Area aft of hinge center line (including tab)	16.49 sq ft
Area of balance	4.57 sq ft
Total area	42.1 sq ft
Trim tab area	1.32 sq ft

Figure 10 - PLAN VIEW, SHOWING PRINCIPAL DIMENSIONS



ITEM NO.	PART NUMBER	ASSEMBLY NAME (1 OF EACH REQUIRED)	NO. REQ.
1.	5090812	STABILIZER, VERTICAL	
2.	5062450-1	TAB, ELEVATOR—R.H.	
3.	5062449-1	ELEVATOR, COVERED—R.H.	
4.	5090810	STABILIZER, HORIZONTAL—R.H.	
5.	5167341-18	DOOR, UPPER FLEXIBLE GUN—L.H.	
	5167341-19	DOOR, UPPER FLEXIBLE GUN—R.H.	
6.	5176988	EN-TOSURE, REAR COCKPIT FIXED	
7.	5069790	ENCLOSURE, GUNNER'S SLIDING	
8.	5065826	TRUSS, FUSELAGE STA. 25 TO 229½	
9.	5090913	ENCLOSURE, BOMB BAY (AIRPLANES AF 42-53535 THROUGH AF 42-54144)	
	5090913-500	ENCLOSURE, BOMB BAY (AIRPLANES AF 42-54145 AND UP)	
10.	5069761	DOOR, PILOT'S ENCLOSURE	
11.	5062435-1	FLAP, INBOARD LANDING—R.H.	
12.	5062434	FLAP, OUTBOARD LANDING—R.H.	
13.	5090807-1	WING, COMPLETE INNER—R.H. (AIRPLANES AF 42-53535 THROUGH AF 42-53784)	
	5090807-517	WING, COMPLETE INNER—R.H. (AIRPLANES AF 42-53785 THROUGH AF 42-54144)	
	5090807-519	WING, COMPLETE INNER—R.H. (AIRPLANES AF 42-54145 AND UP)	
14.	5064718-1	TAB, AILERON—R.H.	
15.	5062415-1	AILERON—R.H.	
16.	5090805-1	PANEL, WING TIP—R.H.	
17.	5090802-503	WING, COMPLETE OUTER—R.H.	
18.	5062497-508	GEAR, MAIN LANDING—R.H.	
19.	4068443-1	RING, ANTIDRAG—R.H.	
20.	5090849-501	NACELLE—R.H.	
21.	5068149-1	DOOR, NACELLE OUTBOARD—R.H.	
22.	5068148-1	DOOR, NACELLE INBOARD—R.H.	
23.	5065394-500	MOUNT, ENGINE—R.H.	
24.	5065334-1	FRAME, LANDING GEAR SUPPORT—R.H.	
25.	5169243	FLOOR, PILOT'S CENTER	
26.	5167582	CAP, REMOVABLE NOSE	
27.	5167278	NOSE, ATTACK	
28.	5173152	ENCLOSURE, PILOT'S	
29.	5090815	STRUCTURE, FUSELAGE	
30.	5097678	PANEL, CENTER—STATION 0	
31.	5062431-502	GEAR, NOSE WHEEL	
32.	5068009	PANEL—STATION 75 TO 130	
33.	5065871	FRAME, LOWER CROSS TIE FUSELAGE MAIN	
34.	5065869	FRAME, UPPER CROSS TIE FUSELAGE MAIN	
35.	5065430	TIE, FUSELAGE CROSS—STA. 108½	
36.	4168443	RING, ANTIDRAG—L.H.	
37.	5065331	TIE, FUSELAGE CROSS—STA. 193.125	
38.	5065394	MOUNT, ENGINE—L.H.	
39.	5090849-500	NACELLE—L.H.	
40.	5068148	DOOR, NACELLE INBOARD—L.H.	
41.	5068149	DOOR, NACELLE OUTBOARD—L.H.	
42.	5065334	FRAME, LANDING GEAR SUPPORT—L.H.	
43.	5062497-508	GEAR, MAIN LANDING—L.H.	
44.	5090802-502	WING, COMPLETE OUTER—L.H.	
45.	5090805	PANEL, WING TIP—L.H.	
46.	5062415	AILERON—L.H.	
47.	5064718	TAB, AILERON—L.H.	
48.	5062434	FLAP, OUTBOARD LANDING—L.H.	
49.	5090807	WING, COMPLETE INNER—L.H. (AIRPLANES AF 42-53535 THROUGH AF 42-53784)	
	5090807-516	WING, COMPLETE INNER—L.H. (AIRPLANES AF 42-53785 THROUGH AF 42-54144)	
	5090807-518	WING, COMPLETE INNER—L.H. (AIRPLANES AF 42-54145 AND UP)	
50.	5062435	FLAP, INBOARD LANDING—L.H.	
51.	5090810	STABILIZER, HORIZONTAL—L.H.	
52.	5062449	ELEVATOR, COVERED—L.H.	
53.	5062450	TAB, ELEVATOR—L.H.	
54.	5090822-500	CONE, FUSELAGE TAIL	
55.	5114526	TAB, RUDDER	
56.	5062452	RUDDER, COVERED	

Figure 11 - EXPLODED VIEW OF MAJOR ASSEMBLIES



SECTION III

Shipment, Erection, and Storage Procedure

1. SHIPMENT OF AIRPLANE.

a. FERRYING. - The A-20G attack bomber can be equipped with auxiliary fuel containers providing sufficient range to be flown to destination.

b. PREPARATION FOR SHIPMENT.

(1) ENGINES AND PROPELLERS.

(a) Clean exterior of the engines and accessories with an approved solvent, and dry with an air blast.

(b) Drain leaded fuel from all fuel containers, then connect a fuel container, free of leaded fuel, directly to the carburetors. Run the engines at least 15 minutes at 1000 rpm on an unleaded fuel such as 73 octane, Specification AN-VV-F-761 (clear), to prevent corrosion. In a tropical zone or near tidewater, operate the engine on the unleaded fuel within 12 hours after any previous run on leaded fuel. Before stopping the engine, make sure that cylinder head temperatures have cooled. Stop the engine by moving the mixture control into the IDLE CUT-OFF position and then turn the ignition switch OFF.

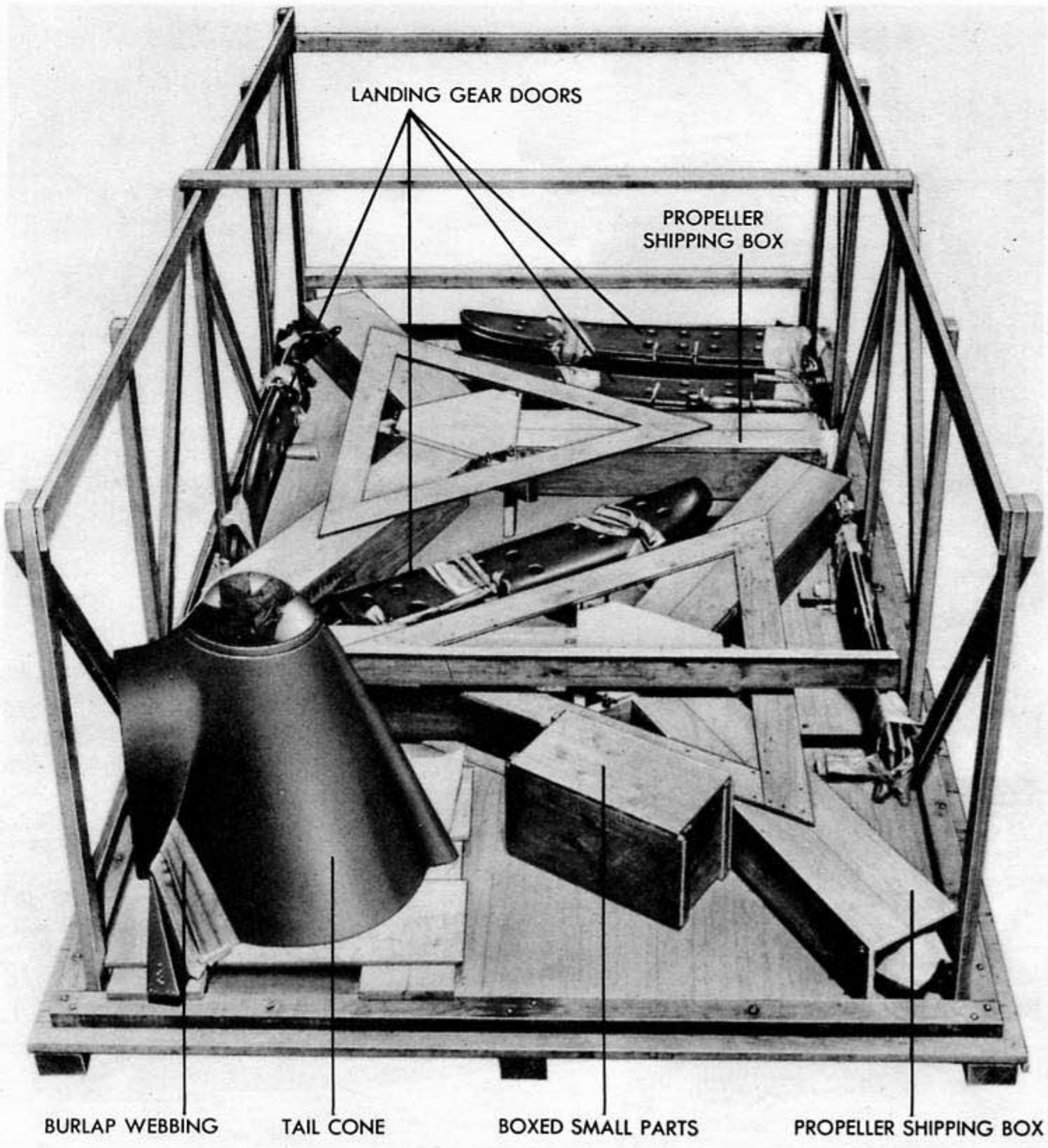


Figure 12 - WING BOX CRATING - FIRST LAYER

(3) PREPARING AND PACKING WINGS AND OTHER REMOVED PARTS.

(a) To save time, pack the wing box as it is constructed. When finished it should contain wings, propellers, horizontal stabilizers, vertical stabilizer, elevators, rudder, tail cone, actuating arms of landing gear doors, main landing gear nacelle doors, nose landing gear doors, spark plugs, radio antennas, bead sight, and one set of self-sealing fuel lines (fuel lines lashed to boards to prevent bending). Before packing, clean these parts with naphtha and spray all bare metal surfaces with Paralketone, Specification AN-VV-C-576. Coat all surfaces of the propeller with compound, Specification AN-VV-C-576. Seal propeller hub and dome openings with oilcloth and waxed paper. Then pack the propeller in a propeller-shipping box. (See figure 12.) Coat each spark plug contact with compound, Specification AN-VV-C-576. Install brass threaded protector cap, wrap each individual plug in waxed paper, and pack in a cardboard container marked with the engine serial number and number of the airplane.

(b) Construct and pack the wing box as follows:

1. Nail 2- by 8-inch flooring to three 6- by 6-inch skids.

2. Build an inner crate of 2- by 4-inch studding and bracing.

3. Pack all large parts except tail cone in the horizontal position. Securely attach the tail cone to the bottom of the wing box as follows: Cut 1- by 6-inch wooden blocks to the inside contour of the base

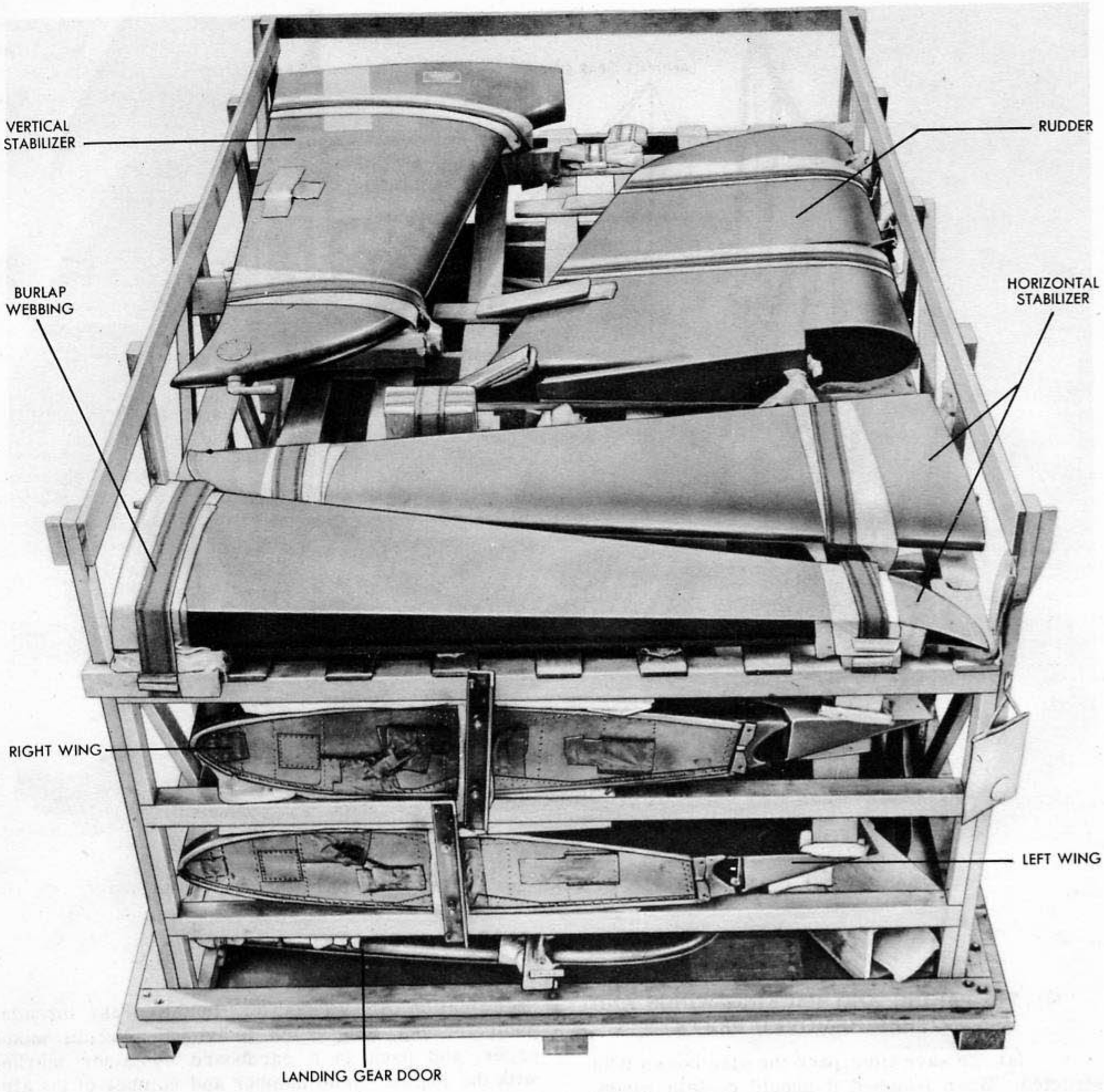


Figure 13 - WING BOX CRATING-TOP VIEW

of the tail cone. Bolt the blocks to the bottom of the wing box and attach the tail cone to the blocks with screws protected with fiber washers. Secure the tail cone to the bottom of the case with burlap webbing. (See figure 12.) Do not brace the tail cone against the side or end of the wing box. Pack the parts in layers: propellers, landing gear doors, spark plugs, etc., in the first layer; right wing in the second layer; left wing in the third layer; etc. (See figure 13.)

4. Complete the sides and ends of the box with 2- by 4-inch frames lined with waterproof paper (370 square feet required) and with 1- by 6-inch sheathing on the outside.

5. Construct the top of 2- by 4-inch frame with two layers of 1- by 6-inch laid at a 90-degree angle to each other with 55-pound roofing paper between the first and second layers of the sheathing. Cement all seams of the roofing paper.

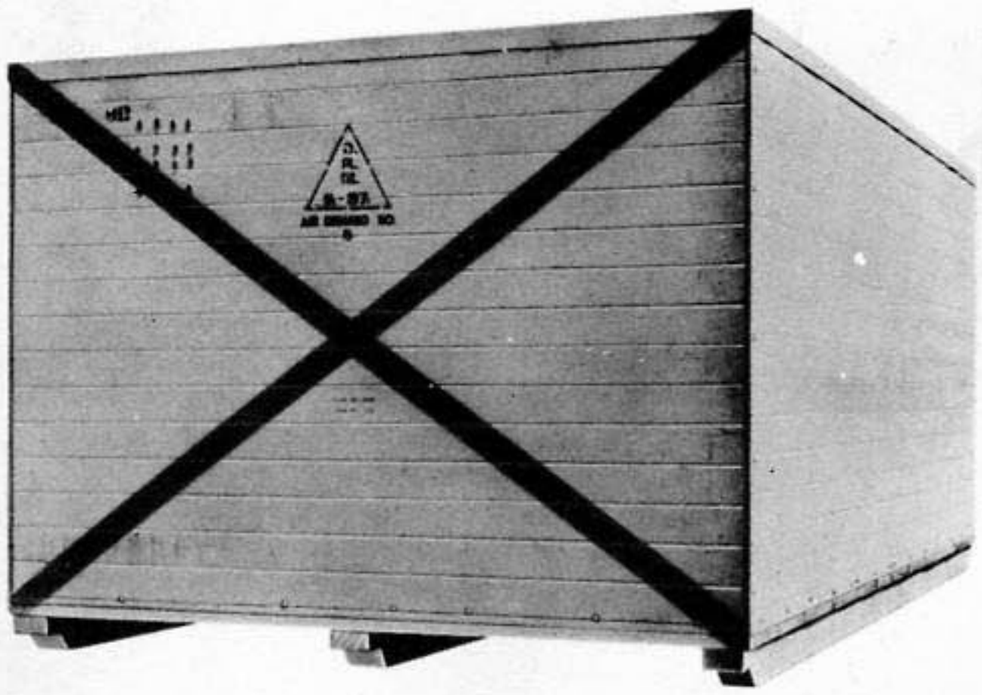


Figure 14 - WING BOX

6. Bolt together the sides, ends, and top of the box.

7. Cut a 16- by 22-inch hinged door for ventilation in one end of the box. Before the door is installed, place a heavy-mesh galvanized screen over the door opening. Close the door with a 4 1/2-inch safety-type hasp.

8. To prevent slipping of the hoisting slings, notch the outside box skids to a depth of 1 1/2-inch near the corners.

9. Paint and label the box.

(4) PREPARING FUSELAGE.

(a) Remove the nose guns.

(b) Clean fuselage with naphtha and touch up with paint where necessary.

(c) Secure all loose cables and controls to prevent movement.

(d) Pack within the fuselage all loose items such as tool kits, engine cover plates, and spare assembly parts.

(e) Coat the exterior of each engine cowling with compound, Specification AN-VV-C-576, and cover with oilcloth aft to the leading edge of the wing, and tape in place. Then install a waterproof engine cover. Lace the cover at the bottom, coat the lacing with RB cement, or equivalent, and then cover it with waterproof adhesive tape. Tape the rear of the engine cover to protect from moisture.

(f) Cover the openings of the engine exhaust tail pipes with waterproof plywood, then with oilcloth tied in place. Tape over the openings in the nacelle fairing and the tail pipes.

(g) Remove the main landing gear and the nose wheel nacelle doors, and wire waterproof plywood covers in place.

(h) Leave batteries in the airplane and clean the batteries. Check each battery for water content and fill if necessary. Disconnect and clean both battery cables. Tie battery cables clear of the battery to prevent contact with terminals. Clean each battery post, and coat with compound, Specification AN-VV-C-576. Be sure that battery plugs and vents are unobstructed to allow escape of gases from the battery container.

(i) Clean wheel assemblies and touch up with paint where necessary. Spray with two heavy coats of compound, Specification AN-VV-C-576. Apply compound, Specification AN-VV-C-576, to the interior surface. Use masking tape to keep the compound away from the brake disk assemblies on the wheel. Clean tires with naphtha after spraying the wheels.

(j) Seal with shipping tape all exterior openings on the fuselage and inner wings.

(k) Cover the outboard ends of the inner wings with waxed paper, then with oilcloth. Seal edges of the oilcloth to the outer surface of the wing with shipping tape. Paint the oilcloth an olive-drab color.

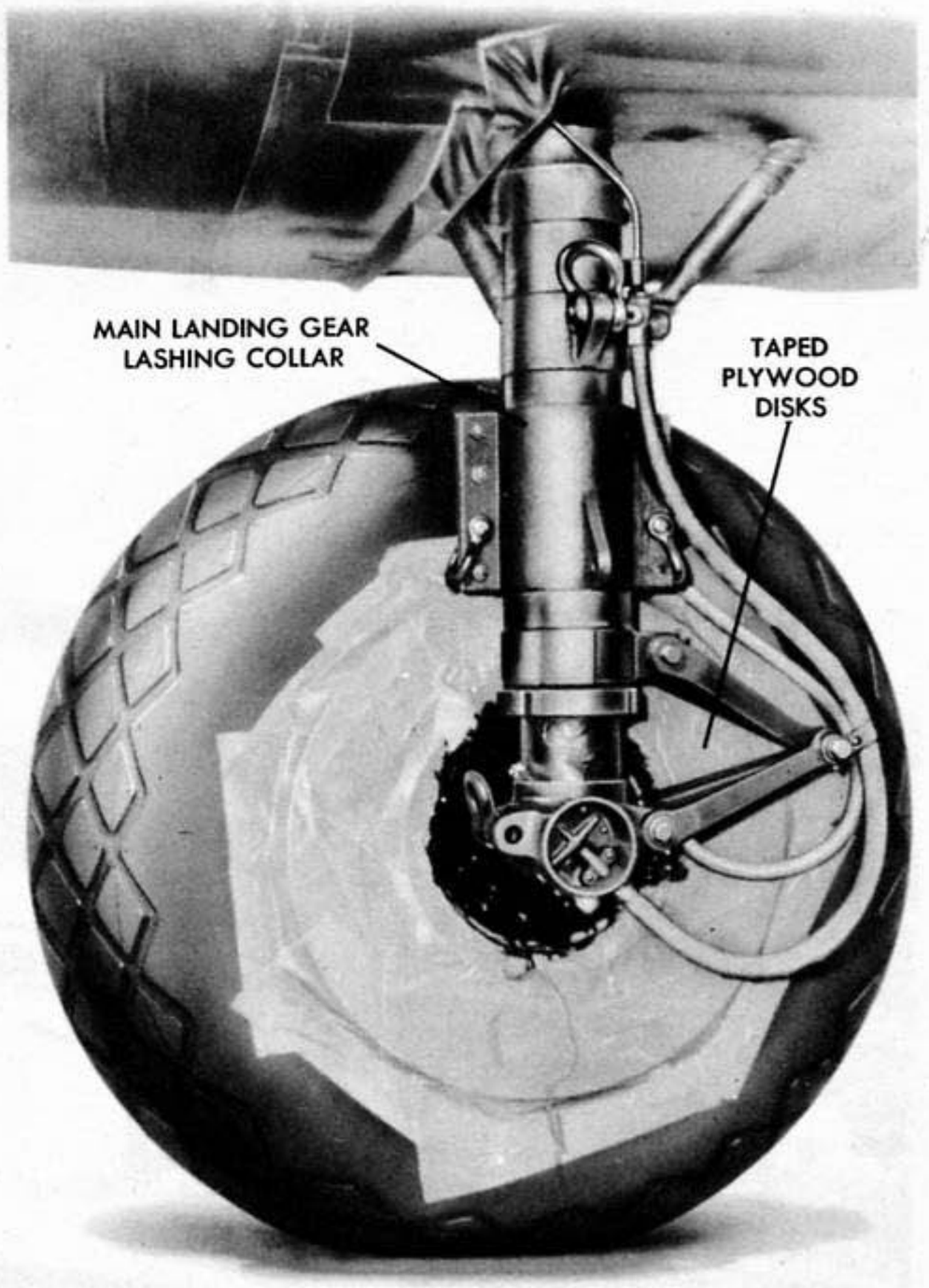


Figure 15 - PLYWOOD DISKS INSTALLED ON WHEEL

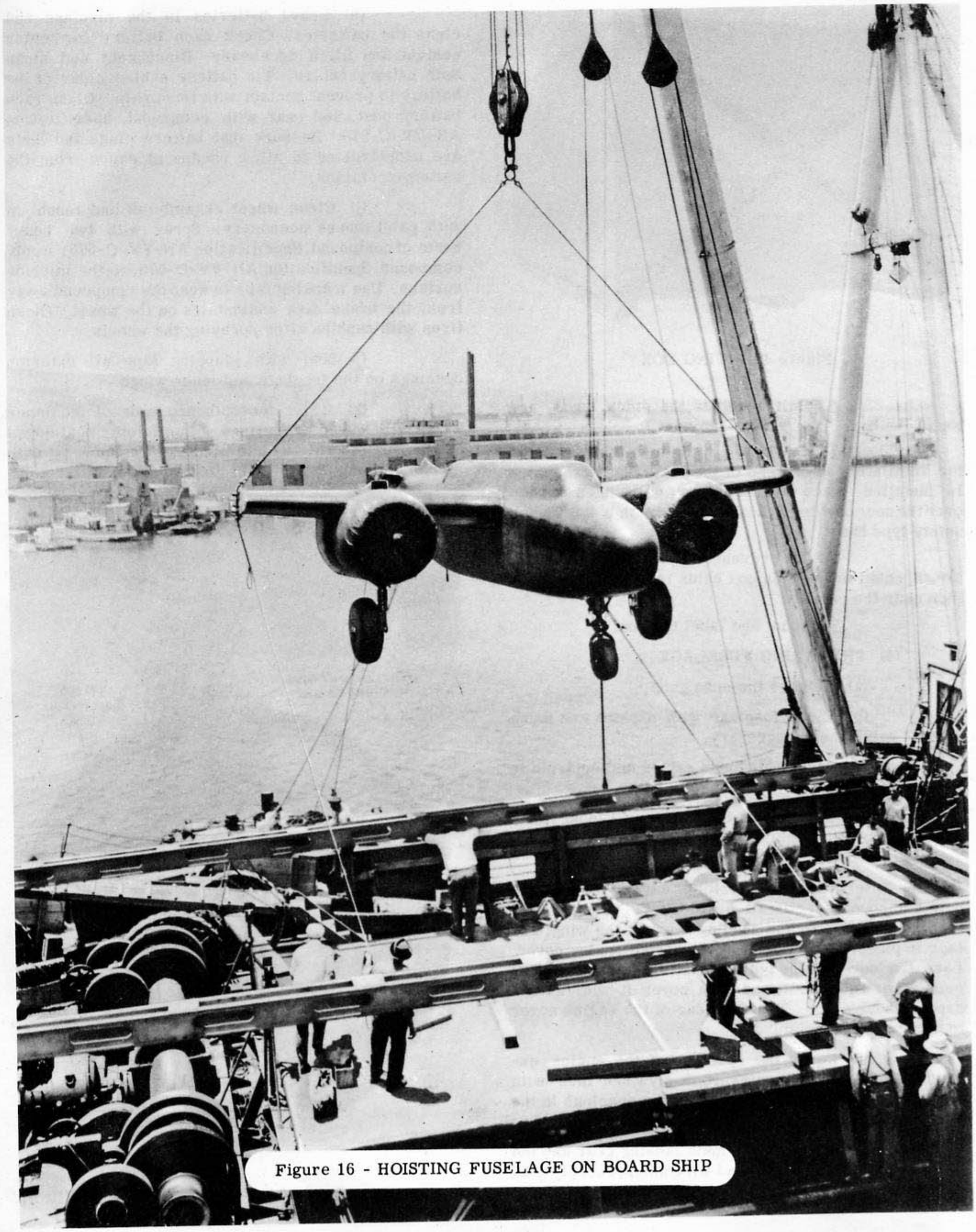


Figure 16 - HOISTING FUSELAGE ON BOARD SHIP

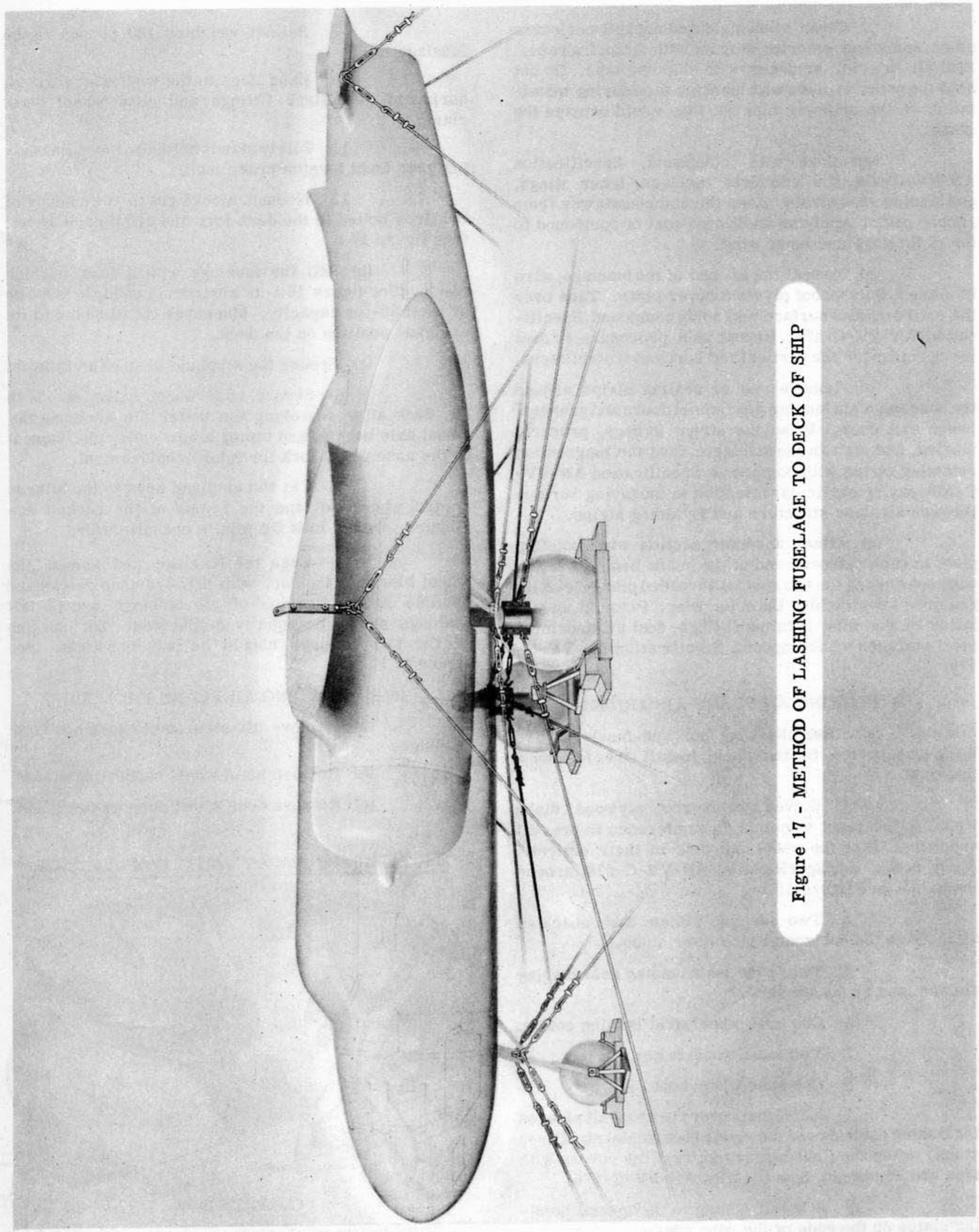


Figure 17 - METHOD OF LASHING FUSELAGE TO DECK OF SHIP

SECTION

III

Handling and General Maintenance Instructions

1. ACCESS AND INSPECTION PROVISIONS.

a. Easily removed inspection plates are located on the fuselage, empennage, wings, and nacelles. This permits access to parts needing periodic inspection, adjustment, or servicing. (See figures 18 and 19.)

2. GROUND HANDLING.

a. HOISTING AND JACKING. - Location of hoisting and jacking points is given in figure 20. Allowable applied loads and angularities of attachment are indicated in the same figure. Typical tools and supports are shown in figures 23 and 24.

b. LEVELING. - The airplane may be transversely and longitudinally leveled by placing a spirit level on the three level lugs under pilot's walkway. A convenient means of adjusting the level of the airplane is to inflate and deflate landing gear shock strut. Do not press valve to deflate. Back out the valve body enough to allow air to escape. See figure 21 for location of valves.

c. TRICING ARRANGEMENTS. - Methods of hoisting the assembled ship are indicated in the table, figure 20. The same arrangement applies when the airplane is partially disassembled.

A FIXED GUN INSPECTION DOOR
B ALTERNATE GUN FAIRING
C FUEL VALVE CONTROLS ACCESS
D DECK ACCESS
E HANDGRIP AND STEP DOORS
F VERTICAL STAB. ATTACH. ACCESS
G PITOT LINE AND WIRING ACCESS
H HINGE MOUNT ACCESS
J HORIZONTAL STAB. ATTACH. ACCESS
K ELEVATOR TAB CONTROL ACCESS
L TORQUE TUBE ATTACH. ACCESS
M HINGE MOUNT ACCESS
N RUDDER TAB CONTROL ACCESS
O RUDDER TAB ACTUATING ARM FAIRING
P RUDDER TAB ACTUATING ARM FAIRING
Q 20MM CANNON ACCESS
R .50 CAL. ACCESS
S NOSE HAND HOLE DOOR

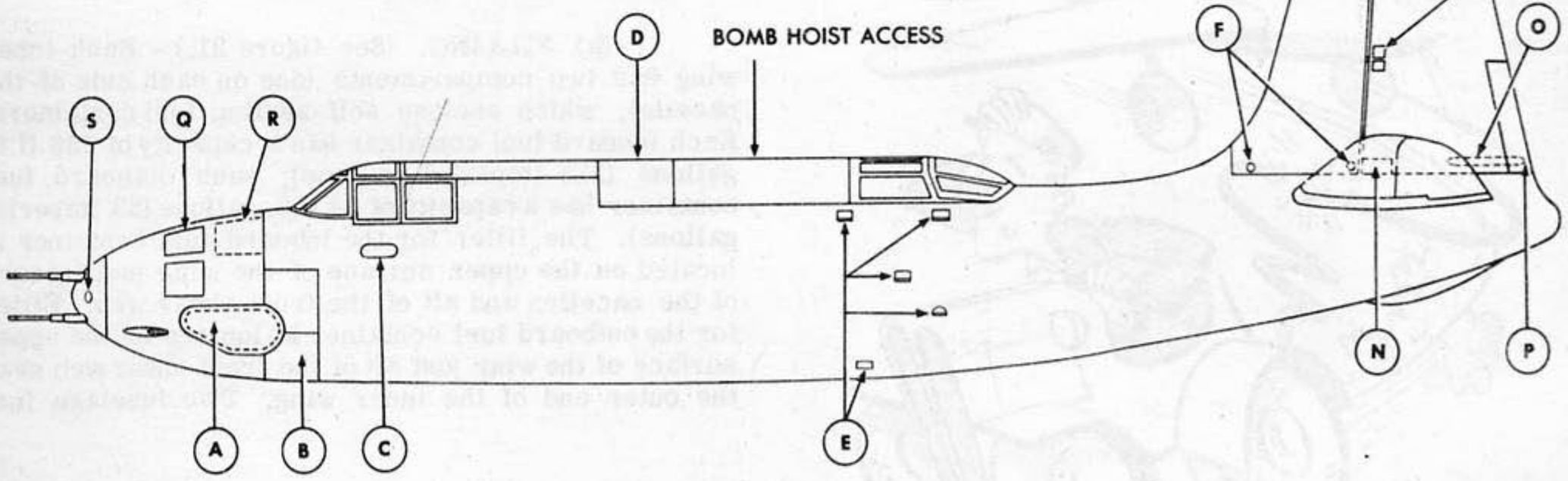


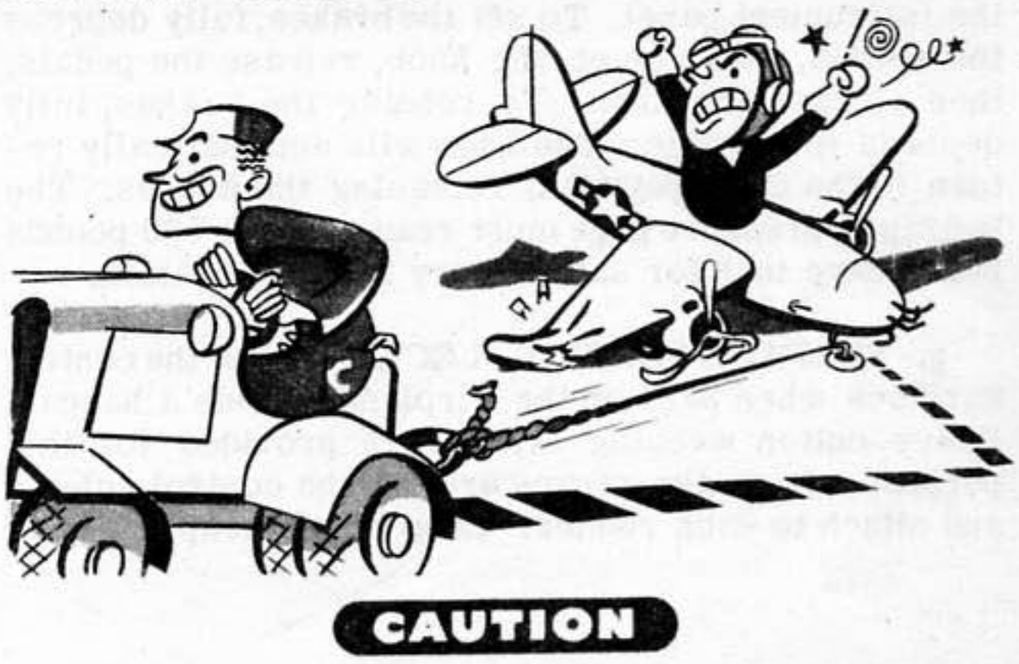
Figure 18 - FUSELAGE AND EMPENNAGE ACCESS DOORS

d. TIE-DOWN - PARKING INSTRUCTIONS

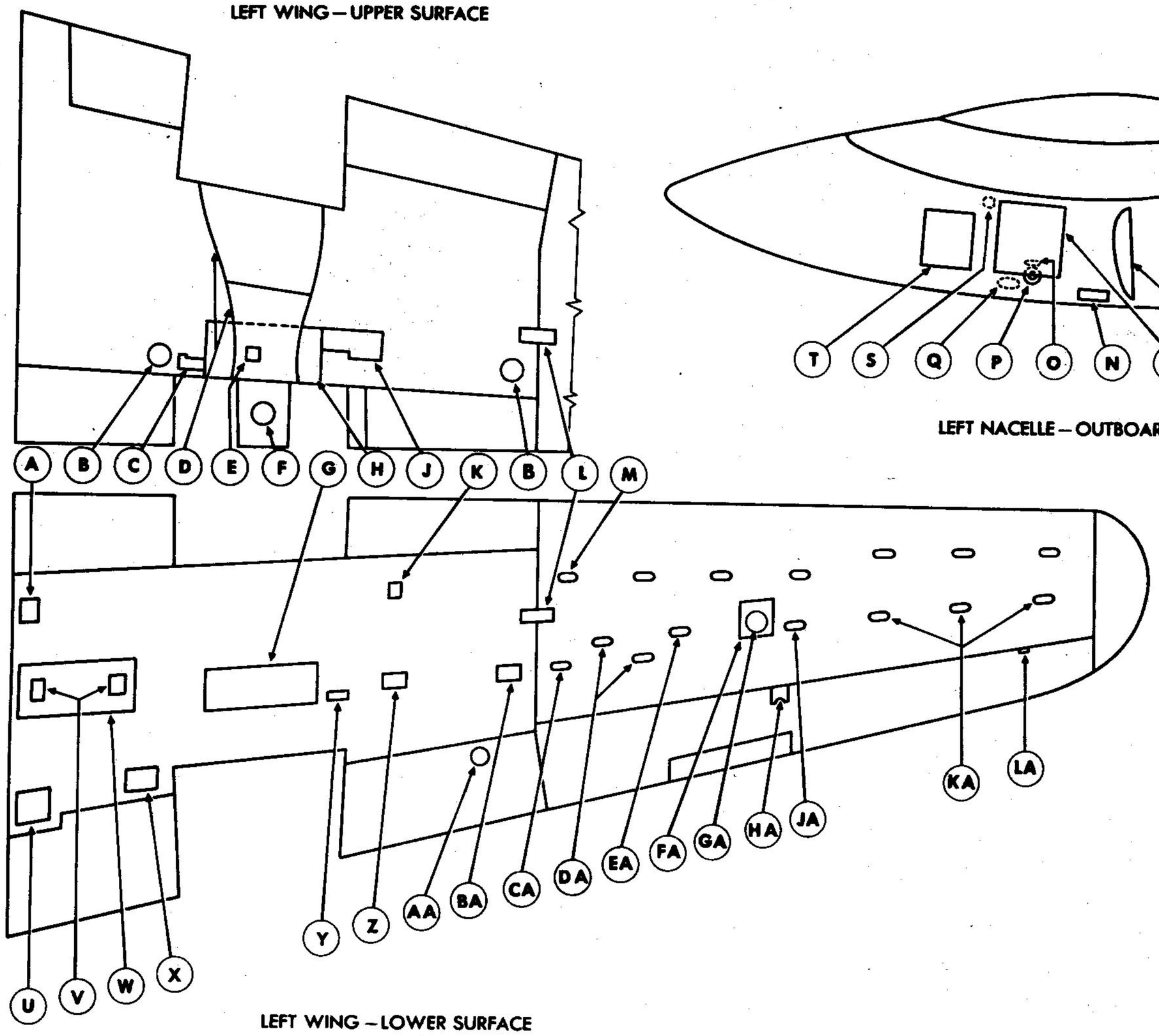
(1) The eyes at the lower end of the main landing gear shock struts are used for towing as well as tie-down rings. A retractable tie-down ring is located midway of each outer wing, adjacent to the main spar Landing gear rings are used to take up the main load while those on the outer wings are used only to keep the airplane level.

(2) Where no fixed mooring anchorage is provided, employ the type D-1 mooring kit furnished with the airplane. Screw the anchor rod into the arrow. Then slip the driving rod over the anchor rod into the socket of the arrow, with the cam on the driving rod turned so that the arrow prongs will not spread while driving. If the ground is hard, break the surface by using the ground-breaking pin. Aline the rod with the point of attachment on the airplane and drive the arrow into the ground until the driving rod handle is about three inches from the ground. Rotate the handle about 90 degrees and strike the driving rod a sharp blow to spread the arrow prongs. Turn the driving rod back and withdraw it from the ground. Attach the eye assembly and tie one end of the mooring rope to it. Pull upward sharply to set the arrow. Then secure the rope to the mooring fitting on the airplane. To withdraw the rod, unscrew it, leaving the arrow buried in the ground.

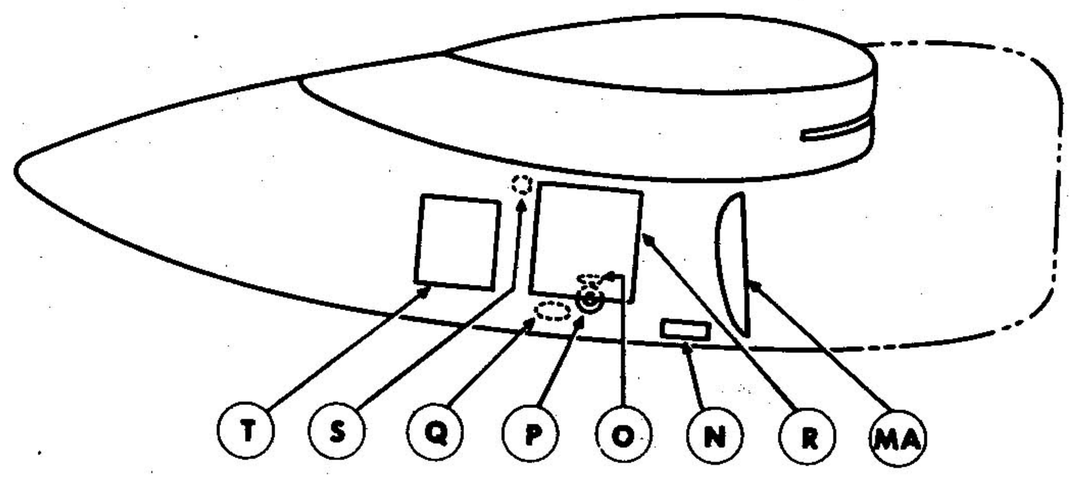
e. TOWING. - The airplane may be towed by the eyes at the lower end of the main landing gear shock struts, or by the eyes on the forward side of the nose wheel fork. The nose wheel towing bar is installed (figure 19) by placing it between the eyes on the nose wheel and inserting the hinge pin. Pull out the nose wheel release pin and turn it 90 degrees to the right. This will hold the pin in released position, allowing the nose wheel to caster 360 degrees. Be sure to install the attached safety pin when the nose wheel release pin is reinstalled.



When towing the airplane by the nose wheel fork, avoid sharp turns, sudden starts or stops, and rough terrain.



LEFT WING — LOWER SURFACE

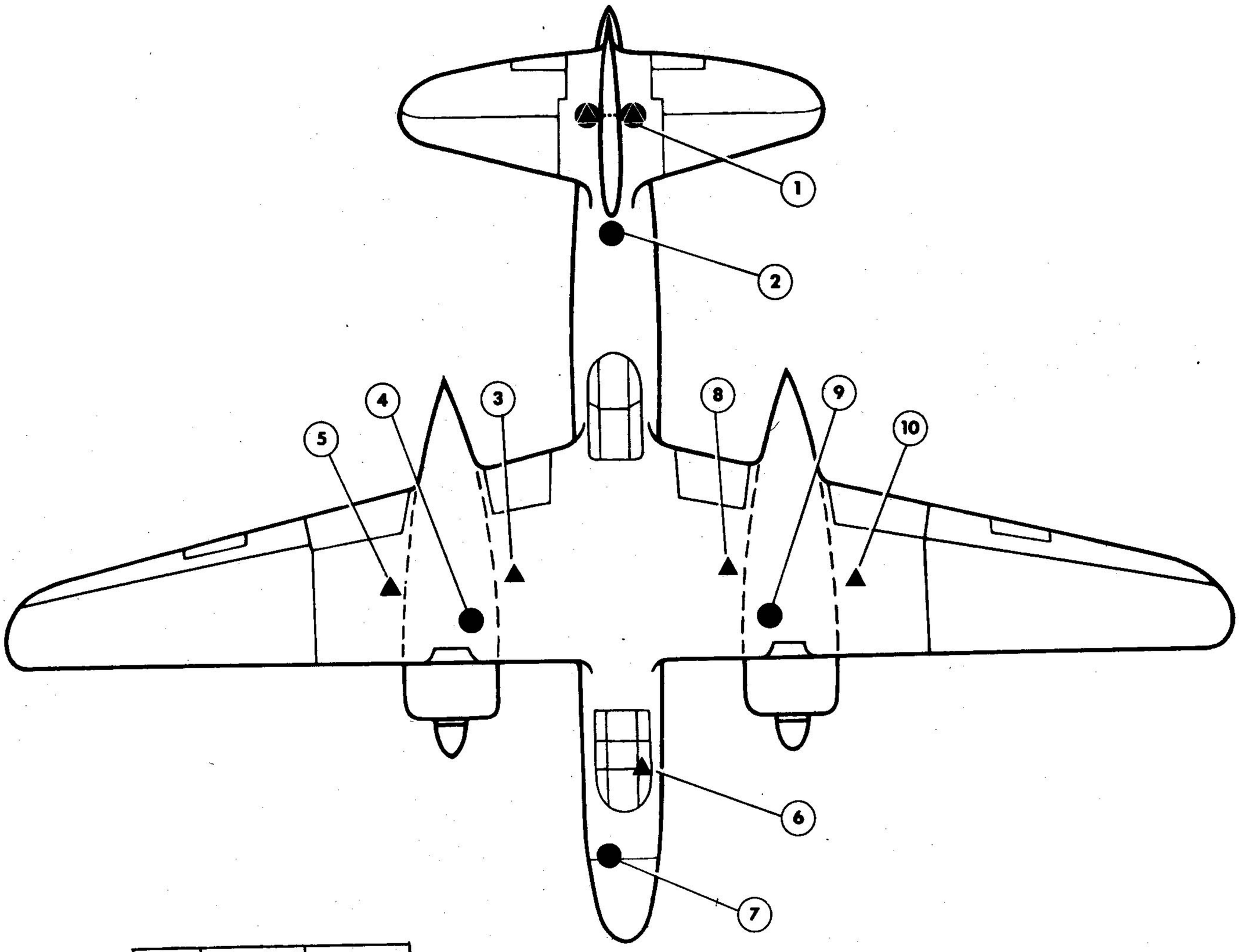


LEFT NACELLE — OUTBOARD

A FUEL TANK DRAIN (INBOARD)
B FUEL TANK FILLER NECK ACCESS
C FUEL LINES AND LEADING EDGE ATTACHMENT BOLT ACCESS (OUTBOARD)
D CARBURETOR AIR SCOOP FAIRING
E OIL TANK FILLER NECK ACCESS
F CARBURETOR AIR SCOOP ACCESS
G CONDUIT LINE AND CABLES ACCESS
H OIL TANK COVER
J FUEL LINES AND LEADING EDGE ATTACHMENT BOLT ACCESS (INBOARD)
K FUEL TANK DRAIN
L WING ATTACHMENT BOLT ACCESS
M WING STRUCTURE ACCESS (NO. 5 DOORS)
N FUEL STRAINER ACCESS
O OIL COOLER DRAIN ACCESS
P LANDING GEAR PIN ACCESS (INBOARD)
Q LANDING GEAR PIN ACCESS (OUTBOARD)
R OIL COOLER ACCESS
S LANDING GEAR PIN ACCESS
T OIL COOLER DUCT FLAP

U CONDUIT AND HYDRAULIC LINES ACCESS
V CONDUIT, LINES AND CABLES ACCESS
W CONDUIT, LINES AND CABLES ACCESS
X CONDUIT AND HYDRAULIC LINES ACCESS
Y FUEL LINES ACCESS
Z CONDUIT AND HYDRAULIC LINES ACCESS
AA FLAP HINGE COVER
BA AILERON AND TAB PULLEY BRACKET
CA OUTER WING ELEC. DISC. ACCESS (NO. 1 DOOR)
DA AILERON AND TAB FAIRLEADS ACCESS (NO. 3 DOORS)
EA AILERON AND TAB TURNBUCKLES ACCESS (NO. 1 DOOR)
FA AILERON DIFFERENTIAL ACCESS
GA AILERON DIFFERENTIAL ACCESS
HA AILERON HINGE COVER (INBOARD)
JA AILERON TAB DRUM ACCESS (NO. 3 DOOR)
KA WING TIP LIGHT CONDUIT ACCESS
LA AILERON HINGE COVER (OUTBOARD)
MA COOLER AIR FLOW SCOOP

Figure 19 - WING AND NACELLE ACCESS DOORS



PNT. NO.	TOOL USED	MAX. ALLOW. APPLIED LOAD
1	LIFT BAR	2,670
2	HOIST	1,820
3	JACK	11,600
4	HOIST	10,400
5	JACK	7,770
6	JACK	6,480
7	HOIST	4,600
8	JACK	11,500
9	HOIST	10,400
10	JACK	9,230

OPERATION	METHODS
TO RAISE NOSE GEAR	1. HOIST AT 7 OR 2. JACK AT 6 OR 3. PULL DOWN ON 1
TO RAISE LEFT WHEEL (SIMILAR FOR RIGHT)	1. JACK AT 10 OR 2. JACK AT 8 OR 3. HOIST ON 9
TO RAISE FUS. ONLY	1. HOIST ON 2 AND 7
TO RAISE ENTIRE SHIP	1. HOIST 4 AND 9 AND 2 AND 7 2. JACK AT 3 AND 8 AND 6 OR 3. JACK AT 5 AND 10 AND 6 OR 4. JACK AT 3 AND 10 OR 8 AND 5 AND 6

Figure 20 - HOISTING AND JACKING POINTS

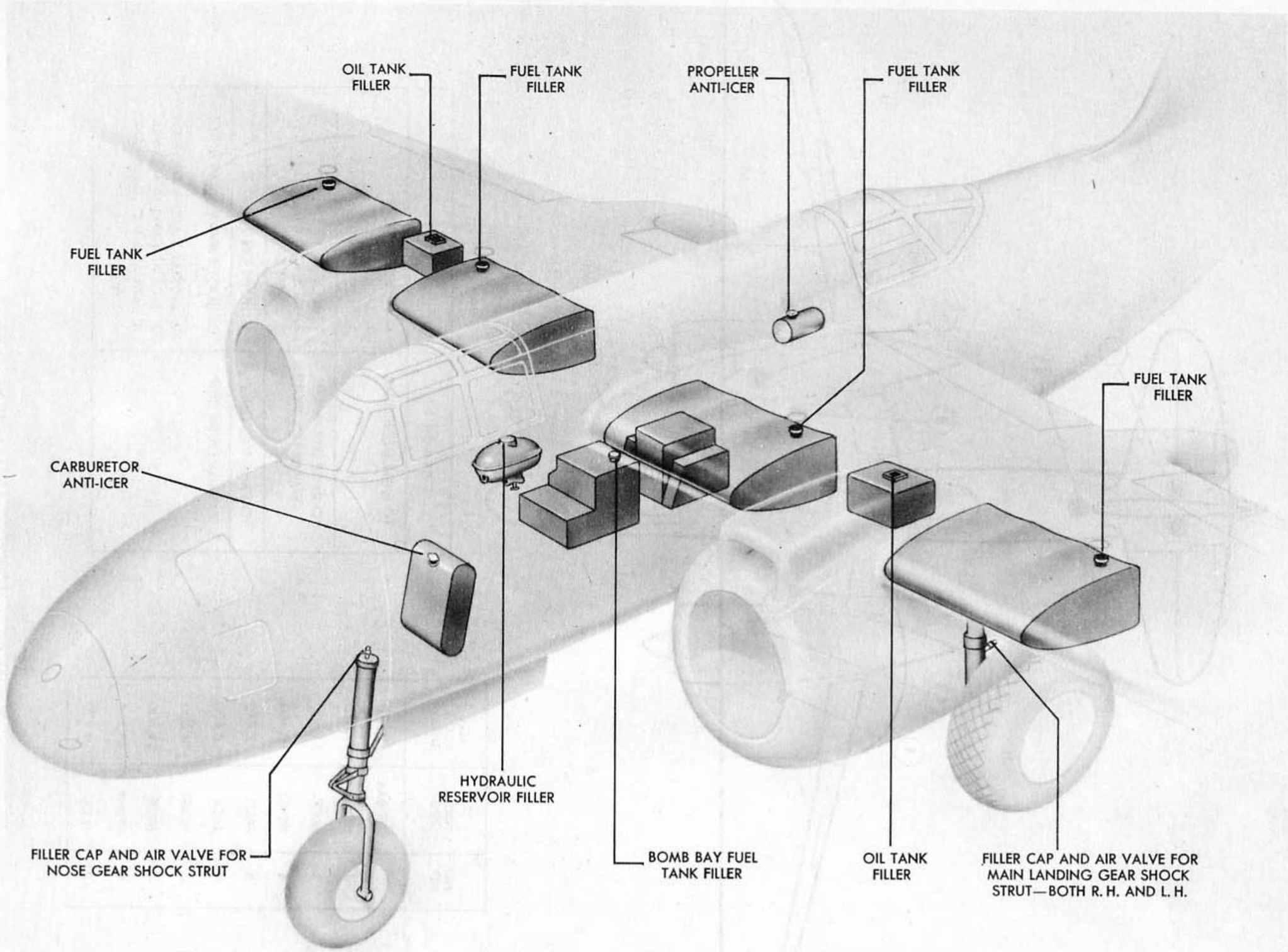


Figure 21 - FILLER CAP DIAGRAM

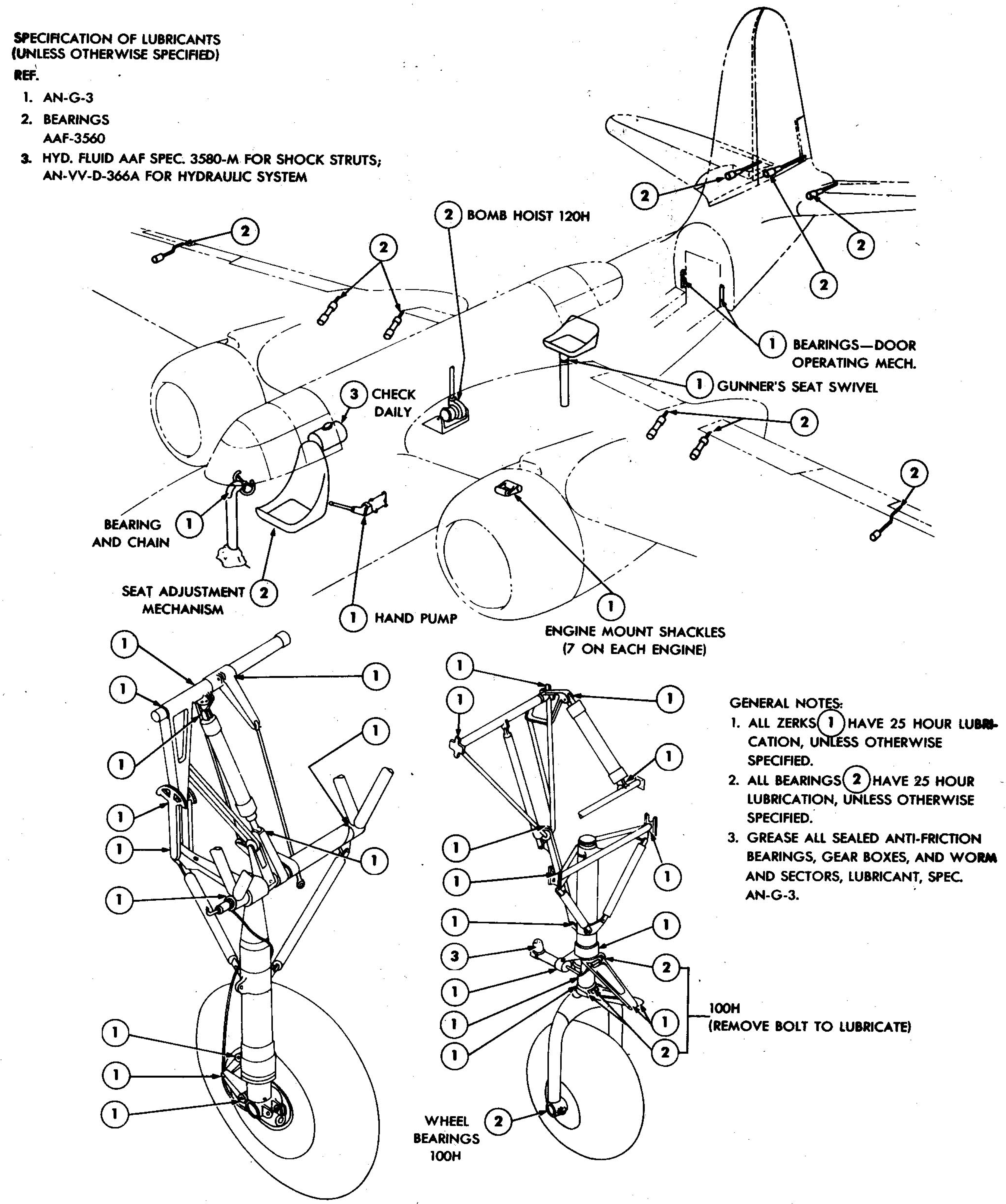
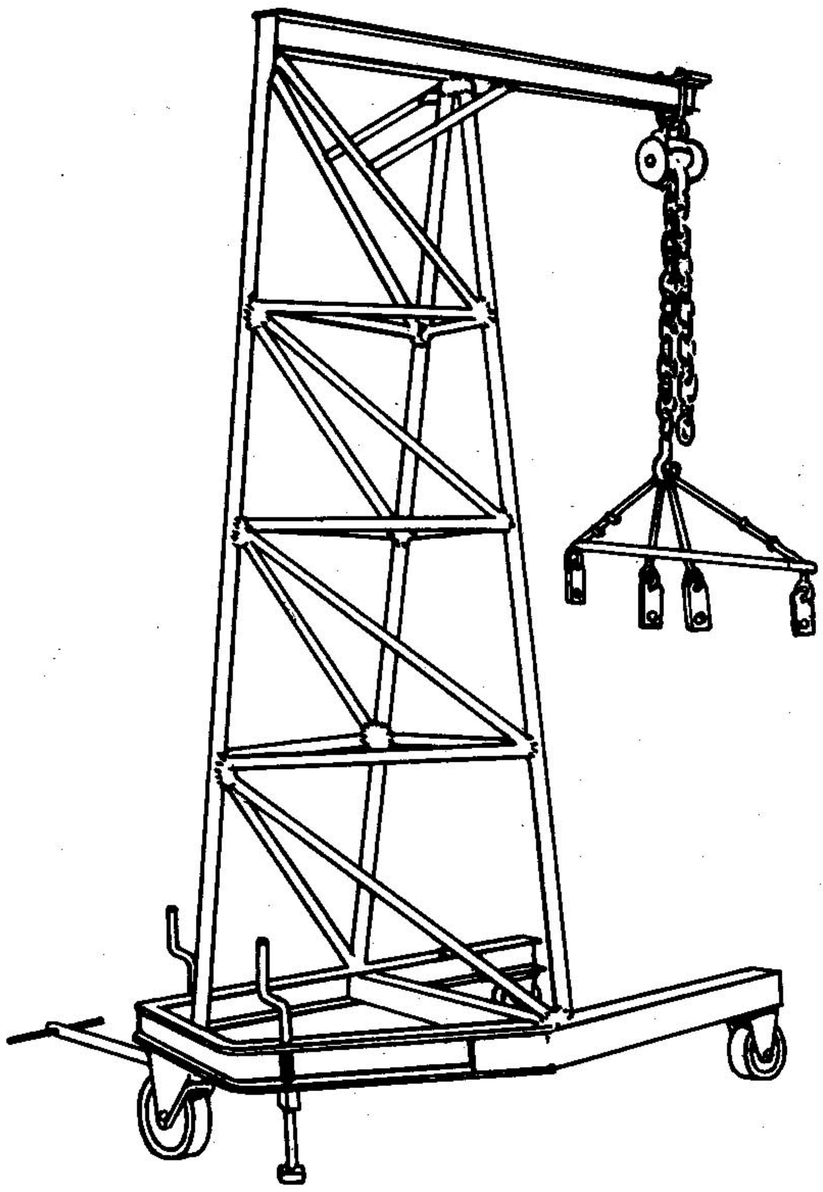
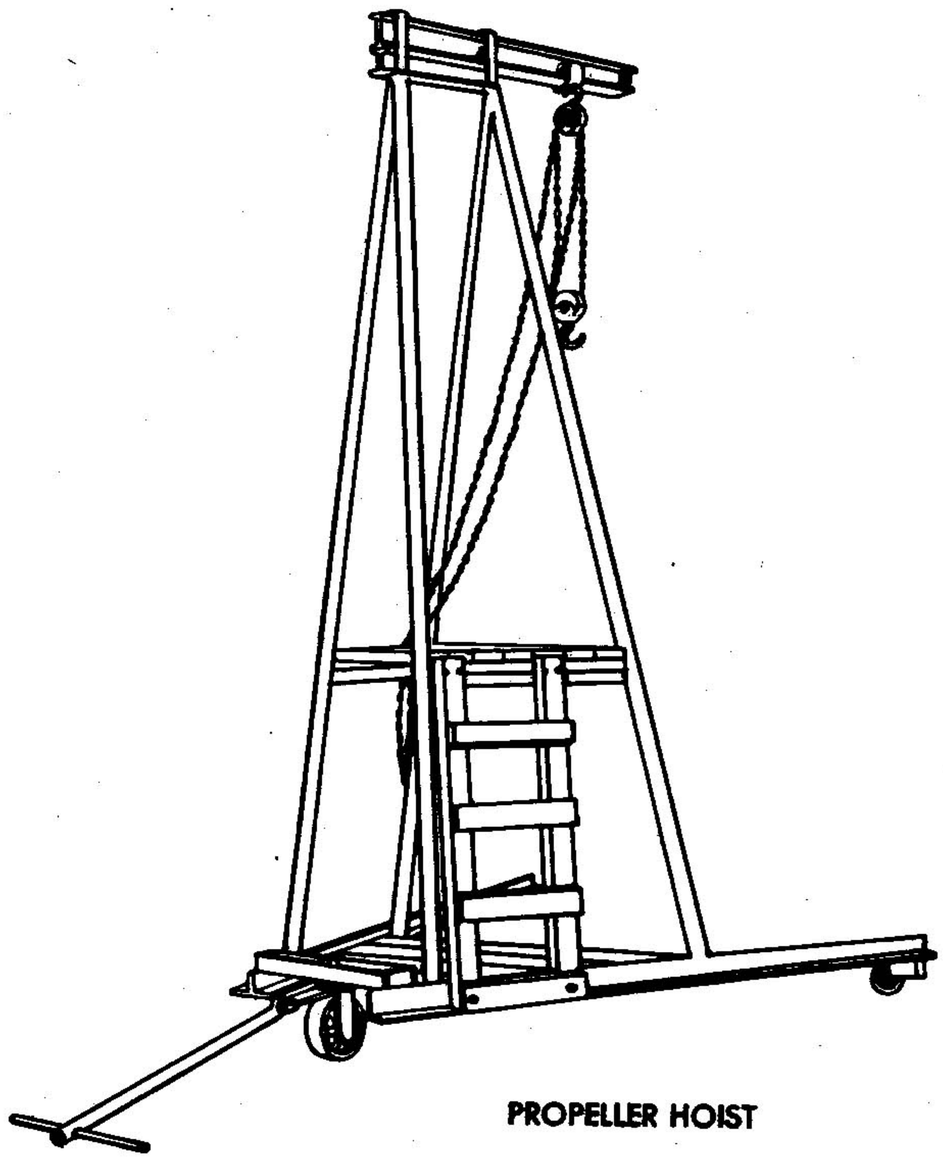


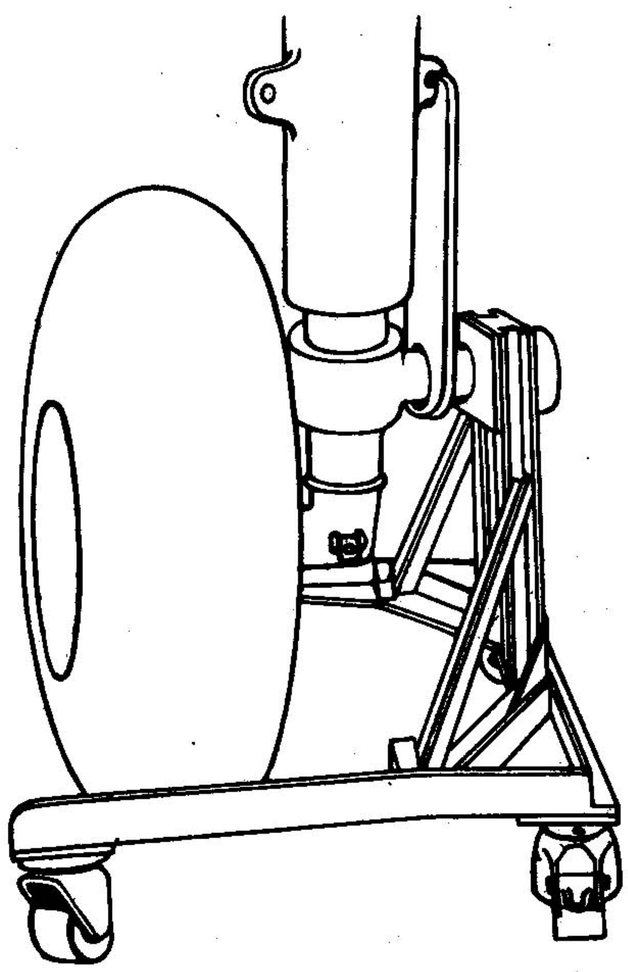
Figure 22 - LUBRICATION CHART



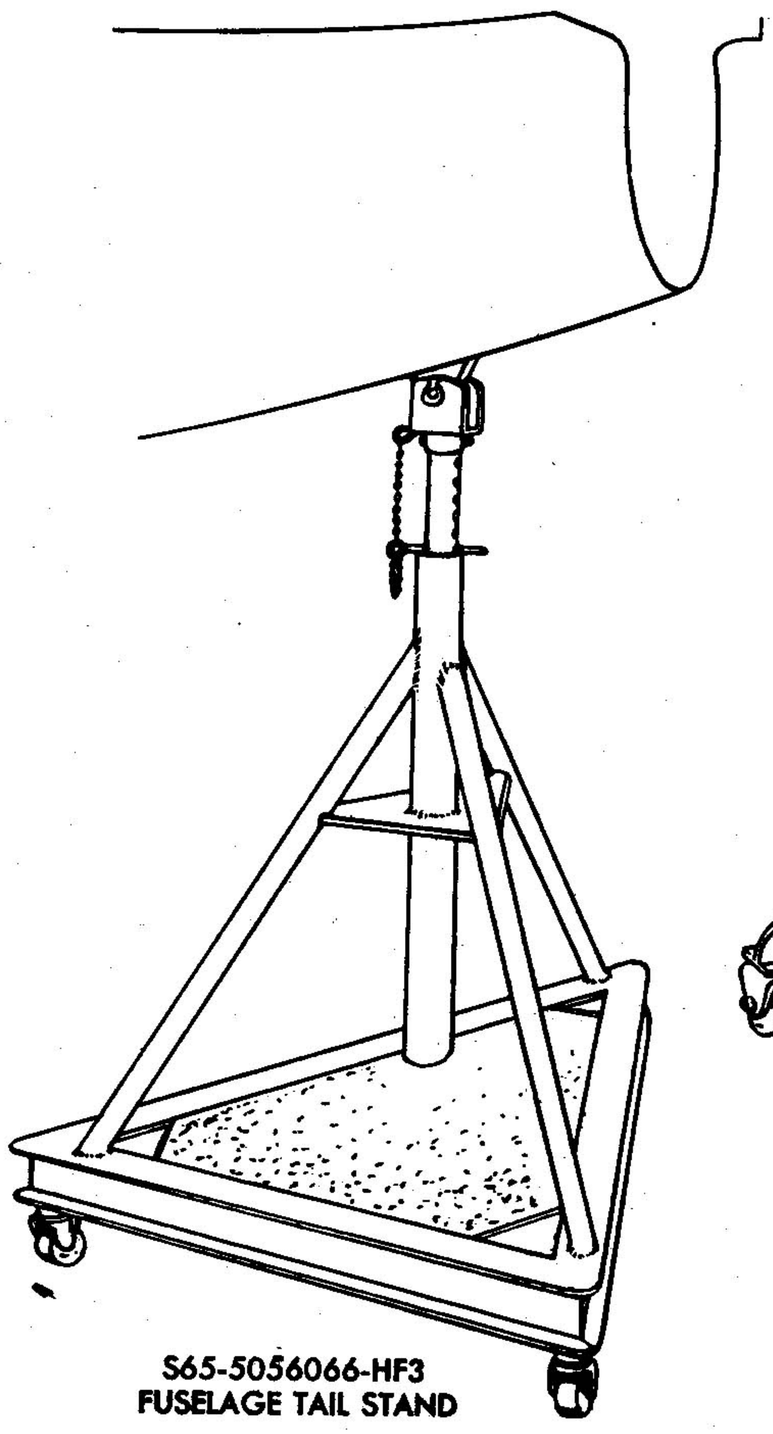
S65-7067-HF
ENGINE HOIST SLING



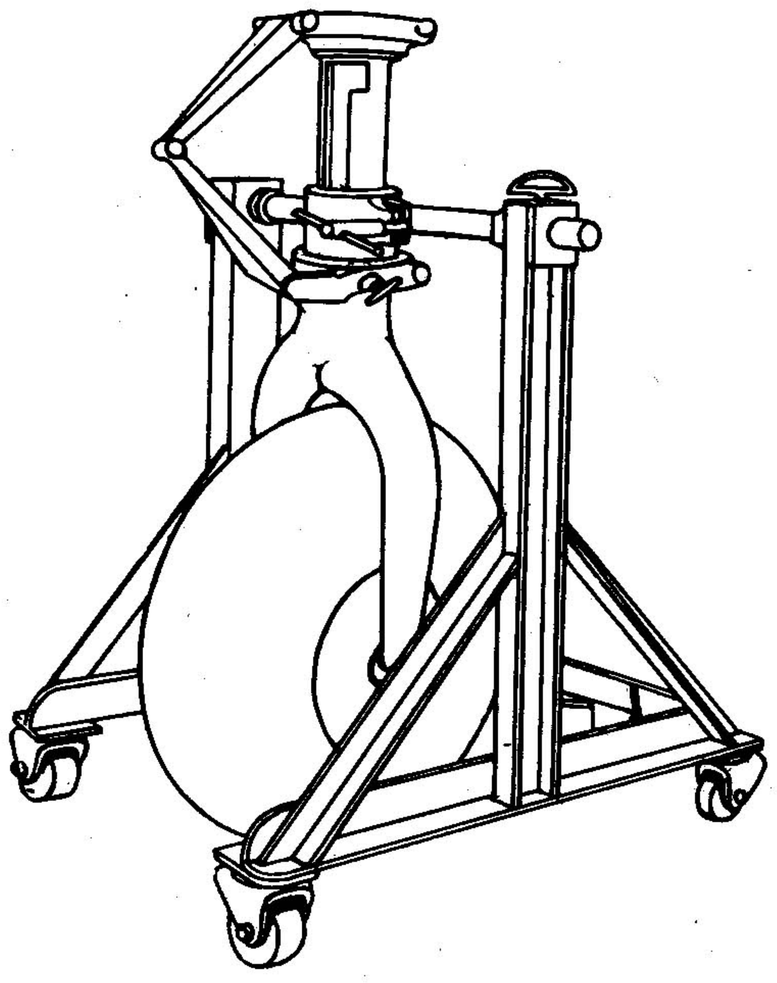
PROPELLER HOIST



S65-5056111-HF2
LANDING GEAR INSTALLATION DOLLY

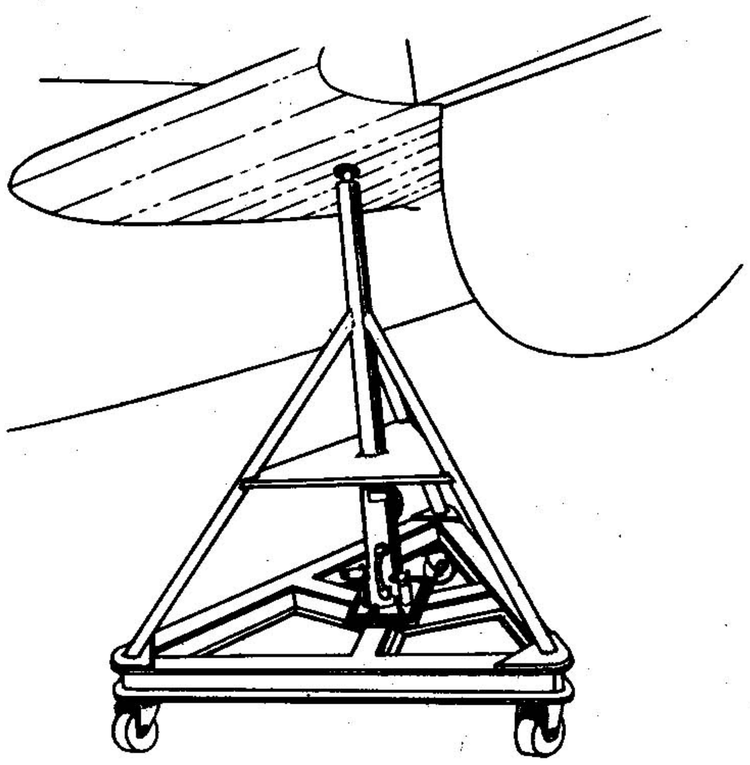


S65-5056066-HF3
FUSELAGE TAIL STAND

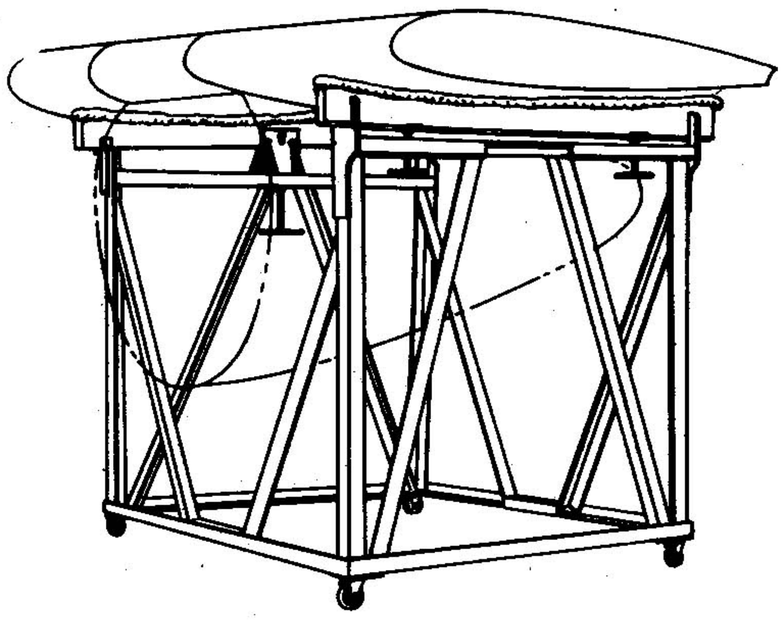


S65-5062498-HF1
NOSE WHEEL INSTALLATION DOLLY

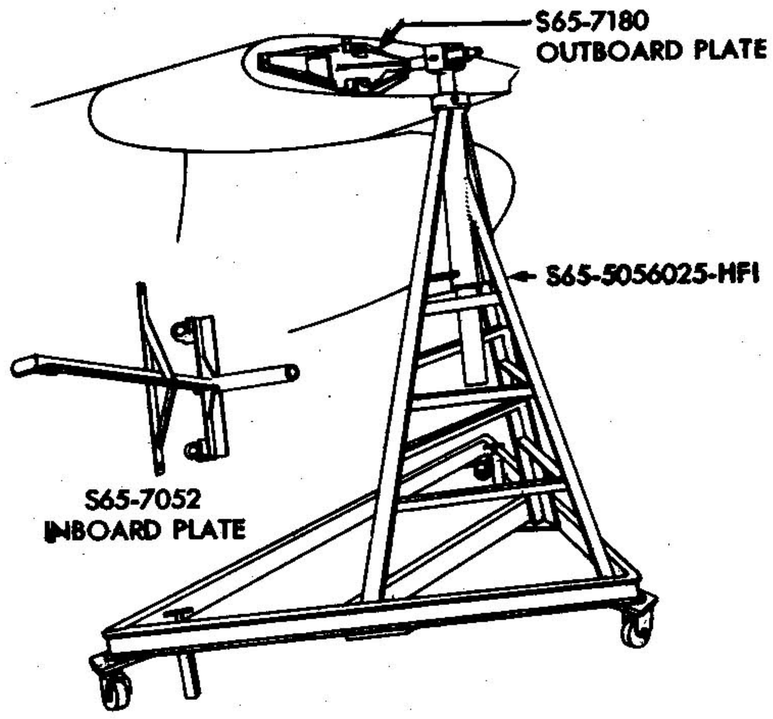
Figure 23 - HANDLING FIXTURES



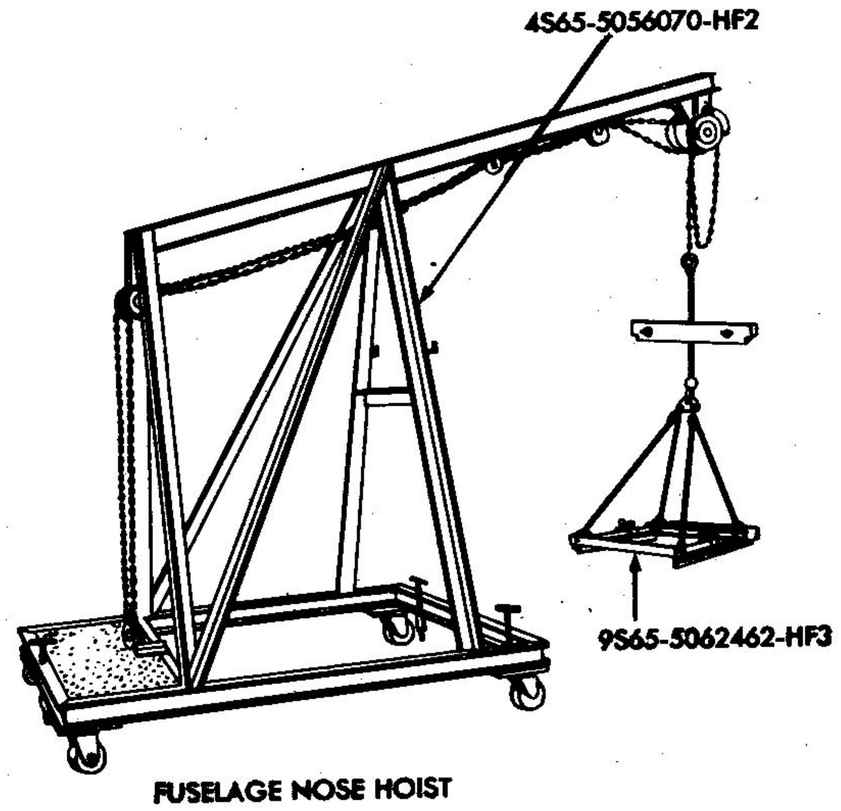
S65-5062418-HF6
INNER WING TRIPOD
WITH HYDRAULIC JACK



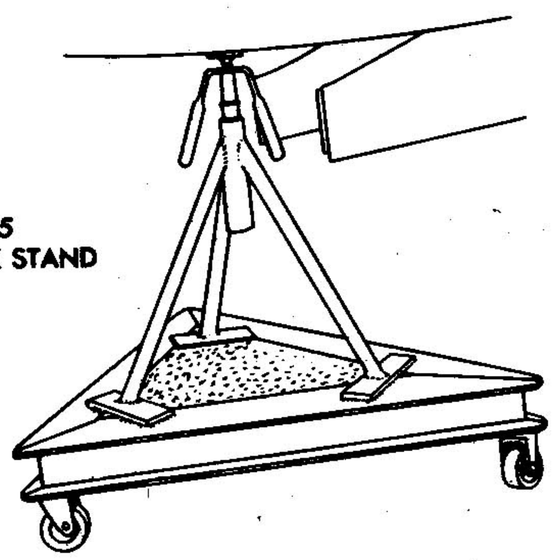
S65-5056025-HF7
INNER WING DOLLY



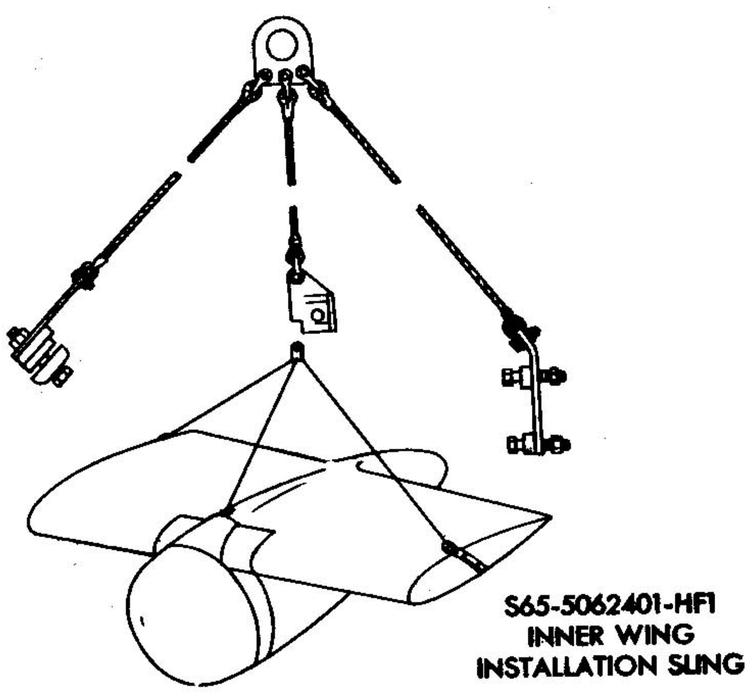
INNER WING TRIPOD



FUSELAGE NOSE HOIST



S65-5056066-HF25
FUSELAGE NOSE JACK STAND



S65-5062401-HF1
INNER WING
INSTALLATION SLING

Figure 24 - HANDLING FIXTURES

SECTION

IV

Major Component Parts and Installations

1. GENERAL.

a. This section covers the description, removal and disassembly, repair (other than structural) and adjustment, tests, assembly and installation for the major component parts of the airplane.

2. WING GROUP.

a. DESCRIPTION.

(1) GENERAL. - Each wing consists of an inner and outer wing. The inner wings are secured to the fuselage and outer wings are attached to the inner wings. The engine nacelles are an integral part of the inner wings. Two landing flaps are secured to the trailing edges of the outer wings. (See figure 25.) Access doors and cover plates are located throughout the wings to provide for inspection and maintenance. (See figure 19.)

(2) WING TIPS. - The wing tip (figure 25) forms the outboard end of each wing and is formed of alclad sheet ribs, extruded angle longitudinals of aluminum alloy and alclad covering. Formation signal lights are located on the top and bottom sides of the wing tips. Each tip weighs slightly over five pounds.

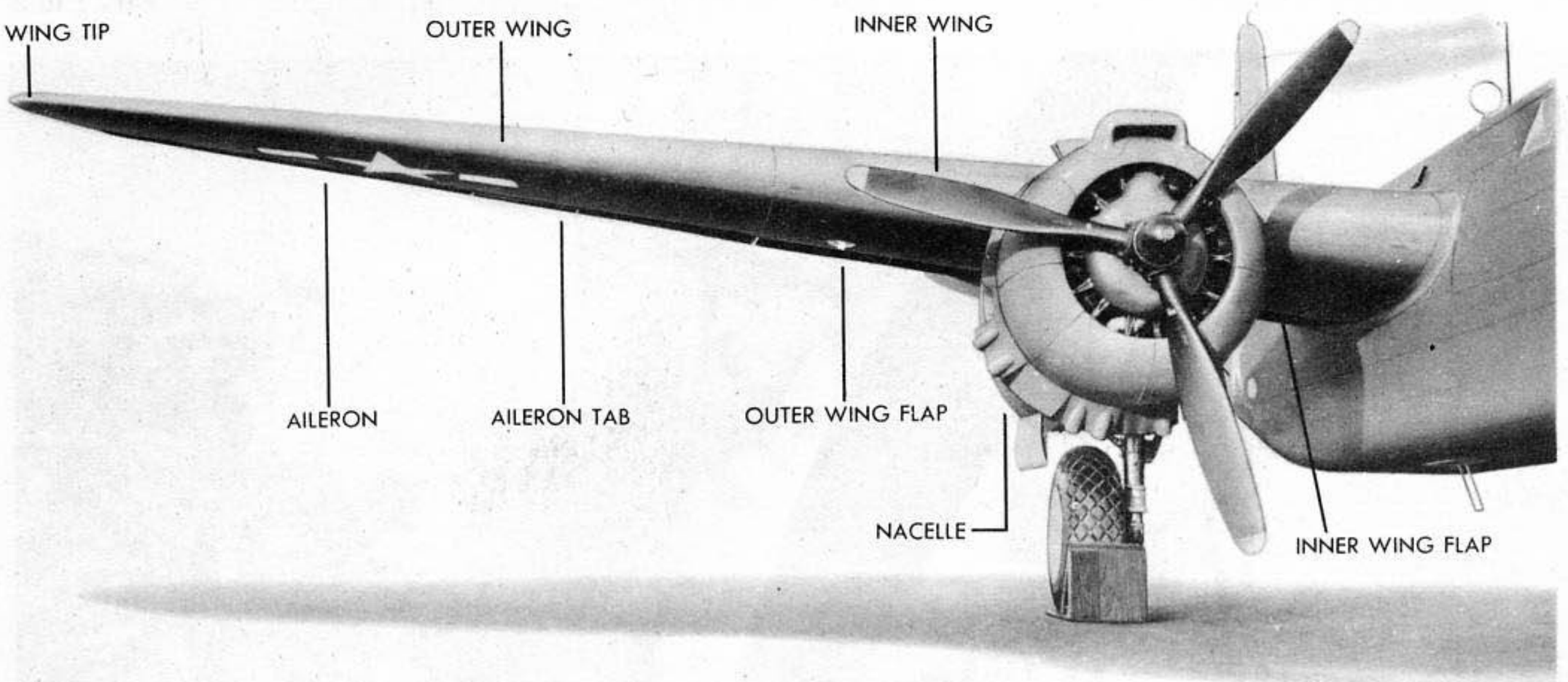


Figure 25 - INSTALLED WING

(3) AILERONS AND AILERON TABS. - The aileron (figure 25) incorporates a main spar and an auxiliary spar for the tab to be fastened upon, with ribs spaced at approximately 12-inch intervals throughout the span. Sheet alclad is used for construction of the leading edge of the aileron to which are attached lead weights for static balance. These weights are secured to the alclad sheeting by flathead screws and elastic stop nuts or self-locking fiber insert nuts. Then the entire surface of the aileron is covered with fabric. The aileron tab is constructed of sheet alclad and, while it is part of the aileron, it may be operated with, or independently of, the aileron to control balance of the airplane in flight. The aileron is mounted on three hinging brackets at the rear shear web of the outer wing. Removal and assembly of the aileron and tab may be performed without removing the outer wing from the airplane. Each aileron weighs about 44 pounds.

(4) OUTER WINGS. - The outer wing (figure 25) incorporates a main spar and rear shear web with ribs spaced at approximately 12-inch intervals throughout the span. The assembly is made up of the wing, aileron, aileron tab, and wing tip.

(5) OUTBOARD WING FLAPS. - The flaps (figure 25) are hydraulically operated by actuating struts and serve as air brakes to decrease landing speed. The flaps are of all metal construction similar to the wing. Each of the two outboard wing flaps is hinged to the rear shear web of the inner wing outboard of the engine nacelle. A single wing flap weighs approximately 17 pounds.

(6) INBOARD WING FLAPS. - The inboard wing flaps (figure 25) are the same construction as the outboard flaps and operate the same. Each of the two inboard flaps is hinged to the rear shear web of the inner wing inboard of the engine nacelle.

(7) INNER WINGS. - Each of the two inner wings (figure 25) is of all-metal cantilever construction with an engine nacelle permanently attached. A single spar forms the basic structural unit. The front and rear shear webs provide additional strength. Each wing incorporates two flaps, a retractable landing light, and a detachable leading edge to provide access to the self-sealing fuel containers. An inner wing weighs approximately 2200 pounds without engine or landing gear.

b. TROUBLE SHOOTING.

SYMPTOM	CAUSE	REMEDY
Restricted movement or binding.	Faulty controls.	See paragraph 15, this section.
	Broken or worn hinge or horn.	Repair or replace broken or worn parts.
Surface warped.	Ribs loose from spar.	Replace assembly and send to depot for repairs.

SYMPTOM	CAUSE	REMEDY
	Broken ribs.	Replace assembly and send to depot for repairs.
Torn or weakened covering.	Accident or age.	Repair or replace covering.
	Internal structural defect.	Replace assembly and send to depot for repairs.
Loose rivets or tears around rivets.	Internal structural defect.	Replace assembly and send to depot for repairs.
	Excessive vibration.	Locate cause of vibration and eliminate. Replace assembly and return to depot for repairs.
	Accident or age.	Replace assembly and send to depot for repairs.
Bent or broken horn or hinge.	Accident or structural defect.	Replace defective parts.
Loosened horn, hinge, or hinge pin.	Safety wire broken or missing.	Tighten and safety loose part.
	Rivets pulled.	Replace rivets.
Excessive vibration of surface.	Internal structural defect.	Replace assembly and send to depot for repairs.
	Attaching parts loosened.	Tighten and safety attaching parts.
	Faulty controls.	See paragraph 15, this section.

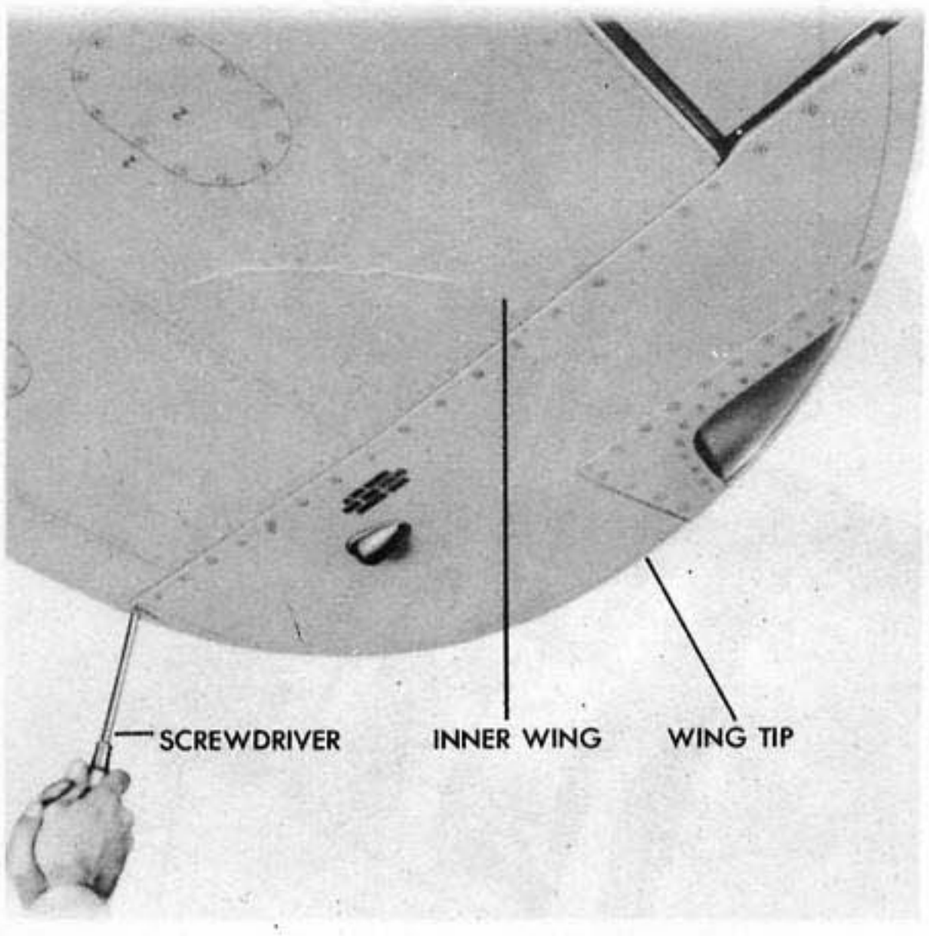


Figure 26 - REMOVING WING TIP

c. REMOVAL.

(1) REMOVAL OF WING TIP. (See figure 26.)

(a) Remove the flathead screws which secure the wing tip to the outboard end of the wing.

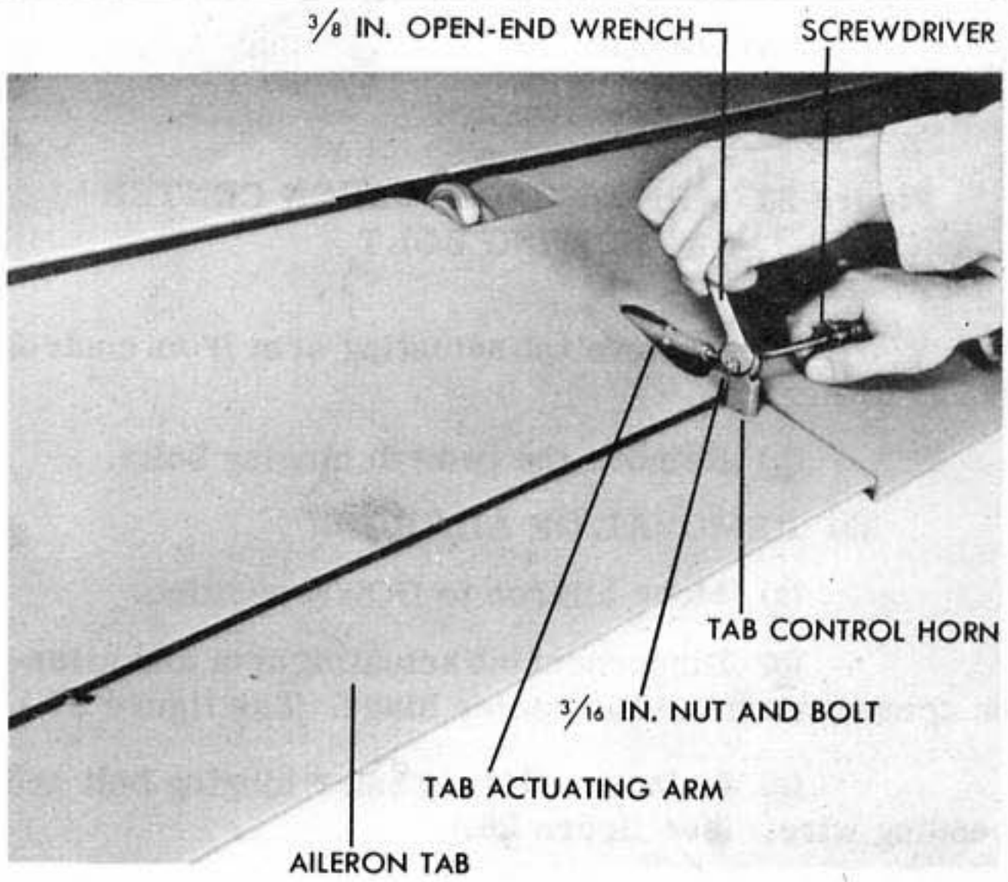


Figure 27 - DISCONNECTING AILERON TAB ACTUATING ARM

(b) Pull wing tip outward.

(c) Disconnect at the cannon plug the flexible cable leading to the formation light.

(2) REMOVAL OF AILERON TAB. (See figure 27.)

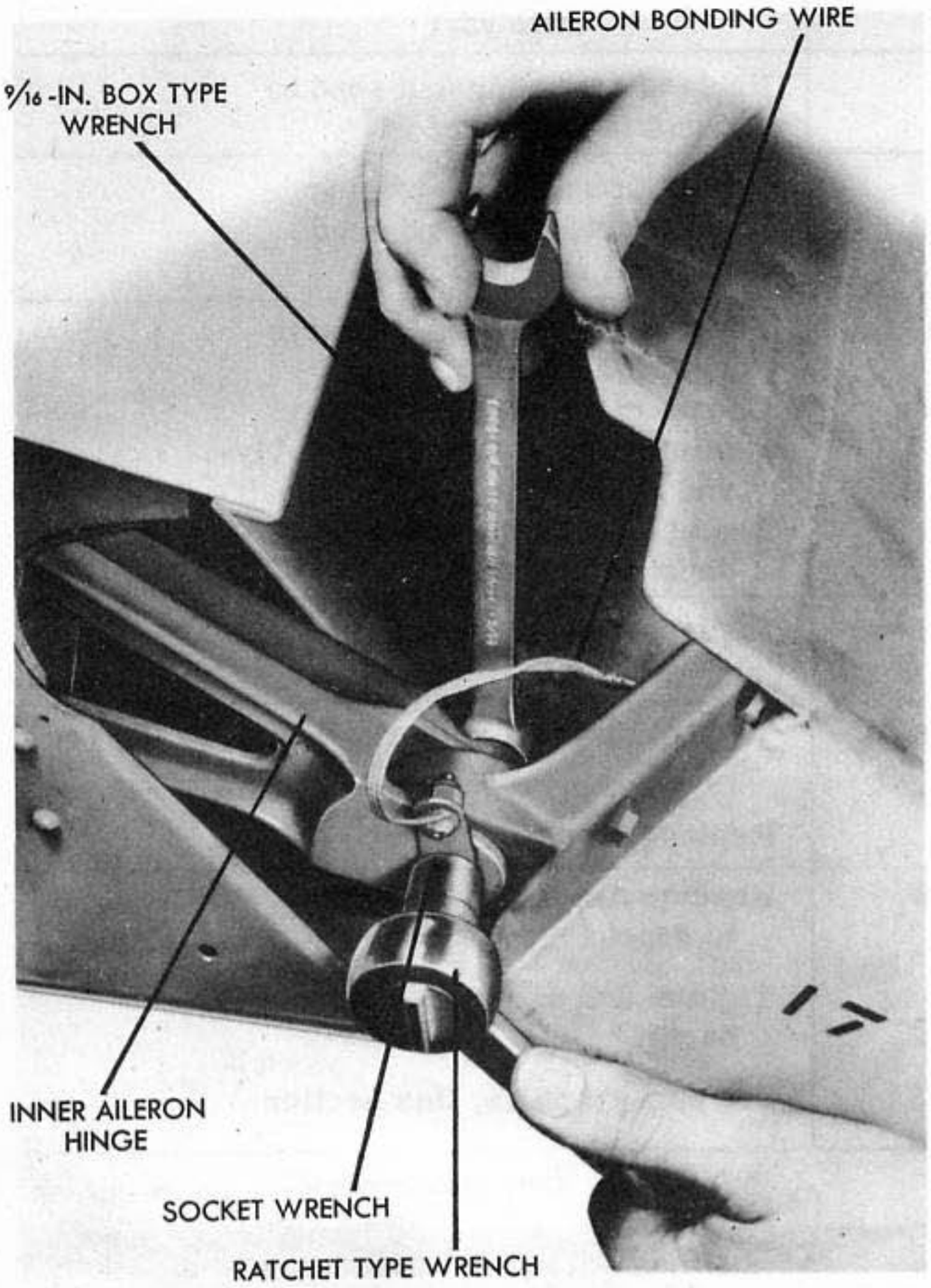


Figure 28 - REMOVING AILERON CENTER HINGING BOLT

(a) Remove tab actuating arm from control horn.

(b) Remove the two tab hinging bolts.

(3) REMOVAL OF AILERON.

(a) Move aileron to DOWN position.

(b) Disconnect tab actuating arm and aileron actuating arm at the center hinge. (See figure 27.)

(c) Remove aileron center hinging bolt and bonding wire. (See figure 28.)

(d) Remove aileron outer hinging bolt.

(e) Swing aileron to UP position.

(f) Remove aileron inner hinging bolt. (See figure 28.)

(4) REMOVAL OF OUTER WING.

(a) Drain outboard and inboard fuel containers by removing drain plugs through access doors (A) and (Z). (See figure 19.)

(b) Disconnect aileron cables through outboard access door (DA). (See figure 19.)

(c) Remove access door (JA). (See figure 19.)

(d) Tape aileron tab drum to prevent unwinding.

(e) Tape aileron cockpit control drum to prevent unwinding at indicator bracket.

(f) Disconnect tab control cable through access door (JA). (See figure 19.)

(g) Disconnect electrical connections through access door (CA). (See figure 19.)

(h) Remove access door (M). (See figure 19.)

(i) Disconnect main and vent gas lines.

(j) Remove leading edge wing attaching bolt through access door (M) of outer wing. (See figure 19.)

(k) Remove the two rear shear web wing attaching internal wrenching bolts after lowering the outboard flap on the inner wing and the aileron on the outer wing.

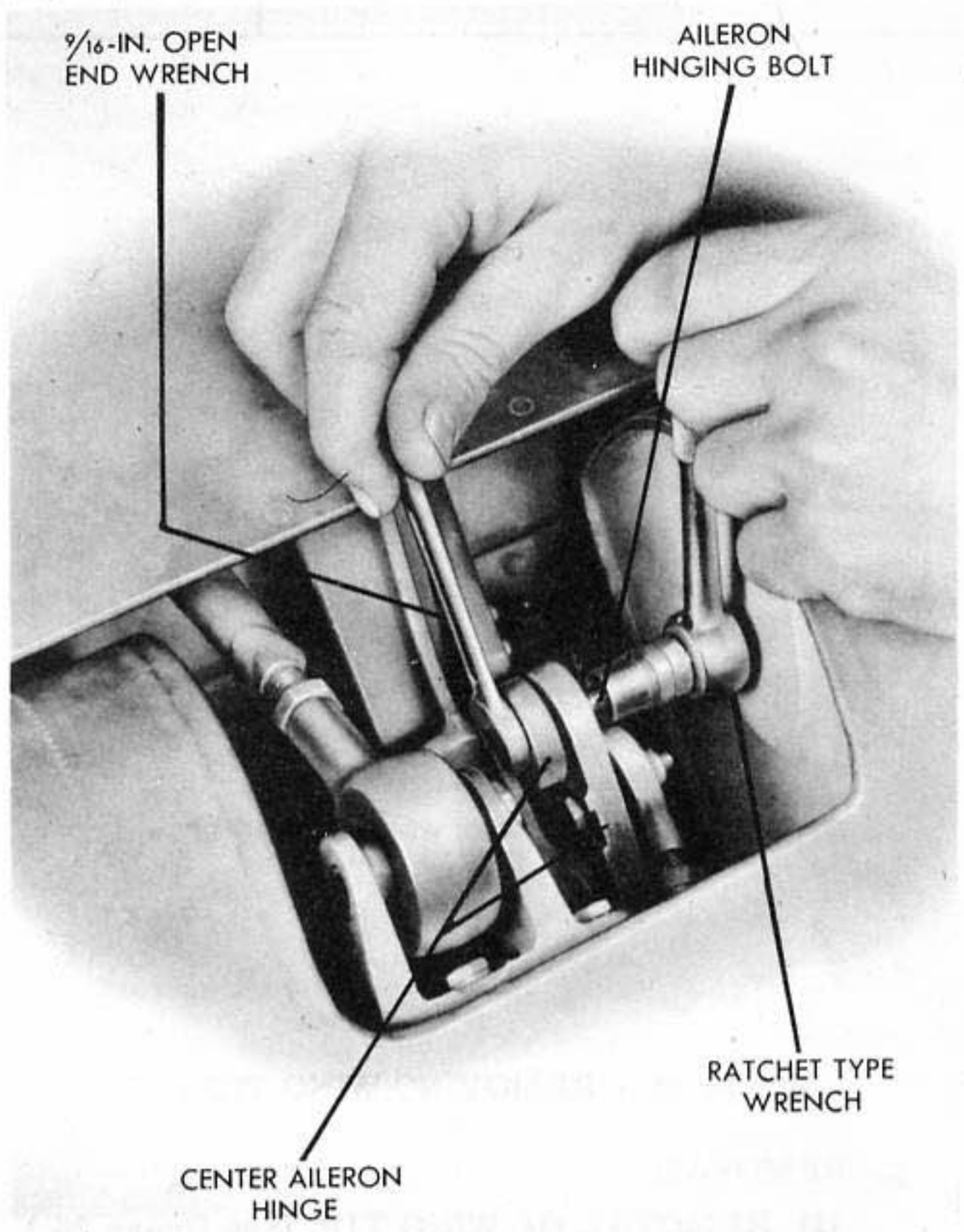


Figure 29 - REMOVING AILERON INNER HINGING BOLT

Figure 30 - REMOVING NUT FROM MAIN SPAR WING ATTACHING BOLT

(l) Remove the main spar top and bottom wing attaching bolt nuts through the spar fittings access opening (L). (See figures 20 and 36.)

(m) Lower the wing flap and raise the aileron.

(n) Move outer wing to the rear and off the main spar wing attaching bolts. This wing weighs about 250 pounds and requires four men to handle it manually. It can be handled easily by the use of a dolly.

(5) REMOVAL OF OUTBOARD WING FLAP. (See figure 37.)

(a) Remove flap hinge access door cover (AA). (See figure 20.)

(b) Remove center actuating arm hinge pin from flap at the nacelle, watching the bushing shim to prevent its loss.

(c) Remove pivot arm below cylinder connection at the nacelle.

(d) Remove outboard hinge bolt through the outboard lightening hole in the end of the flap through access door (AA). (See figure 20.)

(6) REMOVAL OF INBOARD WING FLAP.

(a) Lower flap to approximate HALF-DOWN position.

(b) Remove cylinder actuating arm hinge pin from flap in nacelle, watching bushing and shim to prevent their loss.

(c) Remove pivot arm bolt below cylinder connection, watching bushing and shim to prevent their loss.

(d) Remove hinge bolt at the outboard end of flap through the lightening hole.

(7) REMOVAL OF INNER WING.

(a) Remove outer wing, outboard wing flap, and inboard wing flap.

(b) Place jacks at jacking points 1, 6, and 3 or 8. (See figure 21.)

(c) Drain oil tank at left side of the accessory section of the engine nacelle at the Y valve.

(d) Remove the propeller, and then remove the engine.

(e) Remove landing gear wheel.

(f) Remove landing gear.

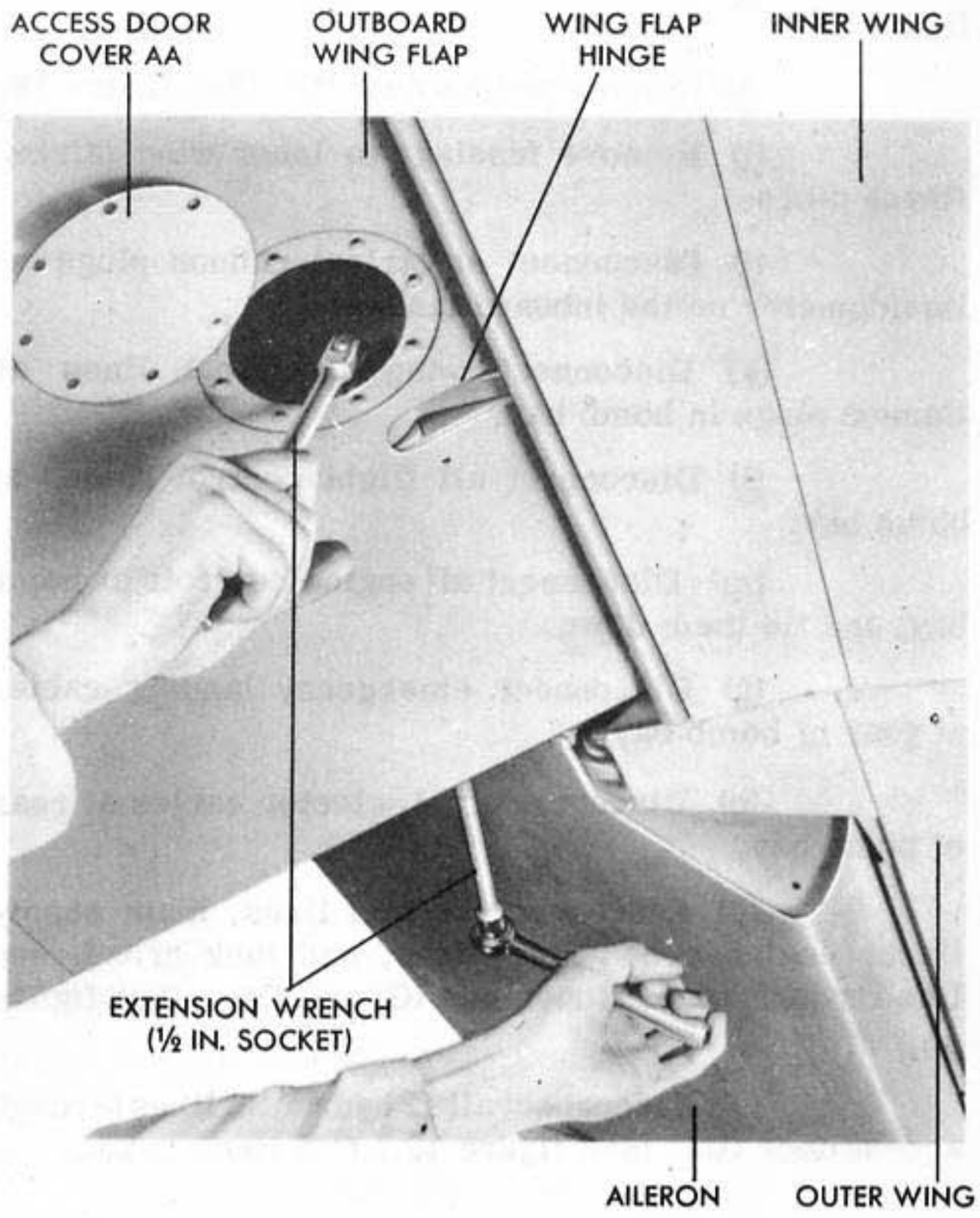


Figure 31 - REMOVING OUTBOARD WING FLAP

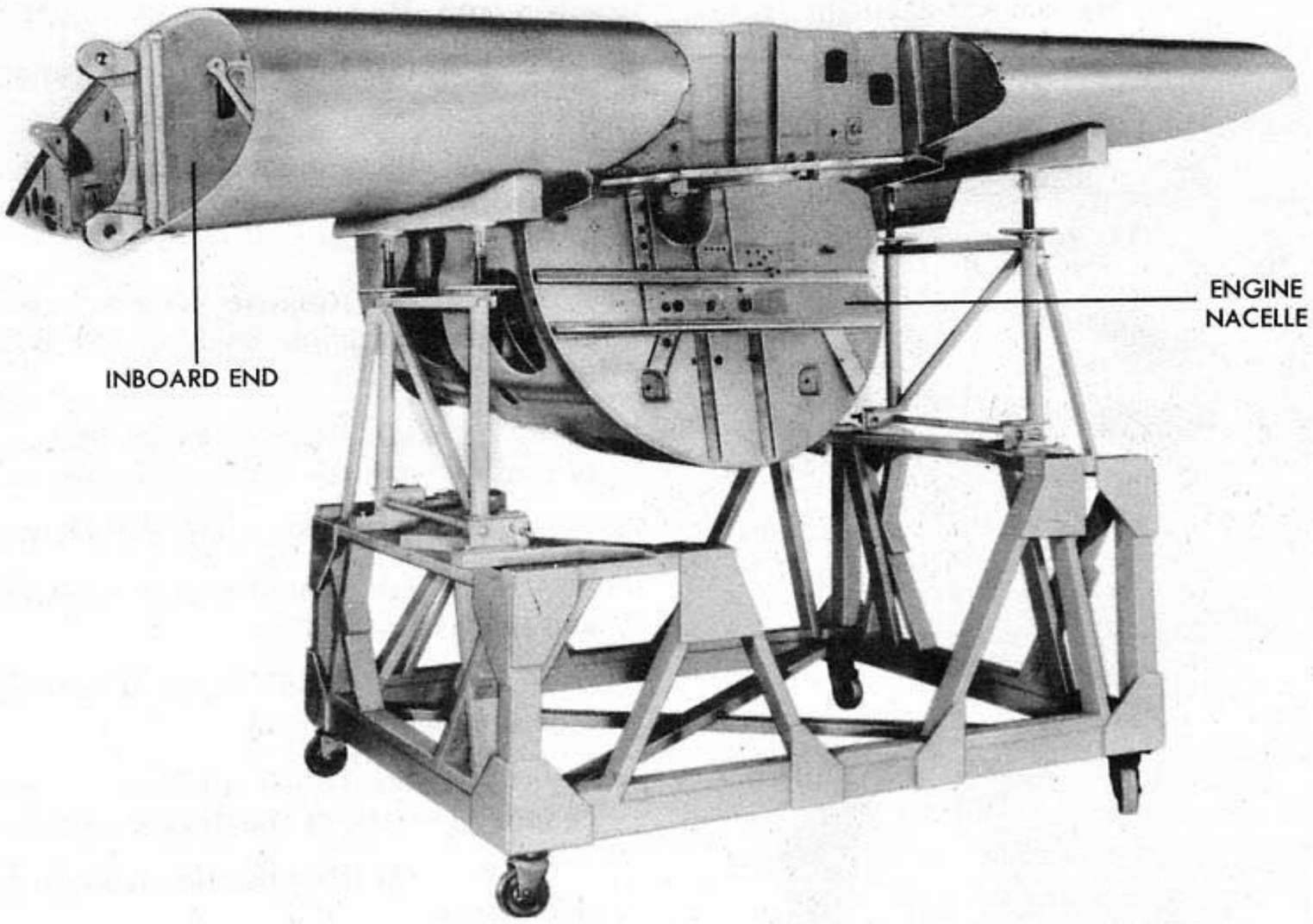


Figure 32 - INNER WING

(g) Remove access doors (V) and (U). (See figure 19.)

(h) Remove access door (G). (See figure 19.)

(i) Remove fuselage to inner wing fairing (three pieces).

(j) Disconnect electrical cannon plugs at liquidometer on the inboard tank.

(k) Disconnect wing electrical lines at Cannon plugs in bomb bay.

(l) Disconnect all flight control cables at bomb bay.

(m) Disconnect all engine controls at bomb bay, and tie them down.

(n) Disconnect emergency landing cables at rear of bomb bay.

(o) Disconnect fuel selector cables at rear of bomb bay.

(p) Disconnect all fuel lines, main supply lines, engine cross-feed lines, and tank cross-feed line through access openings (G) and (V). (See figure 19.)

(q) Disconnect all 12 hydraulic lines through access door (U). (See figure 19.) Cap lines to keep out dirt.

(r) Disconnect oil pressure line through access door (U). (See figure 19.)

(s) Disconnect fuel pressure through access door (U). (See figure 19.)

(t) Disconnect vacuum suction lines through access door (U). (See figure 19.)

(u) Disconnect manifold pressure lines through access door (U). (See figure 19.)

(v) Disconnect leading and trailing edge brackets.

(w) Install inner wing installation sling, special tool, S65-5062401-HF1 (figure 25), if available. When not available, the wing can be supported by a chainfall (not less than 1 1/2-ton capacity) or by block and tackle made of 3/8-inch or heavier manilla rope, or by a sling cradle made of heavy manilla rope. When using a sling cradle, the outboard end of the wing tends to raise too fast and bind the bolt. To overcome this trouble, cinch tightly the two inboard hoist lines and allow the outboard line to be slightly slack.

(x) Remove nut and washer from top center attaching bolt on outside of fuselage. Then remove the bolt after weight of the wing is just supported or equalized. This can be determined when the bolt is relieved of all drag by tapping the bolt head with a lead mallet. The sling must be jockeyed until the bolt is free. To remove the bolt use Douglas tool, S65-14041-G-DET-110, if available; otherwise use any bolt with threads that fit the female threads cut in the head of the attaching bolt.

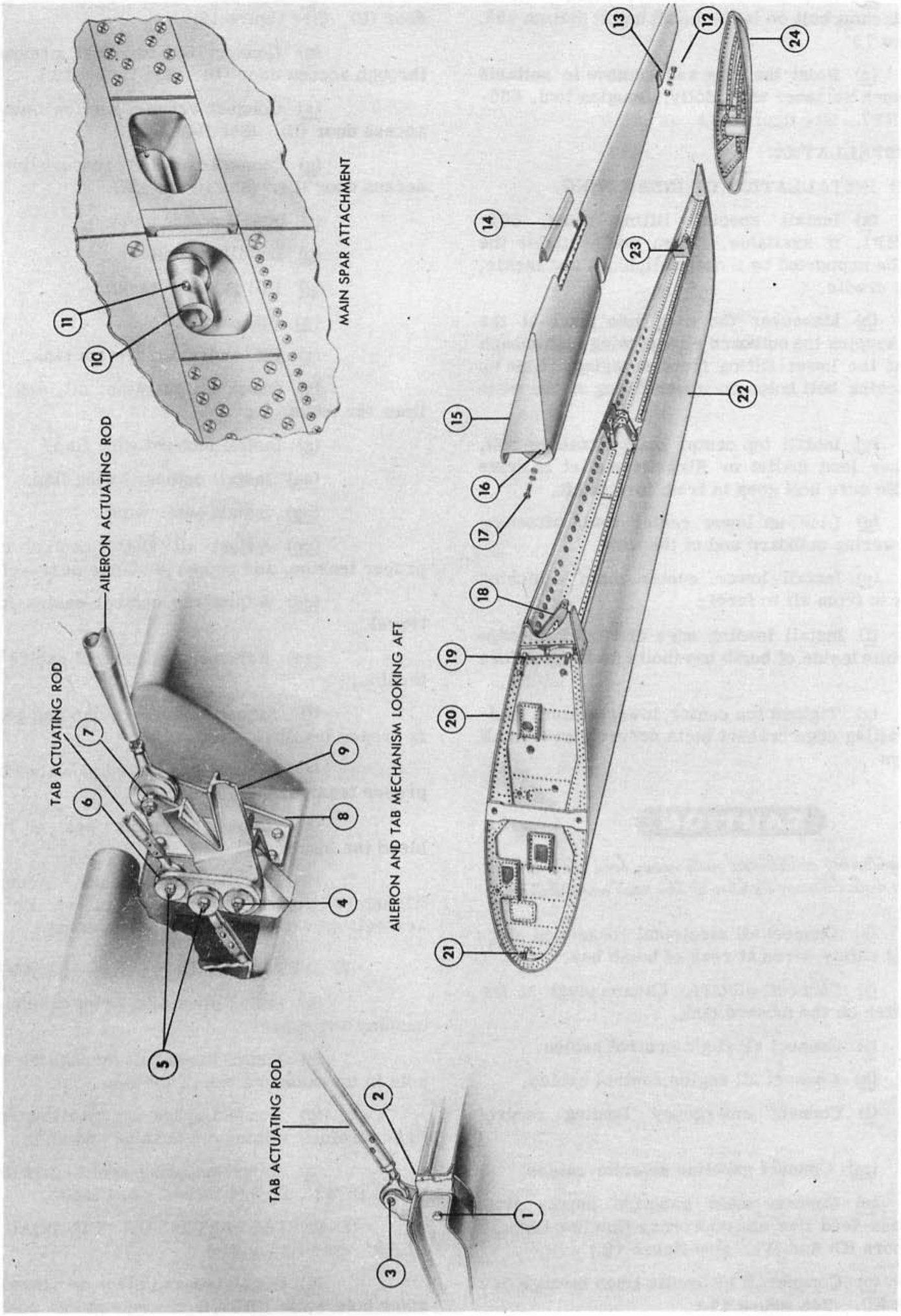
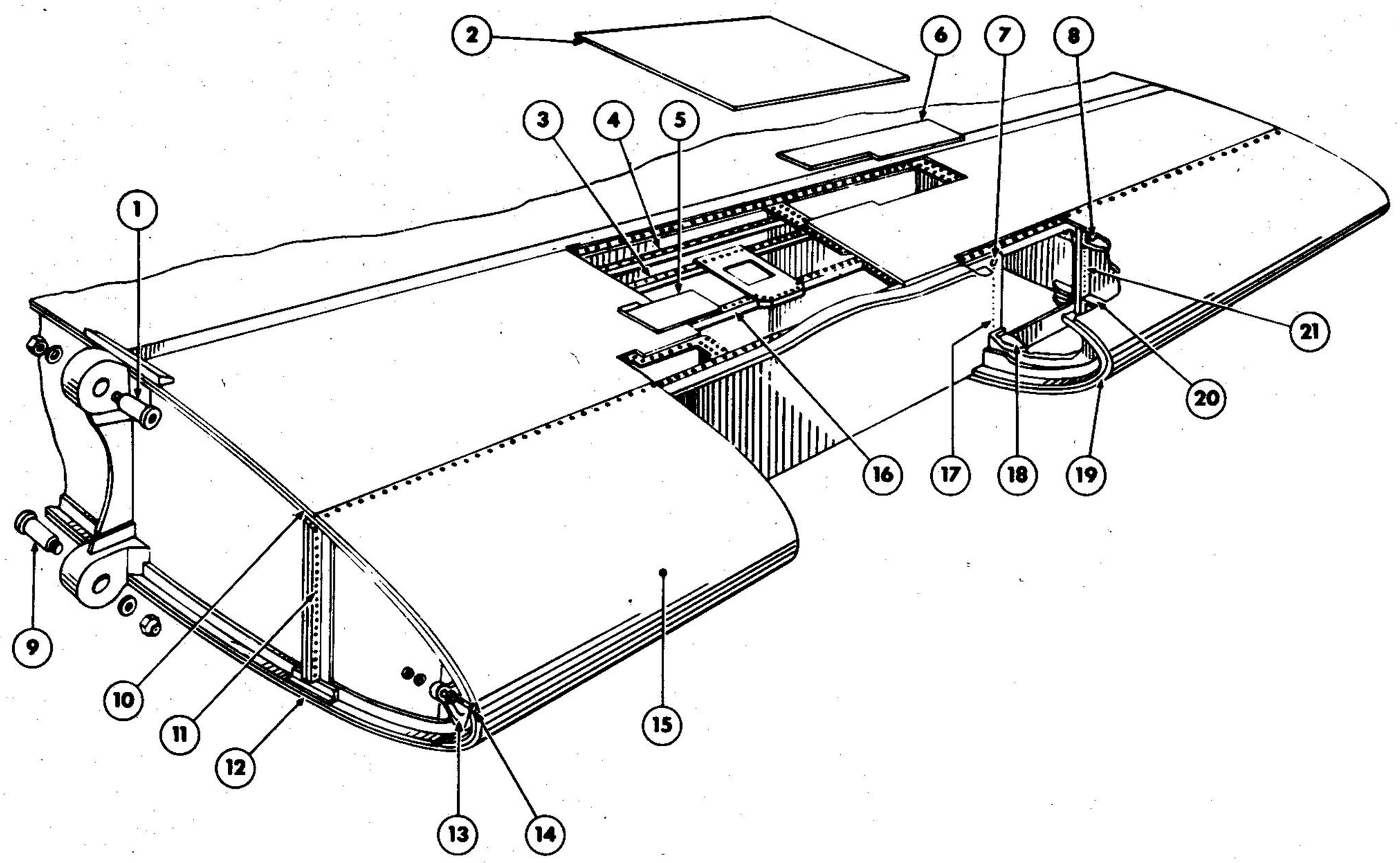
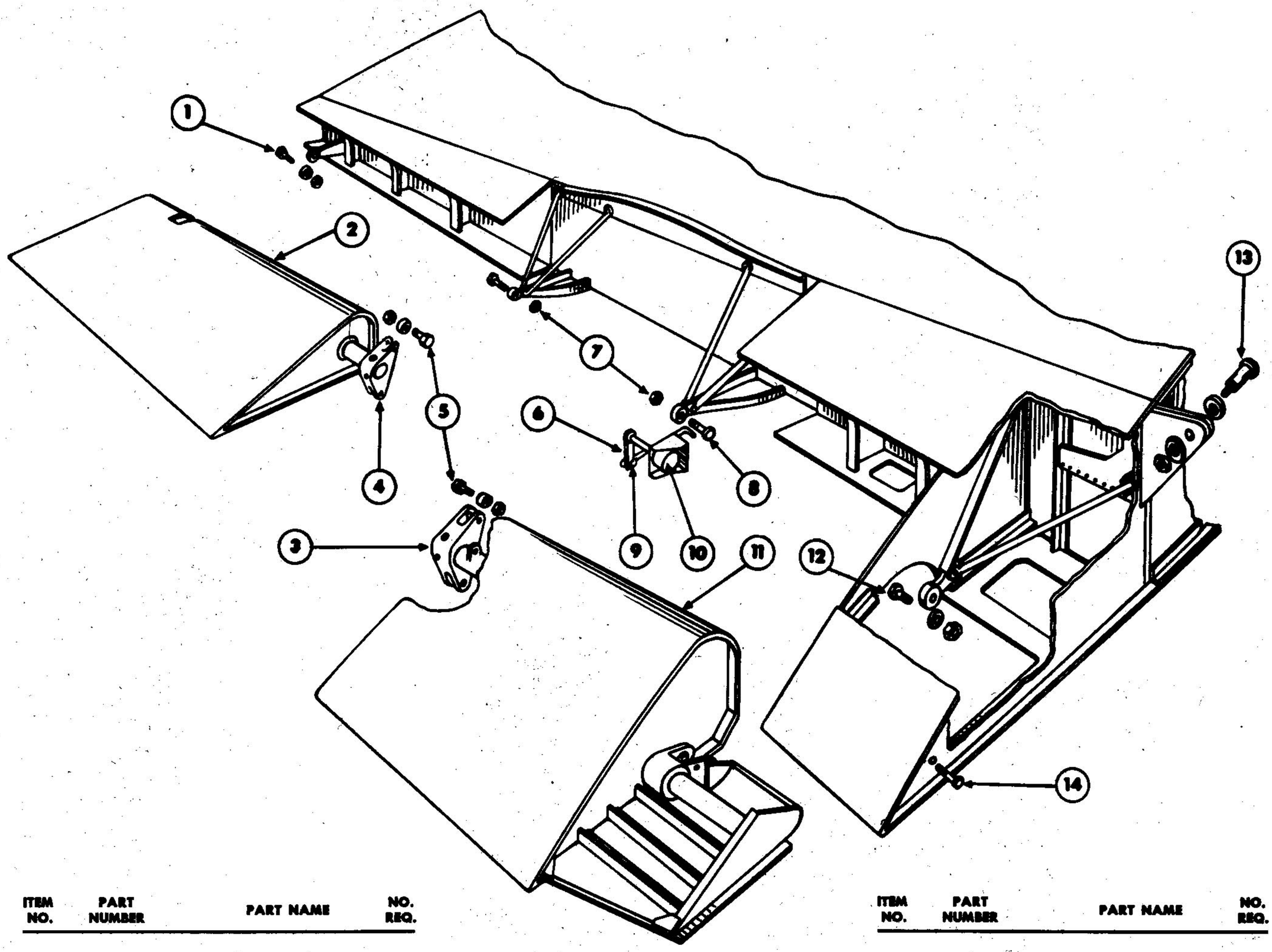


Figure 33 - OUTER WING ASSEMBLY AND INSTALLATION



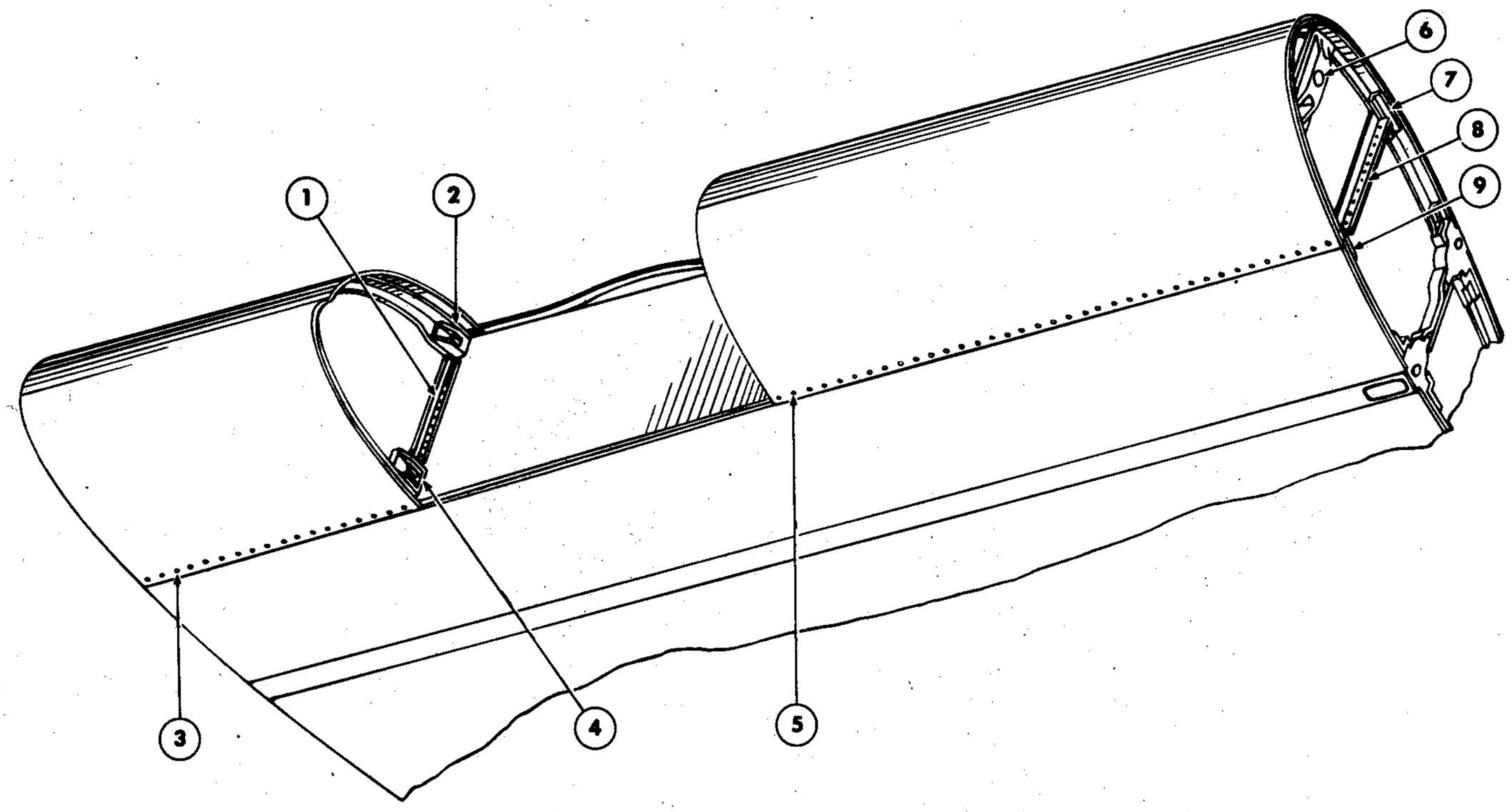
ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	2064982-2	PIN, FUSELAGE AND WING ATTACHING	1
	1066831	WASHER, FUSELAGE AND WING ATTACHING PIN	1
	AN310-14	NUT	1
2.	5106819	STRUCTURE ASSEMBLY, INBOARD WING PANEL SHEAR WEB TO SPAR—L.H.	1
	5106819-1	STRUCTURE ASSEMBLY, INBOARD WING PANEL SHEAR WEB TO SPAR—R.H.	1
	1029421-10-8	SCREW, 100° RECESSED FLAT HEAD	10
	1029421-10-10	SCREW, 100° RECESSED FLAT HEAD	115
	1029421-10-12	SCREW, 100° RECESSED FLAT HEAD	2
3.	5106819	LONGITUDINAL, INBOARD WING PANEL	1
	2067906-16	BOLT	2
	1075888-6A	WASHER, HOLLOW HEX. HEAD BOLT	2
	1108468	NUT, FITTING ATTACHING, ⅜"	2
	146142-187-109	PIN, NUT LOCK	2
4.	5106819	LONGITUDINAL, INBOARD WING PANEL	1
	2067906-16	BOLT	2
	1075888-6A	NUT; HOLLOW HEX. HEAD	2
	146142-187-109	PIN, NUT LOCK	2
5.	5106819-180	PLATE, INBOARD WING COVER—L.H.	1
	5106819-181	PLATE, INBOARD WING COVER—R.H.	1
	1029421-10-8	SCREW, 100° RECESSED FLAT HEAD	9
	1029421-10-10	SCREW, 100° RECESSED FLAT HEAD	34
	1029421-10-12	SCREW, 100° RECESSED FLAT HEAD	1
6.	5106819-104	PLATE, INBOARD WING COVER—L.H.	1
	5106819-105	PLATE, INBOARD WING COVER—R.H.	1
	1029421-10-8	SCREW, 100° RECESSED FLAT HEAD	15
	1029421-10-10	SCREW, 100° RECESSED FLAT HEAD	41
7.	2076908-23	BOLT, ½" x 20 HOLLOW HEX. HEAD	1
	1075888-8A	WASHER, HOLLOW HEX. HEAD BOLT	1
	1109099	NUT, FITTING ATTACHING, ½"	1
	146142-187-208	PIN, NUT LOCK	1
	4108738-2	FITTING ASSEMBLY, STATION 100.16 UPPER FRONT ATTACHING—L.H.	1
	4108738-3	FITTING ASSEMBLY, STATION 100.16 UPPER FRONT ATTACHING—R.H.	1
	AN5-17A	BOLT—TWO AFT HOLES	2
	AN5-6A	BOLT—TWO FORWARD HOLES	2
	AN6-7A	BOLT—CENTER HOLE	1
	AC365-524	NUT	4
	AC365-624	NUT	1
	AN960-10L	WASHER	1
	4109025	FITTING, INNER WING STATION 100.16 UPPER ATTACHING—L.H.	1
	4109025-1	FITTING, INNER WING STATION 100.16 UPPER ATTACHING—R.H.	1
	1029421-516-13	SCREW, 100° RECESSED FLAT HEAD	2

Figure 34 - UPPER SURFACE OF FRONT SECTION OF INNER WING



ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	AN5-14A	BOLT, HINGE	1
	AN310-5	NUT	1
	AN960-516	WASHER	1
2.	5062434	FLAP ASSEMBLY, OUTBOARD LANDING—L.H.	1
	5062434-1	FLAP ASSEMBLY, OUTBOARD LANDING—R.H.	1
3.	4061651	ARM, FLAP OPERATING	1
	AC386-3-18A	PIN, TAPER	1
	AC386-3-19A	PIN, TAPER	1
	AC364-428	NUT	2
	AC975-4	WASHER	2
4.	4061651-2	ARM, FLAP OPERATING	1
	AC386-3-18A	PIN, TAPER	1
	AC386-3-19A	PIN, TAPER	1
	AC364-428	NUT	2
	AC975-4	WASHER	2
5.	AN4-15	BOLT, HINGE	2
	AN310-4	NUT	2
	1026614-4	SPACER (.018) O.D. BEARING	2
6.	1029951	LEVER, PLATE	1
7.	AN310-8	NUT	2
8.	AN8-21	BOLT	2
	AN960-10	WASHER	2
	AN380-2-2	COTTER	2
9.	AN393-11	PIN	1
10.	TYPE TJ-9	TRANSMITTER, G. E.	1
	AN515-8-16	SCREW	4
	AC365-832	NUT	4
11.	5062435	FLAP ASSEMBLY, INBOARD LANDING—L.H.	1
	5062435-1	FLAP ASSEMBLY, INBOARD LANDING—R.H.	1
12.	AN5-24	BOLT, HINGE	1
	AN960-516	WASHER	1
	AN310-5	NUT	1
13.	1060306	BOLT, WING TO FUSELAGE ATTACHING	1
	AC975-8	WASHER	1
	AN960-816	WASHER	1
	AN320-8	NUT	1
14.	AN4-11A	BOLT	2
	AC365-428	NUT	2
	AN960-416	WASHER	2

Figure 35 - UPPER SURFACE OF REAR SECTION OF INNER WING



ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	AN3-5A	BOLT, FLANGE ATTACHING	14
	AN960-10	WASHER	14
2.	2076906-20	BOLT, 3/8" x 24 HOLLOW HEX. HEAD	1
	1076888-6A	WASHER, HOLLOW HEX. HEAD BOLT	1
	1108468	NUT, FITTING ATTACHING, 3/8"	1
	146142-187-114	PIN, NUT LOCK	1
	2108996	FITTING, STATION 48.45 INNER WING UPPER AFT ATTACHING—L.H.	1
	2108996-1	FITTING, STATION 48.45 INNER WING UPPER AFT ATTACHING—R.H.	1
	1029421-516-13	SCREW, 100° RECESSED FLAT HEAD	1
	1029421-516-15	SCREW, 100° RECESSED FLAT HEAD	2
	AN960-516	WASHER	3
	AC365-524	NUT	3
	1029421-416-19	SCREW, 100° RECESSED FLAT HEAD	1
	AN960-516	WASHER	1
	AC365-428	NUT	1
	1029421-10-18	SCREW, 100° RECESSED FLAT HEAD	2
	AN960-516	WASHER	2
	AC365-1032	NUT	2
	AN5-6A	BOLT—ATTACHMENT TO BRACKET	2
	AN960-516	WASHER	2
	AC365-524	NUT	2
	2109100-2	FITTING, STATION 48.45 INNER WING UPPER FORWARD ATTACHING	6
	AN5-7A	BOLT	6
	AC365-524	NUT	6
	AN960-516	WASHER	6
3.	1029421-10-10	SCREW, 100° RECESSED FLAT HEAD	98
4.	2076906-20	BOLT, 3/8" x 24 HOLLOW HEX. HEAD	2
	1075888-6A	WASHER, HOLLOW HEX. HEAD BOLT	2
	1108468	NUT, FITTING ATTACHING, 3/8"	2
	146142-187-204	PIN, NUT LOCK	1
	1029421-516-14	SCREW, 100° RECESSED FLAT HEAD	6
	AN960-516	WASHER	6
	AC365-524	NUT	6

ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
	4107523-2	FITTING ASSEMBLY, INNER WING STATION 48.45 FORWARD—L.H.	1
	4107523-3	FITTING ASSEMBLY, INNER WING STATION 48.45 FORWARD—R.H.	1
	4107524	FITTING ASSEMBLY, INNER WING STATION 48.45 AFT—L.H.	1
	4107524-1	FITTING ASSEMBLY, INNER WING STATION 48.45 AFT—R.H.	1
	1029421-516-13	SCREW, 100° RECESSED FLAT HEAD	6
	AN960-516	WASHER	6
	AC365-524	NUT	6
5.	1029421-10-10	SCREW, 100° RECESSED FLAT HEAD	114
6.	1107832	FITTING, WING ATTACHING NUT PLATE SHORT	1
	AN510-10-20	SCREW	2
	AC365-1032	NUT	2
7.	1107867	DOUBLER, STA. 157.11 LEADING EDGE TO FORWARD SECTION, UPPER—L.H.	1
	1107867-1	DOUBLER, STA. 157.11 LEADING EDGE TO FORWARD SECTION, UPPER—R.H.	1
	AN3-7A	BOLT	4
	1029421-10-12	SCREW, 100° RECESSED FLAT HEAD	4
	AN960-10	WASHER	4
	AC365-1032	NUT	4
8.	AN3-5A	BOLT, FLANGE ATTACHING	11
	AN960-10	WASHER	11
	AC365-1032	NUT	11
9.	1108029	DOUBLER, STA. 157.11 LEADING EDGE TO FORWARD SECTION, LOWER—L.H.	1
	1108029-1	DOUBLER, STA. 157.11 LEADING EDGE TO FORWARD SECTION, LOWER—R.H.	1
	AN3-7A	BOLT	4
	1029421-10-12	SCREW, 100° RECESSED FLAT HEAD	4
	AN960-10	WASHER	4
	AC365-1032	NUT	4

Figure 36 - LOWER SURFACE OF FRONT SECTION OF INNER WING

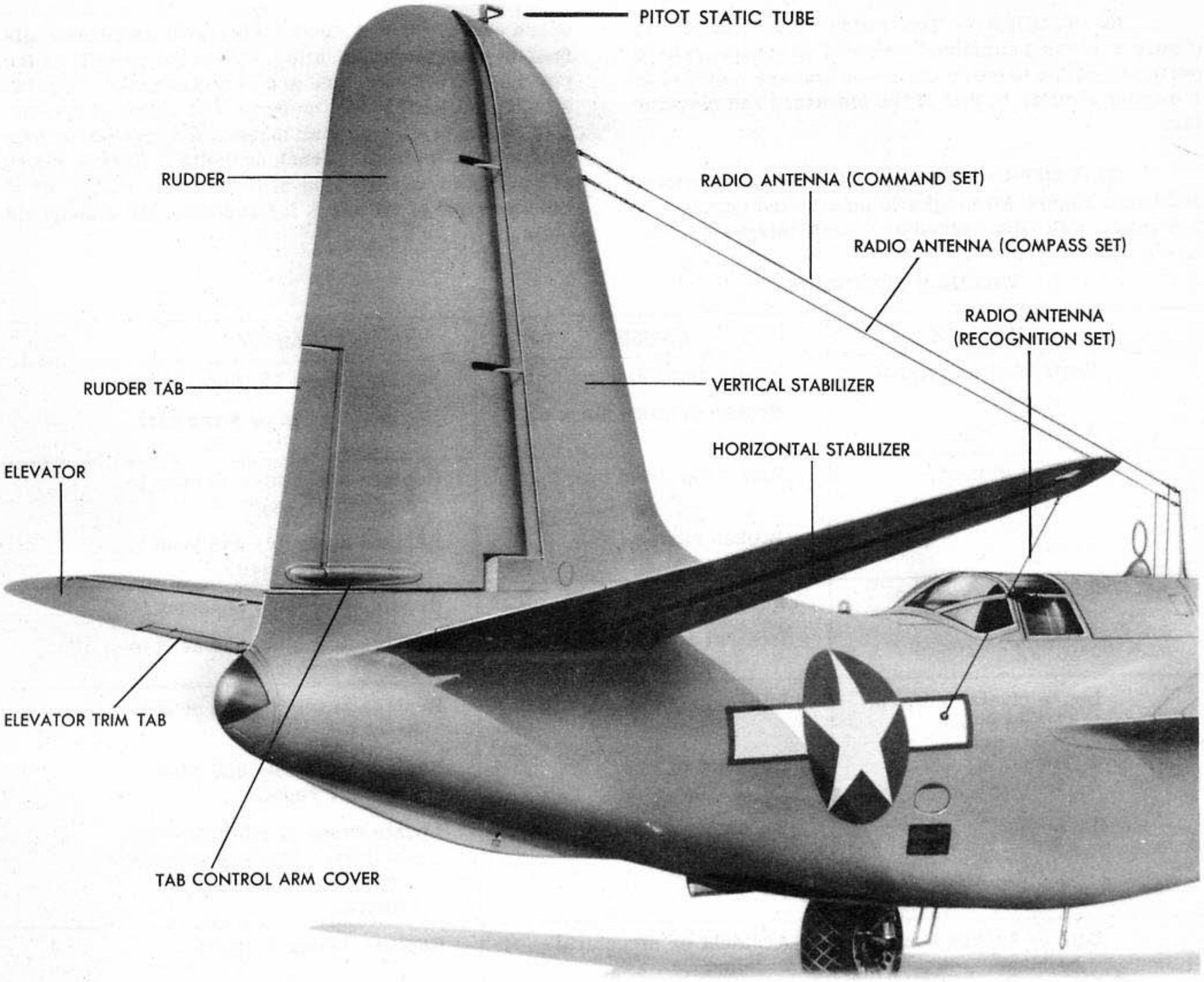


Figure 37 - EMPENNAGE

(3) ELEVATORS. - Each of the two elevators (figure 37) weighs 35 pounds and consists of a single spar of flange alclad sheets with ribs formed of the same material. The leading edge is covered with alclad sheet, and the complete assembly is covered with fabric. Each elevator is hinged to the horizontal stabilizer at two points. A trim tab is attached to the trailing edge of each elevator by two hinges and its actuating rod. A torque tube which incorporates a control horn for attaching the cables is attached to the inboard end of each elevator and connects the elevators to the universal joint at the center line of the fuselage. Design of the elevators is such that the right-hand and left-hand elevators may be interchanged in an emergency.

(4) HORIZONTAL STABILIZER. - Each half of the horizontal stabilizer (figure 37) weighs 42 pounds and is made up of two spars with ribs spaced at intervals of approximately five inches. The spars are made of formed sheet alclad with extruded angle cap strips of aluminum alloy. Ribs and covering are of alclad sheet. The tip assembly attaches at Station 114 (figure 7) with flathead machine screws. The complete assemblies are attached to the fuselage at four points with 1/2-inch bolts of the internal wrenching type. The upper attachment holes are drilled 1/2 inch for a snug fit while the lower ones are drilled 9/16 inch to give a loose fit. In this type connection, the upper bolts take the shear and the lower bolts take the tension.

(5) RUDDER TAB. - The rudder tab (figure 37) is hinged to the trailing edge of the rudder. Its construction is the same as the elevator trim tabs.

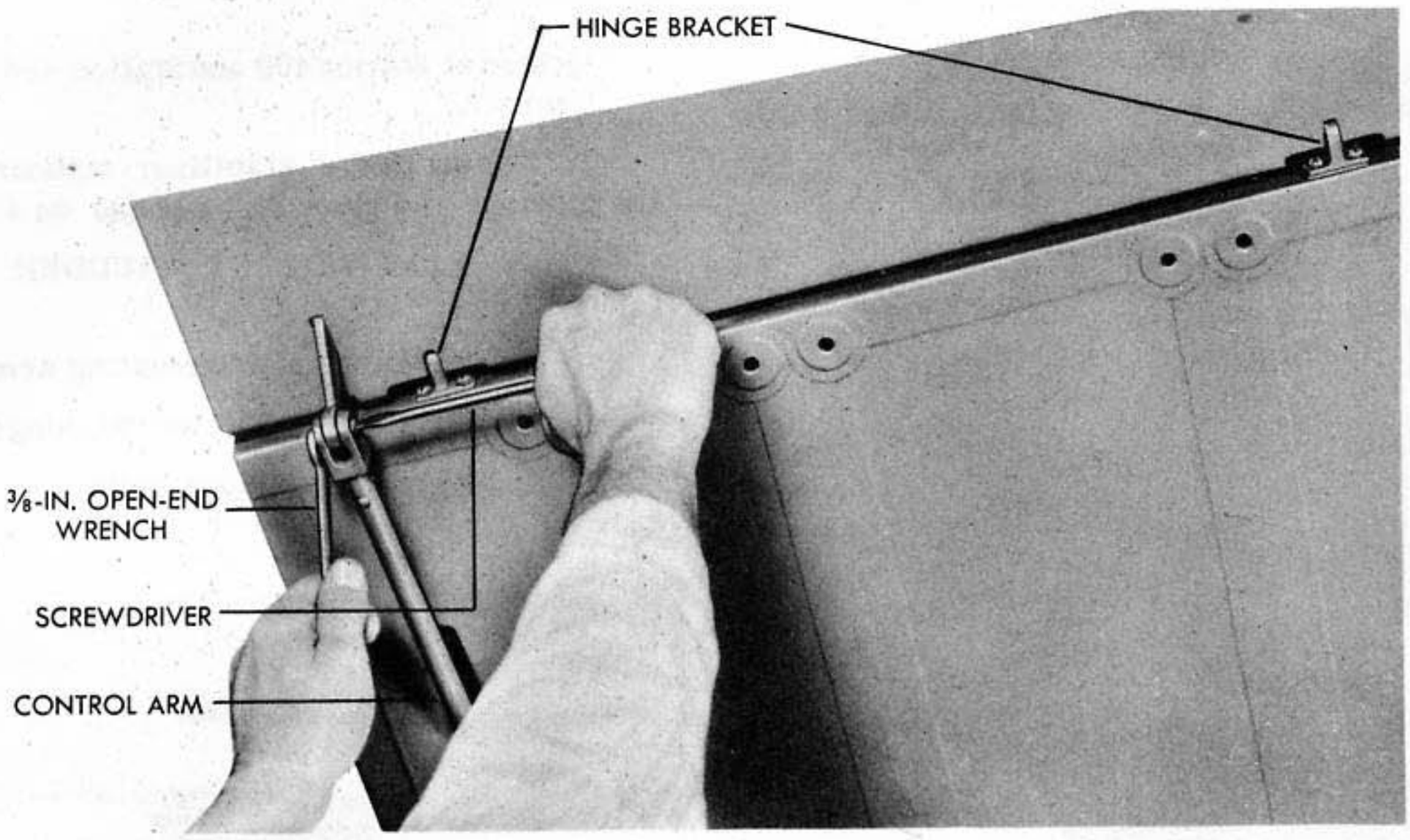


Figure 38 - REMOVING ELEVATOR TRIM TAB

(d) Remove outboard access door (H).

(e) Remove outboard hinge attaching bolts through outboard access door (H).

(f) Remove inboard access door (H).

(g) Remove inboard hinge attaching bolt through inboard access door (H).

(h) Move elevator down away from hinge and out from elevator torque tube in a horizontal position.

(3) REMOVAL OF HORIZONTAL STABILIZER. (See figure 40.)

(a) Remove elevator.

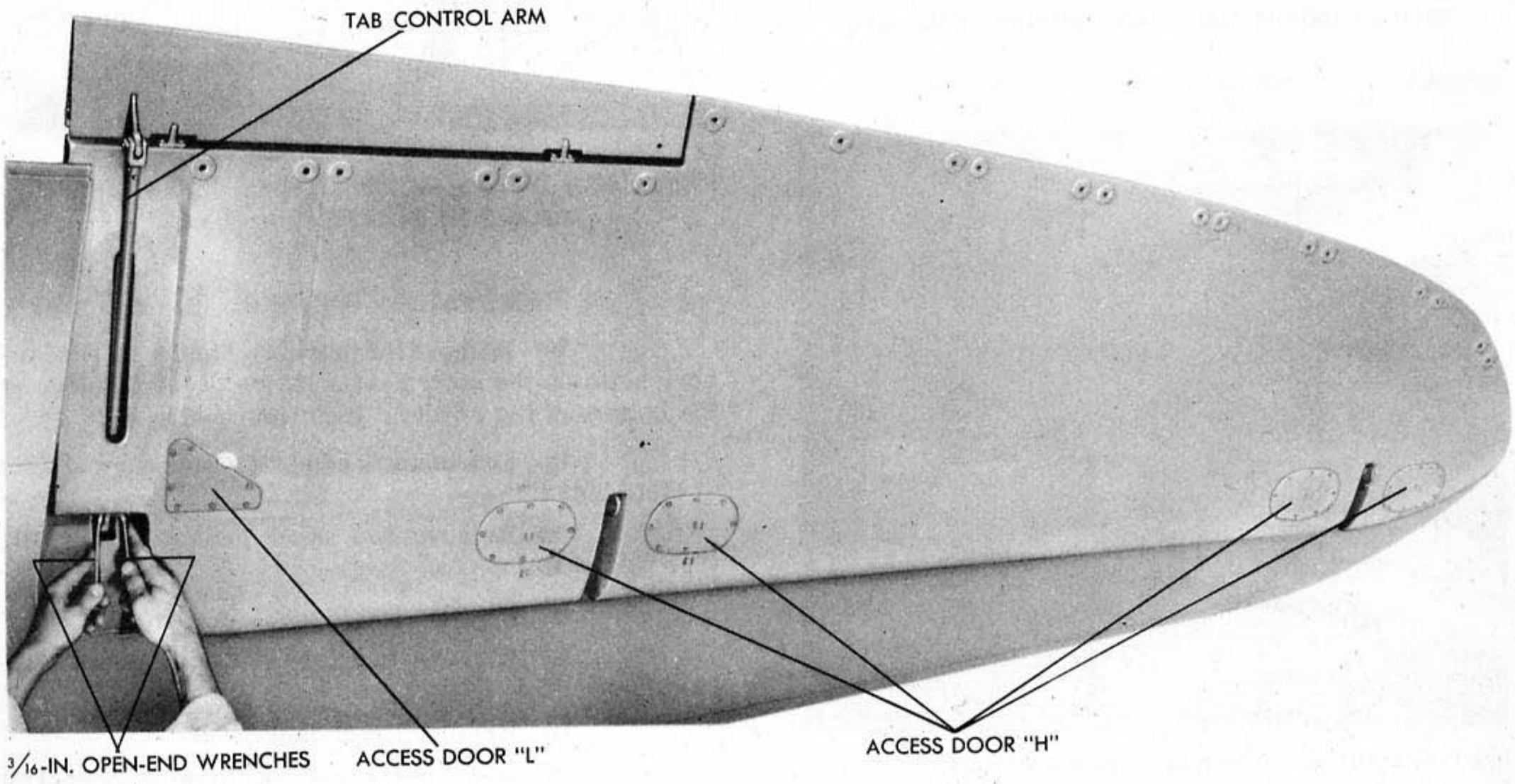


Figure 39 - REMOVING ELEVATOR

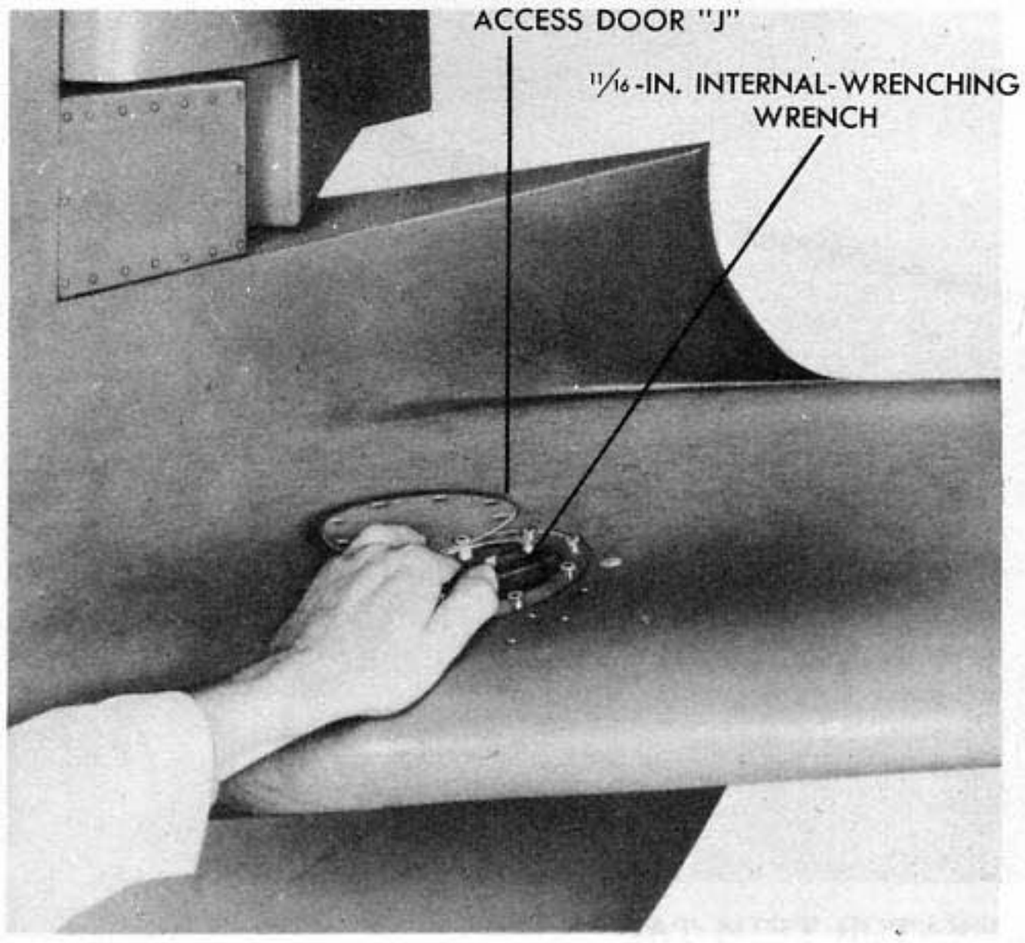


Figure 40 - REMOVING HORIZONTAL STABILIZER

(b) Remove access door (J) at leading edge of the horizontal stabilizer.

(c) Remove the two leading edge internal wrenching bolts and the two trailing edge internal wrenching bolts.

NOTE

This operation requires one man inside of the fuselage and one man on the outside. Bolts are located at Station 409 and Station 436 rear. (See figure 7.)

(d) Move stabilizer outboard away from the fuselage and place in a rack or on a padded bench.

(4) REMOVAL OF RUDDER TAB. (See figure 41.)

(a) Disconnect actuating arm.

(b) Remove the two tab hinge strips.

(c) Remove hinge bolts.

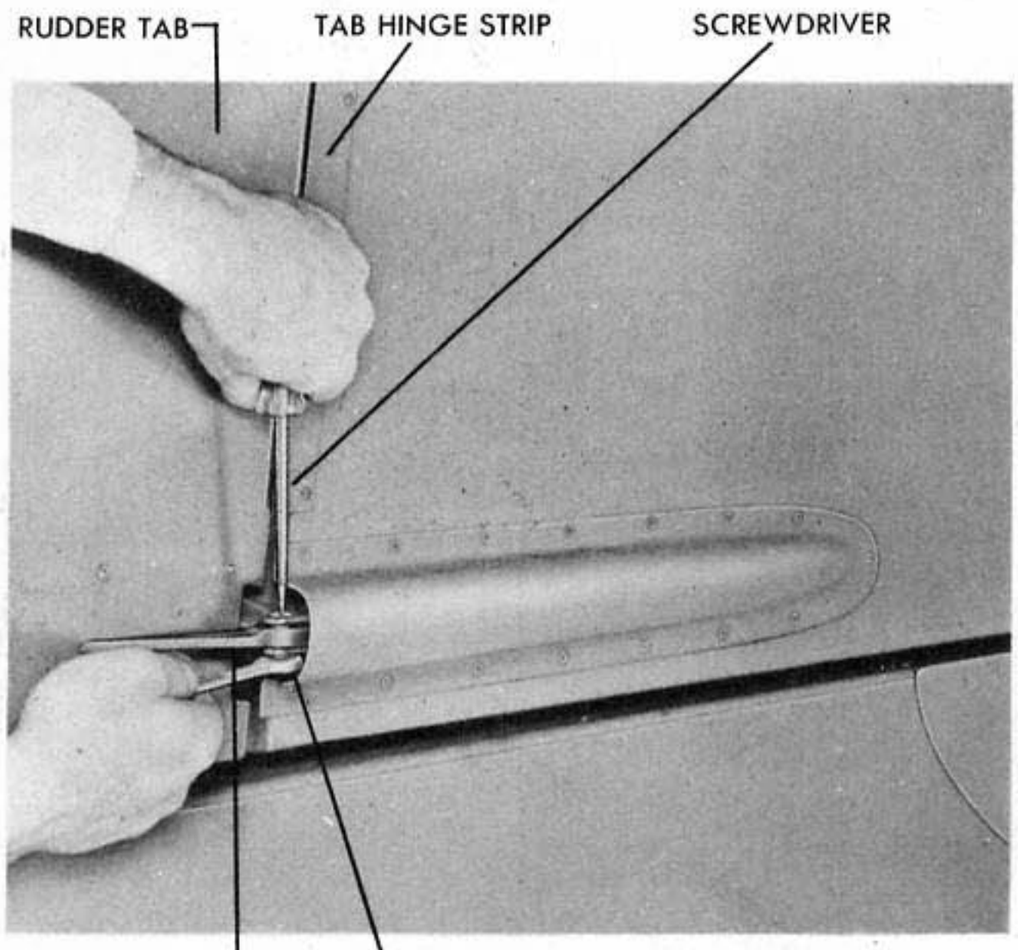


Figure 41 - REMOVING RUDDER TAB

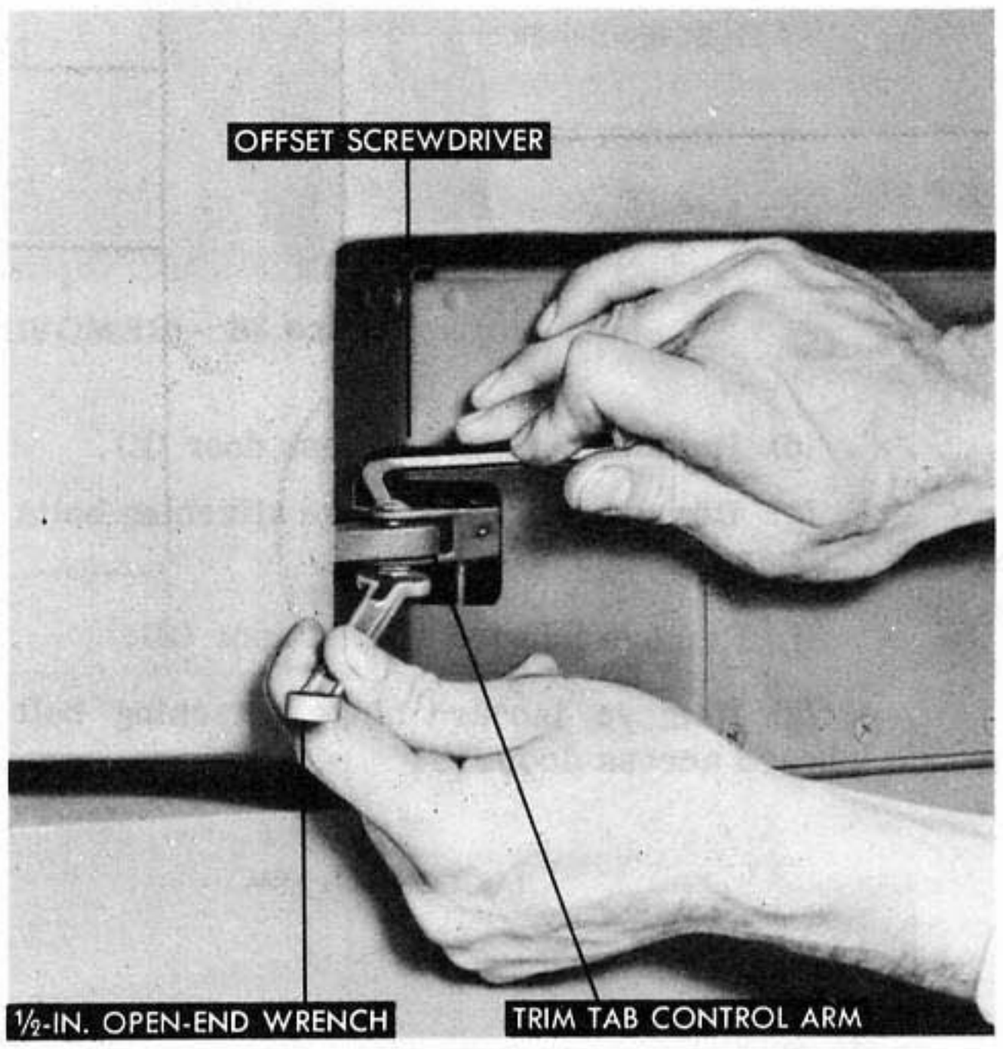


Figure 42 - DISCONNECTING TRIM TAB CONTROL ARM FOR RUDDER REMOVAL

(5) REMOVAL OF RUDDER. (See figure 42.)

(a) Remove the four attachment-to-rudder-horn bolts on the control arm inside of the fuselage at the bottom of the rudder. (See figure 47.)

(b) Disconnect rudder trim tab control arm at Station 436.

(c) Remove two upper access doors (M). (See figure 18.)

(d) Remove upper hinge bolt.

(e) Remove two lower access doors (M). (See figure 18.)

(f) Remove lower hinge bolt.

(g) Lift rudder out and up at a 10-degree angle to either the right or left in order that the collar of the torque tube will clear the opening in the fuselage.

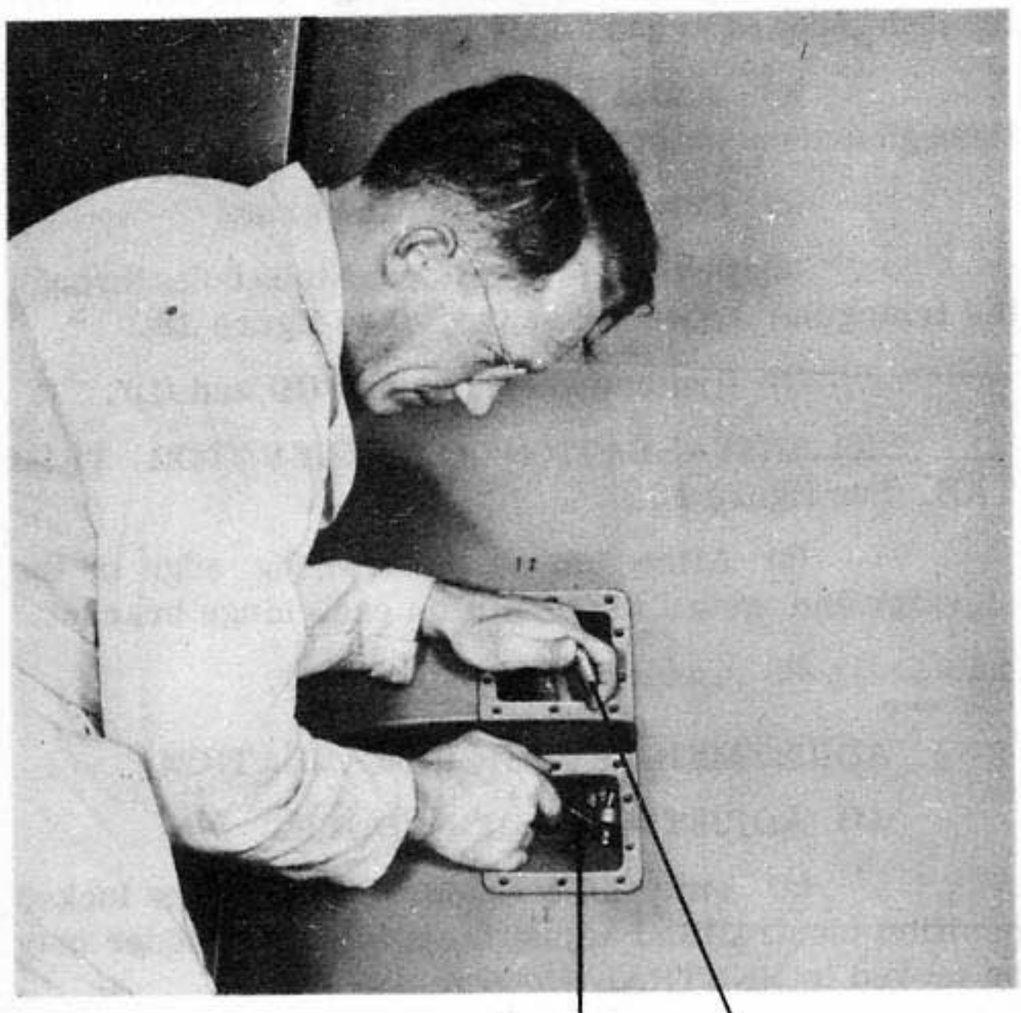


Figure 43 - REMOVING RUDDER LOWER HINGE BOLT

(h) Place rudder in a rack or on a padded bench.

(6) REMOVAL OF VERTICAL STABILIZER. (See figure 44.)

(a) Remove rudder.

(b) Remove trim tab drum covers at Station 425 held in place by screws. (See figure 7.)

(c) Disconnect pitot lines at Station 400. (See figure 7.)

(d) Disconnect electrical connection at junction box Station 380. (See figure 7.)

(e) Remove the access door cover (F) (figure 18) on each side of the stabilizer, front.

(f) Remove the access door cover (F) (figure 18) on each side of the stabilizer, rear.

(g) With one man inside of the fuselage and one man outside, remove the two bolts at the front of the vertical stabilizer and the two bolts at the rear of the vertical stabilizer.

(h) Lift stabilizer straight up and away from the fuselage to clear the pitot static tubes located at the base of the stabilizer. Place in rack or stand on leading edge.

d. INSTALLATION.

(1) INSTALLATION OF VERTICAL STABILIZER. (See figure 44.)

(a) Place stabilizer in position on the fuselage.

(b) With one man inside of the fuselage and one man outside, install two attaching bolts at rear of stabilizer through rear access doors (f). (See figure 18.)

(c) Install the two attaching bolts at the front of the stabilizer through front access doors (F). (See figure 18.)

(d) Install front and rear access door covers (F) (figure 18) on right and left sides of stabilizer.

(e) Connect electrical connections at junction box at Station 380. (See figure 7.)

(f) Connect pitot plugs at Station 400. (See figure 7.)

(g) Install trim tab drum cover held in place by screws at Station 425. (See figure 7.)

(h) Install rudder.

(2) INSTALLATION OF RUDDER. (See figure 47.)

(a) Insert rudder control shaft and aline hinges.

(b) Install lower hinge bolt.

(c) Install upper hinge bolt.

(d) Install the four attachment-to-rudder-horn bolts on the control arm inside of the fuselage, at the bottom of the rudder.

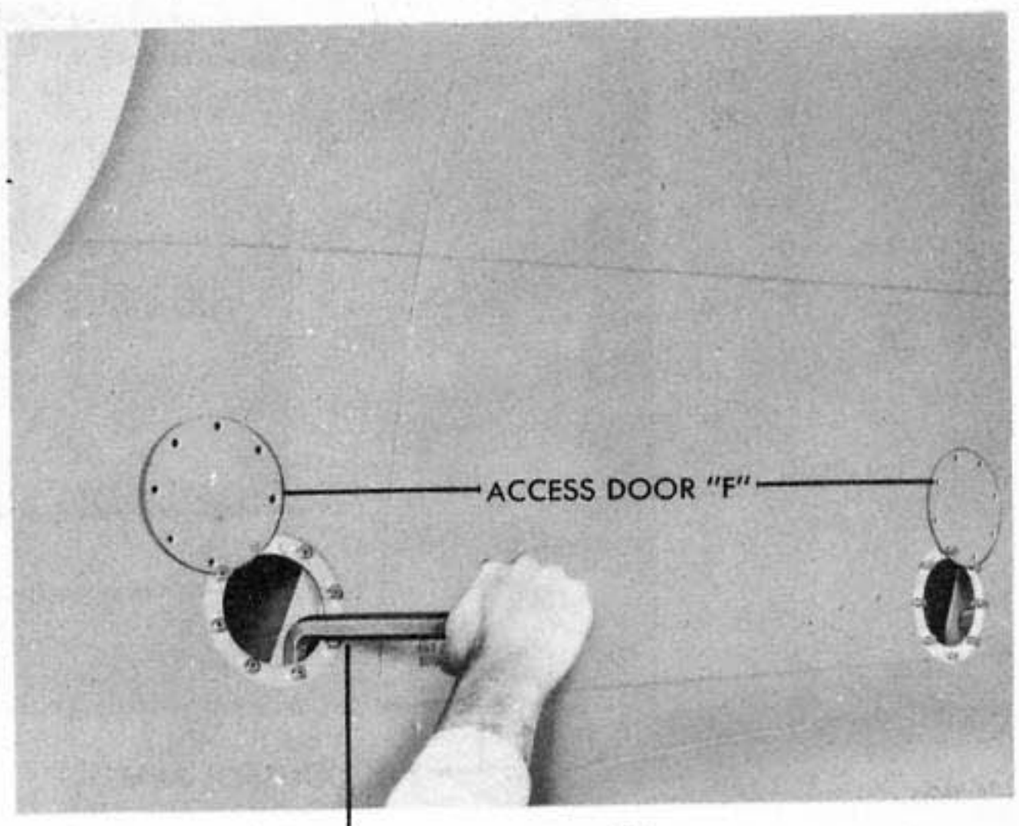


Figure 44 - REMOVING VERTICAL STABILIZER

(e) Connect trim tab control arm.

(f) Install two lower access doors (M). (See figure 18.)

(g) Install two upper access doors (M). (See figure 18.)

(3) INSTALLATION OF RUDDER TAB. (See figure 41.)

(a) Install upper hinge bolt.

(b) Install lower hinge bolt.

(c) Connect actuating arm.

(d) Install the two tab hinge strips on trailing edge of rudder.

(4) INSTALLATION OF HORIZONTAL STABILIZER. (See figure 40.)

(a) Move stabilizer into position.

(b) Install internal wrenching bolts at Station 409 and Station 436. (See figure 7.) Two men (one inside fuselage and one outside) are required to perform this operation.

(c) Install elevators.

(d) Install access doors.

(5) INSTALLATION OF ELEVATOR. (See figure 39.)

(a) Aline elevator hinges.

(b) Install inboard hinge attaching bolt through inboard access door (H). (See figure 18.)

(c) Install outboard hinge attaching bolt through access outboard door (H). (See figure 18.)

(d) Connect tab actuating arm.

(e) Install elevator torque tube bolts through the triangular access door (L). (See figure 18.)

(f) Replace access doors (H) and (L).

(6) INSTALLATION OF ELEVATOR TRIM TAB. (See figure 38.)

(a) Aline tab on the trailing edge of the elevator and install hinge bolt on each hinge bracket.

(b) Connect tab control arm.

e. ADJUSTMENT AFTER INSTALLATION.

(1) ADJUSTMENT OF RUDDER.

(a) Put pilot's rudder pedals in the locked position (neutral) and adjust turnbuckle so rudder may be moved to NEUTRAL.

(b) Adjust stops for pilot's rudder pedal torque tube horns, accessible through a cover plate on the side of the fuselage for rudder movement of 22-1/2 degrees to the right and left, or a distance of 19-1/2 - 7/8 inch measured from the lower corner of the rudder tab trailing edge (tab in neutral) to the empennage stub rudder fairing.

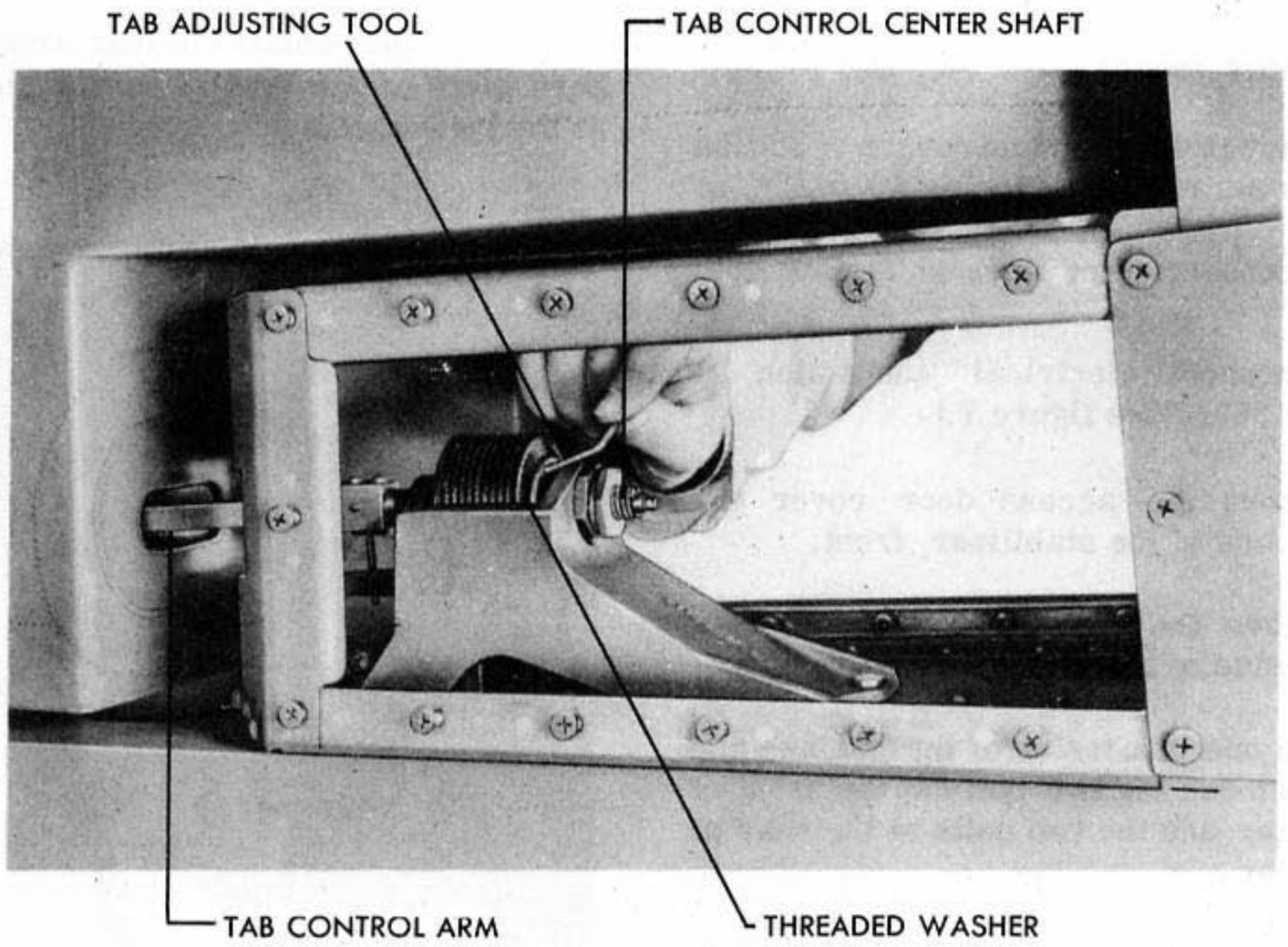
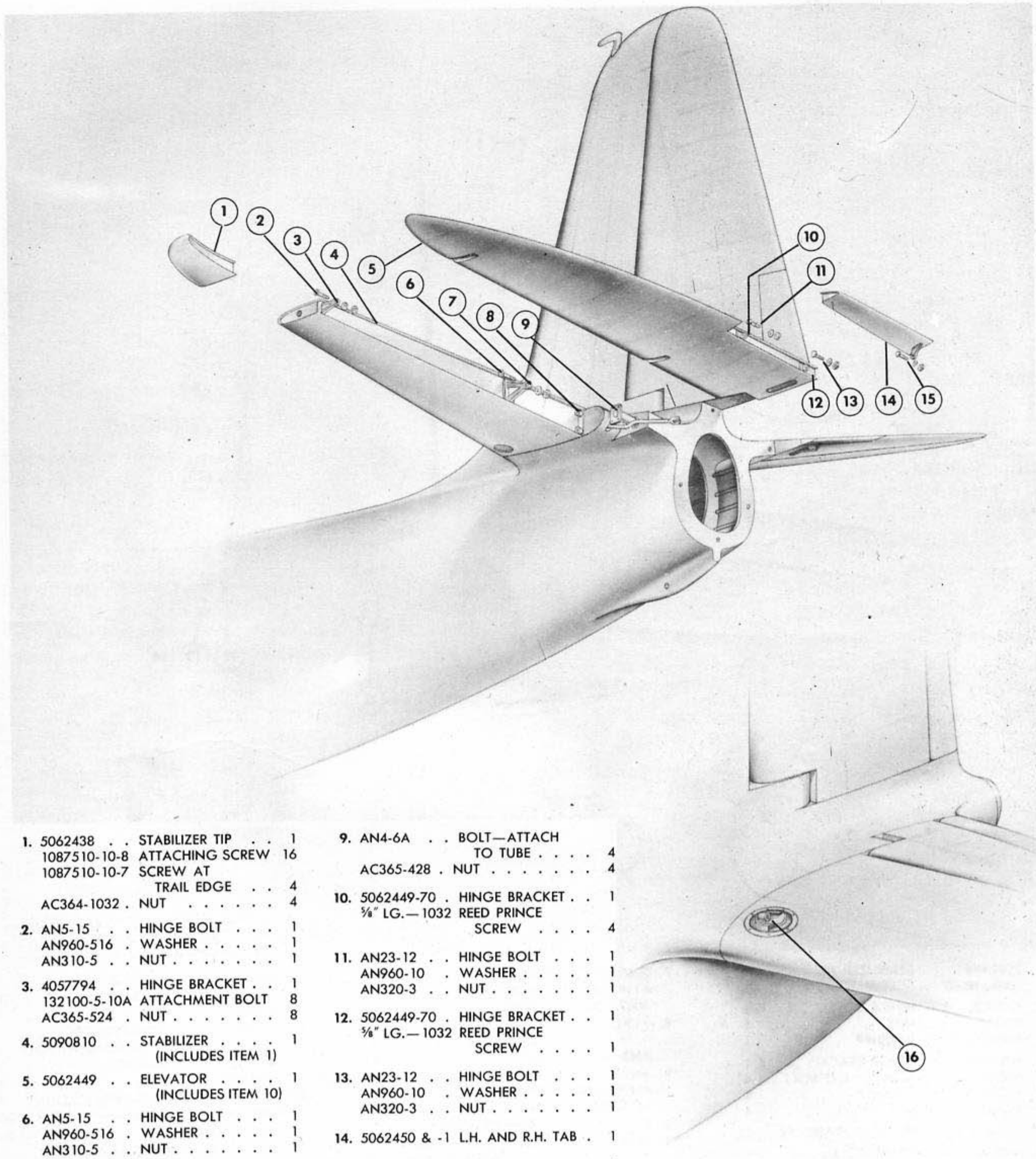
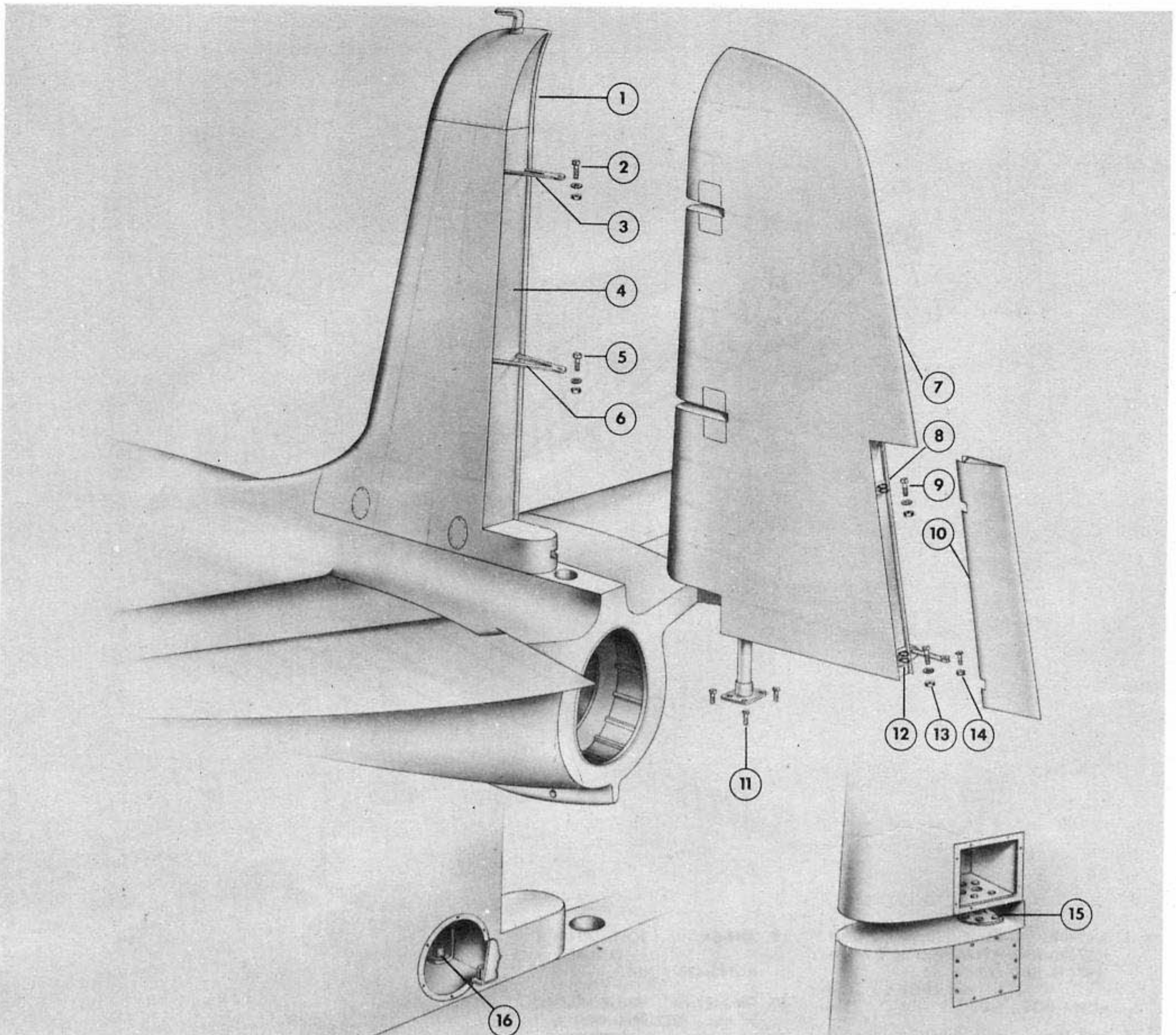


Figure 45 - ADJUSTING RUDDER TAB



1.	5062438	STABILIZER TIP	1
	1087510-10-8	ATTACHING SCREW	16
	1087510-10-7	SCREW AT TRAIL EDGE	4
	AC364-1032	NUT	4
2.	AN5-15	HINGE BOLT	1
	AN960-516	WASHER	1
	AN310-5	NUT	1
3.	4057794	HINGE BRACKET	1
	132100-5-10A	ATTACHMENT BOLT	8
	AC365-524	NUT	8
4.	5090810	STABILIZER (INCLUDES ITEM 1)	1
5.	5062449	ELEVATOR (INCLUDES ITEM 10)	1
6.	AN5-15	HINGE BOLT	1
	AN960-516	WASHER	1
	AN310-5	NUT	1
7.	4057795	HINGE BRACKET	1
	132100-5-10A	ATTACHMENT BOLT	8
	AC365-524	NUT	8
8.	2076909-27	ATTACHMENT BOLT	2
	1075888-9	WASHER	2
	2032517-918	NUT	2
9.	AN4-6A	BOLT—ATTACH TO TUBE	4
	AC365-428	NUT	4
10.	5062449-70	HINGE BRACKET	1
	5/8" LG.—1032	REED PRINCE SCREW	4
11.	AN23-12	HINGE BOLT	1
	AN960-10	WASHER	1
	AN320-3	NUT	1
12.	5062449-70	HINGE BRACKET	1
	5/8" LG.—1032	REED PRINCE SCREW	1
13.	AN23-12	HINGE BOLT	1
	AN960-10	WASHER	1
	AN320-3	NUT	1
14.	5062450 & -1	L.H. AND R.H. TAB	1
15.	AN23-12	BOLT	1
	AN960-10	WASHER	1
	AN320-3	NUT	1
16.	2076908-26	ATTACHMENT BOLT	2
	1075888-8	WASHER	2
	2032517-820	NUT	2

Figure 46 - HORIZONTAL TAIL INSTALLATION



1.	5062444	STABILIZER TIP	1
	1087510-10	SCREW	42
2.	AN5-16	HINGE BOLT	1
	AN310-5	NUT	1
	AN960-516	WASHER	1
3.	4061724	HINGE BRACKET	1
	AN5-7A	ATTACHMENT BOLT	4
	AN960-516	WASHER	4
	AC365-524	NUT	4
4.	5090812	VERTICAL STABILIZER	1
5.	AN5-16	HINGE BOLT	1
	AN960-516	WASHER	1
	AN310-5	NUT	1
6.	4061725	HINGE BRACKET	1
	132100-5-17A	ATTACHMENT BOLT	4
	AN960-516	WASHER	4
	AC365-524	NUT	4
7.	5062452	RUDDER ASSEMBLY	1
	4114249	FAIRING	1
	1087510-8-7	SCREW	15
8.	2130238	UPPER HINGE BRACKET	1
	AN3-5A	BOLT	4
9.	AN24-17	HINGE BOLT	1
	AN960-416	WASHER	1
	AN320-4	NUT	1
10.	5114526	TRIM TAB ASSEMBLY	1
11.	AN4-12A	BOLTS—ATTACHMENT TO RUDDER HORN	4
	AN960-416	WASHER	4
	AC365-428	NUT	4
12.	2130239	LOWER HINGE BRACKET	1
	AN3-5A	ATTACHMENT BOLT	2
	AN4-6A	ATTACHMENT BOLT	1
13.	AN24-17	HINGE BOLT	1
	AN960-416	WASHER	1
	AN320-4	NUT	1
14.	AN24-17	ACTUATING ROD ATTACHMENT BOLT	1
	AN960-416	WASHER	1
	AN320-4	NUT	1
15.	1067651	HINGE BOLT MOUNT	4
	AN3-4A	ATTACHMENT BOLT	20
	AC365-1032	NUT	20
16.	2076909-27	REAR ATTACHMENT BOLT	2
	1075888-9	WASHER	2
	2032517-918	NUT	2
	2076909-30	FORWARD ATTACHMENT BOLT	2
	1075888-9	WASHER	2
	2032517-918	NUT	2

Figure 47 - VERTICAL TAIL INSTALLATION

(c) Adjust rubber bumpers in tail section so that they just touch horns with pedals depressed to limits.

(d) Adjust all turnbuckles to tension indicated on cable rigging tension chart, Section 8, this handbook.

(e) Safety all turnbuckles.

(2) ADJUSTMENT OF RUDDER TAB. (See figure 45.)

(a) Disconnect tab control arm. With tab indicator in the cockpit at ZERO, the cables should come off center of drum at surface. If they do, no adjustment is needed; otherwise, proceed with following steps:

1 Loosen jam nut on tab control center shaft.

2 Cut safety wire from adjustment nut and loosen nut until 1/4-inch play is obtained.

3 Slide threaded washer free of dowel pins at the opposite end of the center control shaft. Turn the threaded washer right or left until cables come off drum at center with indicator at ZERO.

4 Tighten adjusting nut until play does not exceed 1/32 inch.

5 Tighten and safety jam nut on tab control center shaft and connect tab control arm.

6 Check for proper throw in inches which should be 1-3/4 inches - 1/4 inch to right and left of center.

(3) ADJUSTMENT OF ELEVATOR.

(a) Be sure all elevator control cables are properly seated in the grooves of the pulleys and that no slack is present in the cables.

(b) Adjust the stops at the torque horns to allow the elevators to move UP, 14-1/8 inches $\pm$ 5/16 inch; and DOWN, 9-7/16 inches $\pm$ 5/16 inch, measured at root.

(4) ADJUSTMENT OF ELEVATOR TRIM TAB. (See figure 45.)

(a) To check for proper travel, first disconnect tab control arm. Tab indicator in cockpit should be at zero, and cables should come off center of drum at surface.

(b) Loosen the jam nut on tab control center shaft.

(c) Cut the safety wire off the adjustment nut.

(d) Loosen adjusting nut until 1/4-inch play is obtained.

(e) Slide threaded washer free of the dowel pins on the tab drums at the opposite end of the center control shaft. If the tab is down from neutral flight position, lengthen the shaft to the desired position at neutral by turning threaded washer counterclockwise looking aft. Shorten the shaft, if the tab is in UP position from neutral to the desired position at neutral by turning clockwise looking aft.

(f) Tighten the adjusting nut to eliminate end play. Play must not exceed 1/32 inch.

(g) Tighten locking nut. Safety the adjusting nut.

(h) Reinstall the tab control arm.

(i) Check for proper throw in inches which should be 3/4 inch $\pm$ 5/32 inch UP, and 1-11/32 inch $\pm$ 5/32 inch DOWN. If throw is not within these limits, repeat steps (e) through (i).

4. FUSELAGE.

a. DESCRIPTION.

(1) GENERAL. (See figure 48.) - The fuselage is an all-metal semi-monocoque structure made up of formed alclad sheet frames, extruded aluminum alloy longitudinals, and an alclad covering. It has five divisions: attack nose, pilot's cockpit, bomb bay, gunners' compartment, and tail compartment. The skin is attached to the frames and longitudinals with rivets.

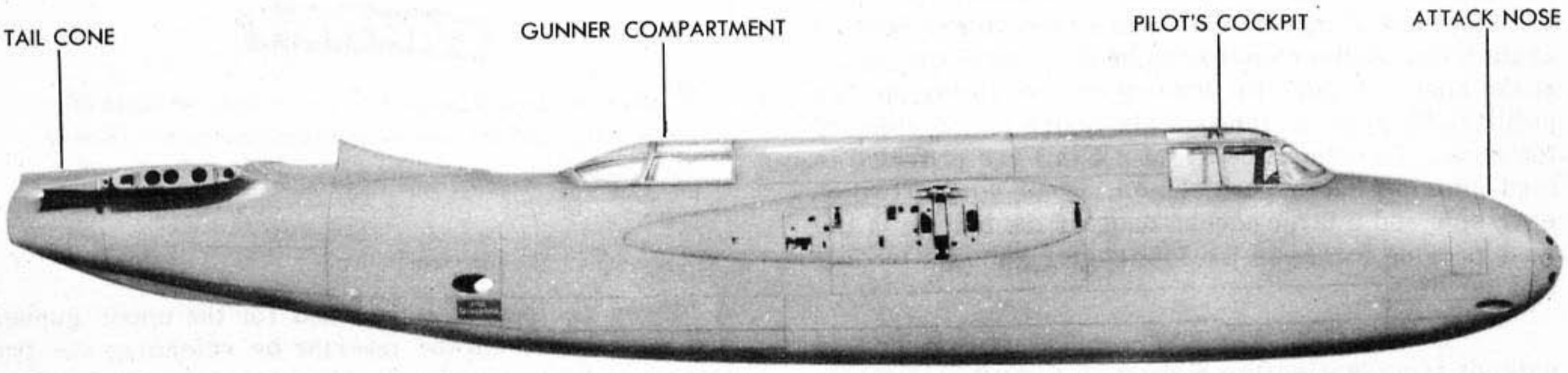
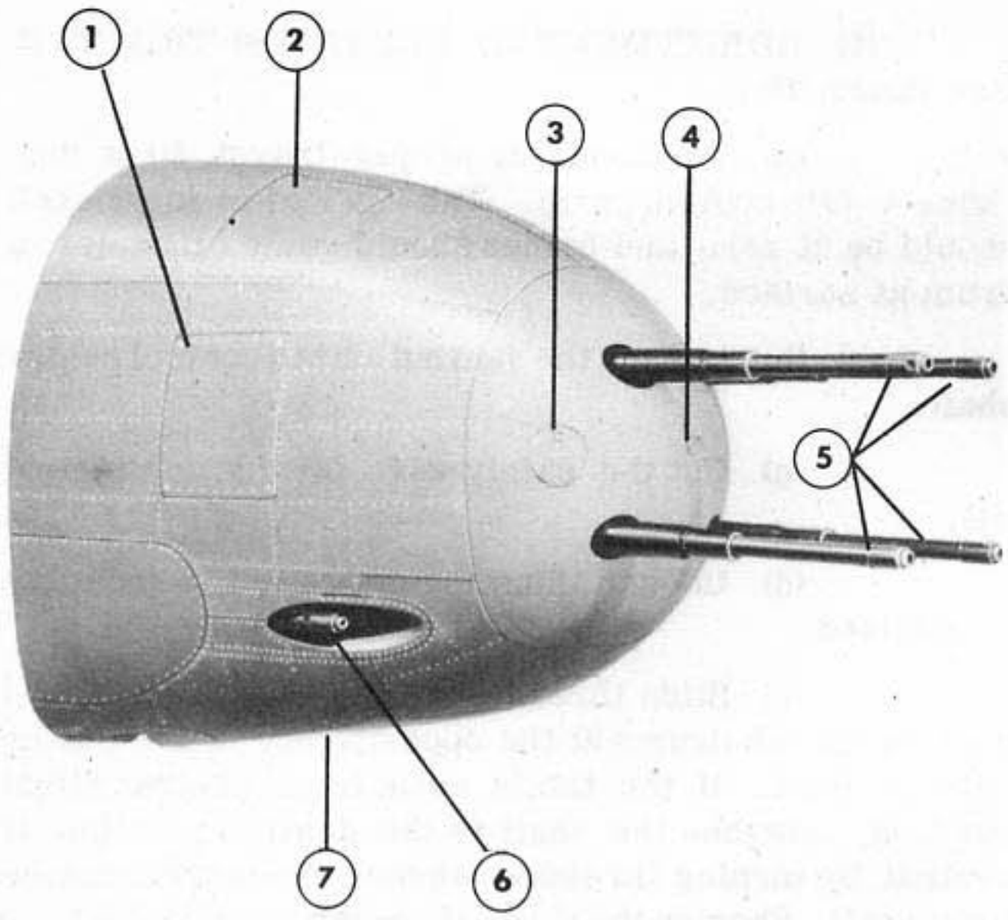


Figure 48 - FUSELAGE



1. LOWER ACCESS DOOR R.H.
2. UPPER ACCESS DOOR R.H.
3. ATTACK NOSE TIP ACCESS DOOR
4. GUN CAMERA DOOR
5. 20-MM CANNON
6. .50 CALIBER GUN
7. LOWER ACCESS DOOR

Figure 49 - ATTACK NOSE

Lap joints are used, with the vertical laps either joggled to make a smooth contour or beveled along the edge of the outer sheet. The enclosures are composed of formed aluminum alloy extrusions, which support panels of Plexiglas and shatterproof glass. Access doors and cover plates are located throughout the fuselage for inspection and maintenance, as shown in figure 18. Frames and bulkheads are located by measuring in inches from the zero datum line which is the front face of the frame to which the nose section is attached. (See figure 7.) Points aft of the datum line are referred to with positive dimensions, and those forward with negative dimensions.

(2) ATTACK NOSE. (See figure 49.) - The attack nose section (figure 49) forms the compartment for the forward armament of the airplane and attaches to the fuselage with ten internal-wrenching bolts at Station 0. (See figure 7.) Six fixed forward-firing guns are mounted in the attack nose. Ammunition boxes are installed alongside each gun in the center portion of the nose. A gun camera can be mounted in the center of the nose. Access for loading and servicing the two caliber .50 guns is through six doors in the sides of the nose. Two small doors (4 x 4 in.) are provided to feed ammunition through chutes. Four doors, two on each side and a large access door on the bottom of the nose provide access to the four center guns for loading and servicing.

(3) PILOT'S COCKPIT. - The pilot's cockpit extends from Station 0 to Station 56 (figure 7) immediately back of the nose wheel well, and contains all of the equipment necessary for normal and emergency operation of the airplane. Entrance must be made through the upper hatch which extends from Station 37 to Station 130 (figure 7) and has its outside latch handle located in the left rear corner. Steps and handholes are provided in the side of the fuselage just aft of the left wing trailing edge for access to the wing walkway and the pilot's cockpit. The lower (retractable) step may be extended by pushing the release button located just above the wing trailing edge in the side of the fuselage. The step must be retracted by pushing it into the fuselage from the outside or pulling it up from within the gunners' compartment. To close the hatch from the interior, the knee of the rear brace must be broken by pulling down on the handle located above the pilot's head on the center line of the hatch. The interior latch control handle is installed to the left of the rear brace control handle. The hatch is also used as the emergency exit for the pilot. To release, pull forward on the handle located at the rear of the transparent section. Pulling this handle removes the hinge pins from the right side and disconnects the latches on the left. Push the hatch clear of the airplane and the air stream will carry it away.

30 (4) BOMB BAY. - The bomb bay is in two sections, fore and aft, and extends from Station 75 to Station 229. (See figure 7.) Doors which extend the full length of the bay are hinged at the sides of the fuselage and are hydraulically actuated. The lower portion of each section of the bomb bay is equipped with supports for two bomb racks. The oxygen system is installed in the upper portion of the forward bomb bay, and the radio equipment is installed in the upper portion of the rear bomb bay. The truss along the top of this section extends from the pilot's to the gunners' compartment, and supports the heating and ventilating unit.

(5) GUNNERS' COMPARTMENT. - The gunners' compartment extends from Station 229 to Station 372 (figure 7) with the entrance door located in the bottom of the fuselage at the rear of the compartment. The latch lever in the center of the door is used during normal entrance and exit. A crank mechanism at the right side of the compartment may be used to open the door from the interior and hold it in open position.

CAUTION

Before the door is opened by the crank, be sure the latch lever at the center of the door is raised. Raising the latch lever "breaks" the knee in the actuating linkage to prevent bending the linkage when the crank is operated.

A hinged enclosure is provided for the upper gunner and is opened from the interior by releasing the two latches at its forward end. After releasing the latches, pull down on the forward end and slide the enclosure

forward until it engages the catches which hold it in stowed position. The enclosure can be opened from the exterior only if the upper right latch has been disengaged from within the compartment. To open the enclosure from the exterior, tear through the fabric patch which covers the access hole of the upper left latch. Release the latch, push down on the forward end of the enclosure and slide the section forward. When the sliding enclosure and the lower entrance door are used as emergency exits, they are operated in the same manner as for normal entrance and exit. A gun tunnel equipped with doors is located just aft of the hinged enclosure and encloses the barrels of the guns when they are in the stowed position. For removing or stowing the guns, the doors are operated by a crank mounted on the left side of the compartment near the floor. The truck on which the upper guns are mounted rolls on a semicircular track bolted to the fuselage. Provision is made for mounting five box-type ammunition magazines on each side of the compartment to supply the upper guns. The lower gun is mounted just forward of the entrance door on a transverse arm which hinges upward and to the left for stowage. Provision is made on the left side of the compartment for mounting five drum-type ammunition magazines to supply the lower gun.

(6) TAIL CONE. - The tail cone (figure 54) is attached to the fuselage at Station 454 (figure 7) by six 3/8-inch internal-wrenching bolts. A formation signal light is installed in the tip of the cone and is enclosed by a cover of molded Plexiglas. Weight of the cone is 27 pounds.

b. TROUBLE SHOOTING.

SYMPTOM	CAUSE	REMEDY
Presence of corrosion.	Protective coating damaged.	Clean corroded part and cover with suitable protective coating such as paint, oil, etc.
	Battery fumes attacking metal parts.	Inspect and repair battery ventilating system. Service battery sump.
	Cracked battery case allows acid to drop onto metal parts.	Replace battery. Remove corrosion and apply suitable protective coating, such as paint or lubricant.
Distorted or ruptured skin. Excessive vibration.	Structural failure due to accident or defect.	Repair or replace bent or broken parts.
	Loose bolts.	Tighten and safety loose bolts.
	Pulled or loosened rivets.	Replace rivets. Replace sheet metal through which rivets have pulled.
Bent structural members, longerons, or braces.	Accident.	Replace damaged parts.

c. REMOVAL.

(1) REMOVAL OF ATTACK NOSE.

(a) Open the access doors (figure 18) on the right and left sides. These doors are held in closed position by a spring loaded lock. By pushing on the side marked PUSH, the lock springs open and the access door may be swung open.

(b) Remove the attack nose tip which is held in place by six winged clip spring fasteners easily reached through access door on side of tip. Slide the tip forward over the gun barrels. (See figure 50.)

(c) Remove armament from attack nose. This permits access to the eight internal wrenching bolts which hold the nose to the fuselage at Station 0. (See figure 7.)

(d) Remove ten internal wrenching bolts from the nose through the access doors and move the nose away from the airplane. Weight of the nose is approximately 400 pounds. About six men are required to handle it manually.

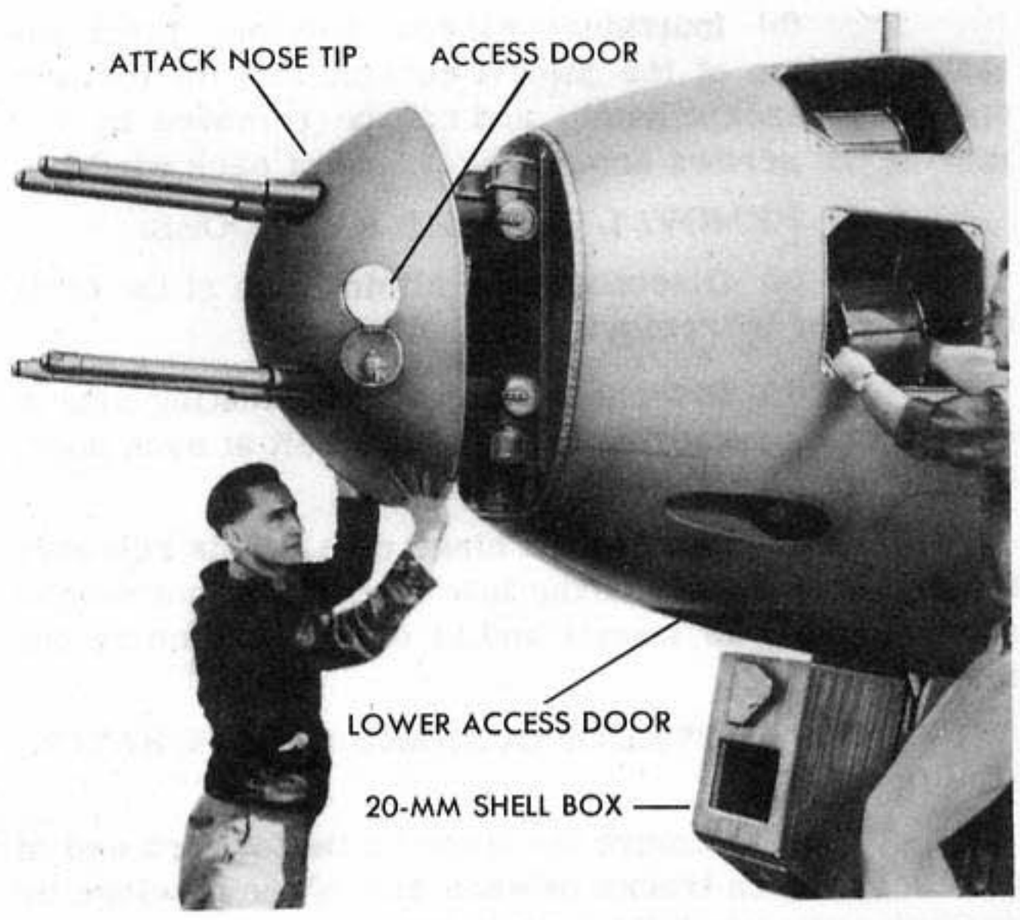


Figure 50 - REMOVING ATTACK NOSE TIP

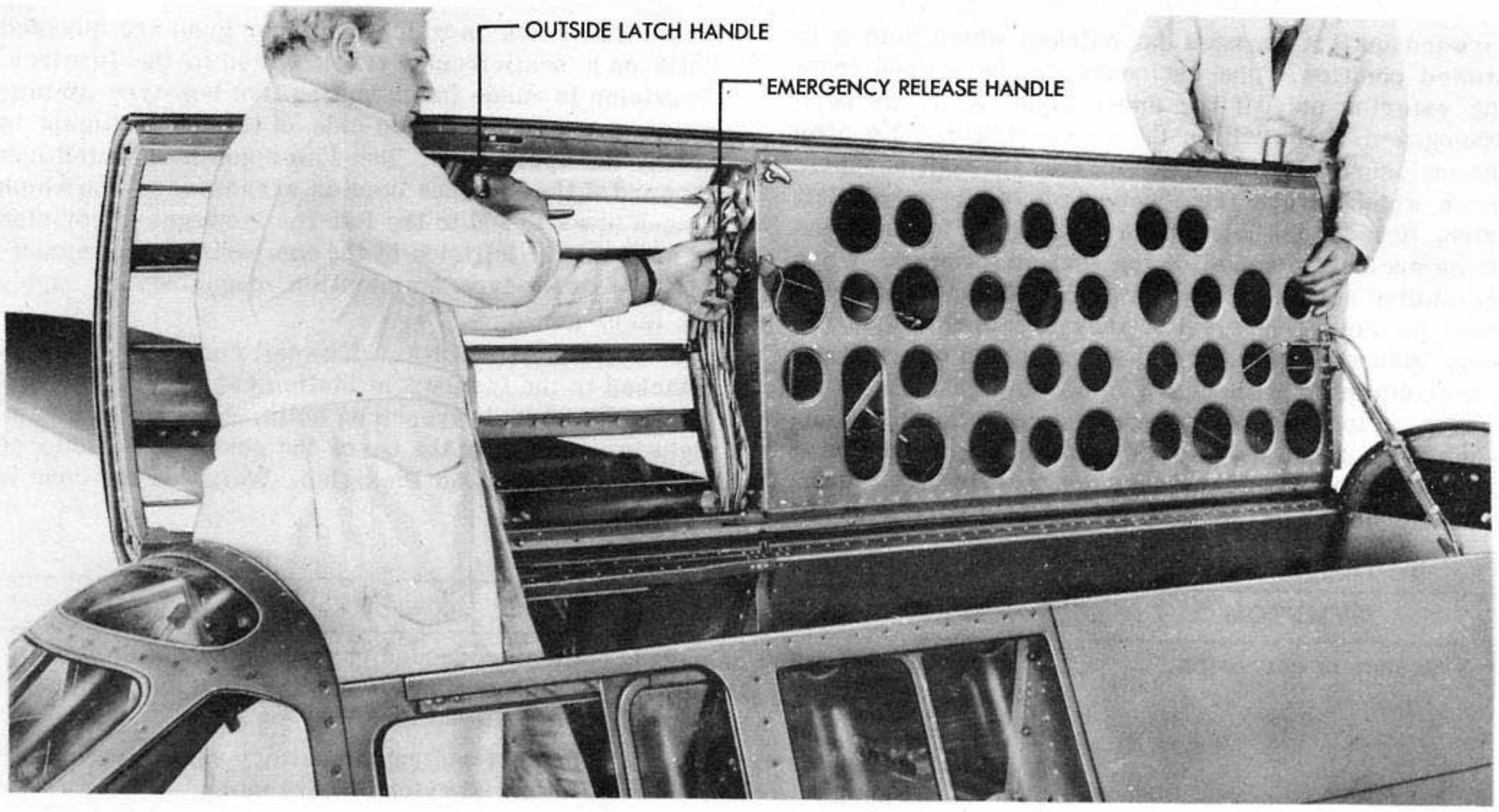


Figure 51 - REMOVING PILOT'S ESCAPE HATCH

(2) REMOVAL OF PILOT'S ESCAPE HATCH. (See figure 51.)

(a) Lift outside latch handle located on the left side of the door. Swing the door upward and to the right. Pull the emergency release handle which is located aft of the transparent panel. This will release the hinge pins, and escape hatch may be removed. Its weight is slightly less than 40 pounds and it can easily be handled by one or two men.

(b) Individual window sections form the vision section of the pilot's cockpit and the forward end of the escape hatch, and can be removed by removing the screws around the frame of each window.

(3) REMOVAL OF BOMB BAY DOORS.

(a) Disconnect the alining arm at the front of each door by removing the bolt.

(b) Disconnect the center actuating arm at each door by removing the 1/4-inch bolt at each door. (See figure 52.)

(c) Remove all hinge pins. This releases the bomb bay door from the fuselage. Each door weighs approximately 23 pounds and is easily handled by one man.

(4) REMOVAL OF GUNNERS' ESCAPE HATCH. (See figure 53.)

(a) Remove the stops on the forward end of the escape hatch tracks on each side of the fuselage by removing the two 3/16-inch bolts from each stop.

(b) Slide the escape hatch forward and remove from the airplane. The hatch weighs a little less than 32 pounds and can be easily handled by one man.

(c) Remove the screws from the three brackets on each side of the fuselage and the screws

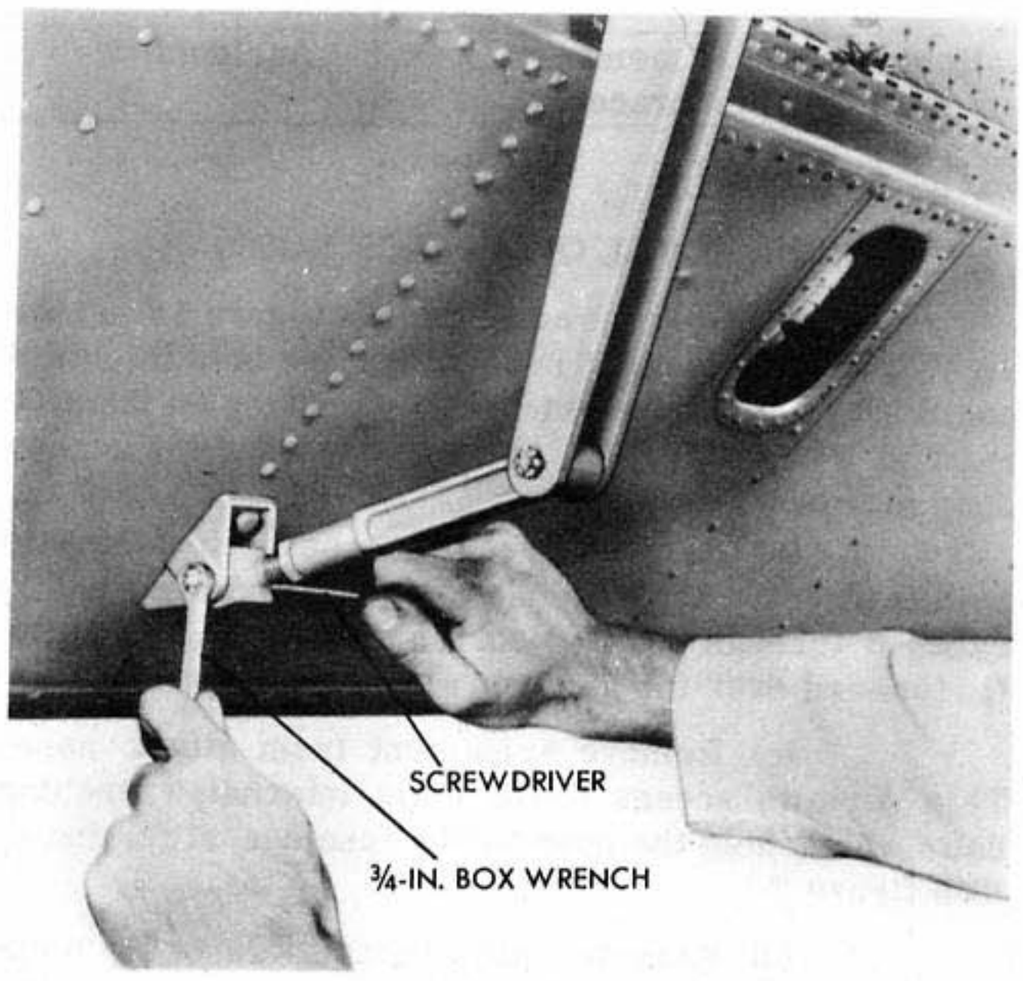


Figure 52 - DISCONNECTING BOMB BAY DOOR ACTUATING ARM

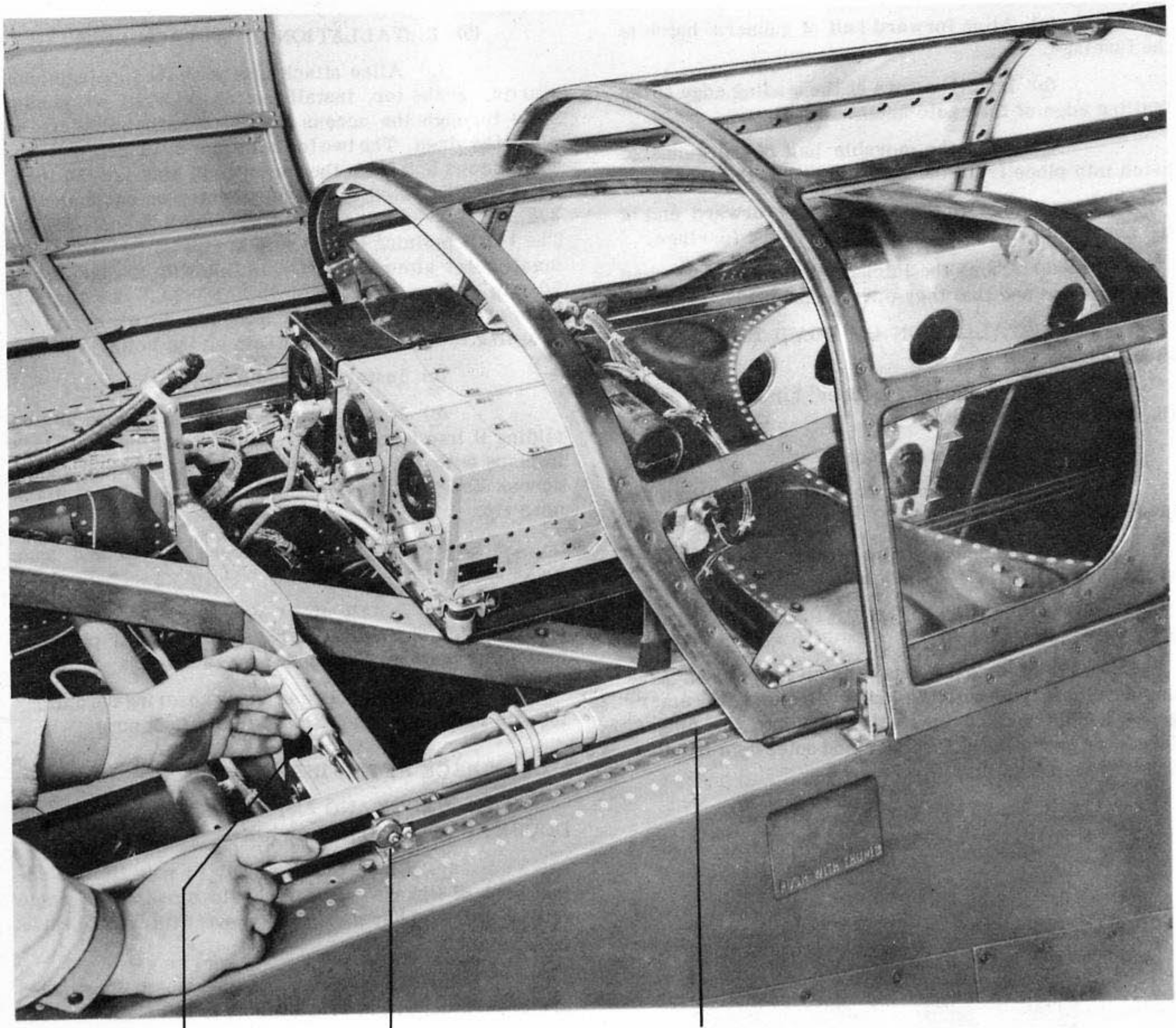


Figure 53 - REMOVING GUNNERS' ESCAPE HATCH

from the leading edge of the gunners' compartment to the trailing edge of the radio hatch. Remove the forward stationary half of the gunners' hatch.

(5) REMOVAL OF TAIL CONE.

(a) Disconnect the formation and running light wires at the junction box just ahead of Station 453-1/2 - inside of the fuselage.

(b) Remove the six bolts which attach the tail cone to the fuselage at Station 453-1/2. This is done from the inside of the fuselage.

(c) Move the tail cone away from the fuselage. One man can lift it easily.

d. INSTALLATION.

(1) INSTALLATION OF TAIL CONE.

(a) Move tail cone into position at Station 453.

(b) Install the six bolts that hold the tail cone to the fuselage, starting at the top. Tighten securely.

(c) Connect the electric wires at the junction box just ahead of Station 453-1/2. (See figure 7.)

(2) INSTALLATION OF GUNNERS' ESCAPE HATCH. (See figure 53.)

(a) Aline forward half of gunners' hatch at the fuselage.

(b) Install screws at the leading edge to the trailing edge of the radio hatch.

(c) Slide the movable half of the gunners' hatch into place from the forward end of the track.

(d) Install the stop on the forward end of the escape hatch track on each side of the fuselage.

(e) Check the latches in stowed and locked positions and see that they operate properly.

(3) INSTALLATION OF BOMB BAY DOORS. (See figure 52.)

(a) Lubricate the door hinges and aline them with the fuselage.

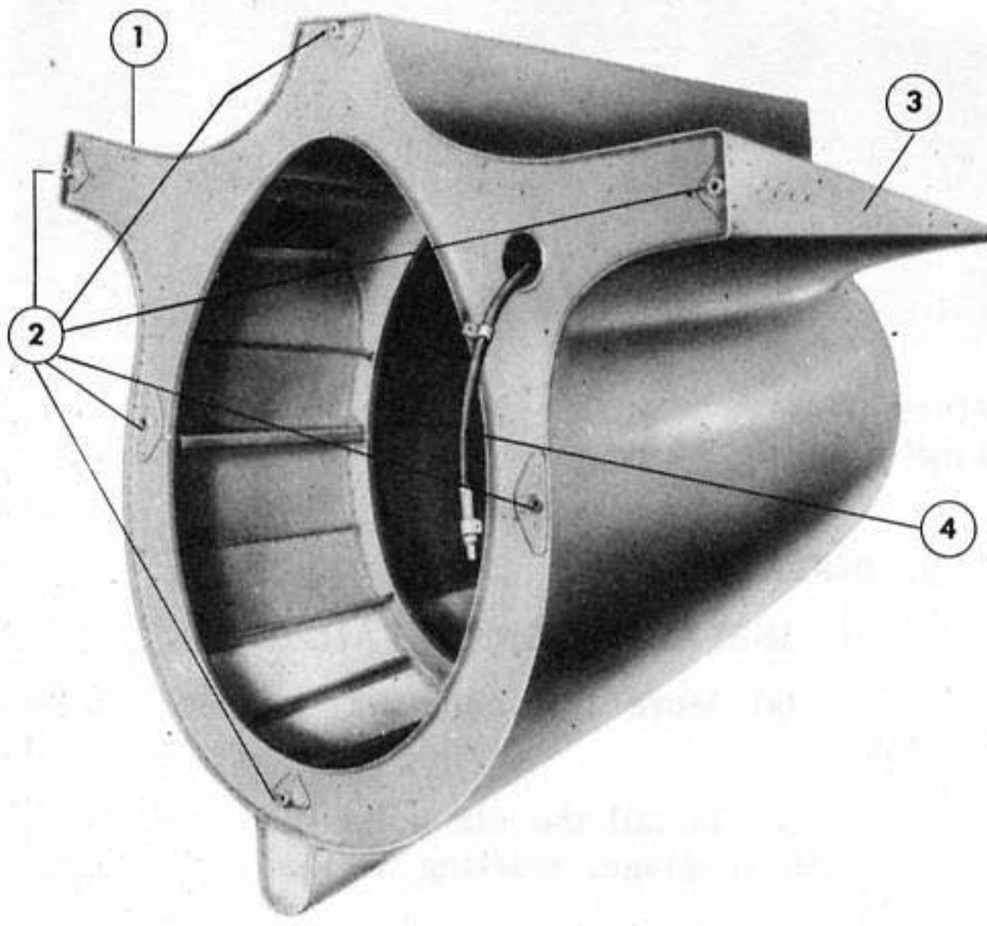
(b) Install hinge pins.

(c) Attach the center actuating arm to the door with one 1/4-inch bolt.

(d) Attach the front alining arm to the front of the door with one 1/4-inch bolt.

(4) INSTALLATION OF PILOT'S ESCAPE HATCH. (See figure 51.)

(a) Place the escape hatch in position. Line up the release pins with the hinges. Release the emergency handle and the pins will slide into the hinges. Check the operation of the inner and outer door handles. Safety-wire hinge pins.



1. ELEVATOR FAIRING
2. ATTACHING BOLT HOLES
3. ELEVATOR FAIRING
4. RUNNING LIGHTS AND FORMATION SIGNAL LIGHT ELECTRIC CABLE

Figure 54 - TAIL CONE REMOVED

(5) INSTALLATION OF ATTACK NOSE.

(a) Aline attack nose with the fuselage and, starting at the top, install the ten internal wrenching bolts through the access doors. These bolts are of assorted sizes. The two top bolts are 5/16 inch, AN-15. The second bolt from the top on each side is 5/16 inch, AN-17. The third bolt from the top on each side is 3/8 inch, AN-20. The bottom bolts are 3/8 inch, AN-22. The two remaining bolts which are installed through the small holes almost directly in line with the two lower 20-mm cannon are 3/16 inch, AN3-7A. See that all bolts are started, then tighten them securely by criss-crossing to minimize any strain on the bolts.

(b) Install armament in attack nose.

(c) Install attack nose tip figure 50 by sliding it into position over the forward guns and lock in place with the six clip spring fasteners through the access doors on the right and left sides of the attack nose tip.

(d) Close access doors on tip and snap locks shut.

(e) Install upper and lower access doors on each side of the nose. These are held in place by four Dzus fasteners on each access door.

(f) Install access doors covering the caliber .50 gun located on each side of the attack nose.

e. CHECK AFTER INSTALLATION.

(1) CHECK AND ADJUSTMENT OF BOMB BAY DOORS AFTER INSTALLATION.

(a) Close doors slowly to note fit and adjustment of linkage. Doors should close at the same rate of speed. They should not move with control valve in neutral.

(b) If necessary to adjust bomb door cross arms, turn the cross arm eyebolt to the right or left.

(c) Tighten check nut after adjustment has been made.

5. ENGINE COWLING.

a. DESCRIPTION.

(1) GENERAL. (See figure 55.) - Engine cowling consists of a flap bow ring, lower movable flaps, upper movable flaps, fixed flaps and nose fillets, diaphragm (inner cowl ring), antidrag ring, accessory cowling sheets, dishpan cover (used on winterized airplanes only), and the carburetor air scoop. Main purposes of the cowling are to provide a smooth contour covering the engine, which fairs into the nacelle and wing, and to control air passing through the engine and into the carburetor. The cowling is constructed for quick installation and removal, permitting access to all parts of the engine.

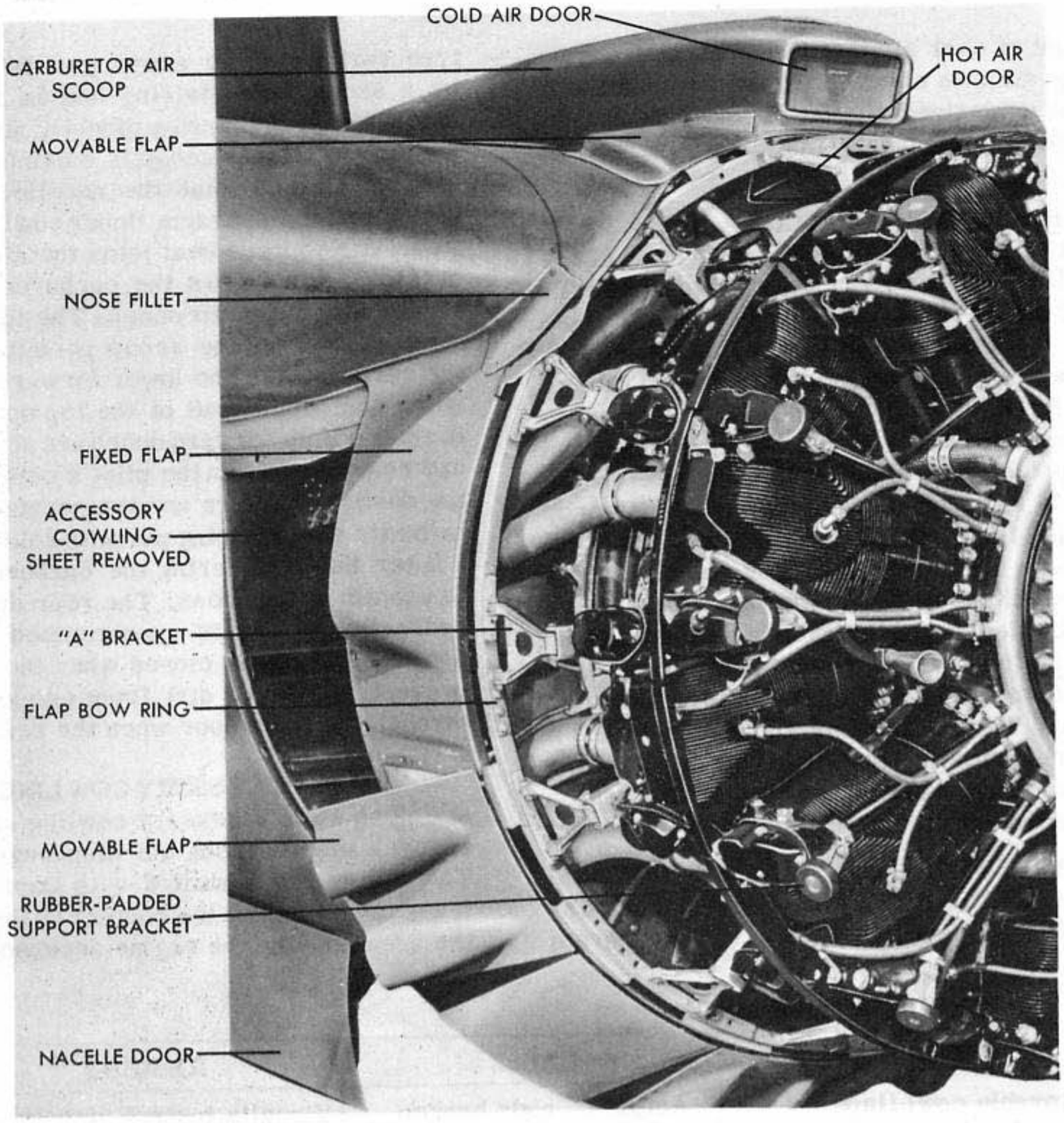


Figure 55 - ENGINE COWLING

(2) FLAP BOW RING. (See figure 55.) - The flap bow ring is constructed of aluminum alloy, installed on the engine by 14 "A" brackets using 1/4-inch bolts and castellated nuts. The ring is electrically bonded by four flexible metal straps spaced equally around the ring.

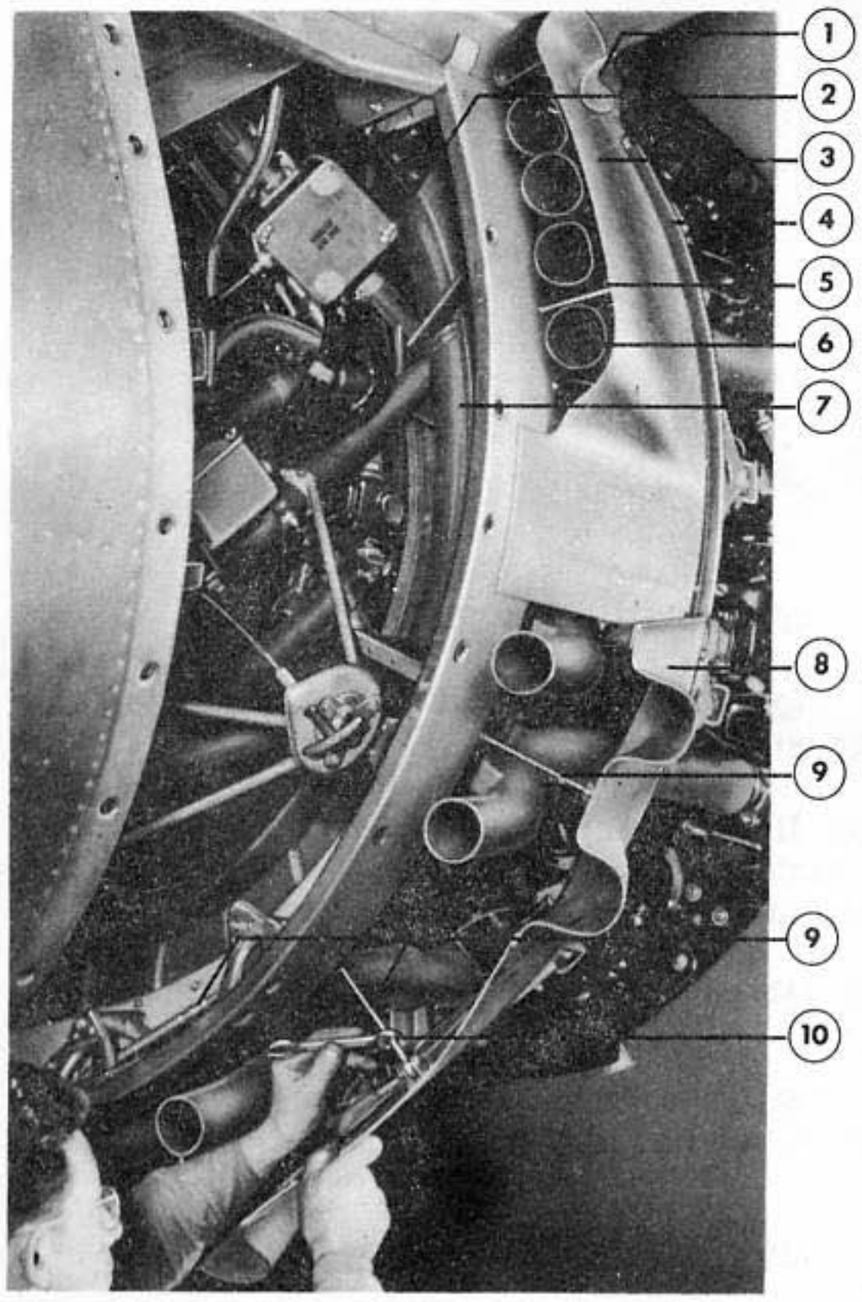
(3) MOVABLE COWL FLAPS. (See figure 55.) The five lower movable flaps are sheet alclad, hinged to the flap bow ring by clevis bolts. The two upper movable flaps are sheet alclad and are hinged in a similar manner but must be cut and formed to fit each airplane. All seven movable flaps are actuated hydraulically and controlled by the pilot.

(4) FIXED COWL FLAPS. (See figure 55.) - There are two sheet alclad fixed flaps (one inboard, one outboard), which are a continuation of the lower movable flaps. The leading edge of each fixed flap is attached to the engine mount by rods. The trailing edge is secured to the diaphragm by screws. A nose fillet is attached to the upper end of each fixed flap and extends to the leading edge of the wing.

(5) DIAPHRAGM. (See figure 56.) - The diaphragm (inner cowl ring) is of stainless steel and attaches to the engine mount. On the forward face of the diaphragm are mounted the exhaust ejector stacks. On the aft face of the diaphragm is the mechanism for actuating the movable flaps. The entire engine mount and diaphragm assembly is attached to the engine by seven dynamic suspensors.

(6) ANTIDRAG RING. (See figure 8.) - The antidrag ring is formed of sheet alclad in three sections and covers that part of the engine between the propeller and the flap bow ring. To the aft end of the antidrag ring are attached lugs which hook over the flap bow ring and overcome a tendency of the antidrag ring to pull forward. The antidrag ring is additionally attached by trunnion bolts and Dzus fasteners, which secure the forward end of the ring to 14 rubber-padded support brackets mounted on the cylinder heads.

(7) DISHPAN COVER. (See figure 57.) - The alclad dishpan cover slips over the propeller shaft and covers the engine block and propeller governor, cutting



1. NOSE FILLET
2. ENGINE ACCESSORY SECTION, COWLING REMOVED
3. FIXED FLAP
4. NEOPRENE SEAL
5. SPACER BAR
6. EXHAUST EJECTOR STACKS
7. DIAPHRAGM
8. MOVABLE FLAP
9. ACTUATING ROD
10. 5/8" OPEN END WRENCH

Figure 56 - ADJUSTING LOWER COWL FLAPS

(c) Inspect for collapsed anti-icer line and replace any damaged line.

(5) REPLACEMENT OF ACCESSORY COWLING SHEET PARTS. - Replace any broken Dzus springs, Dzus fasteners, Carr fasteners and air-locks.

f. ADJUSTMENTS.

(1) ADJUSTMENT OF MOVABLE COWL FLAPS. (See figure 56.)

(a) Adjust lower flaps for the following clearances:

1 One-quarter inch between flap and exhaust stack and/or diaphragm in closed position (1/8 inch on winterized airplanes).

2 Dovetail must overlap adjacent flap by at least 1/8 inch.

3 There must be a 1/16-inch preload where the movable flap meets the fixed flap.

(b) Adjust upper flaps for a minimum overlap of 3/8 inch on both rub strips. Then adjust upper flaps for a 1/16-inch preload.

NOTE

Adjust all movable flaps by removing the bolts from one end of the actuating rod and by turning the rod bearing. Turning clockwise will shorten the rod and turning counterclockwise will lengthen the rod.

(2) ADJUSTMENT OF FIXED COWL FLAP. - Minimum clearance between fixed flap and exhaust ejector stacks is 1/8 inch and preferred clearance is 1/4 inch. Adjust with special tool, Douglas No. A633-5166050-SF2 (stack bending bar). If stacks are in correct position and flap is still too close to the stacks, use fiber wedge and a rawhide mallet to form flap for proper clearance. If this hammering breaks the spot weld on the bead doublers, remove the flap and install 1/8-inch rivets every 3/4 inch.

(3) ADJUSTMENT OF CARBURETOR AIR SCOOP (nonram type). - Check adjustment of hot and cold air doors to assure that doors close tightly. Be sure the hot air door locks (passes over center) in both open and closed positions. Adjust aft cold air door to closed position without preload by turning the eyebolts on the cylinder IN or OUT. Hook up the long rod of the master bell crank to the crank on the jackshaft. Hook up the center rod from jackshaft to the front door bell crank. Then adjust front door to a slight preload, using the short rod for adjustment. Be sure front door in open position is in full UP position.

g. ASSEMBLY AND INSTALLATION.

(1) INSTALLATION OF ACCESSORY COWLING SHEETS. - Place each sheet in position and tighten the Dzus fasteners. There are 15 fasteners on the inboard sheet, 17 fasteners on the outboard sheet, and 12 fasteners on the lower sheet. The sheets may be installed in any sequence.

(2) INSTALLATION OF CARBURETOR AIR SCOOP (nonram type). (See figure 55.)

(a) It is not necessary to remove the upper cowl flaps, but their removal will provide easier access to the scoop.

(b) Directly on top of the wing install the inner duct in the scoop by installing four bolts and connecting two clamps. Then install the air scoop access door (identified by six Carr fasteners) and the two side panels.

(c) In the air scoop duct connect the synchronizing rod between the two cold air intake doors.

(d) In the engine accessory section connect hot and cold air door control cables, air scoop temperature bulb, carburetor anti-icer lines and Neoprene adapter seal.

(3) INSTALLATION OF CARBURETOR AIR SCOOP (ram type). (See figure 55.)

(a) Before installing, safety hot air door in the COLD position and tape the cable to hold it on the pulley.

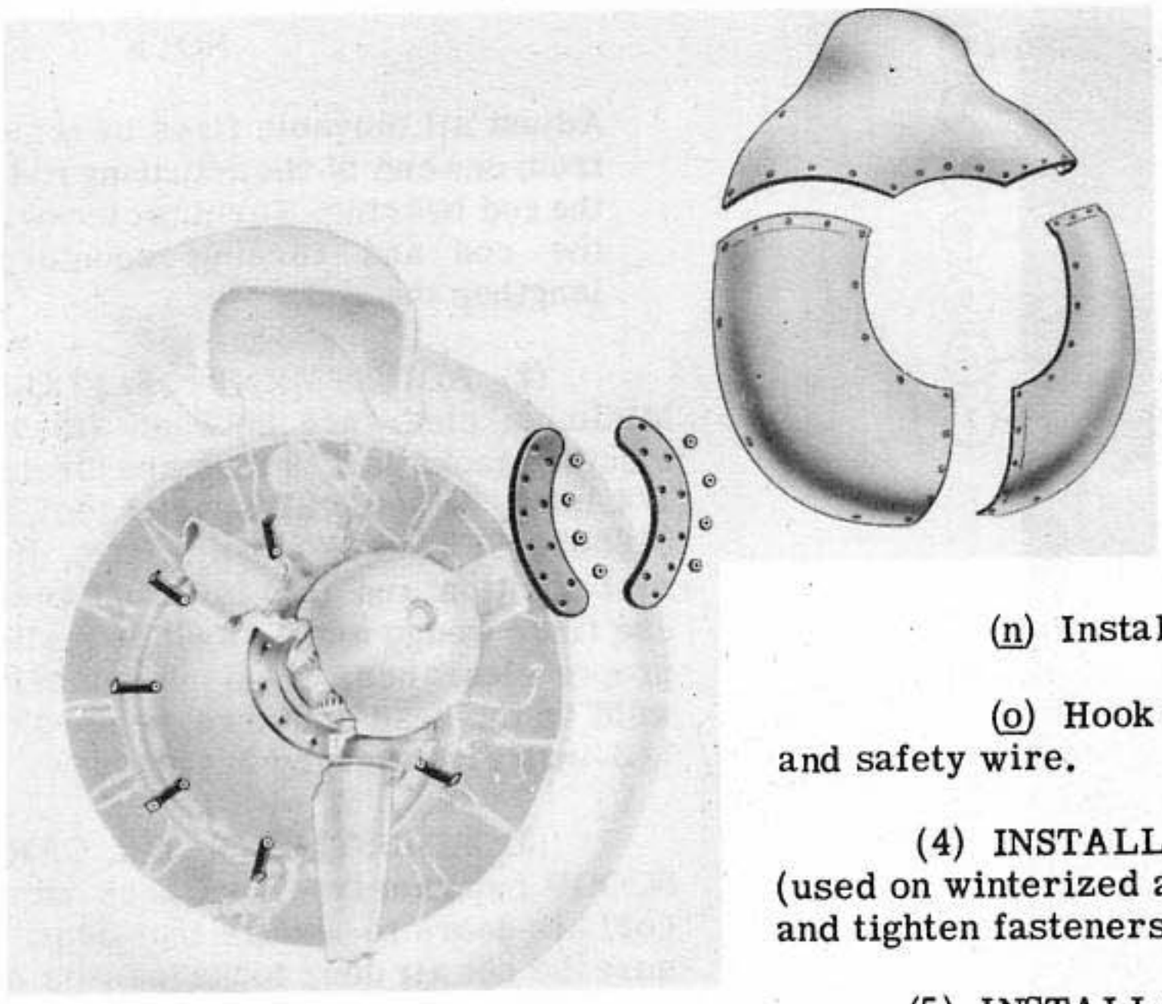


Figure 57
DISH-PAN COVER -
EXPLODED VIEW

(b) Before installing, assure that the Neoprene collar is clamped securely to the air scoop; place the other clamp around the Neoprene collar and roll it back (like a cuff) over both clamps.

(c) Lower air scoop into position.

(d) Unroll Neoprene collar. It will thereby fit itself to the carburetor air scoop adapter.

(e) Push the loose clamp down until it fits around the bottom of the Neoprene collar.

NOTE

If the clamp will not go down in front, remove the inspection plates at the sides of the air scoop.

(f) Tighten the lower clamp with a flat screwdriver.

(g) Install ten cap screws along the sides of the air scoop into the venturi ring. Be careful not to force any of the cap screws. If screws will not start easily, drill sheet metal out to 1/4-inch diameter.

(h) Install five cap screws under air scoop fairing.

(i) Replace cover on air scoop fairing.

(j) Install six Phillips head screws in air scoop fairing.

(k) Connect four anti-icer lines to back of air scoop.

(l) Connect electric plug to air temperature bulb on back of air scoop.

(m) Install exit fairings for upper cowl flaps.

(n) Install cover plates on wing.

(o) Hook up control cables, removing tape and safety wire.

(4) INSTALLATION OF DISHPAN COVER (used on winterized airplanes only). - Place cover ON and tighten fasteners. (See figure 57.)

(5) INSTALLATION OF ANTIDRAG RING. (See figure 8.)

(a) The ring is in three segments, which may be installed one at a time. Place the segment in position.

(b) Tighten Dzus fasteners.

(c) Tighten trunnion bolts with Douglas special tool, RS-1618 wrench.

(d) Install safety wires.

(6) INSTALLATION OF DIAPHRAGM (inner cowl ring).

(a) Installation of the diaphragm and complete engine mount assembly requires previous removal of the engine and the carburetor air scoop. Then place the assembly in position and install bolts in the seven dynamic suspensors. Connect all control cables and hydraulic lines. Install carburetor air scoop.

(b) The diaphragm is constructed in four segments. Each segment may be installed without removing the engine as follows:

1 Place segment in position and install all screws attaching segment to engine mount and to other segments.

2 Install exhaust ejector stacks on the segment.

3 Connect control cables and hydraulic lines.

(7) INSTALLATION OF FIXED COWL FLAPS. (See figure 55.)

(a) INBOARD FIXED FLAPS.

1 Place flap in position and install 15 screws.

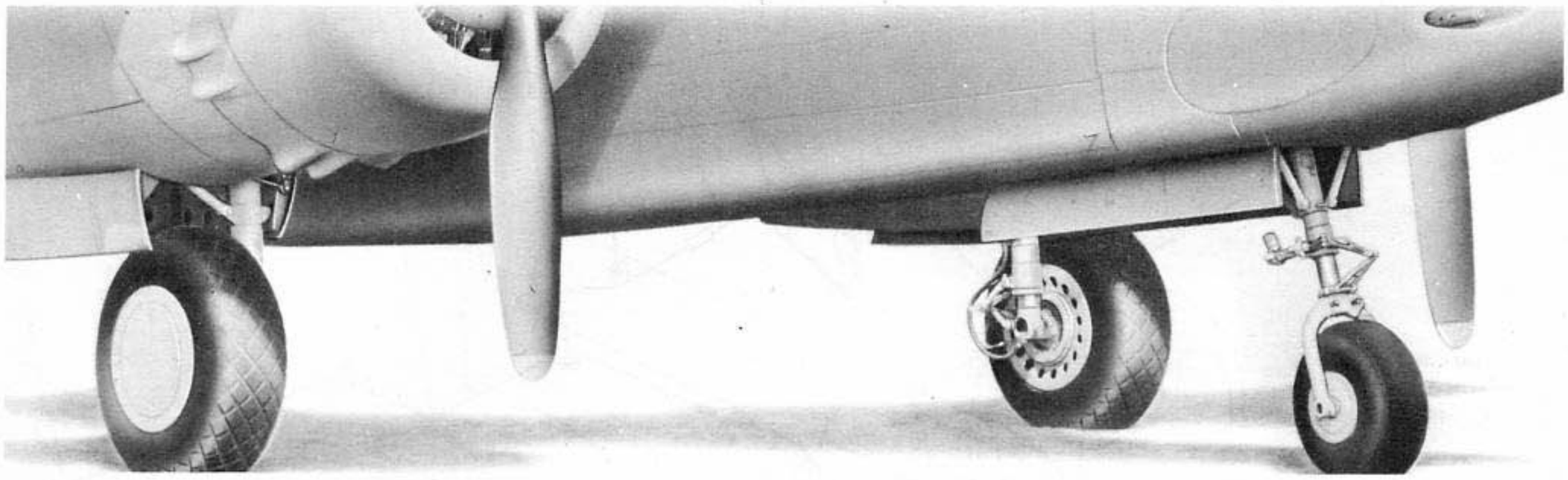


Figure 58 - ALIGHTING GEAR

2 Install nose fillet by installing four screws.

(b) OUTBOARD FIXED FLAPS.

1 Place flap in position by installing screws and spacer bolts.

2 Install nose fillet by installing four screws.

NOTE

There are two spacer bolts on the left-hand engine and one spacer bolt on the right-hand engine.

(8) INSTALLATION OF MOVABLE COWL FLAPS (five lower and two upper). (See figure 55.) - Install clevis bolts in the two hinges on each flap and connect the actuating rod to each flap.

(9) INSTALLATION OF FLAP BOW RING. (See figure 55.)

(a) Slide the ring over the engine and in place.

(b) Install 1/4-inch bolts in the 14 "A" brackets.

NOTE

If propeller is installed, split the ring by removing four 1/4-inch bolts on the inboard side and four on the outboard side.

(c) If the movable flaps have not been previously removed from the ring, the complete assembly of the flaps and the flap bow ring may be installed by installing the 14 quarter-inch bolts in the "A" brackets and connecting the actuating rods to the flaps. If the propeller is installed, split the ring as directed above.

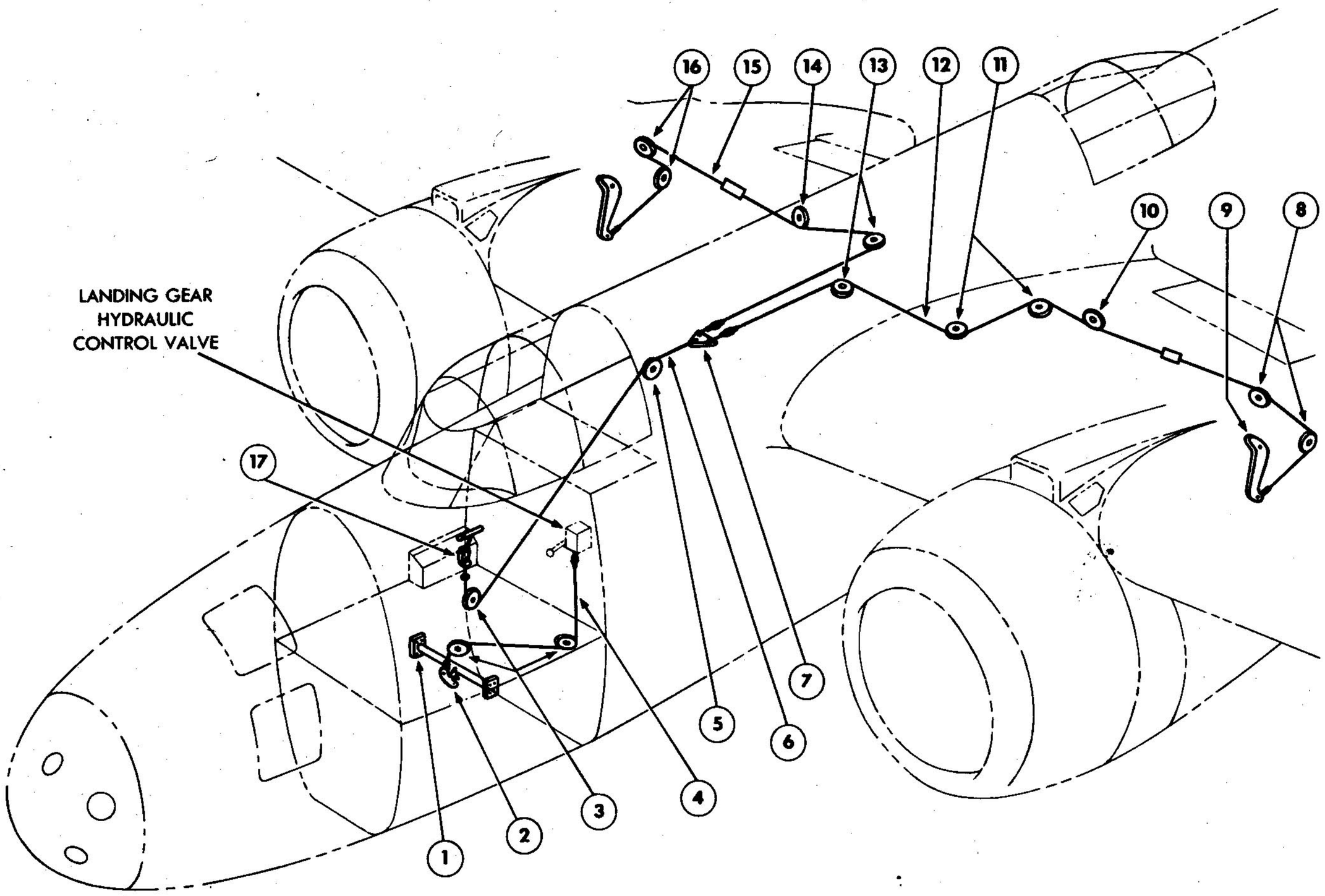
6. ALIGHTING GEAR.

a. DESCRIPTION.

(1) GENERAL. - The alighting gear consists of three separate units, a main unit mounted in each engine nacelle and a nose wheel unit mounted just aft of the fuselage Station 0. (See figure 58.) The gear is actuated hydraulically and controlled by a lever on the panel at the left side of the pilot's seat. (See figure 60.) An emergency release handle, located to the right of the pilot's seat near the floor (figure 60) is used to extend the main gear in the event of hydraulic system failure. The emergency release disconnects the main gear latches allowing the bungees to extend the gear. To release the nose wheel latch, move the alighting gear control lever to the DOWN position. When the alighting gear is retracted each unit is completely enclosed by doors operated by linkages connected to the gear.

(2) SIGNAL SYSTEMS. - An indicator located in the lower left corner of the pilot's instrument panel shows the position of the alighting gear at all times. A warning horn, mounted on the deck immediately aft of the pilot's seat, sounds whenever the throttles are closed to less than 1/4 segment and the gear is in any position other than full down and locked. The horn may

Figure 59 - ALIGHTING GEAR CONTROLS



ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	2063154	BEAM	1
	AN3-4	BOLT	8
	AN960-10	WASHER	8
	AC365-1032	NUT	8
2.	1063612	HOOK	1
	AN502-10-16	BOLT, ADJUSTMENT	1
	AN315-3R	NUT, ADJUSTMENT	1
	2033901-10S-323-028	SPACER	2
	1026614G5-012	SPACER	1
	1063611	SPRING	1
	124682-5814-065	WASHER	2
	AN5-26	BOLT	1
	AN320-5	NUT	1
	AN380-2-3	COTTER	1
3.	AN210-2A	PULLEY	3
4.	2064974-6	CABLE ASSEMBLY (40 INCHES)	1
	AN160-8S	FORK	1
	AN155-8S	BARREL	1
5.	AN210-2A	PULLEY	1
6.	2069407	CABLE ASSEMBLY (99⅜ INCHES)	1
7.	1059861	LINK	1
	AN23-9	BOLT	3
	AN320-3	NUT	3
8.	AN210-2A	PULLEY	2
9.	1069221	LEVER	2
10.	AN210-1A	PULLEY	1
11.	AN210-2A	PULLEY	2
12.	2068537-2	CABLE ASSEMBLY (170¼ INCHES)	1
13.	AN210-2A	PULLEY	2
14.	AN210-1A	PULLEY	1
15.	2068537-1	CABLE ASSEMBLY (133⅜ INCHES)	1
16.	AN210-2A	PULLEY	2
17.	AN520-416-8	SCREW	2

Figure 60 - LANDING GEAR MECHANICAL RELEASE

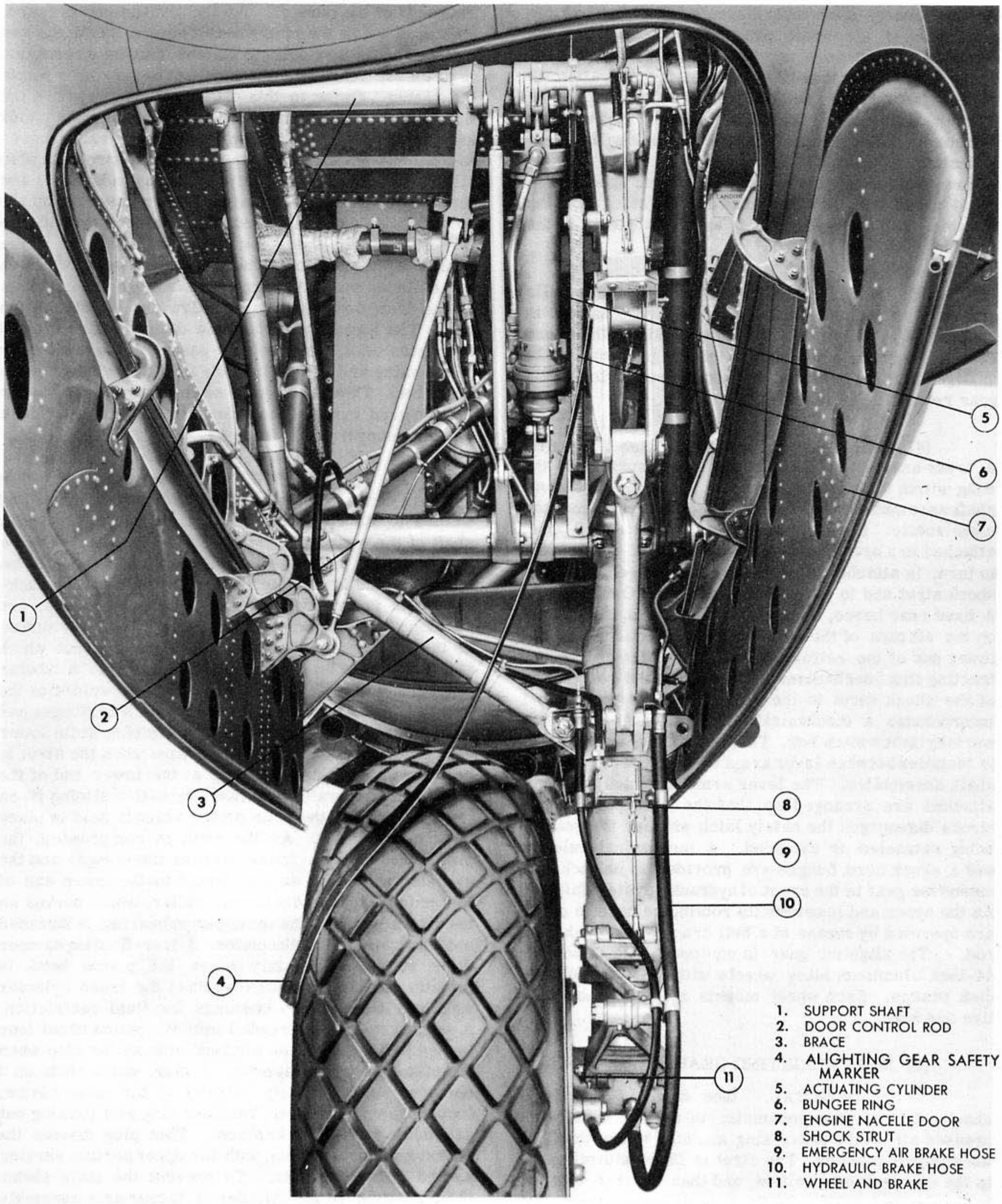
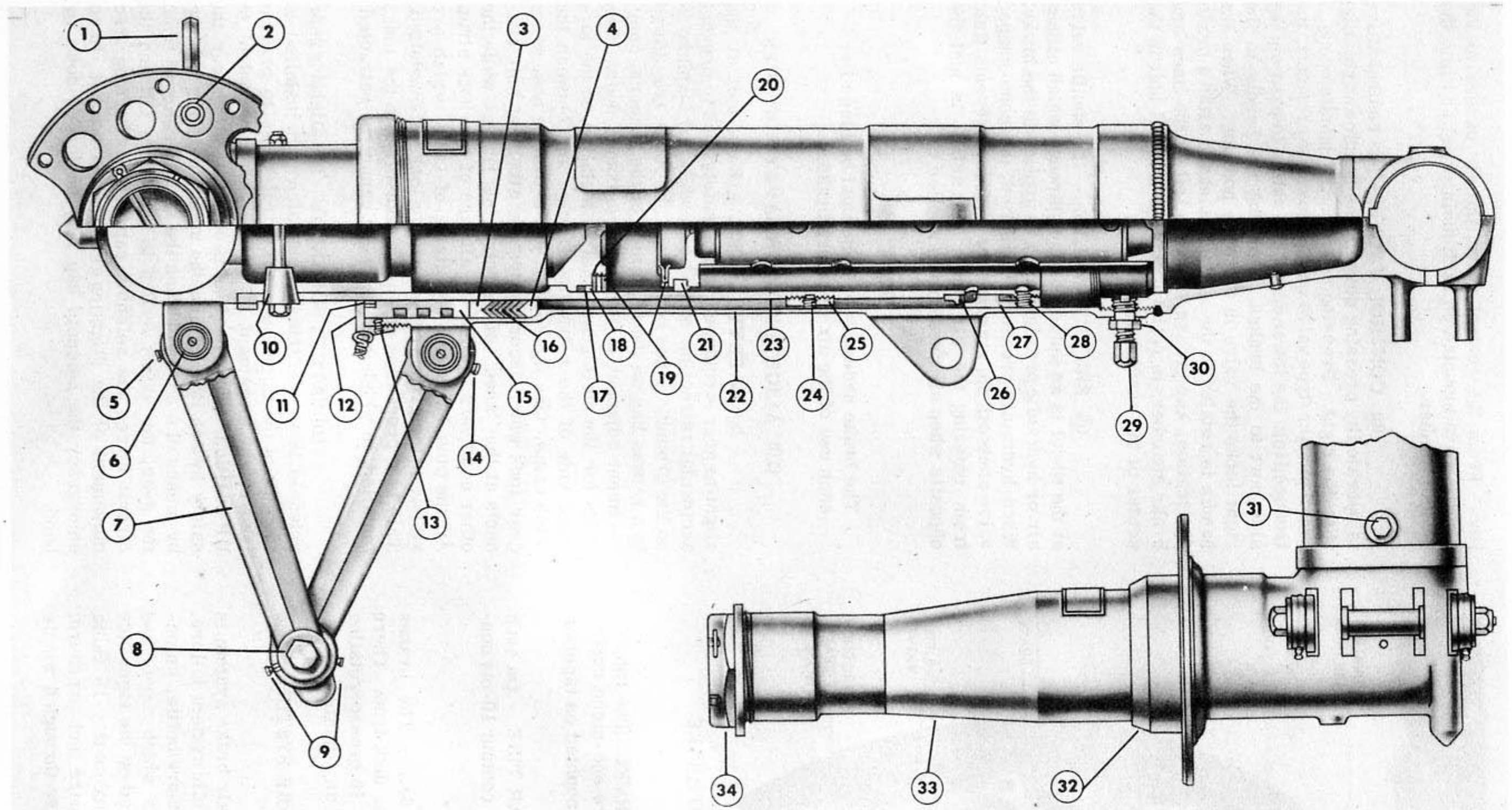


Figure 61 - MAIN ALIGHTING GEAR



ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	65324	EYE, TOWING	1
2.	65322	SHAFT, TOWING	1
3.	66846	RING, PACKING	1
4.	65329	RING, PACKING	1
5.	65406	FITTING, ZERK	1
6.	120-S-315	BOLT	2
	121-S-5	NUT	
	65314	SLEEVE	
	65311	SPACER	
7.	65321	ARM ASSEMBLY, TORQUE	2
8.	120-S-521	BOLT	1
	121-S-7	NUT	1

ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
	65316	WASHER	1
	65310	LUG	1
	65309	SPACER	1
	65316	BUSHING	1
	65311	SPACER	1
	65366	WASHER	2
9.	65406	FITTING, ZERK	2
10.	54026	BUSHING, TAPER	1
11.	65327	PACKING	1
12.	65326	RING, PACKING	1
13.	66876	SETSCREW	1
14.	65406	FITTING, ZERK	1

ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
15.	65328	RING, RETAINER	1
16.	185-S-56	PACKING, CHEVRON	5
	65460	FILLER, PACKING	1
17.	64044	PACKING	1
18.	65043	RING, RETAINER	1
19.	65045	NUT, PACKING	2
20.	65337	PLUG	1
21.	65348	RING, PISTON	1
22.	65359	PLUNGER ASSEMBLY, CYLINDER	1
23.	65338	PISTON, MAIN	1
24.	65330	SETSCREW	1

ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
25.	65331	STOP, PISTON	1
26.	65332	RING, DAMPER VALVE	1
27.	65333	HEAD, PISTON	1
28.	65323	SETSCREW	1
29.	53027	VALVE ASSEMBLY	1
30.	53050	GASKET	1
31.	120-S-211	BOLT	1
	121-S-2	NUT	1
32.	56698	COLLAR, AXLE	1
33.	65367	AXLE ASSEMBLY	1
34.	110-S-5	NUT, RETAINER	1

Figure 62 - Main Alighting Gear Shock Strut Assembly

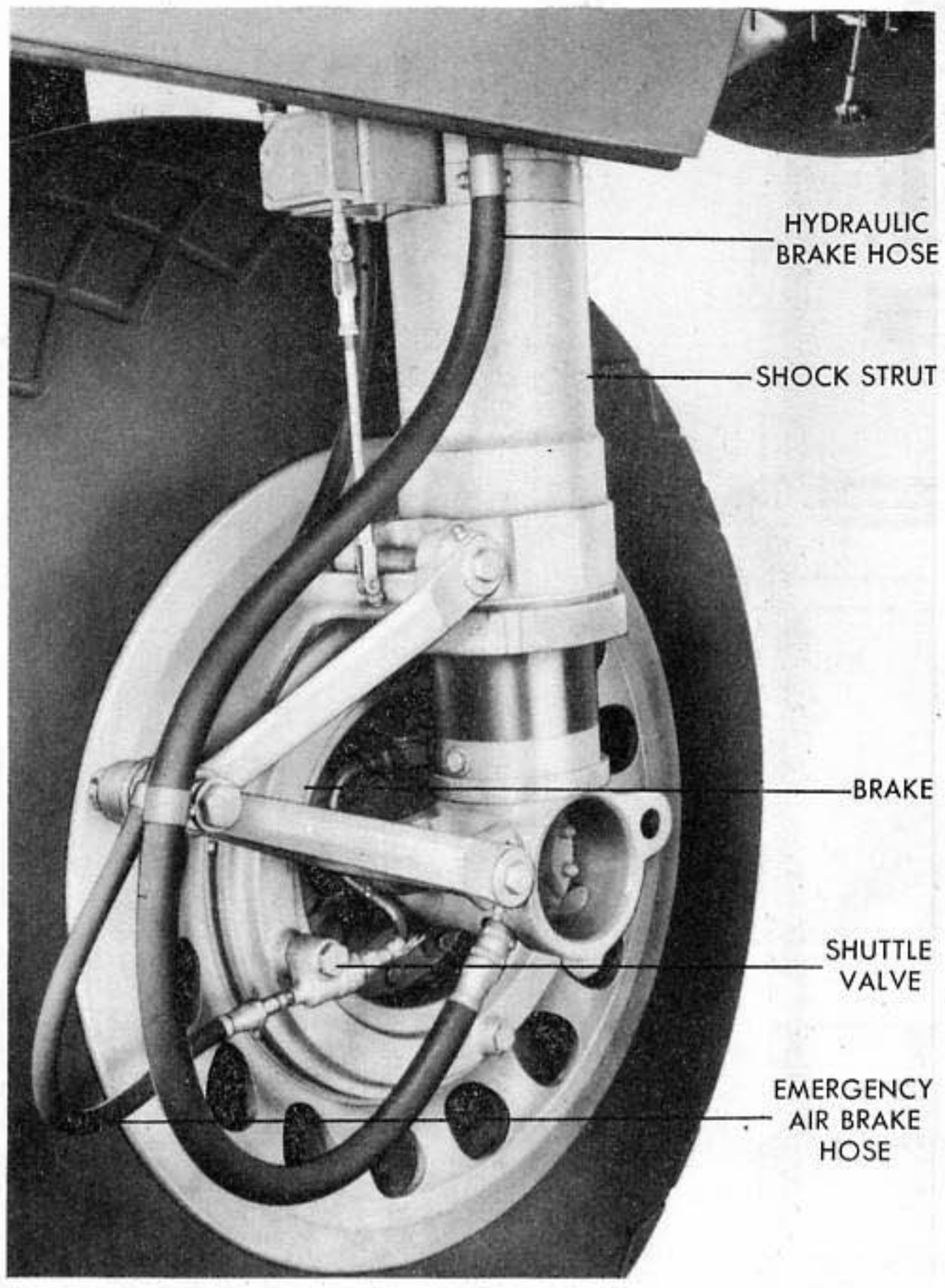


Figure 63 - WHEEL AND BRAKE

(6) MAIN ALIGHTING GEAR WHEEL. (See figure 63.) - Wheels of the alighting gear are one-piece castings of aluminum alloy. They are mounted on tapered roller bearings.

(7) MAIN ALIGHTING GEAR TIRE - On each wheel is mounted a 44-inch smooth contour 10-ply nonskid diamond tread tire and tube.

(8) BRAKES. (See figure 63.) - The brakes are hydraulically operated and of the disk type. There are 17 steel stationary plates and 16 bronze rotating plates. Adjustment is by means of an adjusting ring.

(9) EMERGENCY AIR BRAKE SYSTEM. (See figure 64.)

(a) GENERAL. - The air brake system is for emergency use in case of hydraulic system failure. The air brake incorporates a pressure bottle, an on-off control valve and shuttle valves which supply and control the air. The bottle, located on the right side of the nose wheel well, holds approximately 18 cubic inches of air at 400 pounds per square inch pressure, which is supplied to the on-off valve through a single line. From the control valve the air passes to the shuttle valve mounted on each main wheel and into the brake chamber.

(b) CONTROL VALVE. - The control valve is operated by pressing down on the handle and rotating it to the right. Pressing down on the handle opens a small plunger-type valve which allows air pressure, introduced into the lower end of the valve, to pass out the side port to the brakes. Rotating the handle to the right locks the valve in the open position. When the handle is rotated to the left and released after a brake application, any pressure that is left in the lines and brake chambers is relieved through a small hole in the center of the handle shaft.

(c) SHUTTLE VALVE - The shuttle valve at the wheel is an automatic unit through which either air or hydraulic pressure may be applied to the brake. When hydraulic pressure is applied, the cone-shaped valve shuts off the air pressure port and prevents fluid from entering the air line. The action is just the opposite when air pressure is applied.

NOTE

The brake hydraulic system must be bled after each use of the air pressure brake.

(10) ALIGHTING GEAR SAFETY DEVICES.

(a) SAFETY LOCKS. - Each unit of the alighting gear is equipped with a safety lock to prevent accidental retraction of that unit while the airplane is on the ground. When not in use, the locks are stowed in a canvas bag on the right side of the gunners' compartment adjacent to the lower entrance door. The locks for the main gear must be installed on the forward side of the retracting linkage and between the latch cams. (See figure 65.) The end of the nose wheel gear lock which incorporates the attaching bolt connects at the "knee" of the retracting linkage while the other end bears against the aft face of the shock strut. All the pins have long red strips of cloth, which are visible to the ground crew when the locks are installed. This is a precaution against a take-off with the locks installed, in which case the gear cannot be retracted.

(b) SAFETY SOLENOID. - The alighting gear solenoid is an electrically operated unit installed to the side of the alighting gear control valve to prevent inadvertent movement of the alighting gear control to UP position. When any load is on the alighting gear, the safety switch is OFF and the solenoid cap is held up by means of a spring. When the load is relieved from the gear, the safety switch is moved to ON and the circuit forces the solenoid cap down, affording free movement of the alighting gear control handle. In an emergency the solenoid cap may be forced down by hand.

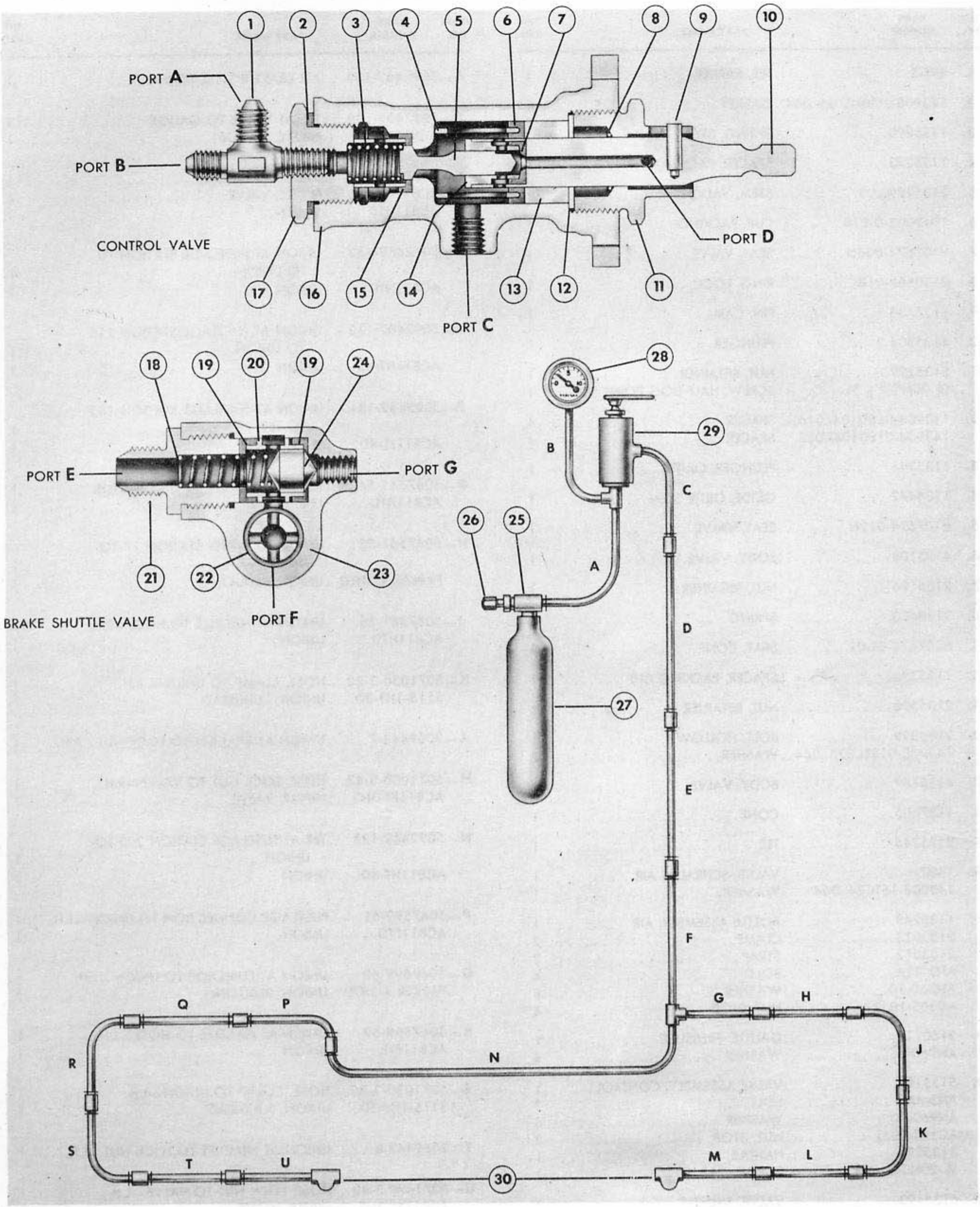


Figure 64 - EMERGENCY AIR-BRAKE SYSTEM

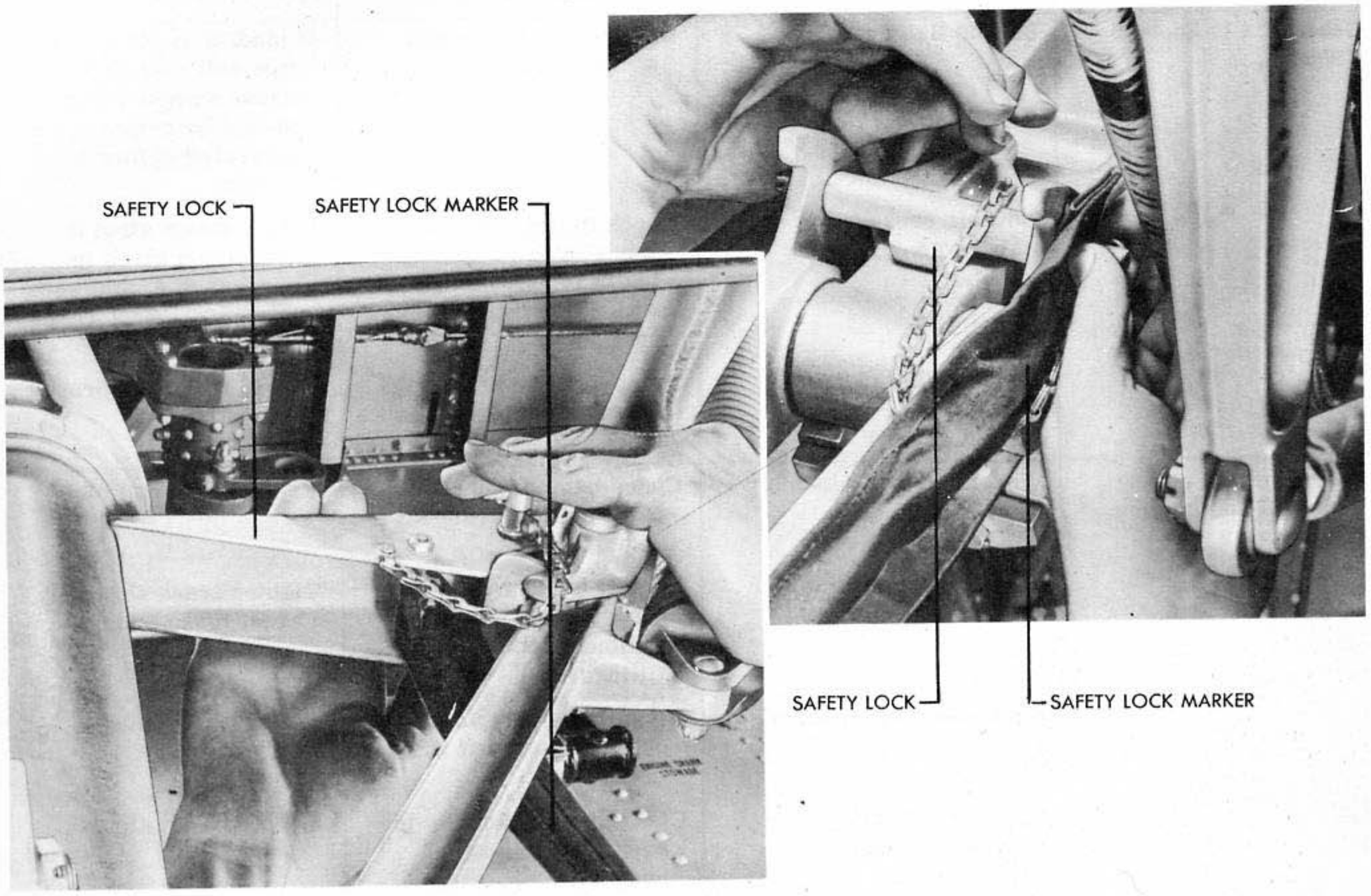


Figure 65 - INSTALLING ALIGHTING GEAR SAFETY LOCK

b. TROUBLE SHOOTING.

SYMPTOM	CAUSE	ISOLATION	REMEDY
Gear fails to extend or retract when operated hydraulically.	Lack of lubrication.	Visually inspect mechanism to determine if in need of lubricant.	Lubricate as required.
	Broken hydraulic line in landing gear system.	Loss of fluid and failure of pumps to maintain 850 ± 25 pounds per square inch pressure as long as control valve is in the DOWN position will indicate broken line.	Repair or replace hydraulic line. Replace fluid.
	No hydraulic pressure.		See Section 4, paragraph 16, this handbook.
	Improper adjustment of latch assembly.	Check latch assembly and see if it is operating properly.	Make correct adjustment.
Gear fails to extend when test-operated by emergency release (airplane on jacks).	Emergency cable disconnected.	Check to see if cable has become disconnected.	Connect cable and adjust.

SYMPTOM	CAUSE	ISOLATION	REMEDY
No pressure is indicated by the air pressure gage.	No air under pressure in the emergency brake bottle.	Inflate bottle to 850 pounds per square inch pressure as directed, and observe pressure gage for evidence of leakage in air brake valve.	Remove, disassemble, and repair air brake valve if leaking.
Alighting gear does not respond to operation of the pilot's control handle, and the indicated hydraulic pressure remains constant.	Faulty adjustment of, or mechanical failure in the cable system from the pilot's control to the alighting gear valve.	Inspect the cable system between the control handle and the alighting gear control valve.	Replace or adjust parts where necessary.

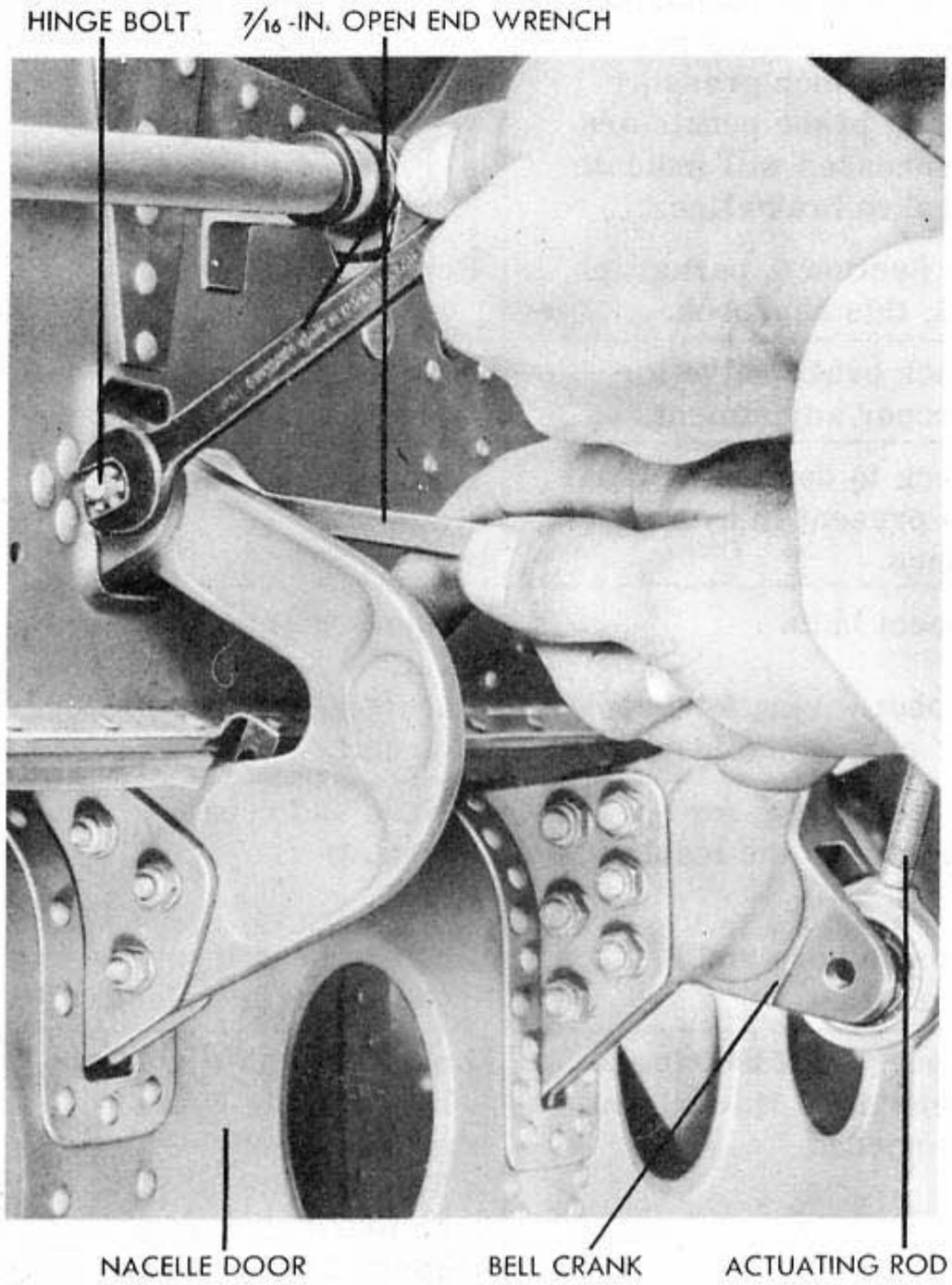


Figure 66 - REMOVING NACELLE DOOR

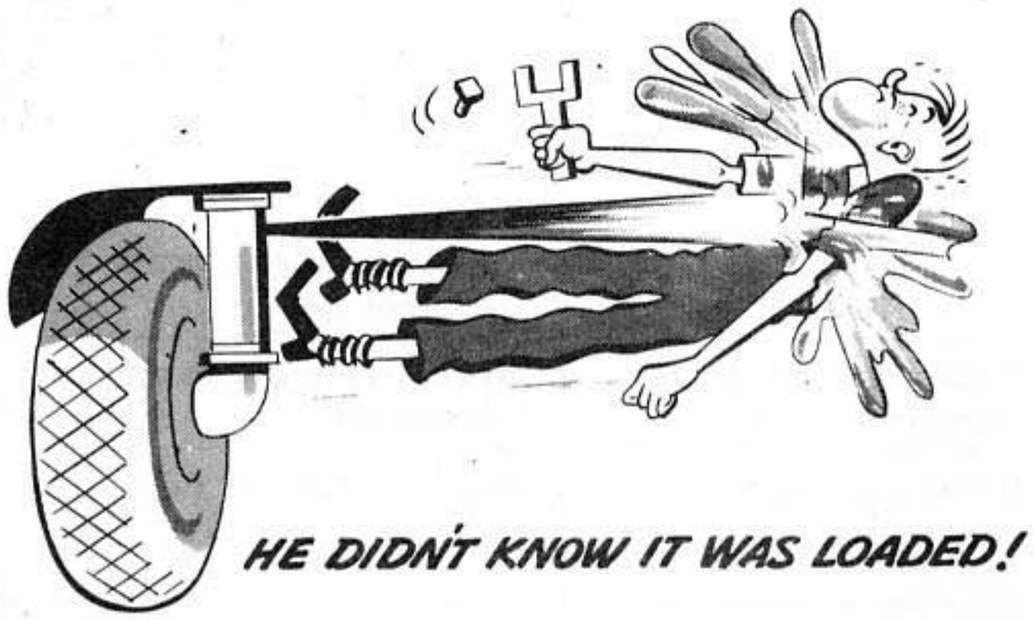
c. REMOVAL AND DISASSEMBLY.

(1) REMOVAL OF NACELLE DOORS. (See figure 66.)

(a) Disconnect actuating link at bell crank on outboard door.

(b) Remove cross link at front of nacelle doors.

(c) Remove hinge bolts and release doors from nacelle.



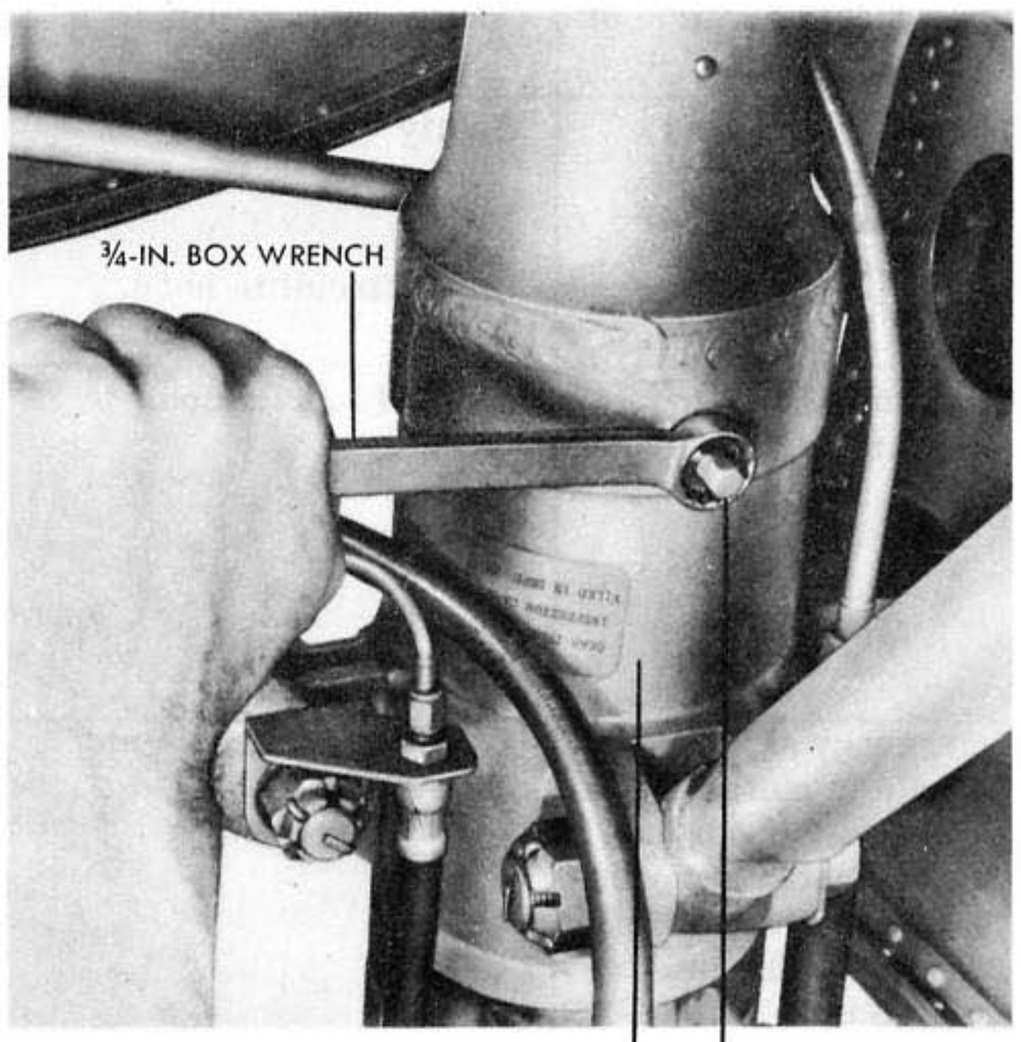


Figure 67 - LOOSENING SHOCK STRUT AIR VALVE BODY

(2) REMOVAL OF MAIN ALIGHTING GEAR. - In the following procedure all the item numbers referred to are shown in figure 78.

(a) Support the airplane on tripod stands and relieve the air pressure in the shock strut by slowly backing off the air valve body. DO NOT REMOVE FILLER PLUG UNTIL ALL AIR HAS ESCAPED. Do not depress the valve core. (See figure 67.)

(b) Remove the interconnecting rod at the forward end of the enclosure doors. Disconnect the actuating rod at the outboard door. (See figure 68.) Remove hinge bolts and release door from nacelle. Remove doors. Relieve pressure in the hydraulic system by operating the wing flaps until the pressure gage reads "zero." Disconnect and plug the alighting gear hydraulic lines.

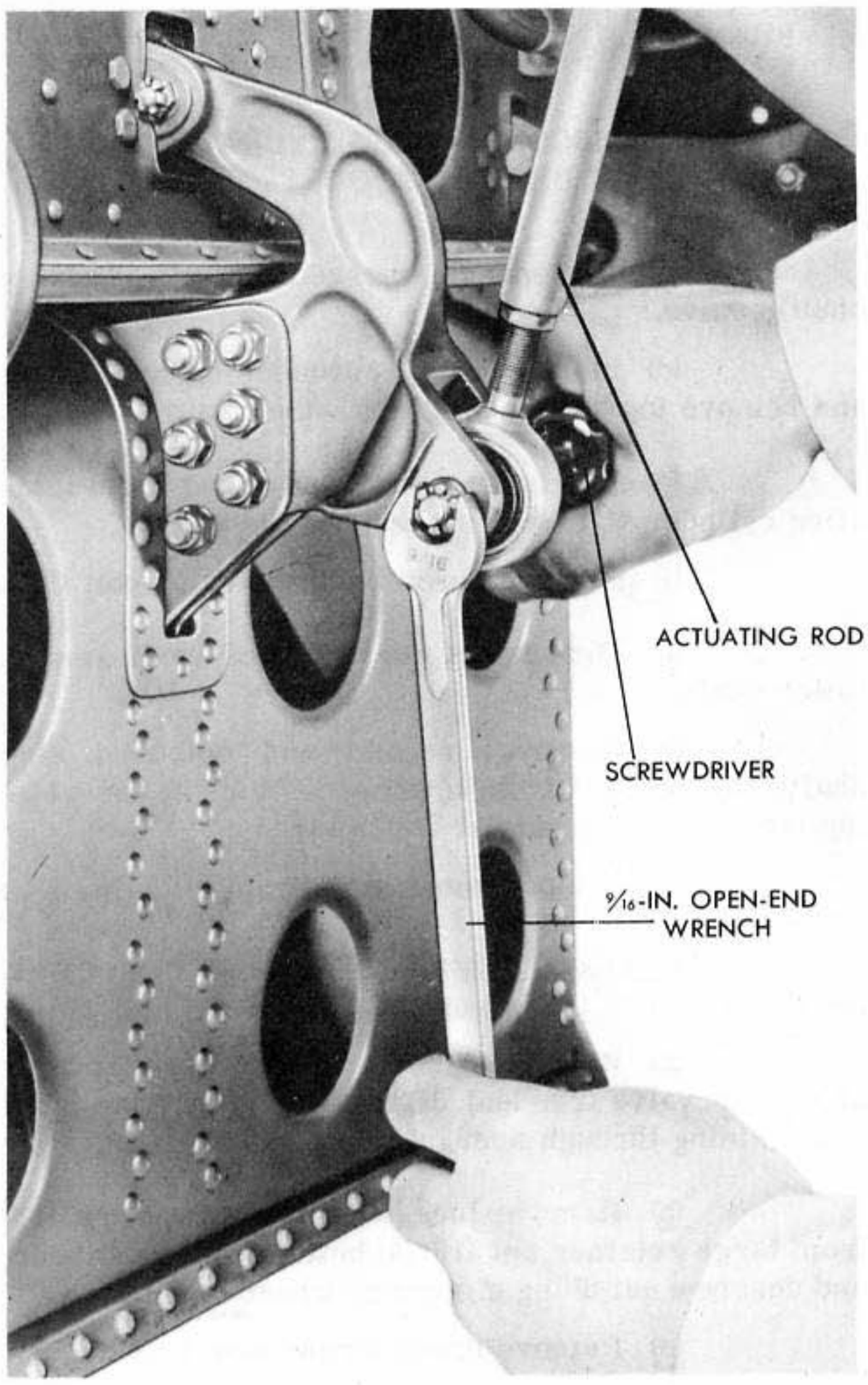
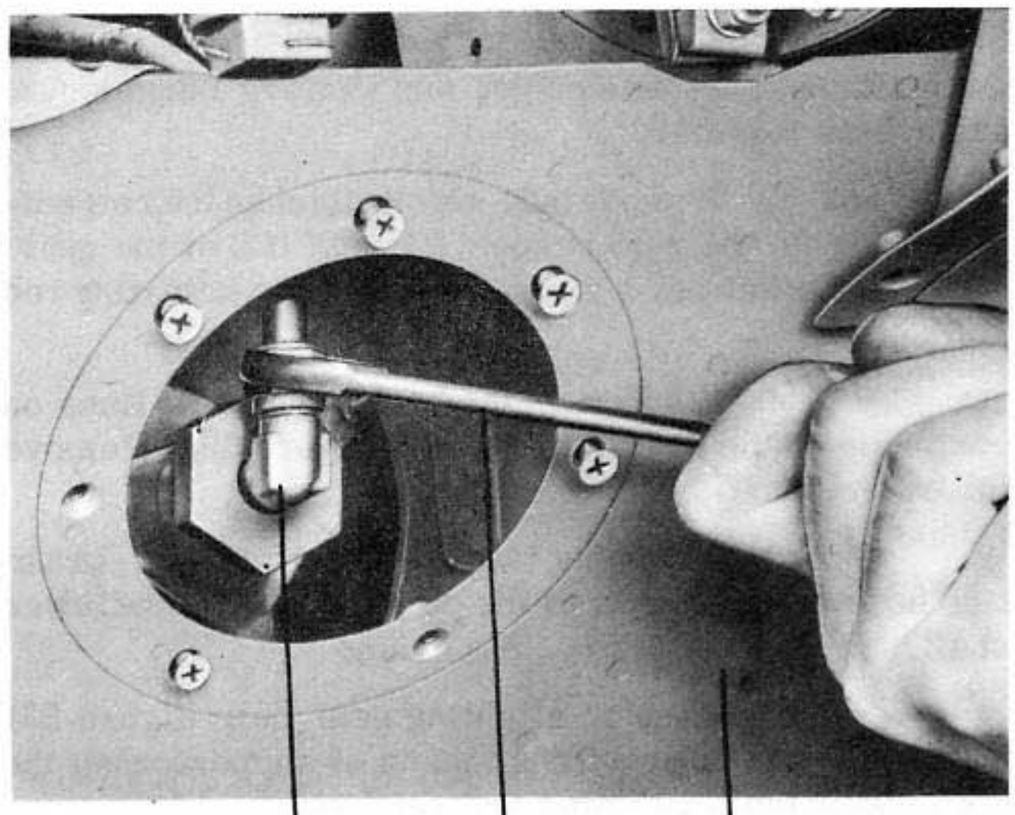


Figure 68 - DISCONNECTING ALIGHTING GEAR. DOOR ACTUATING ROD



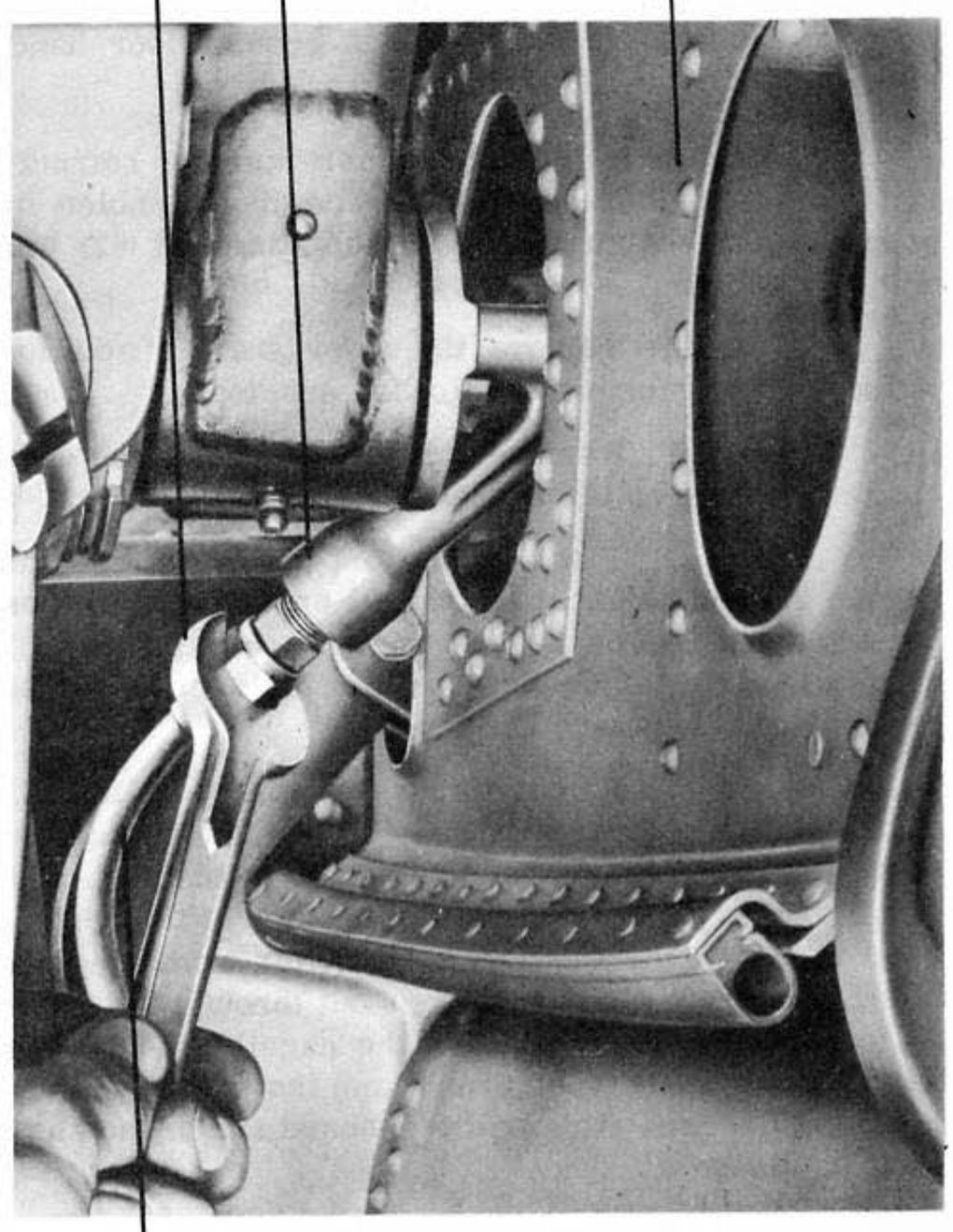


Figure 69 - DISCONNECTING BRAKE HYDRAULIC LINES

(c) Insert a bungee spreader between the pulleys of the bungee unit. (See figure 76.) Adjust it

to relieve the load on the spool mounting bolts. Remove the bolts holding two spools, and remove bungee (20) and spools together.

(d) Remove bolt which attaches the retracting linkage to the rear braces (11) and (13) of the gear. Remove the actuating strut (19) and door actuating rod (12).

(e) Disconnect the brake hydraulic lines on each side of the swivel joint. (See figure 69.) Remove the swivel joint.

(f) Disconnect the emergency air brake line hose at the aft side of the outboard end of the lower shaft.

(g) Place an alighting gear dolly (figure 23) under the gear to provide a means of support when the pin locking bolts and pins are removed.

(h) Remove nuts and washers (36) and (55) from each end of the shaft and the pin locking bolts (47) and (54). Using an alighting gear pin puller remove the pins by working through access door hand holes (P) and (Q). (See figure 19.)

(i) The latch mechanism and the retracting links (32), (34) and (35) may be disassembled by removing the bearing cap (63), actuating rod (62) and bolts (4) and (7).

(j) To remove the upper shaft in addition to the gear, perform the following substeps:

1 Remove bolt (44) that holds the door crank retaining collar in place.

2 Place a support under the engine (figure 23) and adjust it so that all engine weight is on the support and not on the alighting gear truss. This will relieve loads on the rear attaching bolts of the truss during their removal.

3 Remove truss attaching bolts (31) and (46). The outboard bolt may be reached through the hole in the rear shear web directly aft of the bolt. The large access hole in the lower surface of the wing is used to reach the inboard bolt. After removing the bolts, the shaft may be driven out through the cover plate on the outboard side of the nacelle. The upper retracting link, the door crank, and the door crank retaining collar will slide off the inboard end of the shaft as it is removed.

(k) Remove the alighting gear.

(3) REMOVAL OF MAIN ALIGHTING GEAR SHOCK STRUT. (See figure 78.)

(a) Remove wheel and brake.

(b) Disconnect hydraulic brake line at upper end and then at the axle, and cap the openings. (See figure 70.)

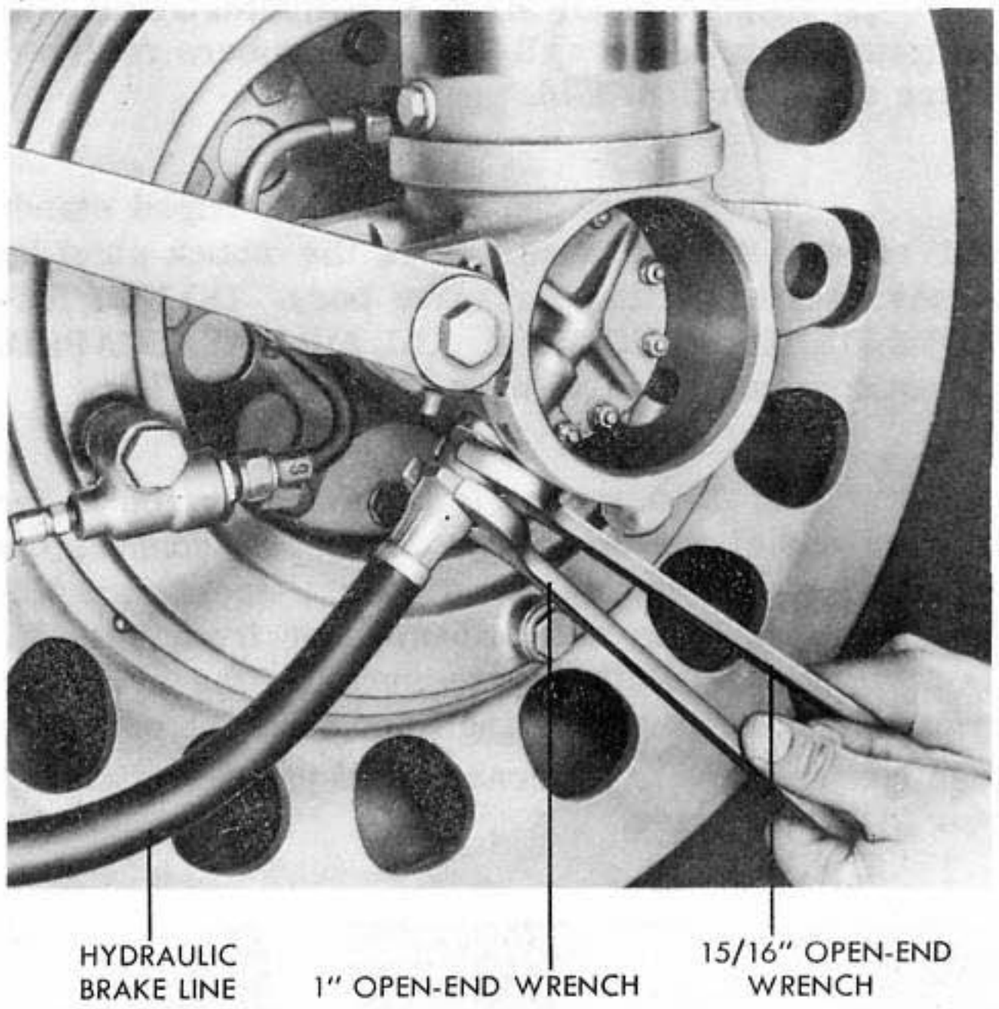


Figure 70 - DISCONNECTING HYDRAULIC LINE AT BRAKE DEBOOSTER

(c) Disconnect emergency air brake from shuttle valve.

(d) Install bungee spreader in bungee (20) and remove top bungee spool (2). (See figure 76.)

(e) Disconnect lower end of hydraulic actuating cylinder (19) by removing lower eyebolt.

(f) Remove lower latch attaching bolt (9).

(g) Disconnect actuating rod from arm on lower shaft.

(h) Remove inboard and outboard stub shafts (38) and (56) from lower cross tube by unscrewing the castellated nuts at both ends.

(i) Remove shock strut from alighting gear.

(4) DISASSEMBLY OF MAIN ALIGHTING GEAR SHOCK STRUT. (See figure 62.)

(a) Relieve all air pressure in shock strut at the air valve (29) and drain oil by inverting strut and draining through hydraulic inlet fitting hole.

(b) Remove lock wire and set screw (13) from large retainer nut (12) on bottom of the cylinder, and unscrew nut using a spanner wrench.

(c) Remove lower torque arm bolt (6).

(d) Replace the air valve body and slowly inflate the strut BY HAND or with hydraulic pressure, to a fully extended position. Increase the pressure

enough to force the piston assembly out of the cylinder. It may be necessary to use a slight bumping action to break packing rings loose.

(e) Remove the set screws (28) and unscrew the bronze piston head (27).

(f) Remove the damper valve ring (26).

(g) Remove set screws (24) from bronze piston stop (25) and unscrew stop from piston.

(h) Remove the packing ring (4), five chevron packings (16), packing ring (3), retainer ring (15), large bronze piston bearing and packing nut (12) from the upper end of the piston.

(5) REMOVAL OF MAIN ALIGHTING GEAR WHEEL. (See figure 71.)

(a) Remove cover plate from the wheel by taking out fasteners. Pull the hub cap from the axle.

(b) Remove cotter pin, castellated nut, and washer from axle.

(c) Remove wheel assembly by sliding outward until free. Do not allow the wheel bearings to fall from the wheel when it is being removed.

(d) Place wheel and tire assembly on floor with brake side up as wheel seal ring extends slightly beyond tire line and may become damaged if placed face down.

Figure 71 - REMOVING MAIN ALIGHTING GEAR WHEEL

(6) REMOVAL OF MAIN ALIGHTING GEAR TIRE.

(a) Remove the valve core and deflate tube completely. Remove any accessories that may be holding the stem.

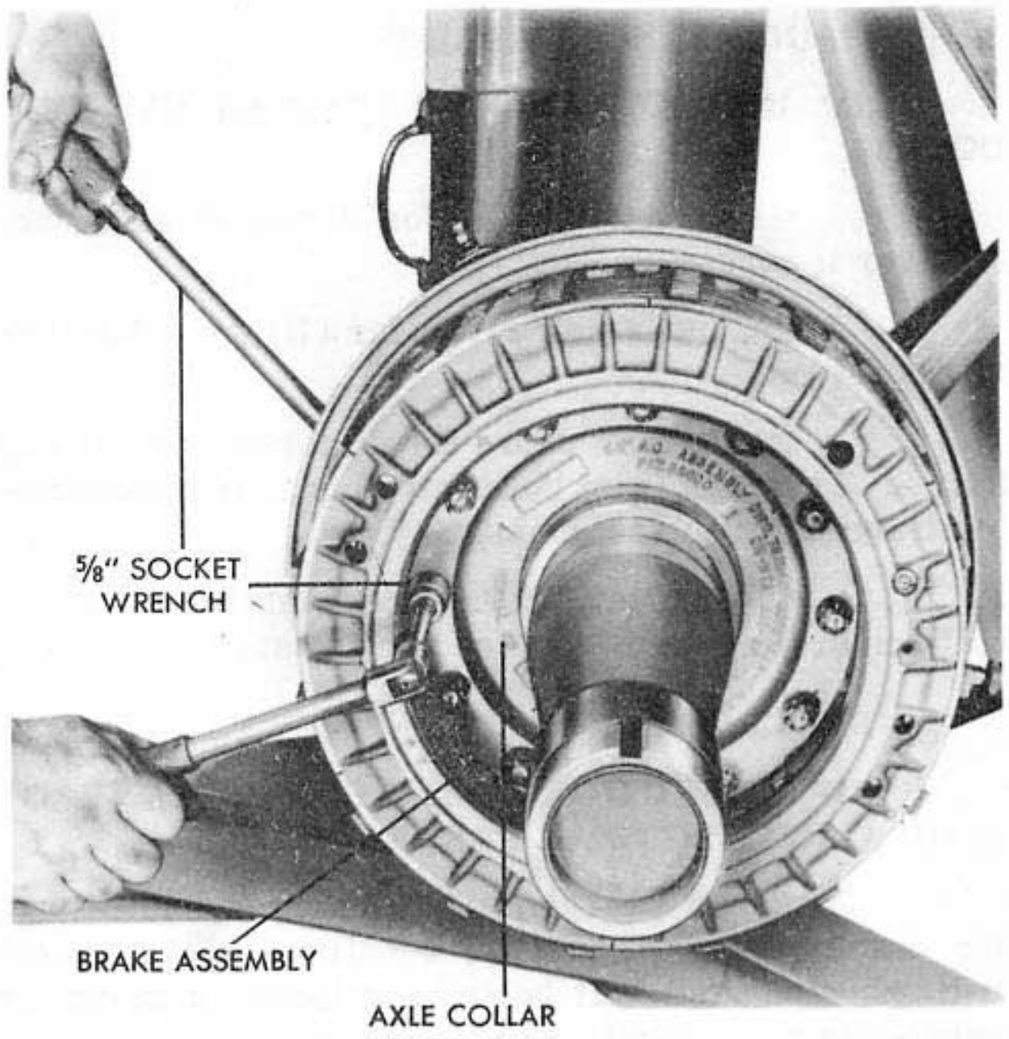


Figure 72 - REMOVING BRAKE

(b) Force outer bead from the bead seat by any suitable means that will not injure the tire or tube.

(c) Insert two irons under the outer bead (about two or three inches apart) and force the bead over the flange at the valve; at the same time force the bead into a well at a point opposite the valve.

(d) Using one iron, work the rest of the outer bead over the flange a little at a time.

(e) Break the inner bead from the bead seat in the same manner as outer bead.

(7) REMOVAL OF BRAKES. (See figure 72.)

(a) Remove wheel.

(b) Disconnect emergency air brake hose from shuttle valve.

(c) Remove the 12 bolts which secure the brake assembly to the axle collar.

(8) DISASSEMBLY OF BRAKES. (See figure 63.)

(a) Remove lock screw from adjustment ring. Remove ring by turning it counterclockwise.

(b) Remove plates.

(c) Remove asbestos heat transfer ring.

(d) Remove the six finger springs.

(e) Remove the cup retainer ring.

(f) Remove the Neoprene cup.

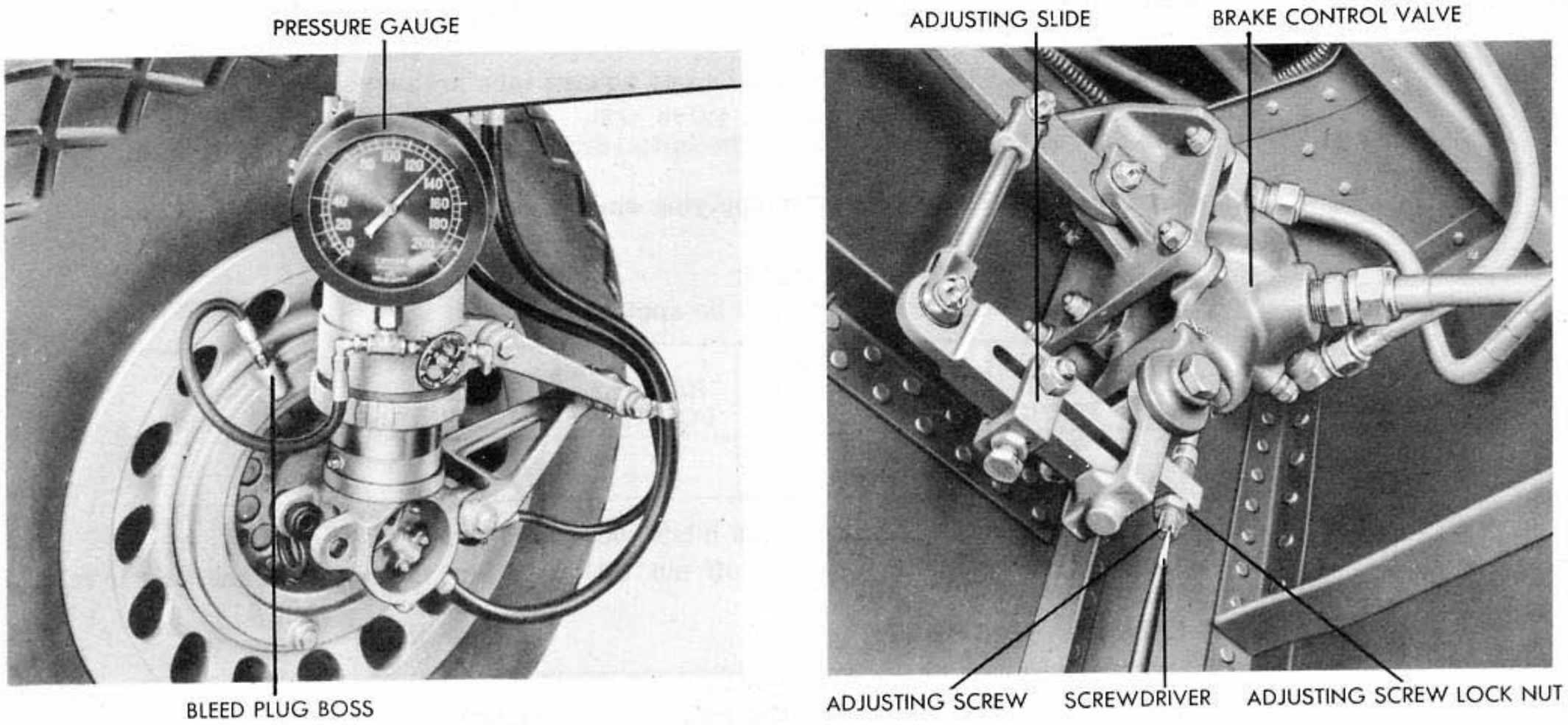


Figure 73 - ADJUSTING BRAKES

2 Tighten the retaining ring until snug, then back off to give a total clearance (between all the disks) of 0.112 ± 0.005 inch. Continue to back the ring off until the next lock position is reached.

3 If feeler gages are not available, the above adjustment may be made on the basis that one complete turn of the retainer ring gives 0.060-inch clearance.

4 Install and safety the lock screw.

5 Install wheel.

(b) BRAKE CONTROL VALVE.

1 Remove bleed plug at brake and install 200 pounds per square inch pressure gage. (See figure 73.)

2 Have man in cockpit pump up accumulator to 850 pounds per square inch.

3 With brakes OFF, loosen adjusting screw nut at brake control valve (one in each upper forward corner of the nose wheel well) and tighten adjusting screw until 20 pounds per square inch is reached on the gage, then loosen adjusting screw until gage reads zero. Repeat up to 20 back to zero a few times until exact zero point is determined. Then back off adjusting screw an additional 1/2 turn and tighten adjusting screw lock nut. (See figure 73.) Be sure man in cockpit maintains 850 pounds per square inch in accumulator while above adjustment is made.

4 Have man in cockpit kick brake full ON. Gage at brake should read 130 to 135 pounds per square inch pressure. If it does not, release brake and move adjusting slide fore or aft until 130 to 135 is reached with brake full ON, then safety. (See figure 73.) Moving aft decreases pressure. Moving forward increases pressure. Be sure man in cockpit maintains 850 pounds per square inch pressure in accumulator while above adjustment is made.

5 After adjusting both brake control valves apply parking brake. Pressure should not drop below 100 pounds per square inch. If it does, adjustment of parking linkage is necessary.

6 Remove gages and watch fluid level. It should not drop and there should be no bubbles.

7 Reinstall bleed plug and bleed screw.

8 Kill pressure in system, return hand pump bypass valve to SYSTEM position and recheck fluid level in hydraulic reservoir. Add fluid, Specification AN-VV-O-366a, if necessary.

(3) BLEEDING BRAKES. (See figure 74.) - Remove the screw from the bleeder port nut and install a bleeder hose, placing the free end of the hose in a fluid container. Inspect to see that the fluid reservoir is full and that the system pressure is up to approximately 150 pounds per square inch. Unscrew the bleeder port about 1/2 turn. Apply brakes and allow the fluid to escape until it is free of any evidence of air bubbles. With the end of the hose immersed in oil, slowly release the brakes and wait 30 seconds before tightening the bleeder port nut.

(4) TESTS OF EMERGENCY AIR BRAKE SYSTEM. (See figure 64.)

(a) COMPLETE SYSTEM.

1 Inflate bottle (27) to 400 (+50, -0) pounds per square inch pressure.

2 With foot brakes off, operate control valve (29). Maintain pressure for three minutes. If pressure gage (28) shows decrease in pressure after the initial drop, check fittings with soapy water. Repair leaks.

3 Bleed hydraulic brake system after applying emergency air brakes.

(b) CONTROL VALVE ASSEMBLY.

NOTE

In following tests, air must be applied suddenly.

TEST PORT	PORTS PLUGGED	TEST FLUID	PRESSURE (POUNDS PER SQUARE INCH)	HANDLE POSITION	LEAKAGE ALLOWABLE	TIME (MINUTES)
B	A	Air	800	OFF	None	3
B	A and C	Air	800	OFF	None	3

1 Plunger assembly should begin to open intake port 1/16 inch before end of travel.

2 After making above adjustment, back off nut (11) until slot indexes with one hole in valve body (16). Lock with set screw.

(c) SHUTTLE VALVE ASSEMBLY.

TEST PORT	PORTS PLUGGED	TEST FLUID	PRESSURE (POUNDS PER SQUARE INCH)	LEAKAGE ALLOWABLE	TIME (MINUTES)
E	F	Oil	900	None	1
G	F	Air	800	None	3
E	F	Oil	100	None	3

g. ASSEMBLY AND INSTALLATION.

(1) ASSEMBLY OF BRAKES. (See figure 75.)

(a) Replace the Neoprene cup.

(b) Install the retainer ring, lining up pin with center of any spline.

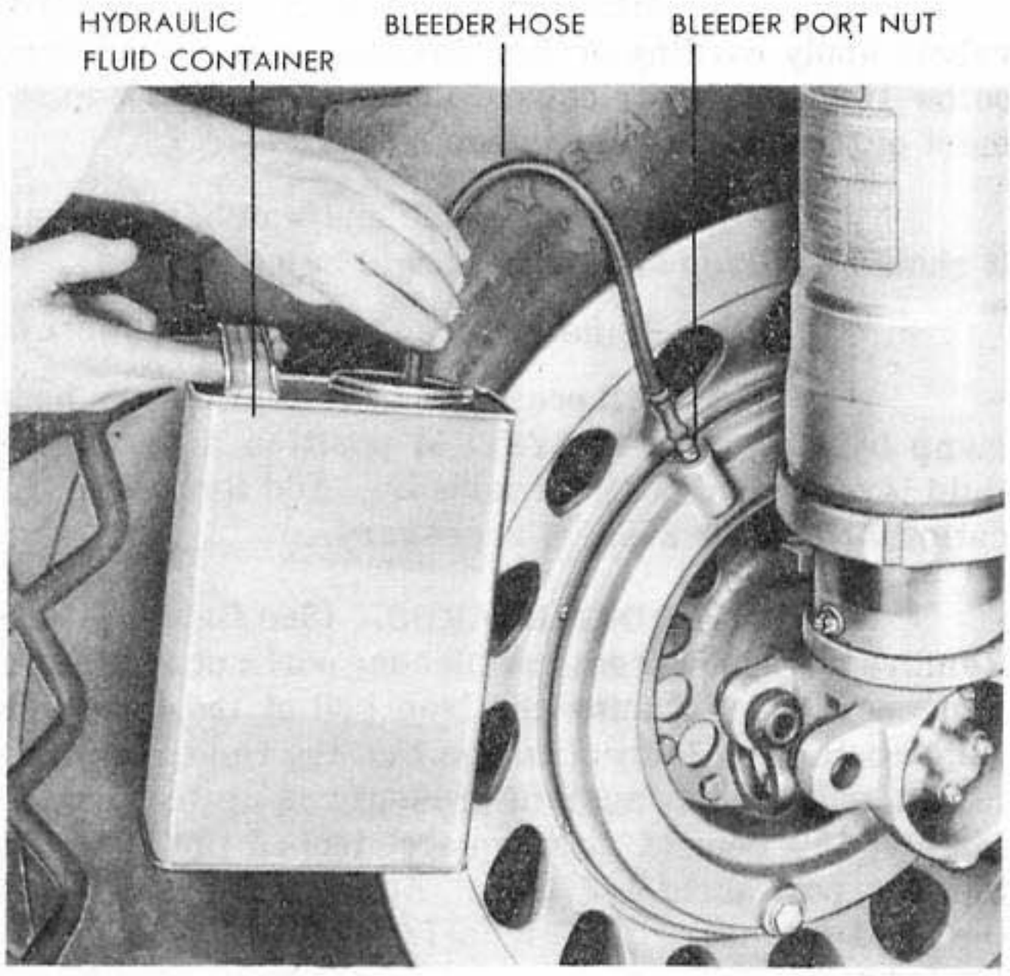


Figure 74 - BLEEDING BRAKES

(c) Install finger springs, being careful to have ends rest on steel insert buttons.

(d) Install asbestos heat transfer ring, lining up pin with hole.

(e) Assemble plates, beginning with a steel stationary plate and alternating steel and bronze plates. There are 17 steel plates and 16 bronze plates (steel at each end against the insulator disk and the retainer ring).

(f) Install adjustment ring, turning clockwise. Tighten until snug, then back off until 0.112 ± 0.005-inch clearance between ring and plates is reached. Check clearance at three points simultaneously (use three gages). One revolution of the ring equals 0.060 inch. Line up lock screw hole at point nearest correct adjustment.

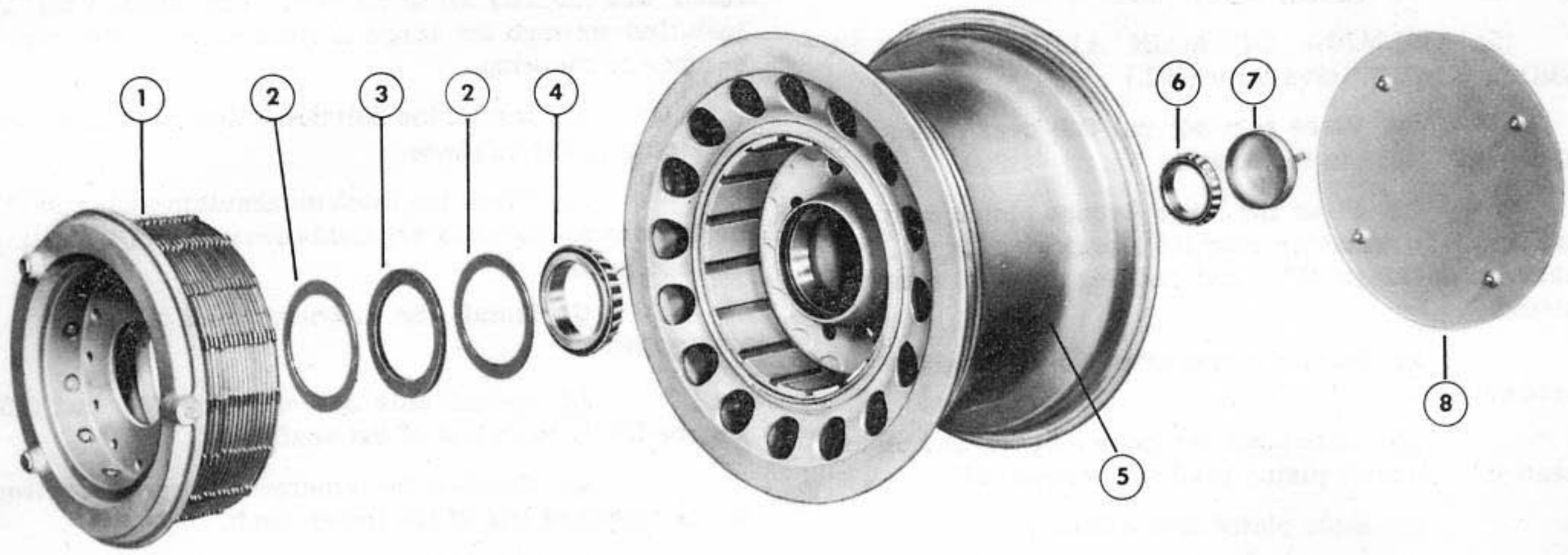
(g) Install and safety the lock screw. Line up splines.

(2) INSTALLATION OF BRAKES.

(a) Secure brake assembly to axle collar with the eight bolts.

(b) Install shuttle valve and connect emergency air-brake hose. (See figure 75.)

(c) Install wheel after adjusting brake unit.



ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	731946	BRAKE ASSEMBLY	1
2.	218349-4	RING, BEARING CLOSURE	2
3.	218350-4	WASHER, BEARING CLOSURE FELT	1
4.	42375	BEARING, ROLLER	1
5.	731944	WHEEL SUBASSEMBLY	1
6.	34300	BEARING, ROLLER	1
7.	218627	CAP ASSEMBLY, HUB	1
8.	218628	FAIRING ASSEMBLY	1

Figure 75 - WHEEL AND BRAKE - EXPLODED VIEW

(3) INSTALLATION OF MAIN ALIGHTING GEAR TIRE.

(a) Insert the tube into tire with the heavy spot of the tube marked with a 1/2-inch by 2-inch colored bar in line with the light spot on the tire which is marked with a colored dot. Inflate slightly to round out the tire.

(b) Mount tire from the outside of the wheel (the side which has the valve hole), forcing the first bead over the flange by hand as much as possible. Then use a tire iron to force a little of the bead at a time and to force into the well that portion of the bead which is already over the flange.

(c) Line up valve in tube with valve hole in wheel by rotating the tire and tube on the wheel. Keep balance marks exactly in line.

(d) Force tube over flange by using hand pressure at one point and then work the rest of the tube over the flange.

(e) Start valve through valve hole and apply a valve stem extension or other suitable means to hold the valve in place while the second bead is being applied.

(f) Force the second bead over the flange, starting at a point directly opposite the valve and working bead in the same manner as the first bead.

(g) Adjust tire and wheel to be as concentric as possible. Then inflate tube and force beads of tire onto bead seat and against the flange.

(h) After tire beads have been seated, permit tube to readjust all strains by deflating completely.

(i) Inflate to the deflection markers, approximately 42 pounds per square inch (approximately 36 pounds for operation on soft airport surfaces) with airplane loaded normally.

(4) INSTALLATION OF MAIN ALIGHTING GEAR WHEEL. (See figure 75.)

(a) Line up the keyways in all the bronze brake disks with a straightedge. Apply brakes to hold the disks in position.

(b) Cover inner bearing with a light coating of grease, Specification AN-G-5, and install in wheel.

(c) Install inner washers in wheel.

(d) Install wire lock ring.

(e) Slide the wheel on the axle and over the brake. Be sure the keyways in the wheel line up with the keys of the disks and that the wheel engages the last disk.

(f) Cover the outer bearing with a light coating of grease, Specification AN-G-5, and slide over ends of axle.

(g) Install outer washer and castellated nut and tighten nut as far as possible with wrench. Back off until free. Turn up until finger tight. Then turn one castellation more and install cotter.

(h) Install hub cap.

(i) Install cover plate.

(5) ASSEMBLY OF MAIN ALIGHTING GEAR SHOCK STRUT. (See figure 62.)

(a) Place retainer nut (12) over piston and allow it to slide to the bottom.

(b) Place the large bronze piston bearing, packing (11), retainer ring (15), packing ring (3), five chevron packings (16), and packing ring (4) over the piston.

(c) Install piston stop (25) and tighten set screws (24).

(d) Install damper valve ring (26) and piston head (27). Install piston head set screws (28).

(e) Slide piston into cylinder.

(f) Assemble retainer nut (12) to the cylinder. Nut is tightened handtight only.

(g) Tighten safety lock screws (13) in retainer nut (12).

(h) Install lower torque arm bolt (6).

(6) INSTALLATION OF MAIN ALIGHTING GEAR SHOCK STRUT. (See figure 62.)

(a) Place shock strut in position in respect to the remainder of the alighting gear.

(b) Connect the inboard and outboard stub shafts (38) and (56) to the lower cross tube. Screw the castellated nuts on both ends of the shafts and safety the nuts.

(c) Install the lower large attaching bolt.

(d) Connect the lower end of the hydraulic actuating cylinder (19) by means of the eyebolt.

(e) Install top bungee spool (2) and remove bungee spreader from bungee (20).

(f) Uncap hydraulic line and fittings and install the hose. (See figure 67.)

(g) Connect emergency air-brake hose to shuttle valve.

(h) Connect actuating strut.

(i) Install brake and wheel.

(7) INSTALLATION OF MAIN ALIGHTING GEAR. (See figure 78.)

(a) Place the alighting gear in position in airplane and slide the door crank retaining collar, door crank and upper retracting link to the inboard end of the shaft.

(b) Install the shaft through the cover plate on the outboard side of the nacelle.

(c) Install the truss attaching bolts. The outboard bolt is installed through the hole in the rear shear web directly aft of the bolt. The inboard bolt is installed through the large access hole in the lower surface of the wing.

(d) Install the bolt that holds the door crank retaining collar in place.

(e) Place the latch mechanism and retracting links in position and assemble bearing cap, actuating rod and bolts.

(f) Install the alighting gear pin and pin locking bolts.

(g) Install nuts and washers (36) and (55) (figure 58) to each end of the shaft.

(h) Connect the emergency air-brake line to the outboard end of the lower shaft.

(i) Install the brake hydraulic swivel joint and connect the brake hydraulic lines to each side of it.

(j) Install the door actuating rod and the actuating strut.

(k) Install the bolt that attaches the retracting linkage to the line brake (11) and (13) (figure 78) of the gear.

(l) Install the bungee and spools and remove the bungee spreader. (See figure 76.)

(m) Connect the alighting gear hydraulic lines to the actuating strut.

(n) Install the nacelle alighting gear doors. After adjusting gear (step h (1), below, connect the

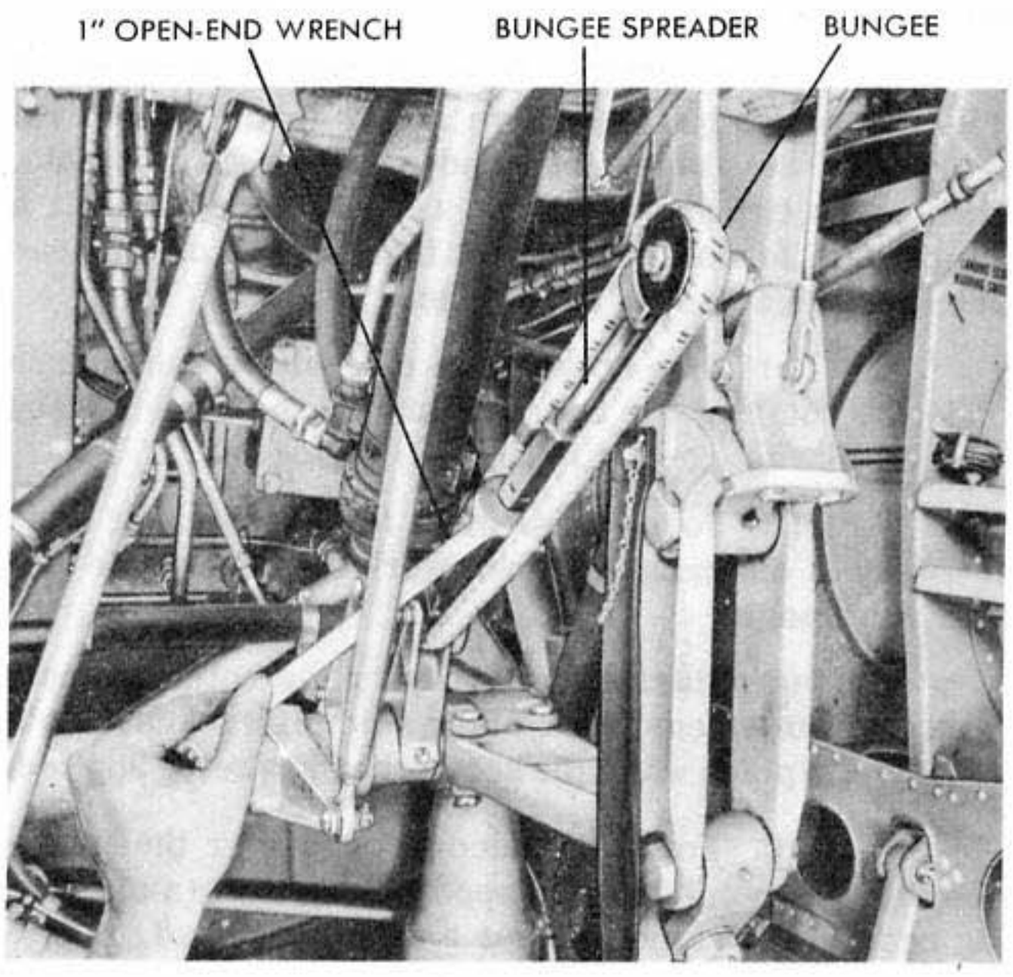


Figure 76 - INSTALLING MAIN ALIGHTING GEAR BUNGEE

actuating rod at the outboard door. Assemble the interconnecting rod at the forward end of the doors.

(8) INSTALLATION OF NACELLE DOORS.

(a) Hold door in DOWN position, install hinge bolts, castellated nuts and cotter pins. Install other door in same manner.

(b) Connect outboard door actuating rod, leaving check nuts loose.

h. FINAL TEST AFTER ASSEMBLY.

(1) TEST AND ADJUSTMENT OF MAIN ALIGHTING GEAR WHEEL AFTER INSTALLATION. - Rotate wheel to determine if any drag is present. Loosen axle nut if necessary. Remove wheel if binding is present. Inspect the parts to determine cause. If felt washer appears to have been responsible, reinstall the wheel correctly using the same parts. If any other part appears to have been at fault, replace the part.

(2) TEST AND ADJUSTMENT OF MAIN ALIGHTING GEAR SHOCK STRUT AFTER INSTALLATION.

(a) Relieve any air pressure that may be present in the strut by slowly backing off the body of the inflation valve. Do not depress the valve core. After the pressure is relieved, remove the valve and fill the strut with hydraulic fluid through the valve hole.

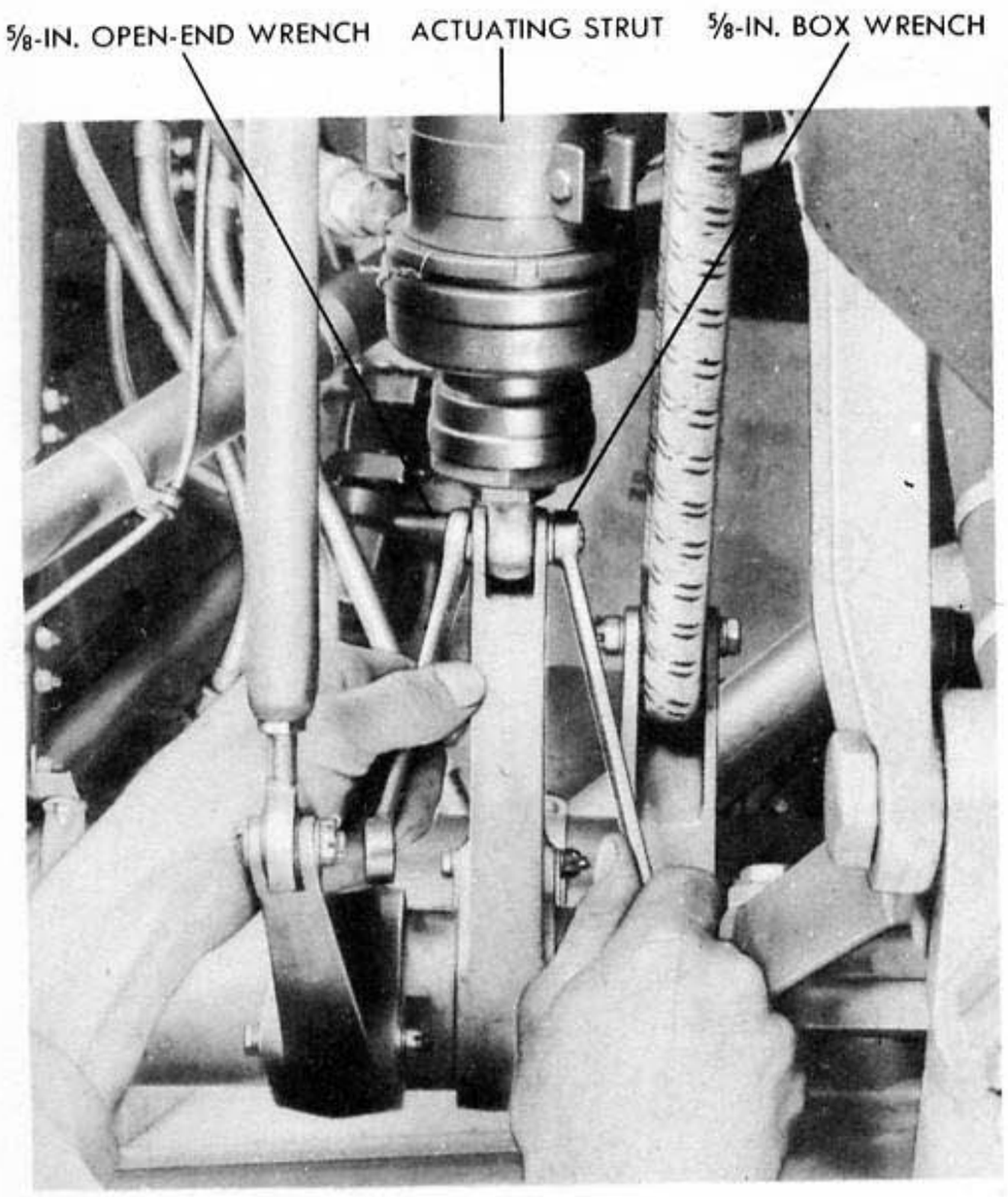


Figure 77 - DISCONNECTING ALIGHTING GEAR ACTUATING STRUT AT LOWER END

(b) Insert the valve loosely. Fully extend and compress the strut to eliminate any air traps. Remove the valve and recheck the fluid level, making additions of fluid if necessary.

(c) With the airplane in a standing position, inflate the strut through the air valve to give the following dimension: measuring from the center of the bolt holes on the torque arm to the lower end of the shock strut cylinder, 4-13/16 inches, loaded for take-off. Use an air bottle containing 2000 pounds per square inch pressure. Rock the airplane fore and aft while inflating the strut to overcome packing friction so that a correct dimension may be read.

(d) If there is evidence of fluid or air leakage at the packing gland relieve the air pressure in the strut and tighten the packing nut by hand. If normal hand tightening does not stop the leakage replace the packing and make a general check of other parts.

(3) TEST AND ADJUSTMENT OF MAIN ALIGHTING GEAR AFTER INSTALLATION. (See figure 78.)

(a) All tests and adjustments are made with nacelle doors disconnected. Start with the gear in DOWN position to assure correct operation of the gear.

(b) Adjust the two bolts (33) at the lower end of the upper retracting link (32) so that the centerlines of bolts (7) and (9) and the upper shaft are in line within 0.010 inch.

(c) Move lug (17) full forward against its rollers by pulling down on the latch actuating rod (62) and thus rotating the latch shaft (65). The small lever at the outboard end of the shaft should hold the lug against the rollers and, at the same time, the two ears which support the emergency release lever should just touch the lower surface of the clamp on the upper link (32). If, when rotating the shaft, the ears contact the clamp before the small lever moves the lug against its rollers, file the inner radius of the ears to correct this condition.

(d) Adjust the length of the latch actuating rod to give a minimum of 5/16-inch latch engagement over the end of the cam segment. Move the lug (17) full aft against the rollers, and in this position, the latch cap (6) should clear the cam by 1/16 inch (+ 1/16, - 0) measured radially.

(e) Shim the latch cap to give 0.005-inch to 0.015-inch clearance with the end of the cam segment in the latched position.

(f) With the bottoming cap of the actuating strut backed full out and locked, disconnect the strut at its lower end. (See figure 77.) Apply 850 pounds per square inch DOWN pressure and then adjust the piston eyebolt to match the hole in the lever arm (21) and insert the bolt.

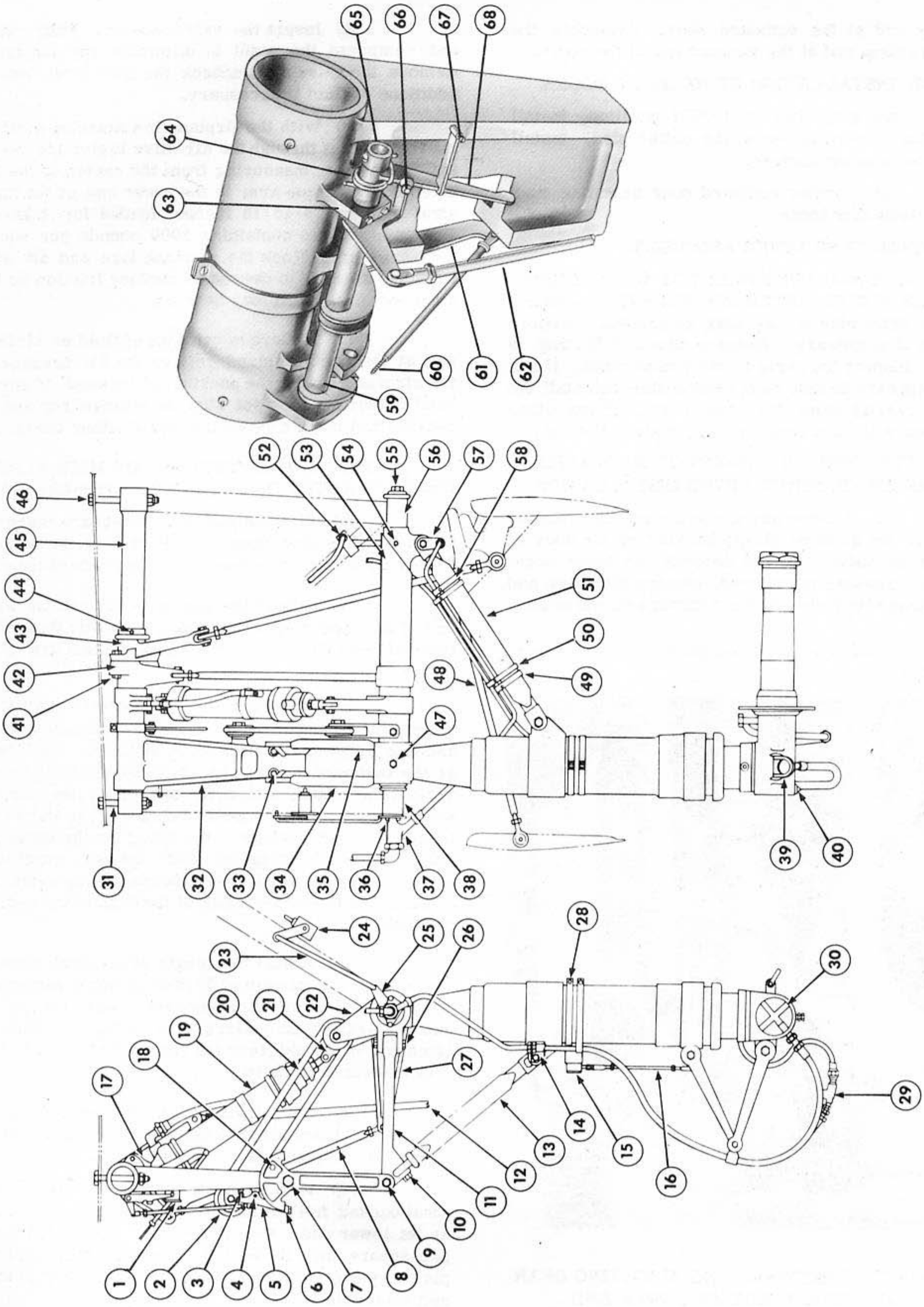
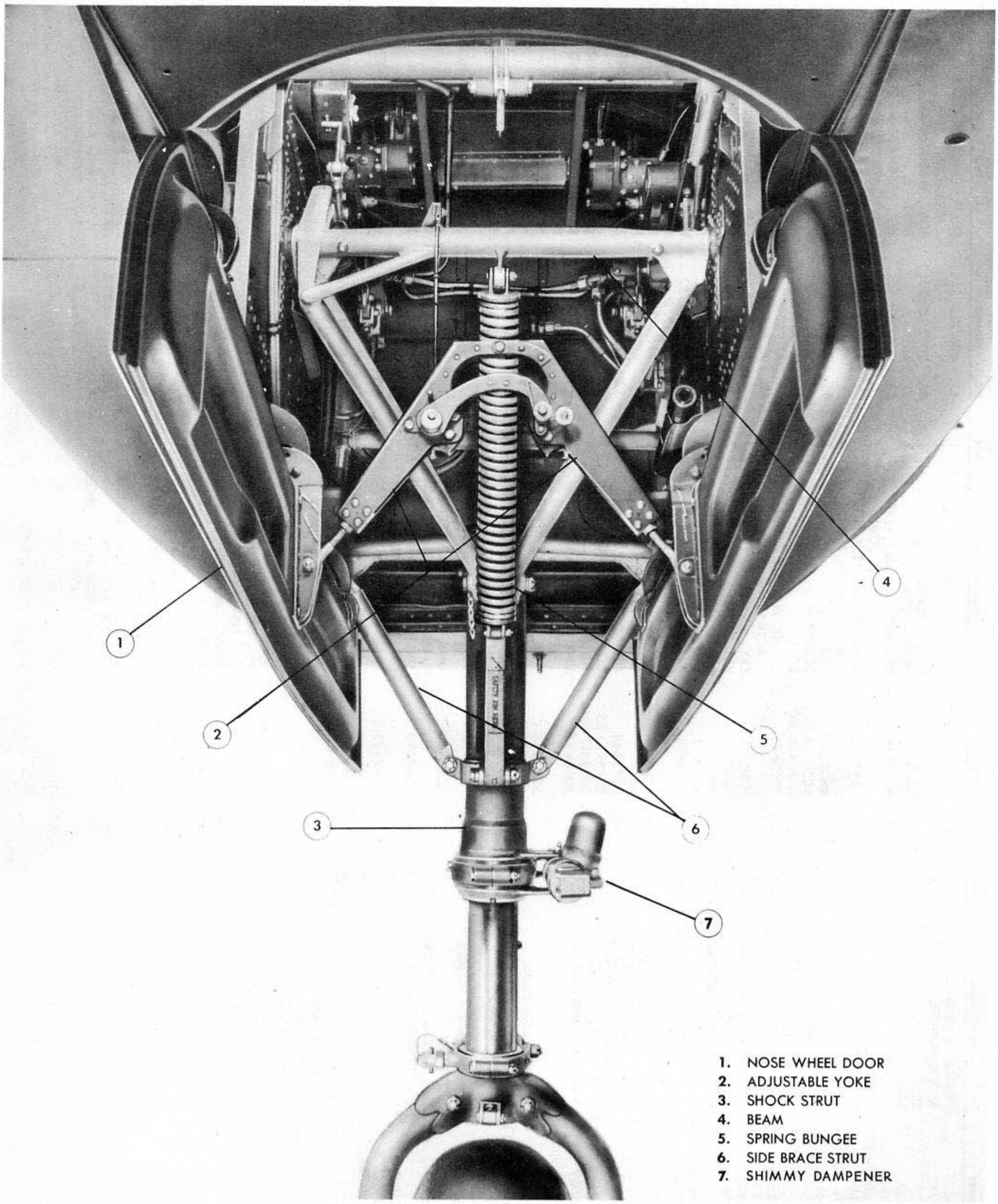


Figure 78 - MAIN ALIGHTING GEAR ASSEMBLY AND INSTALLATION



1. NOSE WHEEL DOOR
2. ADJUSTABLE YOKE
3. SHOCK STRUT
4. BEAM
5. SPRING BUNGEE
6. SIDE BRACE STRUT
7. SHIMMY DAMPENER

Figure 79 - NOSE ALIGHTING GEAR

approximately 30 degrees each side of neutral. The wheel may be made to caster 360 degrees by pulling out on the lock pin located just above the fork on the left side of the strut. As the nose gear retracts, the shock strut engages the yoke mechanism which, in turn, closes the doors.

(3) NOSE ALIGHTING GEAR SHOCK STRUT. (See figure 86.) - Operation and general arrangement of the nose wheel shock strut is the same as that of the main gear except that the damper valve ring does not have small openings for fluid restriction.

(4) NOSE WHEEL SNUBBER. (See figure 87.) - The nose wheel snubber is a double-acting strut. Its function is to prevent shimmy (unnecessary castering) of the nose wheel during taxiing operations.

(5) NOSE WHEEL. (See figure 85.) - The nose landing gear uses a Hayes 10-inch wheel consisting of a main aluminum alloy casting with removable flange and dust covers for the bearings. This Hayes wheel is interchangeable with the Goodyear nose alighting gear wheel (used on A-20C, P-70 and F-3 airplanes) when the collar on the axle is changed.

(6) NOSE ALIGHTING GEAR TIRE. - The nose wheel mounts a 26-inch smooth casing, self-earthing, and a 26-inch non-cactus proof smooth contour tube.

b. TROUBLE SHOOTING.

SYMPTOM	CAUSE	ISOLATION	REMEDY
Nose gear fails to extend when operated by emergency release.	Nose wheel door mechanism not allowing nose gear to extend.	Visually inspect shock struts for extension and torque links for freedom of operation. Check door mechanical adjustment.	Clean, lubricate, and/or replace torque link bearings. Adjust door mechanism for retracting.
Nose wheel fork hard to turn.	Snubber assembly binding.	Inspect snubber piston for pitting, or binding of the piston rod.	Repair or replace snubber assembly.
	Shock strut piston binding due to improper packing adjustment.	Disassemble shock strut and inspect for wear or other damage.	Replace damaged parts, or parts excessively worn.

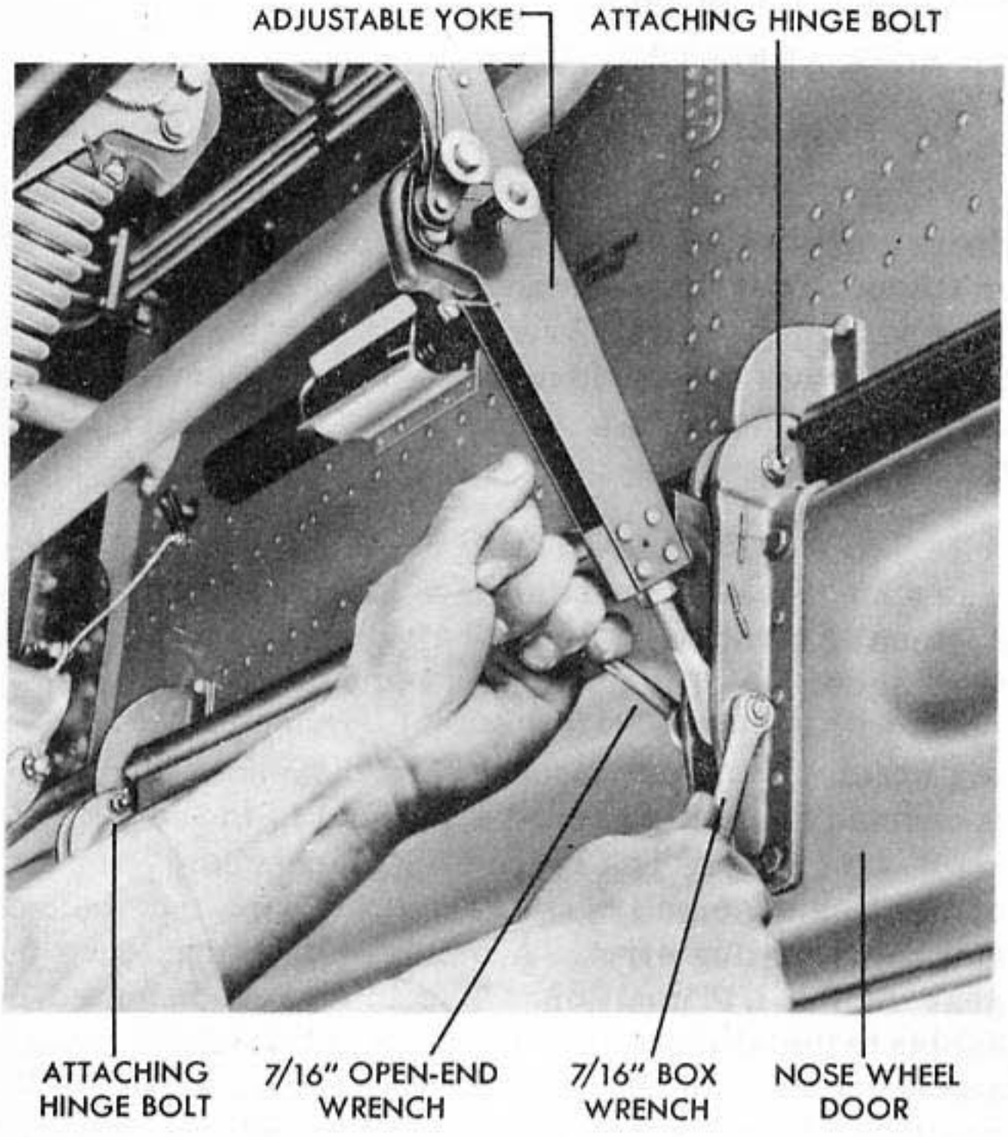


Figure 80 - REMOVING NOSE WHEEL DOOR

NOTE

Trouble shooting data, except that applying exclusively to brakes, given in paragraph 6, this section, also applies to the nose gear.

c. REMOVAL AND DISASSEMBLY.

(1) REMOVAL OF NOSE WHEEL DOORS. (See figure 80.)

(a) Disconnect adjustable yoke from doors.

(b) Remove the three attaching hinge bolts, first removing the cotter pin secured through each castellated nut.

CAUTION

Do not remove the door attaching brackets from the fuselage.

(2) REMOVAL OF NOSE ALIGHTING GEAR AND NOSE ALIGHTING GEAR SHOCK STRUT. - All item numbers referred to are on figure 85.

(a) Remove the nose wheel doors.

(b) Support the airplane on tripod stands and relieve the air pressure in the shock strut by slowly backing off the air valve body.

(c) Partially retract the gear. While the spring bungee (17) is extended, bind it with heavy steel wire. Fully extend the gear and remove the bungee assembly.

(d) Relieve the hydraulic system pressure by operating the wing flaps until the pressure gage reads zero. Disconnect and plug the hydraulic lines at the actuating strut (9). Remove the actuating strut.

(e) Arrange a support to carry the weight of the gear assembly.

(f) Disconnect the rear brace arm at the shock strut and then remove the retracting linkage as follows: Remove the taper pins which hold the main mounting pins (10) in place. Remove the nuts which attach the pins to the fuselage structure. These may be reached through the large access doors in the side walls of the nose wheel well. Free the unit for removal by driving the mounting pins into the tubular shaft. The pins may be pulled out after the unit has been taken out of the airplane.

(g) Remove the gear assembly in an identical manner to that of the retracting mechanism. The nuts which attach the mounting pins to the fuselage structure are accessible through the fixed gun access openings.

(h) The attaching bolts for the tube which supports the lower end of the actuating strut may be reached through the fixed gun access openings. If it is desired to remove the tube on which the latch hook is mounted, the attaching bolts may be reached through the access doors in the side walls of the nose wheel well.

(3) DISASSEMBLY AND TEST OF NOSE ALIGHTING GEAR SHOCK STRUT. (See figure 86.)

(a) Remove wheel.

(b) Remove cross beam assembly and side braces from strut.

(c) Remove snubber from shock strut.

(d) Remove or disconnect torque arm assembly (28) from shock strut piston.

(e) Slowly release all air pressure at valve (1).

(f) Remove valve assembly (1) and drain oil.

(g) Remove safety (18) and unscrew retainer nut (19). Be careful not to roughen or tear feather edge on packing ring.

(h) Remove piston assembly, using a slight bumping action if necessary to loosen packing.

(i) Remove safety screws (6) from piston head (5). Remove piston head (5). Do not damage threads.

(j) Remove collar (3) and damper valve ring (4) from piston head (5).

(k) Loosen set screws and remove piston stop (8) from piston.

(l) Remove packing ring (9) from piston.

(m) Remove chevron packing (10) from piston.

(n) Remove packing ring (11) from piston.

(o) Remove retaining ring (16) from piston.

(p) Slide retainer nut (19) from piston.

(4) REMOVAL OF NOSE WHEEL SNUBBER. (See figure 87.)

(a) Remove the two drilled studs which attach the cylinder end (10) to the alighting gear.

(b) Remove the bolt which attaches piston rod (12) to alighting gear.

(5) DISASSEMBLY OF NOSE WHEEL SNUBBER (See figure 87.)

(a) Remove plug (22) and drain fluid from snubber.

(b) Unscrew nut from reservoir end of tube (20).

(c) Remove bolts (4) attaching reservoir (21) to cylinder head (3) and remove reservoir from cylinder (8).

(d) Remove head lock nut (6).

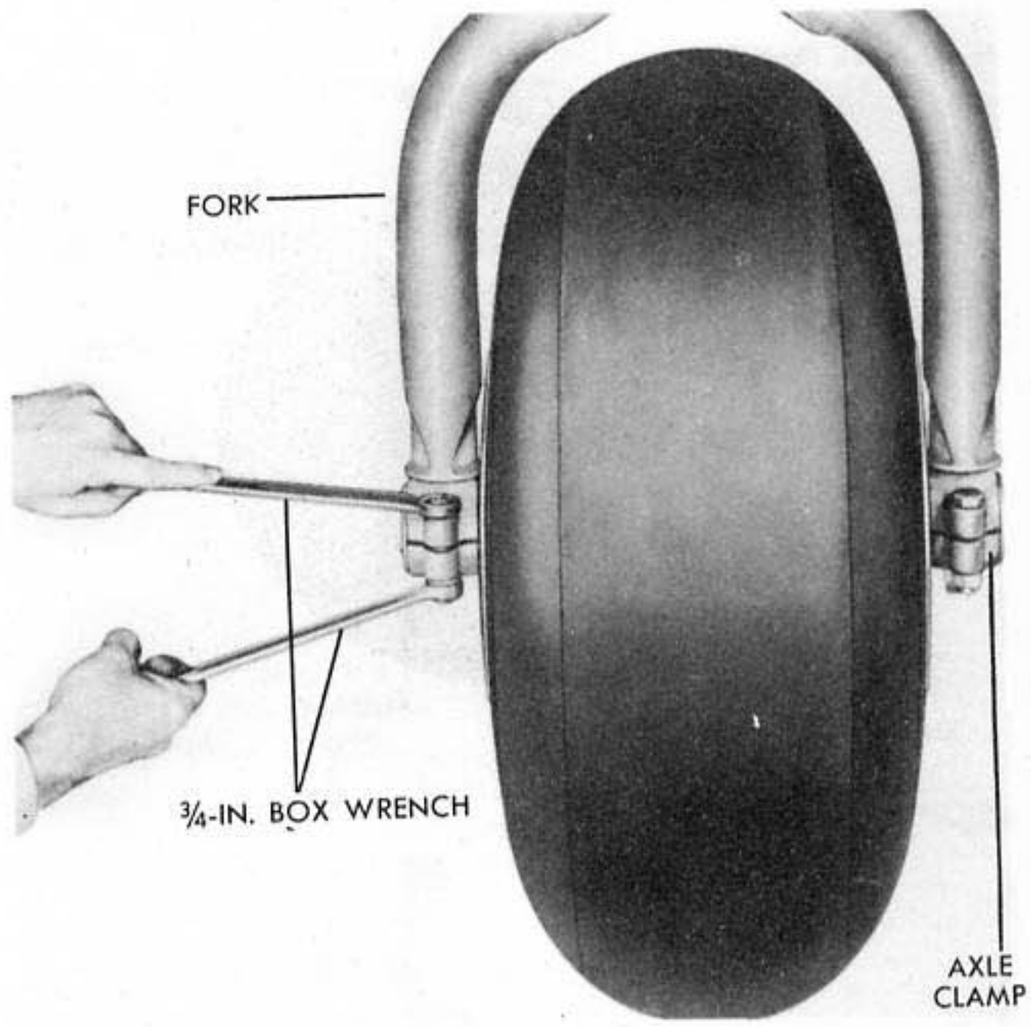


Figure 81 - - REMOVING NOSE WHEEL

(e) Unscrew and remove cylinder head (3) and washer (5).

(f) Unscrew nut from end of piston rod (12) and slide out rod.

(g) Remove piston (7) from cylinder (8).

(h) Remove packing nut (11), packing (13), packing ring (14), packing and packing ring (15) from cylinder end (10).

(i) Unscrew fitting which attaches tube (20) to cylinder end (10). Remove tube (20), fitting, and washer (19) from cylinder end (10).

(j) Remove valve plug (16), washer (18), and valve from cylinder end (10).

(6) REMOVAL OF NOSE WHEEL. (See figure 81.)

(a) Remove bolts from axle clamps on lower end of fork.

(b) Remove clamps and slide wheel assembly from fork.

(7) REMOVAL OF NOSE ALIGHTING GEAR TIRE. (See figure 82.)

(a) Remove valve core and allow tire to deflate.

(b) Remove fairing snap ring and fairing.

(c) Remove flange snap ring and flange pins.

(d) Lift removable flange from wheel.

(e) Remove tire from wheel.

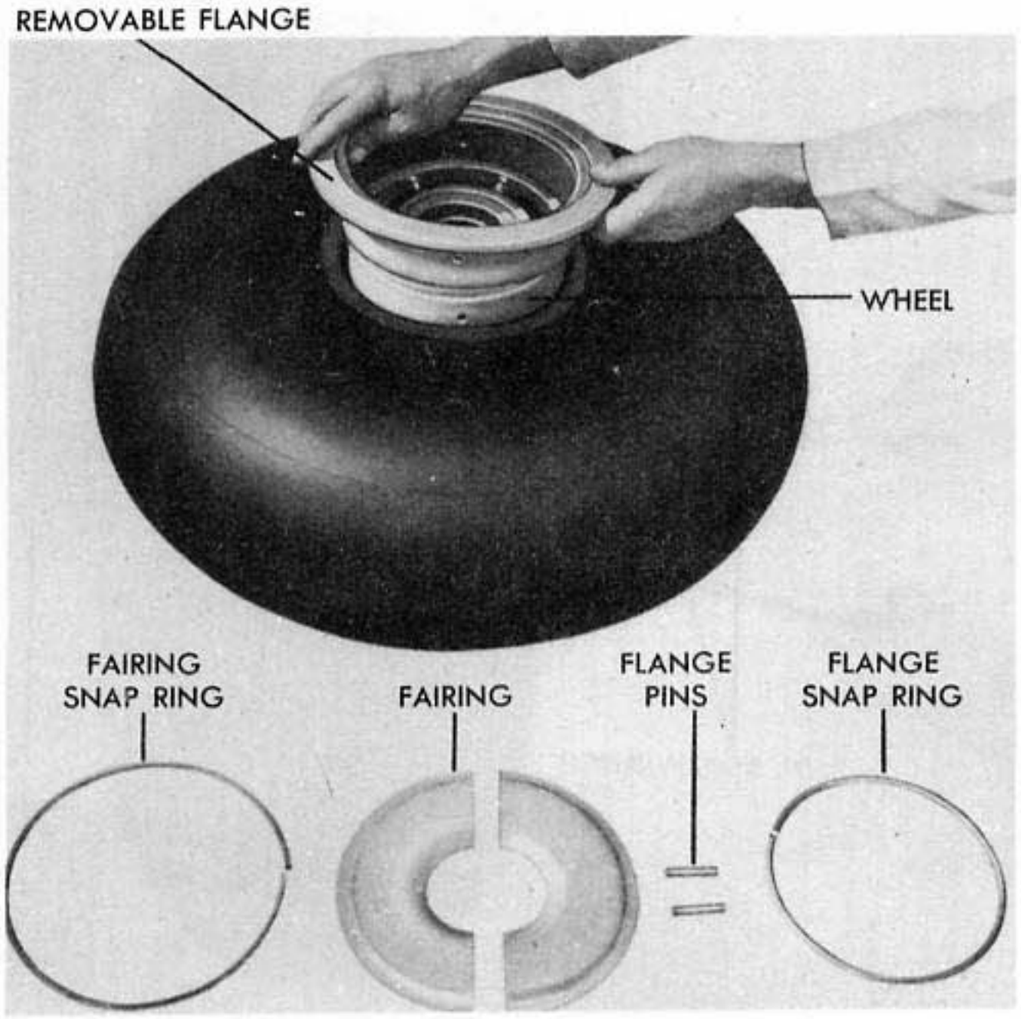


Figure 82 - REMOVING NOSE WHEEL TIRE

d. REPLACEMENTS.

(1) INSPECTION AND REPAIR OF NOSE WHEEL DOORS.

(a) Examine the bulb rubber seal around the doors and replace when necessary. This rubber deteriorates from normal use and from contact with hydraulic fluid. Replace if deteriorated or damaged.

(b) Inspect doors to see if they are bent or torn. Replace if damaged.

(2) INSPECTION AND REPLACEMENT OF NOSE ALIGHTING GEAR PARTS.

(a) Inspect shock strut, snubber, fork, braces and fittings for cracks, bends, security, condition of attachment fittings, elongated bolt holes, and loose, missing, or unsafetied nuts. Replace damaged parts.

(b) Inspect latches for distortion or cracks. Replace if necessary.

(c) Inspect all shafts and braces to determine if they are bent. Replace if they cannot be straightened.

(d) Check fit of all pins, bolts, and shafts in their respective holes. Replace worn or damaged parts.

(3) INSPECTION AND REPLACEMENT OF NOSE ALIGHTING GEAR SHOCK STRUT PARTS.

(a) Clean all metal parts in solvent and dry with an air blast.

(b) Inspect piston and cylinder for scored, roughened, or out-of-round condition. Replace if any of these defects are present.

(c) Inspect feather edge lip of the retainer nut. Replace ring if lip is roughened or torn.

(d) Replace all packing.

(e) Inspect all remaining metal parts. Replace any that are worn or damaged.

(4) INSPECTION AND REPLACEMENT OF NOSE WHEEL SNUBBER PARTS.

(a) Inspect all metal parts for being worn, bent, pitted, or scored. Inspect valve spring to see if it has lost its resiliency. Replace damaged parts.

(b) Replace all gaskets and packings.

(5) INSPECTION AND REPLACEMENT OF NOSE WHEEL PARTS. - Inspect wheel for cracks, distorted rim flanges, pitted or improperly seated bearing cups, worn or broken bearings, and roughened bearing surface on axle. Replace worn, broken, or damaged parts.

(6) INSPECTION AND REPLACEMENT OF NOSE ALIGHTING GEAR TIRE. - Replace tire if it has

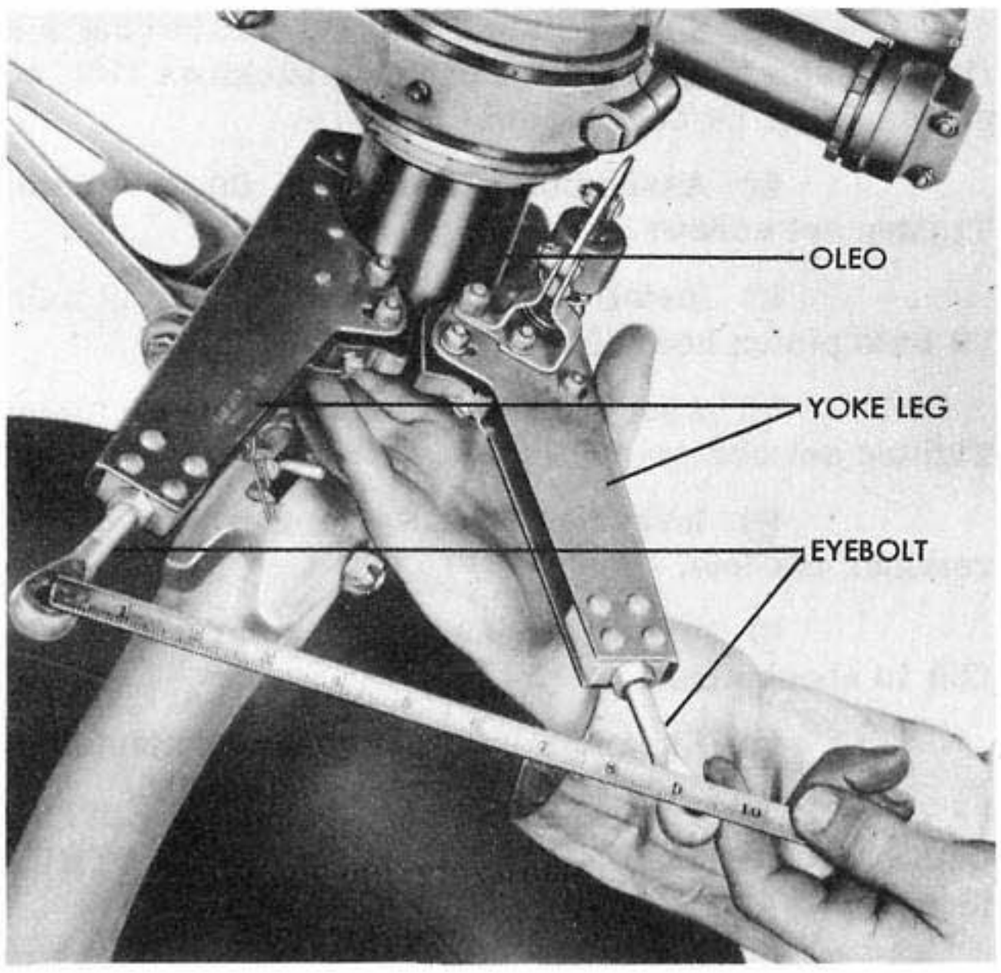


Figure 83 - ADJUSTING NOSE WHEEL DOORS

cord breaks, deep cuts, large blisters, loose cords, broken or cut bead, or if badly worn. Replace tube if wrinkled or cracked.

e. ADJUSTMENTS.

(1) ADJUSTMENT OF NOSE WHEEL DOORS. (See figure 83.)

(a) Adjust eyebolts in yoke legs for 2-5/8 inches dimension from center of eyebolt hole to butt of yoke leg.

(b) Place yoke around nose gear oleo and attach jig to eyebolts so that eyebolt holes are nine inches apart. (See figure 85.)

(c) Check clearance of yoke around oleo. Inside diameter of yoke should be approximately 1/16 inch greater than oleo outside of diameter.

(d) Install yoke and set guide blocks at roughly 2-15/16 inches. (See figure 85.)

(e) Retract nose gear and adjust yoke eyebolts for correct door closing preload.

(f) Extend gear and set cam, part No. 1135737, to accommodate latch, part No. 2063174, when distance from yoke eyebolt hole center to opposite eyebolt hole center is exactly 17 inches. Use jig for this dimension. (See figure 85.)

(g) Adjust guide blocks so that 2-15/16-inch jig block will slip firmly between them.

(h) Attach cable to bell crank, part No. 1135728, and rig so that pin, part 1135729, protrudes 27/32 inch ± 1/32 inch when nose gear is down.

f. TESTS.

(1) TEST OF NOSE ALIGHTING GEAR SHOCK STRUT BEFORE INSTALLATION. - With strut in compressed position fill with hydraulic fluid, Specification 3580-M, and replace the valve assembly. Inflate with air (300 pounds) to extended position. Test for leakage with soap solution. Release the air. Now the oleo must be collapsible by hand. If not, the piston is not operating freely and the packing nut must be adjusted or the cause of the trouble found and remedied.

(2) TEST OF NOSE WHEEL SNUBBER BEFORE INSTALLATION. (See figure 87.)

(a) Fill the reservoir to the bottom of the filler neck boss with fluid, Specification AN-VV-O-366a.

(b) Apply 500 pounds (plus 140 pounds per square inch maximum packing friction pressure) at the piston rod. It should take 4-1/2 ± 1 seconds to extend the piston rod and 5-1/2 ± 1 seconds to retract it.

(c) Extend piston rod and apply 250 pounds per square inch pressure at the reservoir. There must be no leakage at any point.

(d) Safety the filler plug.

g. ASSEMBLY AND INSTALLATION.

(1) INSTALLATION OF NOSE ALIGHTING GEAR TIRE. (See figure 82.)

(a) Insert tube in tire and inflate slightly.

(b) Slide tire and tube onto wheel with valve through valve hole in wheel.

(c) Place removable flange in position on wheel and install flange pins and flange snap ring.

(d) Inflate tire carefully to 53 (+2-0) pounds per square inch. Tap flange snap ring lightly during inflation to ensure correct seating.

(e) Install fairing and fairing snap ring.

(2) INSTALLATION OF NOSE WHEEL. (See figure 81.)

(a) Be sure valve stem is on opposite side of the snubber.

(b) Install wheel with two axle clamps and four axle clamp bolts. Safety the bolts.

(3) ASSEMBLY OF NOSE WHEEL SNUBBER. (See figure 87.)

(a) Install valve, washer (18), and plug (16) into cylinder end (10).

(b) Insert washer (19) into its opening in cylinder end (10). Connect tube (20) to cylinder end (10).

(c) Wipe all parts clean and apply thread lubricant on all threads.

(d) Install packing ring (15), new packing, packing ring (14), packing (13) and packing nut (11) in cylinder end (10).

(e) Insert piston (7) into cylinder (8).

(f) Insert piston rod (12) through cylinder end (10) and piston (7). Install lock washer and nut on end of piston rod.

(g) Install washer (5) and cylinder head (3).

(h) Install head lock nut (6).

(i) Place reservoir (21) in position, using a new gasket (1). Install bolts and nuts (4).

(j) Safety the packing nut (11) and valve plug (16) if removed.

(4) INSTALLATION OF NOSE WHEEL SNUBBER (See figure 87.)

(a) Place snubber in position on alighting gear.

(b) Install the two drilled studs which attach the cylinder end (10) to alighting gear.

(c) Install the bolt which attaches piston rod (12) to alighting gear.

(d) Lubricate the three Zerk fittings at points of attachment.

(5) ASSEMBLY OF NOSE WHEEL SHOCK STRUT. (See figure 86.)

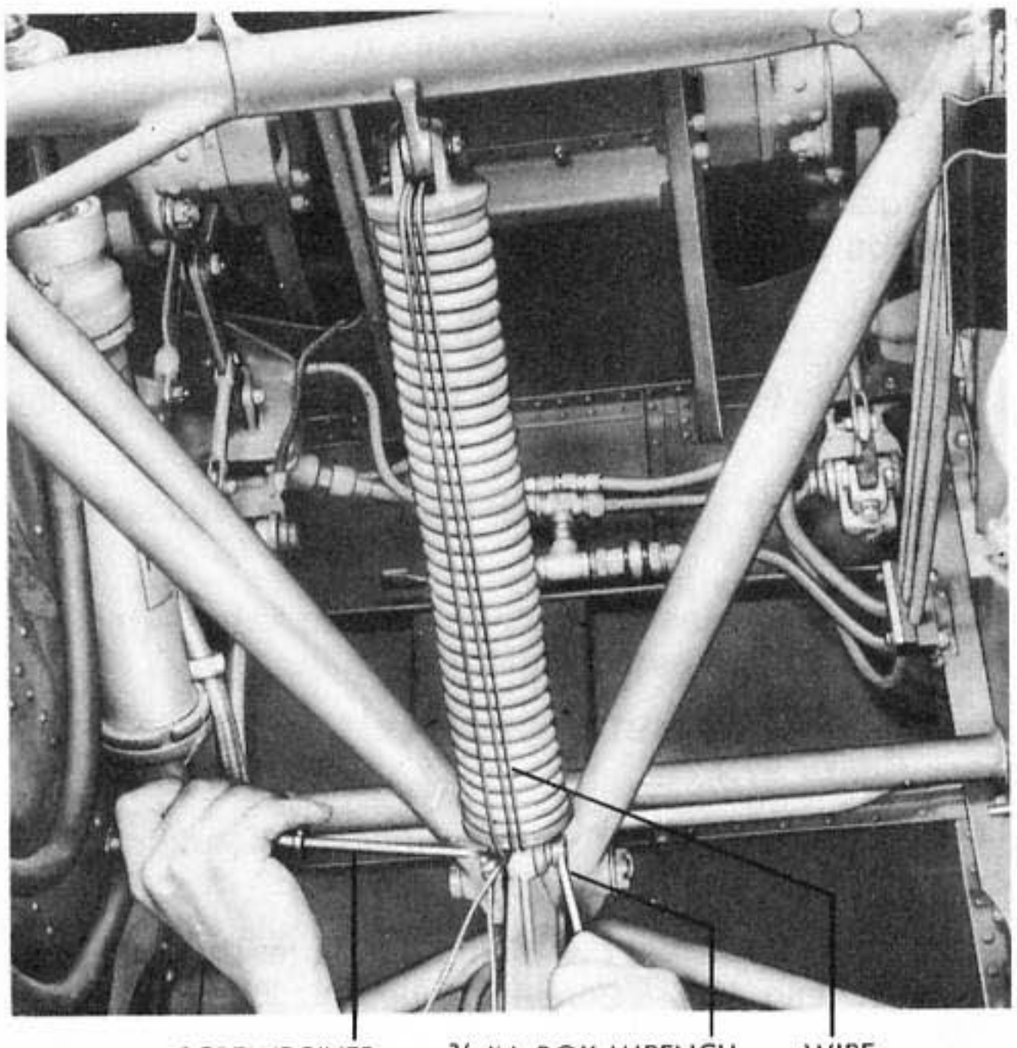


Figure 84 - INSTALLING NOSE LANDING GEAR BUNGEE

(a) Slide retainer nut (19), retaining ring (16), packing ring (11), five chevron packings (10), and packing ring (9) onto piston.

(b) Assemble piston stop (8) to piston. Tighten set screws.

(c) Install damper valve ring (4) and collar (3) onto piston head (5).

(d) Assemble piston head (5) to piston. Tighten set screws (6).

(e) Insert piston in cylinder and tighten retainer nut (19).

(f) Install or connect torque arm assembly (28) to shock strut.

(g) Assemble snubber to shock strut.

(6) INSTALLATION OF NOSE ALIGHTING GEAR AND NOSE ALIGHTING GEAR SHOCK STRUT. (See figure 85.)

(a) Place the unit in position in airplane. Drive the mounting pins into position. Assemble the nuts to the pins.

(b) Drive in taper pins which hold the mounting pins in place.

(c) Install the actuating strut.

(d) Unplug the hydraulic lines and attach to the actuating strut.

(e) With the gear fully extended, install the bungee. (See figure 84.)

(f) Install the nose wheel doors.

(7) INSTALLATION OF NOSE WHEEL DOORS.

(a) Install the three attaching hinge bolts and be sure that spacers are in place on each hinge.

(b) Safety each castellated nut with a cotter pin.

(c) Connect and adjust the adjustable yoke.

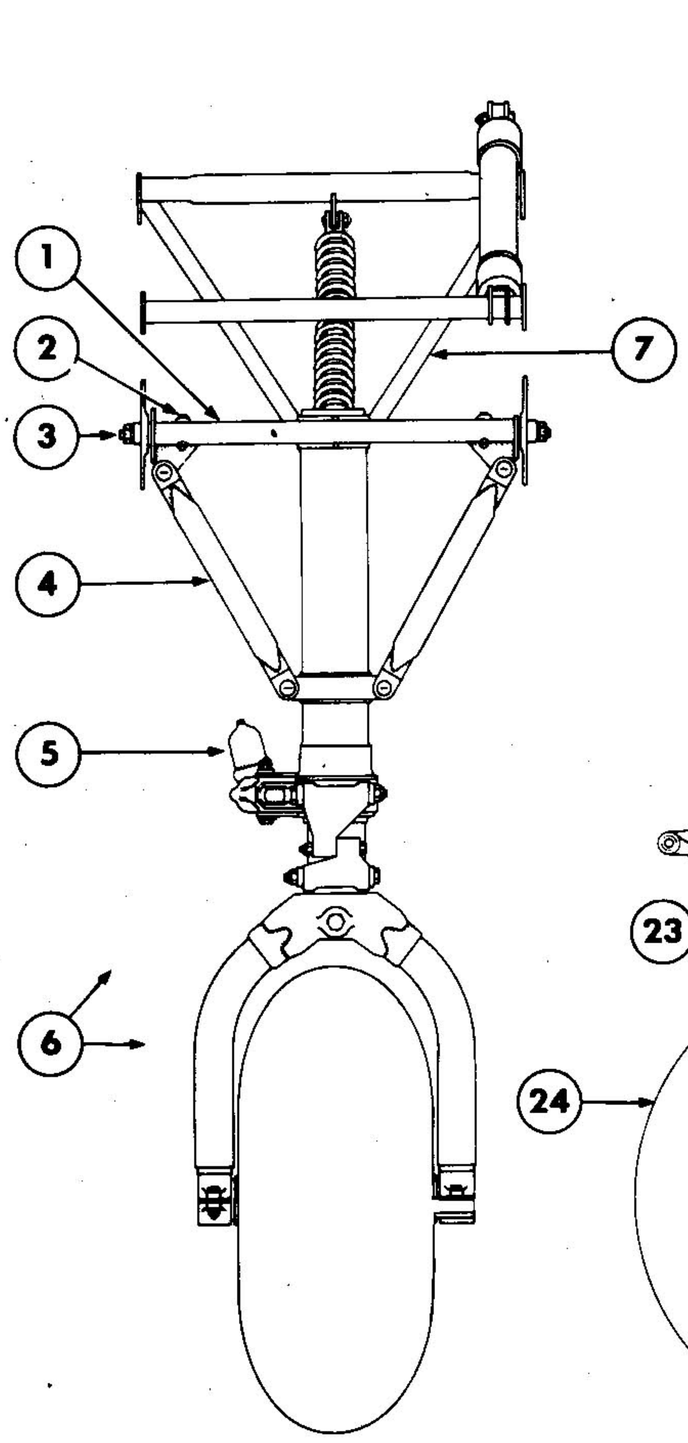
h. FINAL TEST AFTER ASSEMBLY.

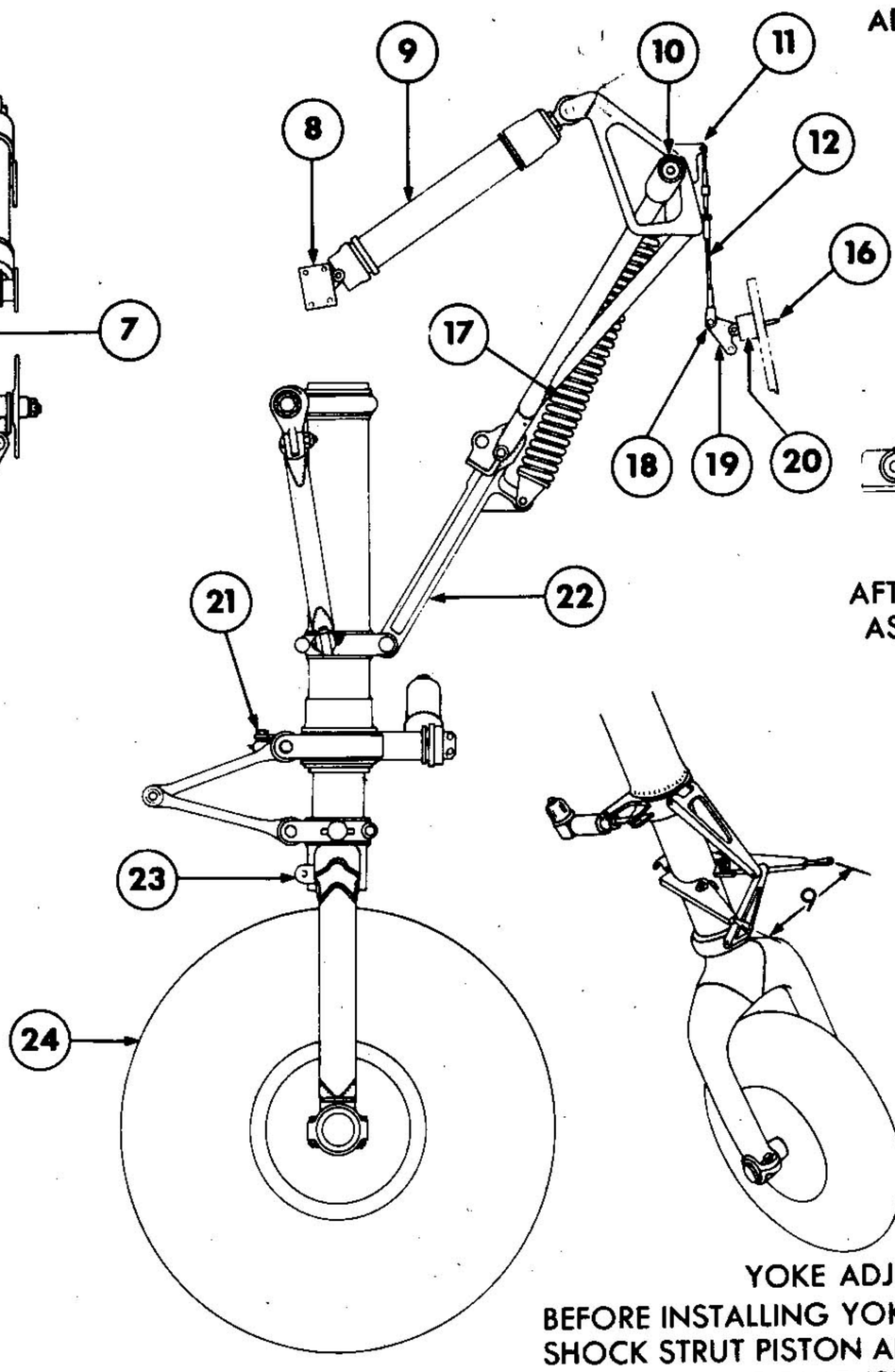
(1) TEST AND ADJUSTMENT OF NOSE WHEEL AFTER INSTALLATION. - Turn the wheel and determine that bearings are not too loose or too tight. If wheel shakes, wobbles, or binds, bearings must be adjusted.

(2) TEST AND ADJUSTMENT OF NOSE ALIGHTING GEAR SHOCK STRUT AND SNUBBER AFTER INSTALLATION.

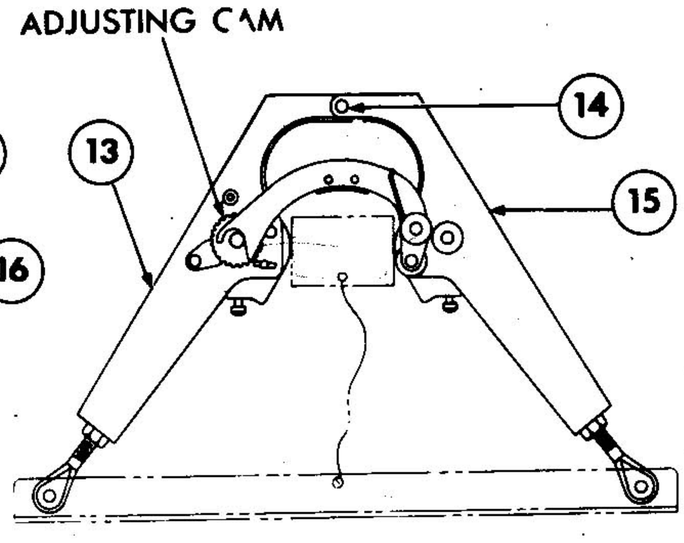
(a) Fill the completely collapsed strut through filler plug opening with hydraulic fluid, Specification 3580-M. Replace filler plug.

(b) With the airplane in a static position and loaded for take-off, inflate the strut through the

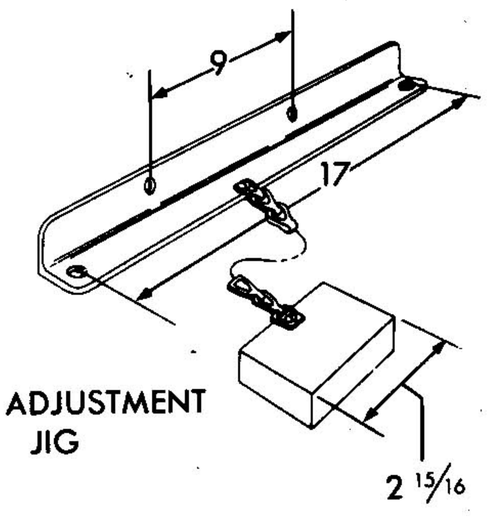




YOKE ADJUSTMENT 1
BEFORE INSTALLING YOKE, HOLD IT AROUND THE SHOCK STRUT PISTON AND ADJUST EYEBOLTS TO THE DIMENSION SHOWN.



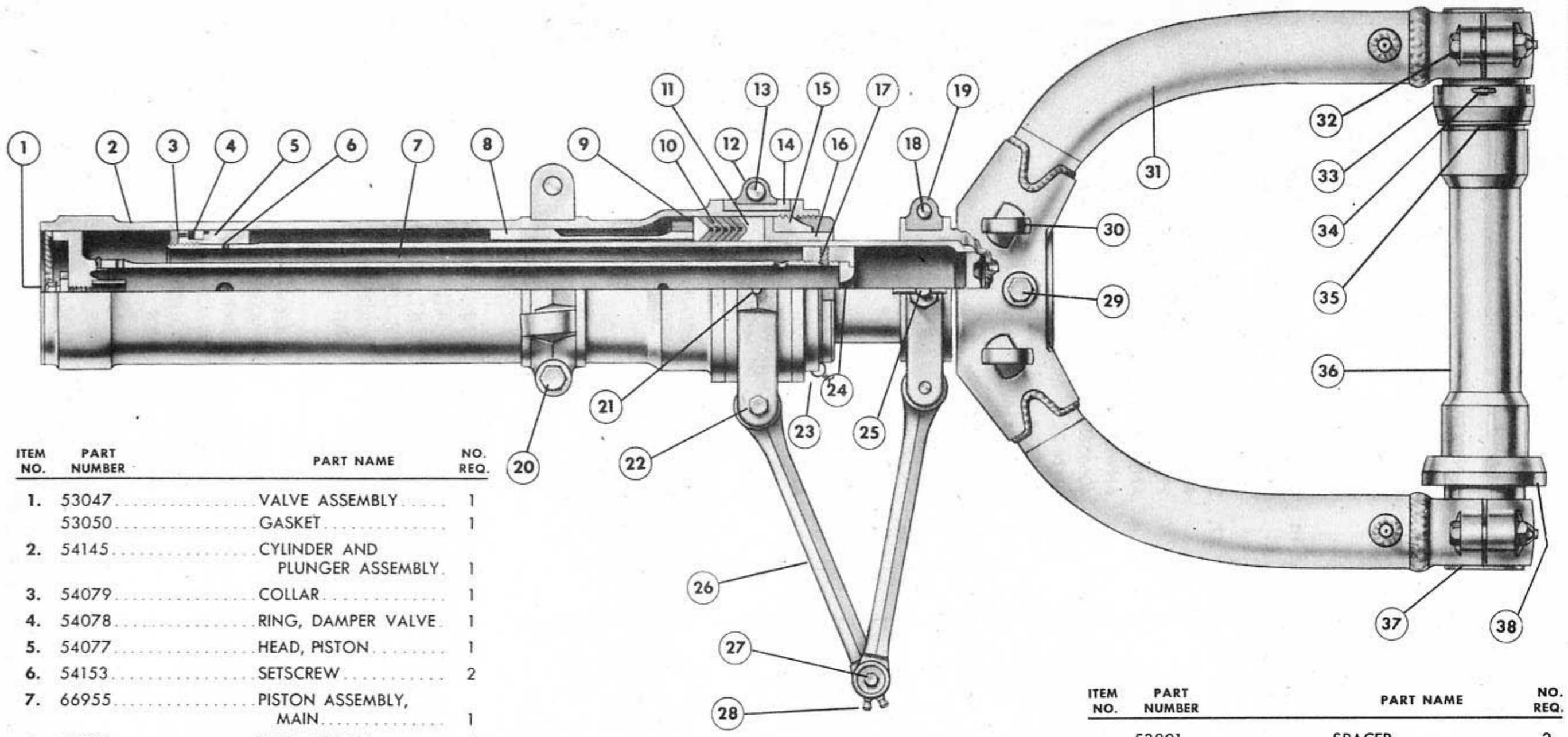
YOKE ADJUSTMENT 2
AFTER INSTALLING YOKE, ADJUST TO FIT JIG AS SHOWN AND SET CAM SO THAT LATCH BOTTOMS ON THE CAM PIN.



YOKE ADJUSTMENT JIG

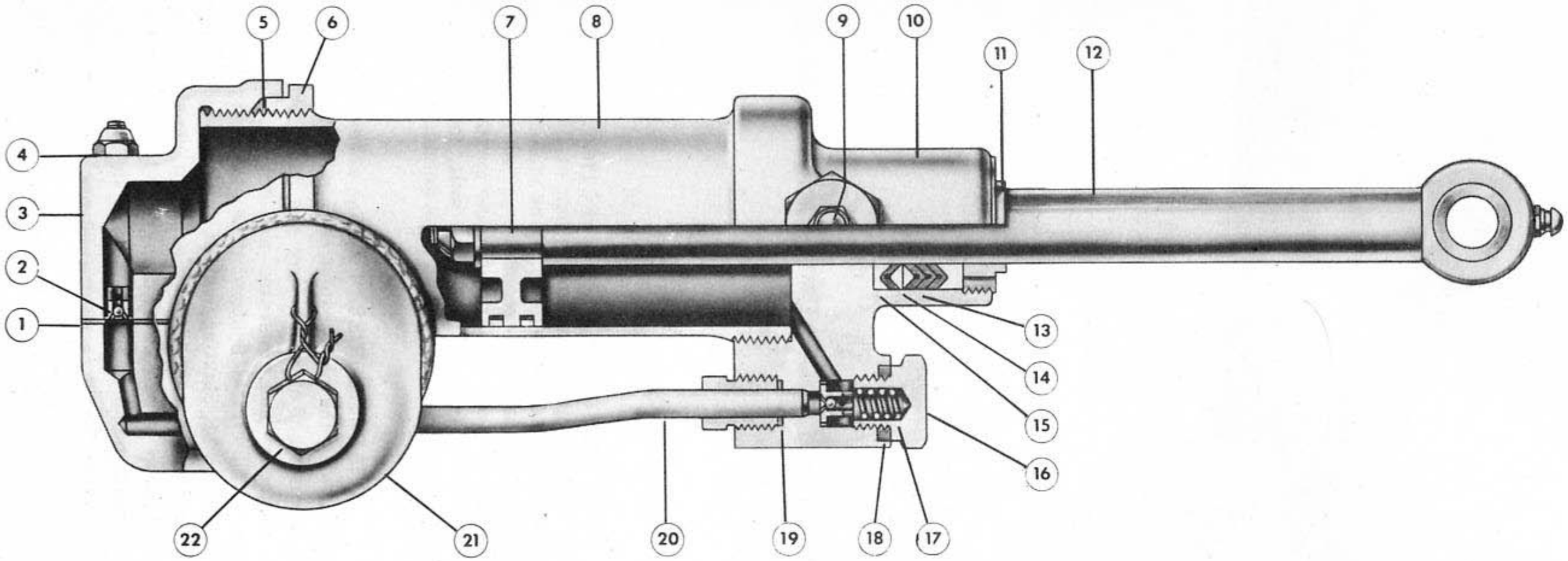
ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	5057531	BEAM ASSEMBLY, WELD	1
	1054841	KEY, CROSS BEAM	1
2.	386-4-13	PIN, TAPER	2
	AN975-5	WASHER	2
	AN320-5	NUT	2
	124681-S11-125	DISK	2
3.	1057233	PIN, CROSS BEAM	2
	1057258	WASHER, CROSS	2
	AN320-10	NUT	2
4.	4057030	STRUT, SIDE BRACE	2
	AN28-24	BOLT	4
	AN320-8	NUT	4
5.	5069115	SNUBBER ASSEMBLY	1
	501A10-6	SETSCREW	2
6.	5062541-500	GEAR ASSEMBLY	1
7.	5057661	LINK ASSEMBLY	1
8.	5057501	SUPPORT, CYLINDER	1
	AN4-5A	BOLT	4
	365-428	NUT, STOP	4
	AN960-416	WASHER	4
	AN3-4A	BOLT	2
	365-1032	NUT, STOP	2
	AN960-10	WASHER	2
9.	5062532	STRUT, ACTUATING	1
	AN6-21	BOLT, UPPER	1
	AN6-14	BOLT, LOWER	1
	AN310-6	NUT	2
	1059608-375-624-749	SPACER	2
	AN960-616	WASHER	2

Figure 85 - NOSE WHEEL ASSEMBLY AND INSTALLATION



ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	53047	VALVE ASSEMBLY	1
	53050	GASKET	1
2.	54145	CYLINDER AND PLUNGER ASSEMBLY	1
3.	54079	COLLAR	1
4.	54078	RING, DAMPER VALVE	1
5.	54077	HEAD, PISTON	1
6.	54153	SETSCREW	2
7.	66955	PISTON ASSEMBLY, MAIN	1
8.	65029	STOP, PISTON	1
9.	65463	RING, PACKING	1
10.	185-S-39 (AN6225-40)	PACKING, CHEVRON	5
11.	65462	RING, PACKING	1
12.	65375	FITTING, UPPER TORQUE	1
13.	120-S-678 (AN6-25)	BOLT	1
	121-S-3 (AN310-6)	NUT	1
14.	54172	BUSHING	1
15.	65499	NUT, RETAINER	1
16.	54074	RING, RETAINING	1
17.	53097	SETSCREW	1
18.	121-S-3 (AN310-6)	NUT	1
	120-S-678 (AN6-25)	BOLT	1
19.	65373	FITTING, LOWER TORQUE	1
20.	120-S-678 (AN6-25)	BOLT	1
	121-S-3 (AN310-6)	NUT	1
21.	54043	PIN	1
22.	120-S-309 (AN8-52)	BOLT	2
	121-S-5 (AN310-8)	NUT	2
	54097	SLEEVE	2
23.	66064	WIRE, LOCK	1
24.	67079	DISK, ORIFICE	1
25.	54090	LOCK, PLUNGER	1
	67121	NUT, LOCK	1
	54088	SPRING	1
26.	65405	ARM ASSEMBLY, TORQUE	2
27.	120-S-679 (AN6-27)	BOLT	1
	121-S-3 (AN310-6)	NUT	1
	53763	SLEEVE	1
	53801	SPACER	2
28.	65406	FITTING, ZERK	2
29.	120-S-139 (AN8-44)	BOLT	1
	121-S-5 (AN310-8)	NUT	1
	2169550	LATCH ASSEMBLY	1
	AN960-816	WASHER	1
30.	54437	EYE, TOWING	2
	121-S-5 (AN310-8)	NUT	2
31.	65377	FORK ASSEMBLY	1
32.	120-S-692 (AN8-21)	BOLT	4
	121-S-5 (AN310-8)	NUT	4
33.	56501	NUT, ADJUSTMENT	1
34.	112-S-83	COTTER	1
35.	110-S-17 (AN7503-3)	SPACER	1
36.	56498	AXLE	1
37.	54179	CLAMP, AXLE	2
38.	56502	COLLAR	1

FIGURE 86 - NOSE ALIGHTING GEAR SHOCK STRUT ASSEMBLY



ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	1090030	GASKET	1
2.	1090027	VALVE	2
3.	4090961	HEAD, CYLINDER	1
4.	AN3-20A	BOLT	2
	AN365-1032	NUT	2
5.	143908-128 SR 202-093	WASHER	2
6.	1066165	NUT, HEAD LOCK	1
7.	1090020	PISTON	1
	1133497	RING, PISTON	2
	AN310-6	NUT	1
8.	2064871	CYLINDER	1
9.	1069912	STUD	2
10.	4090962	END, CYLINDER	1
11.	1057177	NUT, PACKING	1

ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
12.	2069482	ROD, PISTON	1
13.	5135865-3-020	PACKING, CHEVRON	4
14.	1012954-D020-006	RING, PACKING, END	2
15.	1012953-D020-006	RING, PACKING, CENTER	2
16.	1138459	PLUG, VALVE	1
17.	1138467	SPRING	
18.	1138504	WASHER	1
19.	143908-008 SR 012-093	WASHER	6
20.	5069115-2	TUBE	1
	PARKER 4B	NUT	2
21.	2069574	RESERVOIR	1
22.	2117859	PLUG	1
	1138517	WASHER	1

Figure 87 - NOSE WHEEL SNUBBER ASSEMBLY

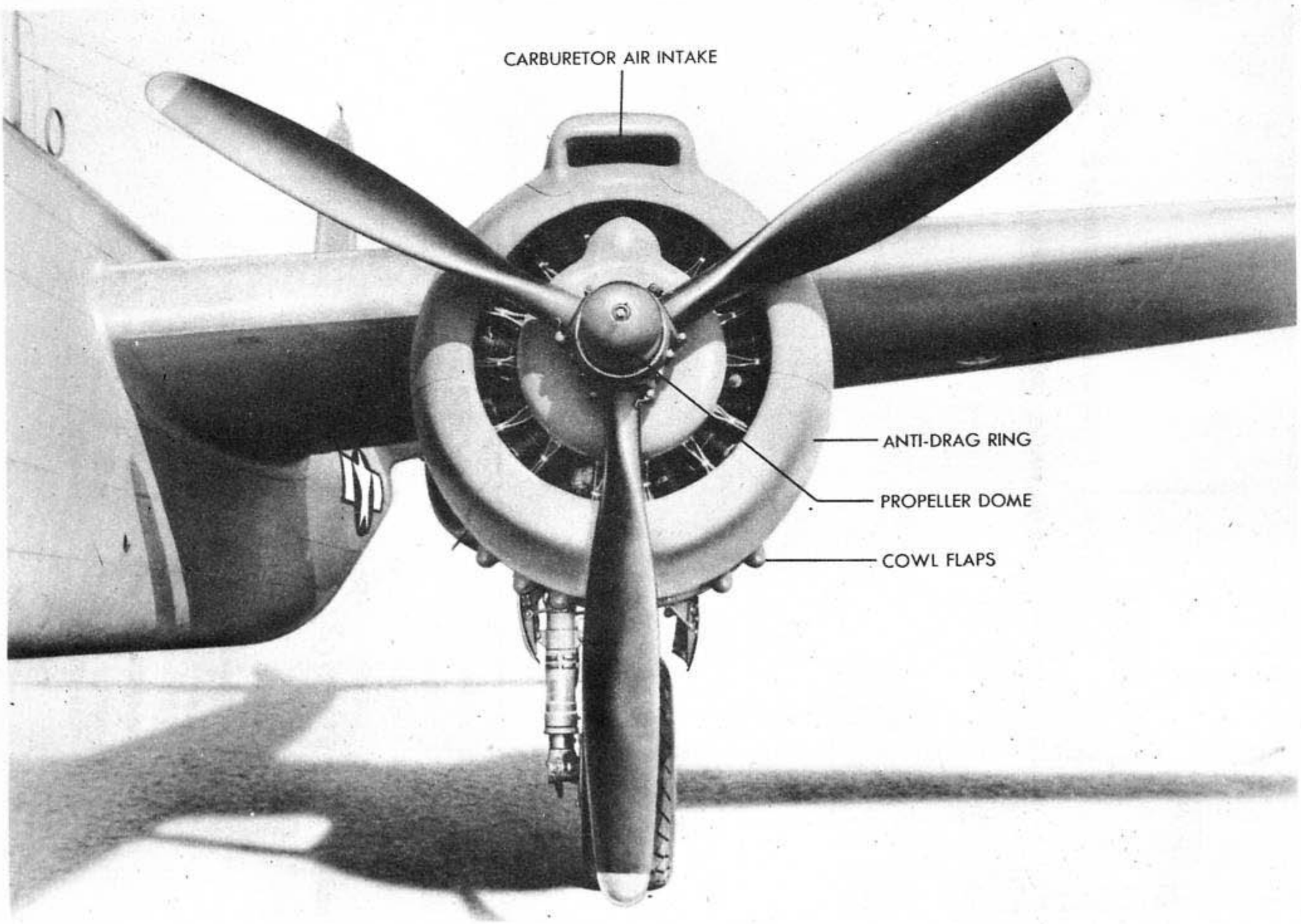


Figure 88 - FRONT VIEW OF POWER PLANT

8. POWER PLANT.

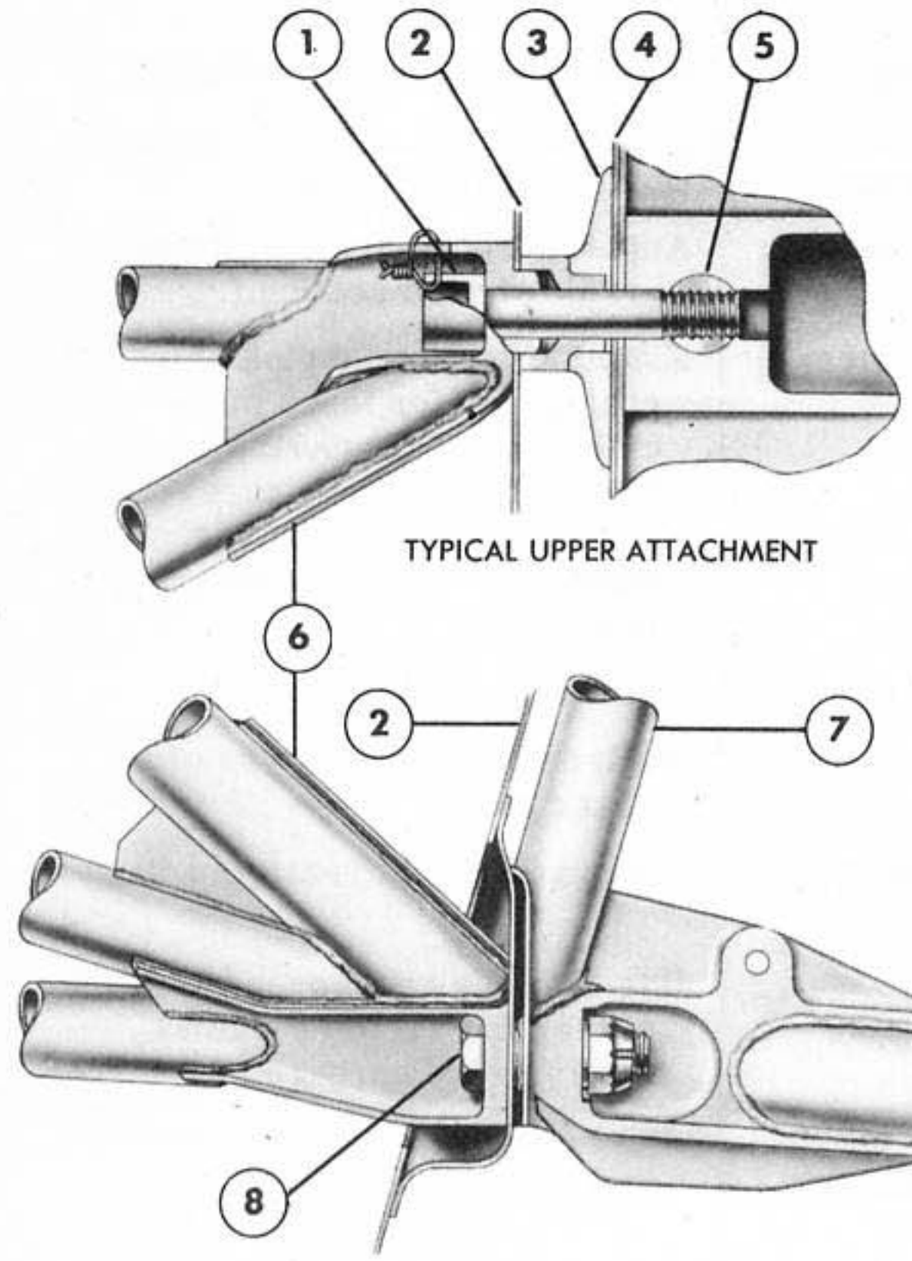
a. DESCRIPTION.

(1) GENERAL. - This airplane is equipped with two 14-cylinder Wright Model R-2600-23 engines, each weighing 1950 pounds. Each engine produces 1600 brake horsepower at sea level take-off at 2400 rpm. The engines are of the radial, air-cooled, double-row cylinder type. One engine is mounted on the front of each engine nacelle by a welded tube engine mount which attaches at two points on the nacelle fire wall and at two points on the front shear web. (See figure 89.) The ring section of the mount carries the engine which is attached at seven points. Each engine is housed by an antidrag ring formed of sheet aluminum alloy. Immediately behind the antidrag ring are the cowl flaps which open to permit engine cooling. An engine accessories cowling covers the space between the cowl flaps and the fire wall.

(2) COMPLETE ENGINE SECTION. (See figure 90.) - The complete engine section of the nacelle is composed of the engine and the engine mount and everything attached to them except the propeller and antidrag ring. The nacelle is designed so that the complete engine section forward of the fire wall, including fuel and oil lines, may be handled as a quickly detachable unit.

(3) ACCESSORIES. - Engine accessories are treated under the paragraphs of this section dealing with the system of which they are part. For example, magnetos and generator are covered in paragraph 17, Electrical System. The starter is treated in paragraph 11, Starting System. The carburetor and fuel pump are covered in paragraph 13, Fuel System. The oil pump is treated in paragraph 12, Oil System; the vacuum pump in paragraph 14, Instruments; and the hydraulic pump in paragraph 16, Hydraulic System.

SYMPTOM	CAUSE	REMEDY
	Piston rings incorrectly installed.	Install piston rings correctly.
	Clogged oil lines, strainers, or coolers.	Remove obstruction.
	Malfunction of oil system.	See Oil System Trouble Shooting, paragraph 12, this section.



TYPICAL UPPER ATTACHMENT

TYPICAL LOWER ATTACHMENT

ITEM NO.	PART NUMBER	PART NAME	NO. REQ.
1.	2076910-31	BOLT, OUTBOARD	1
	2076910-45	BOLT, INBOARD	1
2.	5090850	FIRE WALL ASSEMBLY—L.H. NACELLE	1
	5090851	FIRE WALL ASSEMBLY—R.H. NACELLE	1
3.	2062143	PAD ASSEMBLY, ENGINE MOUNT SUPPORT—OUTBOARD	1
	4061646	SUPPORT ASSEMBLY, ENGINE MOUNT ATTACHMENT—INBOARD	1
4.	5106862-14	WEB, WING FRONT SHEAR—INBOARD—L.H.	1
	5106862-15	WEB, WING FRONT SHEAR—INBOARD—R.H.	1
5.	1064717	PLUG, ENGINE MOUNT FITTING	2
6.	5065394	MOUNT ASSEMBLY, ENGINE	1
7.	5065334	FRAME ASS'Y., LANDING GEAR SUPPORT—L.H.	1
	5065334-1	FRAME ASS'Y., LANDING GEAR SUPPORT—R.H.	1
8.	AN10-20	BOLT	2
	AN310-10	NUT	2
	AN960-1016	WASHER	6

Figure 89 - ENGINE MOUNT ATTACHMENT

c. REMOVAL AND DISASSEMBLY.

(1) REMOVAL OF ENGINE.

(a) Remove propeller.

(b) Remove antidrag ring. (See figure 88.)

(c) Remove accessory cowling.

(d) Drain the oil at the Y drain (figure 91); or if no suitable oil container is available, unscrew Wittek clamps at the engine, slide hose aft on oil line, and quickly insert a wooden plug in the hose. Although a pint of oil may be lost, time is saved and the oil, since it is left in the airplane, cannot get dirty.

(e) Wire the throttle butterfly valve at the carburetor in closed position.

(f) Break the engine control rigging at the turnbuckles in the accessory section. (See figure 93.) Remove fair-lead holder cover on venturi ring and pull propeller governor control cables forward through the venturi ring. (See figure 96.)

(g) Remove the carburetor air scoop as follows:

1 Remove cover plates on both sides of scoop.

2 Remove exit fairings for upper cowl flaps from wing on both sides of scoop.

3 Disconnect air temperature bulb connection from middle of back of scoop.

4 Disconnect four carburetor anti-icer lines from back of scoop.

5 Remove cover from top of air scoop fairing.

6 Remove five cap screws under air scoop fairing.

7 Remove six Phillips head screws from air scoop fairing.

8 Remove ten remaining cap screws that hold sides of air scoop to the venturi ring.

9 Disconnect control cables.

10 Loosen the lower clamp on the Neoprene collar that connects the scoop to the carburetor.

11 Lift the air scoop off.

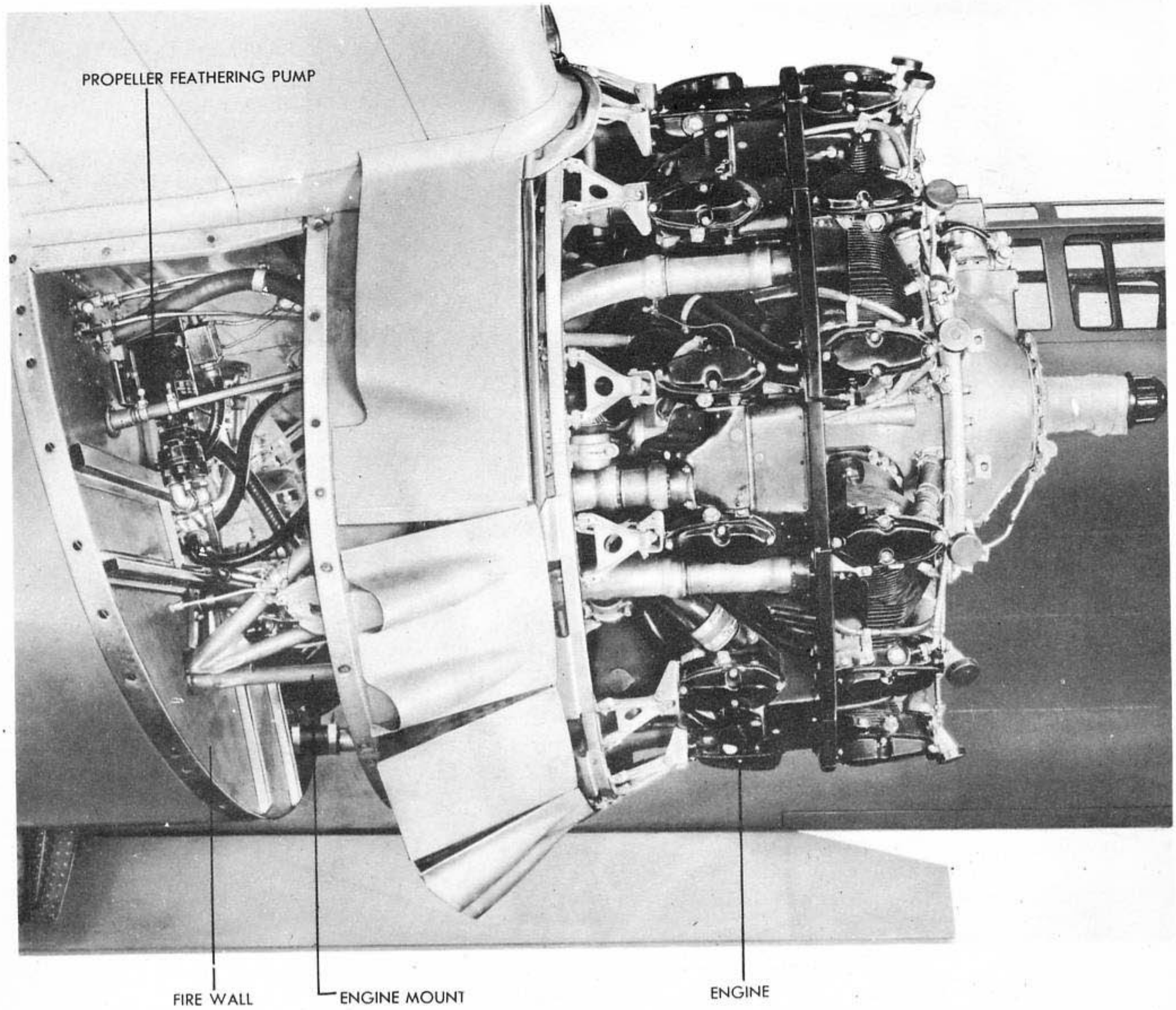


Figure 90 - COMPLETE ENGINE SECTION

(h) Remove the main fuel line and cross-feed line from the fuel pump and fire wall. (See figure 92.)

(i) Remove the carburetor.

(j) Disconnect the instrument lines at the step in the fire wall. (See figure 92.) The fuel pressure gage and fuel pressure vent line need not be disconnected at fire wall, but only at the carburetor.

(k) Remove the fuel pump from the engine. (See figure 92.)

(l) Remove the tachometer generator from the engine. (See figure 92.)

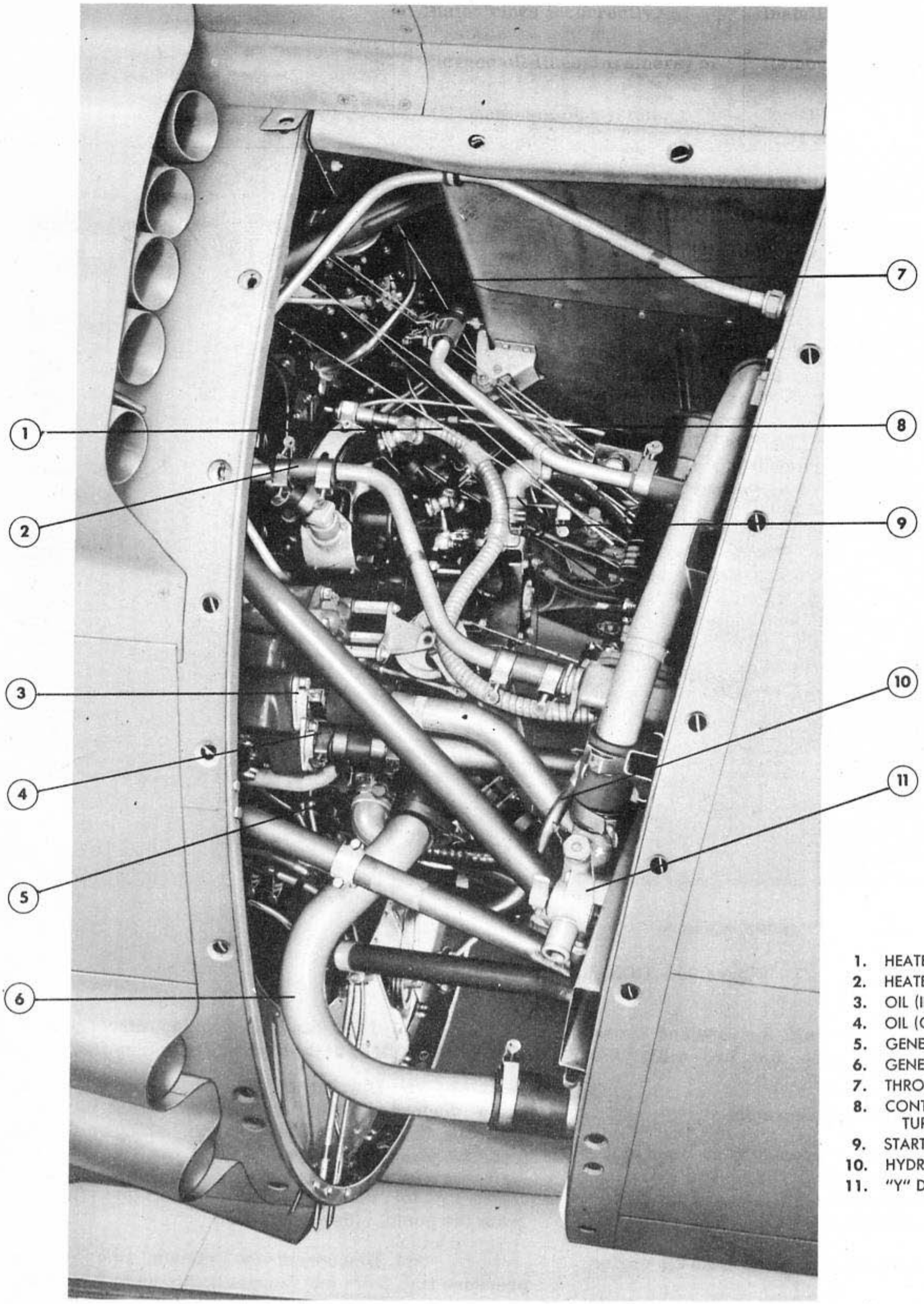
(m) If oil has been drained, disconnect the oil IN and OUT lines at the engine fitting. (See figure 91.)

(n) Disconnect the hydraulic suction line at the disconnect valve on the fire wall to eliminate air locks in the rest of the system. . Remove the line from the pump. (See figure 92.)

(o) Disconnect the hydraulic pressure line from the pump. (See figure 92.)

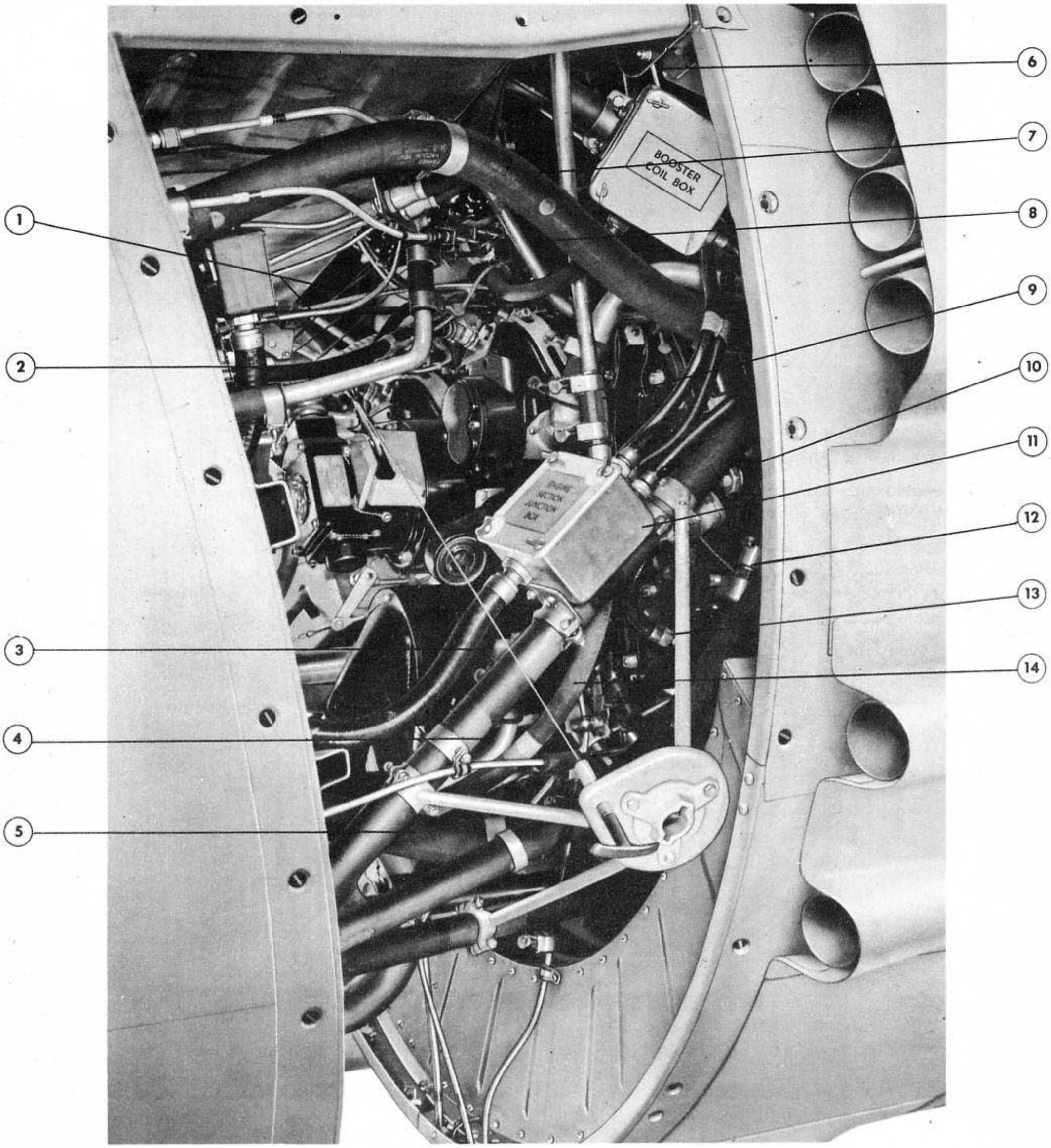
(p) Disconnect the vacuum line and the pressure line from the vacuum pump. (See figure 92.)

(q) Disconnect the hose connection midway between fire wall and engine on the heater intake, and



1. HEATER EXHAUST LINE
2. HEATER INTAKE LINE
3. OIL (IN) LINE
4. OIL (OUT) LINE
5. GENERATOR CANNON PLUG
6. GENERATOR BLAST TUBE
7. THROTTLE VALVE
8. CONTROL RIGGING TURNBUCKLES
9. STARTER CANNON PLUG
10. HYDROMATIC LINE
11. "Y" DRAIN

Figure 91 - LEFT-HAND VIEW OF ENGINE ACCESSORY SECTION - COWLING REMOVED



1. INSTRUMENT LINES
2. MAGNETO CABLE
3. HYDRAULIC PRESSURE LINE
4. HYDRAULIC SUCTION LINE
5. MAIN FUEL LINE
6. OIL FOAM LINE
7. CROSS FEED LINE
8. OIL SEPARATOR DRAIN LINE
9. DE-ICER LINE
10. FUEL PUMP
11. ENGINE JUNCTION BOX
12. TACHOMETER MAGNETO
13. TACHOMETER MAGNETO ELECTRICAL CONNECTION
14. VACUUM LINE

Figure 92 - RIGHT-HAND VIEW OF ENGINE ACCESSORY SECTION - COWLING REMOVED

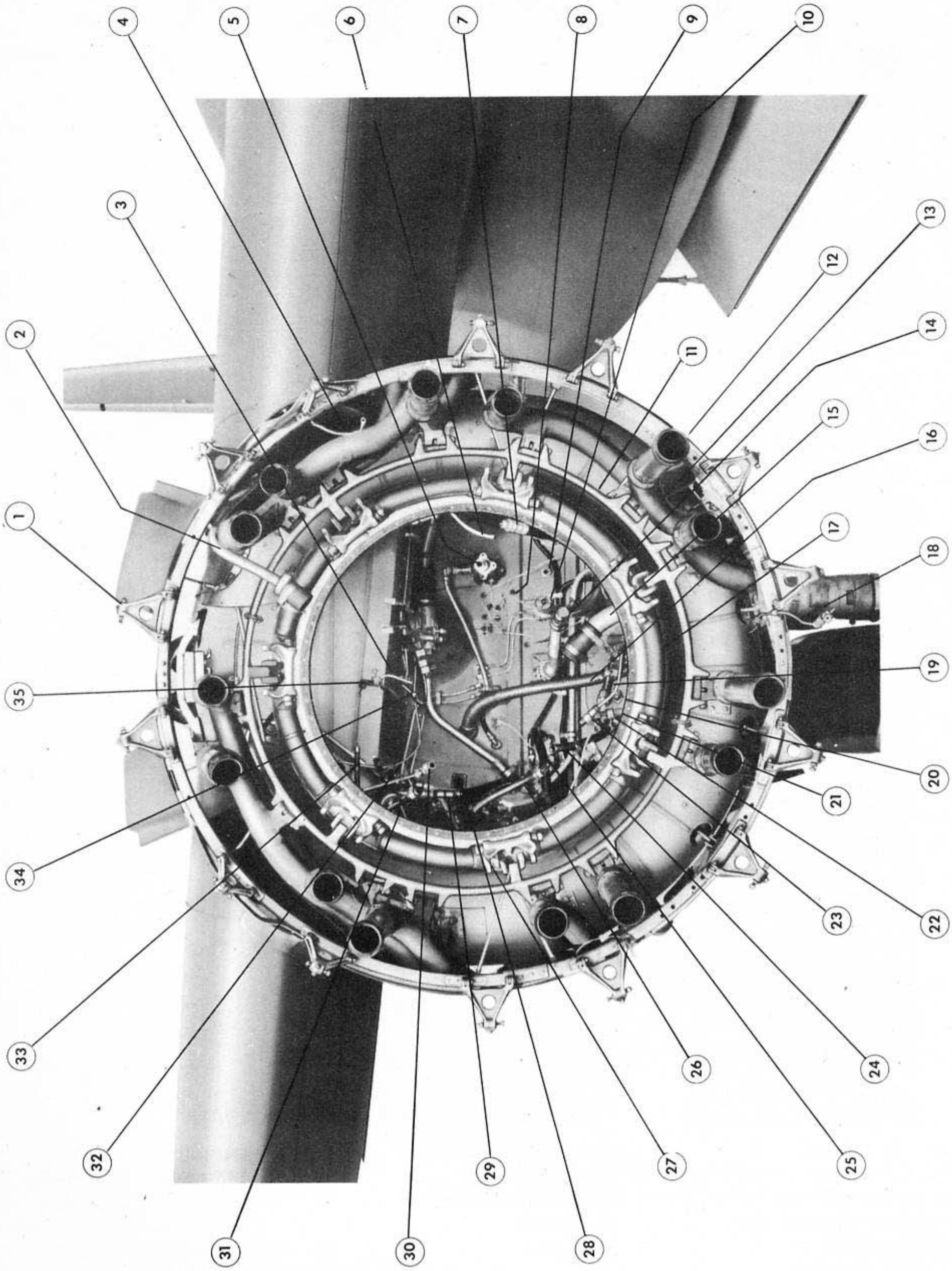
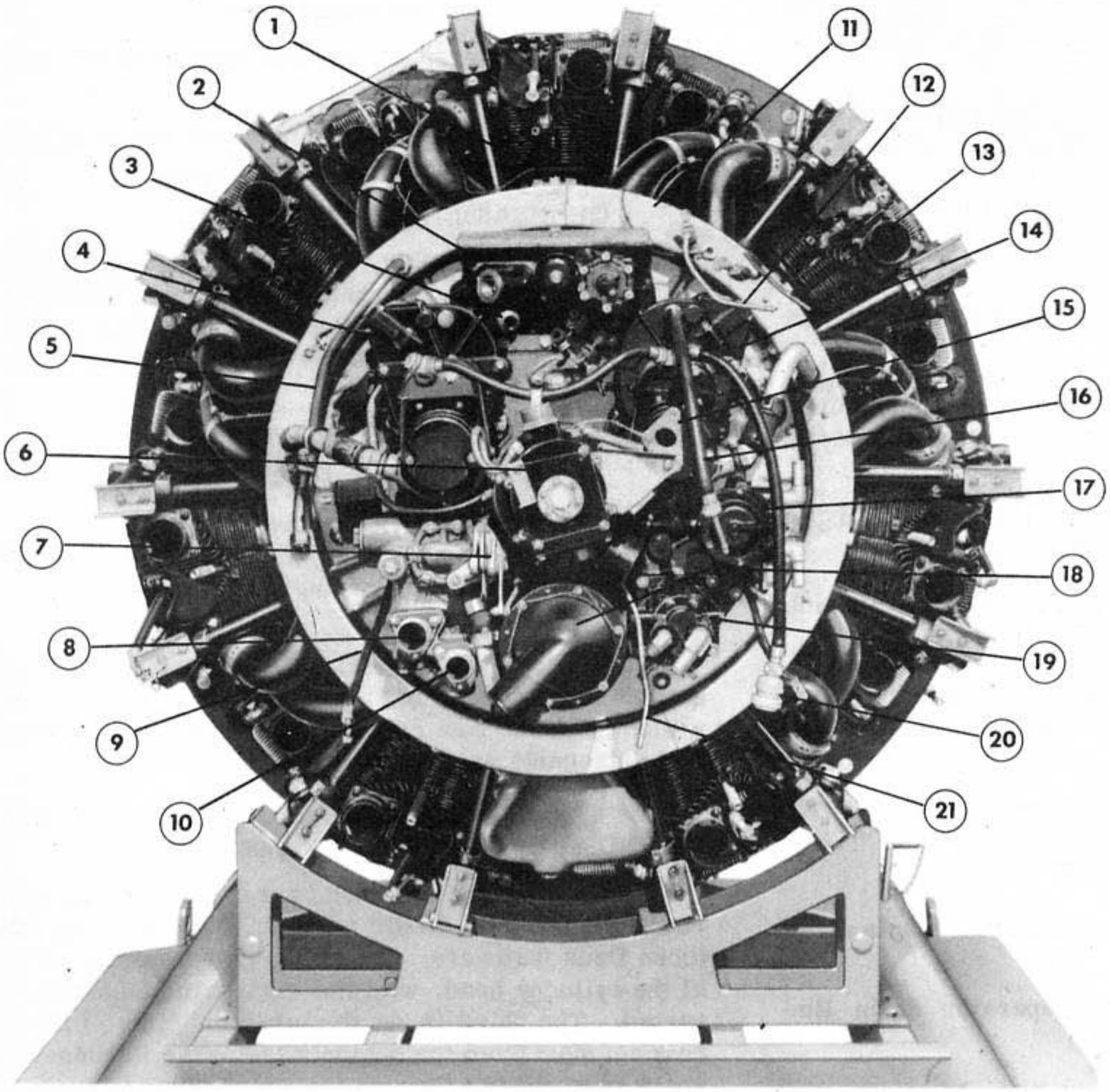


Figure 93 - NACELLE ENGINE CONNECTIONS - ENGINE REMOVED

LEGEND FOR FIGURE 93

1. ANTI-DRAG RING BRACKET
2. CRANKCASE BREATHER LINE
3. MANIFOLD PRESSURE GAUGE LINE
4. BONDING STRAP
5. HEATER CUT-OUT SWITCH
6. OIL FOAM LINE—L. H.
7. PROPELLER GOVERNOR HYDRAULIC LINE
8. FAIR LEAD FOR ENGINE CONTROL CABLES
9. HEATER EXHAUST FITTING
10. OIL IN LINE
11. EXHAUST STACK RING
12. EXHAUST TUBE
13. EXHAUST STACK
14. OIL SCAVENGER LINE
15. GENERATOR BLAST TUBE
16. GENERATOR CONDUIT
17. ENGINE MOUNT RING
18. NO. 9 CYLINDER DRAIN LINE
19. HYDRAULIC PUMP PRESSURE LINE
20. DISCONNECT VALVE FOR HYDRAULIC SUCTION LINE
21. FUEL PUMP DRAIN LINE
22. STARTER DRAIN LINE
23. SUPERCHARGER DRAIN LINE
24. VACUUM SUCTION LINE
25. STARTER CONDUIT
26. TACHOMETER MAGNETO CONDUIT
27. LORD DYNAFOCAL MOUNT
28. MAGNETO CANNON PLUG CONNECTION
29. VACUUM PUMP DISCHARGE LINE
30. OIL SEPARATOR DRAIN LINE
31. OIL FOAM LINE—R. H.
32. FUEL PRESSURE GAUGE STATIC LINE
33. PROPELLER FEATHERING CONDUIT
34. OIL PRESSURE GAUGE LINE
35. FUEL PRESSURE LINE



1. LORD DYNAFOCAL MOUNT
2. CARBURETOR ADAPTER
3. HEATER EXHAUST CONNECTION
4. MAGNETO
5. PROPELLER GOVERNOR HYDROMATIC LINE
6. STARTER
7. SUPERCHARGER CONTROL BRACKET
8. OIL PUMP INLET
9. BONDING STRAP
10. OIL PUMP OUTLET
11. FIRE SEAL
12. PROPELLER ANTI-ICER LINE
13. PRIMER LINE
14. MAGNETO
15. STARTER HAND ENGAGING MECHANISM
16. BOOSTER COIL CABLE
17. VACUUM PUMP
18. GENERATOR
19. HYDRAULIC PUMP
20. MAGNETO CONDUIT
21. STARTER DRAIN LINE

Figure 94 - REAR VIEW OF REMOVED ENGINE

disconnect exhaust lines at the fire wall, letting them hang down from the engine. (See figure 91.)

(r) Disconnect the propeller feathering hydromatic line at the inner baffle, or the forward end of the hose. (See figure 91.)

(s) Disconnect the generator cable at the generator Cannon plug. (See figure 91.)

(t) Disconnect the starter cable at the starter Cannon plug. (See figure 91.)

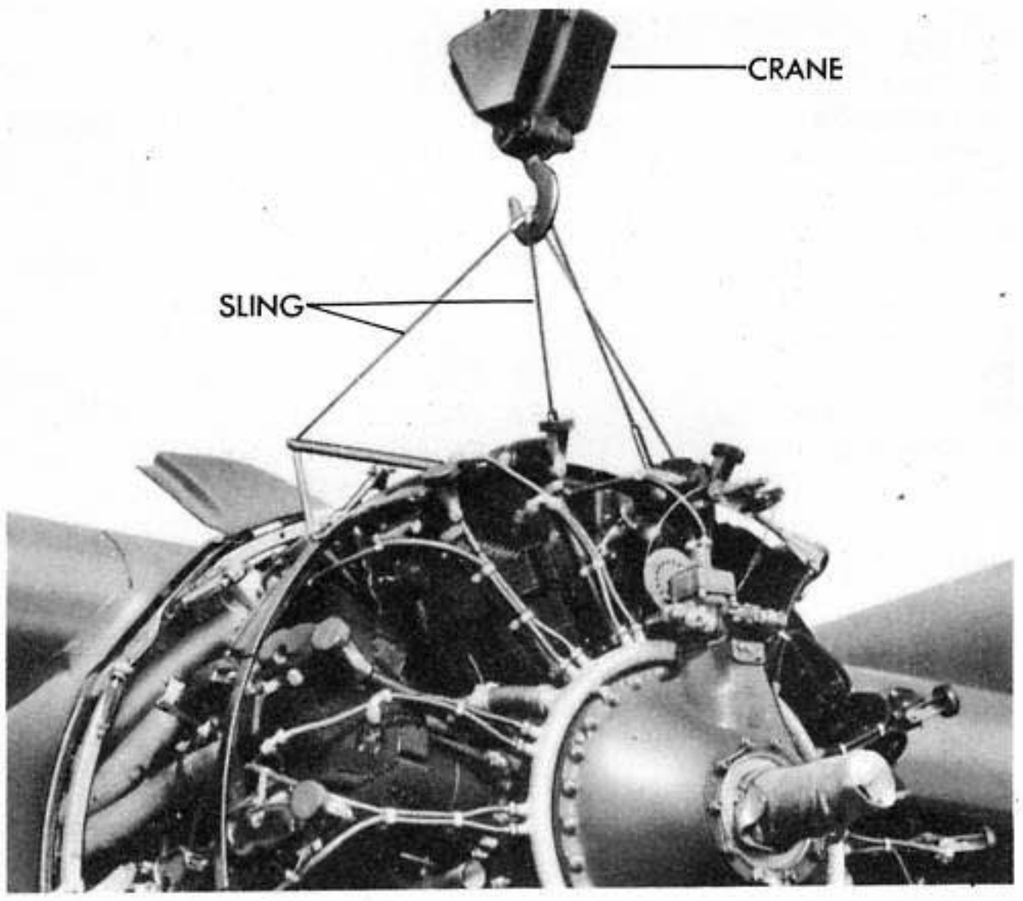


Figure 95 - CRANE ENGAGED FOR ENGINE REMOVAL

(u) Disconnect the magneto Cannon plug on the fire wall. (See figure 92.)

(v) Unsolder propeller governor cutout switch wire at the governor on airplanes with serial numbers below AF 42-53884.

(w) Disconnect the cowl flap support ring at the engine cylinder brackets. (See figure 93.)

(x) Disconnect the No. 9 cylinder drain line at the BT nut on the cylinder. (See figure 94.)

(y) Remove the right-hand breather line and cap (figure 93), and remove the left-hand breather line.

(z) Disconnect the propeller cutout switch at engine junction box (figure 92 on airplanes with serial numbers 42-53884 and above.

(aa) Disconnect the two thermocouple wires at the fire wall.

(bb) Disconnect oil separator drain line from the engine. (See figure 92.)

(cc) Remove both oil foam lines, one on each side of the engine. (See figure 92.)

(dd) Disconnect the engine-to-mount electrical bonding strap. (See figure 94.)

(ee) Disconnect the generator blast tube. (See figure 91.)

(ff) Support the tail of the airplane with a tail stand.

(gg) Install a removal sling to the rocker arm bolts nearest vertical center line of engine on cylinders No. 2 and 14. Install another removal sling, equipped with a spacer bar, to similar rocker arm bolts on cylinders No. 3 and 13. (See figure 95.) Attach sling by putting nuts on backwards.

(hh) Hook a crane to the two removal slings and support the engine weight with the crane. (See figure 95.)

(ii) Remove the Lord Dynafocal mount. (See figure 93.)

(jj) To facilitate engine installation, mark on the ground the location of the crane.

(kk) Pull the engine forward.

(ll) Lower engine into engine stand. (See figure 96.)

(mm) Plug all openings with paper to prevent foreign matter from entering engine.

(2) DISASSEMBLY OF ENGINE.

(a) GENERAL. - The following instructions are limited to "top overhaul" of engines, including removal and replacement of parts. Where it is ascertained that internal parts of the engine have been damaged, replace the engine.

(b) REMOVAL OF PARTS.

NOTE

Remove cotter pins, safety wire, and palnuts as required from parts being disassembled. Remove all sections of cowling which would interfere with the work.

1 GENERAL. - Rear row cylinder baffles consist of three detachable parts per cylinder, while the front row cylinder baffles are composed of five detachable parts each.

2 REMOVAL OF SINGLE REAR ROW CYLINDER HEAD BAFFLES. (See figure 96.)

a. Detach rear segment of the rear row cylinder head baffle assembly by detaching the three Dzus fasteners. Two Dzus fasteners are on top of the cylinder head, with the right-hand fastener inverted. The third is on the left-hand side. Lift the rear segment from the engine, passing the disconnected spark plug conduit through the spark plug air duct.

b. Remove the front segment of the same baffle after detaching its four Dzus fasteners.

3. REMOVAL OF COMPLETE REAR ROW CYLINDER HEAD BAFFLE ASSEMBLY. (See figure 96.)

a. Detach the three Dzus fasteners in the continuous wall section, and the fourth fastener in the right-hand cylinder barrel baffle.

1. REAR ROW CYLINDER HEAD BAFFLE ASSEMBLY
2. FRONT ROW CYLINDER HEAD BAFFLE
3. CYLINDER BARREL BAFFLE
4. SPARK PLUG
5. VALVE PUSH ROD COVER
6. PROPELLER GOVERNOR CONTROL CABLES
7. PROPELLER GOVERNOR CUT-OUT SWITCH

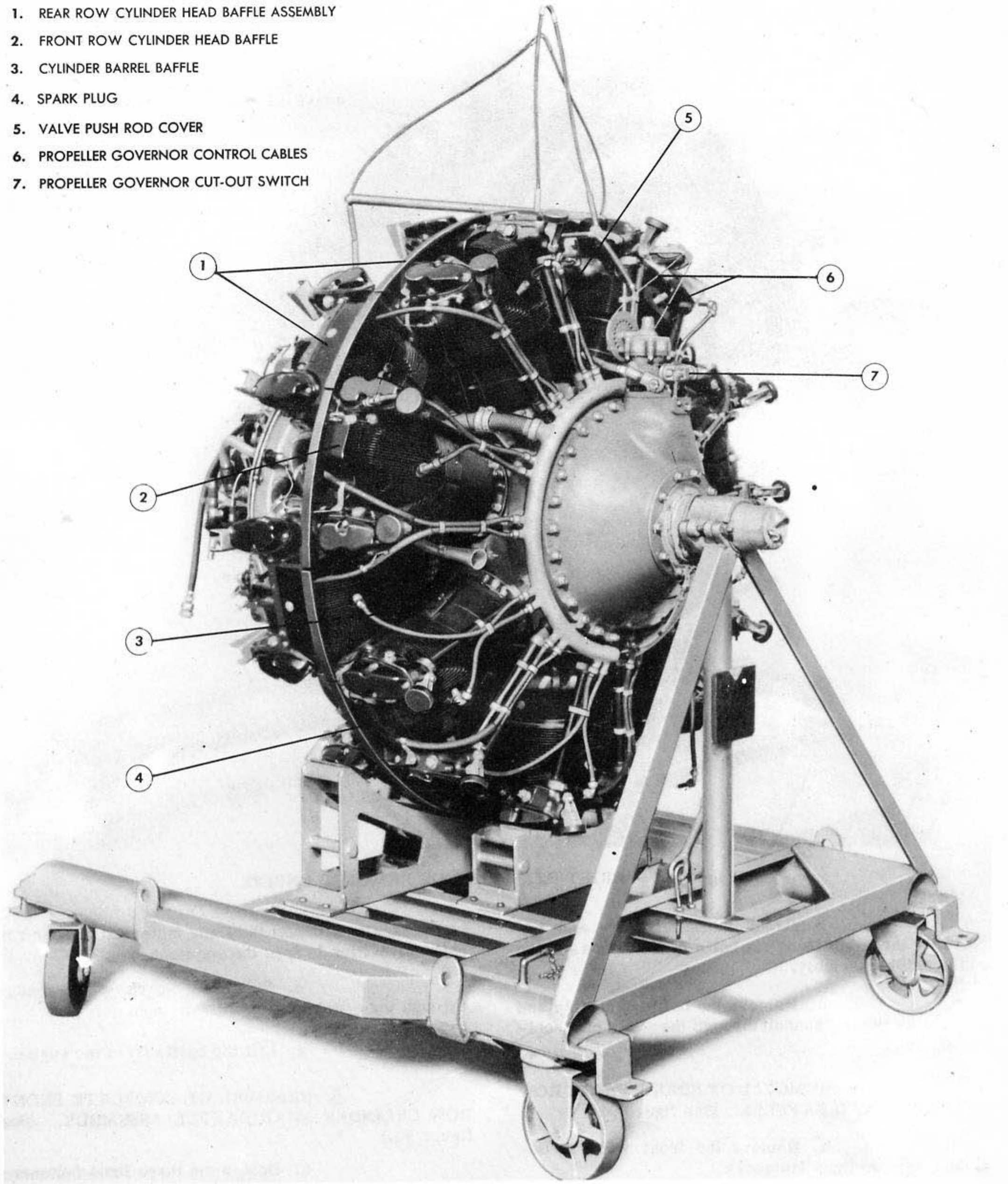


Figure 96 - LEFT FRONT VIEW OF REMOVED ENGINE

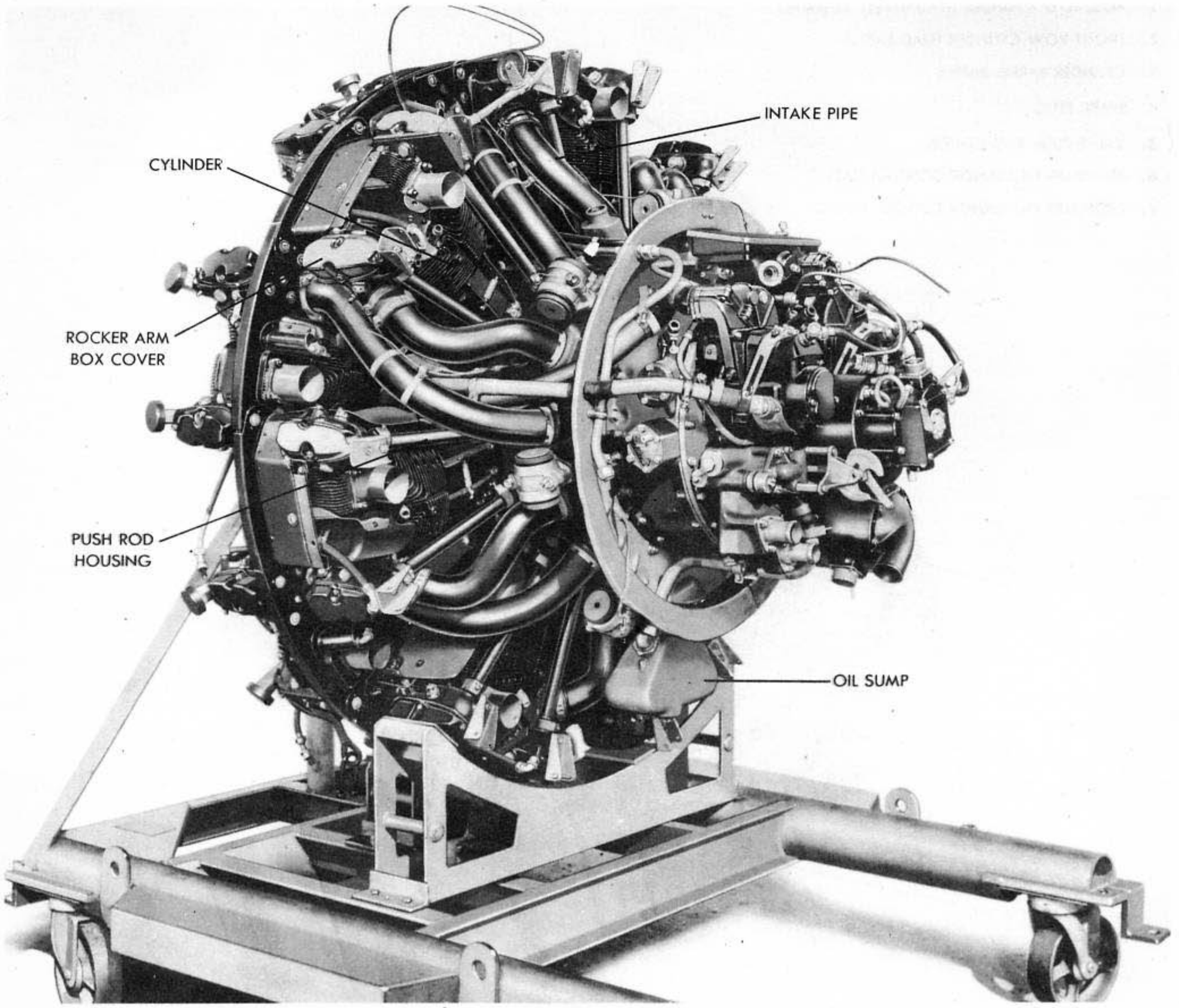


Figure 97 - RIGHT REAR VIEW OF REMOVED ENGINE

b. Break the safety wire and remove the three attaching cap bolts in the frame section of the baffle assembly.

c. Remove the baffle assembly and pull the spark plug conduit through the spark plug cooling air duct.

4. REMOVAL OF SINGLE FRONT ROW CYLINDER HEAD BAFFLES. (See figure 96.)

a. Remove the front baffle by detaching the two Dzus fasteners.

b. Detach the five Dzus fasteners through the wall section of the rear segment. It may be necessary to detach the Dzus fasteners of rear row cylinder baffles to free the segment.

c. Pull the spark plug conduit through the spark plug cooling air duct.

d. Lift the baffle from the engine.

5. REMOVAL OF COMPLETE FRONT ROW CYLINDER HEAD BAFFLE ASSEMBLY. (See figure 96.)

a. Detach the three Dzus fasteners which attach each front row cylinder cowl supporting wall section to the adjacent rear row cylinder cowl supporting wall section.

b. Break the safety wire and remove the three gusset attaching cap screws having a plain washer under the head of each.

c. Remove the intake pipe flange attaching cap screw which holds the short steel strap. It may be necessary to detach a few Dzus fasteners of adjacent rear row cylinders to remove the front row cylinder head baffle assembly.

d. Withdraw the spark plug conduit from the spark plug cooling air duct when the baffle unit is free from the cylinder head.

6. REMOVAL OF CYLINDER BARREL BAFFLES. (See figure 96.) - Cylinder baffles on both front and rear row cylinders are similar, but not interchangeable. The rear bank cylinder baffles are reinforced with leather padding at their leading edges where they make contact with the adjacent front bank cylinder baffles. All cylinder baffle assemblies are made up of four parts - consisting of two curved plate deflectors, a semicircular sheet steel clamp, and a spring-loaded latch bolt which holds the rear edges of the deflectors together. On either row of cylinders, the barrel baffles may be removed by the following procedure, although it may be necessary to remove an intake pipe to reach a front row cylinder barrel.

a. Break the lock wire and remove the attaching cap bolt and plain washer in the cylinder head exhaust rocker box.

b. Detach the adjacent Dzus fastener which holds the front and rear row cylinder barrel baffles together.

c. Spring the threaded end of the spring-loaded latch bolt out of its seat in the right-hand baffle. Do not loosen the lock nuts for this operation, as they have been adjusted at the initial assembly of the engine to give the desired spring tension.

d. Remove the right-hand baffle from the hooked end of the steel clamp and lift from engine. Swing the clamp outwards on the bolt which hinges it to the left-hand baffle, and remove the left-hand baffle from the engine. On the front row cylinders, the clamp may be sprung toward the crankcase to clear the push rod housings.

NOTE

Due to the close clearance next to the oil sump, cylinders No. 7 and No. 9 do not have a bolt holding the cylinder baffle clamp, but utilize a steel strap and a short clamp which are hooked into slots in the baffles. Upon removal of the latch bolt, all parts may be withdrawn readily. Study the alinement of clamp before removal to assure proper reinstallation.

7. REMOVAL OF INTAKE PIPES. (See figure 98.)

a. Intake pipes of the upper eight cylinders support the priming system. When removing one of these intake pipes, remove the attaching nuts from each end of the individual priming tube. Disconnect the attaching clips on intake pipe and remove the priming tube.

b. Loosen the packing nut at the crankcase end of the intake pipe to avoid damaging the intake pipe and clamps.

c. To remove an intake pipe from a front row cylinder, it is necessary to remove the three flange attaching cap bolts in the cylinder head. The cylinder head baffle attaching strap will have to be moved to one side to permit withdrawing the intake pipe and flange. The packing nut and packing may be left in the supercharger front housing. Plug the openings to prevent entry of foreign matter.

d. To remove an intake pipe from a rear row cylinder after the packing nut has been loosened, loosen the two hose connection clamps at the cylinder head with a screwdriver. Slide the hose connection along the intake pipe until the assembly can be withdrawn. Leave the loosened packing nut in the supercharger front housing. Plug the openings.

8. REMOVAL OF OIL SUMP. (See figure 97.))

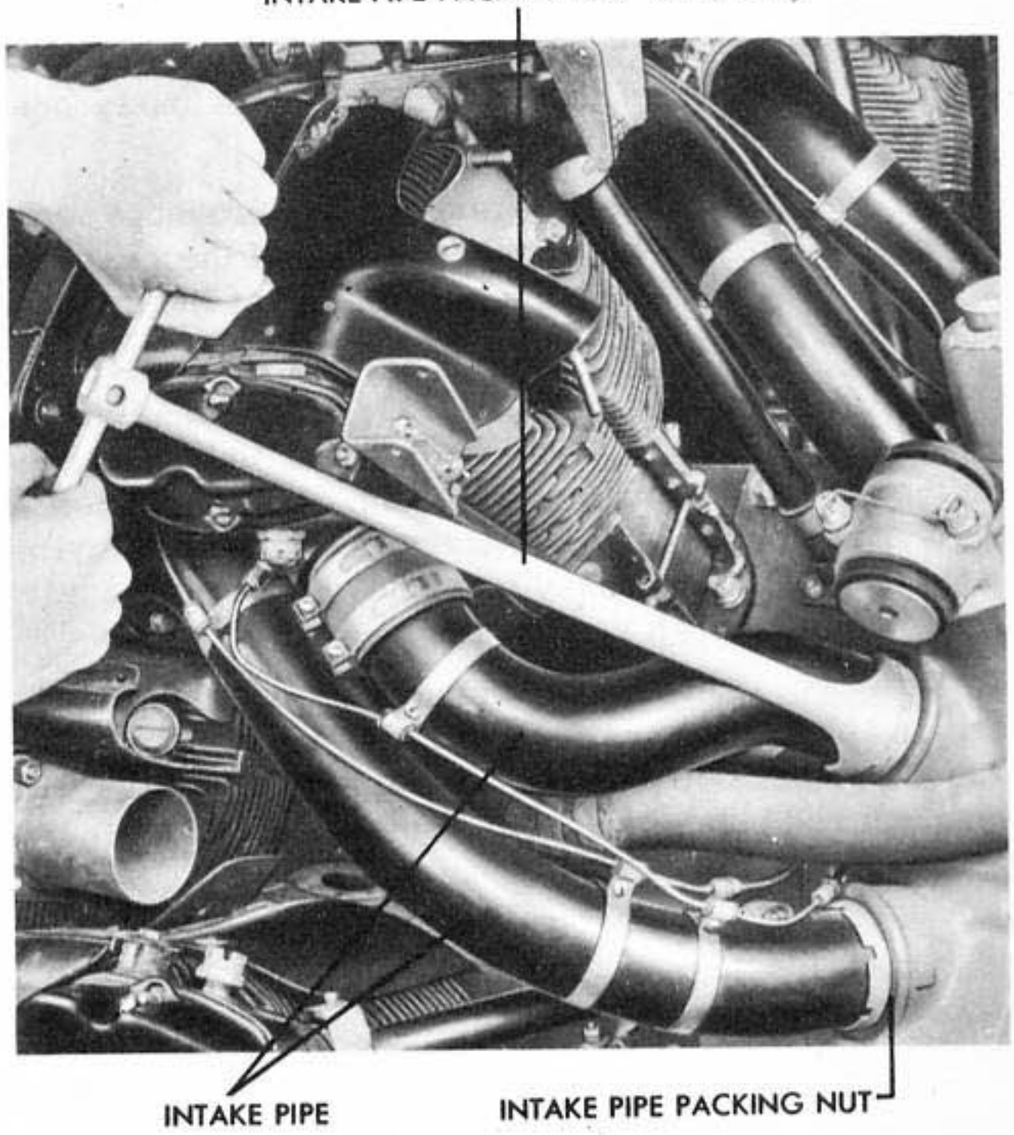


Figure 98 - REMOVING INTAKE PIPES

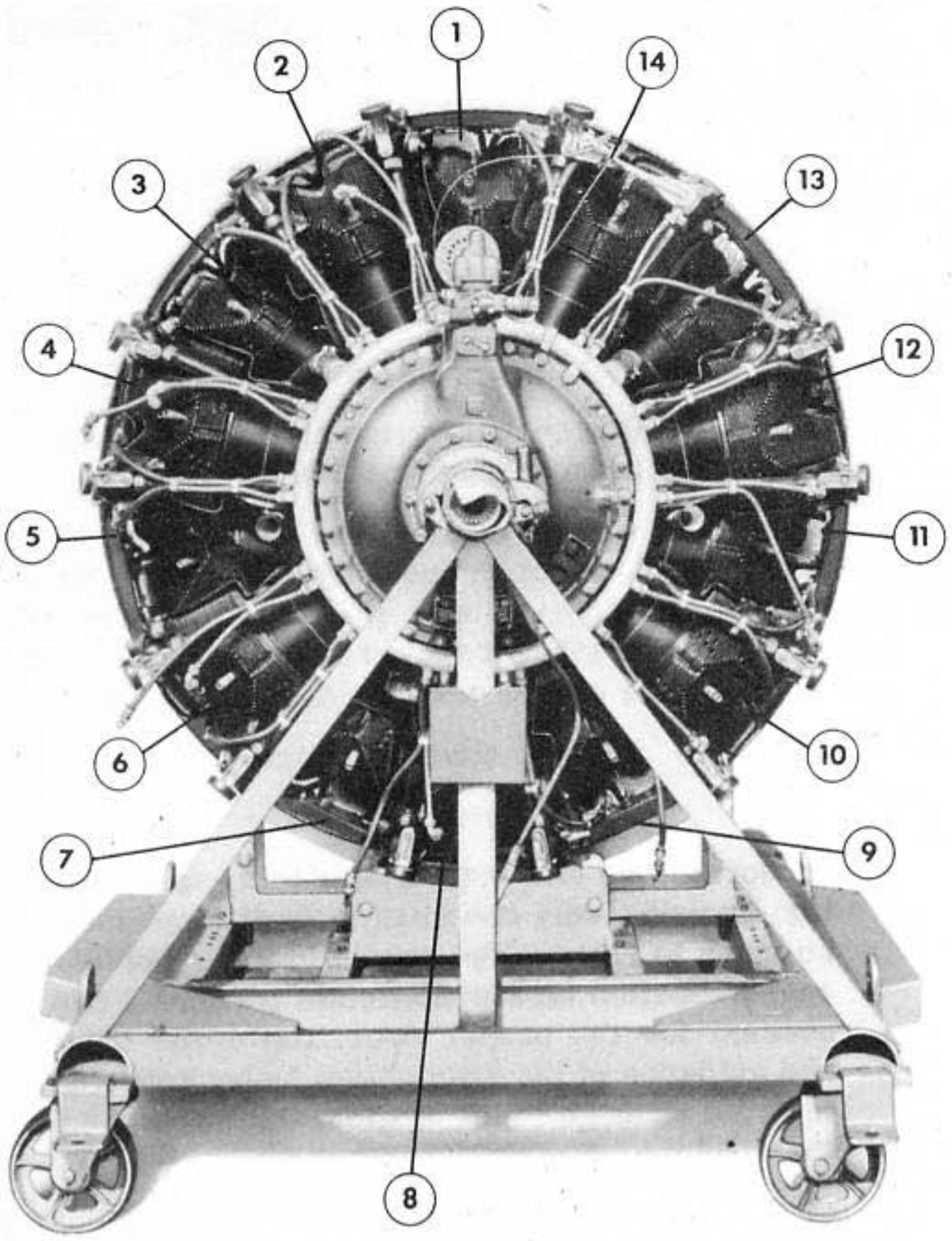


Figure 99 - CYLINDER NUMBERING SCHEME

d. Remove the rocker box covers, rocker arms, push rods, and housing. Remove the rocker box ignition wire clip, leaving the clip on the shield.

e. Disconnect the cylinder barrel baffles and remove.

f. To remove cylinders adjacent to the two main radio shielded ignition units, it will be necessary to loosen the conduit attaching yokes and shielding couplings to render the cylinder hold-down nuts accessible.

g. Remove the sump to remove cylinders No. 7, 8, and 9. (See figure 99.)

h. Remove both spark plugs.

i. Move the crankshaft until the piston in the cylinder being removed is at the top of its stroke. Break the safety wire through the 16-cylinder hold-down nuts and remove the nuts. Remove the spherical washers under the nuts and pull the cylinder straight outward clear of the piston. If the cylinder is to be reused, install fin protecter around the lower fins of the cylinder head.

11. REMOVAL OF PISTON. (See figure 102.)

a. Extract both piston pin retainers, using the special removing tool. Insert the spade-shaped end of the tool between any two spring coils. Turn the handle 90 degrees to engage the coils with the shoulders of the spade. Pry the piston pin retainer spring from its groove in the piston, resting the curved leg of the tool against the side of the piston. Place one hand over the piston pin bore on the piston to catch the retainer spring when it snaps out.

b. Push the loose fitting piston pin out of the piston with the fingers, holding the piston from falling. If the piston pin is stuck, force it out with the piston pin removing tool. Encircle the piston with a felt-lined stirrup and screw the shoulder drift into the piston pin. Remove the piston and pin from the engine and prevent the connecting rod from striking the crankcase by installing a connecting rod guide over the cylinder hold-down studs. Plug the hole in the crankcase to prevent foreign matter from entering.

12. REMOVAL OF VALVE. (See figures 100 and 101.)

Figure 100 - COMPRESSING VALVE SPRING FOR REMOVAL

(d) INTAKE PIPES - Dents, cracks, holes.

(e) OIL SUMP - Dirt, magnetism of drain plug, cracks.

(f) PUSH RODS - Straightness, wear on ball ends, security of ball ends.

(g) VALVE TAPPETS - Improper fit of valve adjusting screws, restricted movement of inner race in ball bearing, cracks, wear.

(h) VALVE SPRINGS - Breaks, inadequate pressure, rust, improper height.

(i) VALVES - Stretching, drawing, poor seating surface, corrosion.

(j) CYLINDERS - Scored barrels, cracked heads, worn valve inserts, excessive carbon deposits, worn rocker arm shaft bushings, mutilated spark plug bushings, worn or damaged valve guides.

(k) PISTONS - Cracked heads and skirts, broken ring lands, scored piston pin holes, excessive carbon deposits, broken rings, worn rings, rings seized in grooves due to excessive carbon, scored skirts.

e. REPLACEMENTS.

(1) Replace spark plugs after 100 hours of service or before that time in case of failure. Visual inspection of the spark plugs upon removal may reveal some condition responsible for the apparent spark plug failure.

(a) Electrodes heavily coated with carbon indicate the cylinder is passing oil.

(b) Clean, but discolored, electrodes indicate that the engine has been running hot. This could be caused by use of poor fuel, excessive manifold pressure, or by a loose core.

(c) White powder on the electrodes, after operating with tetraethyl lead fuel, means the plug is running hot.

(d) A coating of fresh oil indicates the plug is not firing.

(2) Do not stone gear teeth faces to remove chipped, pitted, or scuffed conditions. Stoning alters tooth profile which causes wear and possible gear failure. Replace gears if chipped, pitted, or scuffed.

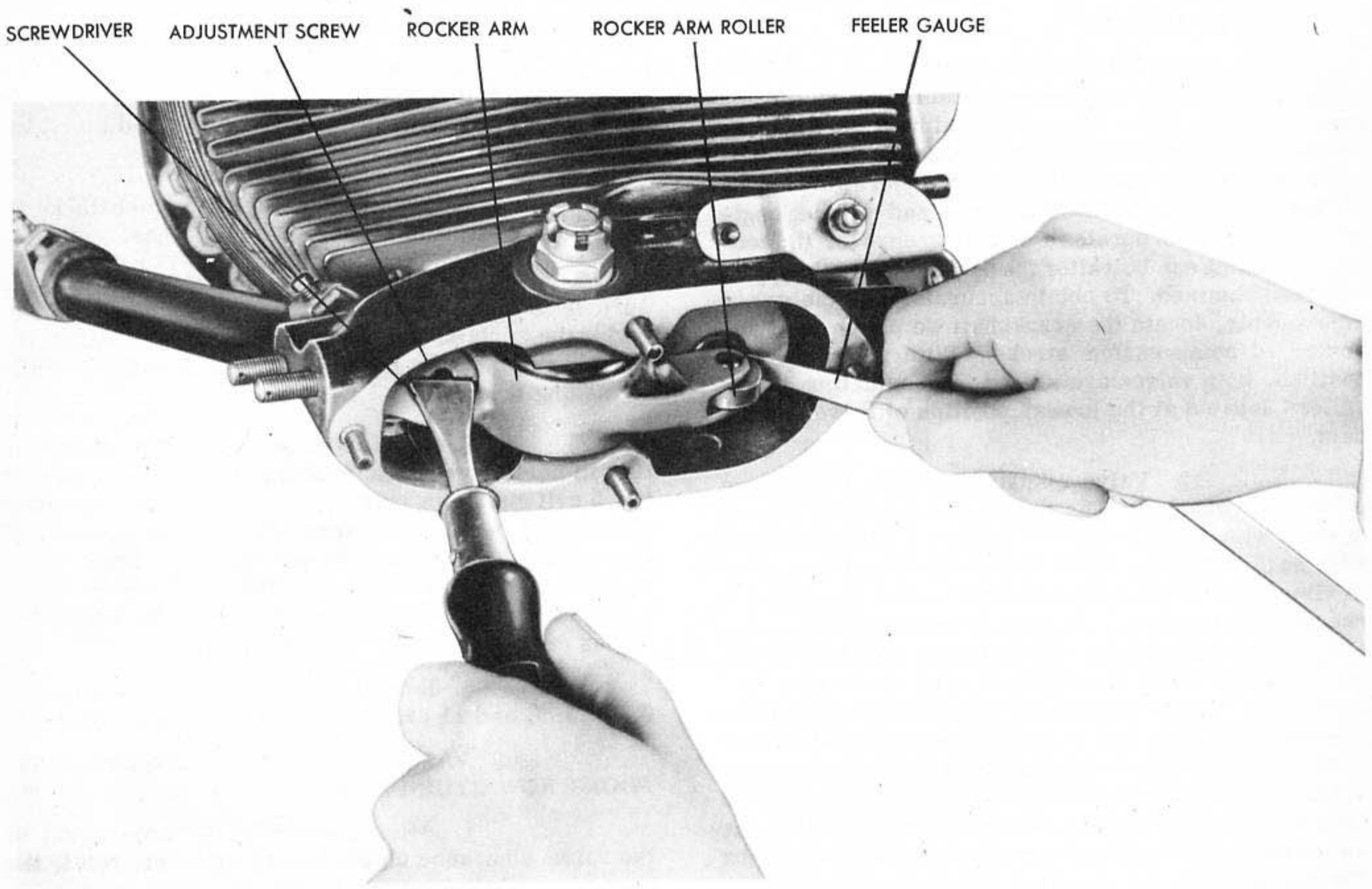


Figure 101 - ADJUSTING VALVE CLEARANCE

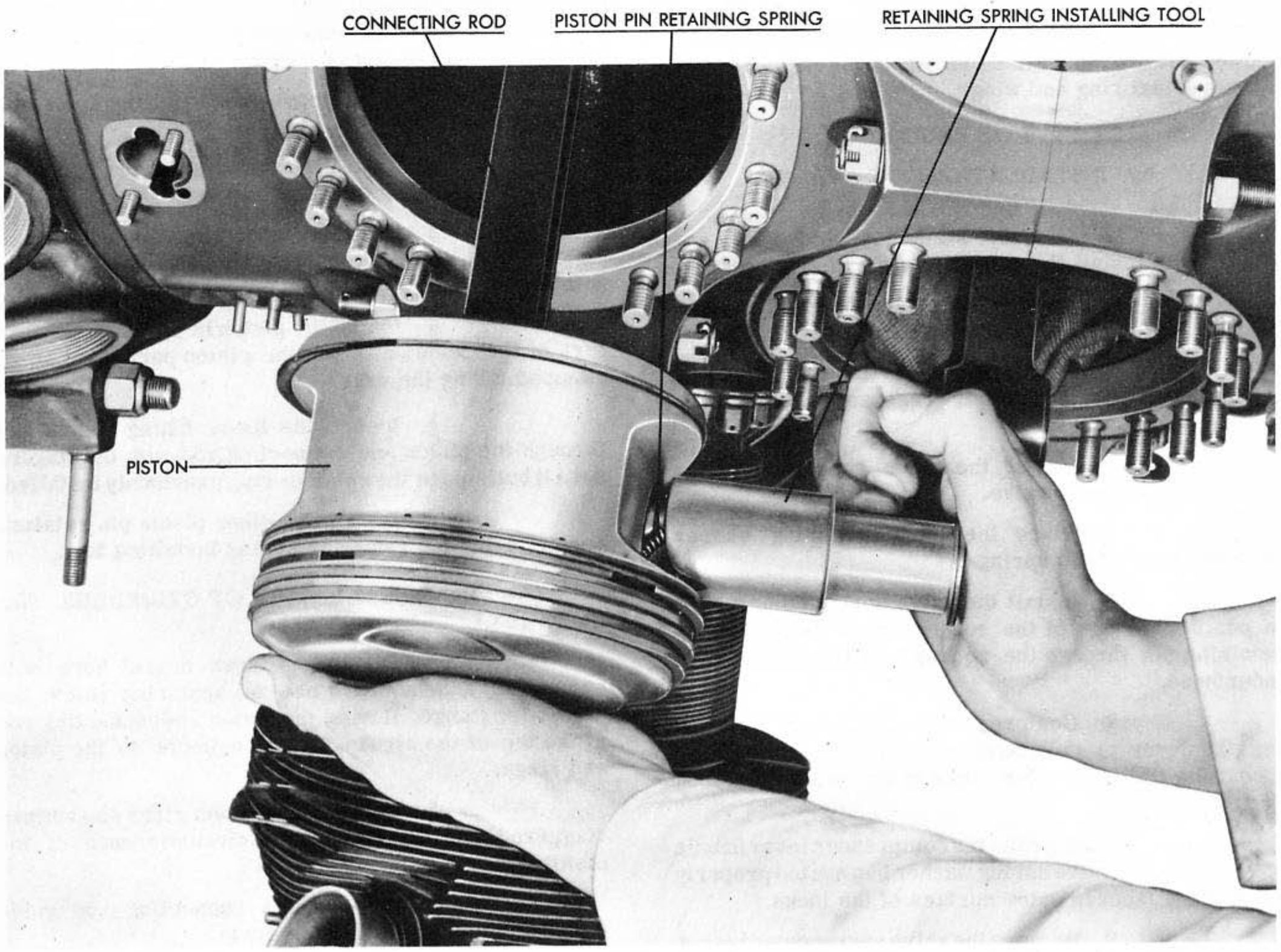


Figure 102 - INSTALLING PISTON PIN LOCK

adjustment of its valve clearance. Move the crankshaft back and forth until a position is obtained where the intake rocker arm of cylinder No. 10 (at the left of cylinder No. 12) is in the approximate midpoint of its opening stroke and the exhaust rocker arm of cylinder No. 14 (at the right of cylinder No. 12) is at the approximate midpoint of its closing stroke. (See figure 99.)

2. Adjust the valve clearance of No. 12 cylinder as previously explained.

3. Turn the propeller shaft in the direction of normal rotation to place the valve mechanism of the No. 2 cylinder in proper position for adjustment of valve clearances, and adjust its valve clearance.

4. In a like manner, adjust the valve clearance of cylinders No. 6, 10, 14, 4, and 8 respectively. (See figure 99.)

g. ASSEMBLY AND INSTALLATION.

(1) INSTALLATION OF COMPLETE ENGINE SECTION. (See figure 90.)

(a) Hoist the completely assembled engine section into position on the forward end of the nacelle. Install the four bolts to secure the engine mount to the nacelle (1,200 inch-pound torque).

(b) Remove the hoist from the sling and remove sling from the engine.

(c) Connect the engine and propeller cables at turnbuckles in the engine section.

(d) Connect all electrical connections at the Cannon plugs on the fire wall.

(e) Remove the caps from the lines and connect all engine section piping at the fire wall.

(f) Install the propeller.

(g) Connect the two propeller feathering lines to the pump.

(h) Check to see that the engine has oil and that the de-icer and hydraulic lines are functioning. Check all systems for leaks.

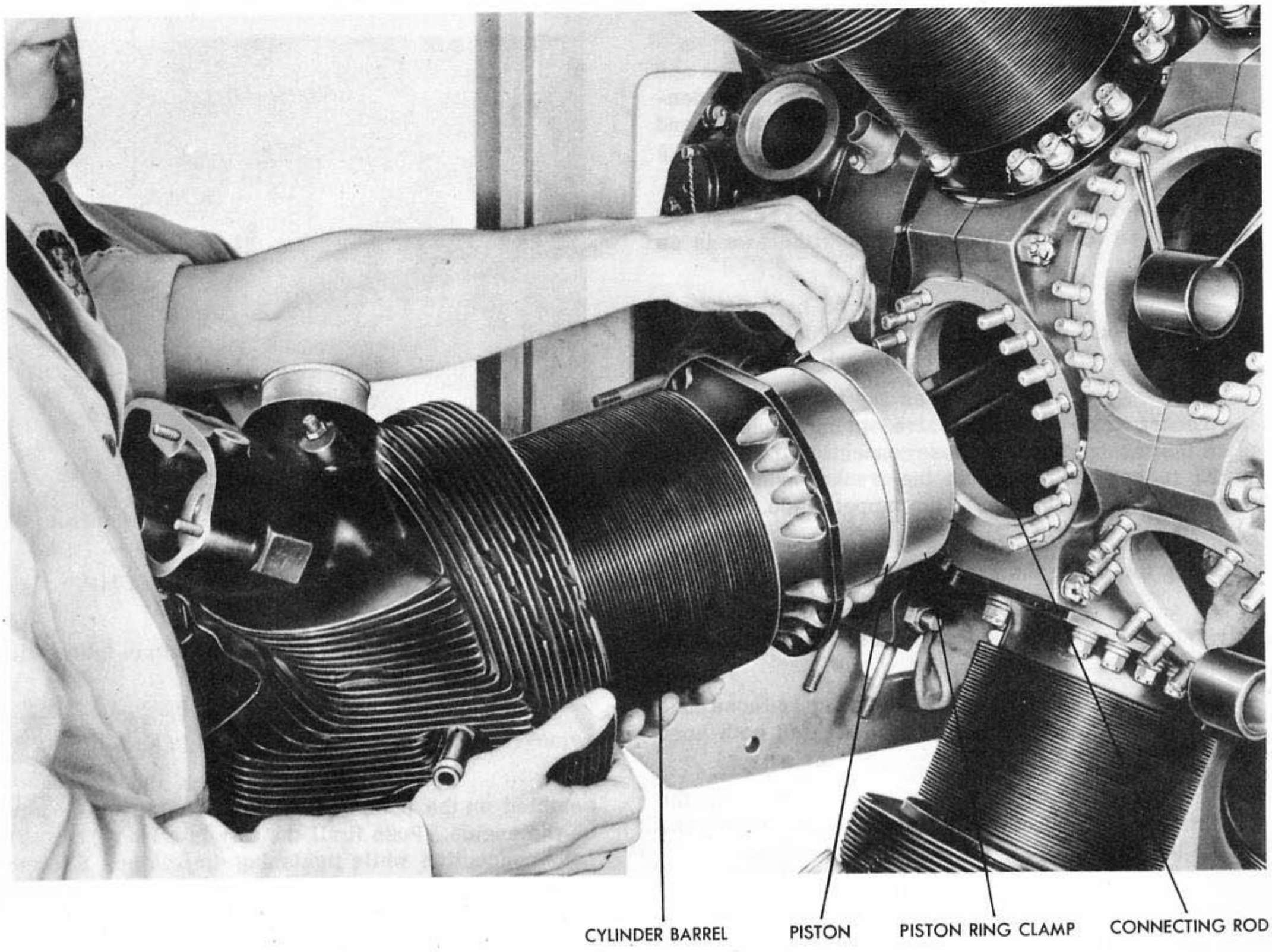


Figure 103 - INSTALLING CYLINDER

their proper locations. Install only the clips, washers, or brackets supplied with the engine to the cylinder hold-down nuts.

10 Using a torque of approximately 300 inch-pounds, tighten two nuts on opposite sides of the cylinder and approximately 90 degrees from each of the special locating nuts.

11 Using the same torque, tighten two more nuts on opposite sides of the cylinder and approximately 45 degrees from the special locating nuts.

12 Proceed in this manner until all nuts are tightened.

13 Remove the special locating nuts, and replace with standard nuts and washers, using approximately 300 inch pounds torque.

14 Tighten all the nuts consecutively around the cylinder, using torque of 400 to 450 inch-pounds.

(d) ASSEMBLY AND INSTALLATION OF PUSH RODS AND VALVE TAPPETS.

1 Place the tappet roller equipment, with its bronze supporting bushing, in the slotted end of the tappet, and insert the floating pin.

2 Slide the tappet and roller into the tappet guide, and install the retaining circlet with the installing tool.

3 Install new gasket under the tappet guide flange, and insert into crankcase.

4 Install a plain washer, nuts, and palnut on each of the two attaching studs.

5 Insert the coil spring and valve tappet ball socket into the tappet.

6 Oil all parts with engine oil.

7 Install the short hose connection and one clamp on the rocker box end of the push rod housing

identified by the location of the beading being approximately 3/8 inch from the end.

8 Install the long hose connection and two clamps on the crankcase end of the housing identified by the location of the beading directly on the end of the housing. Engine oil wiped on the push rod housing will relieve any binding of the hose connection.

9 Procedure when the rocker arm was not removed when the push rod was withdrawn is as follows:

a. Oil the push rod ball ends and insert the push rod in its housing. Push hose connection at the crankcase end back flush with the bead.

b. Compress the valve spring with the rocker arm. With the valve spring compressed, slide the push rod housing hose connection into position at the rocker box, and push the crankcase end of the push rod through the slot in the tappet guide.

c. Remove the valve spring compressing tool from the rocker arm.

d. Push the push rod housing all the way into its rocker box hose connection, and tighten the hose clamp.

e. Slide the crankcase end hose connection over the tappet guide, and tighten both hose clamps.

f. Move the crankshaft until the piston is on top dead center of its firing stroke and adjust the valve clearance.

g. Apply engine oil to the rocker arm and install the rocker box cover and gaskets. On any upper cylinder, fill the rocker boxes with engine

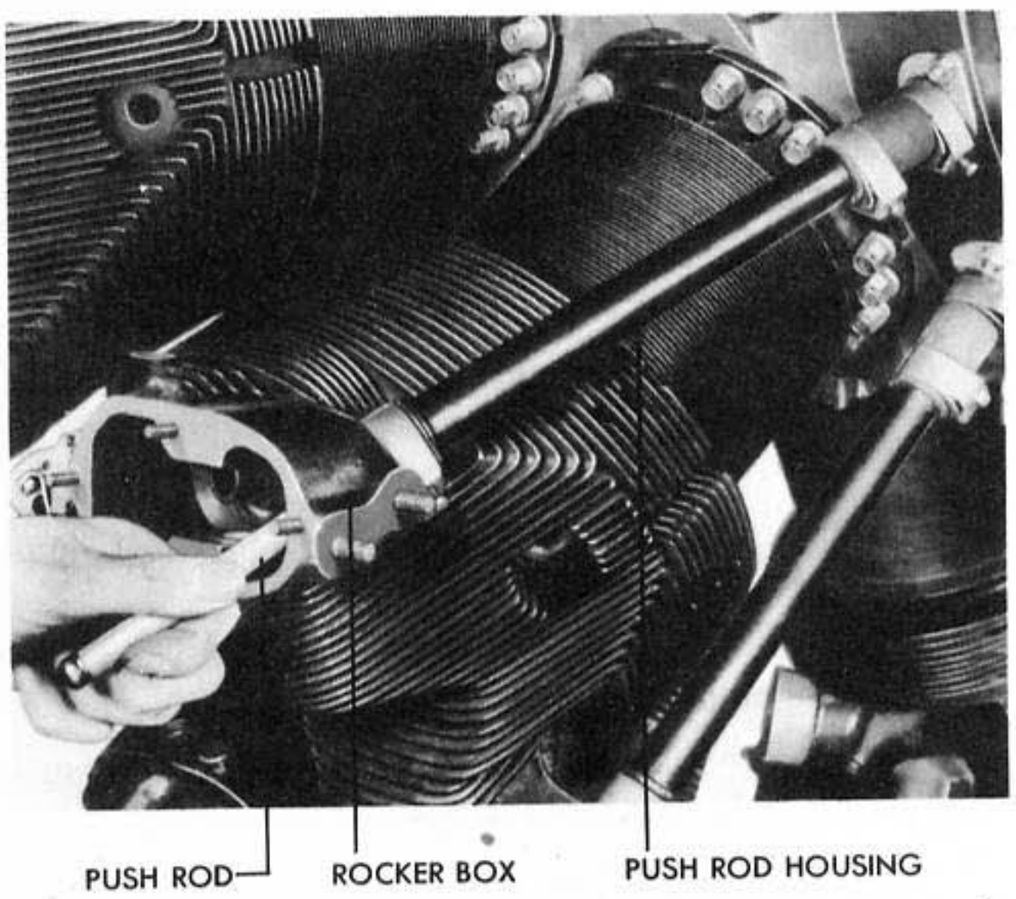


Figure 104 - INSTALLING PUSH ROD

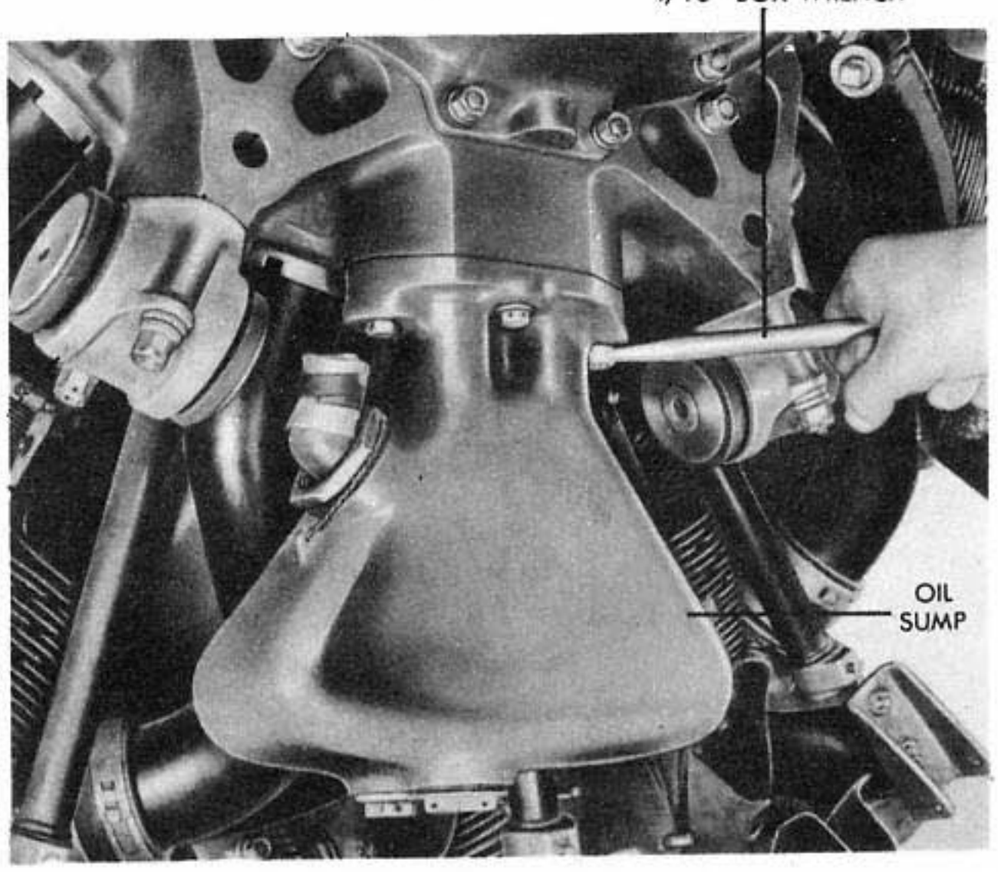


Figure 105 - INSTALLING OIL SUMP

oil before installing cover to assure ample lubrication when the engine is first started.

10 Procedure if the rocker arm was removed at removal of the push rod is as follows:

a. With the hoses and clamps assembled on the push rod housing, install the housing on the engine. Push it all the way into its rocker arm hose connection while tightening the clamp. Slide the hose connection over the tappet guide, and tighten both clamps.

b. Oil the push rod ball sockets with engine oil, and insert in push rod housing through the rocker box. (See figure 104.)

c. Install the rocker arm and insert the rocker bolt through its hub. Interchangeable spherical seating washers and oil seal rings are used on both ends of the rocker bolt. Insert the bolt with the head on the inboard side of the rocker box next to the cylinder head.

d. Check the end clearance between the binding inner race and the rocker box. If it is in excess of 0.005 inch, remove the bolt and install shim.

e. Tighten the rocker bolt nut to a torque value of 250 to 325 inch-pounds. If excessive torque is necessary to line up the cotter pin hole, remove the nut and substitute a new washer.

f. Move the crankshaft until the piston is on top dead center of its firing stroke and adjust the valve clearance. (See step (e) following.)

g. Apply engine oil to the rocker arm and install the rocker box cover and gasket. On

g. Install the right-hand baffle in position with the slot at the front edge over the hinged clamp hooked end.

h. Loosely install the cap bolt and plain washer, attaching the baffle to the exhaust rocker box.

i. Attach the adjacent Dzus fastener which holds the front end rear row cylinder barrel baffles together.

j. If the latch bolt spring tension has been previously adjusted, snap the bolt into its seat in the right-hand baffle. Tighten the attaching cap bolt in the rocker box, and safety-wire it securely. In case of a new replacement cylinder barrel baffle assembly, the latch bolt should be swung into its seat and one nut screwed up until the baffles are held snugly and yet allow easy disassembly and assembly. Maintain the desired tension by tightening the second nut on the first. Cylinder baffles on No. 7 and No. 9 cylinders do not have hinged clamps due to interference with the oil sump. In installing baffles on these cylinders, it is to be noted that the short baffles are installed on the side of the cylinder barrel adjacent to the sump. The curved steel strap which rests on the cylinder barrel fins is hooked to the short baffle by a hook clamp which is located on the 19th space between the cylinder barrel fins.

(h) INSTALLATION OF FRONT ROW CYLINDER HEAD BAFFLES. (See figure 106.)

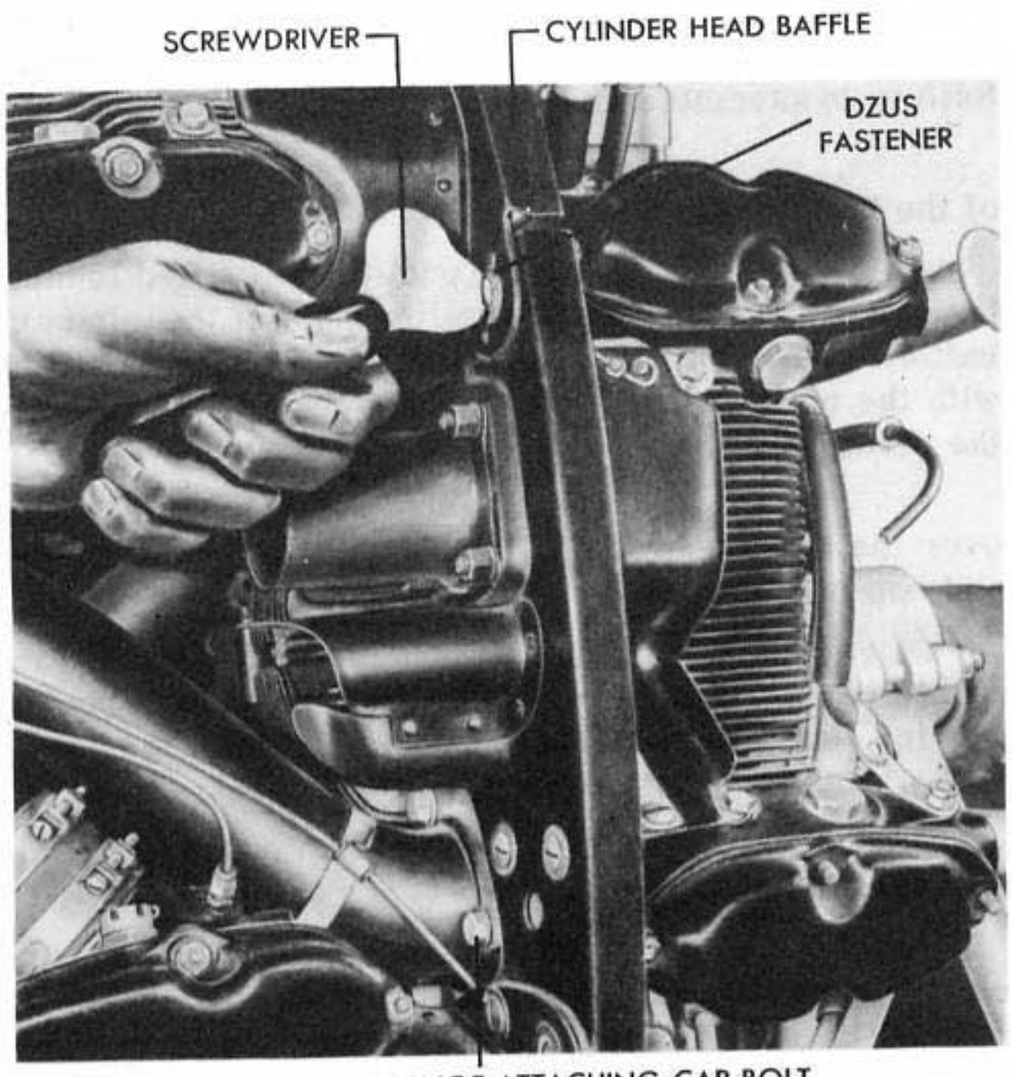


Figure 106 - INSTALLING FRONT ROW CYLINDER HEAD BAFFLES

1 If the entire front row cylinder head baffle assembly has been removed, reassemble the five component parts before installation as follows:

a. Bolt the steel strap to the right-hand gusset, but do not tighten until the proper angle is determined when the entire baffle assembly is installed on the cylinder head. Use a plain nut and lock washer on the attaching cap bolt.

b. Attach the right-hand gusset to the front face of cowl supporting wall section with the two Dzus fasteners.

c. Install the left-hand gusset to the under side of the front baffle with the Dzus fastener.

d. Attach the front baffle and the left-hand gusset assembly to the cowl supporting section with the Dzus fastener through the right-hand gusset.

2 Pass the ignition wire through the spark plug cooling air duct. Place the front row cylinder head baffle assembly in position on the cylinder head, working the Dzus fasteners into their mating holes but not connecting them to their lock springs. The cowl supporting wall section must be in front of the adjacent rear row cylinder wall sections.

3 Install the three cylinder head attaching cap screws and washers loosely. One bolt is located at each of the two cylinder head rocker boxes, and the other at the rear of the exhaust rocker box.

4 Install loosely the intake pipe flange attaching cap bolt, shakeproof lock washer, and plain washer through the short steel strap.

5 Attach the three Dzus fasteners through the continuous cowl supporting wall section. Tighten the four cap bolts. Safety-wire the three smaller bolts. The Dzus fasteners adjacent to the cap bolt in the exhaust rocker box rear end may be detached for accessibility.

6 Tighten the nut on the bolt attaching the steel strap to the right-hand gusset. Install the cotter pin.

(i) INSTALLATION OF REAR ROW CYLINDER HEAD BAFFLES. (See figure 96.)

1 If the entire rear row cylinder head baffle assembly has been removed, assemble the three component parts prior to installation as follows:

a. Place the front segment on the intermediate frame section, followed by the rear segment.

b. Attach the three Dzus fasteners to hold the assembly together. Two of the fasteners are on top of the rear segment and the third is at the left-hand side.

NOTE

If the clamp will not go down in front, remove the inspection plates at the sides of the air scoop.

6 Tighten the lower clamp, using a flat screwdriver.

7 Install ten cap screws along the sides of the air scoop into the venturi ring. Be careful not to force any of the cap screws. If screws will not start easily, drill sheet metal out to 1/4-inch diameter.

8 Install five cap screws under air scoop fairing.

9 Replace cover on air scoop fairing.

10 Install six Phillips head screws in air scoop fairing.

11 Connect four anti-icer lines to back of air scoop.

12 Connect electric plug to air temperature bulb on back of air scoop.

13 Install exit fairings for upper cowl flaps.

14 Install cover plates on wing.

15 Hook up control cables, removing tape and safety wire.

(bb) Connect the engine control rigging. (See figure 91.)

(cc) Connect the generator blast tubes. (See figure 91.)

(dd) Fill the oil containers with oil, Specification AN-VV-O-446a, grade 1100A.

(ee) Install the propeller.

(ff) Ground-test the engine.

(gg) Install the antidrag ring. (See figure 88.)

(hh) Install the accessory cowling.

h. FINAL TEST AFTER ASSEMBLY.

(1) GROUND RUN-IN OF ENGINES.

(a) GENERAL. - After general replacement of internal wearing parts (bearings, bushings, pistons, rings, and similar parts), test-run engines to ensure proper functioning. Block-test engines if equipment is available. Otherwise, when running-in and testing of engines are necessary, operate the engines when installed in the airplane, using the regular airplane instruments for determining proper operation. To obtain maximum cooling, remove the cowling and keep the propeller in low pitch.

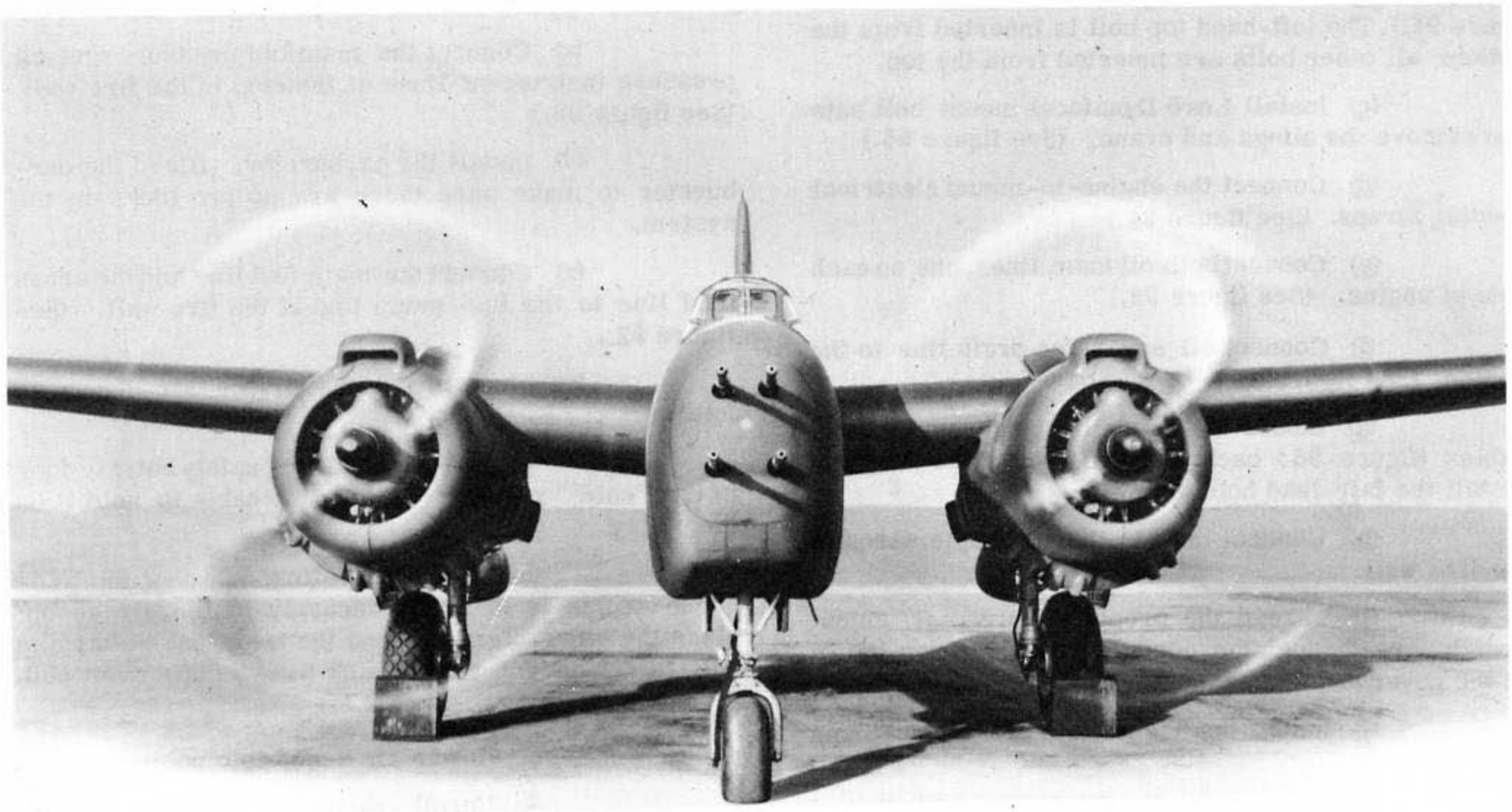


Figure 107 - RUNNING-IN ENGINES

Figure 108 - INSTALLED ENGINE CONTROLS

9. ENGINE AND PROPELLER CONTROLS.

a. DESCRIPTION (See Figures 108, 110, 111, and 112.)

(1) GENERAL. - Engine and propeller controls are grouped on the left side of the pilot's cockpit. Cables attached to control handle pulleys provide the means of adjusting the engine and propeller controls. From the control handle pulleys, the cables run aft to the main spar in the fuselage, outboard to the left-hand side of their respective nacelles, and down to the differential pulley beam aft of the fire wall. Cables provide the operation of the controls forward of the fire wall. All control cables are of 3/32 inch 7 by 7 preformed flexible steel wire. For identification, colored bands of paint will be found on all cables.

(2) ENGINE COWL AND OIL COOLER FLAP CONTROLS. (See figure 109.) - The engine cowl flaps are actuated by hydraulic pressure and are controlled by valves located on the panel at the right side of the pilot's seat. Upper cowl flaps for each engine are controlled in unison by a single valve handle. Lower cowl flaps for each engine are controlled by individual valve handles. The oil cooler flaps are connected by cables to the lower cowl flap mechanism and operate simultaneously with the lower cowl flaps. To open the cowl flaps, move the respective control to OPEN position; when the flaps are open as desired, return the control to NEUTRAL position. To avoid buffeting, the upper cowl flaps should be closed at all times in flight and opened only while the engines are running on the ground.

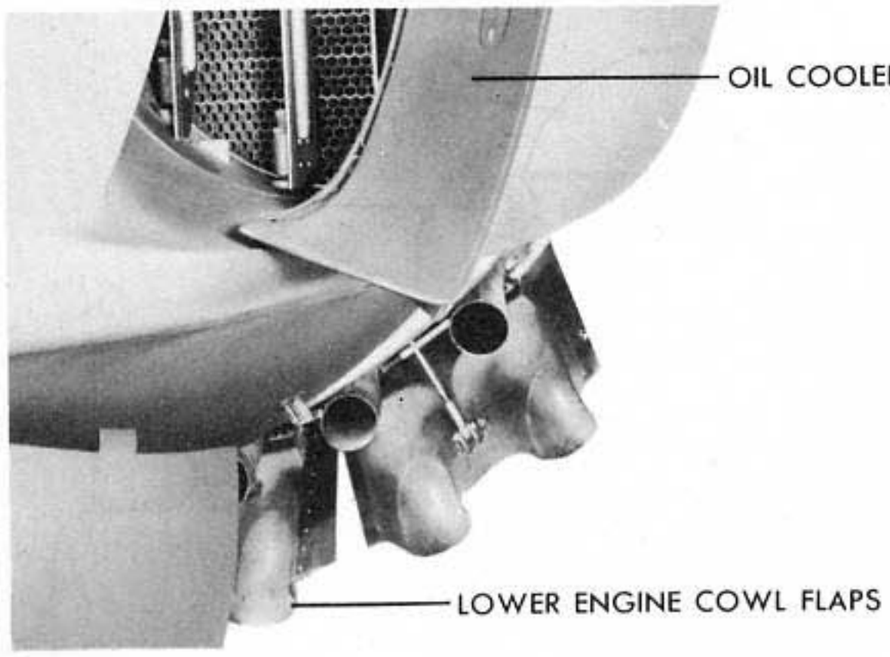


Figure 109 - ENGINE COWL AND OIL COOLER FLAPS

b. RIGGING. - Rigging the engine and propeller controls consists of adjusting the cable turnbuckles so that the control handles in the cockpit and the stops in the engine section reach their fore and aft stops at the same time. The rigging tension of the cables should be 60 percent of the amounts noted on the Cable Rigging Tensions Chart, Section 8, this handbook. If in adjusting any of the controls a "spring-back" is noted at either end of the control quadrant, readjust the system to equalize the amount of "spring-back" at each end of the quadrant.

c. REPLACEMENT OF CABLES. - When replacing a cable, check the length and location of the stop on the new cable against the old cable, as well as the dimensions noted on Engine Control Data Chart, Section 8. All replacement cables should be proof-loaded to 552 pounds before installation. A thread line soldered to the end of the cable will facilitate installation.