P-38L/em

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FOR OFFICIAL USE ONLY

ERECTION AND MAINTENANCE INSTRUCTIONS

FOR

ARMY MODEL P-38L-1 AIRPLANE

Published under joint authority of the Commanding General, Army Air Forces, the Chief of the Bureau of Aeronautics, and the Air Council of the United Kingdom.

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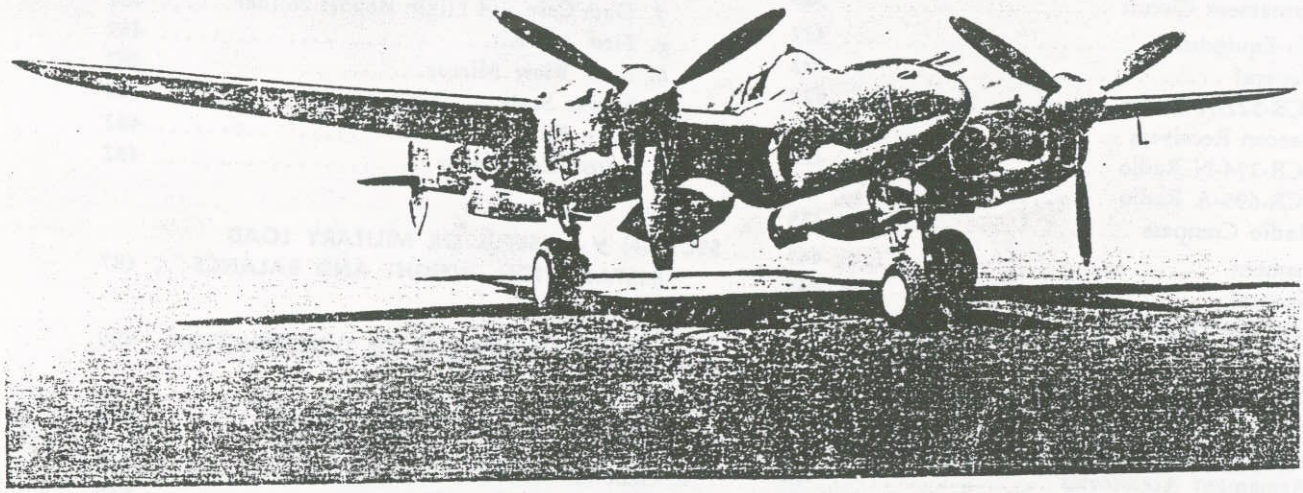


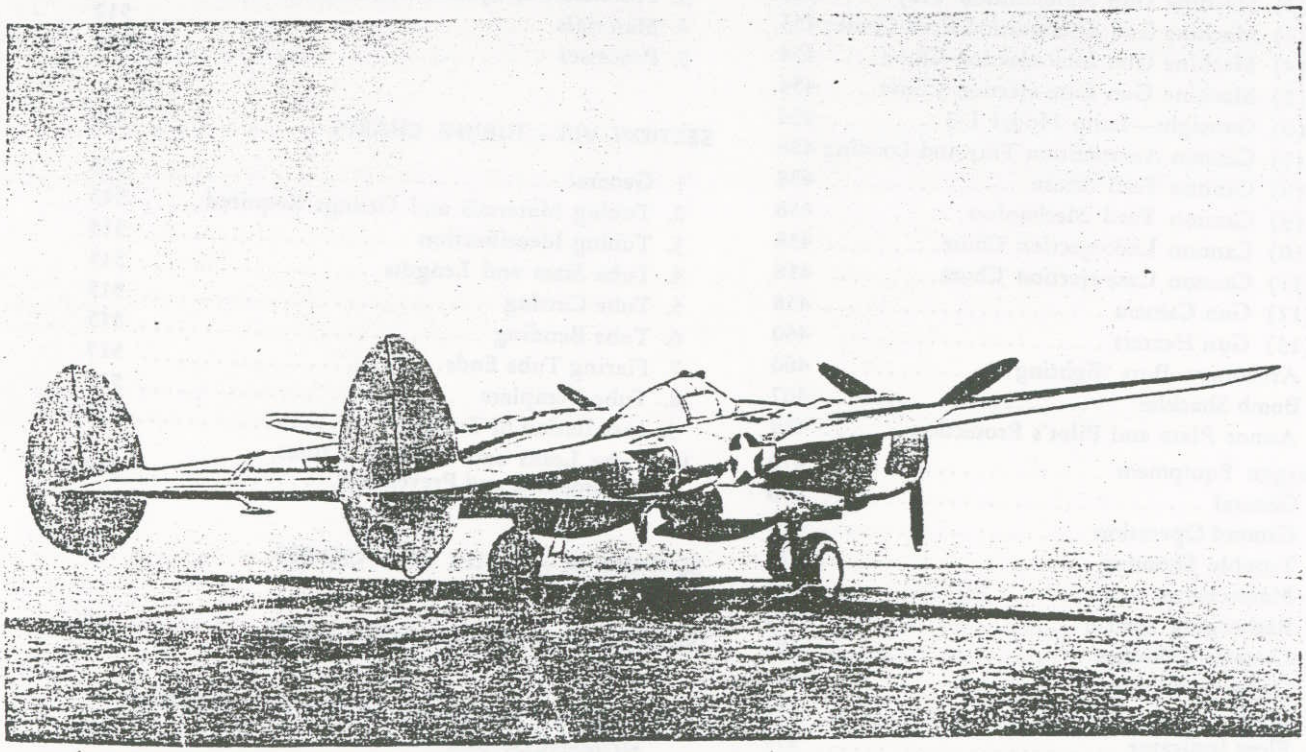


Figure 1 — P-38L Airplane, Three-quarter Front and Rear Views

SECTION I

DESCRIPTION, DIMENSIONS, AND LEADING PARTICULARS

1. DESCRIPTION.

The P-38L airplane is an all-metal, mid-wing, single-seater monoplane.

Each airplane is powered with two Allison liquid-cooled engines, which are fitted with Curtiss electric full-feathering propellers. Twin booms, extending aft from the engine nacelles, support the tail unit. Exposed skin is butt-jointed and flush-riveted. The wing, which consists of the center section and two outer wing panels, is of the full cantilever stressed-skin type. The gondola-type fuselage extends forward from the trailing edge of the center section at the plane of symmetry. A handhole on the aft left side, and a retractable ladder at the aft end of the fuselage, permit mounting the center section, from which access to the cockpit is gained by opening the hinged portion of the cockpit enclosure.

The fully-retractable tricycle-type landing gear is made of three units, consisting of a strut, axle, and wheel. When retracted the landing gear units are enclosed in each wheel well by flush, automatically-operated doors. A conventional control column and handwheel operate the ailerons and elevator, while the rudders are actuated by pedals which also incorporate the brake actuating mechanism. Adjustable trim tabs are manually controlled from the cockpit.

Mounted in the nose section of the fuselage of the airplane is the armament equipment which consists of four .50-caliber machine guns and one 20-mm cannon controlled by button and trigger switch on the control wheel in the cockpit. A gun camera is located in the left-hand drop tank fairing.

Fuselage and wing stations are shown in figures 3, 4, and 5.

2. DIMENSIONS.

For principal overall dimensions of the airplane, see figure 2.

3. LEADING PARTICULARS.

Airplane designation by Army Air Forces: P-38L-1.

a. PRINCIPAL DIMENSIONS.—Airplane in level flight position unless otherwise stated. (Lockheed Ref. 197349.)

GENERAL.

Span	52 ft. 0 in.
Length (overall)	37 ft. $9\frac{15}{16}$ in.
Height (overall at rest: max. propeller ht.)	12 ft. $10\frac{1}{8}$ in.

WINGS

Airfoil Section, Root	N.A.C.A. 23016
Airfoil Section, Tip	N.A.C.A. 4412
Chord at Root	9 ft. 9 in.
Chord near Tip (24 ft. 1 in. from center line)	3 ft. 6 in.
Incidence	+ 2 degrees
Dihedral (measured on top face of main beam)	5° 40′
Sweepback at Station 0	-5° 11′ 31″

STABILIZER

Span	21 ft. 9 in.
Maximum Chord	3 ft. 9 in.
Incidence	0 degrees
Dihedral	0 degrees

FUSELAGE

Width (maximum)	3 ft. 2 in.
Height (maximum)	6 ft. $\frac{1}{4}$ in.
Length	19 ft. 8 in.

b. AREAS.

Wings (less Ailerons)	303.06 sq. ft.
Wings (with Flaps extended)	369.26 sq. ft.
Ailerons (total)	25.44 sq. ft.
Flaps (total)	42.60 sq. ft.
Stabilizer (including Elevator)	78.54 sq. ft.
Elevator (including Tab)	24.55 sq. ft.
Elevator Trim Tab	1.73 sq. ft.
Fins (total)	27.42 sq. ft.
Rudders (total including Tabs)	21.36 sq. ft.
Rudder Trim Tabs (total)	2.74 sq. ft.

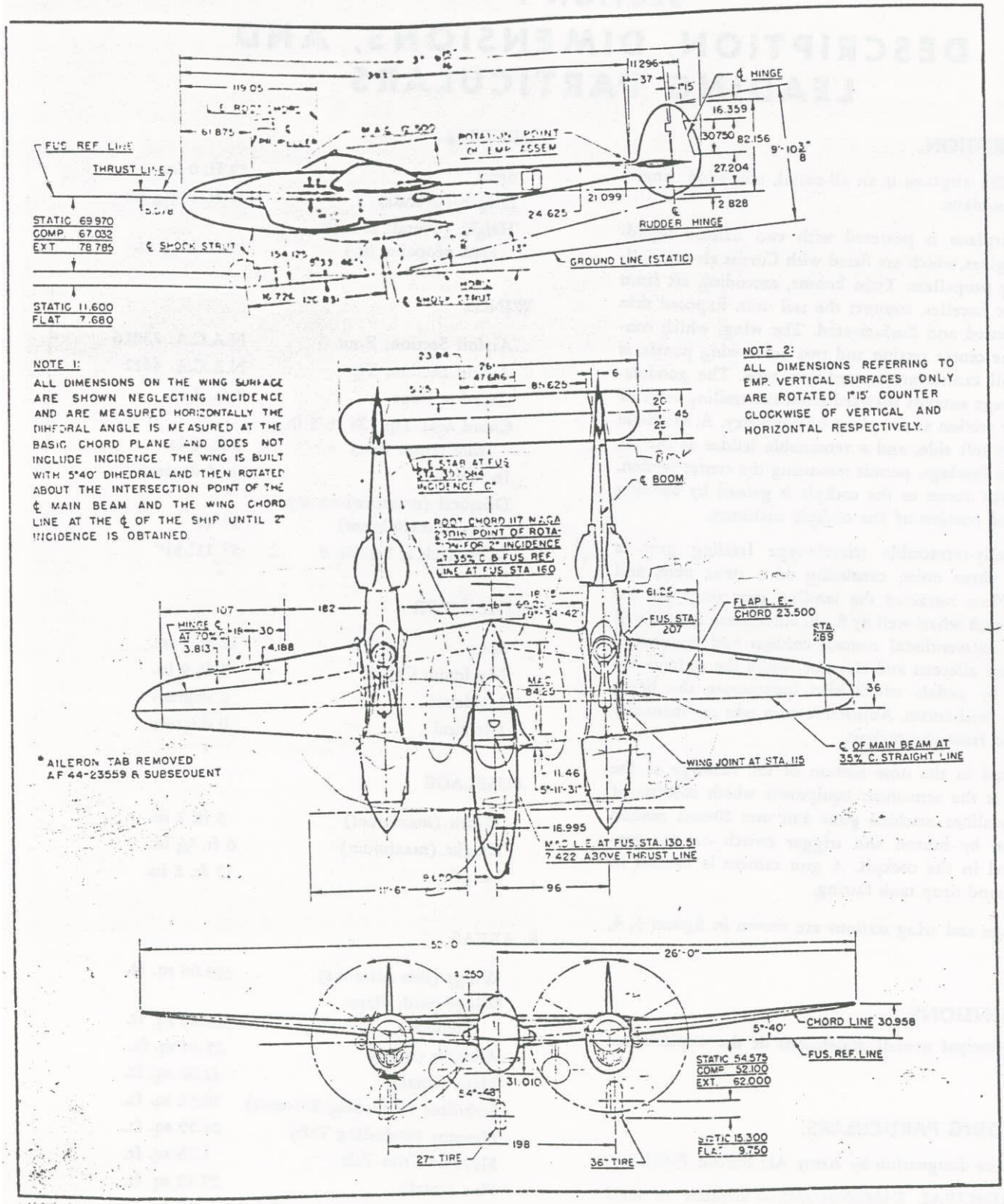
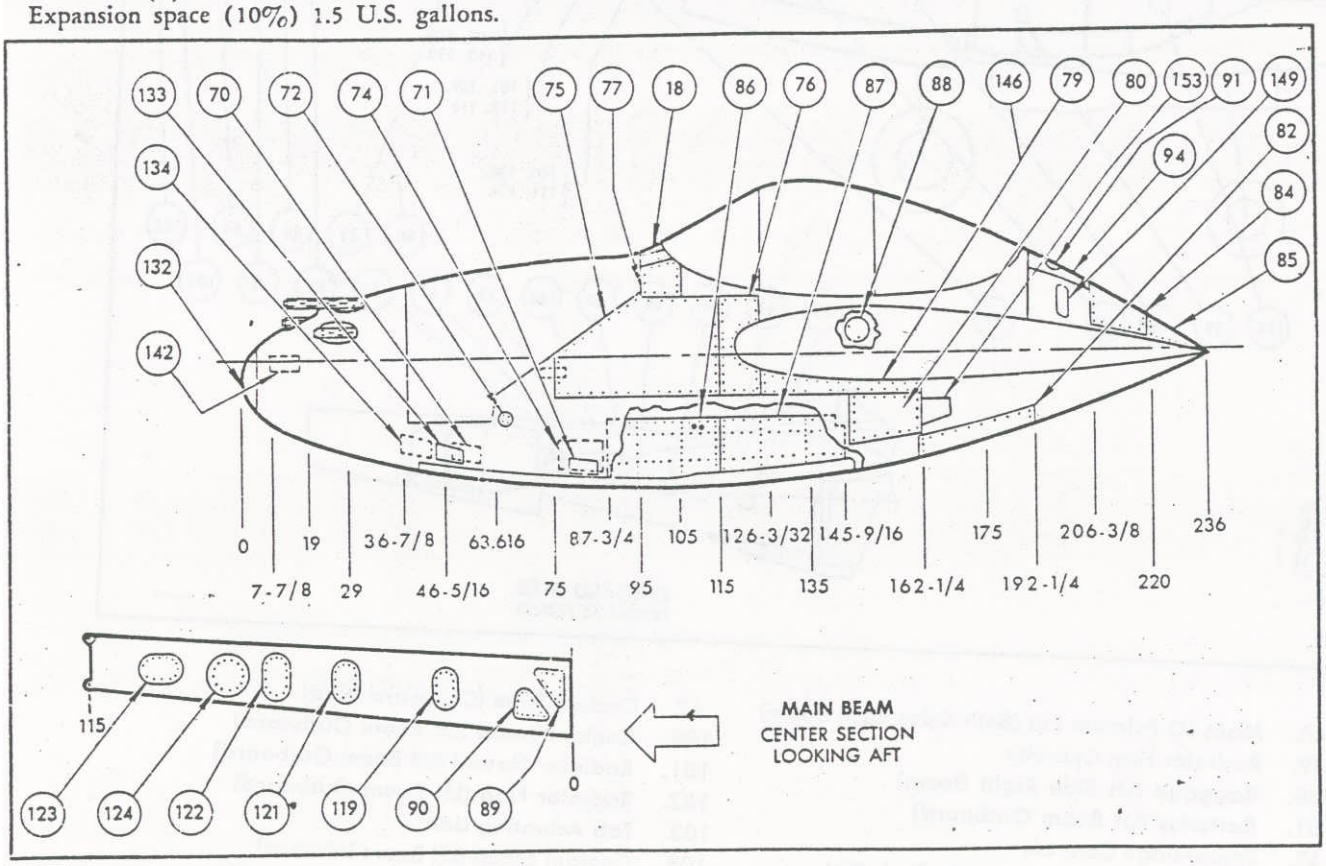


Figure 2 — General Arrangement

g. TANK CAPACITIES

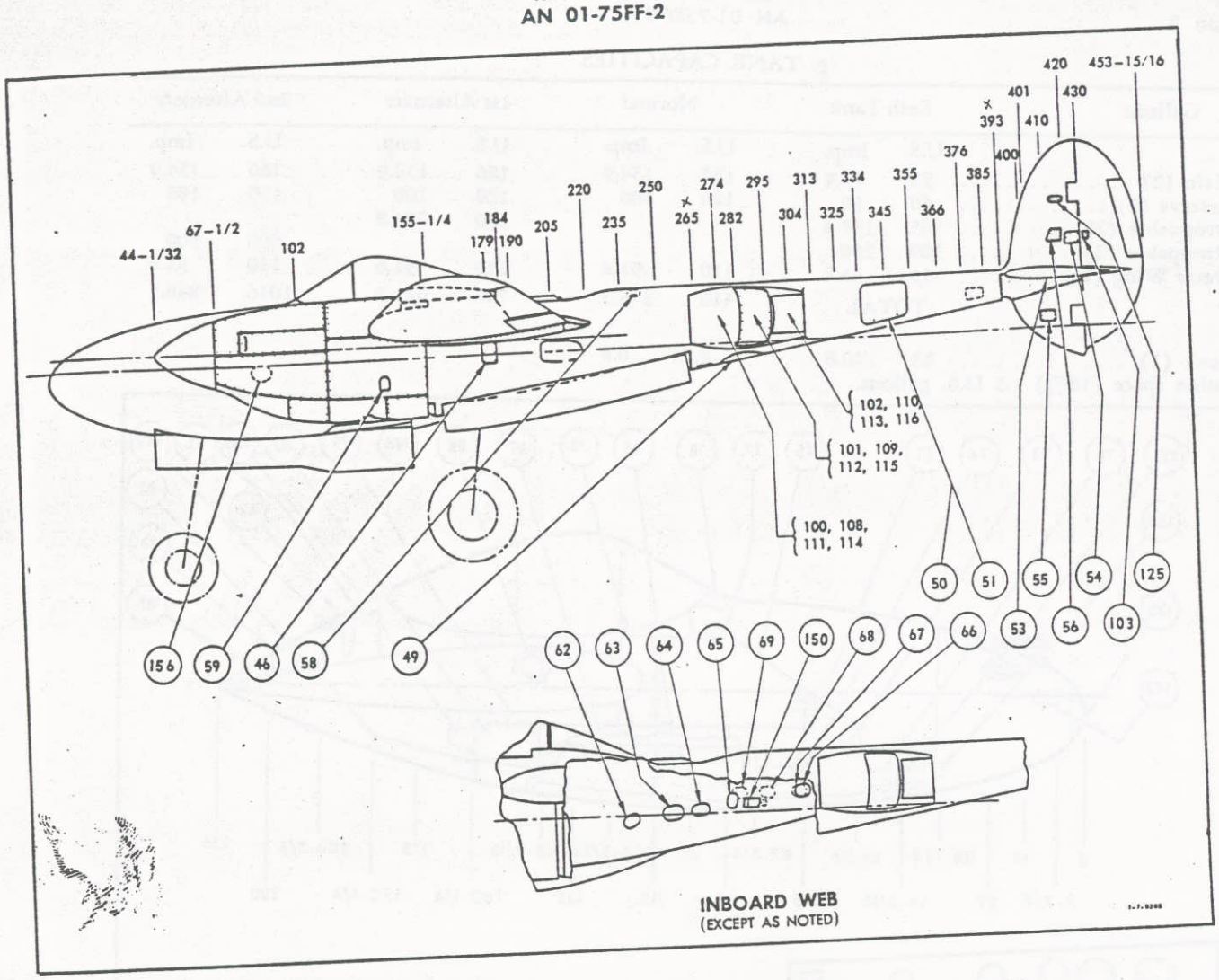
Gallons	Each Tank		Normal		1st Alternate		2nd Alternate	
FUEL	U.S.	Imp.	U.S.	Imp.	U.S.	Imp.	U.S.	Imp.
Main (2)	93	77.4	186	154.9	186	154.9	186	154.9
Reserve (2)	60	50	120	100	120	100	120	100
Droppable (2)	165	137.4			330	274.8		
Droppable (2)	300	250					600	500
Outer Wing (2)	55	45.8	110	91.6	110	91.6	110	91.6
	TOTAL		416	346.5	746	621.3	1016	846.5
OIL								
Tank (1)	13	10.8	8.25	6.8				

Expansion space (10%) 1.5 U.S. gallons.



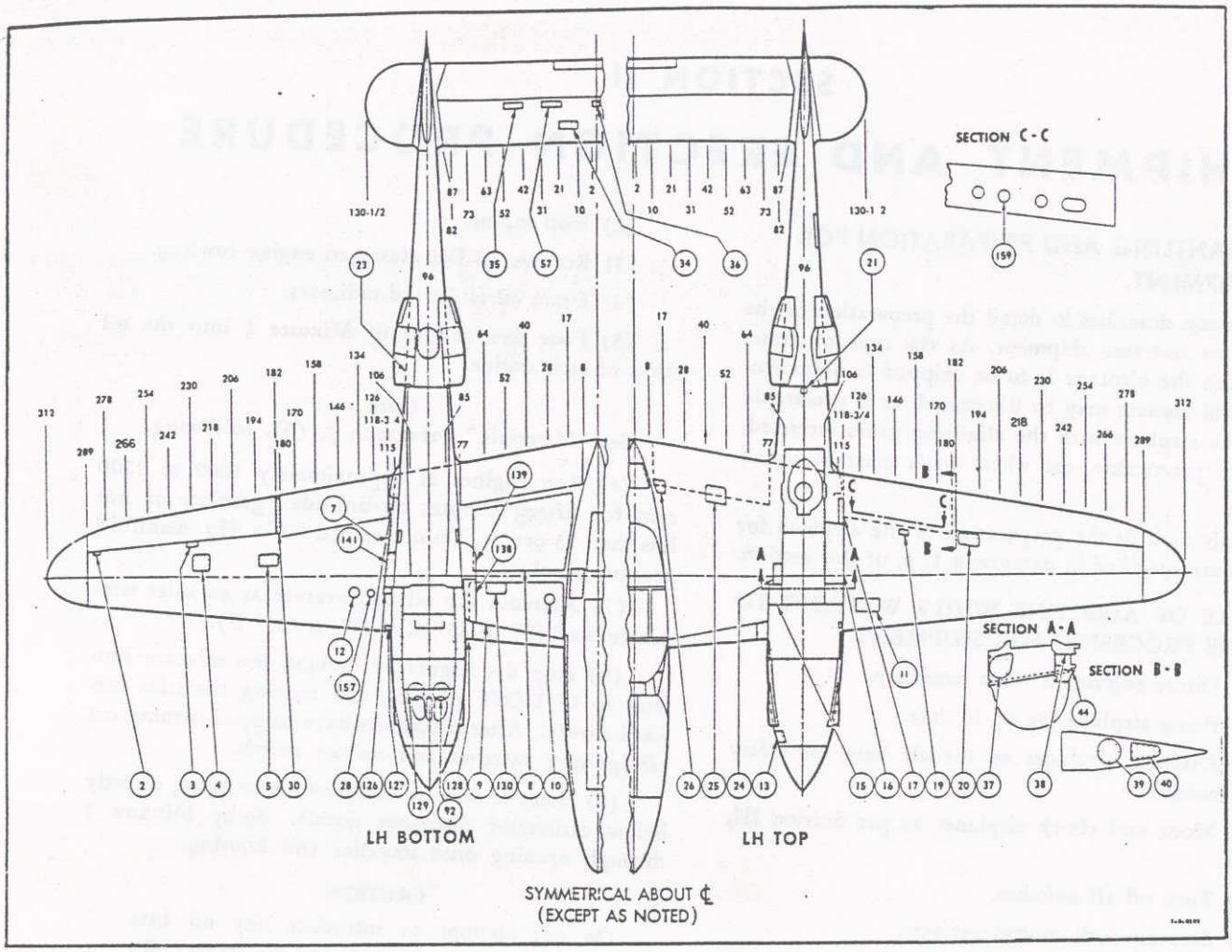
18. Instruments
70. Shell Ejection
71. Shell Ejection
72. Nose Landing Gear Fulcrum Pin
74. Shell Ejection
75. Plumbing and Electrical
76. Plumbing and Electrical
77. Instruments
79. Window Mechanism (RH Only)
80. Control Cables and Plumbing
82. Fuel Sump, Strainers and Valves
84. Flap Motor
85. Ladder Mechanism
86. Plumbing and Controls
87. Plumbing and Controls
88. Reserve Fuel Gage
89. Surface Controls
90. Surface Controls
91. Hand Hole and Hydraulic Tank Filler Well
94. Main Hydraulic Reservoir
119. Surface Control Cables
121. Surface Control Cables
122. Surface Control Cables
123. Surface Control Cables
124. Control Pulleys
132. Nose Camera Door
133. Shell Ejection
134. Shell Ejection
142. Camera Access Door
146. Window Mechanism (LH Only) and Bomb Control
149. Hand Hold Hydraulic Tank Sight Gage
153. Auxiliary Fuel Pump.

Figure 3 — Fuselage Station Locations and Removable Panels



46. Main LG Fulcrum Pin (Both Sides Each Boom)
49. Radiator Flap Cylinder
50. Baggage (LH Side Right Boom)
51. Batteries (LH Boom Outboard)
53. Empennage Controls
54. Tab Actuating Unit (LH Side Each Fin)
55. Elevator Pulleys (LH Side Each Fin)
56. Elevator Pulleys
58. Supercharger Oil
59. Starter Extension (RH Side Both Nacelles)
62. Coolant Tube
63. Coolant Tube and Empennage Surface Controls
64.
65. Coolant Tube and Tab Cable
66. Coolant Tube and Tab Cable
67. Coolant Tube (Outboard Web)
68. Coolant Tube (Outboard Web) — use NAS205-6 screws only
69. Coolant Tube (Outboard Web)
100. Coolant Scoop (LH Boom Outboard)
101. Radiator Shroud (LH Boom Outboard)
102. Radiator Flap (LH Boom Outboard)
103. Tab Actuating Unit
108. Coolant Scoop (LH Boom Inboard)
109. Radiator Shroud (LH Boom Inboard)
110. Radiator Flap (LH Boom Inboard)
111. Coolant Scoop (RH Boom Outboard)
112. Radiator Shroud (RH Boom Outboard)
113. Radiator Flap (RH Boom Outboard)
114. Coolant Scoop (RH Boom Inboard)
115. Radiator Shroud (RH Boom Inboard)
116. Radiator Flap (RH Boom Inboard)
125. Position Light (Inboard Side of Each Fin)
150. Uplock Inspection Covers (Inboard Web)
156. Ground Heater Duct

Figure 4 — Boom Station Locations and Removable Panels



2. Aileron Counter Weight
3. Aileron Push-pull Tube
4. Aileron Booster Mechanism
5. Aileron Cable
7. Wing Joint
8. Fuel Tank Inspection
9. Fuel Tank Inspection
10. Fuel Drain
11. Wing Tank Booster Pump
12. Fuel Drain
13. Coolant Filler Cap (RH Side Both Nacelles)
15. Engine Oil — use grade 1120
16. Wing Joint
17. Flap Cables
19. Flap Cables
20. Flap Cables
21. Lift Lug
23. Coolant Tube Joint
24. Lift Lug
25. Flap Cables
26. Flap Cables
28. Flap Cables
30. Flap Cables and Pulleys
34. Rudder Tab Stop
35. Elevator Tab Stop (LH Only)
36. Elevator Tab Actuating Mechanism
37. Empennage Control Cables
38. Wing Pins
39. Flap Cables
40. Flap Cables
44. Wing Pins
57. Tab Cable Turnbuckle (LH Only)
92. Oil Cooler Drain
126. Leading Edge Attachment Bolt
127. Engine Mount Bolt
128. Engine Mount Fitting and Plumbing
129. Oil Cooler Drain
130. Engine Control Cables
138. Fairing
139. Fairing
141. Fillet Junction Box
157. Fuel Pump Adjustment
159. Electric Dive Flaps

Figure 5 — Wing and Stabilizer Station Locations and Removable Panels

SECTION II

SHIPMENT AND ERECTION PROCEDURE

1. DISMANTLING AND PREPARATION FOR SHIPMENT.

This section describes in detail the preparation of the airplane for overseas shipment. As the type of vessel upon which the airplane is to be shipped is unknown, only typical layouts may be illustrated. It is preferable to ship the airplane with the alighting gears retracted, but if not practicable, the wheel wells must be sealed carefully.

Materials used in the preparation of the airplane for shipment are specified in paragraph 1, *p*, of this section.

a. CARE OF AIRPLANE WHILE WAITING TO BE PROCESSED FOR SHIPMENT.

(1) Dilute engine oil when necessary.

(2) Bring airplane log up to date.

(3) Disperse airplanes on the air base for safety and convenience.

(4) Moor and chock airplanes as per Section III, par. 2, *d*.

(5) Turn off all switches.

(6) Securely lock control surfaces.

(7) Lock cockpit hatch and windows.

(8) Cover pitot mast.

(9) Install supercharger, cockpit, and engine covers.

(10) Treat all armament for overseas shipment as soon as possible.

(11) Correct all mechanical defects.

(12) Note and fill all shortages.

(13) Pull propeller through two complete revolutions daily.

(14) After seventh day of temporary storage, run up engines on unleaded gasoline for at least fifteen minutes.

(15) Treat airplane engines and superchargers with Mixture 1 by tenth day of temporary storage.

(16) Run flaps through one cycle daily to prevent corrosion of moving parts.

b. FINAL RUN-UP PROCEDURE.

(1) Run engine until definite rise in oil temperature is noted.

(2) Stop engine.

(3) Remove all Dzus-fastened engine cowling.

(4) Drain oil tanks and radiators.

(5) Pour five gallons of Mixture 1 into the oil tanks of each engine.

Note

See "Materials," paragraph *p*, (6), following.

(6) Run engines at approximately 1000 to 1200 rpm for fifteen minutes on unleaded gasoline of not less than 73 octane. Do not exceed 20 in. Hg. manifold pressure absolute.

(7) Maintain the oil temperature at an inlet temperature of 65° to 85° C (149° to 185° F).

(8) Stop the engine by moving the mixture controls to CUT-OFF position and moving throttles forward slowly. After propellers have stopped turning cut off ignition switches and master switch.

(9) Remove mixture temperature test plug directly below carburetor discharge nozzle. Spray Mixture 1 through opening onto impeller and housing.

CAUTION

Do not attempt to introduce any oil into induction system through the air stacks. Oil admitted in this manner will enter the carburetor air chambers causing damage to the carburetor diaphragms and affect its metering characteristics.

(10) Remove cowl formers on top of engines to permit removal of cylinder head covers.

(11) Remove cylinder head covers and spark plugs.

CAUTION

Remove the cylinder-head-covers and spark plugs within twenty minutes after the engines are stopped to prevent condensation of vapors within the engine.

(12) Remove oil drain plugs from the rear of the oil pan.

(13) Remove panel 82. (See figure 3.) Open fuel strainers to drain system completely. Operate electric booster pumps.

(14) Drain Mixture 1 from four oil radiators.

(15) Drain Mixture 1 from oil tanks.

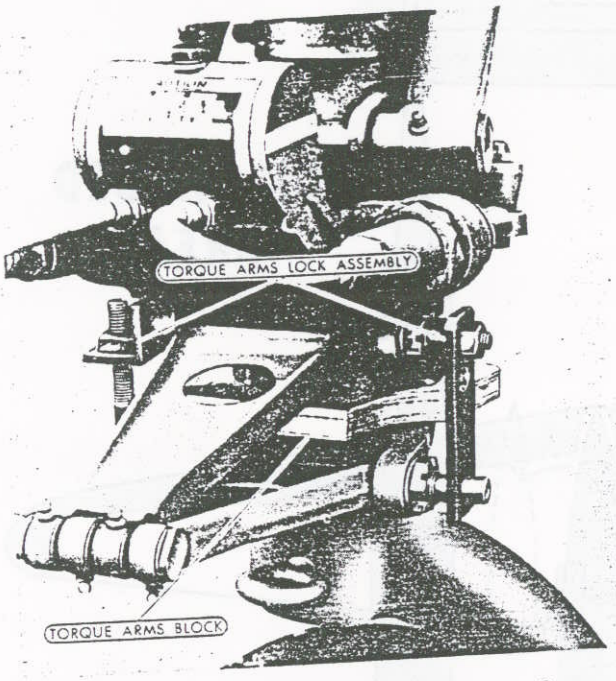


Figure 15 — Torque Arms Lock, Nose Gear

(3) Remove main gear and nose gear fulcrum nuts and install shipping fittings and eye bolts for lashing purposes. (See figures 18 and 19.)

(4) Fair in nose gear and main gear wheel wells with plywood to exclude the entrance of moisture.

(5) When airplane is in stowage position on flight deck, jack airplane by placing a heavy steel bar, approximately seven ft. long, and strong enough to support 6900 lb. at center point under axle, as close to the wheel as possible, and use a jack at each end of this bar.

(6) Place shipping stand under axle and lower airplane. This stand is to be constructed of steel and is to be high enough so that the tire clears the deck by at least one inch. Insert a piece of jute saturated with AN-C-52, type 1, between the stand and the axle. (See figure 20.)

(7) Install axle lock "F" (figure 20).

(8) Secure landing gear shipping stands to the deck.

(9) Bolt a piece of angle iron, with holes drilled in it at intervals of 12 inches to both main gear stands, fore and aft, and secure to flight deck.

(10) Place wheel chocks fore and aft of wheels and secure to shipping stands.

(11) Brush portion of landing gears, extending below wheel wells with a protective coating of AN-C-52, type 2, grade A.

(12) Enclose landing gears, including wheels, in a canvas sack which extends up inside of wheel wells at least 4 in. Brush these sacks with AN-C-52, type 1 to further waterproof them.

(13) Lash airplanes from fulcrum eye bolts to lashing rings on deck. Make lashing rod tight.

Note

This type of shipment is recommended only when the flight deck is at least 25 ft. above the water line.

Coat all shipping irons with AN-C-52, type 2, grade A, where they come into direct contact with the airplane.

See drawing of landing gear shipping stand for instructions on unloading airplane from stand. (See figure 20.)

p. MATERIALS USED IN THE PREPARATION OF AIRCRAFT FOR EXPORT; SPECIFICATIONS THEY MUST MEET; AND WHERE THEY CAN BE PROCURED.

(1) Three and one-half inch webbing in rolls. This comes 72 yards to the roll and can be purchased at almost any industrial center.

(2) Shredded paper for packing small parts in boxes.

(3) Thirty-five pounds smooth roofing paper for roofing wing boxes. These boxes are boarded tight and lined with 20-20-20 car lining paper.

(4) A quantity of water-proof tape, industrial tape in various sizes. Tape must conform to Specification AN-T-12.

(5) Corrosion preventive compound. (External engine spray.)

SPECIFICATIONS

Grade 1120 aviation lubricating oil conforming to Specification AN-VV-O-446	98.0%
Triethanolimine	.5%
Triethanolimine Oleate	1.5%

Note

The commercial designation of this material is: General Petroleum Corp. of California, GPD 308; Black Bear Co., Inc., New York, DB No. 8.

(6) Corrosion-preventive compound (Internal engine spray) must conform to Specification AN-VV-C-576. Commercial designations: Standard Oil Co. of New Jersey, AE 606; Black Bear Co., Inc., DB No. 11, or equivalent.

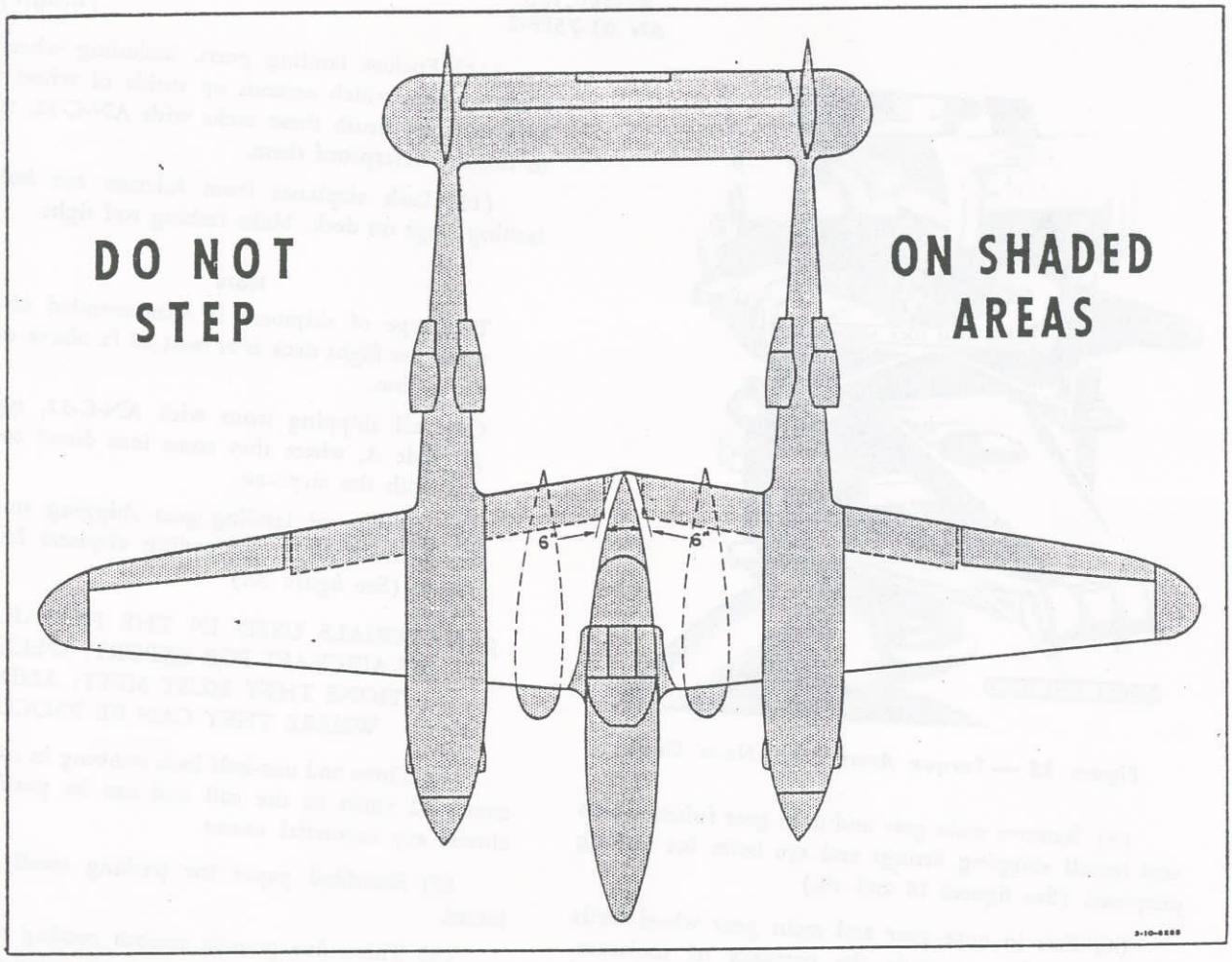


Figure 32 — No Step Diagram

Note

Avoid the use of the carburetor air filters in clear air, as they reduce the critical altitude and range of the airplane.

(k) Place the bomb selector switches "ON" and the arming switch to "SAFE" so that tanks or bombs may be dropped quickly in the event of engine failure at take-off.

(l) Push the propeller circuit breakers.

(m) Wind and set the clock.

(n) Place the generator switch "ON."

(o) Place the battery switch "ON" (the battery switch should be "OFF" when using battery cart or external power).

CAUTION

Before each flight the battery must be checked to determine its state of charge. Care must be taken during engine warm-up and flight to conserve battery energy by using only such electrical equipment as is absolutely necessary.

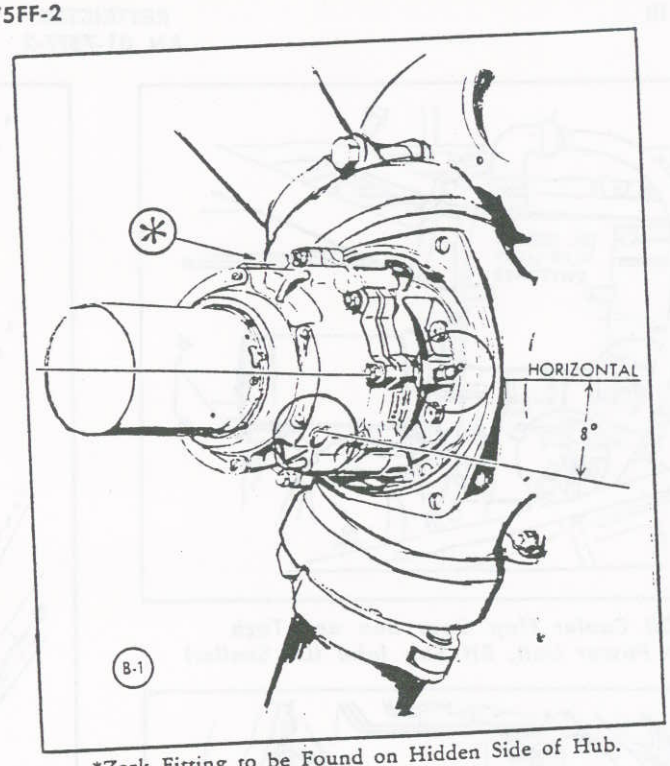
(p) Place the compass switch "ON."

(q) Check the operation of the tank selector valves; when the selector valve is set to "OUTER WING ON," observe the fuel pressure which should register 15-16 lb/sq in., thereby giving a functional check of the outer wing fuel booster pump. Place the selector valves on "RESERVE." (Use RESERVE tanks for the first 15 minutes to allow space in the reserve tanks for the vapor return from the carburetors; then switch to drop tank.)

(r) Check the operation of the dive recovery flaps.

(s) Check the prop switches for operation in the following order: "FEATHER," "DECREASE," and "INCREASE" (only when using external power), and return to "AUTOMATIC."

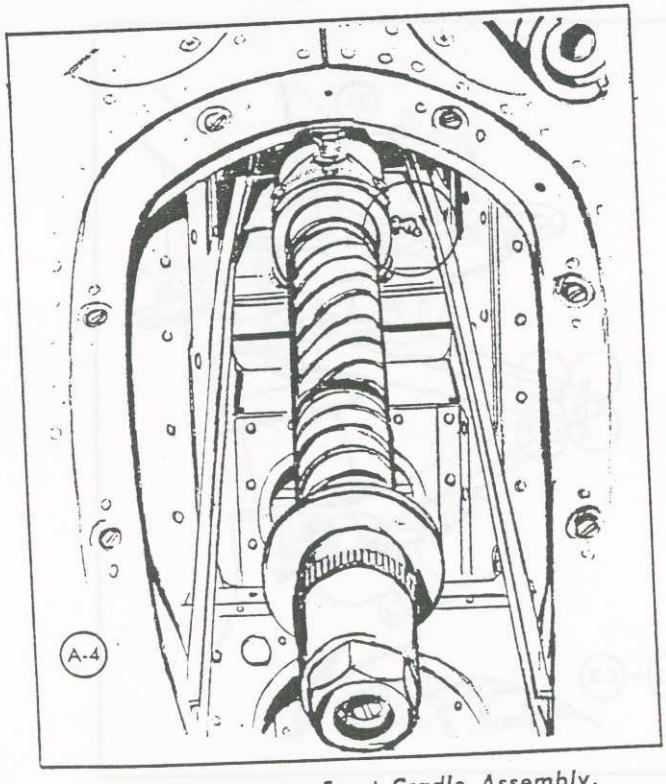
Emergency Hydraulic Hand Pump, RH Cockpit Floor



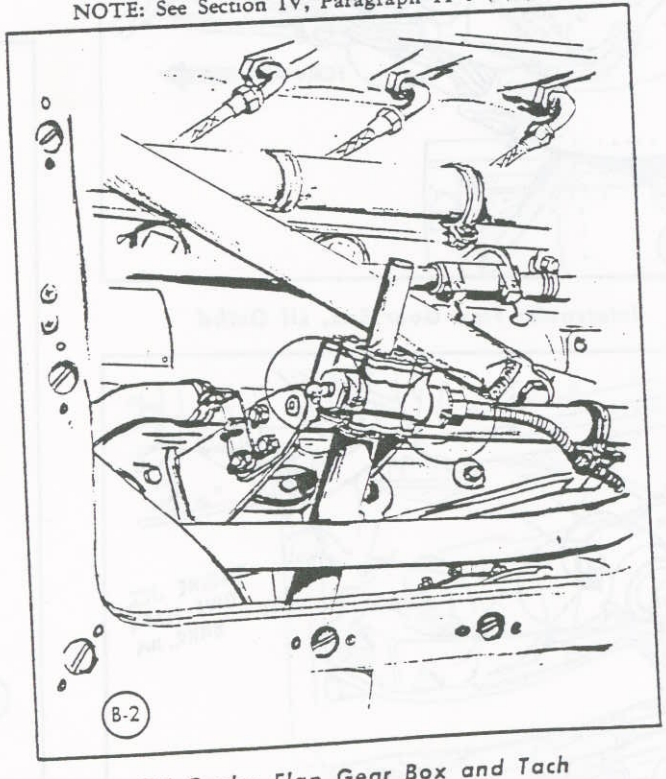
*Zerk Fitting to be Found on Hidden Side of Hub.

Propeller

Lubricant Required:
Hub — Spec. AN-G-4
Speed Reducer — Spec. AN-O-4
NOTE: See Section IV, Paragraph 11 *e* (4) *(b)*.

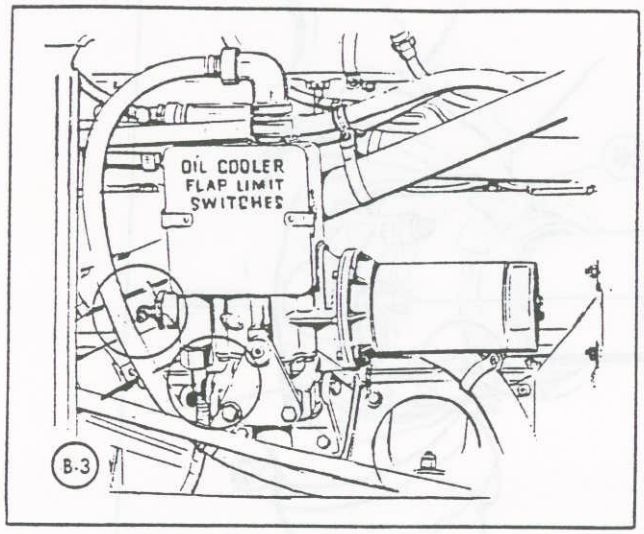


20 MM. Cannon Front Cradle Assembly, Nose Fuselage

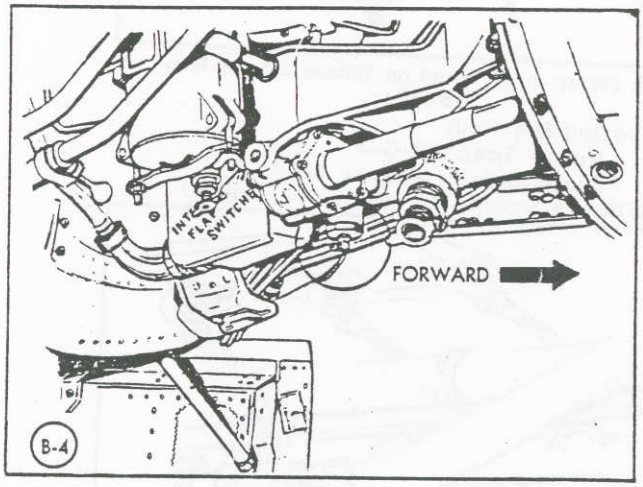


Oil Cooler Flap Gear Box and Tach Shaft Driven Unit, RH Engine Outboard (LH Similar)

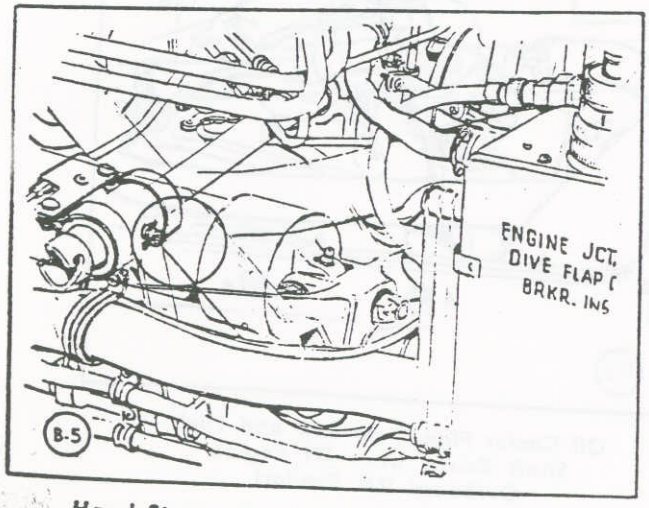
Figure 33 (Sheet 2 of 6 Sheets) — Lubrication Diagram



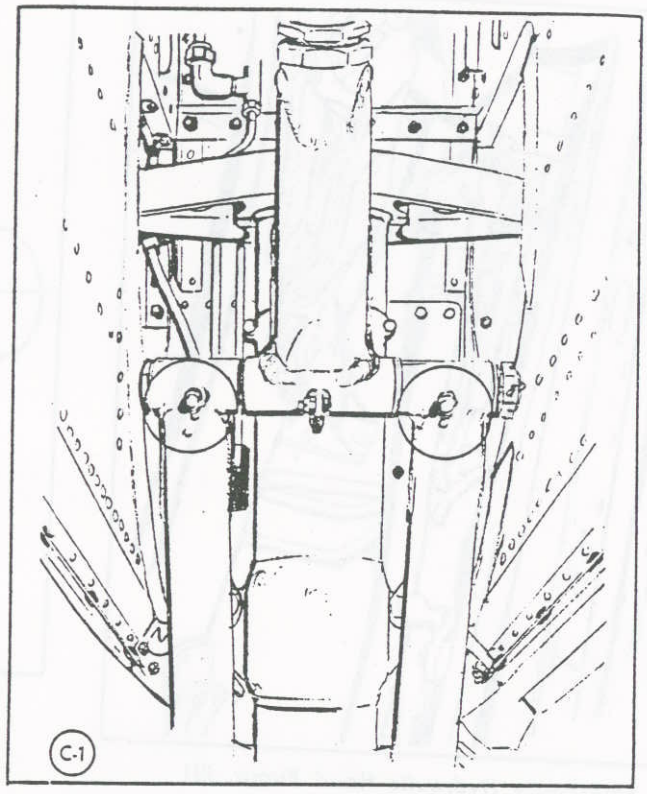
Oil Cooler Flap Gear Box and Tach Shaft Power Unit, RH Eng Inbd (LH Similar)



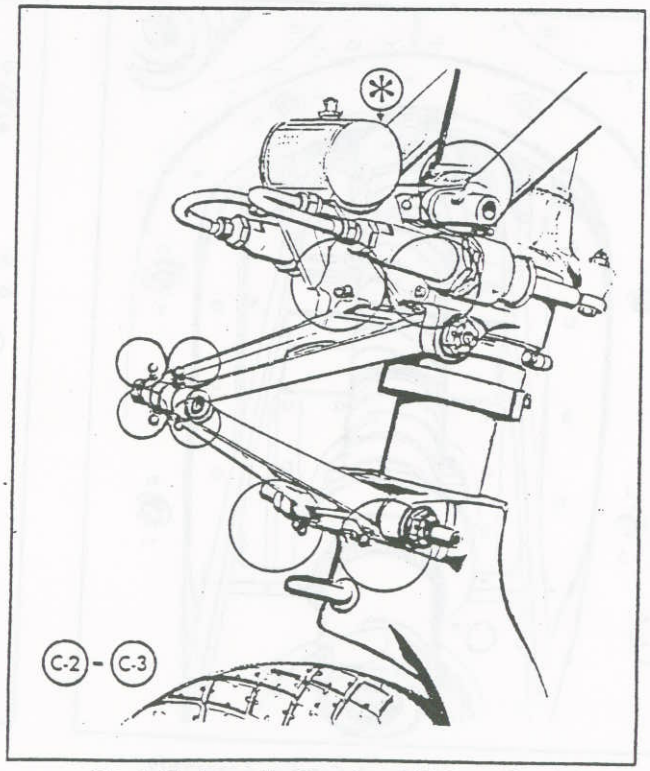
Intercooler Flap Gear Box, LH Outbd



Hand Starter Crank Bearings, LH Inboard



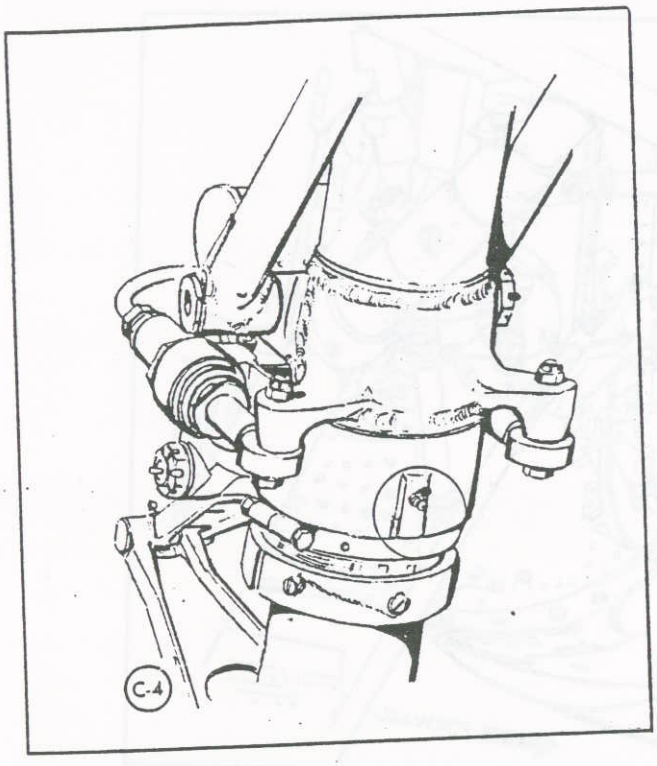
Drag Strut Pivots, Nose Wheel Well



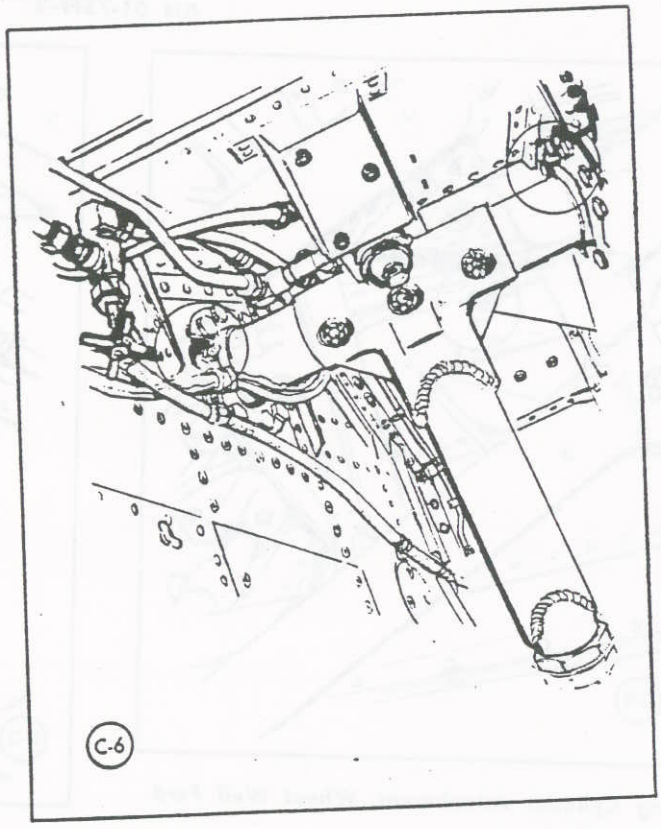
* Zerk Fitting to be Found on RH Drag Strut

Drag Strut Torque Arms

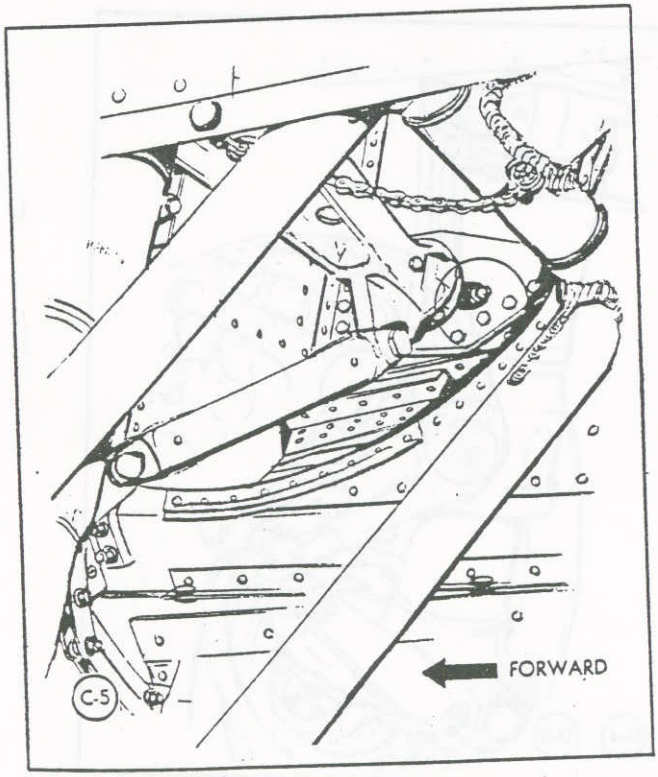
Figure 33 (Sheet 3 of 6 Sheets) — Lubrication Diagram



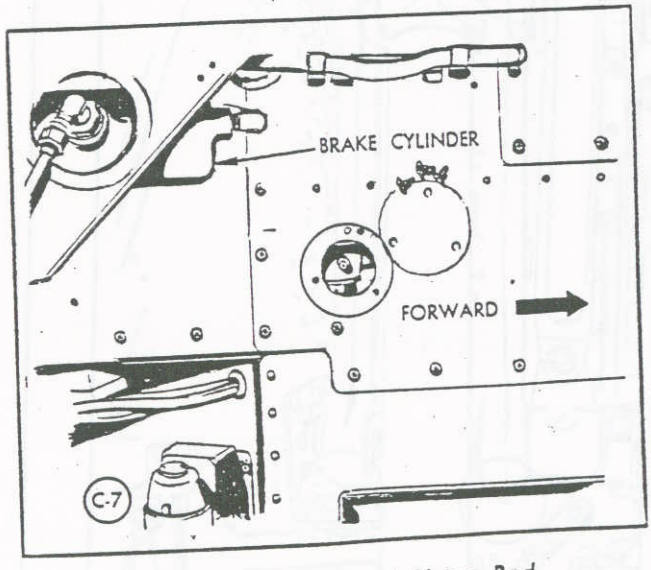
Shimmy Damper Bracket



Torque Arm Lever Bearings, Wheel Well

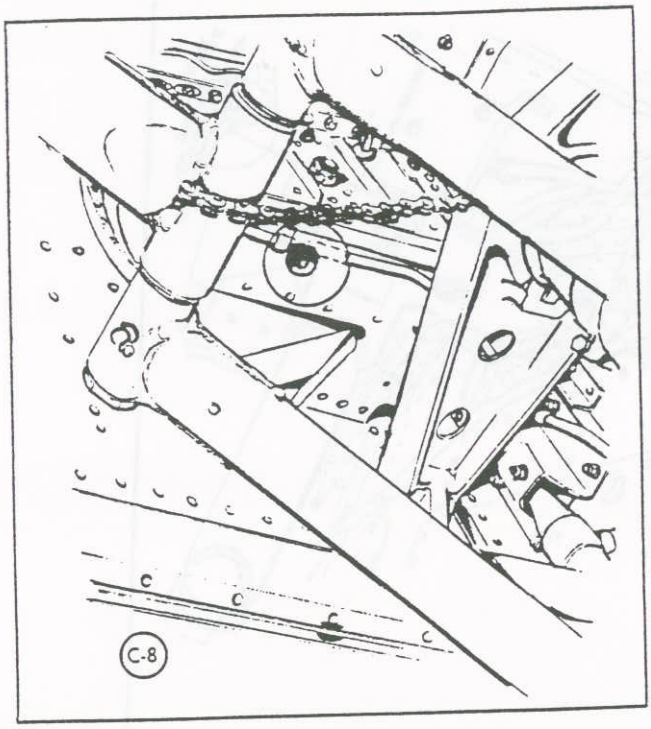


Landing Gear Fulcrum, RH Side Wheel Well

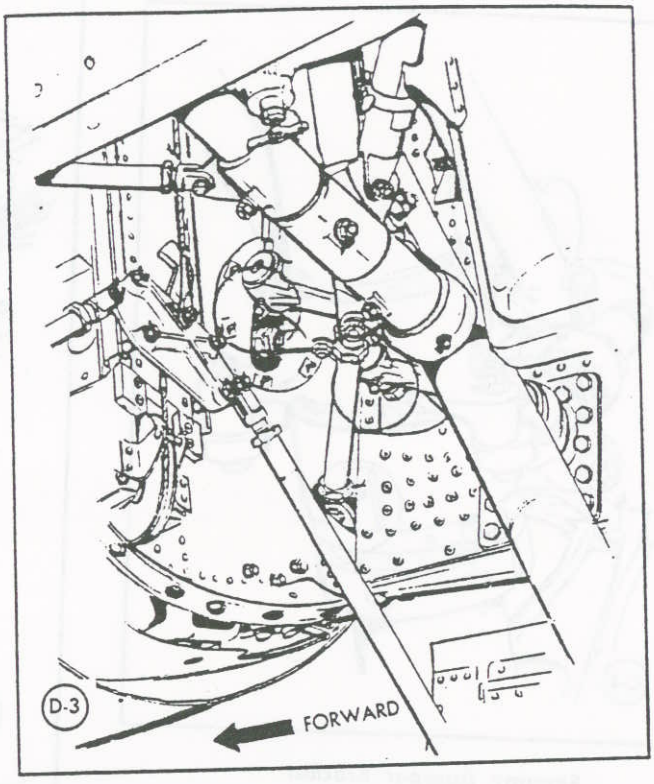


Torque Arm Lever and Piston Rod,
LH Floor of Armament Compartment

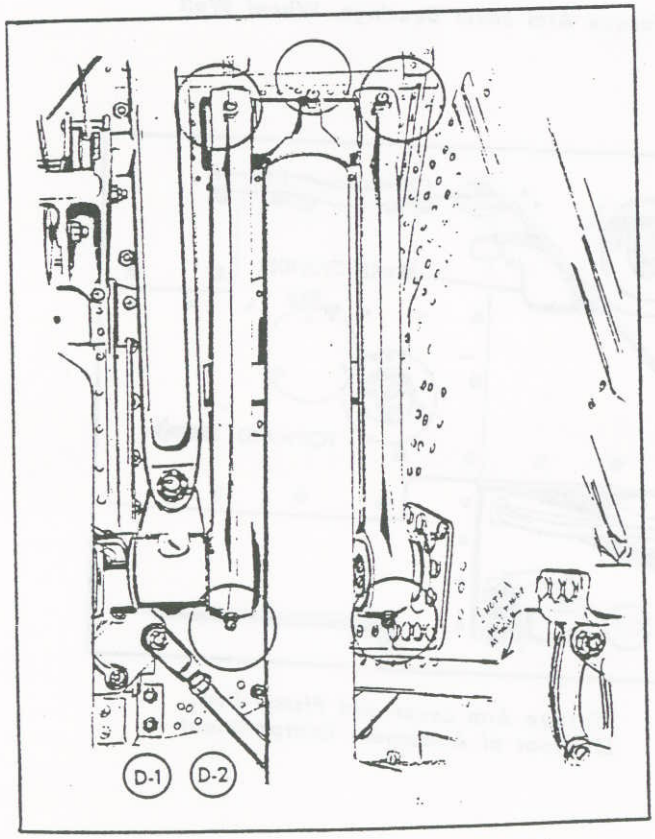
Figure 33 (Sheet 4 of 6 Sheets) — Lubrication Diagram



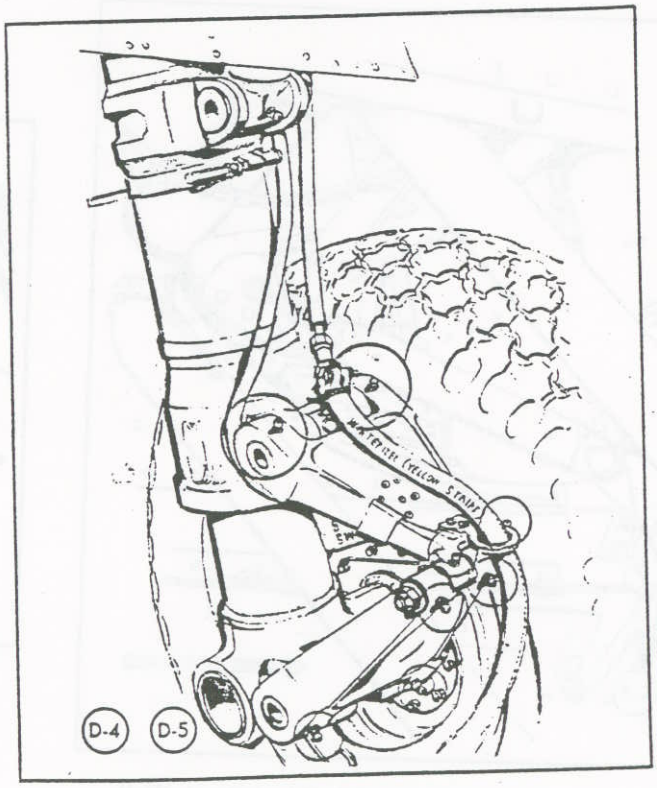
Actuating Cylinder Attachment, Wheel Well Fwd



Drag Link and Piston Rod, Wheel Well Fwd

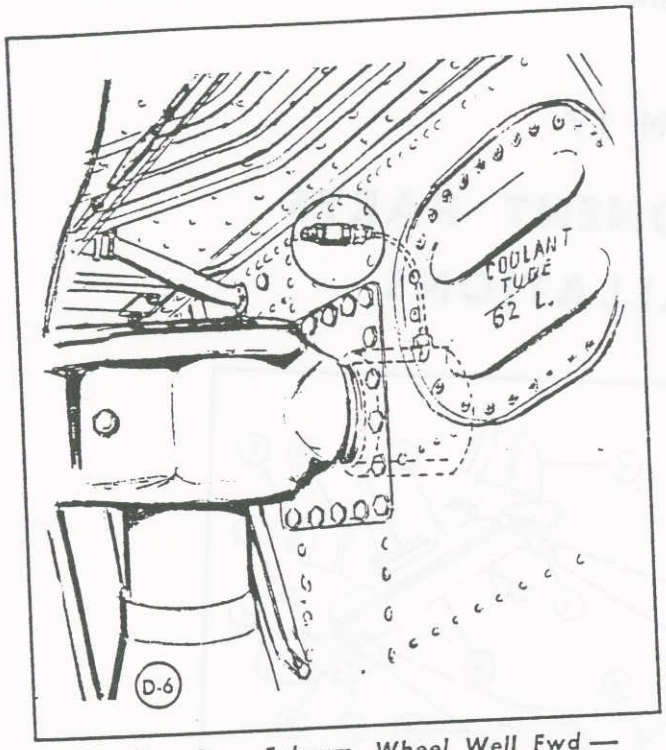


Drag Link, Drag Strut, and Drag Link Pivot — Wheel Well Fwd

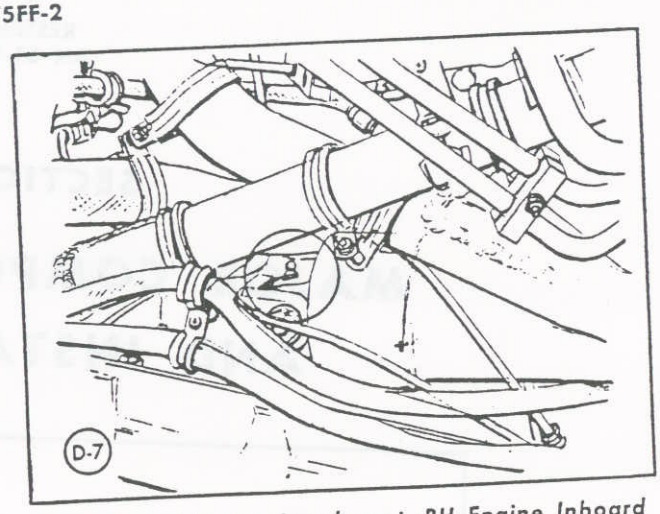


Drag Strut Torque Arms

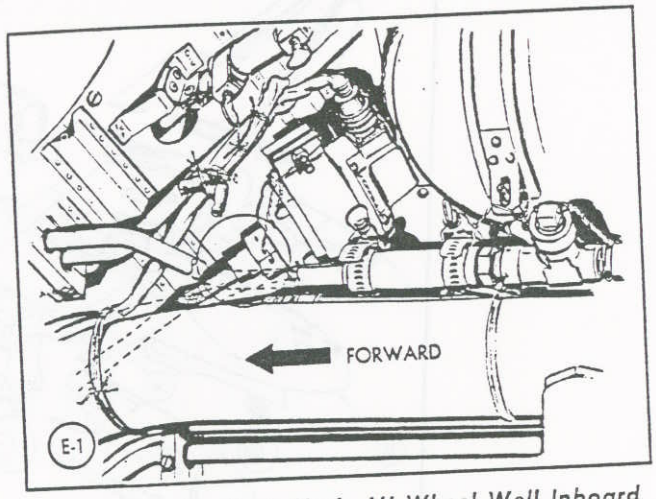
Figure 33 (Sheet 5 of 6 Sheets) — Lubrication Diagram



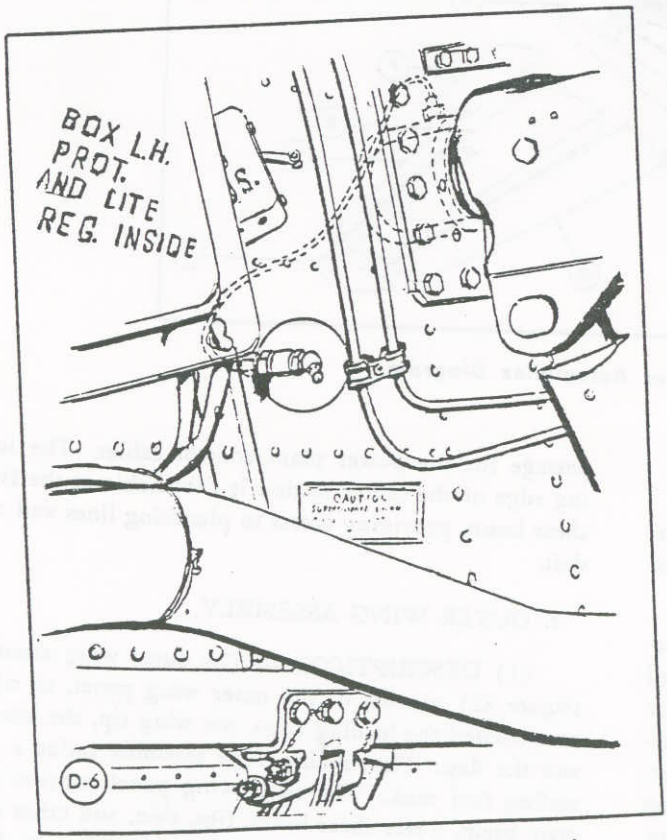
Landing Gear Fulcrum, Wheel Well Fwd — LH Inbd (RH Similar)



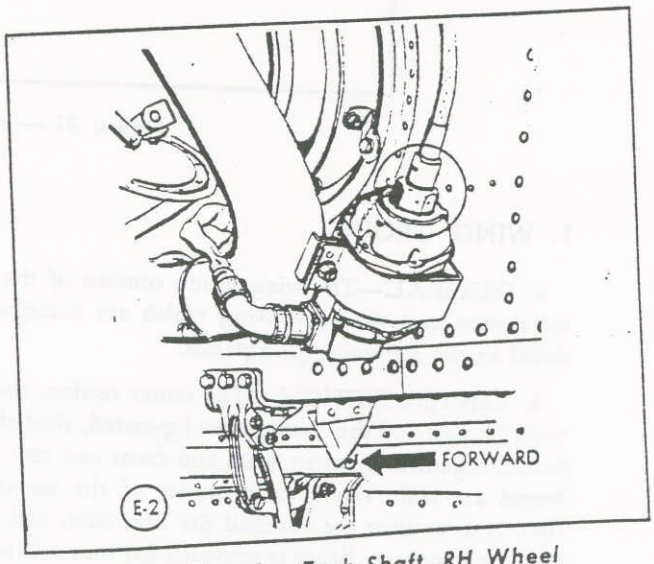
Actuating Cylinder Attachment, RH Engine Inboard



Turbo Warning Tach Shaft, LH Wheel Well Inboard



Landing Gear Fulcrum, Wheel Well Fwd — LH Outbd (RH Similar)



Turbo Warning Tach Shaft, RH Wheel Well Outboard

Figure 33 (Sheet 6 of 6 Sheets) — Lubrication Diagram

SECTION IV

MAJOR COMPONENT PARTS AND INSTALLATIONS

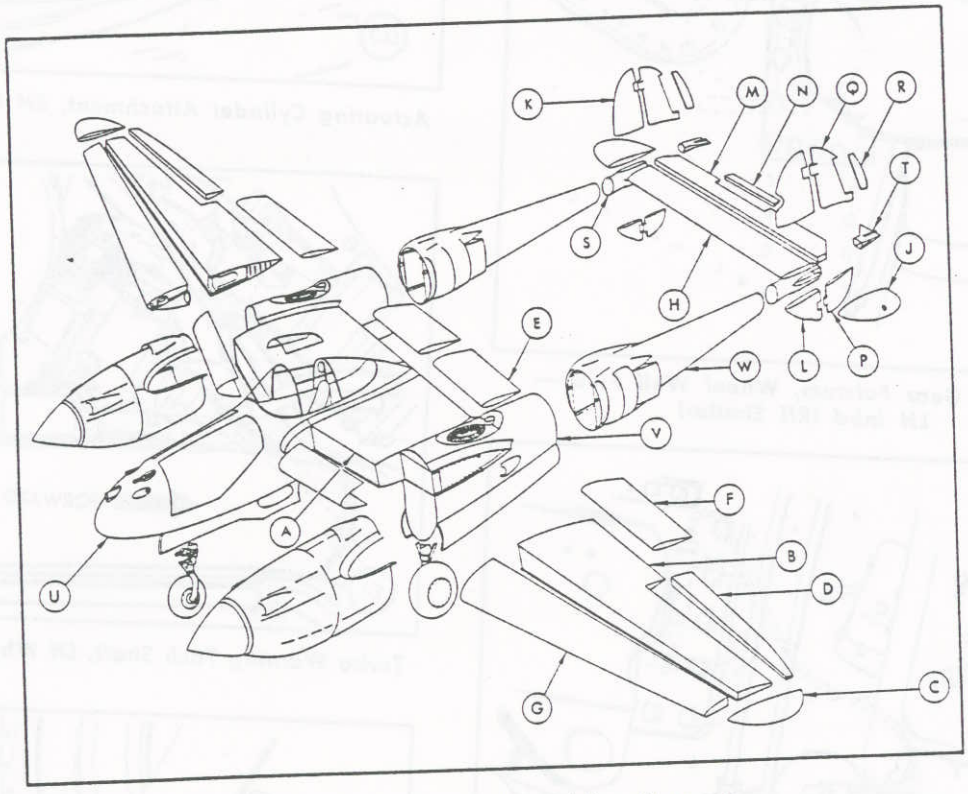


Figure 41 — Major Assemblies Diagram

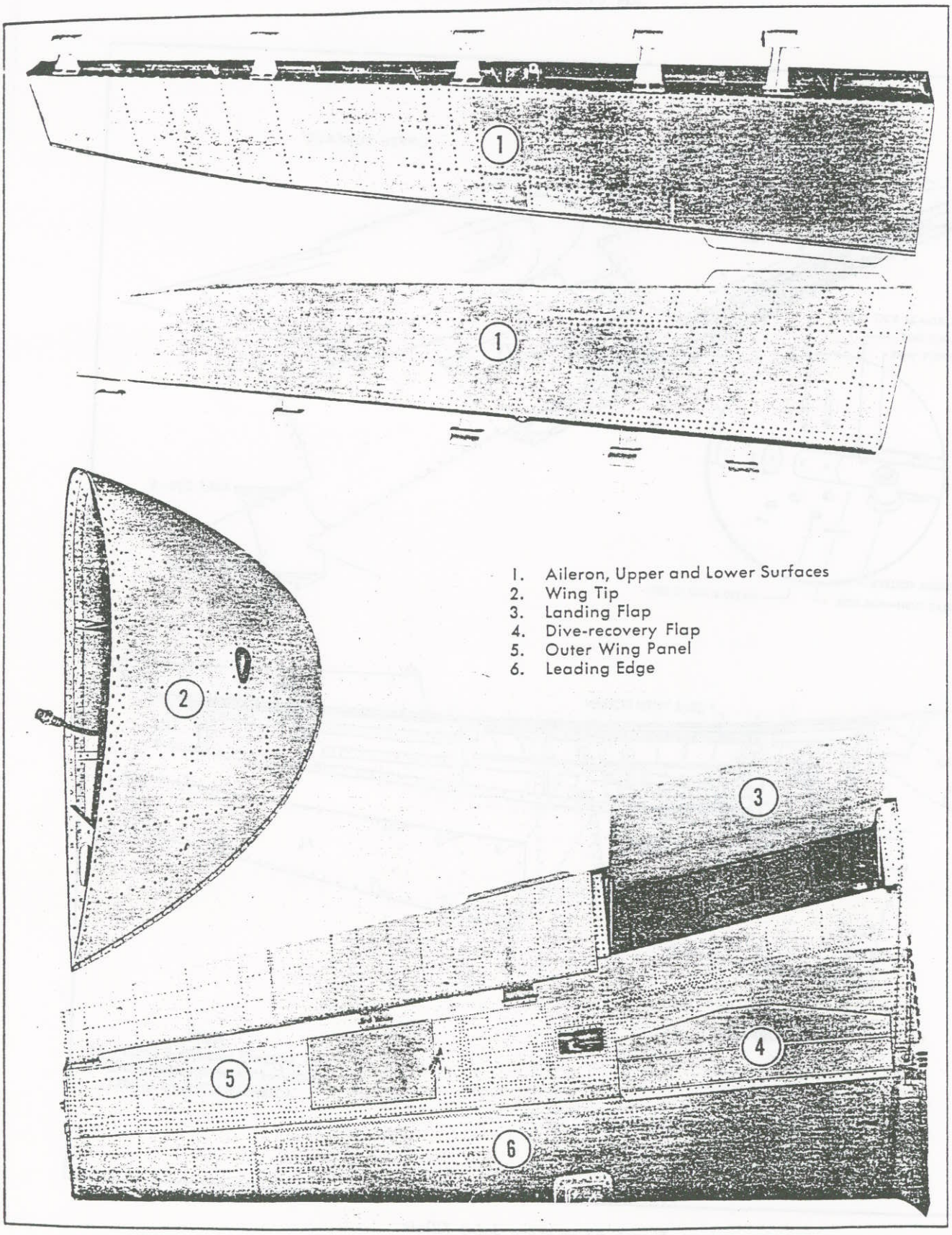
1. WING GROUP.

a. GENERAL.—The wing group consists of the center section and the outer wing which are described in detail in the following paragraphs.

b. CENTER SECTION.—The center section, the forward booms, and the fuselage are jig-mated, riveted, and bolted together. A main beam and front and rear shear beams are main structural members of the center section, and to them are attached the ribs, skin, and intermediate structure. Space is provided for four self-sealing fuel tanks. The center section supports the fuselage, engine nacelle, boom attachments, and two flaps. The surface control cables and trim tab cables are carried outboard from the fuselage inside the main beam. A tube in each forward fuel tank compartment provides passage for the power plant control cables. The leading edge of the center section is detachable at the front shear beam, providing access to plumbing lines and conduit.

c. OUTER WING ASSEMBLY.

(1) DESCRIPTION. — The outer wing assembly (figure 42) consists of the outer wing panel, to which are attached the leading edge, the wing tip, the aileron, and the flap. The leading edge assembly holds a self-sealing fuel tank. The outer wing panel consists of a main beam, a rear shear beam, ribs, skin, and other components. The major components are described in detail in the paragraphs headed, respectively, by their names. The complete outer wing assembly weighs approximately 630 pounds.



1. Aileron, Upper and Lower Surfaces
2. Wing Tip
3. Landing Flap
4. Dive-recovery Flap
5. Outer Wing Panel
6. Leading Edge

Figure 42 — Outer Wing Components

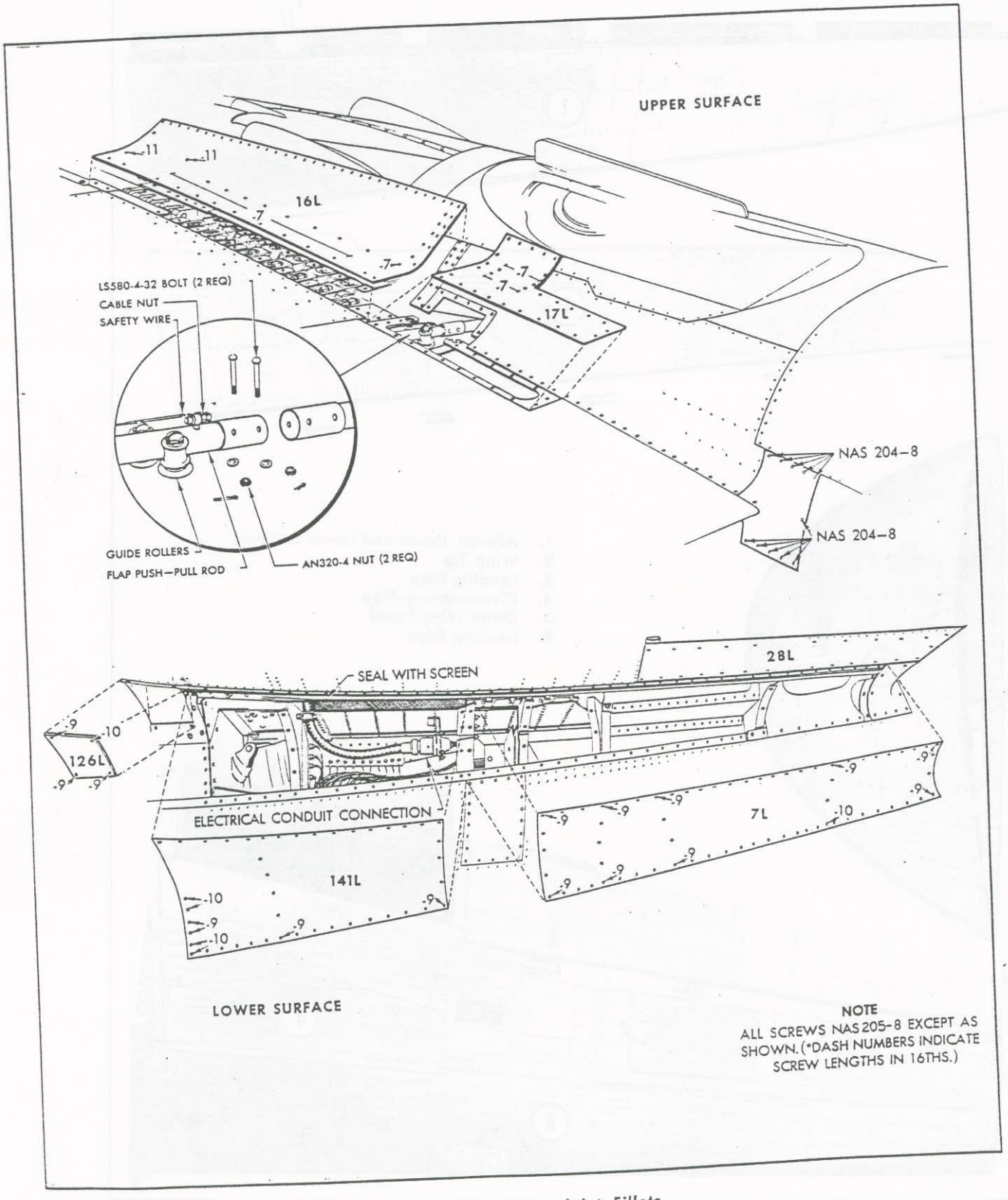
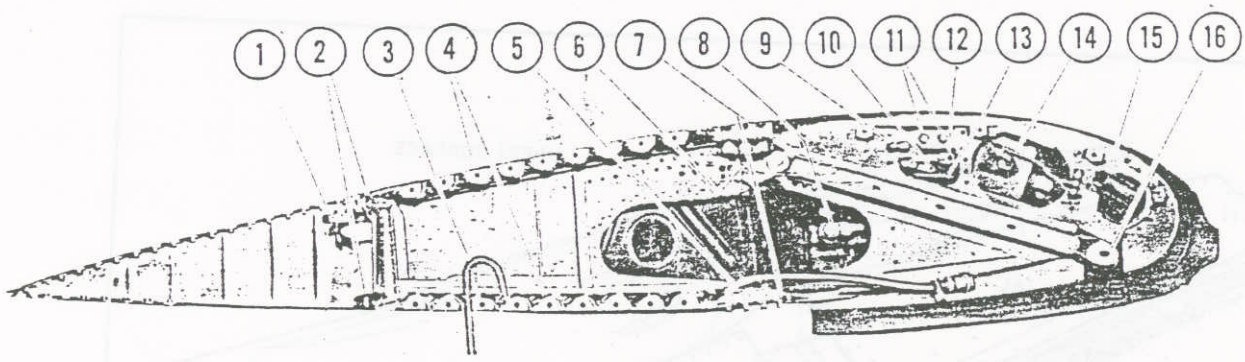
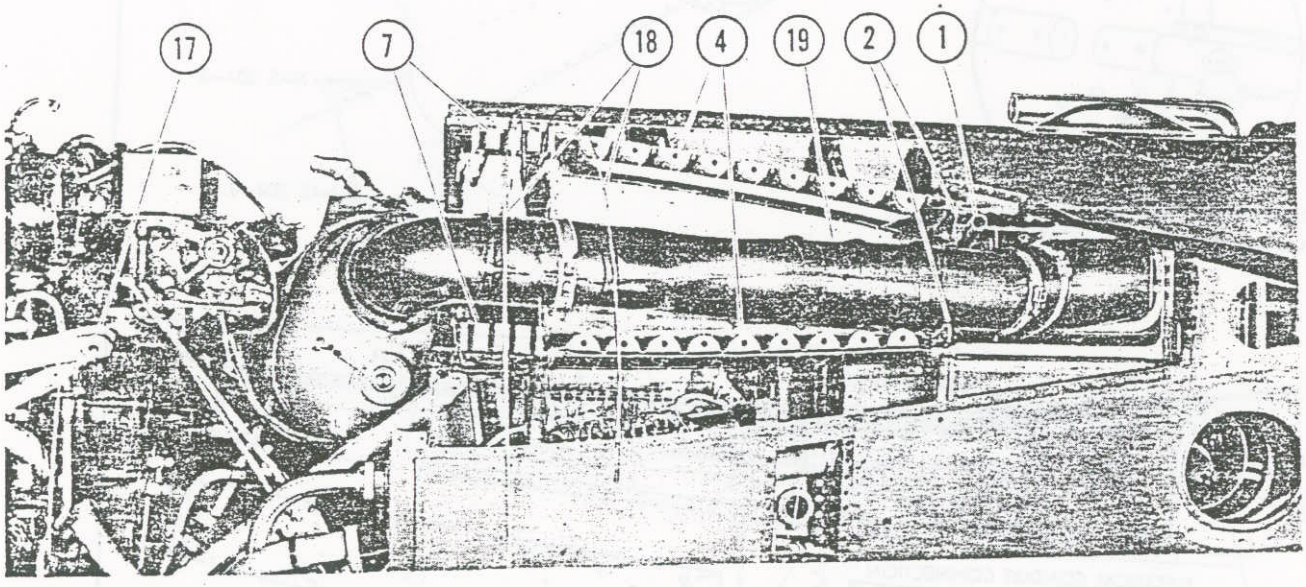


Figure 43 — Wing Joint Fillets



A. OUTER WING



B. CENTER SECTION

1. Flap-drive Tube
2. Shear-beam Attaching Arms
3. Electrical Conduit, Aft
4. Bathtub Fittings
5. Electrical Conduit, Forward
6. Fish Cord Lead-ins for Aileron Cables
7. Main-beam Fittings
8. Fuel-booster Pump
9. Vent Line
10. Pitot-static Lines
11. Aileron-booster Hydraulic Lines
12. Fuel Line
13. Balance Line
14. Solenoid Valve
15. Generator Blast Tube
16. Wing-engine-mount Lug
17. Engine-mount-diagonal Fitting
18. Aileron Cables
19. Turbosupercharger Duct

Figure 44 — Wing Joint, Outer Wing to Center Section

(2) REMOVAL.

(a) Remove engine cowl panels (figure 4) and wing joint fillets adjacent to the wing joint (figures 5 and 43). Remove wing inspection panels.

(b) Disconnect generator blast-tube (left wing) or accessories blast tube (right wing) at hose connection near leading edge "15" (figure 44).

(c) On the left wing only, disconnect pitot-static tubes "10" at the inboard rib of leading edge. Cap all ends.

(d) Disconnect aileron-booster hydraulic-lines "11" at wing joint. Cap ends.

(e) Disconnect outer-wing-tank fuel-line "12." Cap ends.

(f) Disconnect fuel-pump balance-line "13" and fuel-tank vent-line "9." Cap all ends.

(g) Disconnect electrical plugs "3" and "5."

(h) Disconnect aileron cables through handhole "5" (figure 5). Secure outboard cables near handhole with tape. Attach fish cords to inboard cables to provide lead-ins for cable replacement. Secure loose ends at handhole.

(i) Using the hydraulic hand pump, extend the flaps until the flap push-pull tube joint is visible through the opening near outboard side of supercharger (figure 43). Disconnect the outboard and inboard tubes by removing the bolts at the joint. Retract the center section flaps with the hand pump and push outer panel flaps into the wing by hand.

(j) Support the engine with an engine sling (figure 104) or with jacks. Remove bolt "2" (figure 48) through outboard engine-mount diagonal. Remove engine support.

CAUTION

Engine must not be started when diagonal is unfastened.

(k) Support the wing with slings, wooden horses (figures 26 and 45), or employ approximately 10 men for the purpose.

(l) Remove mating screws from upper and lower surfaces of wing aft of rear shear beam.

(m) Remove Allen bolts from bathtub fittings (figure 47). Start on bottom side.

(n) Remove attaching bolts from rear shear beam "2" (figure 44).

(o) Remove lower, then upper, main beam pins (figure 47). After removing safety clip, extract pins with pin puller No. S-10301 and a slide hammer.

(p) Move wing outboard until flap tube is clear of center section. Withdraw aileron cables from outer wing; disconnect fish cords, and attach to fair-lead on inner rib at outboard leading edge. Cover blast tube with masking tape.

(3) INSTALLATION OF OUTER WING ASSEMBLY TO CENTER SECTION.

(a) PREPARATION OF WING ASSEMBLY.

1. Thoroughly clean wing and center section by blowing out with air.

2. Lubricate aileron-booster hydraulic-line and fuel-line unions at wing joint with anti-seize compound, Specification AN-C-53.

3. Remove masking tape from leading-edge blast-tube and install AN884-12-12 hose.

4. String fish cords through rib cut-outs outboard to handhole "5" (figure 5). Tie outboard ends to outer panel cables at handhole "5" and tape inboard ends at inboard rib fair-lead "6" (figure 44).

5. Use 10 men to remove wing from cradle. Shake wing up and down at each end to check for presence of foreign matter inside wing. Remove all foreign matter before installing wing.

6. Place wing on adjustable rack (figure 45), or, if rack is not available, use 10 men to raise wing to proper height and angle of center section.

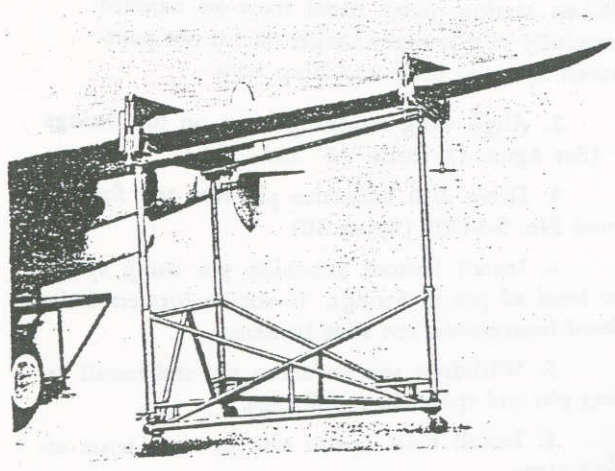
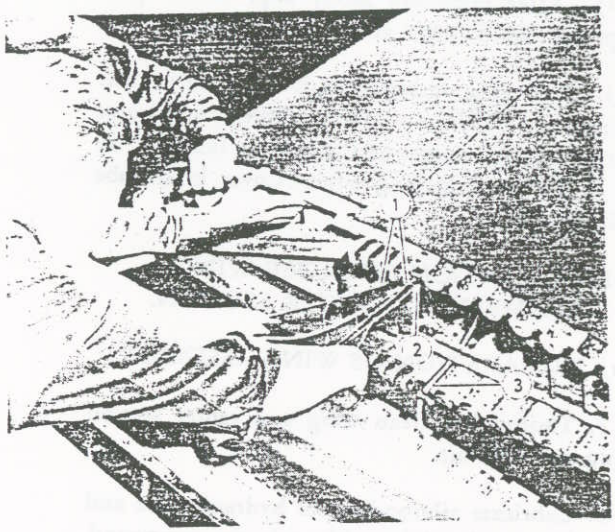


Figure 45 — Wing Rack



1. Fish Cords Tied to Aileron Cables
2. Fair-lead
3. Electrical Conduit from Wing

Figure 46 — Tying Aileron Cables at Wing Joint

7. Tie fish cords to center section aileron cables. String lines through fair-leads, making certain cables are not twisted. (See figure 46, item "2.")

8. Drop forward electrical conduit protruding from wing through cut-out near lower wing fittings "3" (figure 46); drop aft conduit between the second and third aft bathtub fittings "3" (figure 44).

(b) ATTACHMENT OF WING.

1. Mesh wing attachment fittings with center section fittings, adjusting wing to proper height and angles.

CAUTION

When mating, outer panel must be handled carefully so that supercharger duct is not punctured by shear beam attaching arms.

2. Align wing attaching holes on top fittings first. (See figure 47, items "12" and "13.")

3. Drive .010 undersize pin into top fittings. Use tool No. S-34201 (figure 40).

4. Install bottom attaching pin using spacer under head of pin in fittings. If engine formers make pin head inaccessible, use slide hammer.

5. Withdraw top undersize pin and install attaching pin and spacer in top fittings.

6. Install bolts (point aft) in shear beam attaching arms.

a. At the top, use 231583 bolts, AN320-7 nuts, AN960-716 washers, and AN380-3-3 cotter pins.

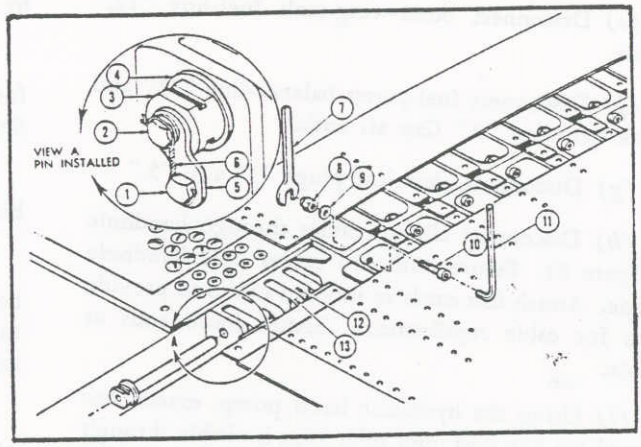
b. At the bottom, use 231584 bolts, AN320-8 nuts, AN960-816 washers, and AN380-3-3 cotter pins.

7. Install bolts in bathtub fittings. Upper surface bolts point inboard; lower surface bolts point outboard. Install washers under nuts. (See figure 47.)

Note

Tighten nuts with open-end wrench and tool No. S-34901. (See figure 40.)

8. Safety main beam attaching pins by rotating safety clips over pins and securing by LS586 bolts screwed into attaching pins. Safety upper and lower clip bolts with safety wire AC995-47-6 (figure 47, view "A").



1. Bolt
2. Bolt
3. Pin
4. Spacer
5. Clip
6. Lock Wire
7. Open-end Wrench
8. Nut
9. Washer
10. Bolt
11. Wrench S-34901
12. Fitting, Center Section
13. Fitting, Outer Wing

Figure 47 — Wing Joint Attachments

(c) CONNECTIONS AT WING JOINT.

1. GENERATOR BLAST-TUBE.—Work rubber hose over end of tubes and use two metal clamps to tighten down. (See figure 44, item "15.")

2. OUTER-WING FUEL-TANK AND AILERON-BOOSTER LINES.

a. Remove caps.

b. Connect aileron-booster hydraulic lines. (See figure 44, item "11.")

c. Connect fuel line "12," fuel-tank vent-line "9," and fuel-pump balance-line "13."

3. PITOT-STATIC TUBES AT INBOARD END OF WING (LEFT WING ONLY).

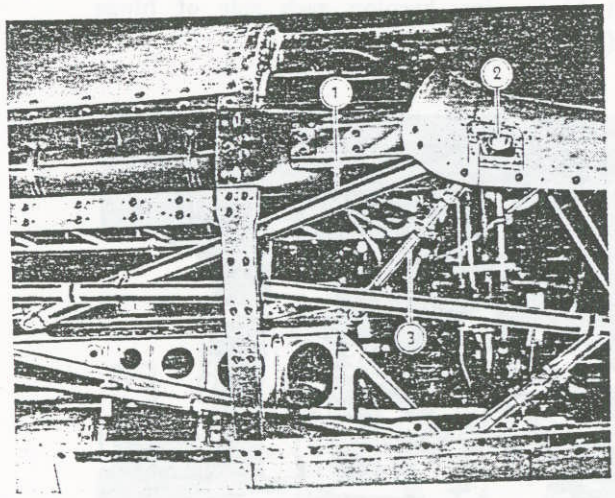
a. Remove caps from ends of pitot-static tubes located in wing leading edge "10."

b. Lubricate threads of unions on black-banded and black-and-green-banded tubes with Specification AN-C-53 anti-seize compound. Tubes are shielded with asbestos wrappers.

c. Connect pitot tubes (forward, black-banded).

d. Connect static tubes (aft, black-and-green-banded).

4. CONNECTING FLAP PUSH-PULL RODS. —Push outer panel flap into wing so that wing-flap rod penetrates center section rod about two inches, and install bolts. Bolts point aft. (See figure 43.)



1. Diagonal (Long)
2. Bolt—Wing Fitting
3. Diagonal (Short)

Figure 48 — Engine-mount-diagonal Connections

5. CONNECTING WING ENGINE-MOUNT LUG TO ENGINE-MOUNT DIAGONAL. *(See figure 48.)*

a. Remove bolt "2" through junction of long diagonal "1" and short diagonal "3." Swing long diagonal outboard from wing-engine-mount lug.

b. Relieve weight on engine mount by supporting engine with a sling (figure 104) or jack.

c. Bolt long diagonal to wing fitting.

d. Bolt short diagonal to long diagonal.

e. Remove engine sling or jack.

6. CONNECTING ELECTRICAL CONDUIT TO CENTER SECTION OUTLET.—Through removable panel 141 attach both wing electrical plugs to connections under center section corrugation. (See figure 43.)

7. CONNECTING AILERON CABLES. *(See figure 70.)*

a. Through handhole "5" (figure 5) draw fish cords attached to aileron cables from main beam.

b. Draw wing aileron-cables inboard through cut-outs to handhole "5" and connect cables with turnbuckles. Remove fish cords.

8. INSTALLING WING JOINT FILLETS.—Install fillets in accordance with figure 43.

9. ADJUSTING CONTROL CABLES. — Adjust control cables in accordance with paragraph 4 *c*, this section.

CAUTION

Seal opening on wing above plate 141 with wire screen, fastened with PK-6 screws and AN960-6 washers; tape around edges to keep any foreign matter in wing out of terminal junctions. (See figure 43.)

d. WING TIPS.

(1) DESCRIPTION.—The wing tip joins to the outer wing panel at wing station 289 and has navigation lights installed in both the top and bottom surfaces.

(2) REMOVAL.

(a) Remove screws from upper and lower surfaces attaching tip to wing.

(b) Remove bolts in rear shear beam and aft rib of wing tip.

(c) Move tip outward sufficiently to reach in and disconnect navigation light conduit.

(3) INSTALLATION.

(a) Clean out tip with air hose and remove all foreign matter.

(b) Try tip for fit. Install with three LS560-8 screws in the upper surface and three in the lower. Inspect for minimum clearance of $\frac{1}{32}$ inch at the butt joint. Remove tip from wing. If necessary, file for correct fit.

(c) Connect electrical cable to navigation lights and safety-wire connection.

Note

Aileron hinge wire must fit into tubing near trailing edge of wing tip.

(d) Install screws in lower surface of wing tip starting from leading edge. Install bolts in rear shear beam and aft rib of wing tip.

(e) Install remainder of screws on lower surface and upper surface.

e. AILERONS.

(1) DESCRIPTION.—The ailerons are located in cut-outs in the outer wings and are attached with piano-type hinges. Push-pull tubes connect the ailerons to the booster unit in the wing in such a manner that when one aileron travels to the maximum UP position, the other travels to the full DOWN position.

(2) REMOVAL.

(See figure 5 for handhole identification.)

(a) Remove wing tip according to paragraph *c* (2); preceding.

(b) Uncover handholes "3," "4," and "5" in lower surface and handhole "20" in upper surface of the outer wing.

(c) Disconnect aileron push-pull tube at "3" where it attaches to the aileron. (Do not allow aileron balance weights to dent wing skin.)

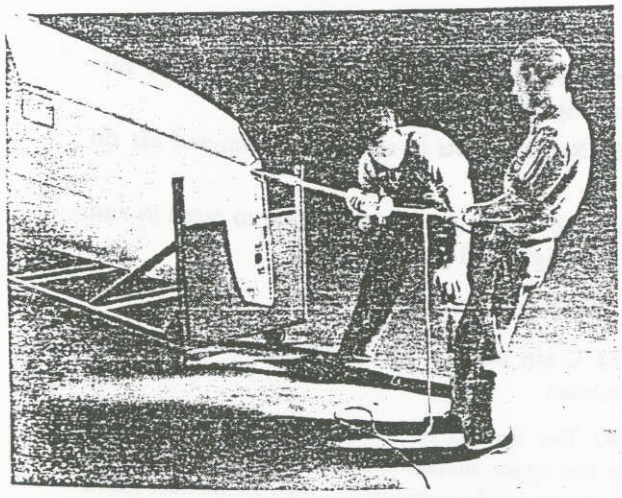


Figure 49 — Withdrawing Aileron Hinge Wire Using Slide Hammer

(d) Withdraw hinge pin and remove aileron. (See figure 49.)

(3) ADJUSTMENTS.

(a) For adjustment of rigging, see paragraph 4 *c* (4), this section.

(b) For adjustment of aileron booster, see paragraph 19 *g* (3), this section.

(c) For adjustment of fixed trim tabs, refer to Section III, paragraph 4 *a* and figure 36.

(4) INSTALLATION.

(a) Check aileron for cleanliness. Examine inside of wing through handholes and remove any foreign matter.

(b) Check and adjust aileron cable rigging according to figure 70 and paragraph 4 *c* (4), this section.

(c) Hold aileron parallel to wing. Beginning at outboard end, pass the counterbalance weights of aileron through cut-out holes in wing.

(d) Mesh the aileron-half of hinge with wing-half of hinge, but do not force into place.

(e) With a hinge pin pusher install .070 (.021 undersize) hinge pins, keeping each side of hinge aligned. (See figures 50 and 51.)

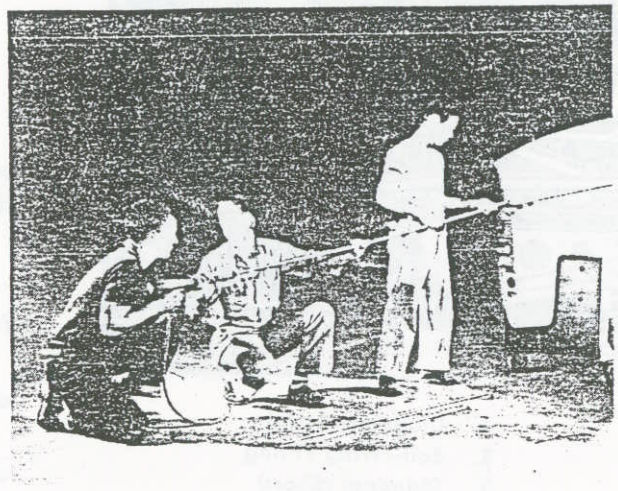


Figure 50 — Driving Aileron Hinge Wire Using Air Gun Set

CAUTION

Never use undersize hinge wire for regular installation. If the hinge wire is carelessly handled, rib at inboard end of hinge may be punctured. Do not bend hinge wire as it is easily broken. Use thin tubing around it to keep it straight.

(f) Check aileron "free throw" as follows:

1. Shim weights if necessary to prevent their hitting wing.

2. Check for 1/8-inch clearance between inboard edge of aileron and outboard edge of flap section. If

filing is necessary, complete fitting before removing test wire.

3. Check for 1/8-inch minimum clearance between fairing on aft wing and aileron on bottom side.

4. Check for 1/32-inch clearance between wing and aileron skins when aileron is in extreme upward position.

5. Put aileron in DOWN position. Trailing edge of aileron should travel 7 3/8 (±1/4) inches from neutral position. (Refer to paragraph 4 *c* (4), this section.)

6. Put aileron in UP position. Trailing edge of aileron should travel 9 3/16 (±1/4) inches from neutral position.

7. Withdraw test wire, using slide hammer (figure 49). Use air-gun set to drive full size hinge wire (.091). In emergency, use an electric motor, but do not gouge the hinge.

CAUTION

Do not drive hinge wire into outboard rib of flap section. Use tubing to prevent kinking of wire. (See figures 50 and 51.)

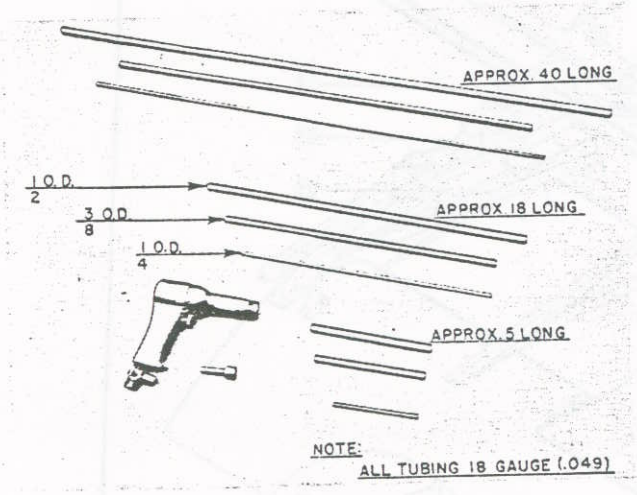


Figure 51 — Air Gun Set and Hinge Wire Driving Equipment

(g) If aileron push-pull tube is not installed, insert tube through access hole at outer panel shear beam "3" (figure 5) and attach at aileron booster bellcrank (figure 70, view A).

After adjustment (see paragraph 4 *c* (4), this section) attach clevis of push-pull tube at aileron, installing bolt with head down.

(h) Check adjustment. (See paragraph 4 *c* (5), this section.)

f. FLAPS.

(1) DESCRIPTION.—The flaps are interconnected and operate together. The center section flap is installed in the lower wing surface between wing stations 8 and 77, and the outer wing flap between stations 119 and 180. The flaps are attached at each end to carriages that roll in tracks built into the wing structure. (See figure 52.) The carriages are linked by cables to push-pull tubes, traveling in roller brackets on the rear face of the rear shear beam. The push-pull tubes are actuated by long screws driven by a hydraulic motor housed under fuselage removable panel 84 (figure 3). On the right-hand side of the motor a hydraulic pressure shut-off valve is geared to the drive shaft.

(2) REMOVAL. *(See figure 52.)*

(a) Extend the flaps with hydraulic hand pump.

(b) Disconnect push-pull rods at adjusting-nuts "3" (figure 52).

(c) Remove the pins attaching upper carriage forgings to flaps "1."

(3) ADJUSTMENTS.—See paragraph 4 *i* (4), this section.

(4) INSTALLATION.

(a) INSTALLATION OF FLAP CARRIAGE.

1. Check to see that eccentric bushing in forward end of the carriage is movable, and that rollers will turn.

2. If previously removed, install micarta stop in forward end of top track.

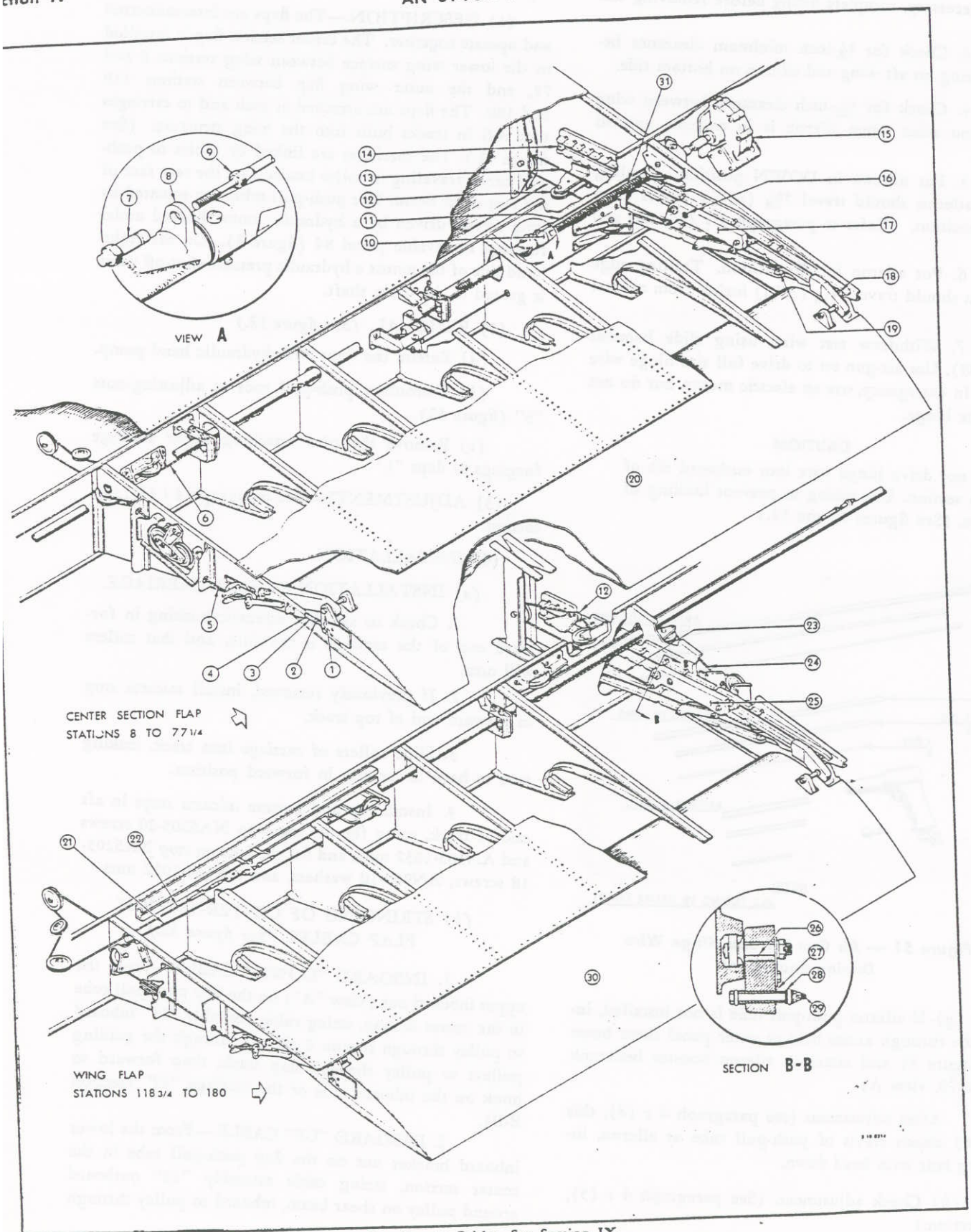
3. Slide rollers of carriage into track, making sure to have lower arm in forward position.

4. Install top and bottom micarta stops in aft end of track, using for the top stop NAS205-20 screws and AN365-1032 nuts, and for the bottom stop NAS205-18 screws, AN960-10 washers, and AN364-1032 nuts.

(b) STRINGING OF CENTER-SECTION FLAP CABLES. *(See figure 52.)*

1. INBOARD "DOWN" CABLE.—From the upper inboard nut (view "A") on the flap push-pull tube in the center section, string cable assembly "11" inboard to pulley through station 8 rib, aft through the guiding pulleys to pulley through flap track, then forward to hook on the inboard side of the carriage "17" (section B-B).

2. INBOARD "UP" CABLE.—From the lower inboard bracket nut on the flap push-pull tube in the center section, string cable assembly "13" outboard around pulley on shear beam, inboard to pulley through



For Key to Cables, See Section IX.

Figure 52 — Wing and Center Section Flap Installation

shear beam, forward through the guiding pulley, and around forward pulley, aft to hook into the outboard side of the carriage "17" (section B-B).

3. OUTBOARD "DOWN" CABLE. — From the cable nut on top of the flap push-pull tube, string cable assembly "5" inboard to pulley on outboard side of station 77, aft through the two guide pulleys, around pulley through rear end of station 77 rib, and forward to the outboard side of the flap carriage "17" (section B-B).

4. OUTBOARD "UP" CABLE.—From the cable nut on the under side of the flap push-pull tube, located inboard of the outboard flap track, string cable assembly "6" outboard to pulley through shear beam forward through the guide pulley around forward pulley, aft to the inboard side of the flap carriage "17" (section B-B).

(c) STRINGING THE WING FLAP CABLES. *(See figure 52.)*

1. Pin, Nut AN320-6
   Washer AN960-616
2. Nut AN364-720
3. Adjusting Nut
4. Nut
5. Cable
6. Cable
7. Cable Nut
8. Cable-nut Lug
9. Cable Fitting
10. Flap Operating Nut
11. Cable
12. Pulley
13. Cable
14. Stop
15. Flap Drive Assembly
16. Adjusting Screw
17. Carriage Assembly
18. Stop
19. Stop
20. Flap Assembly, Center Section
21. Cable
22. Cable
23. Cable
24. Cable
25. Carriage Assembly
26. Eccentric Adjustment
27. Washer AN960-416L
28. Washer
29. Bolt, Spacer, Nut AN310-3
30. Flap Assembly, Outer Wing
31. Flap Drive Screw

NOTE: All pulleys LS806 except as noted. For Key to cables, see Section IX.

Key to Figure 52

1. INBOARD "DOWN" CABLE.—From the cable nut located midway on the flap push-pull tube, string cable assembly "24" inboard to pulley on inboard side of station 119 rib, then aft under guide pulley to the pulley through the aft end of the flap track, and forward to the inboard side of the inboard carriage "25" (section B-B).

2. INBOARD "UP" CABLE.—From the upper cable nut on the flap push-pull tube, string cable assembly "23" outboard along the tube to pulley through shear beam, back to pulley on forward side of shear beam, forward along the guide pulley "12," to front pulley, then aft under the push-pull rod to the outboard side of inboard carriage "25" (section B-B).

3. OUTBOARD "DOWN" CABLE.—From the outboard cable nut, string cable assembly "21" inboard around pulley on shear beam, outboard around pulley on outboard side of station 119 rib, aft around pulley through aft end of flap track, and forward to the outboard side of the carriage "25" (section B-B).

4. OUTBOARD "UP" CABLE.—From the turnbuckle at outboard end of the flap push-pull tube, string cable assembly "22" outboard to pulley through shear beam, around guide roller, forward to forward pulley, located forward of the track, then aft to inboard side of the carriage "25" (section B-B).

(d) HANGING THE FLAP. *(See figure 52.)*

1. Pull both carriage assemblies out to the micarta stops "18" and "19."

2. Use two men to install hinge pins "1" connecting upper flap hinge fittings to aft end of carriage arms. Both fittings must be aligned at the same time.

3. Place lock nuts "2" and "3" on flap terminal and on push-pull rod. Lock nuts "2," AN364-720, on center section flap terminals have fiber inserts which must be on aft side of nut when installed. If new nut is used screw metal end on first to cut thread properly in fiber, then reverse nut.

Note

Complete all operations on both inboard and outboard sides of flap up to this point.

4. Install hexagonal adjusting nut "3" on inboard and outboard flap carriage rod assemblies one turn only.

5. Turn both adjusting nuts together about half the thread distance.

6. Refer to paragraph 4 *i* (4), this section, for adjustment of flap.

(e) ATTACHING THE FLAPS. *(See figure 52.)*

1. Push the flap about half way up, and wedge a screw driver between carriage and track to keep flap in that position.

2. Put bolt "29" through DOWN cable eyelet, and place a wire about five inches long through hole in the bolt.

3. Pull DOWN cable forward to hole, located about midway on the flap track, and push the bolt into the hole.

4. Line up the hole in the forward end of flap carriage and draw the bolt through the carriage by means of the wire.

5. Put UP cable eyelet on bolt and install washers, spacer, and nut as per section B-B.

6. Install UP and DOWN cables on opposite sides, using same procedure.

7. Connect wing push-pull tube to center section push-pull tube and make adjustments as described in paragraph 4 *i* (4), this section.

g. LEADING EDGE.

(1) DESCRIPTION.—The portion of the outer wing forward of the main beam, between wing stations 119 and 289, constitutes the leading-edge assembly. It is attached to the main beam by screws. The wing-tank leading edge weighs 291 pounds.

(2) REMOVAL. *(See figure 53.)*

(a) Remove wing tip in accordance with paragraph *c* (2), preceding.

(b) Remove all engine cowl sections and fillets adjacent to the junction of the nacelle and the leading edge.

(c) Support the engine with a sling or jack and remove the two outboard engine-mount diagonals. (See figure 48.)

CAUTION

Do not attempt to start the engine while the engine-mount diagonals are disconnected.

(d) Remove bolt attaching the outboard leading-edge diagonal support "16" (figure 53) to the upper main-beam fitting lug.

(e) Detach the hose connection on the accessories blast tube at the leading edge.

(f) Disconnect hydraulic fluid, fuel tank vent, fuel pump balance, and fuel lines at wing joint.

(g) (On the left wing only.) Remove the sections of the pitot-static lines that pass through the leading edge at inboard end.

(h) Remove the seven screws which attach the leading edge to the former (figure 53, insert "A") on the bottom skin just forward of the main-beam fitting.

Remove the five screws which attach the extruded stiffener to the inboard leading edge rib just forward of the lower main-beam fitting.

(i) Support the leading edge and remove the screws (on the bottom, then on the top surface) which attach the leading edge to the main beam.

(j) Move the leading edge straight forward until it clears the wing. Cover all duct openings and cap hydraulic and fuel lines.

(3) INSTALLATION. *(See figure 53.)*

(a) Check leading edge mating holes for edge distance of 3/8 inch from center of hole to skin edge, top and bottom sides.

(b) Bevel leading edge ribs with vixen file if aft edge of rib is square.

(c) Make sure that all plate nuts are installed.

(d) Check leading edge mating holes and see that they are dimpled correctly.

Note

All holes used in mating the leading edge are dimpled except 17 in the upper skin at inboard end and two holes in the upper and two in the lower skin at the aft end of the outboard rib of the fuel tank.

(e) Check for and remove any loose articles and foreign matter.

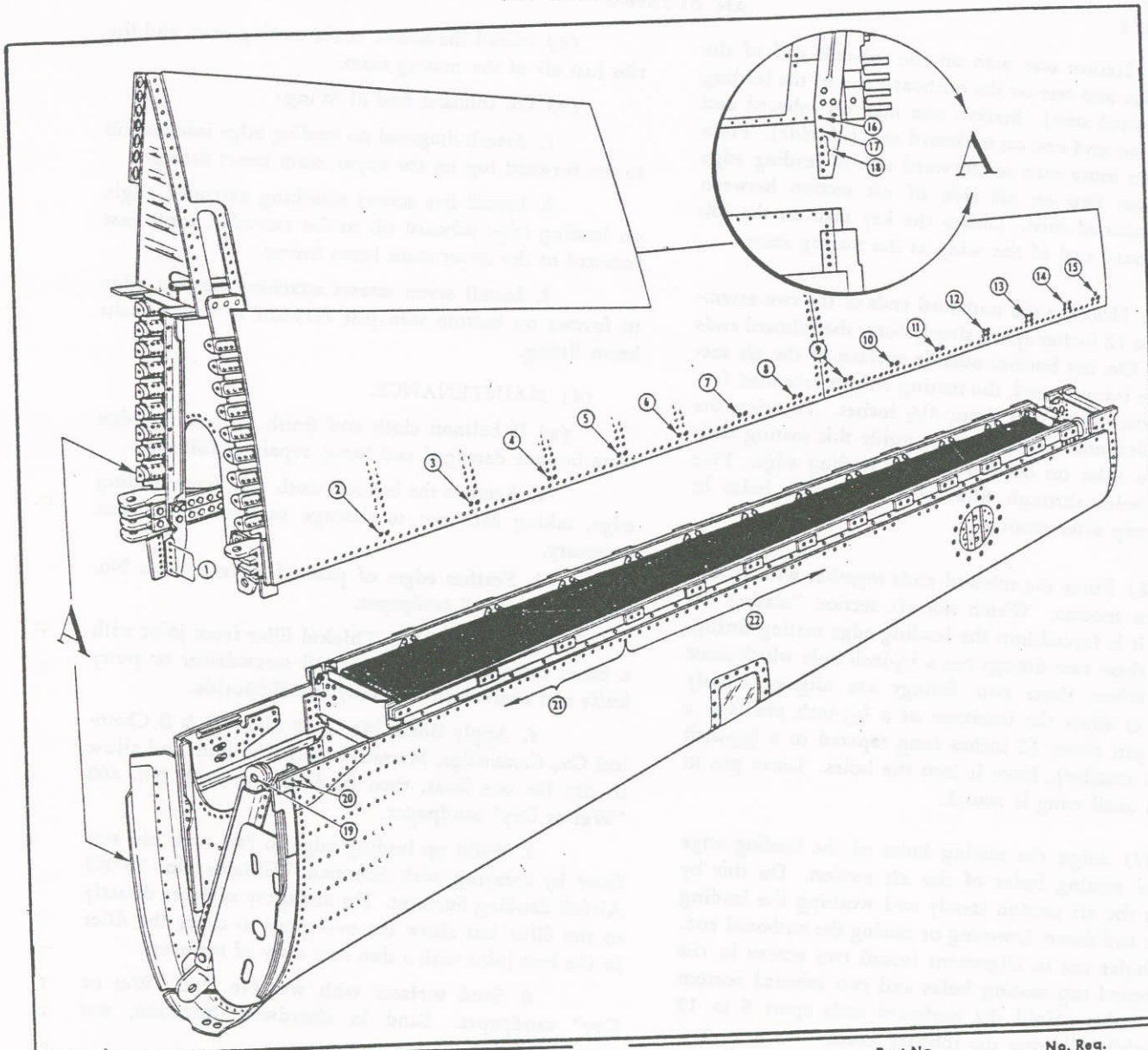
(f) Check to see that gang channel nuts on upper and lower side of inside main beam are in place.

(g) Check cut-outs on main-beam doubler. These are located on ribs at stations 289, 242, 230, 218, and 206. Top and bottom sides have identical cut-outs. These cut-outs should be filed to within 3/8-inch edge distance of nearest gang channel. There should be 3/32-inch clearance from edge of outer skin to edge of cut-out. The corners should have at least 1/8-inch radius.

Note

The leading edge and outer panel are usually mated prior to installation of wing assembly to airplane. If the outer panel is already installed, the following mating procedure may be employed with obvious adaptations.

(h) Place the aft section and leading edge (top side down) on two wooden horses 3 1/2 feet high and 5 1/2 feet long. The surface of each horse should be padded to prevent scratching the outside skin of the wing.



Item	Name	Part No.	No. Req.
1	Screw	LS560-11	5
2	Screw	NAS206-26	2
	Screw	*NAS206-28	1 Inbd.
	Screw	NAS206-30	1 Outbd.
3	Screw	NAS205-24	2
	Screw	*NAS205-26	2
4, 5, 6, 7	Screw	NAS205-24	2
	Screw	*NAS205-24	2
8	Screw	NAS205-23	2
	Screw	*NAS205-23	2
9	Screw	NAS205-23	2
	Screw	*NAS205-22	2
10	Screw	NAS205-24	2
	Screw	*NAS205-23	2
11	Screw	NAS205-23	2
	Screw	*NAS205-23	2
12	Screw	†NAS205-22	2
	Screw	†*NAS205-21	2
13	Screw	†NAS205-21	2
	Screw	†*NAS205-21	2
14	Screw	NAS205-8	4 Leading Edge Skin
	Screw	NAS205-8	2 Fwd.
	Screw	NAS205-22	2 Aft
	Screw	*NAS205-8	4 Leading Edge Skin
	Screw	*NAS205-8	2 Fwd.
	Screw	*NAS205-22	2 Aft
	Screw	NAS205-10	2 Fwd.
15	Screw	NAS205-11	1 Aft
	Screw	*NAS205-10	2 Fwd.
	Screw	*NAS205-11	1 Aft
16	Screw	LS560-16	1
17	Screw	LS560-10	1
18	Screw	LS560-11	1
19	Bolt	AN28-34A	1
	Nut	AN364-820	2
	Washer	AN960-816	3
20	Nut	AN365-1032	56
21	Screw	NAS205-12	21
	Screw	*NAS205-12	98
22	Screw	NAS205-7	124
	Screw	*NAS205-7	

*Lower wing surface callouts.
†Plug two forward holes with putty.

Figure 53 — Points of Attachment, Leading Edge to Wing

(i) Station one man on the inboard end of the leading edge and one on the outboard end of the leading edge (forward side). Station one man on inboard end of aft section and one on outboard end (aft side). Place at least two more men on forward side of leading edge and at least two on aft side of aft section between above mentioned men. Locate the key man on the job at the inboard end of the wing at the mating seam.

(j) Holding the outboard ends of the two assemblies about 12 inches apart, slowly force the inboard ends together. On the bottom outside surface of the aft section at the inboard end, the mating strip is extended forward of the aft section about 4½ inches. To bring the two inboard ends together, first guide this mating strip under the fillet on bottom side of leading edge. Five No. 10 holes through fillet will align with holes in mating strip after mating.

(k) Force the inboard ends together with an up-and-down motion. Watch the aft section "mating fitting" as it is forced into the leading edge mating fitting. Each of these two fittings has a ½-inch hole which must align. When these two fittings are aligned closely enough to allow the insertion of a 3/32-inch pin (use a ½-inch pin about 12 inches long tapered to a 3/32-inch point or smaller), force it into the holes. Leave pin in position until wing is mated.

(l) Align the mating holes of the leading edge with the mating holes of the aft section. Do this by holding the aft section steady and working the leading edge up and down, lowering or raising the outboard end. When holes are in alignment install two screws in the two inboard top mating holes and two inboard bottom mating holes. Hold the outboard ends apart 6 to 12 inches while aligning the inboard holes.

(m) Now force outboard ends together by an up-and-down movement of the leading edge, holding the aft section steady. It will not be possible to force it completely together; therefore, wrap a 10- or 15-foot shock cord (elastic rope) around the two assemblies at the outboard end. Place a wooden block and a piece of felt on the shear beam of the aft section to prevent the cord from bending the fairing at that point. Pull this cord as tight as possible. Sometimes another cord is necessary about midway of the length of the wing. With the use of a paper mallet (a roll of soft paper, weighing about eight pounds and covered with tape) pound the nose or leading edge, holding the aft section steady. During this entire process, use shims of .032-inch maximum thickness from inboard to outboard end, both top and bottom sides to permit leading edge skin to slide over main beam doubler of aft section.

(n) Install the screws in the mating seam and the ribs just aft of the mating seam.

(o) On Inboard End of Wing:

1. Attach diagonal on leading edge inboard rib to the forward lug on the upper main beam fitting.

2. Install five screws attaching extruded angle on leading edge inboard rib to the extruded angle just forward of the lower main beam fitting.

3. Install seven screws attaching leading edge to former on bottom skin just forward of lower main beam fitting.

(4) MAINTENANCE.

(a) If balloon cloth and finish on leading edge seam become damaged and loose, repair as follows:

1. Remove the balloon cloth tape from leading edge, taking care not to damage surfacer more than necessary.

2. Feather edges of painted surfacer with No. 280 "Wet or Dry" sandpaper.

3. Remove black Thiokol filler from joint with a blunt instrument such as a dull screwdriver or putty knife and wash clean with ethylene dichloride.

4. Apply Bostic No. T-78 filler (B & B Chemical Co., Cambridge, Massachusetts) into joint and allow to dry for one hour, then sand smooth with No. 400 "Wet or Dry" sandpaper.

5. Build up leading edge to fair with old surfacer by spraying with Sherman Williams No. 70-002 Airfoil Sanding Surfacer. Do not spray surfacer directly to the filler, but allow the overspray to cover the filler in the butt joint with a thin coat only of surfacer.

6. Sand surfacer with wet No. 280 "Wet or Dry" sandpaper. Sand in chordwise direction, *not* spanwise.

7. Apply two coats of Aluminum Lacquer.

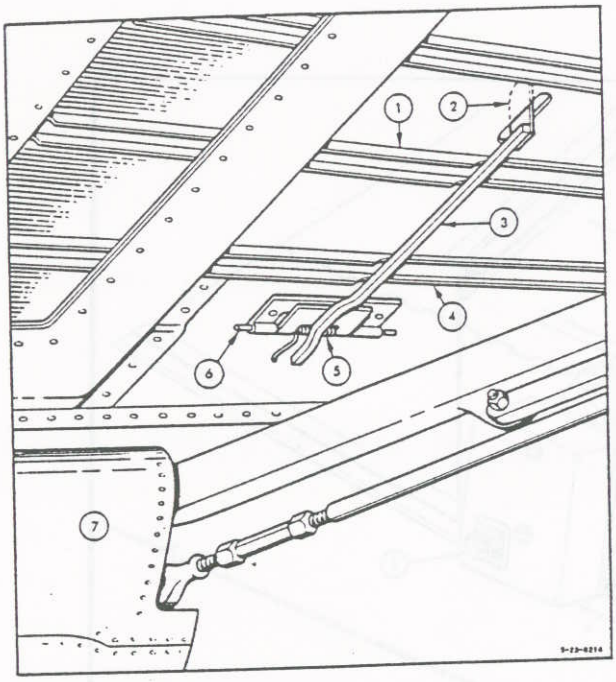
(b) If minor damage occurs to leading edge seam, causing nicks or scratches in finish, repair as follows:

1. Clean out loose particles.

2. Finish according to steps 5, 6, and 7, preceding.

h. FLAP POP-UP INDICATOR. *(See figure 54.)*

(1) DESCRIPTION.—The flap pop-up indicator is located at approximately wing station 74 on the under surface of the left-hand wing directly above the wing flap. The indicator assembly consists of a red flag, lever arm, spring, hinge, and hinge pin assembly. A slotted hole in upper surface of the wing skin permits the flag to protrude when the flap is not fully retracted.



1. Channel
2. Flag
3. Lever Arm
4. Channel
5. Hinge
6. Hinge Pin
7. Center Section Flap

Figure 54 — Flap Pop-up Indicator

(2) OPERATION.—The flap pop-up indicator is constructed to indicate to the pilot the position of the flaps. When the flaps are fully retracted, the indicator is not visible because the top surface of the flap strikes the lever arm and lowers the indicator. When the flaps are extended 3/10-inch from the fully retracted position, the top surface of the flap loses contact with the lever arm and the spring forces the indicator to rise through the hole in the skin of the wing.

(3) REMOVAL.

(a) Fully extend flaps.

(b) Remove hinge pin "6" (figure 54) through access hole in channel adjacent to indicator.

(c) Remove indicator assembly.

(4) INSTALLATION.

(a) Fully extend flaps.

(b) Place indicator in position with spring tightened enough to raise flag (figure 54).

(c) Insert hinge pin "6."

(d) Move flaps and check operation.

j. DIVE-RECOVERY FLAPS.

(1) DESCRIPTION.—The dive-recovery flap installation consists of two hinged panels mounted on the lower surface of each outer wing (L and R) at the main beam and between wing stations 122 and 180. In the retracted position, the flaps bear against the lower surface of the wing. In the extended position, the flaps form an external airbrake. The dive-recovery flaps are operated by an electrically driven jack-screw mechanism through a torque tube assembly which is attached to the jack-screw coupling head.

(2) TROUBLE SHOOTING. (See paragraph 20 *k* (3), this section.)

(3) REMOVAL.

(a) Extend flaps.

(b) Open battery circuit.

(c) Disconnect contactor plug (located on firewall).

CAUTION

Do not operate either flap separately without disconnecting contactor plug of opposite dive flap unit. Failure to remove non-operating flap contactor from circuit may result in severe damage to contactor solenoid.

(d) Withdraw bolts attaching actuating linkage to flap brackets.

(e) Remove screws from hinge strip attached to main beam cap strip and remove flap.

(f) Remove screws holding actuator mount and linkage to wing structure.

(g) Remove actuator bearing bolts.

(h) Turn actuator mount and torque linkage on end and remove from wing.

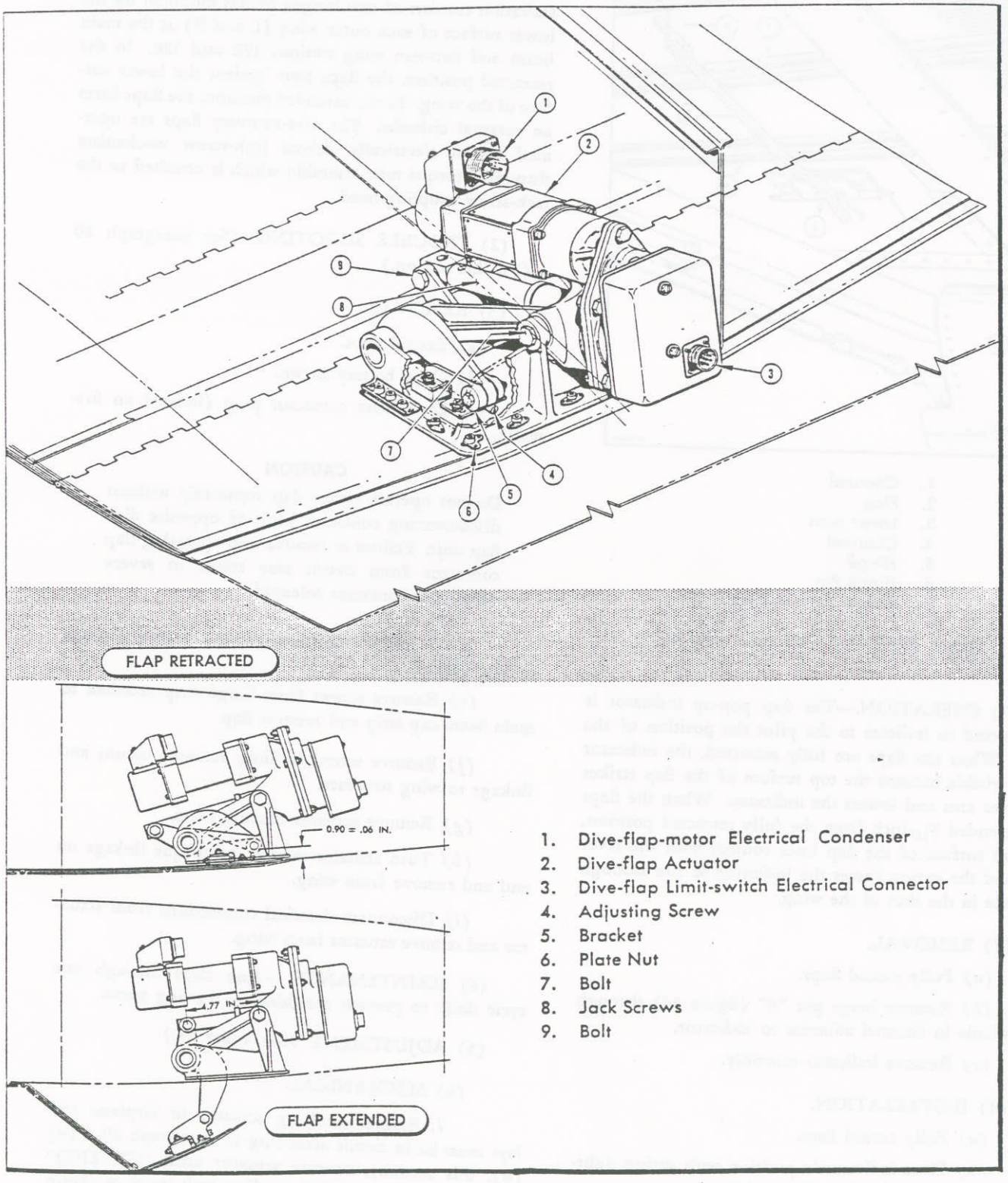
(i) Disconnect electrical connections from actuator and remove actuator from wing.

(4) MAINTENANCE. — Run flaps through one cycle daily to prevent corrosion of moving parts.

(5) ADJUSTMENT. *(See figure 55.)*

(a) MECHANICAL.

1. Before installing actuator in airplane (relays must be in circuit according to paragraph 20 *k* (4) *(d)*, this section), operate actuator until "EXTEND" limit switch is open and then adjust jack screw to obtain 4.77 inches between actuator mounting hole and jack-screw head attaching hole.



1. Dive-flap-motor Electrical Condenser
2. Dive-flap Actuator
3. Dive-flap Limit-switch Electrical Connector
4. Adjusting Screw
5. Bracket
6. Plate Nut
7. Bolt
8. Jack Screws
9. Bolt

Figure 55 — Dive-recovery Flap Installation

2. After mounting bracket assembly and actuator have been installed, insert NAS55-15 bolt in either actuator torque arm and measure distance from lowest edge of bolt to the outer wing lower skin surface when the actuator is in the retracted position. This dimension should be 0.90 (±.06) inch and must be measured before the flaps are connected to the actuating linkage. If ±.06-inch tolerance is exceeded, remove jack-nut bolt and turn jack nut counterclockwise to increase dimension and clockwise to decrease dimension.

3. Adjust flap mounting brackets so that no binding is present and so that trailing edge of flap is close against lower surface of wing when the flap is in the retracted position. Clearance of .25 inch maximum is allowed between aft corners of dive flap and lower surface of wing. Positive contact must be maintained throughout most of the trailing edge. Clearance of .38 inch maximum is allowed between center line of hinge and lower surface of wing.

(b) ELECTRICAL. (See paragraph 20 *k* (4) *(d)*, this section.)

(6) INSTALLATION.

(a) Place actuator in wing as far aft as possible and connect electrical plugs.

(b) Install mounting bracket and torque linkage in wing.

(c) Install actuator-bearing bolts.

(d) Install dive flap by driving hinge pin.

(e) Install bolts attaching flap brackets and torque linkage.

(f) Check adjustments. (See paragraph (5) preceding.)

(7) TEST AFTER INSTALLATION. (See paragraph 20 *k* (4) *(e)*, this section.)

2. EMPENNAGE GROUP.

a. GENERAL.—The empennage unit consists of two empennage booms, two vertical stabilizers, two rudders and tabs, one horizontal stabilizer, and one elevator and tab.

(1) REMOVAL OF EMPENNAGE (COMPLETE.)

Note

It is recommended that the entire empennage assembly be removed whenever any major repair is required.

(a) Secure rudder and elevator tab cranks in cockpit.

(b) Disconnect all right and left empennage control cables in baggage and battery compartments. (Refer to figures 71 and 75.)

(c) Attach shock cord bungees to forward cables and fish cords to aft cables. Tape one end of fish cord near the baggage or battery compartment so that lead-ins are provided when empennage is removed and aft cables are withdrawn from the boom. (Figure 58.)

(d) Remove lower outboard boom fillets from forward empennage boom. (Figure 4, item "53.")

(e) Disconnect electrical conduit between boom and empennage in each boom.

(f) Disconnect radio antennas at vertical stabilizers.

(g) Support empennage with jack stand, or employ 10 men for the purpose. Remove screws attaching booms and empennage. (See figure 56, item "B," and figure 57.)

(h) Pull empennage aft and rock downward to remove. Disconnect fish cords and secure with tape near end of boom.

(i) Attach shock cord bungees to empennage cables. (Figure 58.)

(2) INSTALLATION OF EMPENNAGE (COMPLETE).

(a) Check all components for correct structural and working condition.

(b) Check rigging for correct position of cables for quick mating. Fish cords must be ready in aft boom to provide lead-ins for empennage cables.

(c) Check edge distance and condition of screw holes.

(d) Provide for clearance between aft boom and empennage boom skins. Clearance must increase gradually from 1/32 (± 1/32) inch at the top to 5/16 (± 1/32) inch at the bottom. File if necessary.

(e) Clean entire assembly with air and remove all foreign matter.

(f) If proper jack stand is not available, employ 10 men to hold empennage during mating procedure.

(g) Attach empennage to aft booms with screws (see figure 57), applying 35 to 55 inch-pounds torque.

(h) Attach fish cords to empennage cables. Draw to proper position and join with forward cables in battery compartment and in luggage compartment.

(i) Remove fish cords and bungees.

(j) Connect electrical conduit and radio antennas.

(k) Adjust rigging according to paragraph 4, this section.

(l) Replace all access panels.

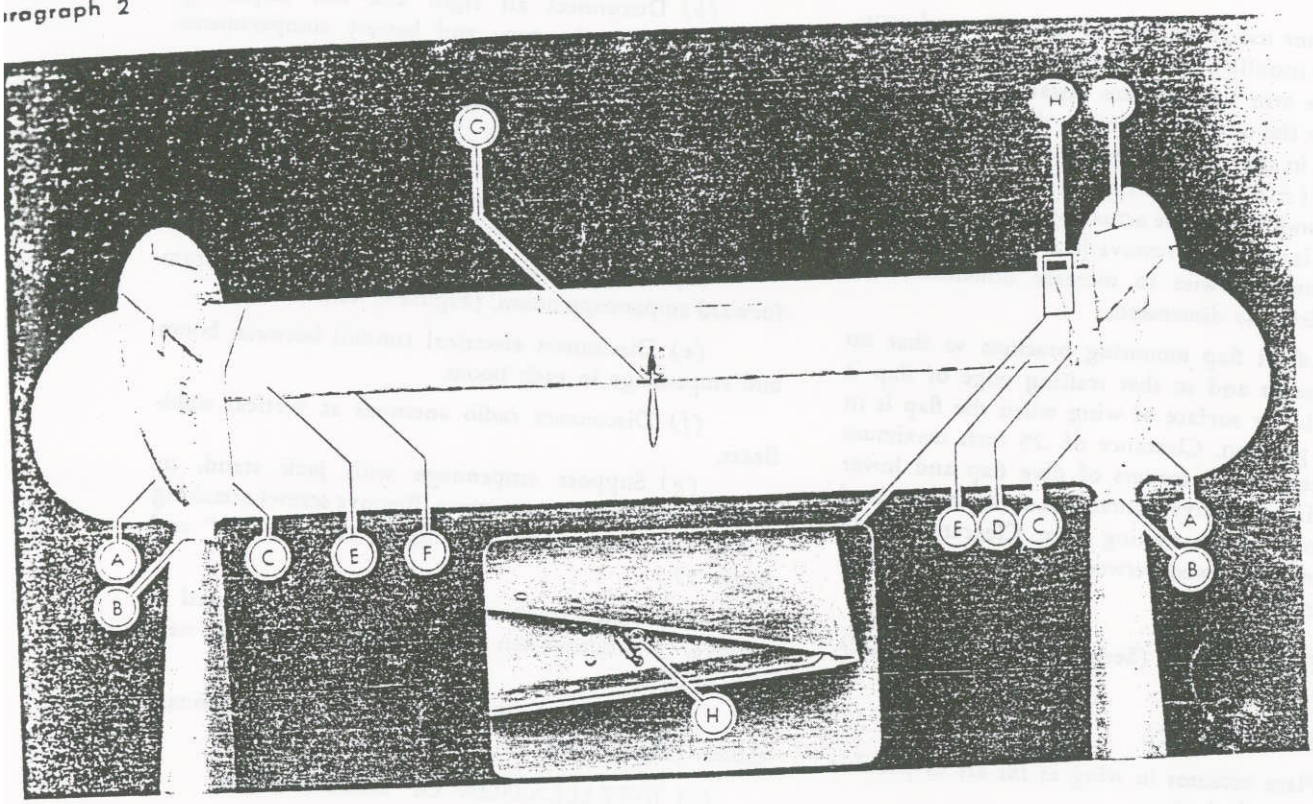


Figure 56 — Empennage Complete

b. HORIZONTAL STABILIZER TIPS.

(1) DESCRIPTION. — The horizontal stabilizer tips are interchangeable right and left and are attached to the outboard sides of the empennage booms.

(2) REMOVAL.—Remove screws around inboard contour of tip and pull tip straight outboard.

(3) INSTALLATION.

(a) Clean tip with air and remove all foreign matter.

(b) Check edge distance and condition of screw holes.

(c) Fit in place, with three screws above and below.

(d) Check for 1/32-inch clearance at butt joint. Remove and file if necessary.

(e) Install all screws.

c. ELEVATOR.

(1) DESCRIPTION.—The elevator is made in one panel and is attached to the horizontal stabilizer by ball-bearing hinges. The operating cables actuate a torque tube in each empennage boom. The torque tubes are fastened to the elevator by screws.

(2) REMOVAL. *(See figure 56.)*

(a) Raise or lower elevator and, through resulting surface gap, disconnect tab push-pull tube from actuating unit by removing AN3-4A bolt and AN365-1032 nut "G."

(b) Remove the screws attaching two small skin plates on upper and lower surfaces of left-hand edge of the elevator "D."

(c) Remove the 24 NAS205-8 screws attaching elevator to torque tubes "E."

(d) Raise elevator until skin notch at left end clears empennage boom.

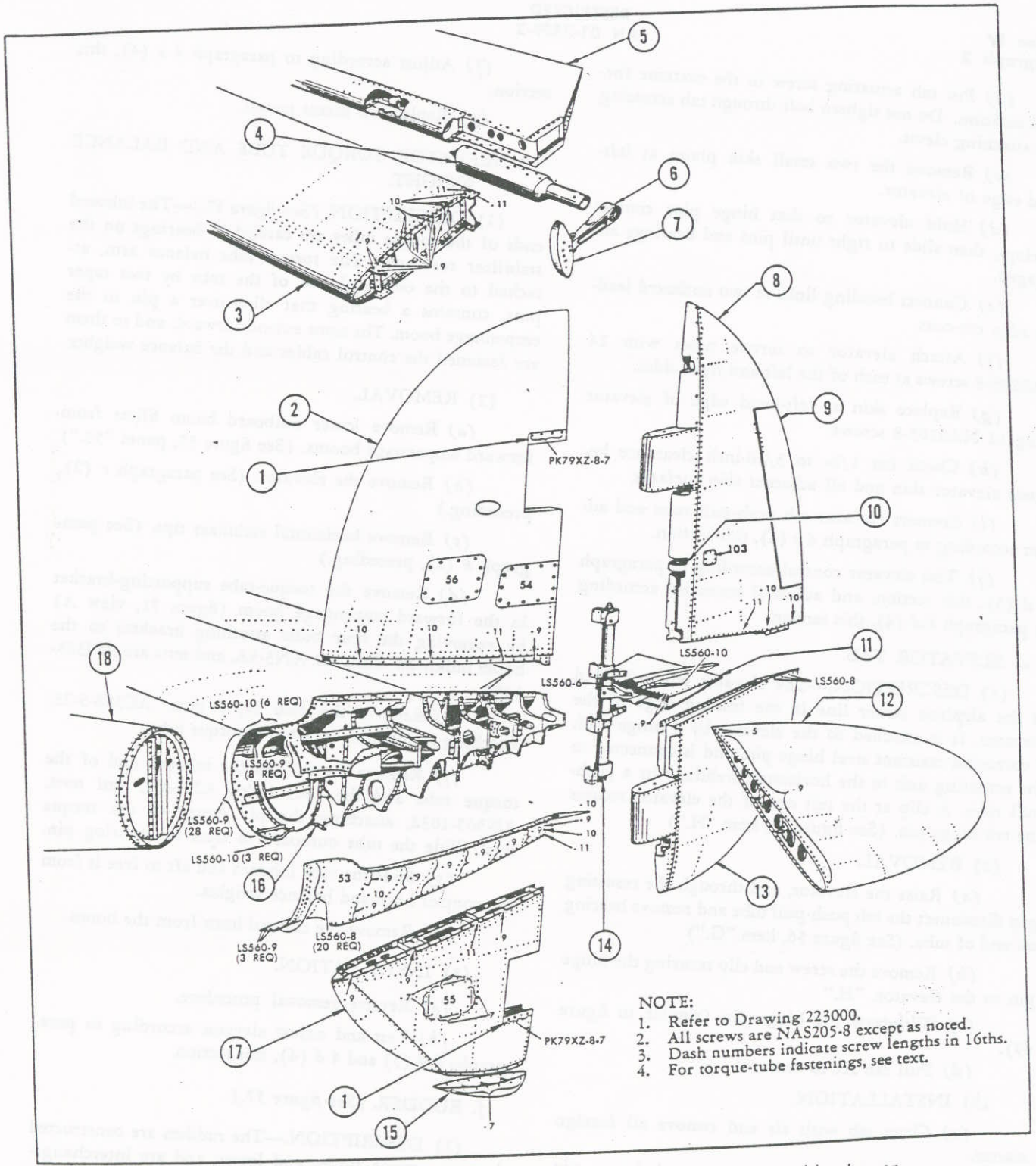
(e) Insert screw driver between hinge bearing housings and pin brackets, prying elevator to left until hinge pins are disengaged from their bearings. Do not damage the bearings "F."

(f) Disconnect bonding links at the two outboard surface gaps "F."

(g) Pull elevator up and aft to remove.

(3) INSTALLATION.

(a) Clean elevator with air and remove all foreign matter.



1. Skin Plates, Rudder Removal
2. Vertical Stabilizer, Upper
3. Horizontal Stabilizer
4. Torque Tube, Elevator
5. Elevator
6. Balance Arm
7. Balance Weight
8. Rudder, Upper
9. Rudder Tab
10. Push-pull Tube
11. Empennage Boom, Aft
12. Stabilizer Tip
13. Rudder, Lower
14. Torque Tube, Rudder
15. Cap
16. Vertical Stabilizer, Lower
17. Empennage Boom, Forward
18. Boom, Aft

Figure 57 — Empennage Installation

(b) Put tab actuating screw in the extreme forward position. Do not tighten bolt through tab actuating unit attaching clevis.

(c) Remove the two small skin plates at left-hand edge of elevator.

(d) Hold elevator so that hinge pins contact bearings, then slide to right until pins and bearings are engaged.

(e) Connect bonding links at two outboard leading edge cut-outs.

(f) Attach elevator to torque tubes with 24 NAS205-8 screws at each of the left and right sides.

(g) Replace skin at left-hand edge of elevator using 12 NAS205-8 screws.

(h) Check for 1/8- to 3/16-inch clearance between elevator skin and all adjacent skin surfaces.

(i) Connect elevator tab push-pull tube and adjust according to paragraph 4 *e* (4), this section.

(j) Test elevator control according to paragraph 4 *d* (5), this section, and adjust if necessary according to paragraph 4 *d* (4), this section.

d. ELEVATOR TAB.

(1) DESCRIPTION.—The elevator tab is located at the airplane center line in the trailing edge of the elevator. It is attached to the elevator by a hinge with a corrosion resistant steel hinge pin, and is connected to the actuating unit in the horizontal stabilizer by a push-pull tube. A clip at the left end of the elevator secures the tab hinge pin. (See figure 56, item "H.")

(2) REMOVAL.

(a) Raise the elevator, and through the resulting gap disconnect the tab push-pull tube and remove bearing on end of tube. (See figure 56, item "G.")

(b) Remove the screw and clip securing the hinge pin to the elevator. "H."

(c) Withdraw the hinge pin (similar to figure 49).

(d) Pull tab aft to remove.

(3) INSTALLATION.

(a) Clean tab with air and remove all foreign matter.

(b) Install corrosion-resistant steel hinge pin according to procedure given in paragraph 1 *e* (4), this section.

(c) Secure hinge pin with clip and screw (figure 56, item "H").

(d) Attach push-pull tube.

(e) Check clearance of 1/8- to 3/16-inch with elevator skin at left and right and both upper and lower surfaces.

(f) Adjust according to paragraph 4 *e* (4), this section.

(g) Replace all access panels.

e. ELEVATOR TORQUE TUBE AND BALANCE WEIGHT.

(1) DESCRIPTION. *(See figure 57.)*—The inboard ends of the torque tubes are carried in bearings on the stabilizer rear spar. The torque tube balance arm, attached to the outboard end of the tube by two taper pins, contains a bearing that slips over a pin to the empennage boom. The arms extend forward, and to them are fastened the control cables and the balance weights.

(2) REMOVAL.

(a) Remove lower outboard boom fillets from forward empennage booms. (See figure 57, panel "53.")

(b) Remove the elevator. (See paragraph *c* (2), preceding.)

(c) Remove horizontal stabilizer tips. (See paragraph *b* (2), preceding.)

(d) Remove the torque-tube supporting-bracket in the forward empennage boom (figure 71, view A) by removing the four bolts attaching brackets to the boom bulkhead. Bolts are AN3-5A, and nuts are AN365-1032.

(e) Remove the two taper pins, AC386-3-25, attaching the control horn to the torque tube.

(f) Remove the nut on the inboard end of the torque tube and the four bolts, AN3-4A, and nuts, AN365-1032, attaching the pin flange to the torque tube. Slide the tube outboard to clear the bearing pin.

(g) Slide the tube inboard and aft to free it from the control horn and balance weights.

(h) Remove the control horn from the boom.

(3) INSTALLATION.

(a) Reverse removal procedure.

(b) Test and adjust elevator according to paragraphs 4 *d* (5) and 4 *d* (4), this section.

f. RUDDER. *(See figure 57.)*

(1) DESCRIPTION.—The rudders are constructed in two sections, upper and lower, and are interchangeable right and left. Rudders are attached to the vertical stabilizer by ball-bearing hinges and to the torque tubes and to each other by screws. A counterbalance extends forward of the hinge line of each section.

(2) REMOVAL.

(a) Remove the six screws connecting the upper and lower rudder sections.

(b) Disconnect tab push-pull tube from actuating unit through cut-out in rudder "10."

(c) Remove the four skin plates on the vertical stabilizers at the rudder balance weight cut-outs "1."

(d) Remove screws attaching rudder to rudder torque tube.

(e) Raise the upper rudder and lower the bottom rudder until the hinge pins are disengaged from their bearings.

(f) Detach bonding links at the hinge connections, one each in upper and lower rudder.

(g) Pull rudder slowly aft.

Note

Either the upper or lower rudder may be removed independently.

(3) INSTALLATION.

(a) Clean rudder with air and remove all foreign matter.

(b) Put tab actuating screw in the extreme forward position. Do not tighten bolt through tab actuating unit attaching clevis.

(c) Reverse steps *(a)* through *(g)* of removal procedure (paragraph (2) preceding).

(a) Check for $\frac{1}{8}$- to $\frac{3}{16}$-inch clearance between rudder skin and all adjacent skin surfaces.

(e) Test rudder control according to paragraph 4 *f* (5), this section, and adjust if necessary according to paragraph 4 *f* (4), this section.

g. RUDDER TABS. *(See figure 57.)*

(1) DESCRIPTION.—The rudder tab is attached to its rudder by a hinge with a corrosion-resistant steel hinge pin, and is connected to the actuating unit by a push-pull tube. A clip in the rudder at the lower end of the upper rudder secures the hinge pin.

(2) REMOVAL.

(a) Remove screw and cotter attaching push-pull tube to tab.

(b) Remove lower rudder. (See paragraph *f* (2), preceding.)

(c) Remove the clip and screw which secure the hinge pin.

(d) Withdraw the hinge pin.

(e) Pull tab aft to remove.

(3) INSTALLATION.

(a) Clean tab with air and remove all foreign matter.

(b) Install corrosion-resistant steel hinge pin according to procedure given in paragraph 1 *e* (4), this section.

(c) Secure hinge pin with clip (similar to item "H," figure 56).

(d) Attach push-pull tube.

(e) Check clearance of $\frac{1}{8}$ to $\frac{3}{16}$ inch with rudder skin at top and bottom and both left and right forward surfaces.

(f) Adjust according to paragraph 4 *g* (4), this section.

(g) Replace all access panels.

h. RUDDER TORQUE TUBES. *(See figure 57.)*

(1) DESCRIPTION.—The torque tubes, bearings, brackets, and arms are assembled as units and are attached to the vertical stabilizers by bolts. The control arm projects outboard from each tube and connects by a push-pull tube to the walking beam in the boom.

(2) REMOVAL.

(a) Remove the lower outboard fillet of empennage boom. (See figure 57, panel "53".)

(b) Remove the rudders. (See paragraph *f* (2), preceding.)

(c) Remove the aft empennage booms. (See paragraph *i* (2), following.)

(d) Disconnect the push-pull tube from the torque tube arm.

(e) Remove the six AN3-5A and 16 NAS205-10 screws attaching the torque-tube-bearing brackets to the vertical stabilizers.

(f) Slip the tube assembly aft to remove.

(3) INSTALLATION.

(a) Reverse removal procedure.

(b) Adjust rudders and tabs according to paragraph 4 *f* (4) and 4 *g* (4), this section.

i. EMPENNAGE BOOM. *(See figure 57.)*

(1) DESCRIPTION.—The empennage boom consists of two parts, the forward empennage boom "16" and the aft empennage boom "11," which are joined at fuselage station 430. The empennage boom forms a tail cone to the aft boom "18," the tail cone fairing to a trailing edge flush with the horizontal stabilizer tip and with the elevator when it is in neu[illegible] position. The horizontal stabilizer tip is attached to both fore-and-aft sections. The forward empennage boom supports the

horizontal and vertical stabilizers, and houses the actuating linkage of the rudder and elevator controls. Access is provided through the lower outboard fillet (panel "53").

(2) REMOVAL.

(a) FORWARD EMPENNAGE BOOM.

1. Remove empennage. (See paragraph *a* (1), preceding.)

2. Remove horizontal stabilizer tip. (See paragraph *b* (2), preceding.)

3. Remove vertical stabilizer. (See paragraph *j* (2), following.)

4. Remove horizontal stabilizer. (See paragraph *k* (2), following.)

(b) AFT EMPENNAGE BOOM.

1. Remove horizontal stabilizer tip. (See paragraph *(b)*, preceding.)

2. Remove the screws attaching aft empennage boom to forward empennage boom. (See figure 57.)

3. Move rudder to extreme outboard position.

4. Pull aft and outboard to remove.

(3) INSTALLATION.

(a) FORWARD EMPENNAGE BOOM. — Reverse removal procedure.

(b) AFT EMPENNAGE BOOM.

1. Clean with air and remove foreign particles.

2. Check edge distance and condition of screw holes.

3. Provide for $\frac{1}{32}$-inch clearance between skin of forward and aft empennage booms. File if necessary.

4. Move rudder to extreme outboard position.

5. Mate aft empennage boom with forward empennage boom and fasten with screws. (See figure 57.)

j. VERTICAL STABILIZERS. *(See figure 57.)*

(1) DESCRIPTION—The vertical stabilizers are constructed in upper and lower sections, interchangeable right and left. In the upper sections are the rudder tab actuating units, a navigation light showing on the outboard side only (the light may be installed from either side), one elevator control pulley, and two rudder tab control pulleys. Each lower section carries one elevator control pulley and a steel shoe to protect the lower tip against damage in the event of a tail-down landing. The rudder hinge brackets and the rudder torque tubes are attached to the rear spars.

(2) REMOVAL.

(a) Remove the lower outboard empennage (panel "53").

(b) Remove the rudders. (See paragraph preceding.)

(c) Remove the bolts and screws attaching der torque tube to the stabilizer.

(d) Secure the rudder tab crank in cock that it cannot be turned.

(e) In the baggage and battery compart attach bungee to forward end of rudder tab cab cord to aft end. Disconnect cable at turnbuckl figure 58.)

(f) In the horizontal stabilizer disconn rudder tab cable and attach fish cords to each en move the micarta tab cable stops. (See figure 58.)

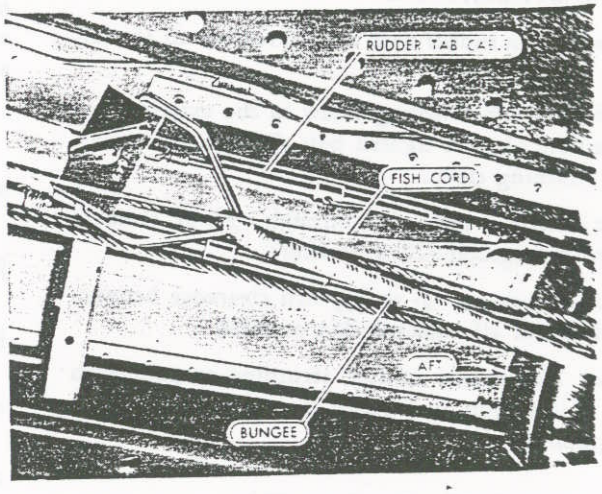


Figure 58 — Bungee on Cable

Note

The above item applies when both vertic stabilizers are to be removed. If, however, on the left one is to be removed, attach a bunge to the right end of the cable and remove on the stop on the left cable, and vice vers Either the upper or the lower sections of th vertical stabilizer may be removed separate The following directions are for removi both.

(g) Tape tab cables at drum to prev winding.

(h) Remove elevator cable from stabili

1. Release cable tension at turnbuckl gage and/or battery compartments.

2. Disconnect cable terminal at elevator balance arm. (See figure 71, view A.)

3. Remove bolts in elevator cable pulleys through access holes "55" and "56" (figure 57).

4. Attach fish cords to cable terminals to provide lead-ins.

5. Withdraw cables from vertical stabilizer; coil and tape to empennage boom when stabilizer is removed.

(i) Remove the screws attaching the vertical stabilizer to the boom.

(j) Lower and remove the lower stabilizer.

(k) Raise the upper stabilizer and through the upper opening in the empennage boom remove the rudder tab cables. Pulleys in empennage boom must be removed.

(l) Detach fish cords and tie in convenient locations to provide lead-ins.

(m) Coil rudder tab cables and tape in convenient location.

(3) INSTALLATION.

(a) Clean vertical stabilizer with air hose and remove all foreign matter.

(b) Check edge distance and condition of screw holes.

(c) Provide for 1/32-inch clearance between skin of stabilizer and skin of forward empennage boom. File if necessary.

(d) String fish cords for rudder tab cable lead-ins in the aft empennage boom and in the horizontal stabilizer if they are not already in place.

(e) String fish cords for elevator cables in upper and lower vertical stabilizer if they are not already in place.

(f) As stabilizer section is moved into place, attach fish cord lead-ins to cables and rig cables.

(g) Attach stabilizer with screws. (See figure 57.)

(h) Attach rudder torque tube. (See figure 57.)

(i) Install rudders (paragraph *f*, preceding).

(j) Adjust elevator, rudders and rudder tab according to paragraphs 4 *d*, *f*, and *g*, this section.

(k) Replace all access panels.

k. HORIZONTAL STABILIZER. *(See figure 57.)*

(1) DESCRIPTION.—The horizontal stabilizer is fastened at each end to the empennage boom. The rear spar carries the elevator hinge brackets and bearings, the end of each elevator torque tube, and the elevator tab actuating unit. An eye, for alternate radio antenna attachment, is located on the leading edge at the center line.

(2) REMOVAL.

(a) Remove empennage. (See paragraph *a* (1), preceding.)

(b) Remove elevator. (See paragraph *c* (2), preceding.)

(c) Remove vertical stabilizers. (See paragraph *j* (2) preceding.)

(d) Remove elevator torque tubes. (See paragraph *e* (2), preceding.)

(e) Disconnect rudder tab cable at access hole "34" (refer to figure 5). Attach fish cords to both terminals to provide lead-ins. Remove micarta stops on tab cable lines. Tape rudder tab actuating drums.

(f) Disconnect elevator tab cable pulleys in forward empennage booms.

(g) Remove the screws attaching the booms to the horizontal stabilizer.

(h) Separate booms from horizontal stabilizer. Detach fish cords; withdraw, coil, and tape cables in convenient location.

(3) INSTALLATION.

(a) Clean all units to be assembled with air and remove foreign matter.

(b) Check edge distance and condition of screw holes.

(c) Provide for 1/32-inch clearance between skin of horizontal stabilizer and skin of forward empennage boom. File if necessary.

(d) String fish cord lead-ins for rudder tab cables in the stabilizer if not already in place.

(e) As stabilizer and boom on each side are moved into place, attach fish cord lead-in to rudder tab cable and draw into place. At left-hand side, guide elevator tab cables around pulleys in empennage boom.

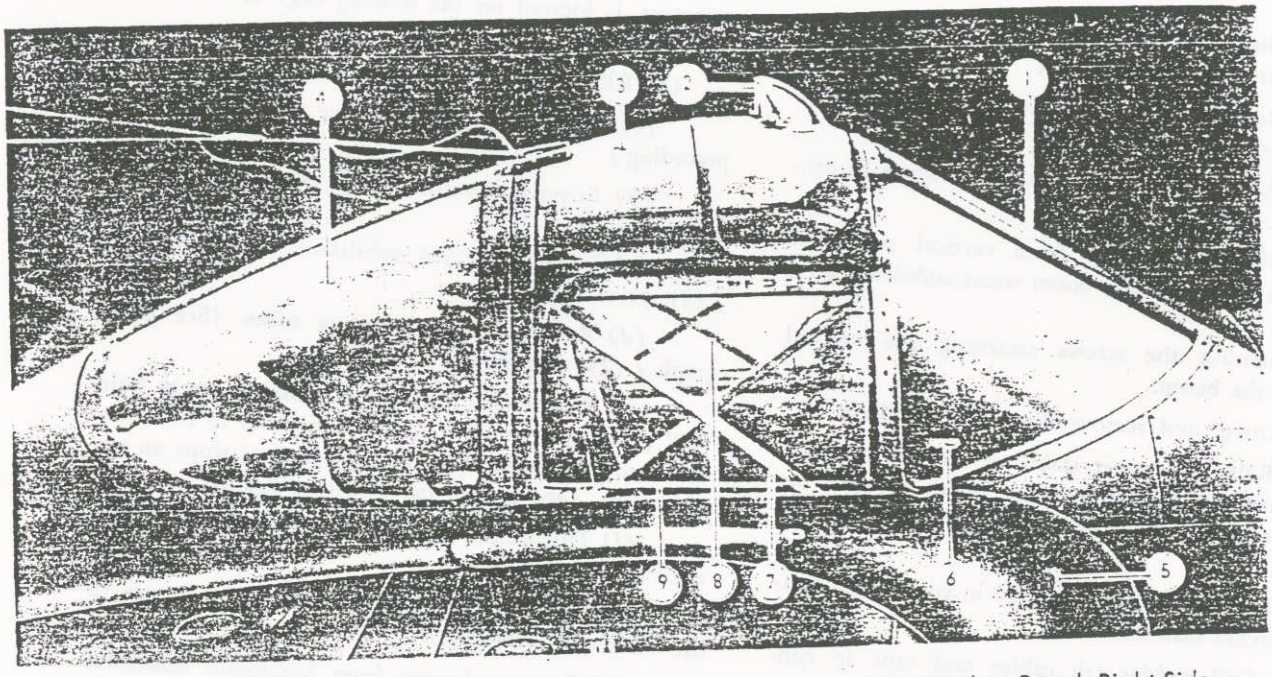
(f) Attach horizontal stabilizer to empennage booms with NAS205 screws. (See figure 57 for lengths.)

3. BODY GROUP.

a. GENERAL.—The body group, consisting of the fuselage, the center section, and forward booms, is jig-mated, riveted and bolted together, and as such is considered as an irreplaceable unit. The aft boom is also jig-mated and bolted but is replaceable.

b. FUSELAGE.

(1) GENERAL.—The fuselage is a flush-riveted all-metal semi-monocoque gondola-type structure. The



1. Windshield Panel, Front
2. Rear View Mirror
3. Hatch
4. Aft Canopy
5. Dive Fillet
6. Windshield Panel, Side
7. Window Panel, Right Side
8. Window Panel, Left Side
9. Seal, Window to Dive Fillet

Figure 59 — Cockpit Enclosure

lower section contains the nose landing gear, a compartment for receiving ejected cannon shell cases and links, major units of the hydraulic pressure control system, and control valves for flaps and landing gear. The fuel valves, strainers, booster pumps, and the engine and surface-control cables are also located in the lower section of the fuselage.

The upper section contains the armament, cockpit, and radio compartments. Access to the armament compartment is provided by two hinged panels secured by Dzus fasteners. The aft section of the fuselage contains the hydraulic reservoir, flap motor drive, and the mounting ladder.

(2) WINDSHIELD.

(a) DESCRIPTION. — The windshield is composed of three separate glass panels. The front bullet-proof panel is made of five layers of glass, set in transparent plastic. The side panels are made of two layers of glass set in the same plastic. All panels are held in the aluminum alloy frame by aluminum retainers.

(b) REMOVAL.

1. Remove left and right dive fillets. (See figure 59.)

2. Remove screws from retainers and lift out glass panels.

(c) CLEANING.—Apply soap and water with the bare hands, a grit-free soft cloth, chamois, or sponge. Use kerosene or naphtha to remove grease or oil, but do not use acetone, benzene, lacquer thinners, or window-cleaning solvents, as these chemicals will soften or "craze" the surface. Never rub the surface of the glass with a dry cloth, as this tends to scratch the surface, and also builds up an electro-static charge, which will attract dust particles. After any cleaning operation, blot the glass with a clean, damp chamois to neutralize any such charge. Apply automobile or furniture wax to cover minor scratches and provide a glossy finish.

(d) REPLACEMENTS.

1. Replace weatherstrips when worn.

2. Replace cracked, chipped, or broken glass.

(e) INSTALLATION. *(See figure 60.)*

Note

All cements must conform to U. S. Army Specification 26544. Remove center panel before installing either side panel. Tighten nuts finger-tight plus one-half turn.

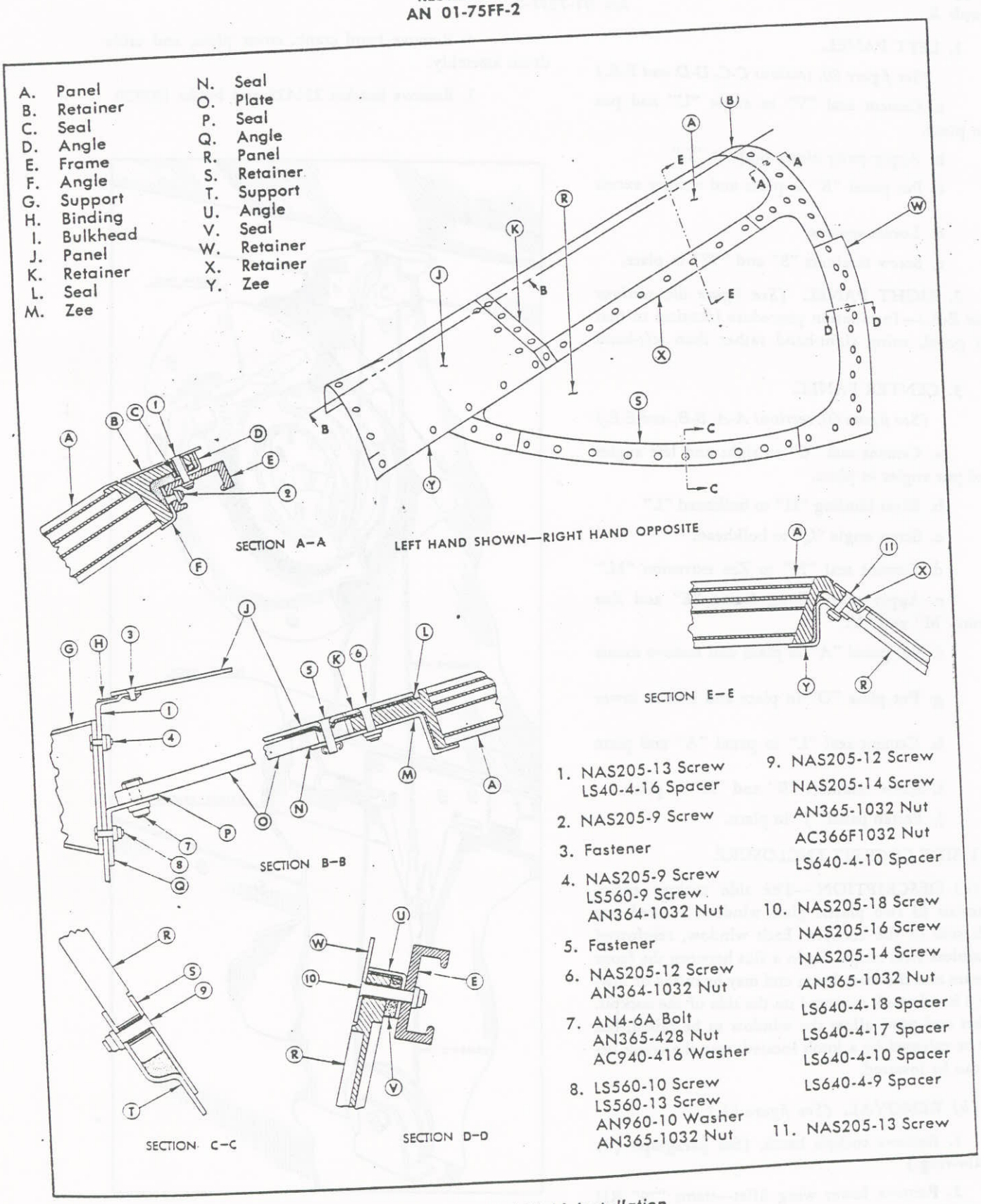


Figure 60 — Windshield Installation

1. LEFT PANEL.

(See figure 60, sections C-C, D-D and E-E.)

a. Cement seal "V" to angle "U" and put angle in place.

b. Apply putty along support "T."

c. Put panel "R" in place and remove excess putty.

d. Locate spacers.

e. Screw retainers "S" and "W" in place.

2. RIGHT PANEL. *(See figure 60, sections D-D and E-E.)*—Installation procedure identical to that for left panel, using right-hand rather than left-hand parts.

3. CENTER PANEL.

(See figure 60, sections A-A, B-B, and E-E.)

a. Cement seal "C" to right and left angles "D" and put angles in place.

b. Rivet binding "H" to bulkhead "I."

c. Screw angle "Q" to bulkhead.

d. Cement seal "N" to Zee extrusion "M."

e. Apply putty along frame "E" and Zee extrusions "M" and "Y."

f. Put panel "A" in place and remove excess putty.

g. Put plate "O" in place and bolt at lower end.

h. Cement seal "L" to panel "A" and plate "O."

i. Screw retainers "B" and "X" in place.

j. Fasten panel "J" in place.

(3) SIDE COCKPIT ENCLOSURE.

(a) DESCRIPTION.—The side cockpit enclosure consists of two plastic glass windows located one on each side of the cockpit. Each window, reinforced with stainless steel strips, fits in a slot between the front shear beam and the main beam and may be raised or lowered by a hand crank mounted on the side of the cockpit. A ratchet and pawl allow the window to be raised, but it must be released by a knob located near the crank before it can be lowered.

(b) REMOVAL. *(See figure 61.)*

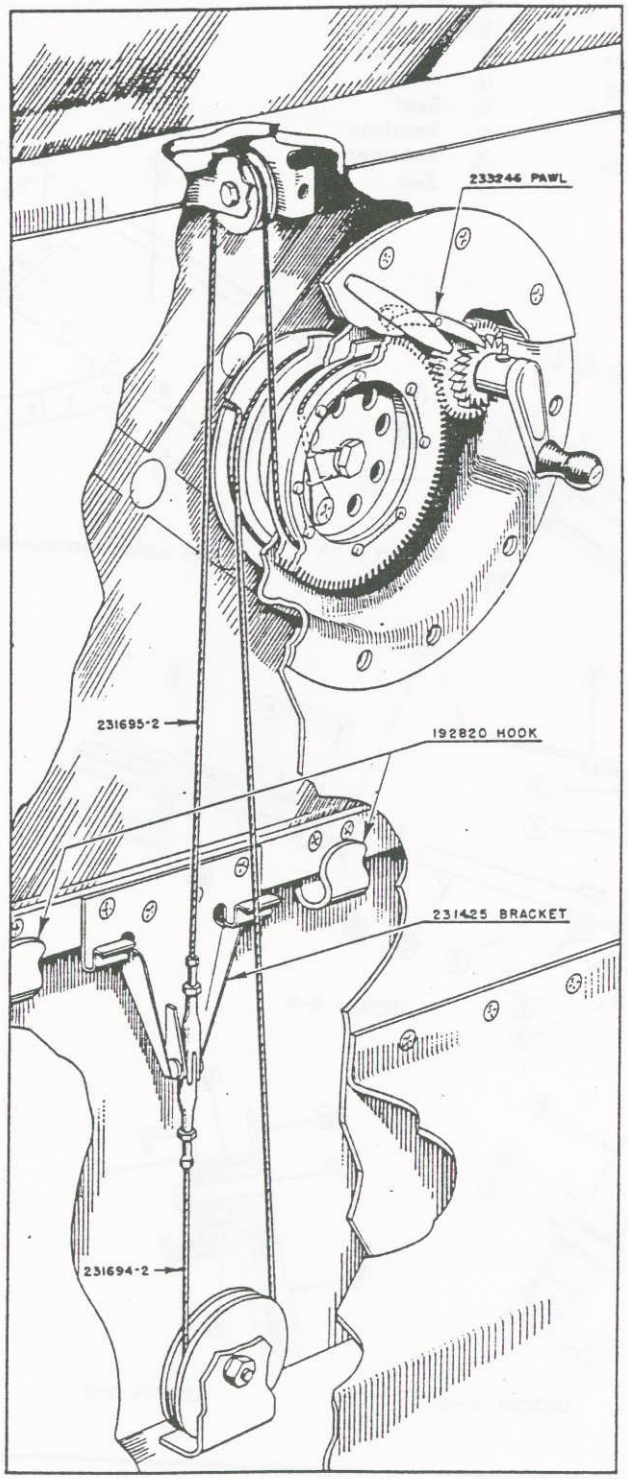
1. Remove cockpit hatch. (See paragraph (4) *(c)*, following.)

2. Remove lower wing fillet—items "79" RH and "146" LH, figure 3.

3. Disconnect cables from bracket 231425.

4. Remove hand crank, cover plate, and cable drum assembly.

5. Remove bracket 231425 and hooks 192820.



For Key to Cables, See Section IX.

Figure 61 — Window Controls

6. Remove aft retaining strip "7" (figure 62).

7. Remove top two screws in front retaining strips LH and RH "W" (figure 60).

8. Lift window panel out.

(c) MAINTENANCE REPAIRS.

1. CLEANING.—See paragraph (2) *(c)* preceding.

2. FINISHING.—General recommended procedure for deep scratches:

Note

Do not sand surface unless absolutely necessary.

a. Clean surface as outlined above.

b. Wrap wet sandpaper (No. 320) around a smooth rubber or wooden block and sand with a free, circular motion. Sand over wide area to prevent optical distortion.

c. Wash surface thoroughly and repeat above operation with a finer wet sandpaper (No. 400).

d. If equipment is available, instead of sanding, buff surface with cotton muslin buffing wheel driven by a high speed drill motor. Load the wheel with rouge by rubbing against jeweler's rouge block. Keep wheel moving quickly and lightly over surface to prevent burning.

e. Apply automobile body cleaner with damp pad of soft cloth. Rub with a free circular motion. Remove cleaner with a damp soft cloth.

f. Apply a good automobile or furniture wax evenly with a cloth pad. Allow wax to dry for a few seconds and polish with a clean, dry cloth.

(d) INSTALLATION. — Reverse removal procedure.

Note

To keep pawl (figure 61) properly aligned with the ratchet, tighten the nut until the pawl has no lateral movement but still can turn freely. (It may be necessary to file the end of the spacer on which the pawl rotates.) Maximum clearance between pawl and washer is .003 inch.

(4) COCKPIT HATCH.

(a) DESCRIPTION. — The cockpit hatch is a molded plastic panel fitted to a metal frame. The hatch opens aft on a hinge attached to the frame. Incorporated in the hinge is a telescope stop (rod sliding in a tube). A pin and cable assembly controlled from in or outside the cockpit locks the hatch in the down position.

(b) OPERATION.—The red-painted handle located in the center of the windshield channel above pilot is attached to a cable, both ends of which are connected by clevis terminals and pins to a latch. These pins are held in position by coil springs contained in a housing, thus the constant tension eliminates any slack in the cable and gives the protruding ends of the pins a door-latch action. One end of a pivoting handle hooks into a bracket of the hatch and with a half-turn the other end is snapped behind the latch, locking the latch in the DOWN position.

A pull on the handle releases the hatch. To give access to the cockpit from the outside, two small handles are located on the forward side of the channel. When turned, these act directly on the latch pins releasing the hatch. Unlocked, the hatch rises about two inches, providing space for manual opening. If, due to emergency, the hatch is released in flight, air pressure will tear the hatch away allowing an unimpeded emergency exit. To secure cockpit, if airplane is left unattended, a Yale lock is installed in the hatch, which latches against the hatch support.

(c) REMOVAL.

1. Remove the two hinge screws and the two aft telescope screws.

2. Remove hatch and fasten rod part of the telescope to hinge on hatch to prevent losing rod and spring.

(d) MAINTENANCE REPAIRS. — See paragraph (2) *(c)* and (3) *(c)* 2, preceding.

(5) AFT CANOPY. *(See figure 62.)*

(a) DESCRIPTION.—The aft canopy, composed of two plastic panels covers the radio compartment. The panels are ¼-inch curved plastic sheets fitted in metal frames secured by Airloc fasteners for quick removal. A synthetic rubber liner cemented to the frame provides the seal between the framework and the cover.

(b) REMOVAL.

1. Disconnect the antenna attachment and lead-in through the glass.

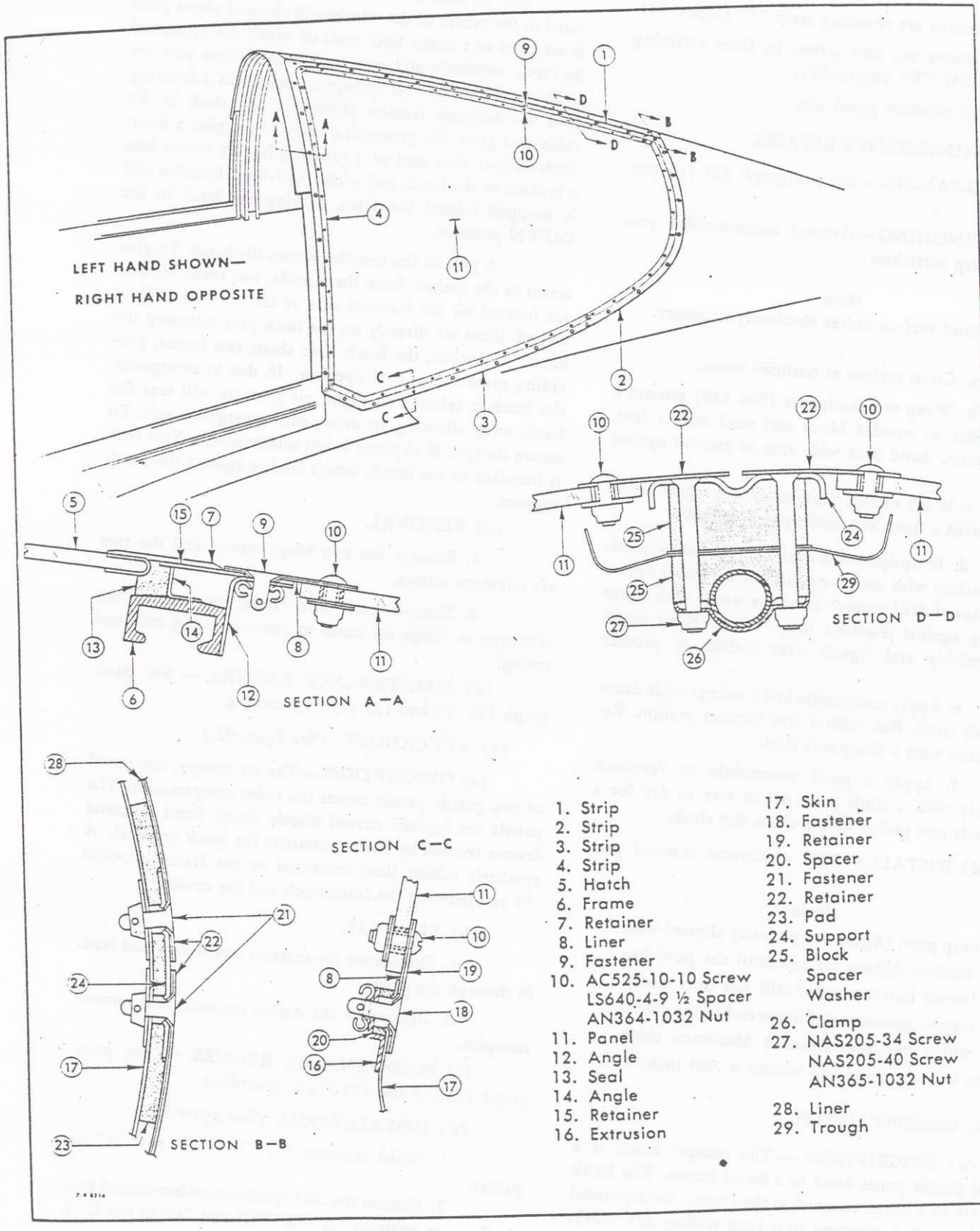
2. Disconnect the Airloc fasteners and remove canopies.

(c) MAINTENANCE REPAIRS. — See paragraph (2) *(c)* and (3) *(c)* 2, preceding.

(d) INSTALLATION. *(See figure 62.)*

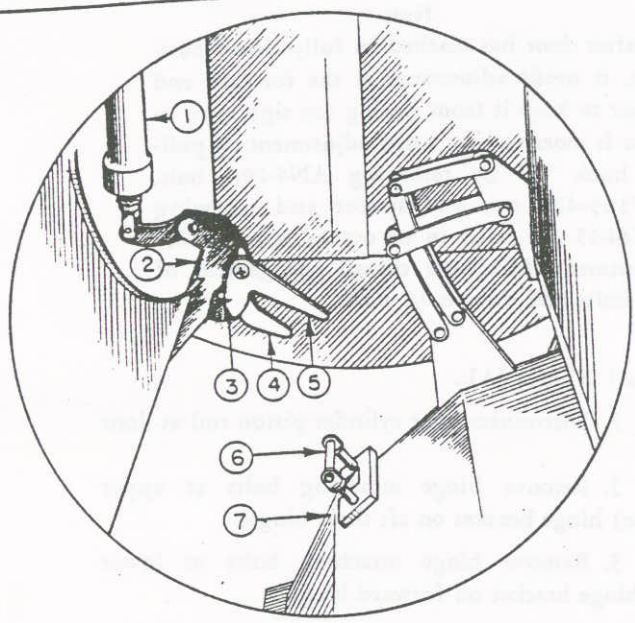
1. Weld retainers "1," "2," "3," and "4" together.

2. Cement the .025 synthetic-rubber-coated fabric liners to retainers "1," "2," "3," and "4," as per U. S. Army Specification 26544.

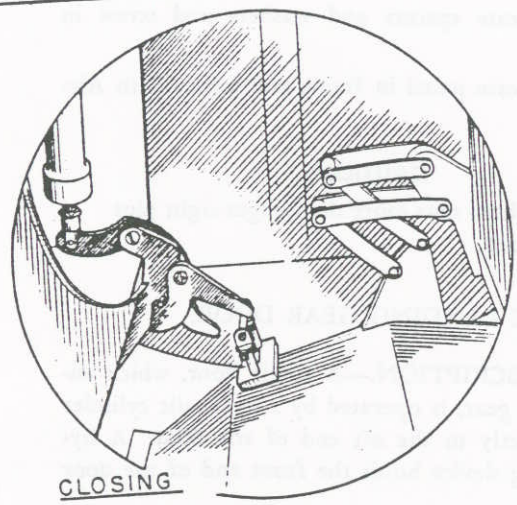


1. Strip
2. Strip
3. Strip
4. Strip
5. Hatch
6. Frame
7. Retainer
8. Liner
9. Fastener
10. AC525-10-10 Screw
    LS640-4-9 ½ Spacer
    AN364-1032 Nut
11. Panel
12. Angle
13. Seal
14. Angle
15. Retainer
16. Extrusion
17. Skin
18. Fastener
19. Retainer
20. Spacer
21. Fastener
22. Retainer
23. Pad
24. Support
25. Block
    Spacer
    Washer
26. Clamp
27. NAS205-34 Screw
    NAS205-40 Screw
    AN365-1032 Nut
28. Liner
29. Trough

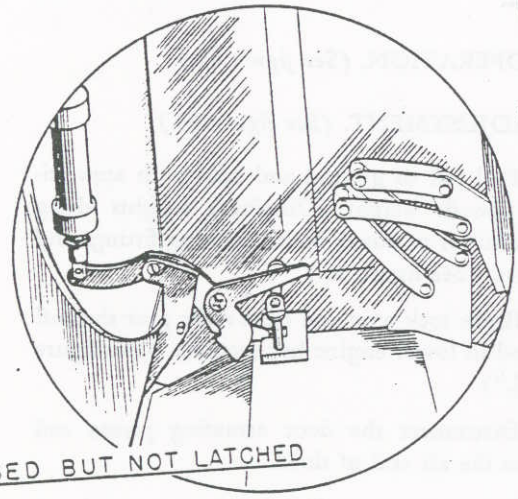
Figure 62 — Aft Canopy



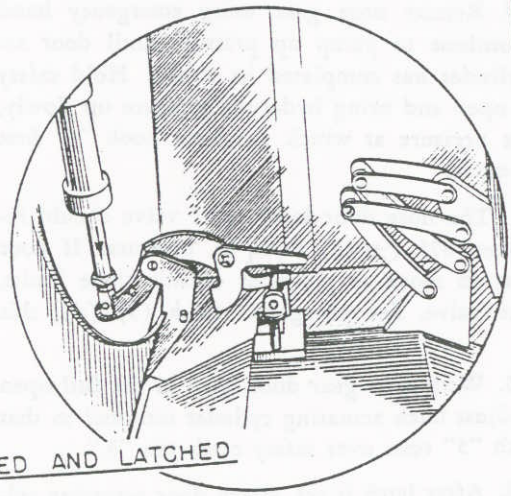
OPEN



CLOSING



CLOSED BUT NOT LATCHED



CLOSED AND LATCHED

1. Lock Cylinder
2. Fitting
3. Pin
4. Hook
5. Catch
6. Pull-up Hook
7. Door

OPERATION

OPENING

Hydraulic fluid acts on the door actuating cylinder "4" (figure 65) and the door lock cylinder "1" (figure 63) simultaneously, but lock cylinder operates first as it has a smaller load in proportion to its size. With the door open, a spring returns catch "5" under pin "3."

CLOSING

1. Door cylinder is closing door. Because of the relief valve (adjusted to 875 lb sq in.) in the hydraulic line, fluid cannot operate lock cylinder until pressure is built up to 875 lb sq in. Therefore, it flows first to the door cylinder and closes the door.

Note

If the relief valve fails and pressure is applied to lock cylinder before the door is closed, the pressure will not move the hook "4" because the pin "3" holds the catch "5." Thus the catch and the relief valve both prevent the hook "4" from being operated before the door is closed.

2. As the door closes, the pull-up hook "6" strikes the arm on the catch "5," pulling the catch from the pin "3." Now the hook "4" is free to move.

3. When the door is fully closed, the hydraulic fluid builds up to exert full system pressure (1350 lb. sq in.) on the relief valve (adjusted to 875 lb sq in.). Thus pressure up to 475 lb/sq in.—the difference between 1350 and 875—acts on the lock cylinder "1." The cylinder moves the hook "4" under the pull-up hook "6" to latch the door securely.

Figure 63 — Nose Landing Gear Door Locking Operation

3. Place retainers on panel.

4. Locate spacers and washers and screw in place.

5. Locate panel in frame and secure with Airloc fasteners.

CAUTION

Do not tighten nuts more than finger-tight plus one-half turn.

(6) NOSE LANDING GEAR DOOR.

(a) DESCRIPTION.—A single door, which encloses the nose gear, is operated by a hydraulic cylinder connected directly to the aft end of the door. A hydraulic latching device holds the front end of the door tightly closed.

(b) OPERATION. *(See figure 63.)*

(c) ADJUSTMENT. *(See figure 63.)*

1. Pull tail to ground and hold with approximately 800 pounds weight. Distribute weights along horizontal stabilizer or attach boom mooring fittings and pull tail down. (See figure 28.)

2. Break lock wire and close main gear shut-off valves, located in lower engine bay sections. (See figure 241, item "Q.")

3. Disconnect the door actuating piston rod (figure 65) at the aft end of door.

4. Retract nose gear using emergency hand pump. Continue to pump up pressure until door actuating cylinder has completed its stroke. Hold safety catch "5" open and bring hydraulic pressure up slowly, noting the pressure at which the latch hook "4" first begins to move.

The nose door latch relief valve should release between 875 ($\pm$ 25) lb/sq in. pressure. If door hook starts to move at pressures outside these limits, reset relief valve. See paragraph 19 *h* (5) *(d)*, this section.

5. With nose gear door latch in the full open position adjust latch actuating cylinder terminal so that safety catch "5" rests over safety catch pin "3."

6. After latch is set, attach door actuating cylinder to door and close door, using hand pump.

7. The aft end of the door, in the open position, must clear gear during its UP or DOWN cycle. If aft end of door fails to close completely, adjust door cylinder piston terminal. When in the open position, door actuating cylinder piston must ride fiber stop-block to prevent vibration.

Note

If, after door has reached its fully closed position, it needs adjustment at the forward end either to keep it from closing too tightly or to close it more tightly, make adjustment on pull-up hook "6" by removing AN4-20A bolt, AN365-428 nut and spacer and screwing AN44-15 eye bolts in or out as required for adjustment. Minimum thread engagement of eye bolts and door is 1/4 inch.

(d) REMOVAL.

1. Disconnect door cylinder piston rod at door bracket.

2. Remove hinge attaching bolts at upper (fuselage) hinge bracket on aft three hinges.

3. Remove hinge attaching bolts at lower (door) hinge bracket on forward hinge.

(e) INSTALLATION. — Reverse removal procedure. For aft three hinges use AN23-20 bolts, AN320-3 nuts, and washers. For forward hinge use AN23-10 bolts, AN320-3 nuts, and washers.

(7) MOUNTING LADDER.

(a) DESCRIPTION. — A retractable ladder is built into the tail cone at the aft end of the fuselage. A handhole is provided on the left side of the fuselage for assistance in mounting the ladder.

(b) OPERATION. *(See figure 64.)*

(c) REMOVAL. *(See figure 64.)*

1. Remove aft fuselage cone panel "85" (figure 3).

2. Remove small spring hooked to handle catch assembly "7."

3. Remove large spring hooked to lug near ladder fulcrum and support arm pivot "6."

4. Remove skin button on side of cone panel and unscrew ladder fulcrum pin.

5. Remove support arm pivot pin.

(d) ADJUSTMENT. *(See figure 64.)*—The ladder when retracted must be flush with the surface of the fuselage. An adjusting screw for raising and lowering the retracted ladder connects the arm "7" to the pivot assembly "6." The screw is reached through the slot for the handle arm "5."

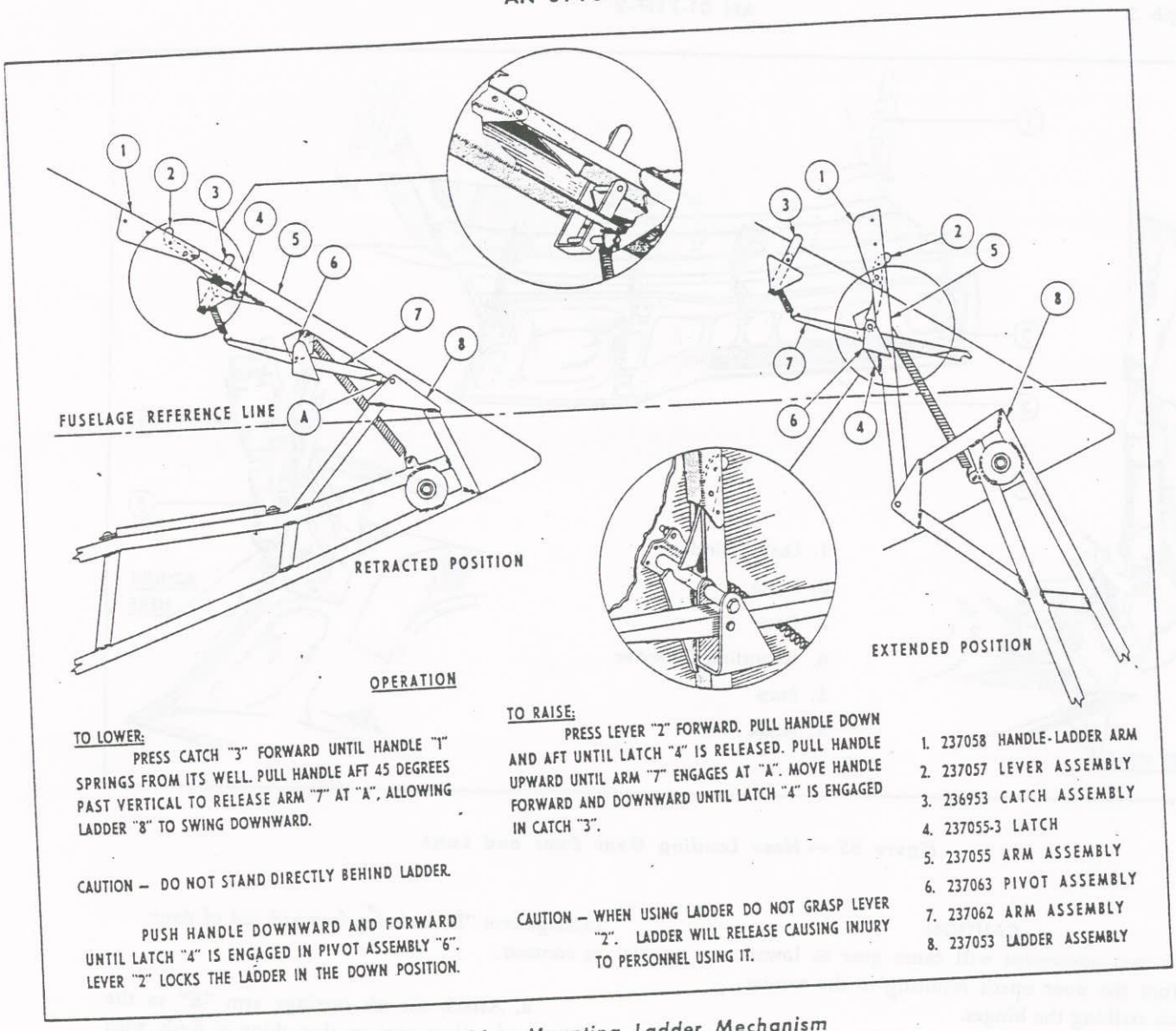


Figure 64 — Mounting Ladder Mechanism

c. BOOMS.

(1) GENERAL.—The empennage is supported by twin booms which extend from the empennage booms to the engine fire walls. Each boom consists of two major components: the forward boom and the aft boom, which are described under their respective headings.

(2) FORWARD BOOM.

(a) GENERAL. — The forward boom extends from the engine fire wall to station 265 and is jig-mated to the center section. The main landing gear and supercharger installations are contained in this section. Stressed skin construction is employed throughout, including the inside skin of the wheel wells and the corrosion-resistant steel skin exposed to supercharger heat.

(b) MAIN LANDING GEAR DOORS.

1. DESCRIPTION. — Two doors, hinged to the lower channels of the forward boom, operate automatically with the landing gear movement. A hydraulic cylinder located in the aft end of the wheel well operates the front and rear door carriages through a linkage of cables and rods.

2. MAINTENANCE REPAIRS. — Lightening holes in the doors are covered with pinked airplane-fabric patches treated with dope. Any damaged patches must be replaced. The installation of washers in hinge brackets may be varied to eliminate end play.

3. ADJUSTMENT. *(See figure 66.)*

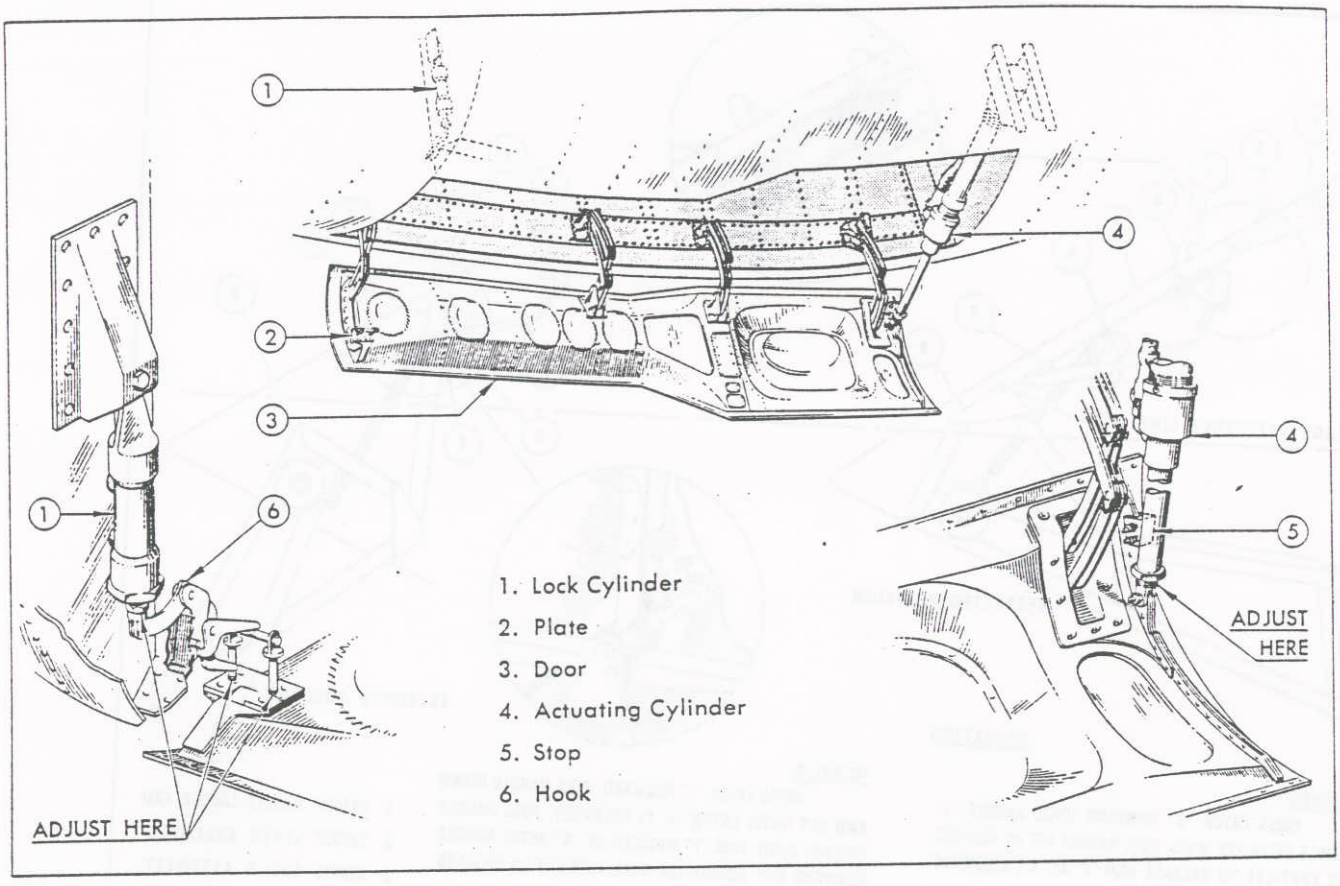


Figure 65 — Nose Landing Gear Door and Latch

CAUTION

Incorrect adustment will cause gear to lower before the door opens resulting in the torque arms striking the hinges.

a. With the doors disconnected from the carriage arms, adjust piston length "A" so that the connected carriage reaches the full UP or latched position when the piston is bottomed.

b. Adjust cable lengths "F" and "G," maintaining a tension of 70 pounds, so that the front and rear operating carriages are synchronized and the cam lock "B" on the front carriage has 1/32- to 1/16-inch clearance above the top of the needle bearing "C" for a rough adjustment.

c. With the gear in the UP position close the main landing gear shut-off valves "Q" (figure 241). Operate hand pump very slowly until piston is bottomed.

Note

When piston is bottomed, piston rod will still extend 7/32 inch. Attach and adjust one forward carriage arm "D" to bring forward end of door to contour.

d. Attach the aft carriage arm "E" to the same door and adjust arm so that door is flush with boom contour when piston is bottomed.

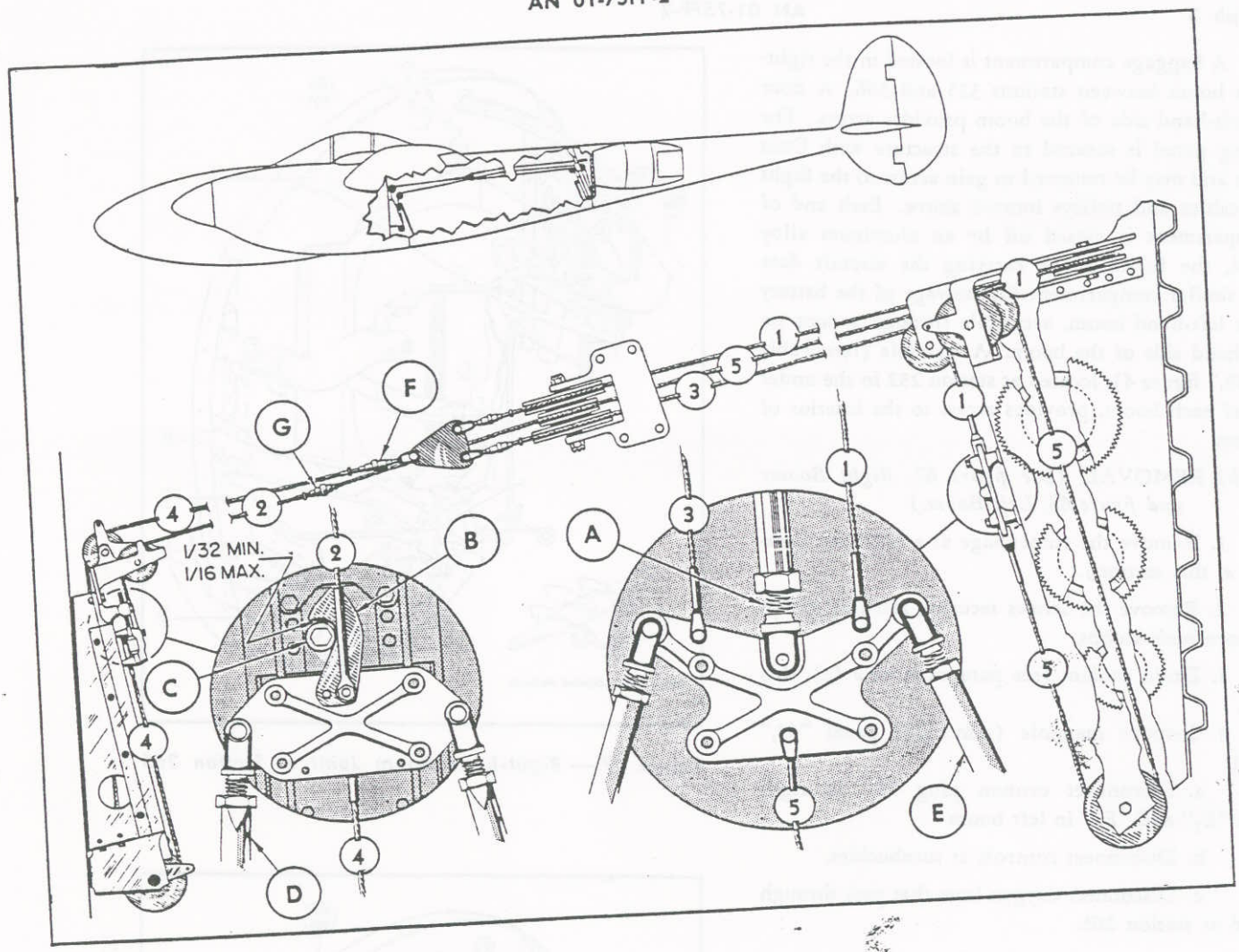
e. Operate door to see if cam lock operates correctly. There should be a clearance of 1/32 inch (maximum 1/16 inch) between cam lock and needle bearing.

CAUTION

This clearance is critical and must be thoroughly checked. Tension in the UP cable should increase to approximately 125 pounds due to piston travel after carriage has stopped.

f. Disconnect doors. Be careful not to alter length of carriage arms.

g. Repeat steps c, d, and e, on opposite door; reconnect doors and check.



A. Piston Length Adjustment
B. Carriage Cam Lock
C. Needle Bearing
D. Forward Carriage Arm
E. Aft Carriage Arm
F. Down Cable Adjustment
G. Up Cable Adjustment

NOTE: Cable tension is 70 (±5) lb.

For Key to Cables, See Section IX.

Figure 66 — Main Landing Gear Door Control Cables

4. REMOVAL.

a. Remove bolts attaching forward and aft carriage arms to door brackets.

b. Remove hinge attaching bolts at upper (boom) hinge fittings.

5. INSTALLATION. — Reverse removal procedure. Use AN3-6 bolts for rear carriage arm attachments and AN3-10 for forward. Carriage arm bolts require AN310-3 nuts and AN960-10 washers. Use AN3-15 bolts, AN310-3 nuts, and washers for hinge installations.

(3) AFT BOOM.

(a) DESCRIPTION.—The aft boom joins the forward boom at station 265 and extends aft to station 393, where it attaches to the empennage boom. The attachment to the forward and empennage booms is made by screws and stop nuts through the skin and webs and by bolts through two forged fittings that mate with fittings on the forward boom channels. Coolant radiator frames are supported by brackets attached to formers at stations 282 and 295.

A baggage compartment is located in the right-hand aft boom between stations 325 and 366. A door on the left-hand side of the boom provides access. The top lining panel is secured to the structure with Dzus fasteners and may be removed to gain access to the flight control cables and pulleys located above. Each end of the compartment is closed off by an aluminum alloy bulkhead, the forward one carrying the aircraft data case. A similar compartment for stowage of the battery is in the left-hand boom, accessible through a door on the left-hand side of the boom. A manhole (removable panel "49," figure 4), located at station 232 in the under surface of each boom, provides access to the interior of each boom.

(b) REMOVAL. *(See figure 67, Right Boom; and figure 68, Left Boom.)*

1. Remove the empennage as a unit (see paragraph 2 *a*, this section).

2. Remove the screws securing radiator scoops and remove both scoops.

3. Drain coolant (see paragraph 14 *a* (3), this section).

4. Remove manhole (removable panel "49," figure 4):

a. Disconnect cannon plug "E" in right boom or "E_1" and "E_2" in left boom.

b. Disconnect controls at turnbuckles.

c. Disconnect oxygen lines that pass through bulkhead at station 265.

CAUTION

Discharge oxygen system before disconnecting oxygen lines. (See paragraph 23 *f* (2), this section.)

5. Disconnect coolant hose connections "C_2" inboard and outboard.

6. Loosen center bolt and screw holding cable guard "G_1" on elevator and rudder cable pulley assembly to enable cable terminals to be withdrawn.

7. Remove guide "G_2" to tab cable pulley assembly.

8. Disconnect hydraulic lines "H."

CAUTION

Relieve pressure on hydraulic system by operating the wing flaps.

9. Disconnect coolant hose connections "C_3."

10. Remove bolts "B" and all screws "S" except five on top.

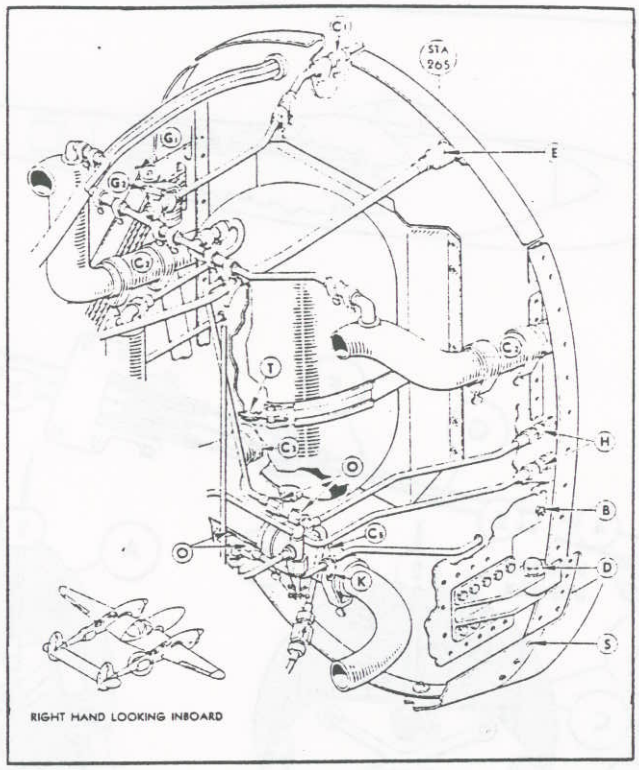


Figure 67 — Right-hand Boom Joint at Station 265

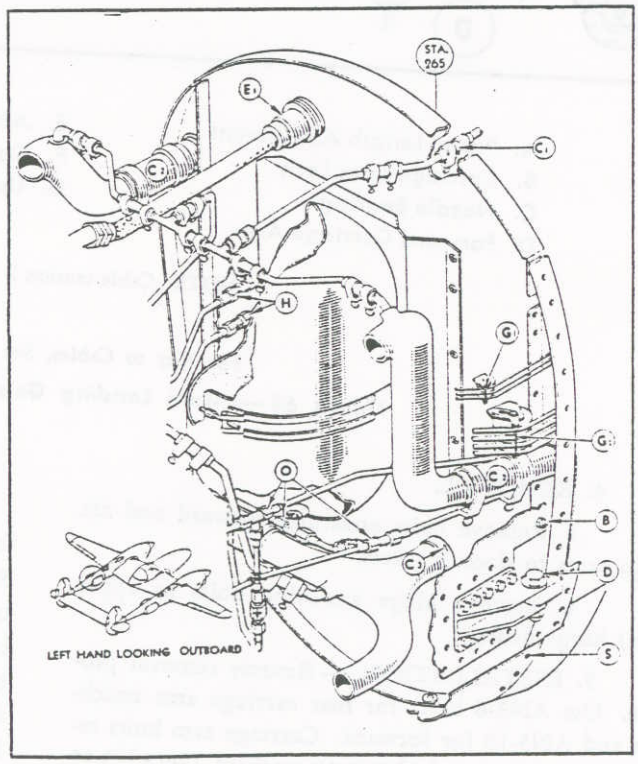


Figure 68 — Left-hand Boom Joint at Station 265

11. Support aft boom with sling, stand, or six men and remove remaining screws and two bolts "D."

12. Move boom carefully aft, watch all cables and tubing to avoid catching.

(c) INSTALLATION. *(See figure 67, Right Boom; and figure 68, Left Boom.)*

1. Clean all components with air and remove all foreign matter.

2. Check all mating screw and bolt holes for position, condition, and edge distance.

3. Provide for $\frac{1}{32}$-inch clearance between skin of forward and aft booms. File and bevel if necessary.

4. Structure (doublers and stringers) of aft boom must not interfere with mating structure. File ends if necessary.

5. String fish cords for cable lead-ins to baggage compartment.

6. Support aft boom with sling, stand, or six men, and move into position. Align holes for bolts "D" with two drift pins and install bolts.

7. Support of boom may be removed when two bolts "D" and five screws "S" (NAS205) are installed in the top skin. Install all screws "S" and bolts "B" (AN23.)

Note

All outside screws are flush. Countersink holes if necessary. Screws must not be long enough to interfere with tubing or other installation.

8. Reverse removal procedure steps *1* to *6*, inclusive, paragraph *(b)* preceding.

9. Adjust empennage controls according to paragraph 4, this section.

10. Replace all access covers.

4. SURFACE CONTROLS.

a. GENERAL.—Preformed tinned or galvanized aircraft cable, Specification AN-RR-C43 is used throughout the surface control system; $\frac{3}{16}$-inch 7 x 19 strand is used for main flight control surfaces; $\frac{1}{8}$-inch 7 x 19 for the wing flaps, and $\frac{1}{16}$-inch 7 x 7 for the trimming tabs. Terminals are swaged on all cable ends except those in the aileron booster and the flap carriages where bushings are centered in eyes bound by nicropress oval sleeves. All cables may be removed by disconnecting pulleys and turnbuckles. Sealed bearing anti-friction pulleys are employed exclusively. The cables are stretched before installation and are protected against corrosion by application of rust-preventive compound, Specification AN-C-52. Cables are identified by bands of colored cellulose tape encircling the ends. (Refer to Section IX, "Control Cable Color Code.") For location of access panels and inspection plates, refer to figures 3, 4, and 5.

The elevator and rudders are each fitted with a trim tab actuated by a revolving drum on an acme-threaded push-pull rod. The trim tabs are manually adjusted in the cockpit by hand cranks geared to operating drums, which are connected by cables to the actuating drums.

Ailerons are not fitted with adjustable trim tabs; however, they are equipped with fixed trim tabs that are used to correct wing heaviness. (Refer to Section III, paragraph 4 *a* and figure 36.) Aileron boosters are incorporated that hydraulically transmit servo action, as long as the pilot rotates the control wheel to exert one-sixth of the aileron load. Without hydraulic pressure the ailerons operate in the normal manner.

Cables must not be twisted when rigging and must not have more than two degrees "pull-off." (The deviation between the center plane of the pulley and the center line of the cable is called pull-off.) If cable and pulley flange chafe each other, alignment must be checked and corrected.

CAUTION

Turnbuckles must not show more than three threads at either end.

Note

When making any cable adjustment, maintain proper cable tension by turning the opposite turnbuckle the same number of opposite turns.

Turnbuckle adjustments of the elevator, rudder, and tab cables are made in the baggage and battery compartments in the aft booms. Other adjustment and disconnect fittings are shown in figures 70, 71, and 75.

b. CONTROL COLUMN. *(All item numbers refer to figure 69 unless otherwise stated.)*

(1) DESCRIPTION. — The control column is a hollow inverted L-shaped member consisting of aluminum alloy tubing. It is mounted in the right-hand side of the fuselage on two ball bearings located below the floor of the cockpit and between the outer skin and wheel well web.

The aileron-control wheel "3" is mounted at the upper extremity of the "L." The wheel turns approximately 144° each way from neutral when full throw of the ailerons is effected. Aileron throw is lim-

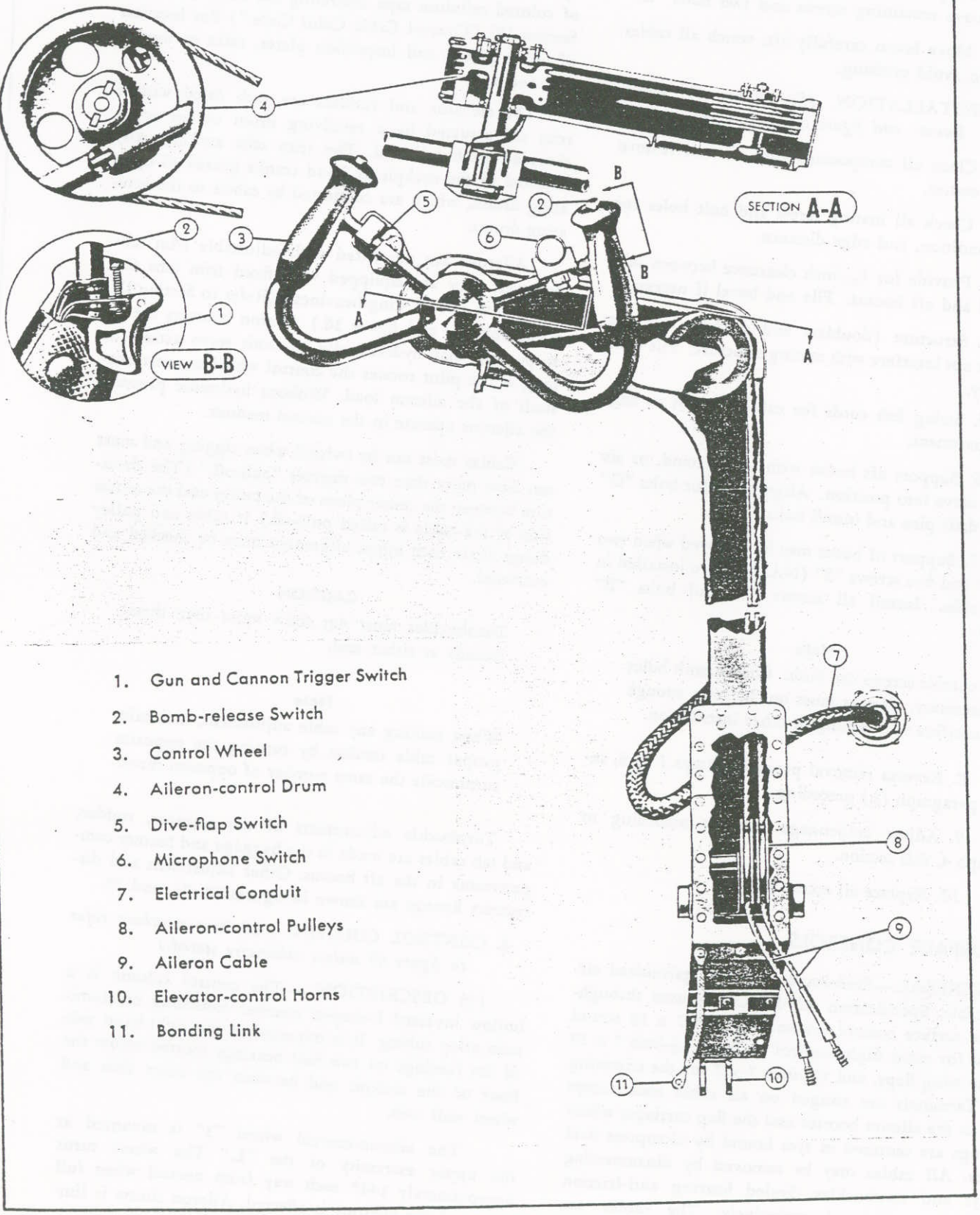


Figure 69 — Control Column

ited by piston travel in the booster-actuating cylinder. The aileron cable is secured to a drum "4" keyed on the control-wheel shaft from whence it is carried over pulleys at the angle of the "L" downward to a second set of pulleys "8" located at the center line of the column pivot bearings where the two ends of the cable leave the column.

The lower extremity of the control column contains the bearings "10" to which are attached the elevator-control cables. Threaded adjustable stops limiting the fore-and-aft movement of the column are located below the floor and may be reached through the wheel well. (Refer to figure 71, view C.)

In addition to flight controls, the control column carries the gun-camera switch box, the gun-sight switch box, and a fluorescent light bulb for the instrument panel. The control wheel has a push-button switch "2" for bomb release and a trigger switch "1" for cannon and machine guns on the right-hand grip, a microphone switch "6" on the right-hand spoke of the wheel, and a dive-flap switch "5" on the left-hand spoke. An engine operation placard is mounted on the aft side of the control column at the angle of the "L."

(2) REMOVAL AND INSTALLATION.

(a) Disconnect the electrical conduit "7."

(b) Unfasten leather boot.

(c) Remove panels "86" and "87" (figure 3).

(d) Disconnect the elevator and aileron control cables in the wheel well.

(e) Detach the control column bonding link "11."

(f) Remove the bolts attaching the pivot bearing housing to the fuselage and lift the column out.

(g) To install, reverse above procedure and rig cables according to directions given in paragraphs *c* and *d*, following.

(3) ADJUSTMENT.—Adjust aileron and elevator controls as described in paragraphs *c* (4) and *d* (4), following.

(4) TEST.—Test aileron and elevator controls as described in paragraphs *c* (5) and *d* (5), following.

c. AILERON CONTROL. *(See figure 70 and paragraph 19 g, this section.)*

(1) DESCRIPTION. — Ends of the cables from the control column are fastened by turnbuckles to both ends of a cable which runs aft to pulleys under the main beam, up through holes in the lower beam cap and around the larger circumference of a reduction drum mounted inside the main beam. (See figure 70.) From this point outboard to each aileron the right- and left-hand systems are independent, and either side may be disabled without affecting the other.

Cables to the ailerons are secured around the smaller circumference of the drum. To the left, one passes over and one under pulleys mounted at the center line of the airplane, through a fair-lead at station 119 near the rear face of the outer panel main beam, and are secured to the quadrant of the aileron booster unit (see paragraph 19 *g*, this section). To the right aileron, the lower cable passes over a pulley at station 15 and from this point outboard the system is similar to that on the left-hand side.

Turnbuckles for adjusting the cables and for breaking them when removing the outer wing panel are accessible through an inspection plate "5" (figure 5) in the lower wing surface aft of the main beam.

(2) OPERATION.—A right turn of the pilot's control wheel raises the right aileron and lowers the left aileron, causing the airplane in flight to roll to the right. Likewise, a left turn of the wheel raises the left aileron and lowers the right, banking the airplane for a left turn. With hydraulic pressure "ON," the aileron booster transmits servo action as long as the pilot rotates the control wheel to exert one-sixth of the aileron load. With hydraulic pressure "OFF" the ailerons operate in the normal manner.

An extreme turn of the control wheel (approximately 144°) will raise one aileron 25° and lower the other 20°. This differential action is achieved by the pivoting position of the push-pull rods on the booster bell crank.

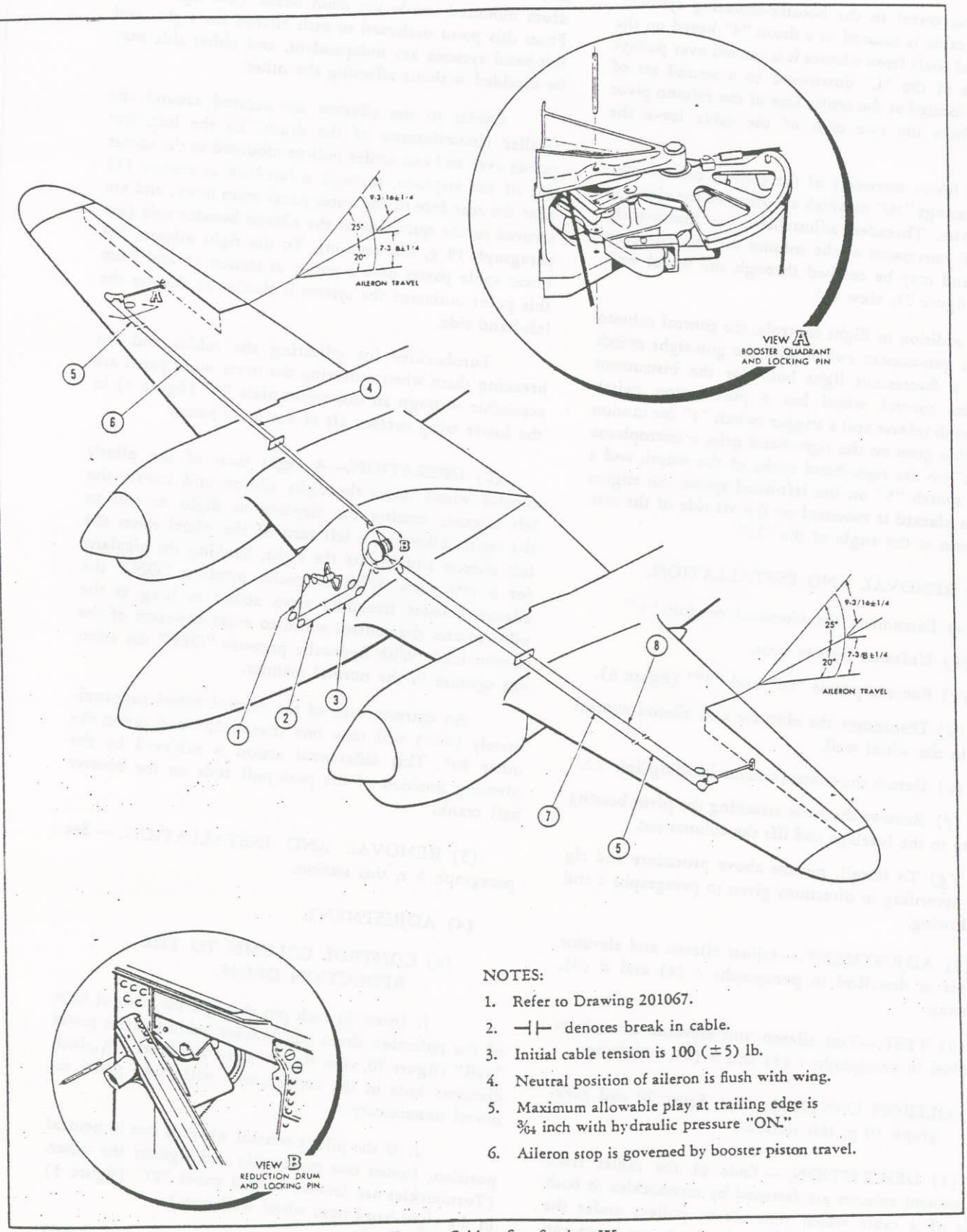
(3) REMOVAL AND INSTALLATION. — See paragraph 1 *e*, this section.

(4) ADJUSTMENT.

(a) CONTROL COLUMN TO THE REDUCTION DRUM.

1. Insert $\frac{3}{8}$-inch pin through the neutral hole of the reduction drum and bracket behind access panel "89R" (figure 70, view B). On some airplanes a $\frac{9}{16}$-inch diameter hole in the access panel will make panel removal unnecessary.

2. If the pilot's control wheel is not in neutral position, loosen one turnbuckle and tighten the other. (Turnbuckles are located behind panel "87" (figure 3) in the right-hand nose wheel well web.)



NOTES:

1. Refer to Drawing 201067.
2. ⊣⊢ denotes break in cable.
3. Initial cable tension is 100 (±5) lb.
4. Neutral position of aileron is flush with wing.
5. Maximum allowable play at trailing edge is 3/64 inch with hydraulic pressure "ON."
6. Aileron stop is governed by booster piston travel.

For Key to Cables, See Section IX.

Figure 70 — Aileron Control System

3. Adjust turnbuckles equally until the cable tension is 100 (±5) lb measured with cable tension indicator.

4. Check control wheel again for neutral position.

5. Replace lock wires on turnbuckles. Remove centering pin. Tape 9/16-inch diameter hole if opened.

(b) FROM THE REDUCTION DRUM TO THE AILERON BOOSTER UNIT.

1. Insert 3/8-inch pin through the neutral hole of the reduction drum and bracket behind access panel "89R" (figure 70, view B.) On some airplanes a 9/16-inch diameter hole in the access panel will make panel removal unnecessary.

2. Insert pin in aligning holes of booster unit. A 3/8-inch by 7-inch rod is required. If provided with an L- or T-shaped handle, the handle may be turned under the skin to prevent dropping.

3. If pin will not fit in aligning holes of booster unit, loosen one turnbuckle and tighten the other the same number of turns. (Turnbuckles are located above access door "5" (figure 5) aft of the main beam at station 188.)

4. Adjust turnbuckles equally until the cable tension is 100 (±5) lb measured with a cable tension indicator. Turnbuckles must be moved aside by deflecting ailerons to make room for cable test through access door "5."

(c) AILERON BOOSTER UNIT. — See paragraph 19 *g* (4), this section.

(d) FROM AILERON BOOSTER UNIT TO AILERON.

WARNING

Be careful not to get arms or fingers caught between the aileron and wing. Since only one-sixth of the aileron load is felt by the pilot, a very little pressure applied to the control wheel could cause serious injury.

1. Insert pin in aligning holes of booster unit.

2. Adjust aileron push-pull rod at aileron attaching clevis so that aileron trailing edge is flush with wing trailing edge within 3/32 (.09) inch. One-half turn of rod changes trailing edge approximately 1/8 inch.

3. Play at trailing edge must not exceed 3/64 (.05) inch. If excessive play is present, shim, rebush, or replace loose parts.

4. Remove pin. With pin removed and hydraulic pressure "OFF," ailerons have play of approximately 1 1/4 inches. This is a normal condition.

(e) FIXED TRIM TABS.—Under normal flight conditions with hydraulic pressure "OFF," both ailerons will ride approximately 1 1/4 inches to 1 3/4 inches high at all speeds. This condition is normal.

Note

Ground personnel are not to bend or otherwise adjust aileron fixed trim tabs unless wing heaviness is evident. For correction of wing heaviness, refer to Section III, paragraph 4 *a*, and figure 36.

(5) TEST. *(See figure 70.)*—Check the following:

(a) Aileron control cable tension—100 (±5) lb.

(b) Control wheel action:

1. Left turn—left aileron UP, right aileron DOWN; right turn—left aileron DOWN, right aileron UP.

2. Neutral position—upper knobs of wheel horizontal—ailerons in neutral.

3. Extreme wheel rotation—approximately 144° to right and left of neutral.

(c) Aileron action:

1. Neutral position—flush within 5/32 (.09) inch with trailing edge of wing.

Note

Measurements may be made with centering pin in booster or without centering pin in booster but with engines running and hydraulic pressure "ON."

2. Extreme throw—9 3/16 (±1/4) inches UP while other aileron is 7 3/8 (±1/4) inches DOWN. Measure both ailerons in both directions at inboard end of trailing edge with hydraulic pressure "ON."

3. Play—maximum at inboard trailing edge—3/64 (.05) inch with hydraulic pressure "ON" or with pressure "OFF" and centering pin in booster.

(d) Connections:

1. Turnbuckles—locked with safety wire.

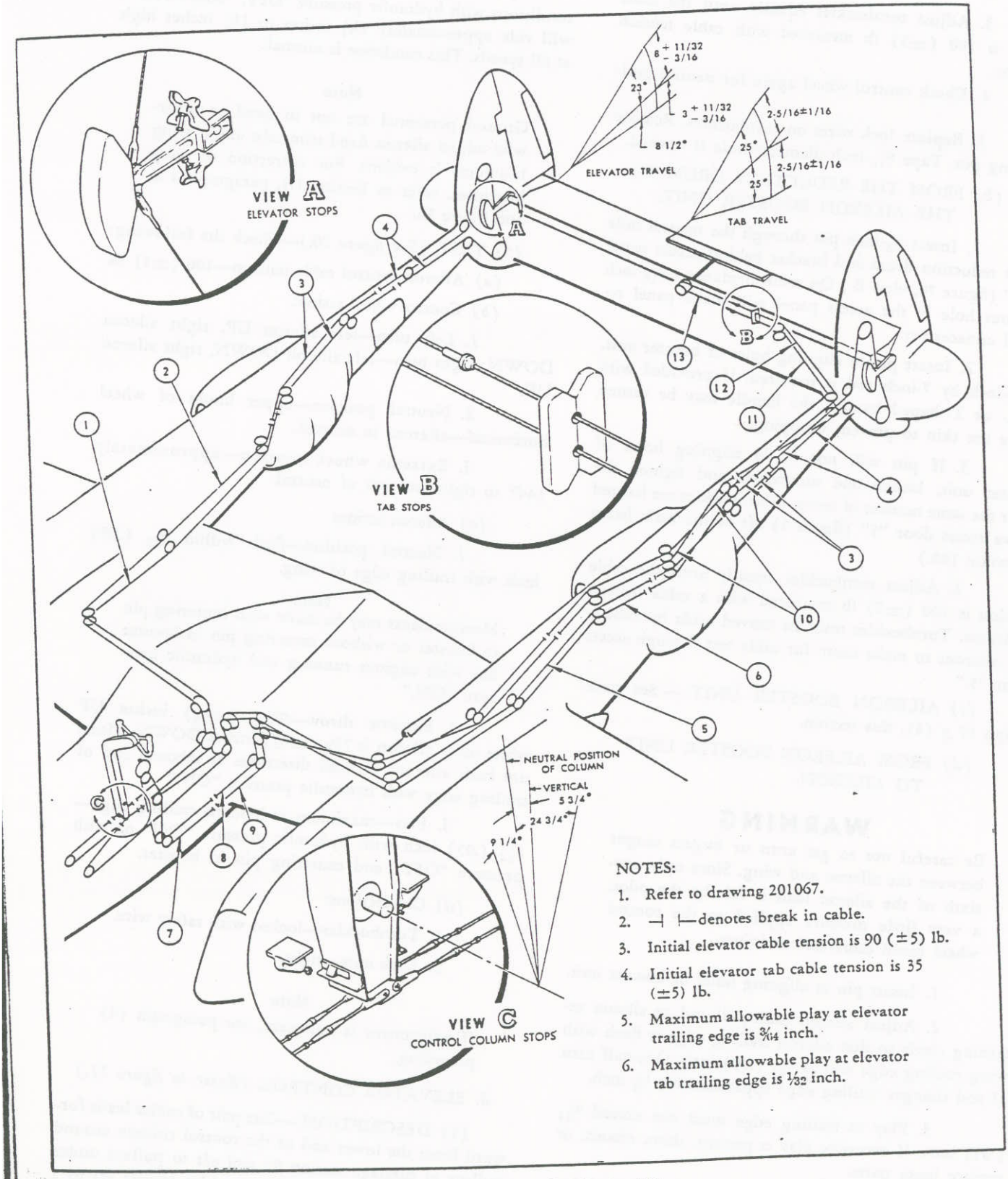
2. Lock nuts—tight.

Note

If adjustment is necessary, see paragraph (4) preceding.

d. ELEVATOR CONTROL. *(Refer to figure 71.)*

(1) DESCRIPTION.—One pair of cables leads forward from the lower end of the control column around pulleys at fuselage station 95 and aft to pulleys under the main beam; another pair of cables travels aft to a similar set of pulleys in the same location. All four cables



For Key to Cables, See Section IX.

Figure 71 — Elevator Control System

enter the beam and pass over pulleys near the lower beam cap. An UP and a DOWN cable travel outboard through the beam each way to pulleys near station "89" where they turn aft into the booms, traveling along the inboard side of each forward boom between the skin and the wheel well web. Aft of the wheel well the cables are in the upper portion of the boom. At station 402 the UP cable goes down into the lower vertical stabilizer, around a pulley and up to the lower eye of the elevator balance arm and the DOWN cable goes up over a pulley in the upper vertical stabilizer and down to the upper eye of the same balance arm whose travel is limited by adjustable stops built into the empennage booms.

(2) OPERATION. — Forward movement of the control column lowers the elevator which raises the tail, causing the airplane to descend. Backward movement has the opposite effect. Extreme movement of the column to its most forward position, 9¼°, lowers the elevator 8½°. The extreme aft position, 24¾°, raises the elevator 23°.

(3) REMOVAL AND INSTALLATION. — (See paragraph 2 *c* (2) and (3), this section.

(4) ADJUSTMENT.

(a) Secure the elevator in neutral position by clamping blocks from the trailing edge of the elevator to the trailing edge of the empennage boom.

(b) Adjust elevator cables to a tension of 90 (±5) lb by loosening or tightening opposite turnbuckles equally. For turnbuckle location, refer to figure 71.

(c) Using a bubble protractor, test the control column for neutral position which is 5¾° forward of vertical when airplane is level. (See figure 72.)

(d) If control column setting is incorrect it may be adjusted by the turnbuckles attached to the bottom of the control column behind access panel "87." To move the top of the column forward, loosen the two front turnbuckles and tighten the two aft turnbuckles, and vice versa. To maintain equal cable tension, all four turnbuckles must be given the same number of turns.

(e) Check cable tension and safety the turnbuckles.

(f) Remove the blocks holding elevator in neutral position.

(g) Set the four elevator stops in the empennage boom to allow the elevator a travel of 8 inches UP and 3 inches DOWN ($+\frac{11}{32}$ or $-\frac{3}{16}$ inch).

(h) Stops in both right and left booms must make contact with the elevator balance arms at the same time. Put elevator in DOWN position. Test travel; if correct see that both stops for the DOWN position make a positive contact with the elevator torque arm. Use the same procedure for the UP position of the elevator. Safety the stops.

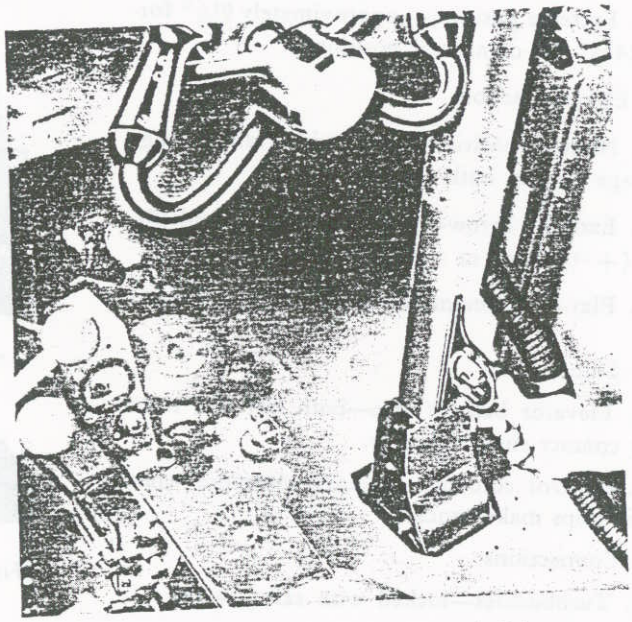


Figure 72 — Neutralizing Control Column

(i) If the trailing edge of the elevator at the left end is higher than the corresponding point on the right end, the elevator twist may be corrected by tightening an elevator DOWN cable turnbuckle in the left boom, loosening the corresponding elevator UP cable turnbuckle and doing the opposite in the other boom. All four turnbuckles should be given the same amount of turn. Recheck cable tension.

(Refer to figure 71 and Section IX for identification of UP and DOWN cables.)

CAUTION

Always test elevator travel at both ends of the trailing edge.

(j) Set the control column stops (refer to figure 71, view C) so that a gage of .003 inch (a sheet of paper) will pass between them and the control column when the elevator is against its stops in the empennage boom.

(k) Safety the stops.

(5) TEST.—Check the following:

(a) Elevator control cable tension—90 (±5) lb.

(b) Control column action:

1. Forward movement, elevator DOWN; aft movement, elevator UP.

2. Neutral position—5¾° (±½°) forward of vertical; elevator in neutral.

3. Extreme position— approximately 9¼° forward and 24¾° aft of neutral position.

(c) Elevator action:

1. Neutral position—flush with trailing edge of empennage booms, both sides.

2. Extreme throw—3 inches DOWN and 8½ inches UP ($+1\frac{1}{32}$ inch or $-\frac{3}{16}$ inch).

3. Play—maximum at trailing edge, $\frac{3}{64}$ (.05) inch.

(d) Stops:

1. Elevator balance arm—both left and right stops must contact simultaneously.

2. Control column—.003-inch clearance when balance arm stops make contact.

(e) Connections:

1. Turnbuckles—locked with safety wire.

2. Lock nuts—tight.

Note

If adjustment is necessary, see paragraph (4), preceding.

e. ELEVATOR TAB CONTROL. *(See figure 71.)*

(1) DESCRIPTION.—An elevator tab control unit is mounted in the side control stand. Cables from this unit go down around pulleys under the floor aft up into the main beams, outboard on the left-hand side to wing station 89, aft through the boom in a manner similar to the elevator cables, diagonally inboard through the horizontal stabilizer and around the tab actuating drum on the center line of the airplane.

(2) OPERATION.—A *counterclockwise* turn of the tab control wheel lowers the elevator tab which raises the elevator in flight, which in turn tends to raise the nose of the airplane. A *clockwise* turn produces an opposite action which lowers the nose of the airplane in flight.

(3) REMOVAL AND INSTALLATION.—See paragraph 2 *d* (2) and (3), this section.

(4) ADJUSTMENT.

(a) Adjust elevator tab cables at turnbuckles to a tension of 35 (±5) pounds. Use cable tension indicator. Safety turnbuckles.

(b) If tab goes beyond limits, 25° or $25\frac{5}{16} \pm \frac{1}{16}$ inches, UP and DOWN, resolder stops on elevator tab cables in position to give correct limits. Stops are reached through access panel number "35" (figure 5) in the lower skin of the horizontal stabilizer.

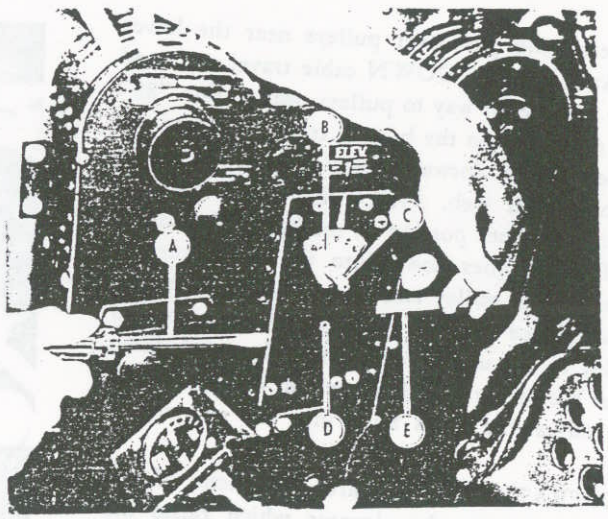


Figure 73 — Elevator Tab Control Adjustment

(c) If tab travel is uneven proceed as follows:

1. Disconnect bolt on aft end of push-pull rod.

2. Loosen lock nut on forward end of push-pull rod.

3. Rotate push-pull rod. One-half turn to the right will lower tab about ⅛ inch.

4. Replace bolt at aft end and tighten lock nut at forward end of push-pull rod.

5. Resolder elevator tab stops if necessary.

(d) If adjustment *(c)* above is insufficient to correct throw proceed as follows:

1. Disconnect four bolts from nut (see figure 74, item "1") at forward end of actuating unit.

2. Shift nut to permit drum to rotate 3½ turns in either direction from neutral.

3. One-eighth turn of nut will move tab .10 inch.

4. Replace bolts in any alternate four of the eight holes and install lock wires.

5. Resolder elevator tab stops if necessary.

(e) If tab play exceeds $\frac{1}{32}$ inch proceed as follows:

1. Tighten bearing retainer (refer to figure 74, item "3") only enough to take up bearing play. Lock retainer with screws and stake heads.

2. Replace bolt at aft end of push-pull rod if it is worn.

3. Shim or rebush bearings in aft end of push-pull rod or in mating tab arms if worn.

4. Replace tab actuator nut "1" (figure 74) and/or shaft "5" if worn.

5. Recheck cable tension.

(f) Check the elevator tab control located on the side control stand in the cockpit. It should indicate "0" (neutral) when the tab is in neutral position; if incorrect, it may be corrected by:

1. Adjusting cable lengths at the turnbuckles, or:

2. Correcting the tab dial position (figure 73) in the following manner:

a. Remove crank from shaft "C" and remove screw "D."

b. Pry out center plate with two screw drivers "A" and "E." Be sure the drivers are behind the dial "B," thereby disengaging the control unit gears.

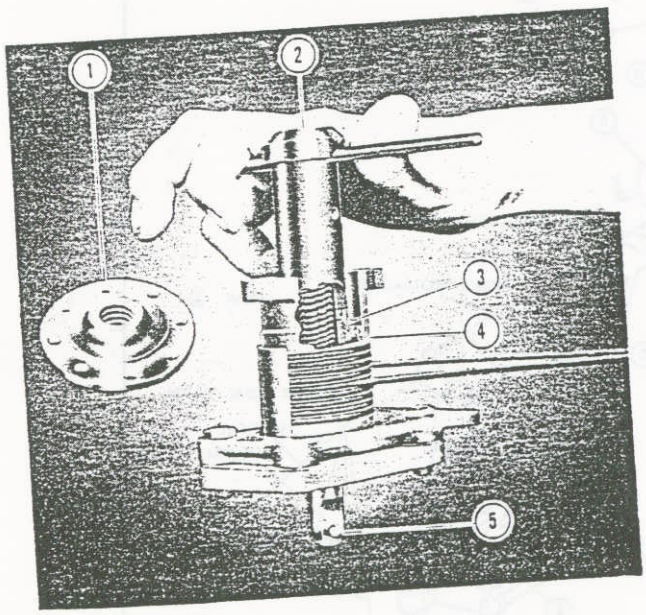
c. Turn dial to neutral by pressing lightly against the face of the dial.

d. Remove screw drivers and allow gears to mesh.

e. Replace screw and crank assembly.

CAUTION

Do not allow the control unit shaft "C" to move from neutral position until the crank is in place.



1. Nut
2. S-34301 Spanner Wrench
3. Retainer
4. Drum
5. Shaft

Figure 74 — Tab Actuating Unit Adjustment

(5) TEST.—Check the following:

(a) Elevator tab control cable tension—35 (±5) lb.

(b) Control action — clockwise movement, tab UP; counterclockwise movement, tab DOWN.

(c) Zero position of control—tab in neutral.

(d) Tab action:

1. Extreme throw—$2\frac{5}{16}$ ($\pm\frac{1}{16}$) inches UP and DOWN.

2. Play—maximum at trailing edge $\frac{1}{32}$ inch.

(e) Connections:

1. Turnbuckles—locked with safety wire.

2. Lock nuts—tight.

Note

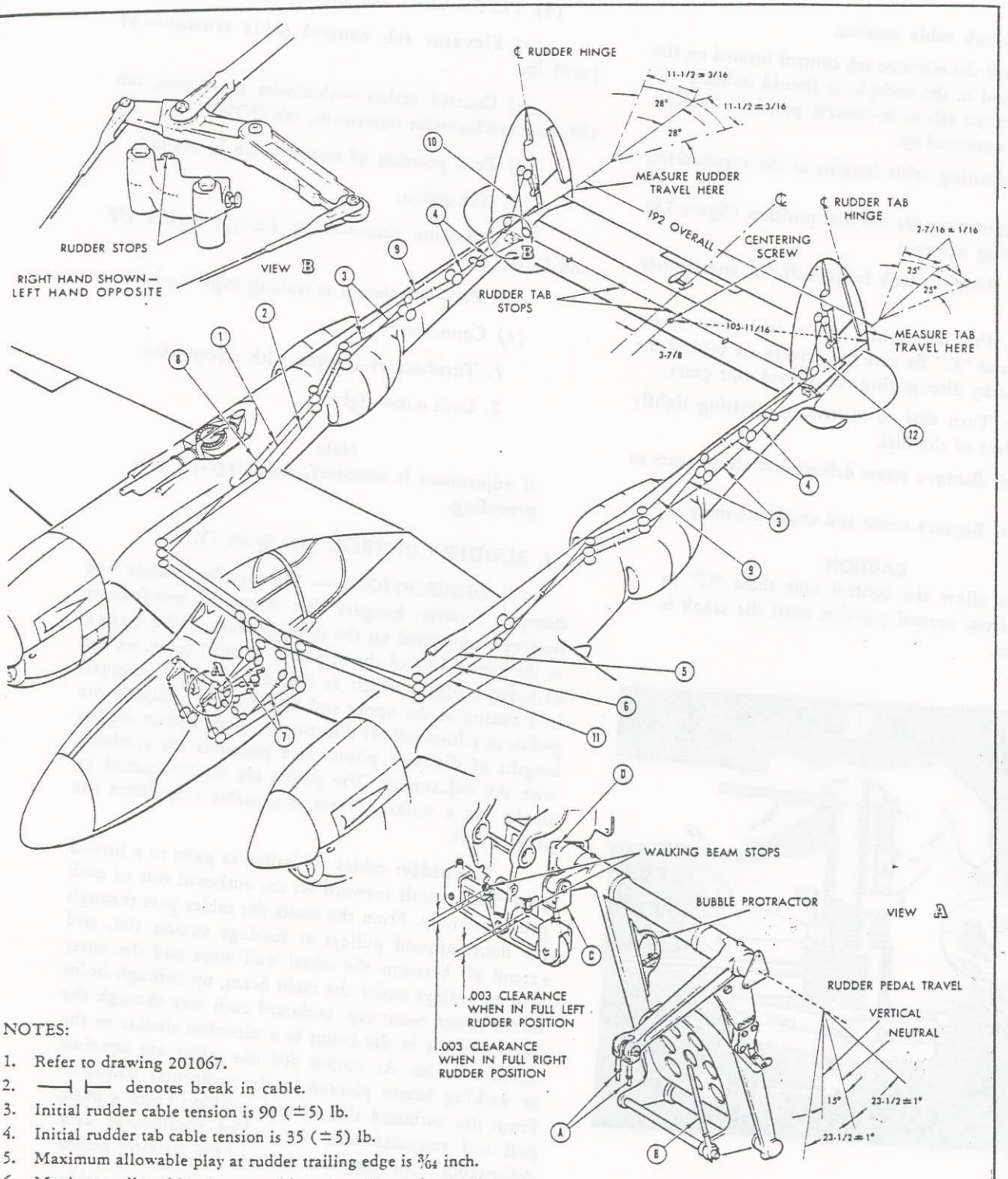
If adjustment is necessary, see paragraph (4), preceding.

f. RUDDER CONTROL. *(See figure 75.)*

(1) DESCRIPTION. — The rudder pedals are clamped between hangers that swing on anti-friction bearings, supported on the fuselage webs, and a casting at the center line of the airplane. A small lever, on the outboard hanger, which is linked to a pawl engaged in a ratchet at the upper end of the hanger, adjusts the pedals in a fore-and-aft direction to accommodate the leg lengths of different pilots. Five positions are available with the adjustment. The pedals are interconnected by cranks and a walking beam. Adjustable stops limit the pedal travel.

The rudder cables are bolted in pairs to a forked mast that extends forward on the outboard side of each pedal assembly. From the masts the cables pass through the floor, around pulleys at fuselage station 105, and extend aft between the wheel well webs and the outer skin to pulleys under the main beam, up through holes in the lower beam cap, outboard each way through the beam and aft in the boom in a direction similar to the elevator cables. At station 402 the cables are attached to walking beams pivoted in the horizontal stabilizer. From the outboard side of each walking beam a push-pull rod connects with the rudder torque-tube arm. Adjustable stops limit the travel of the walking beams.

(2) OPERATION.—Depression of the left rudder pedal forward brings the right rudder pedal aft and deflects both rudders equally to the left causing the airplane in flight to turn to the left. Depression of the right rudder pedal has the opposite effect. Extreme movement of the pedals deflects the rudders 28°.



NOTES:

1. Refer to drawing 201067.
2. —⊣ ⊢— denotes break in cable.
3. Initial rudder cable tension is 90 (±5) lb.
4. Initial rudder tab cable tension is 35 (±5) lb.
5. Maximum allowable play at rudder trailing edge is $\frac{3}{64}$ inch.
6. Maximum allowable play at rudder tab trailing edge is $\frac{1}{32}$ inch.

For Key to Cables, See Section IX.

Figure 75 — Rudder Control System

(3) REMOVAL AND INSTALLATION.

(a) RUDDER PEDALS. *(See figure 75, view A.)*

1. Disconnect the rudder cables "A."

2. Disconnect the brake rods "B."

3. Disconnect the walking beam links "C."

4. Remove the bolts attaching the bearing supports to the fuselage and to the center bracket "D."

5. To install, reverse removal procedure and adjust according to paragraph (4), following.

(b) RUDDERS.—Refer to paragraph 2 *f* (2) and (3), this section.

(4) ADJUSTMENT.

(a) To place rudders in neutral position:

1. Left rudder. Measure 105 $11\frac{1}{16}$ inches from centering screw (see figure 75) to trailing edge of left rudder. Using a soft pencil, mark this neutral position of the rudder on the boom trailing edge.

2. Right rudder. Measure 192 inches from trailing edge of the left rudder when in neutral to the trailing edge of the right rudder. If necessary, adjust rudder push-pull rod in empennage boom until distance is correct. Mark neutral position of right rudder on boom trailing edge.

3. Either clamp rudders in neutral position or have a helper hold them in neutral while rudder pedals are adjusted.

4. Check neutral position of rudders after all other adjustments are made.

(b) To place rudder pedals in neutral position:

1. Place pilot's pedal adjustment in the center notch of the ratchet.

2. When rudders are in neutral position, a bubble protractor (figure 75) placed on the aft face of the rudder pedal support arm should indicate 15° ($\pm\frac{1}{2}$°) aft of vertical.

Note

Airplane must be level or compensation made for airplane position.

3. If bubble protractor reads less than 15° ($\pm\frac{1}{2}$°), loosen turnbuckles to opposite rudder and tighten those on the same side. If more than 15° ($\pm\frac{1}{2}$°), loosen turnbuckles on the same side and tighten those on the opposite side.

4. Recheck neutral position of rudders with neutral position of rudder pedals; if incorrect, adjust turnbuckles in battery and/or baggage compartment.

5. Check rudder travel at full throw for interference with other installations in the cockpit.

(c) To correct rudder travel:

1. Set the stops (figure 75, view B) to allow the rudders a throw of $11\frac{1}{2}$ ($\pm\frac{3}{16}$) inches in either direction.

Note

One turn of the rudder stop bolt equals $\frac{1}{4}$ inch distance of rudder travel.

2. Stops to both rudders must make contact with the walking beams in the empennage booms at the same time.

3. Set the stops on the rudder pedal walking beam (figure 75, view A) to allow a clearance of .003 inch (sheet of paper) when the rudders are at full throw.

4. Make sure that all six rudder stops are safetied.

(d) Adjust rudder cables at turnbuckles to a tension of 90 ($\pm$ 5) lb. Safety all turnbuckles.

(e) Recheck neutral position.

(5) TEST.—Check the following:

(a) Rudder control cable tension—90 ($\pm$ 5) lb.

(b) Pedal action:

1. Left pedal, both rudders to left; right pedal, both rudders to the right.

2. Neutral position—15° ($\pm\frac{1}{2}$°) aft of vertical; both rudders in neutral.

3. Extreme position—must clear other installations.

(c) Rudder action:

1. Neutral position:

a. Left rudder trailing edge—105 $11\frac{1}{16}$ inches from centering screw (see figure 75).

b. Right rudder trailing edge—192 inches from left rudder trailing edge.

2. Extreme throw—$11\frac{1}{2}$ ($\pm\frac{3}{16}$) inches.

3. Play—maximum at trailing edge—$\frac{3}{64}$ (.05) inch.

(d) Stops on walking beams:

1. Empennage—both left and right stops must contact simultaneously.

2. Cockpit (extreme forward part)—.003-inch clearance when empennage stops make contact.

(e) Connections:

1. Turnbuckles—locked with safety wire.

2. Lock nuts—tight.

Note

If adjustment is necessary, see paragraph (4) preceding.

g. RUDDER TAB CONTROL.

(1) DESCRIPTION.—The rudder tab control unit is mounted on the sloping face of the center control stand. The cable from the drum travels forward through the control stand, down through the floor, outboard through the nose wheel well webs, aft and up into the main beam, outboard to wing station 89, aft through the booms similar to the rudder cables, around a pulley at station 402, up into the vertical stabilizer, and down to the tab actuating unit. The left and right rudder units are interconnected by a cable running through the stabilizer. The cable travel is limited by sleeves on the cable and adjustable stops in the stabilizer.

(2) OPERATION.—A clockwise turn of the tab control crank deflects both rudder tabs to the left. In flight, air pressure on the left surface of the tab deflects the rudder to the right which in turn tends to turn the airplane to the right. The procedure is reversed to provide a left-turn tendency or to balance a tendency to yaw to the right.

(3) REMOVAL AND INSTALLATION. — See paragraph 2 *g* (2) and (3), this section.

(4) ADJUSTMENT.

(a) Adjust rudder tab cables at turnbuckles to a tension of 35 (± 5) lb. Use cable tension indicator. Safety turnbuckles.

(b) If tabs go beyond limits to the right and left, resolder stops on rudder tab cables in position to give correct stop. Stops are reached through access panel 34 (figure 5) LH and RH in the lower skin of the horizontal stabilizer.

(c) If tab travel is uneven to right and left:

1. Disconnect bolt on aft end of push-pull rod.

2. Loosen lock nut on forward end of push-pull rod.

3. Rotate push-pull rod. One-half turn to the right will deflect tab to the right about 1/8 inch.

4. Replace bolt at aft end and tighten lock nut at forward end of push-pull rod.

5. Resolder elevator tab stops if necessary.

(d) If adjustment *(4)* (c), preceding is insufficient to correct throw:

1. Disconnect four bolts from nut (see figure 74, item "1") at forward end of actuating unit.

2. Shift nut to permit drum to rotate 3½ turns in either direction from neutral.

3. One-eighth turn of nut will deflect tab about 3/32 inch.

4. Replace bolts in any alternate four of the eight holes and install lock wires.

5. Resolder rudder tab stops if necessary.

(e) If both rudder tabs are not in neutral at the same time:

1. If one is outboard when the other is in neutral:

a. Clamp one tab in neutral with soft wood blocks to trailing edge of rudder.

b. Loosen turnbuckle through access door 34R (figure 5) until unclamped tab can be moved to neutral position.

c. Tighten to proper tension the rudder tab cable in boom on side of unclamped tab.

2. If one tab is inboard when the other is in neutral:

a. Clamp one tab in neutral.

b. Loosen turnbuckle in boom on side of unclamped tab until tab can be moved to neutral position.

c. Tighten turnbuckle through access door 34R (figure 5) until cable is at proper tension of 35 (±5) pounds.

(f) If tab play exceeds 1/32 inch:

1. Tighten bearing retainer "3" (figure 74) only enough to take up bearing play. Lock retainer with screws and stake heads.

2. Replace clevis bolt at aft end of push-pull rod if it is worn.

3. Shim or rebush bearings in aft end of push-pull rod or in mating tab arms if worn.

4. Replace tab actuator nut "1" (figure 74) and/or shaft "5" if worn.

5. Recheck cable tension.

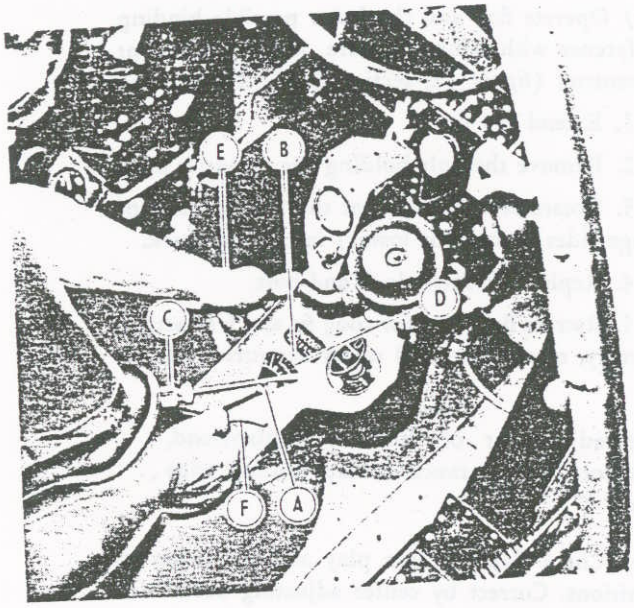


Figure 76 — Rudder Tab Control Adjustment

(g) If tab dial (figure 76) does not indicate *zero* when tabs are in neutral:

1. Remove crank from shaft "A" (figure 76).

2. Remove screw "B" securing dial plate.

3. With a screw driver "C," relieve pressure on the dial "D" by raising the plate. Use the control unit shaft as a fulcrum.

4. With the fingers of the left hand inserted at the left side of the center stand "E," force the dial up, thereby disengaging the dial gears.

Note

If gears refuse to disengage, a hook made of stiff wire may be used on the right-hand side of the center stand to help lift the dial.

5. Turn the dial until it indicates neutral and allow gears to mesh.

6. Remove screw driver; replace screw and crank.

CAUTION

Do not allow the control unit shaft "A" to move from neutral position until the crank is in place.

(5) TEST.—Check the following:

(a) Rudder tab control cable tension—35 (± 5) pounds.

(b) Control action—clockwise movement, tabs to left; counterclockwise movement, tabs to right.

(c) Zero position of control—both tabs in neutral.

(d) Tab action:

1. Extreme throw—$27\frac{7}{16}$ ($\pm\frac{1}{16}$) inches left and right.

2. Play—maximum at trailing edge—$\frac{1}{32}$ inch.

(e) Connections:

1. Turnbuckles—locked with safety wire.

2. Lock nuts—tight.

Note

If adjustment is necessary, see paragraph (4) preceding.

h. SURFACE CONTROL LOCK.

(1) DESCRIPTION. — When the airplane is moored the ailerons and the elevator can be locked by a tube assembly stowed, when not in use, on the sill of the right-hand cockpit window.

(2) MAINTENANCE. — When the airplane is moored, secure the ailerons and the elevator according to directions given with figure 29.

i. WING FLAPS.

(1) DESCRIPTION. *(See figure 52.)*—The wing flaps are controlled by cables attached to a push-pull rod. This rod in turn is actuated by a hydraulic flap motor. The flaps ride on flap carriages "17" and "25" which travel on carriage tracks. The flap retracted position is determined by eccentrics on the forward end of each carriage assembly (figure 52, section B-B), nut adjustments on the lower carriage rods "2," "3," and "4," and cables with adjustable terminal nuts (view A). Access for adjustment is provided when the flaps are extended and when inspection panels (figure 5) are removed.

Note

When installing, testing, or adjusting flaps, always operate them by means of the hand-operated hydraulic pump in the cockpit.

(2) OPERATION.—See paragraph 19 *e* (1) *(a)*, this section.

(3) REMOVAL AND INSTALLATION. — See paragraph 1 *f* (2) and (4), this section.

(4) ADJUSTMENT.

(a) With cables detached, push and pull flaps through full operation by hand. Check for freedom of movement.

(b) Attach cables to flap carriages and flap push-pull rods.

(c) Bring flap cables to 70 (±5) lb tension using the cable nuts on the push-pull rod. (See figure 52, view A.)

(d) Retract the flaps and check the flap leading edge for a .003-inch clearance at the lower wing surface. (See figure 77.)

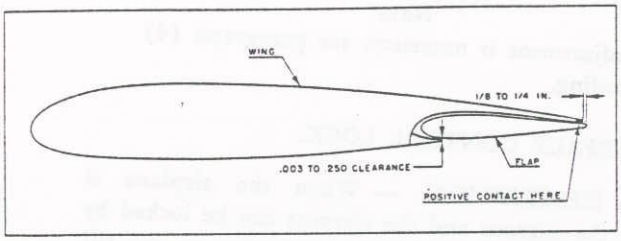


Figure 77 — Wing Flap Adjustment

(e) Check flap trailing edge which must be 1/8 to 1/4 inch beyond the wing trailing edge. (See figure 77.) Make adjustment by tightening UP cables and loosening DOWN cables to further retract flaps. Reverse procedure to extend flaps.

Note

When making adjustment always maintain cable tension by tightening and loosening cable nuts an equal number of turns.

(f) Check flap trailing edge for contact with wing trailing edge, while in retracted position. (See figure 77.) Adjust at the lower carriage rod (figure 52) as follows:

1. Extend flap.

2. Loosen lock nuts "2" and "4."

3. Turn adjusting nut "3" to shorten rod and to lower flap trailing edge. Turn adjusting nut to lengthen rod and to raise the flap trailing edge.

Note

One turn of the nut equals 3/16 inch in flap position.

4. Test by retracting flap. If adjustment is satisfactory, extend flap and tighten lock nuts.

(g) Operate flap and check for possible binding and interference with wing structure. Make adjustment at the eccentrics (figure 52, section B-B), if necessary.

1. Extend the flaps.

2. Remove the bolt holding the eccentric lock.

3. Rotate eccentric so that the forward end of the carriage rides higher (or lower) in the flap track.

4. Replace eccentric lock and bolt.

5. Retract flap; test for snug fit and free action. If satisfactory, extend flap and safety eccentric lock.

Note

After adjustment of forward carriage-end, check for .003 clearance at flap leading edge (figure 77).

(h) Check flap for side play and for looseness in all positions. Correct by center adjusting bolts "16" (figure 52).

1. Remove safety and bolt.

2. Remove adjusting bolt lock.

3. Turn adjusting bolts clockwise to tighten flap in track.

CAUTION

Do not put too much tension on the track rollers or the entire carriage will "freeze" and fail to operate.

4. Replace lock and bolt.

5. Retract flap; test for snug fit and free operation.

6. If adjustment is satisfactory, extend flap and safety lock bolts.

(i) After flap adjustment, synchronize flap travel by adjusting cable lengths, maintaining 70 (±5) lb cable tension.

(5) TEST.—Check the following:

(a) Flap control cable tension—70 (±5) lb.

(b) Flap retracted position:

1. Clearance at leading edge—.003 to .250 inch.

2. Clearance at trailing edge:

a. Positive contact with wing.

b. Overlap of 1/8 to 1/4 inch aft of wing trailing edge.

(c) Flap movement:

1. No binding — must move freely by hand with cables disconnected.

2. No excessive play.

3. All flaps must extend equally.

(d) Stops:

1. Micarta stops at flap track ends are secondary and should not be touched by flap carriage.

2. For limit of flap travel see paragraph 19 *e* (1) *(d)*, this section.

(e) Play in flap motor actuating nut—.035 inch maximum. (Replace if any portion of nut is worn to a knife edge.)

(f) Connections:

1. Swaged cable terminals:

a. Connecting turnbarrels (outboard end of motor-driven push-pull rod) — not more than five visible threads.

b. Connecting nuts (figure 52, view A)—not more than twenty-three visible threads.

2. Push-pull rods—screws must close "witness holes" in nuts "3." Lock nuts must be tight.

3. Castle nuts—safetied with cotter pins.

Note

If adjustment is necessary see paragraph (4), preceding.

j. FLAP TRAVEL LIMIT VALVE.—See paragraph 19 *e* (1) *(d)*, this section.

k. FLAP "POP-UP" INDICATOR.—See paragraph 1 *h*, this section.

l. DIVE RECOVERY FLAPS.

(1) DESCRIPTION.—See paragraph 1 *i* (1), this section.

(2) TROUBLE SHOOTING.—See paragraph 20 k 3, this section.

(3) REMOVAL.—See paragraph 1 *i* (3), this section.

(4) MAINTENANCE.See paragraph 1 *i* (4), this section.

(5) ADJUSTMENT.

(a) MECHANICAL.—See paragraph 1 *i* (5), this section.

(b) ELECTRICAL.—See paragraph 20 *k* (4) *(d)*, this section.

(6) INSTALLATION.—See paragraph 1 *i* (6), this section.

(7) TEST.—See paragraph 20 *k* (4), *(e)*, this section.

5. ALIGHTING GEAR.

a. GENERAL.—The tricycle-type alighting gear consists of two main units mounted in wells in the front section of the forward booms, and a nose wheel unit mounted below the armament compartment and cockpit in the forward section of the fuselage. The gear travel is directly fore-and-aft about the fulcrum points, and is operated by hydraulic piston-type cylinders through cockpit controls connected to the main hydraulic system. All the units retract aft. An emergency hand pump, located at the right of the pilot's seat near the floor, is used to extend the gear in event of hydraulic-system failure. Automatic, hydraulically-operated locks are provided for both the up and the down positions of the gear. When the gear is retracted, flush doors completely enclose it in the wheel wells. Both the fuselage and the boom doors are hydraulically controlled. Each landing gear unit is actuated by means of a hydraulic cylinder and connecting linkage. The main gear assembly is operated by a cylinder placed in the engine-support bay forward of the wheel-well bulkhead. The nose gear unit is moved by a cylinder below the upper deck floor of the armament compartment. The shock strut assembly of each unit is oleo-pneumatic in action, using oil and air as the damping and energizing mediums. A shimmy damper on the nose strut prevents excessive oscillation of the wheel fork. Hydraulically-operated pin up locks engage the hollow wheel axles of each unit and hold the gear in the up position. Down locks are incorporated in the actuating cylinders to hold the piston and gear in the down position. A warning light is installed on the instrument panel to provide a visible means of checking the position of the gear. This light glows whenever the gear is not completely up or down. A handle on the LH side of the cockpit is connected to the landing-gear four-way control valve and determines the actuation of the gear. For the principle of hydraulic operation of the landing gear, see paragraph 19 *h*, this section.

b. MAIN LANDING GEAR. *(See figures 78 and 79.)*

(1) GENERAL.—Each of the two main gear assemblies is made up of an air-oil type shock strut; two drag links, attached to the drag strut; a tubular steel drag strut, attached at one end to the main strut and at the other to the drag links; a hydraulic actuating cylinder, incorporating a down lock unit, connected to the drag links; and a wheel-and-brake assembly including a 36-inch smooth contour tire.

(a) REMOVAL.

1. Raise airplane clear of ground with wing jacks. (See Section III, paragraph 2 *b*.)

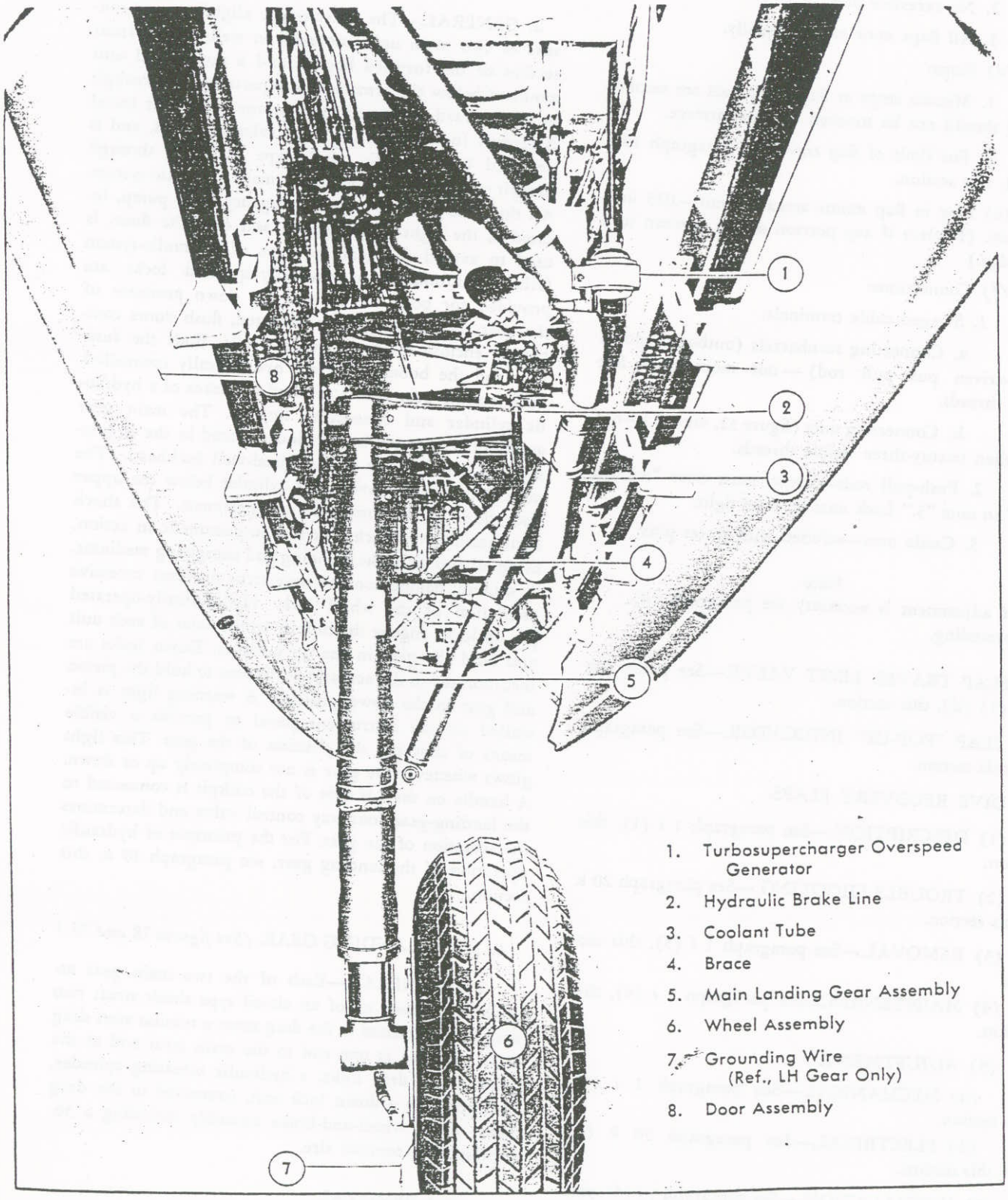
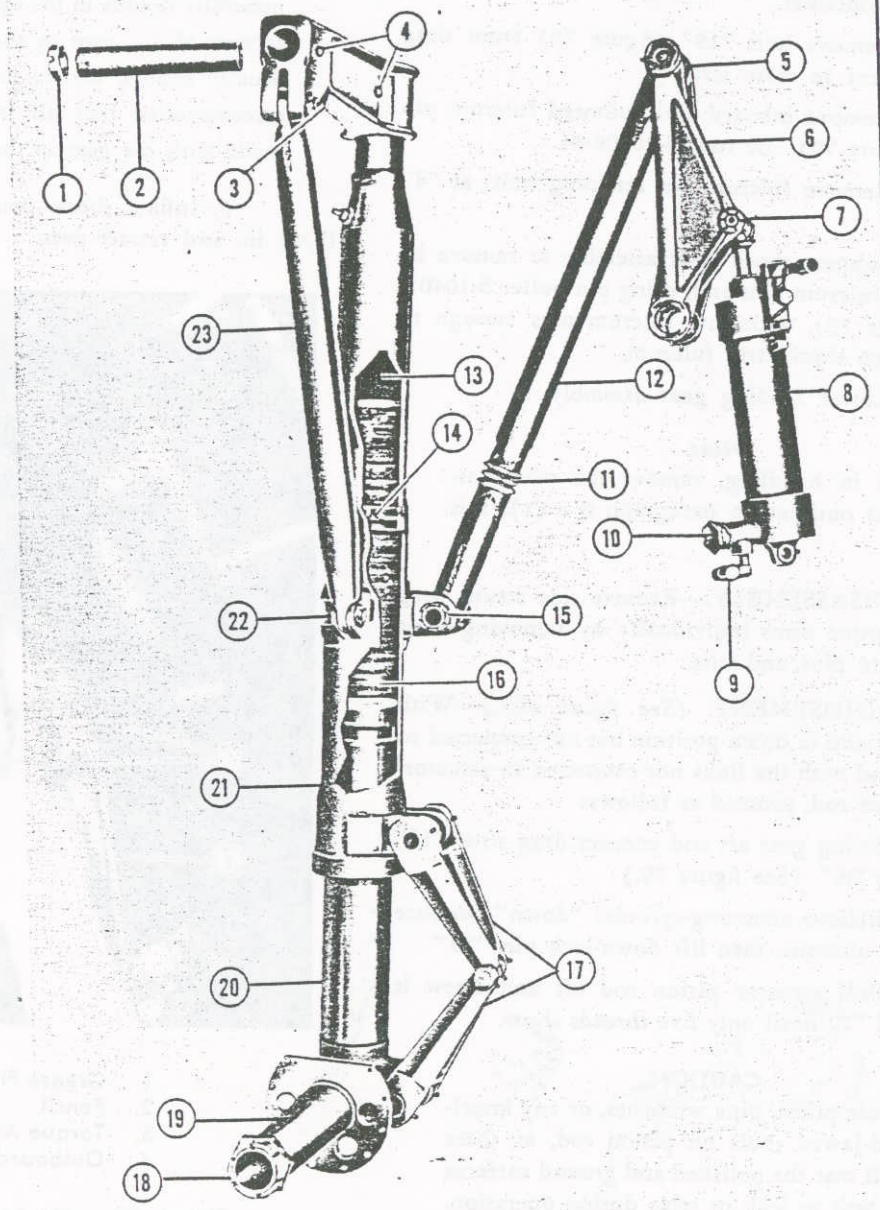


Figure 78 — Main Landing Gear Installation, Rear View



1. Fulcrum Nut
2. Fulcrum Pin
3. Fulcrum
4. Fulcrum Pin Retaining Bolts
5. Drag Link Pin
6. Drag Links
7. Actuating Cylinder End Terminal
8. Actuating Cylinder
9. Down Lock Elbow Fitting
10. Down Lock Pin
11. Drag Strut Adjustment Nut
12. Drag Strut
13. Upper Cylinder Chamber
14. Orifice
15. Drag Strut Attaching Bolt
16. Lower Cylinder Chamber
17. Torque Arms
18. Wheel Axle Nut
19. Wheel Axle
20. Strut Piston
21. Main Shock Strut Cylinder Assembly
22. Side Strut Attaching Bolt
23. Side Strut

TOOLS		
1.	Fulcrum Pin Nut Wrench	S-20408-34
2.	Fulcrum Pin Puller	S-10401
11.	Drag Strut Adjusting Wrench	S-20129
18.	Axle Nut Wrench	S-12102

Figure 79 — Main Landing Gear

2. Remove air filter and duct as a unit. Mark duct to insure proper replacement.

3. Disconnect brake hose "2" (figure 78) at upper boom support bracket and drain hydraulic fluid into a clean container.

4. Remove bolt "15" (figure 79) from drag strut attachment to main strut.

5. Remove inboard and outboard fulcrum pin nuts "1" (figure 79); use tool S-20408-34.

6. Remove fulcrum pin retaining bolts at "4" (figure 79).

7. Support shock strut assembly to remove its weight from fulcrum pins and, using pin puller S-10401, at "2" (figure 79), withdraw fulcrum pins enough to free them from shock strut fulcrum.

8. Lower landing gear assembly.

Note

For ease in handling, remove the wheel assembly as outlined in paragraph 6 *a* (1), this section.

(b) DISASSEMBLY.—Remove side struts, drag links, and torque arms individually by removing their attaching bolts, pins, and nuts.

(c) ADJUSTMENT. *(See figure 400.)*—With gear installed and in down position but not connected to drag links, and with the links not connected to actuator-cylinder piston rod, proceed as follows:

1. Swing gear aft and connect drag strut "12" to drag links "6." (See figure 79.)

2. Relieve actuating-cylinder "down" pressure by operating ailerons, then lift down-lock pin "10."

3. Pull actuator piston rod aft and screw it into terminal "7" until only five threads show.

CAUTION

Do not use pliers, pipe wrenches, or any knurled, hard-jawed tools on piston rod, as these tools will mar the polished and ground surfaces causing unit to leak or seize during operation. Remove turning tool from piston rod before operating landing gear, or damage to firewall may result.

4. Swing gear forward into down-locked position.

Note

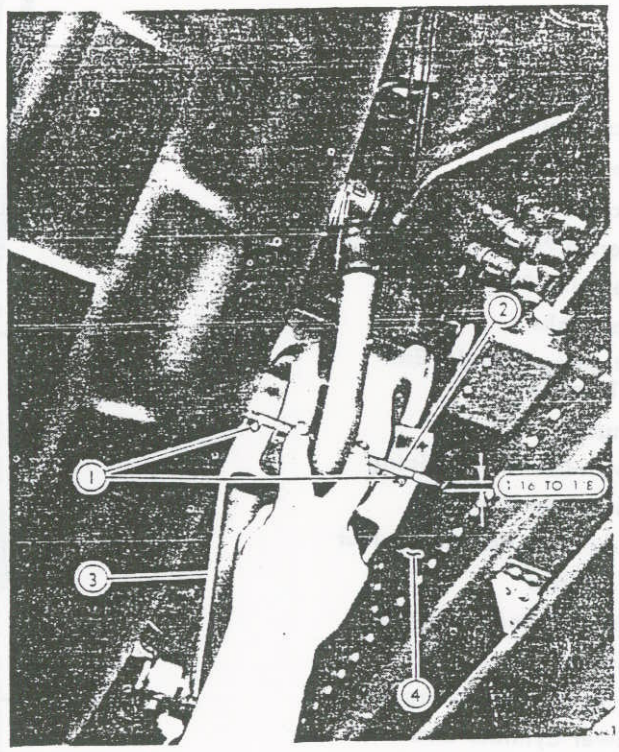
Tool used to hold down lock pin must be removed.

5. Adjust piston rod at "7" (figure 79) to maintain at "C" (figure 400B a distance of from $\frac{1}{16}$ to $\frac{7}{32}$ inch above center line "A-D" of drag strut to center of drag link pivot "C."

Note

Adjustments made in the down position will generally double in the up position; i. e., a correction of $\frac{1}{16}$ inch in the down position will usually change the up position $\frac{1}{8}$ inch. It is recommended that all initial adjustments be made with the gear in the down position.

6. Inflate shock strut to a minimum of 125 lb/sq in. and retract gear.



1. Grease Fittings
2. Pencil
3. Torque Arm
4. Outboard Web

Figure 80 — Up Lock Pin Clearance

7. With a pencil held against grease fittings "1" (figure 80) of torque arm "3" so that the pencil point touches boom web "4," force gear up against bumper, by hand, and down against up lock pin. The length of pencil mark on web indicates up lock pin clearance, which must be $\frac{3}{32}$ ($=\frac{1}{32}$) inch. Adjust drag strut "12" (figure 79) at "11" to get this clearance.

8. With gear retracted, check for $\frac{1}{32}$- to $\frac{5}{32}$-inch "break" over dead center as shown in "A" (figure

400); extending drag strut "12" (figure 79) will raise the gear; shortening the strut will lower the gear.

9. With gear extended, insert putty or similar substance in hollow end of axle at region of up lock pin engagement. Retract gear and pull it down against up lock pin. Extend gear and measure depth of up lock pin impression in putty. Impression should be between $\frac{5}{32}$ to $\frac{5}{16}$ inch deep. To adjust pin, remove bolts holding clip in pin groove (on inboard wheel well web) and turn pin clockwise to reduce "bite" or counterclockwise to increase "bite." (Refer to paragraph 19 *h* (7), this section.) Be sure to replace clip.

10. Check clearance between hub and up lock bumper with gear in up position. Pull down on gear, insert feeler gage, and release gear. Clearance should measure .003 to .010 inch. If drag strut cannot be adjusted, remove bumper and shim as necessary. (See figure 399.)

11. Operate gear through three or four cycles to check for proper functioning.

12. If necessary, make further adjustment by changing piston rod travel with gear in down position, and drag strut "12" with gear in up position. (See figure 79.)

13. Check again for accuracy of settings. If gear fails to extend or retract fully, maladjustment of actuating cylinder piston rod travel exists. Check for rod travel as shown in figure 247. Adjust as outlined in paragraph 19 *h* (6), this section.

(d) TEST.

1. Check all adjustments as gear is run through several cycles.

2. Lower airplane until it is supported on landing gear.

3. Actuate landing gear struts as outlined in paragraph (2) *(g)*, following.

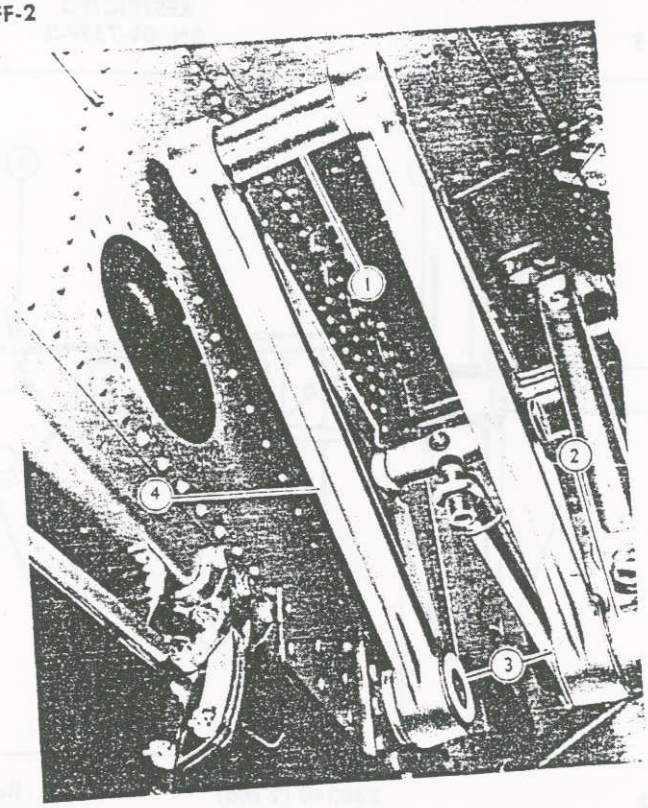
(e) INSTALLATION.

1. PREPARATION. *(See figure 81.)*

a. Check drag links for fit of pin. Pin "1" must be free to turn in drag-link bushings throughout full arc of link travel about pivot points. Grasp pin with hand and move links through complete arc of travel. Wrap pin with tape, if necessary, to prevent slippage while turning.

b. If pin is found to be too tight to turn by hand, remove bolt from outboard diagonal on outboard drag-link-pivot-tube assembly at point of attachment to pivot tube, and withdraw diagonal from attachment.

c. Loosen jam nuts on both ends of inboard diagonal, and turn diagonal tube, lengthening or shortening assembly, at the same time twisting pin and moving drag links simultaneously until pin turns freely throughout arc of link travel. (Turning tube clockwise, looking forward, will cause diagonal to lengthen; counterclockwise, to shorten.) Tighten jam nuts (inboard diagonal) to hold pivot tube alignment, and safety wire.



1. Drag Link Pin
2. Pivot Tube Assembly
3. Pivot Points
4. Drag Link

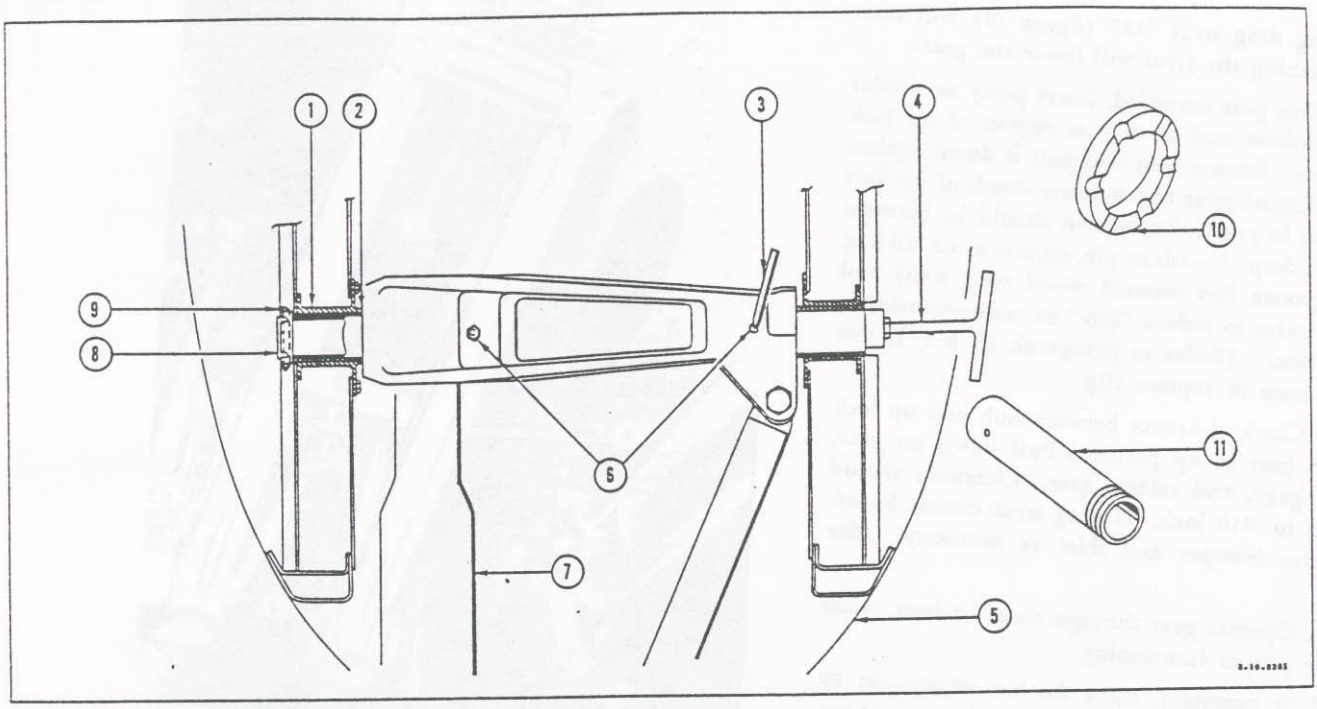
Figure 81 — Drag Link "Free" Pin

CAUTION

Do not put outboard diagonal under tension or compression when installing or adjusting pivot points. Adjust tube length by hand only. Set pivot points by adjusting inboard diagonal only.

Note

Under normal replacement procedure, where airplane or landing gear has not been damaged, do not disturb the setting of boom pivot support. If damage has occurred to the airplane in the area of the landing gear or forward boom structure, and it is impossible to obtain free operation of all units, do not attempt to replace



1.	Fitting	230240 (2 req)	6.	Bolt	AN6-35A (2 req)
2.	Spacer (Use -2, -3, -4, -5, -6, -7, as required for proper adjustment. These may be used on either end of fulcrum.)	LS2803 (8 req, max)		Washer	AN960-616 (2 req)
				Nut	AC365-624 (2 req)
			7.	Strut Assembly	196126
			8.	Pin	225457 (2 req)
				Nut	225479 (2 req)
				Washer	225497 (2 req)
3.	Drift Pin	S-33202	9.	Bolt	AN3-24A (2 req)
4.	Drift Pin			Nut	AC365-1032 (2 req)
5.	Boom Contour Station	179.875	10.	Nut (Use wrench S-20408-34)	225479 (1 req)
			11.	Pin	225458 (1 req)

Figure 82 — Main Landing Gear Fulcrum Alignment

boom pivot supports in the field as special tooling is required for this operation. (Ref. drawing 230587.)

2. INSTALLATION PROCEDURE.

a. Lift strut into place and align fulcrum pins by using aligning pins. (See figure 82.) Support strut against falling.

b. Withdraw outboard aligning pin enough to insert a sufficient number of LS-2803 spacers to give proper side adjustment between drag strut "1" and main landing-gear-strut assembly "3." (See figures 83 and 84.) Replace aligning pin to hold spacers in place. Maximum misalignment of drag strut in relation to shock strut lug "2" with gear in either extended or retracted position must not exceed $\frac{1}{8}$ inch. If this limit is exceeded, reposition drag link washers and fulcrum spacers to give proper adjustment.

c. Remove aligning pins separately and insert fulcrum pins.

d. Align fulcrum pin holes with a drift pin and install retaining bolts.

e. Install fulcrum pin lock nuts and safety-bolt in place.

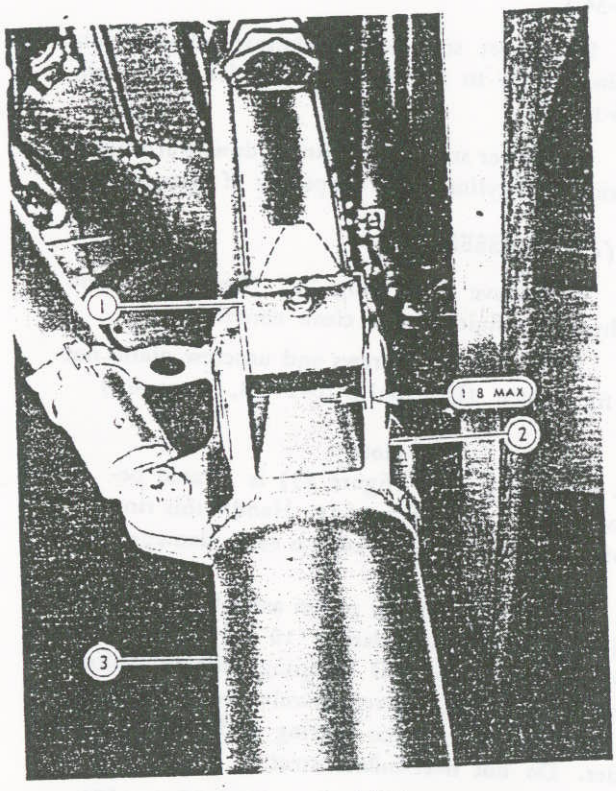
f. Install brake assembly. (Refer to paragraph 6 *b* (3), this section.)

g. Install wheel assembly. (Refer to paragraph 6 *a* (1), this section.)

h. Fill shock strut as outlined in paragraph *b* (2) *(f)*, following.

i. Inflate strut with air until piston extends $2\frac{1}{2}$ to 3 inches from cylinder when airplane is resting on ground.

j. Test gear as outlined in paragraph *(d)*, preceding.



1. Drag Strut End-fitting
2. Drag Strut Attachment Lug
3. Shock Strut Assembly

Figure 83 — Main Landing Gear Strut Misalignment, Extended

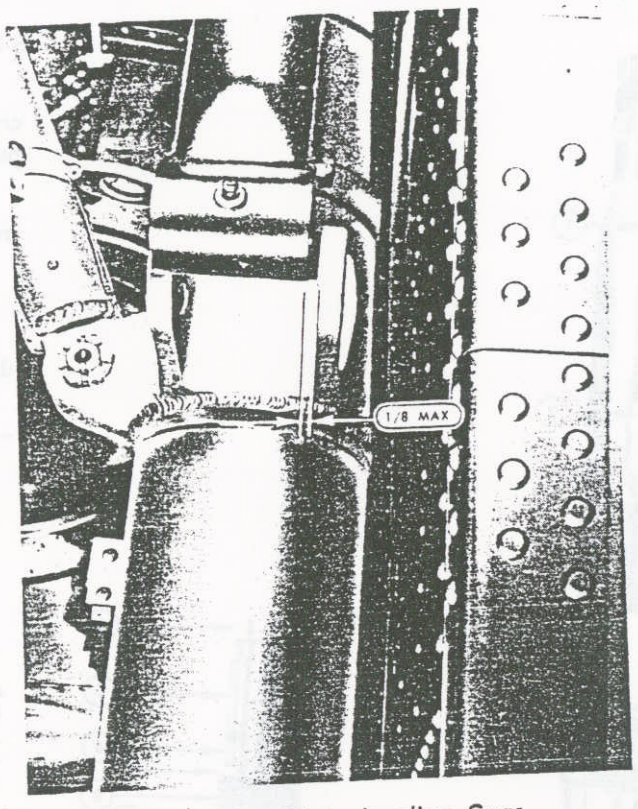


Figure 84 — Main Landing Gear Strut Misalignment, Retracted

(2) MAIN LANDING GEAR SHOCK STRUT.

(a) DESCRIPTION. *(See figure 85.)*—Each main shock strut is oleo-pneumatic in action, with air as the energizing medium, and oil the damping medium. The unit is composed of a cylinder enclosing a piston at the end of which is fastened a wheel axle fitting. Synthetic and leather chevron type packings insure operation without loss of cylinder fluid. Packings are identified by a yellow and a green stripe painted on lower portion of cylinder. The yellow band indicates synthetic packing, and the green band leather packing. Both bands together indicate a combination of packings. Torque arms, attached to both the cylinder and the axle fitting, maintain alignment and prevent rotation of the piston.

(b) OPERATION. *(See figure 79.)*—In compression, when force is applied to axle "19" the upward thrust telescopes piston "20" into cylinder "21." This action, in turn, forces hydraulic fluid in chamber "16" above the piston through orifice "14" into upper cylinder chamber "13," creating a fluid resistance which absorbs part of the shock. Air compressed by the hydraulic fluid in the upper chamber adds further resistance to the telescoping action. After axle pressure has been thus absorbed, the compressed air forces the fluid back into lower cylinder "16," extending the piston. Restriction in flow according to orifice design ensures smooth recovery from shock.

(c) REMOVAL. *(See figure 79.)*

1. Raise airplane clear of ground with wing jacks as outlined in Section III, paragraph 2 *b*.

2. Deflate strut at air valve.

3. Disconnect brake line at lower connection and drain fluid into a clean container. Plug brake line and brake-connection hole.

4. Disconnect side strut "23" at lower point of attachment "22."

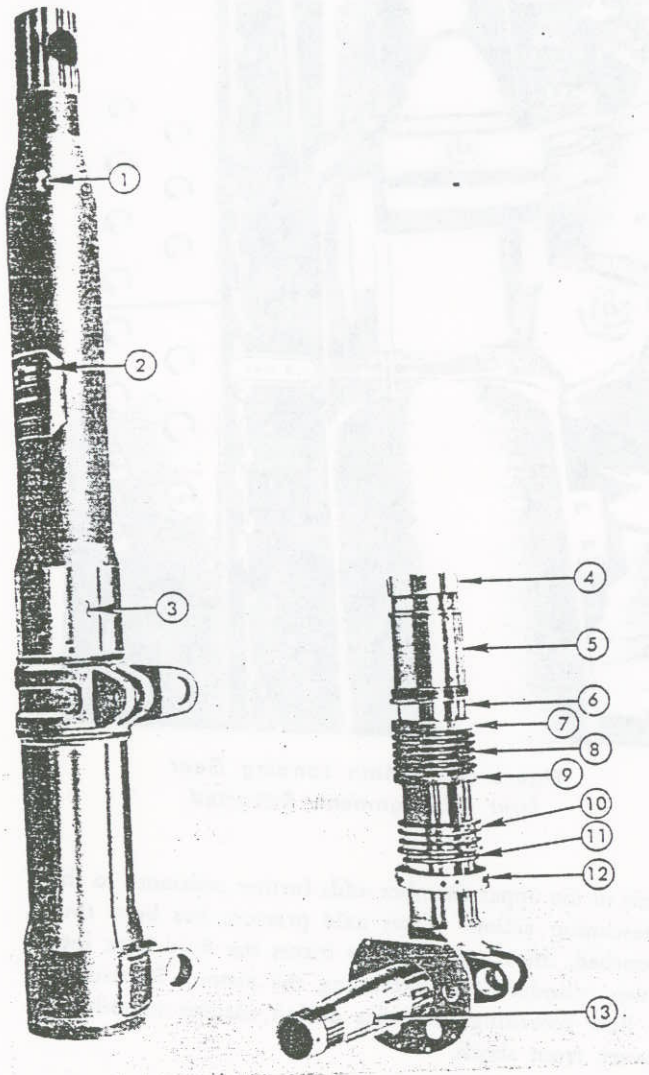
5. Disconnect scissors switch conduit.

Note

Torque arm scissors switch is mounted on LH landing gear strut only.

6. Remove drag strut attachment bolt "15."

7. Remove inboard fulcrum pin retaining bolt.



1. Filler Plug and Air Valve
2. Name Plate
3. Shock Strut Cylinder Assembly
4. Piston Head Top Bearing
5. Piston Sleeve
6. Piston Assembly
7. Upper Packing Spacer
8. Chevron Packing Rings
9. Lower Spacer
10. Bottom Bearing
11. Wiper Ring
12. Gland Nut
13. Axle Assembly

Figure 85 — Main Landing Gear Shock Strut

8. Remove inboard fulcrum pin nut. (Use tool S-20408-34.)

9. Support strut and withdraw inboard fulcrum pin enough to release strut cylinder. (Use pin puller S-10401.)

10. Lower strut by exerting a downward twisting motion until cylinder end drops free of fulcrum "3."

(d) DISASSEMBLY.

1. Remove filler plug "1" (figure 85), and drain hydraulic fluid into a clean container.

2. Remove lock screws and unscrew gland nut "12" (figure 85). (Use tool S-20427-38, figure 40.)

Note

A wiper ring "11" (figure 85) is located between gland nut and bearing. Handle this ring with care for its feather edge is easily damaged.

3. Carefully bump piston assembly down with a mallet or the foot until bearing "10" (figure 85) drops below end of cylinder. If bumping fails to dislodge bearing and packing, replace air-valve body and inflate strut just enough to force bearing and packing from cylinder. Do not over-inflate strut.

4. Disconnect torque arms "17" (figure 79).

5. Unscrew piston retainer sleeve "5" (figure 85). (Use wrench S-33701, figure 40.)

6. Withdraw piston from strut cylinder.

7. Remove piston head by loosening lock screw and unscrewing head. (Use wrench S-20628-21, figure 40.)

CAUTION

When assembling piston head to piston, precaution must be taken to make sure lock screw is tight. Failure to observe this will result in screw loosening and head turning to cause an eventual loss of hydraulic fluid past head into piston body.

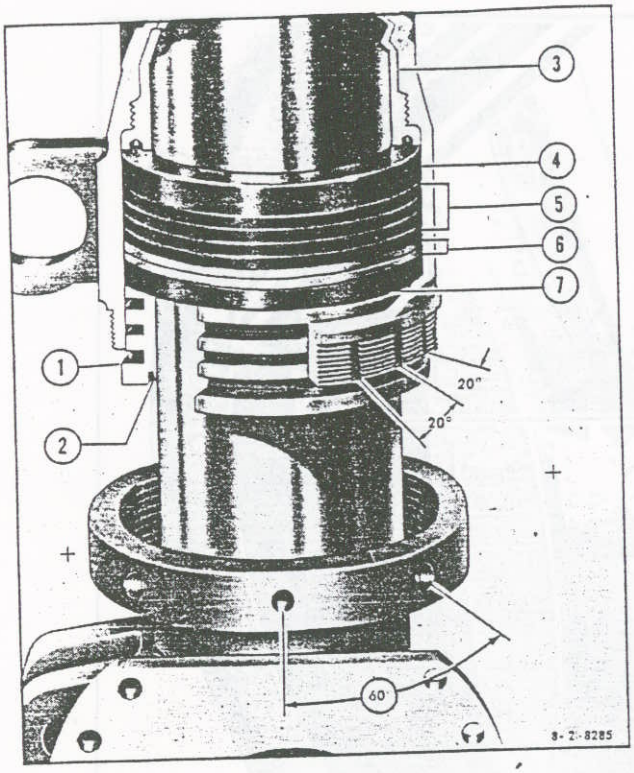
8. Remove strut packing, spacers, bearing, and wiper ring.

(e) MAINTENANCE REPAIR. *(See figure 86.)* —Fluid leakage is the most common source of trouble and may be stopped by adjusting gland nut, or replacing gland packing.

1. ADJUSTMENT OF GLAND NUT.

Note

Make adjustment while strut is installed and weight of airplane rests on landing gear.



1. Bearing
2. Wiper Ring, AN6231
3. Sleeve
4. Upper Spacer
5. Upper Packing, Specification AN6225-49
6. Lower Packing, Specification AAF 43B2237
7. Lower Spacer

Figure 86 — Landing Gear Strut Packing

a. Remove lock screws and gradually tighten gland nut until leakage has stopped. Lock-screw holes are located to allow 18 adjustments (one every 20°) to one complete turn of gland nut.

b. Rock airplane slightly to make sure gland nut has not been tightened enough to cause piston to bind.

c. Replace lock screws and safety wire.

d. If piston seizes or binds, replace gland packing.

2. REPLACEMENT OF PACKING.

Note

Strut must be disassembled to replace packing. Raise airplane off ground with wing jacks and follow procedure for strut disassembly as outlined in paragraph *(d)*, preceding. Place clean container beneath piston to catch hydraulic fluid.

Replace chevron packing rings and spacers individually. Make sure each ring is properly seated before installing the next. Dip rings in strut hydraulic fluid to facilitate installation. Be sure that apex of rings points down, and that correct packings and spacers are installed. Strut chevron packings are composed of two lower rings of leather, conforming to AAF drawing 43B2237, and four upper rings of synthetic material, Specification AN6225-49. If means are available, actuate piston through at least half its travel for a minimum of 500 cycles.

(f) ASSEMBLY. — Reverse disassembly procedure. Compress strut fully and fill cylinder to level of filler hole with approximately one U. S. gallon (0.84 Imperial gallon) of hydraulic fluid, Specification AN-VV-O-366. Actuate piston to remove trapped air and check fluid level. If level is correct, install and securely tighten air valve body and gasket.

(g) TEST.

1. With shock strut installed, rock airplane so strut will alternately extend and compress to overcome packing friction. When properly inflated, piston should extend from cylinder a distance as given in paragraph *(h)*, following. When checking or adjusting strut inflation, place airplane in taxi position on a level surface sheltered from wind.

2. Test filler body and valve and packing gland for air leakage with a neutral soapy-water solution. Leakage at packing gland is indicated by hydraulic fluid seepage, or by bubbles when soapy water is applied.

CAUTION

Do not use soaps of high lye content when testing for leakage as they will etch metal parts. Wipe all surfaces dry of soap solution after inspections have been made.

(h) INSTALLATION. — Reverse removal procedure and lower airplane until entire weight rests on landing gear. Inflate main shock struts until piston extends 2½ inches maximum, with full load, or 3 inches maximum, with light load, measured from red line on piston to end of gland nut. Test gear as outlined in paragraph *(g)*, preceding.

CAUTION

Air valves must be of the high-pressure type in accordance with Specification AN-C-71.

(3) MAIN LANDING GEAR ACTUATING CYLINDER.

(a) DESCRIPTION. — Refer to paragraph 19 *h* (6), this section.

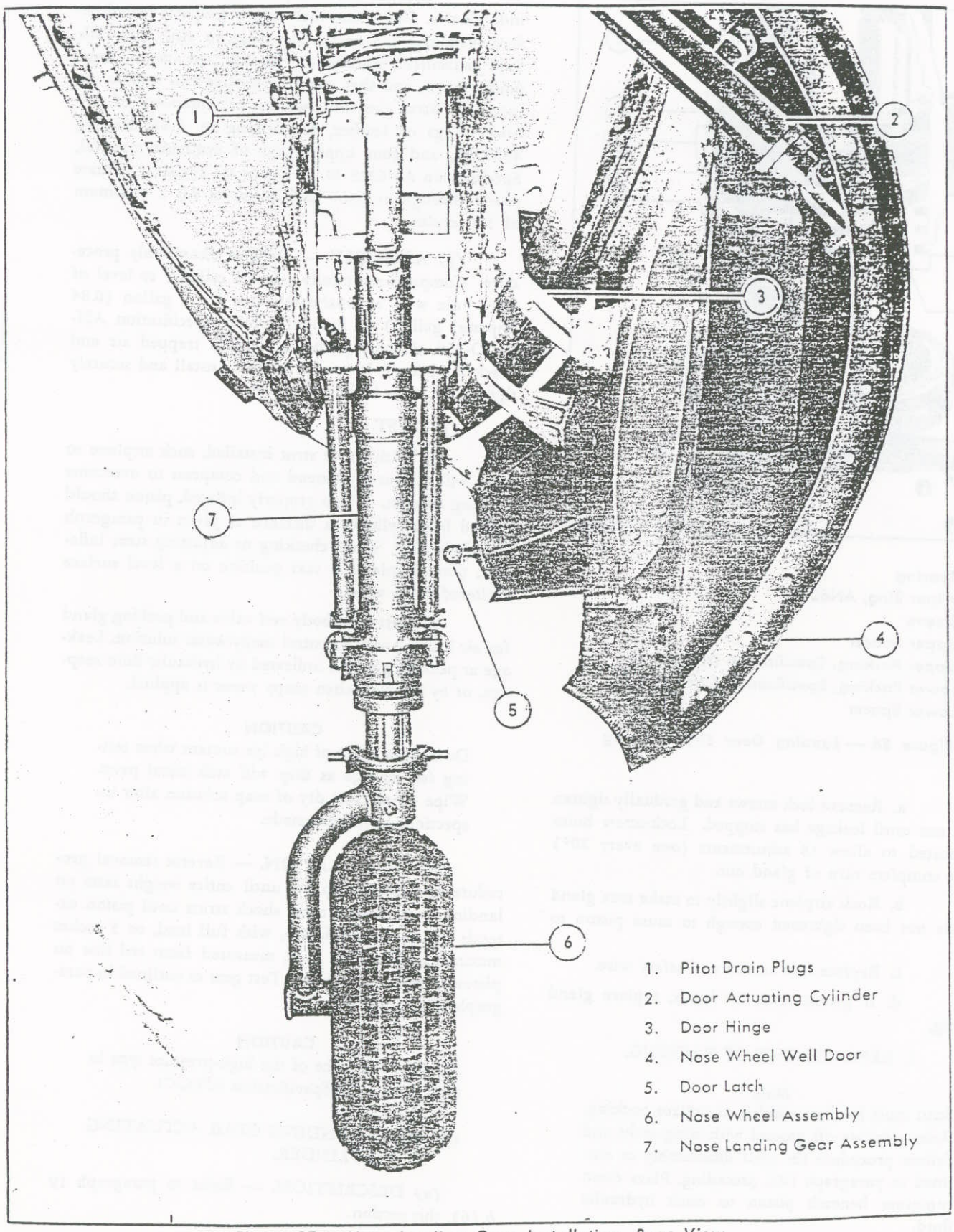


Figure 87 — Nose Landing Gear Installation, Rear View

(*b*) OPERATION. — Refer to paragraph 19 *h* (2), this section.

(*c*) REMOVAL.

1. Raise airplane clear of ground with wing jacks. (See Section III, paragraph 2 *b*.)

2. Relieve hydraulic pressure by operating ailerons.

3. Disconnect and plug hydraulic lines.

4. Detach fire wall seal at fire wall.

5. Remove pin attaching piston-end assembly to drag links at "7" (figure 79).

6. Remove elbow fitting "9" from aft part of cylinder (figure 79).

7. Remove nut holding clevis to support bay.

8. Slide cylinder aft and downward.

(4) UP LOCK.—The main landing gear up lock is mounted on the inboard web of each main wheel well so that the up lock pin engages the hollow end of the wheel axle when the gear is in the UP position. It is connected to the landing gear hydraulic system and releases the gear when extension begins to take place. For a complete description, refer to paragraph 19 *h* (7), this section.

(5) DOWN LOCK.—Incorporated into the main actuating cylinder is a small piston-operated pin which extends into a groove in the main cylinder piston when the gear is fully extended. This pin prevents movement of the gear when extended, and releases the piston during the retraction cycle. For further information, refer to paragraph 19 *h* (7), this section.

c. NOSE LANDING GEAR. *(See figures 87 and 88.)*

(1) GENERAL.—The casterable nose landing gear consists of an air-oil type shock strut, dual drag struts, a wheel fork and torque arms, and a wheel-and-brake assembly mounting a 27-inch smooth contour tire. The gear assembly is kept in alignment when retracted by a mechanical centering device incorporated in the internal construction of the piston and shock strut cylinder. Alignment in the extended position is maintained by the action of the shimmy damper.

(*a*) REMOVAL. *(See figure 88.)* — Gear extended.

1. Block main landing gear wheels and lower tail of airplane. When nose gear is clear of ground, secure tail with 800-pound load.

2. Deflate shock strut at air valve.

3. Remove bolt "23" securing drag strut "20" and disconnect safety chain "21."

Note

For ease of handling, wheel assembly may be removed prior to landing gear removal as outlined in paragraph 6 *a* (1), this section.

4. Remove fulcrum pin retaining bolts.

5. Remove fulcrum pin nuts. (Use tool S-20402-27.)

6. Support landing gear and remove two fulcrum pins "5". (Use pin puller S-10402.) Withdraw pins enough to free fulcrum from its support.

7. Rotate fulcrum until it is clear of airplane structure and lower carefully.

(*b*) DISASSEMBLY. *(See figure 88.)*—Remove side brace struts "6," drag struts "20," and shock struts "7" individually by removing their attaching bolts, pins, and nuts.

(*c*) ADJUSTMENT. *(See figure 396.)*

1. Adjust actuating cylinder piston rod length at clevis attachment "1" (figure 88) until approximately eight threads are visible between lock nut and clevis end.

Note

Shortening piston rod will *increase* break-over-center of drag strut with gear in DOWN position and will *lower* the gear in the UP position. Lengthening piston rod will *decrease* the break-over-center of drag strut with gear in DOWN position and will *raise* the gear in the UP position.

2. Loosen drag strut lock nuts at "24" (figure 88) and adjust length of strut until the distance between the ends of strut tubes is approximately 1⅞ inches.

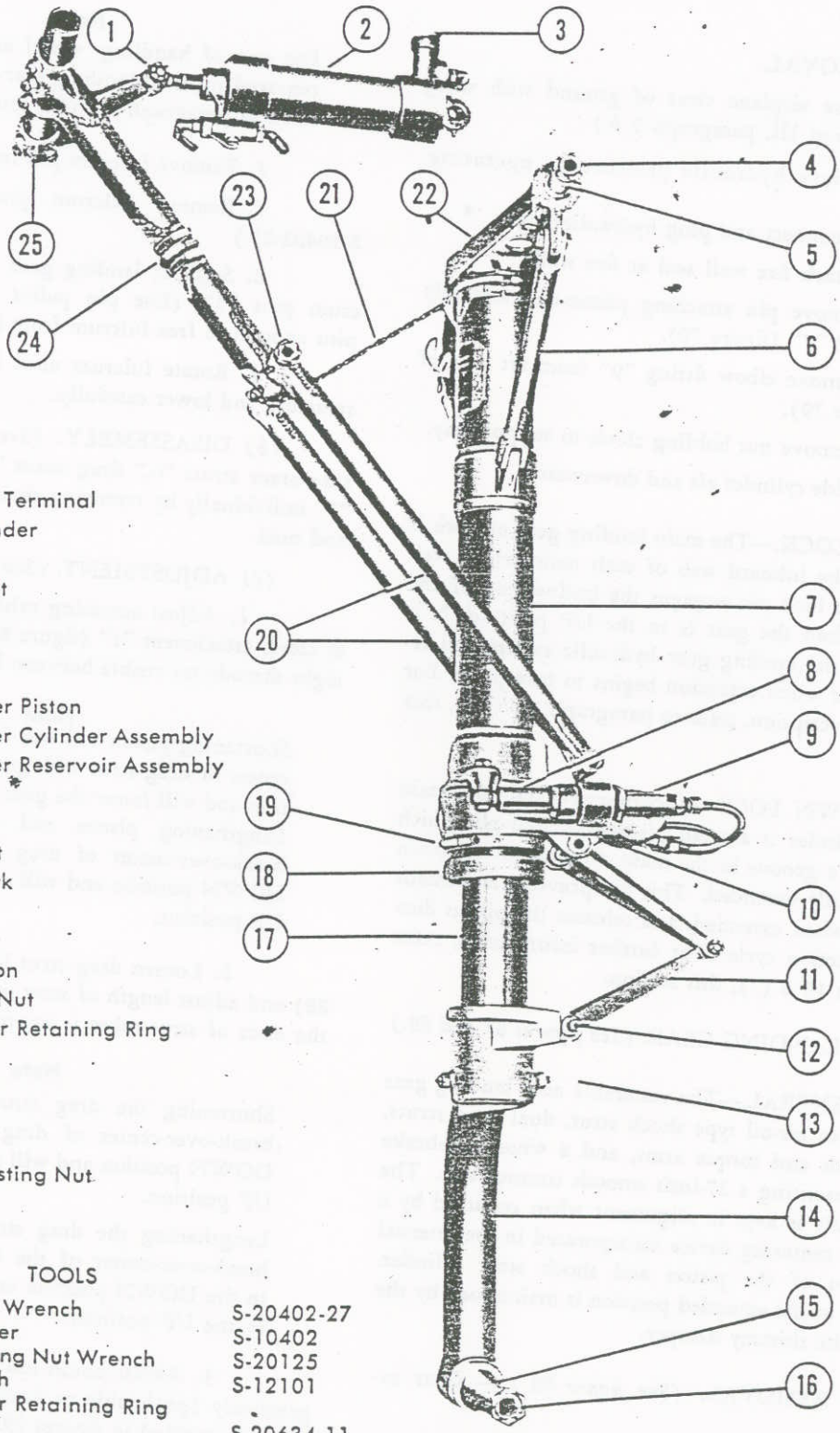
Note

Shortening the drag strut will *decrease* the break-over-center of drag strut with gear in DOWN position and will *lower* the gear in the UP position.

Lengthening the drag strut will *increase* the break-over-center of the drag strut with gear in the DOWN position and will *raise* the gear in the UP position.

3. Adjust piston rod and drag strut length progressively (preferably at drag strut) to obtain final results as specified in figures 393 and 396.

4. Check chain for ¼ inch slack. If necessary, adjust tension by lowering or raising clamp on strut assembly. (See figure 396.)

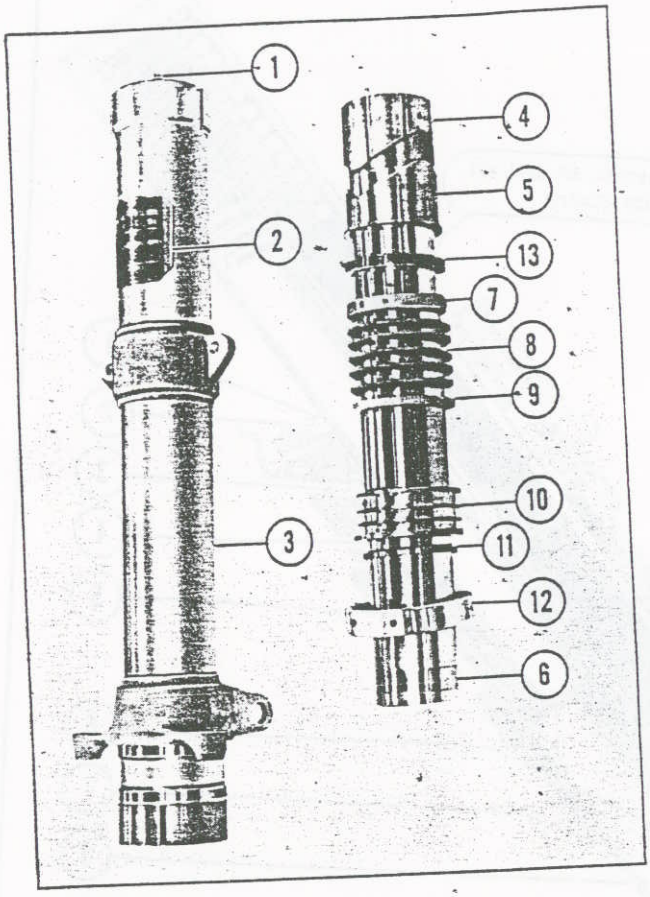


1. Piston Rod End Terminal
2. Actuating Cylinder
3. Down Lock
4. Fulcrum Pin Nut
5. Fulcrum Pin
6. Side Strut
7. Shock Strut
8. Shimmy Damper Piston
9. Shimmy Damper Cylinder Assembly
10. Shimmy Damper Reservoir Assembly
11. Torque Arm
12. Torque Arm Pin
13. Towing Eye Bolt
14. Nose Wheel Fork
15. Wheel Axle
16. Wheel Axle Nut
17. Shock Strut Piston
18. Packing Gland Nut
19. Shimmy Damper Retaining Ring
20. Drag Struts
21. Safety Chain
22. Fulcrum
23. Drag Strut Bolt
24. Drag Strut Adjusting Nut
25. Torque Lever

TOOLS

4.	Fulcrum Pin Nut Wrench	S-20402-27
5.	Fulcrum Pin Puller	S-10402
9.	Cylinder Retaining Nut Wrench	S-20125
16.	Axle Nut Wrench	S-12101
19.	Shimmy Damper Retaining Ring Wrench	S-20634-11
25.	Torque Lever Adjusting Nut Wrench	S-20129

Figure 88 — Nose Landing Gear



1. Filler Plug and Air Valve
2. Name Plate
3. Shock Strut Cylinder Assembly
4. Piston Head Top Bearing
5. Piston Sleeve
6. Piston Assembly
7. Upper Packing Spacer
8. Chevron Packing Rings
9. Lower Spacer
10. Bottom Bearing
11. Wiper Ring
12. Gland Nut
13. Nut

Figure 89 — Nose Landing Gear Shock Strut

(2) NOSE LANDING GEAR SHOCK STRUT.

(a) DESCRIPTION. *(See figure 89.)*—The nose shock strut is of the oleo-pneumatic type, and is similar in construction and operation to the main landing gear shock struts. A cam sleeve "5" engages a corresponding cam cut in the top bearing "4" to maintain a fore-and-aft alignment of the nose wheel when the gear is retracted or not under compression. A shimmy damper is installed above the torque arms to prevent excessive oscillation of the nose wheel at high speeds, but is constructed to permit the wheel to swivel on either side of the center line of the airplane.

(b) REMOVAL. *(See figure 88.)*

1. Follow removal procedure as outlined in paragraph *b* (2) *(c)*, preceding.

2. Support strut and disconnect side brace struts "6" at upper attachment to fulcrum.

3. Lower strut by exerting a downward twisting motion until keys in strut cylinder head loosen sufficiently to allow strut to drop free of fulcrum.

(c) DISASSEMBLY. *(See figure 89.)*—Refer to paragraph *b* (2) *(d)*, preceding.

1. Remove filler plug "1," and drain hydraulic fluid into a clean container.

2. Remove lock screws and unscrew gland nut "12." (Use tool S-20636-21, figure 40.)

Note

A wiper ring "11" is located between gland nut and bearing. Handle this ring with care for its feather edge is easily damaged.

3. Carefully bump piston assembly with a mallet or the foot until bearing "10" drops below end of cylinder. If bumping fails to dislodge bearing and packing, replace air-valve body and inflate strut just enough to force bearing and packing from cylinder. Do not over-inflate strut.

4. Disconnect torque arms.

5. Unscrew piston sleeve "5." (Use tool S-34501, figure 40.)

6. Withdraw piston from strut cylinder.

7. Remove piston head by loosening lock screw and unscrewing head. (Use tool S-20628-21, figure 40.)

CAUTION

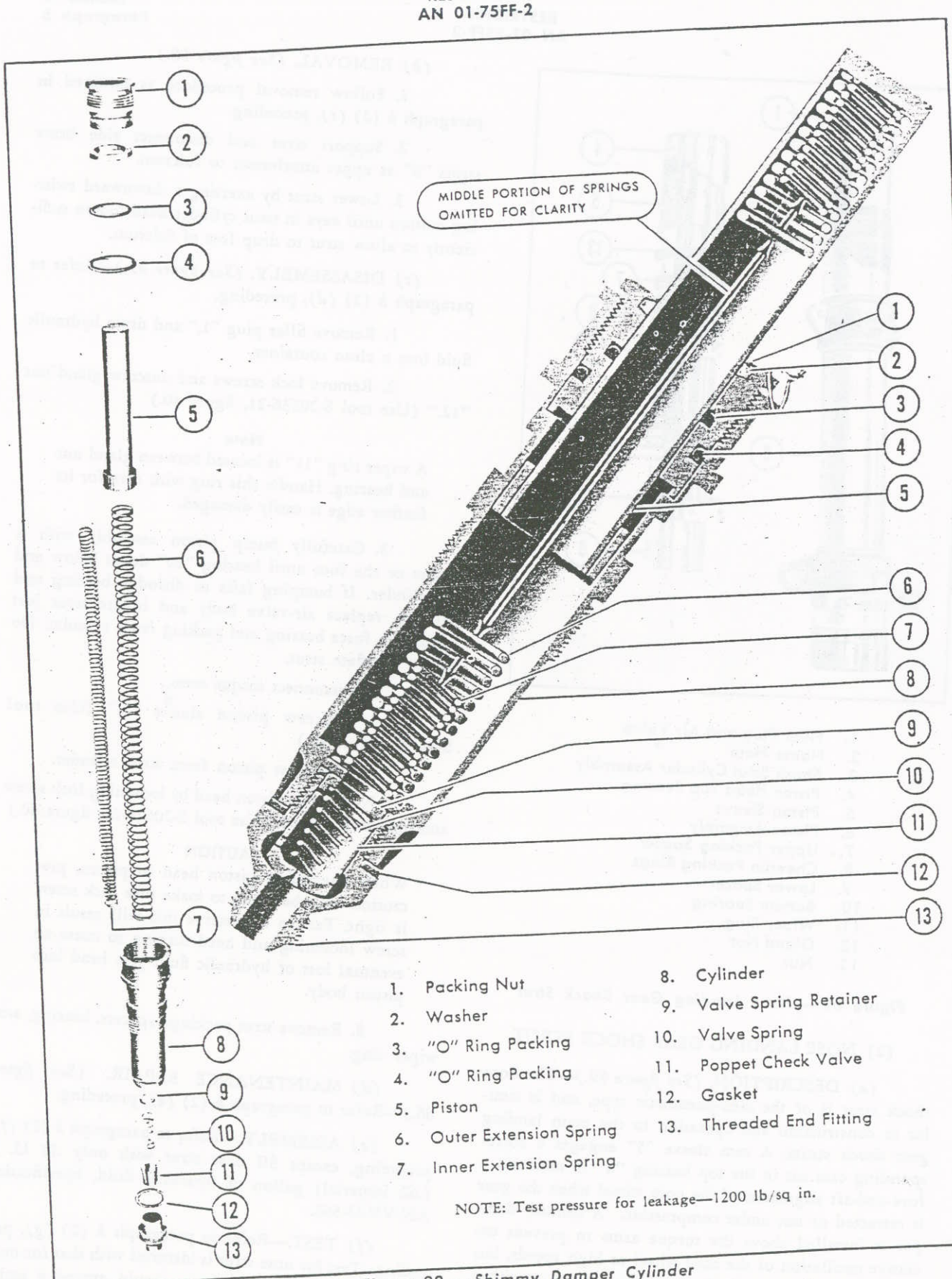
When assembling piston head to piston, precaution must be taken to make sure lock screw is tight. Failure to observe this will result in screw loosening and head turning to cause an eventual loss of hydraulic fluid past head into piston body.

8. Remove strut packings, spacers, bearing, and wiper ring.

(d) MAINTENANCE REPAIR. *(See figure 86.)*—Refer to paragraph *b* (2) *(e)*, preceding.

(e) ASSEMBLY.—Refer to paragraph *b* (2) *(f)*, preceding, except fill nose strut with only .75 U. S. (.62 Imperial) gallon of hydraulic fluid, Specification AN-VV-O-366.

(f) TEST.—Refer to paragraph *b* (2) *(g)*, preceding. Test for nose strut is identical with that for main strut, except nose strut piston should extend 4 inches



1. Packing Nut
2. Washer
3. "O" Ring Packing
4. "O" Ring Packing
5. Piston
6. Outer Extension Spring
7. Inner Extension Spring
8. Cylinder
9. Valve Spring Retainer
10. Valve Spring
11. Poppet Check Valve
12. Gasket
13. Threaded End Fitting

NOTE: Test pressure for leakage—1200 lb/sq in.

Figure 90 — Shimmy Damper Cylinder

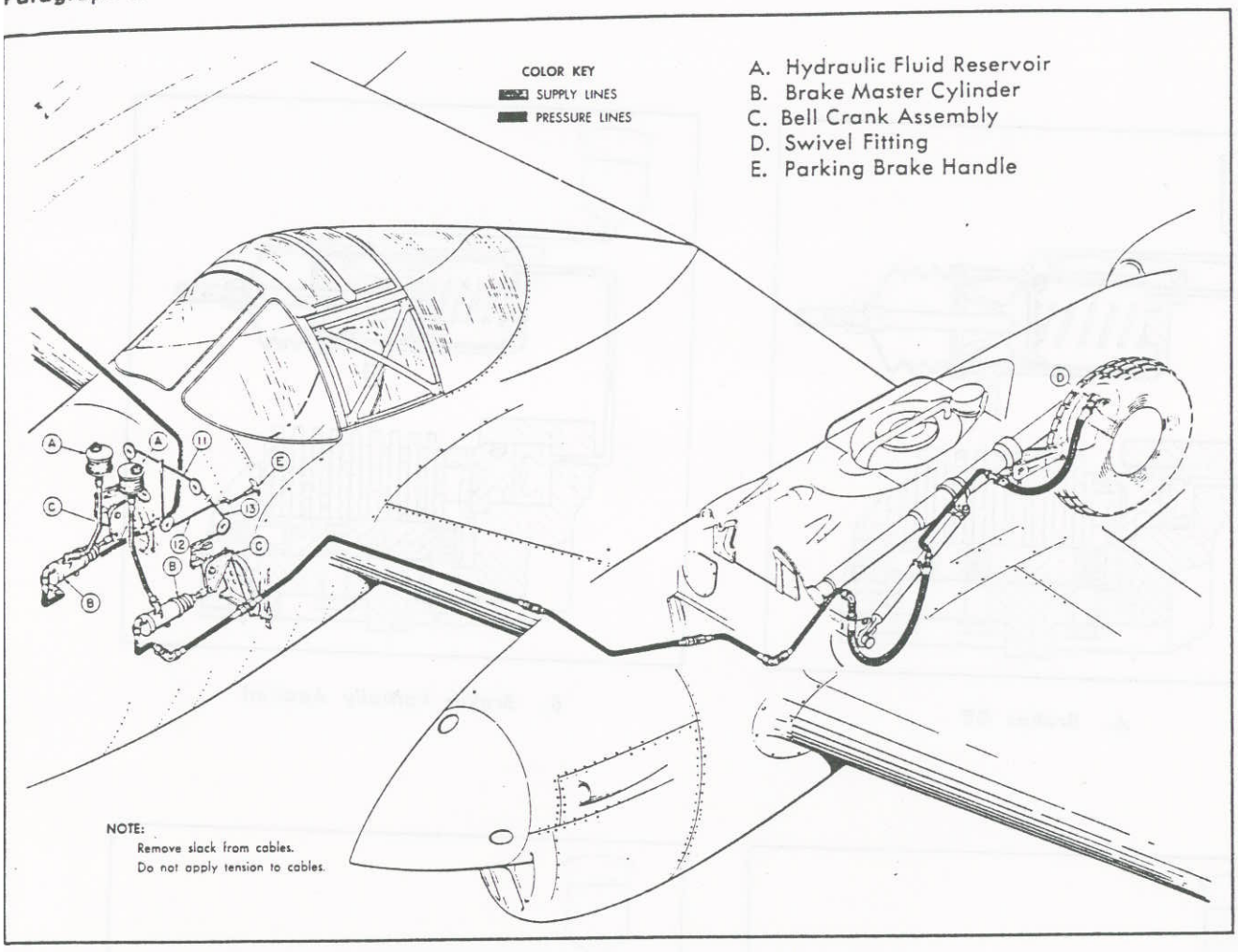


Figure 91 — Brake System Location and Flow Diagram

(2) NOSE LANDING GEAR WHEEL ASSEMBLY.

(a) DESCRIPTION.—The nose wheel assembly consists of a cast wheel, a tire, and a tube, similar to the main wheel assembly. No brakes are installed in the nose wheel assembly. The wheel and tire assembly is mounted on the axle of the nose landing gear strut located in the forward section of the fuselage. The tire is a 27-inch smooth contour, 8-ply casing, Specification AN-C-55A, using a 27-inch SCB Dual Seal tube, Specification AN-I-14, and mounted on a cast magnesium wheel, Specification AN-W-6.

(b) REMOVAL.

1. Block main landing gear wheels and lower tail of airplane.

2. When nose wheel is clear of ground, secure tail with 800-pound load.

3. Remove wheel assembly as outlined in paragraph (1) *(b)*, preceding.

(c) DISASSEMBLY.—Refer to paragraph (1) *(c)*, preceding.

(d) MAINTENANCE REPAIR.—Refer to paragraph (1) *(d)*, preceding.

(e) ASSEMBLY.—Refer to paragraph (1) *(e)*, preceding.

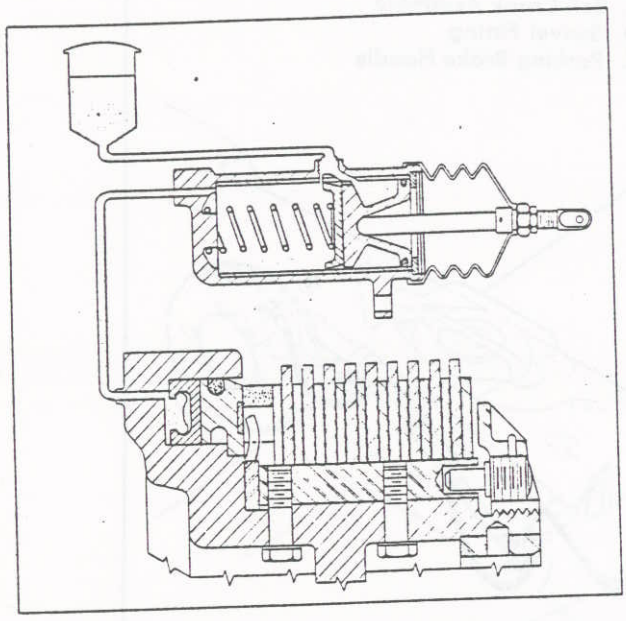
(f) INSTALLATION.

1. Replace wheel assembly as outlined in paragraph (1) *(f)*, preceding.

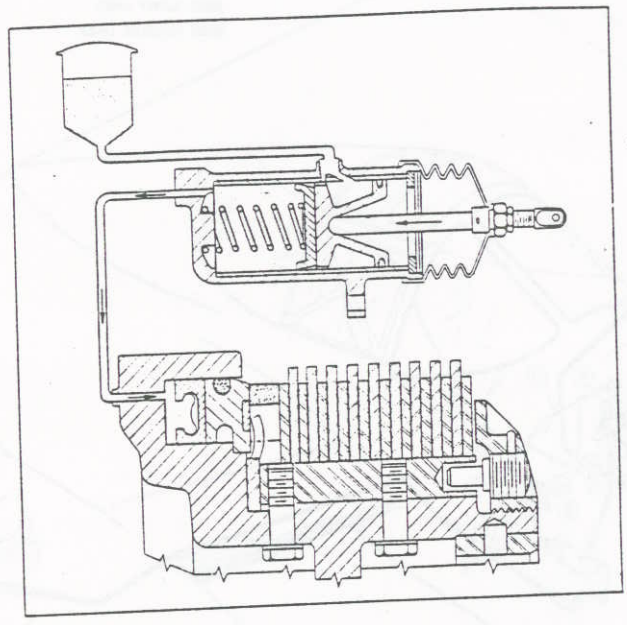
2. Lower nose of airplane and remove load from tail.

b. BRAKE SYSTEM.

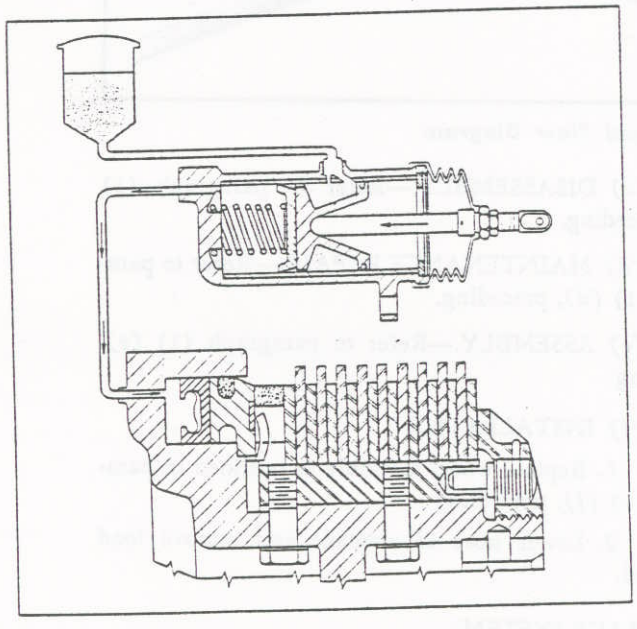
(1) GENERAL. *(See figure 91.)*—The braking system consists of two barrel-type compensating master cylinders, directly connected to two 12.7-inch nine-disc-type brake units. The hydraulic brake fluid is fed by gravity from two reservoirs, located on the aft bulkhead of the gun compartment, to the inlets of the respective



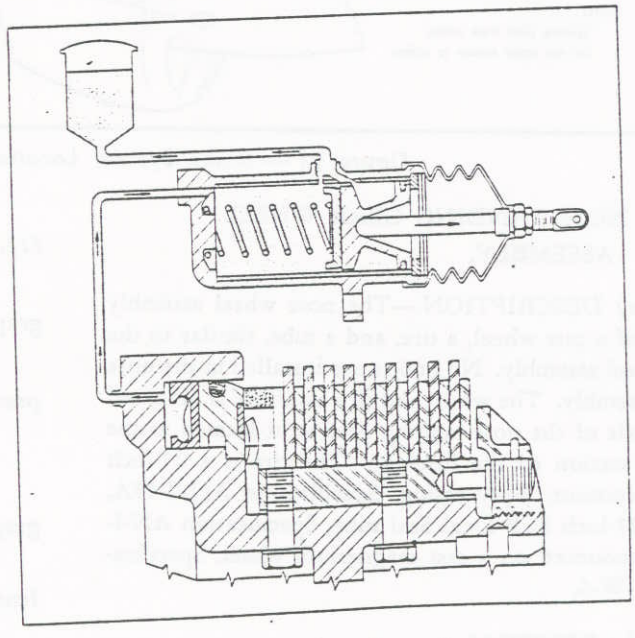
A. Brakes Off



B. Brakes Partially Applied

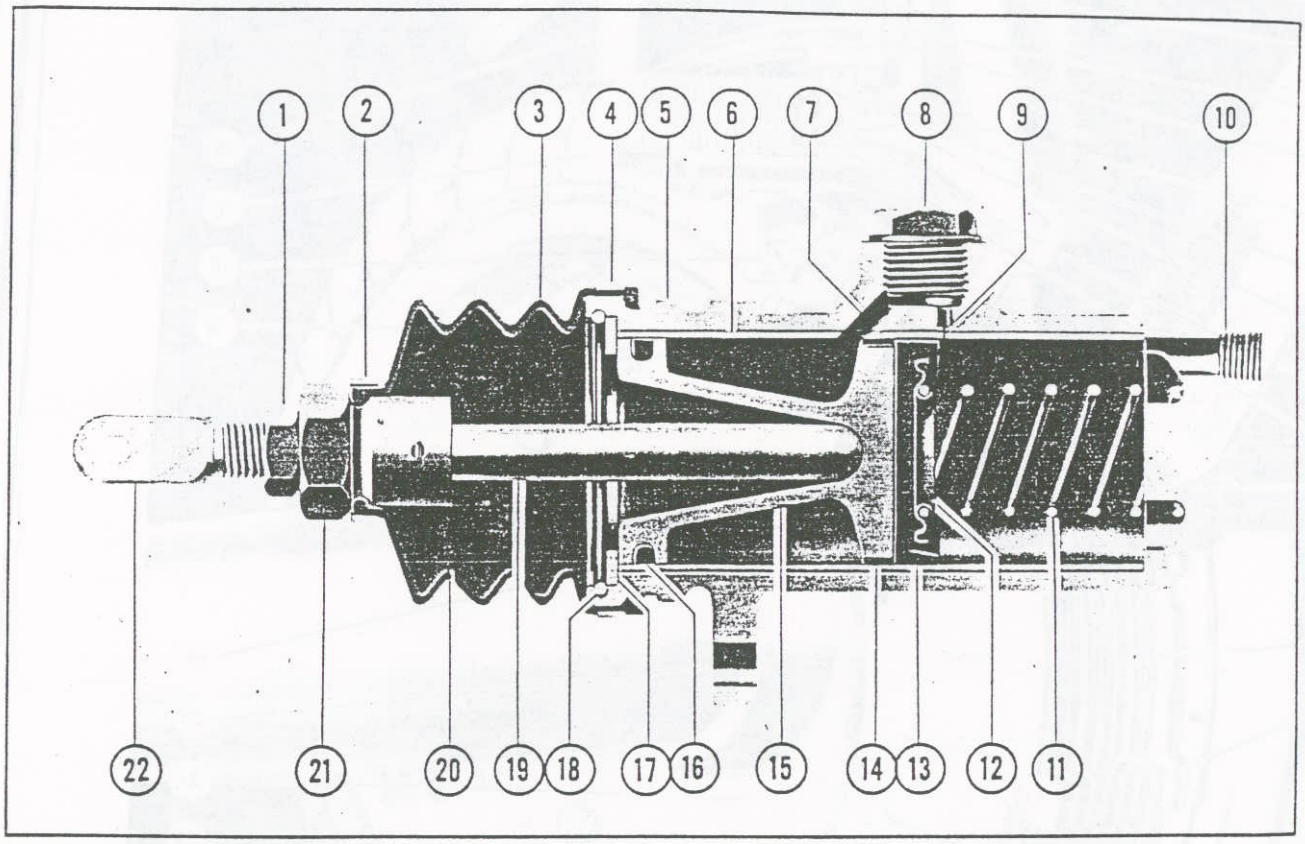


C. Brakes Fully Applied



D. Brakes Released

Figure 92 — Brake Operation Cycle



1. Eyebolt Lock Nut
2. Rubber Boot Strap (Small)
3. Rubber Boot
4. Rubber Boot Strap (Large)
5. Cylinder Body
6. Steel Sleeve Insert
7. Gravity Inlet Port
8. Inlet Connector Fitting
9. Compensating Port
10. Pressure Port
11. Return Spring
12. Spring Seat
13. Front Piston Seal
14. Piston Head Ports
15. Piston
16. Rear Piston Seal
17. Piston Return Stop
18. Snap Ring
19. Piston Rod
20. Boot Air Vent
21. Piston Rod Coupling
22. Eyebolt Terminal

Figure 93 — Brake Master Cylinder

master cylinders (figure 91). The cylinders are located on the aft bulkhead of the gun compartment in line with the rudder pedals. From the master cylinder, the hydraulic fluid pressure is transmitted to the respective brake units through tubing along the front center-section shear beam and through the forward boom to the main landing gear shock strut by flexible tubing. The fluid is carried from the center section to the strut, to allow retraction of the gear, and from the strut to the brake to permit movement of the shock-absorbing unit.

(a) OPERATION. *(See figure 92.)*—The operation of the brake system may be divided into four components or positions in the brake-application cycle: "A," Brakes Off; "B," Partially Applied; "C," Fully Applied, and "D," Released.

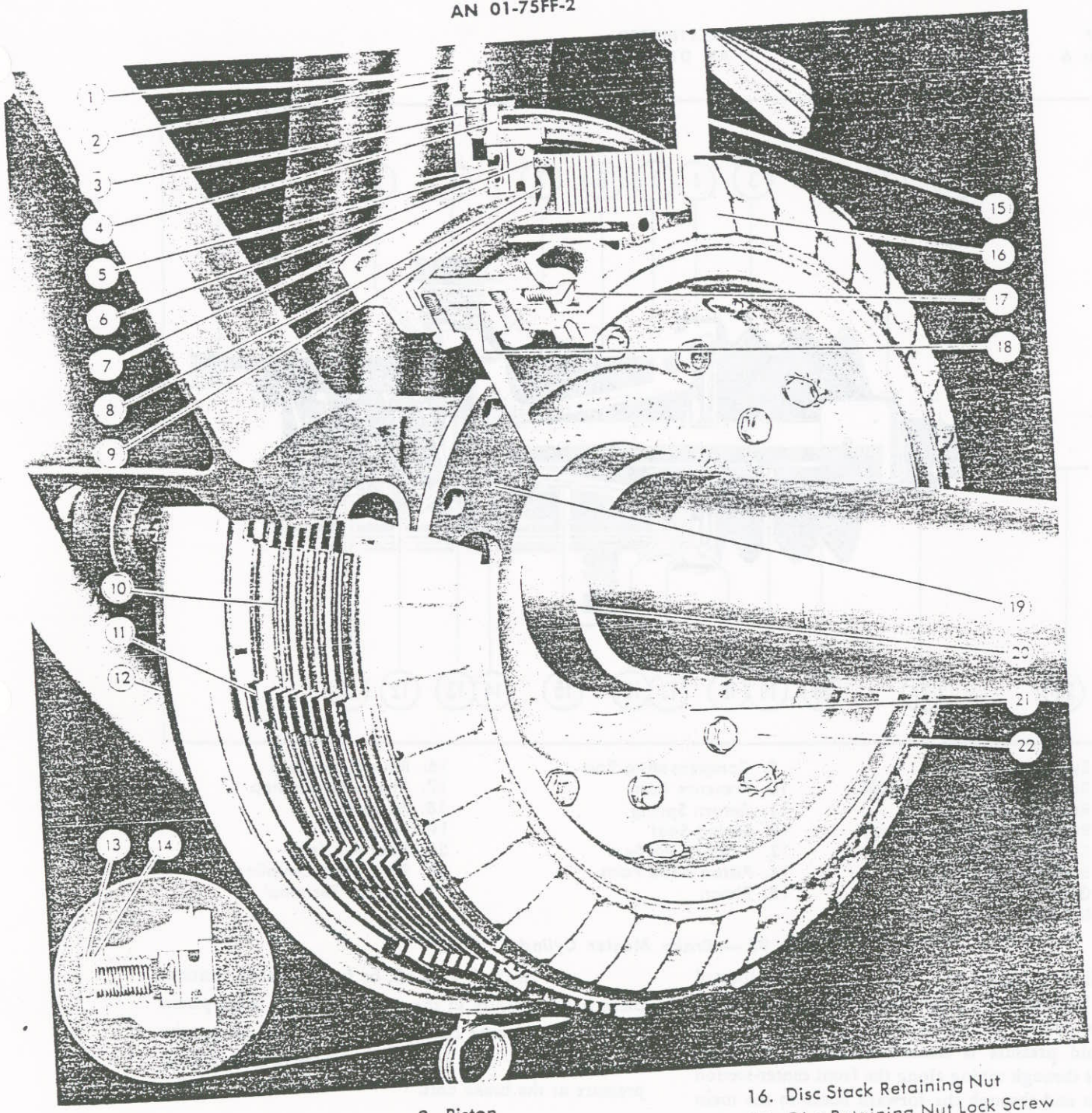
Note

Item numbers in text following are called out on figure 93 except as noted.

1. In the brakes off, or fully released position, there is no pressure in the master cylinder, since piston "15" does not cover compensating port "9." Hence, the brake discs may turn freely, since there is no hydraulic pressure at the brake unit.

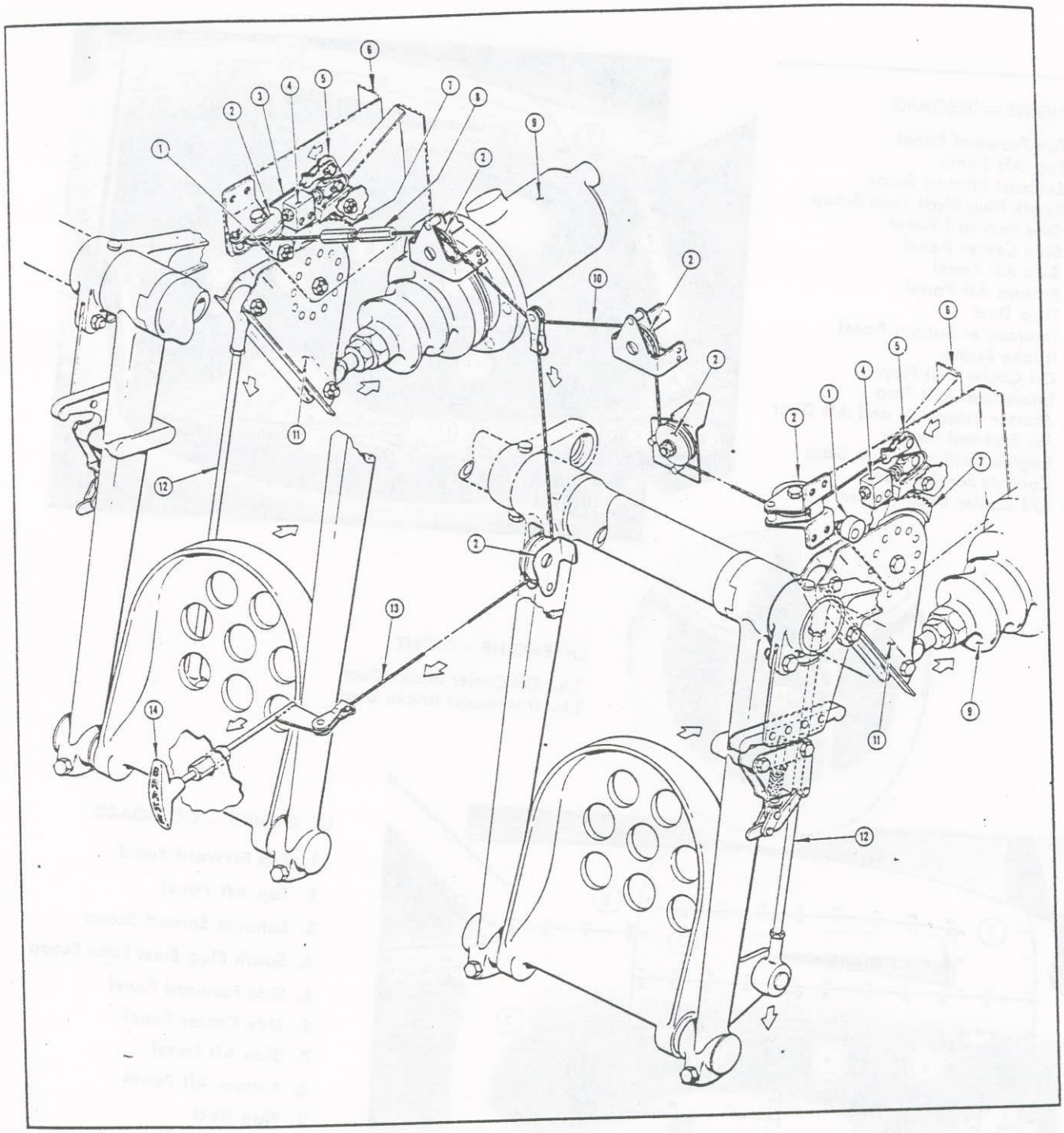
2. When the brake is partially applied, the piston moves forward covering compensating port "9." Any further movement of the piston develops pressure on the fluid in the master cylinder. This is transmitted through the hydraulic lines to the brake cylinder, partially compressing the discs and slowing the rotation of the wheel.

3. To build up braking pressure, a sufficient quantity of fluid must pass to the brake cylinder to cause piston "9" (figure 94) to move out and bring the discs together. After contact is accomplished, any further movement of the master piston brings increased



1. Bleeder Screw
2. Bleeder Washer
3. Bleeder Plug
4. Seal Ring
5. Piston Seal Expander Spring
6. Insulating Disc
7. Piston Seal Gasket
8. Piston Return Spring
9. Piston
10. Stationary Braking Disc
11. Rotating Braking Disc
12. Brake Mounting Anchor Bracket
13. Hydraulic Line Inlet Plug
14. Inlet Washer
15. .066-inch Feeler Gage
16. Disc Stack Retaining Nut
17. Disc Retaining Nut Lock Screw
18. Disc Anchor Key
19. Axle Torque Plate
20. Axle Spacer
21. Torque Plate Attaching Bolts
22. Anchor Key Screw

Figure 94 — Brake Assembly



1. Stop
2. Pulley
3. Cable Assembly
4. Pawl Stop Block
5. Pawl
6. Bell Crank Assembly Bracket
7. Ratchet
8. Cable Adjusting Barrel
9. Brake Master Cylinder
10. Cable Assembly
11. Bell Crank Assembly
12. Pullrod
13. Cable Assembly
14. Handle

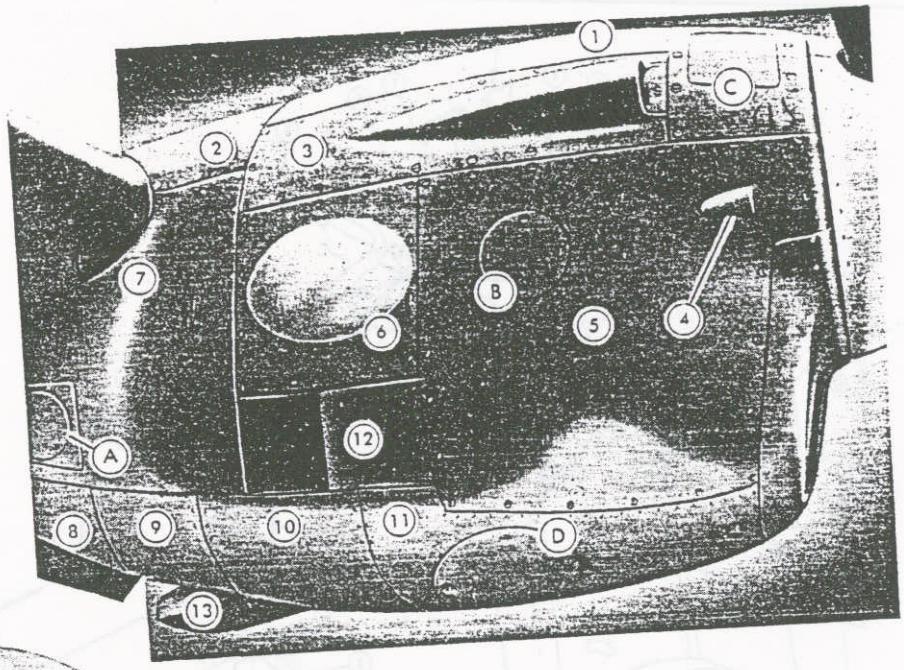
For Key to Cables, See Section IX.

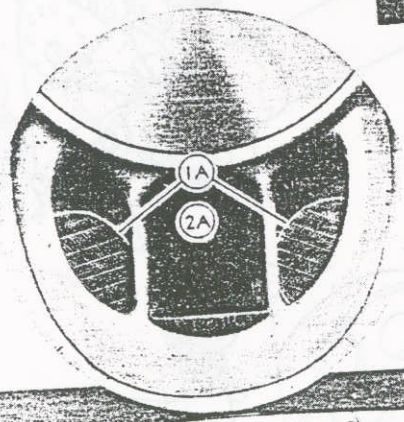
Figure 95 — Parking Brake Installation

LH ENGINE – INBOARD

1. Top Forward Panel
2. Top Aft Panel
3. Exhaust Shroud Scoop
4. Spark Plug Blast Tube Scoop
5. Side Forward Panel
6. Side Center Panel
7. Side Aft Panel
8. Bottom Aft Panel
9. Flap Duct
10. Intercooler Bottom Panel
11. Intake Scoop
12. Oil Cooler Exit Flap
13. Intercooler Exit Flap

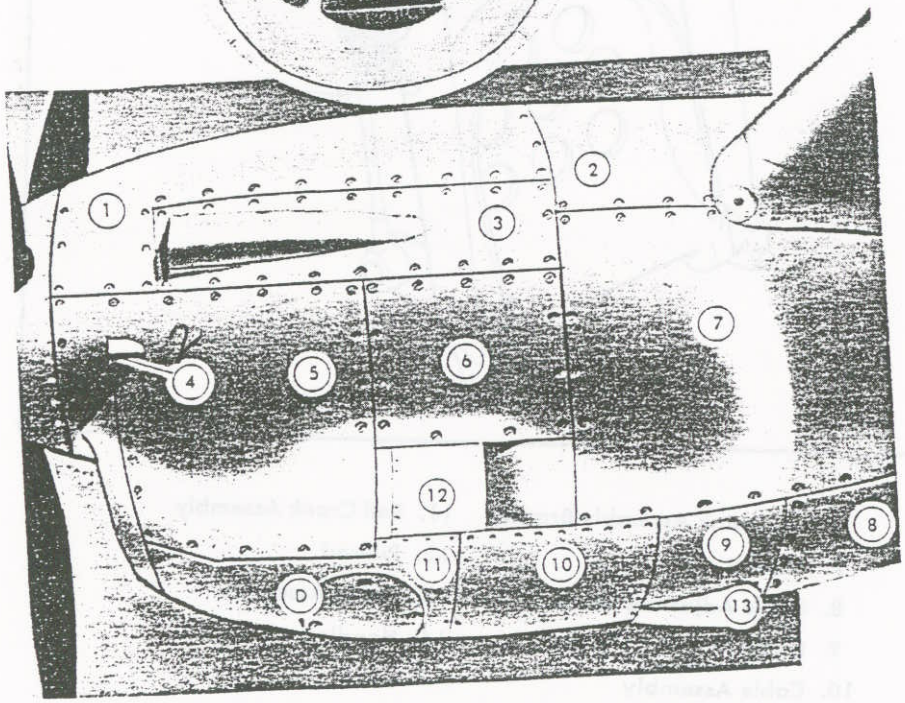
A. Starter Extension and Aft Door for External Heater
B. Engine Section Heater Door
C. Coolant Service Door
D. Oil Cooler Drain Cover





LH ENGINE – FRONT

1A. Oil Cooler Intake Duct
2A. Intercooler Intake Duct



LH ENGINE – OUTBOARD

1. Top Forward Panel
2. Top Aft Panel
3. Exhaust Shroud Scoop
4. Spark Plug Blast Tube Scoop
5. Side Forward Panel
6. Side Center Panel
7. Side Aft Panel
8. Bottom Aft Panel
9. Flap Duct
10. Intercooler Bottom Panel
11. Intake Scoop
12. Oil Cooler Exit Flap
13. Intercooler Exit Flap

Figure 96 — Cowling Identification

7. NACELLE GROUP.

a. GENERAL.—The nacelles consist of the cowling and engine support structure extending forward of the fire wall (station 155¼). The cowling is made up of removable panels which provide access to the engine and accessories for inspection and maintenance. Cooling air ducts are also included in the nacelles.

b. REMOVABLE COWL PANELS. *(See figure 96.)*

(1) Panel "1" provides access to the top of each cylinder bank. The right-hand panel incorporates a service door through which the coolant supply may be checked and replenished.

(2) Panel "2" provides access to the top of the engine accessory housing.

(3) Panel "3" is the external cover of the exhaust manifold and provides access to the exhaust manifold and inner shroud.

(4) Panel "5" provides access to the lower part of the engine. Openings in the forward end accommodate the spark plug blast tube scoop "4. Panel "5" (inboard side only) has a 4-inch heat induction hole and cover plate "B." Removal of the cover plate permits the admission of heat from an external source to prewarm the engine during cold weather operation. Panels "5" and "6" (inboard only) have polished metal areas which make possible a visual check on the position of the nose landing gear from the cockpit.

(5) Panel "7" provides access to the lower section of the engine accessory compartment. Each right-hand panel has a hinged door "A" over the manual starter shaft extension, and meshing control. A three-inch cover plate attached to the door permits induction of external heat to the accessories compartment.

(6) The ducts "1A" and "2A" form the lower forward section of the nacelle and conduct air through the carburetor air intercooler radiator and the oil cooler radiators.

(7) The two panels "8" and "10" provide access to the lower portion of the engine. Panel "11" contains two 7-inch holes and cover plates "D" to provide oil draining facilities for the oil cooler radiators. Panel "9" contains the intercooler exit flap.

Note

Install intercooler exit duct plugs in panel "8" if carburetor air temperatures of 15°C (59°F) or less are experienced during flight at cruising power. The plugs are stowed in the armament compartment as loose equipment. Install plugs at forward ends of right- and left-hand intercooler exit ducts. Secure in place with eight PK 84xA-8-24 screws through duct flange.

(8) Panel "12" is the oil cooler exit flap. The electrical actuating mechanism is accessible through panel "6."

c. COWL FORMERS.—Cowl formers are attached to the engine and other parts of the engine section to provide a base for the removable cowl panels, which are butt-jointed to form a smooth engine housing.

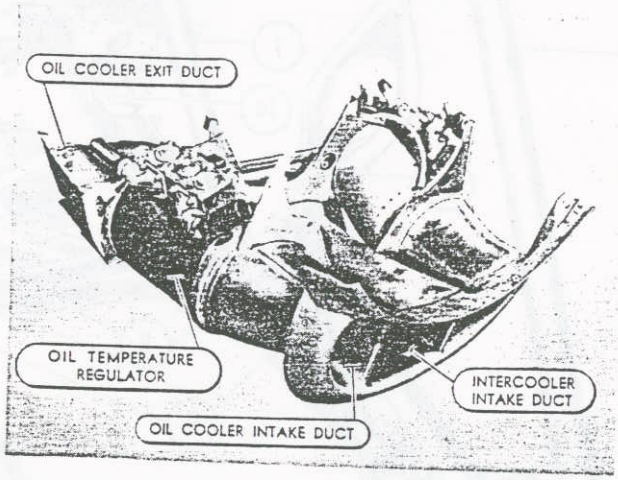


Figure 97 — Air Intake Ducts

d. AIR INTAKE DUCTS.

(1) DESCRIPTION. *(See figure 97.)*—The carburetor air intercooler ducts and oil cooler radiator ducts form the lower section of the engine nacelle. The temperature of the carburetor air and engine oil is controlled by electrically operated exit flaps which control the mass flow of air through the radiator units.

(2) REMOVAL.

(a) Remove the side engine cowls, "5," "6," and "7." (See figure 96.)

(b) Remove the screws and bolts securing the intake duct to the forward bulkhead.

(c) Disconnect the forward side cowl formers.

(d) Disconnect the aft lower cowl formers.

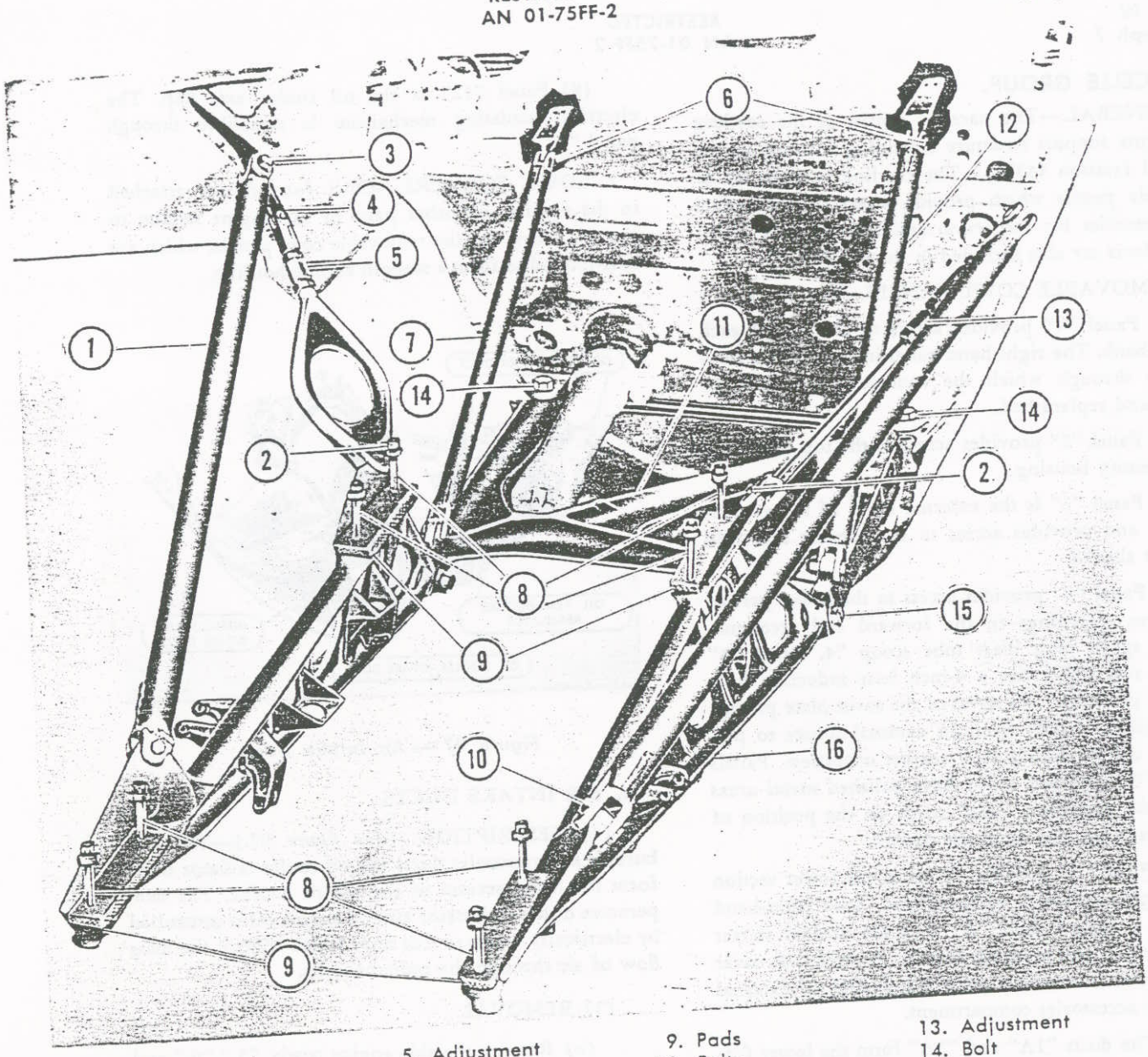
(e) Disconnect the oil cooler flap push-pull tube at the bell crank.

(f) Remove the engine stud nuts which secure the air duct forward mounting brackets.

(g) Disconnect the oil lines at the temperature regulator and drain the oil into a clean container.

Note

If desired the oil temperature regulators may be removed. (Refer to paragraph 15 *g* (2), this section.)



1. Diagonal
2. Bolt
3. Bolt
4. Bolt
5. Adjustment
6. Bolts
7. Diagonal Assembly
*8. Bolts
9. Pads
10. Bolts
11. Bay Assy. Left Engine
12. Diagonal
13. Adjustment
14. Bolt
15. Bolt
16. Truss

*To be tightened to 350-400 inch-pounds.

Figure 98 — Engine Mount and Support Assembly

(h) Support the air intake duct and remove the bolts of the rear mounting brackets.

(i) Remove any additional screws that secure the intake ducts to the engine section.

(j) Lower the duct and regulators (if attached) as a unit. (See figure 97.) This provides access to the underside of the engine.

e. ENGINE MOUNTS AND SUPPORT BAY. *(See figure 98.)*—Each engine mount is composed of three sections: the support bay, trusses, and diagonals. All sections and component parts are secured by machined bolts. Some of the diagonals have adjusting nuts, facilitating installation or replacement of component parts. When installing or inspecting an engine, be sure the tie down bolts, "8," are tightened to 350-400 inch-pounds torque. The support bay, "11," is an aluminum alloy forging supported on the aft ends by fittings attached to the forward boom wheel well channels and forms the aft and lower support for the engine trusses. Two triangular forged aluminum alloy trusses "16" provide support for the engine. Attached to the trusses are the engine mounting pads "9," the oil cooler flap actuator supports and the intercooler supports.

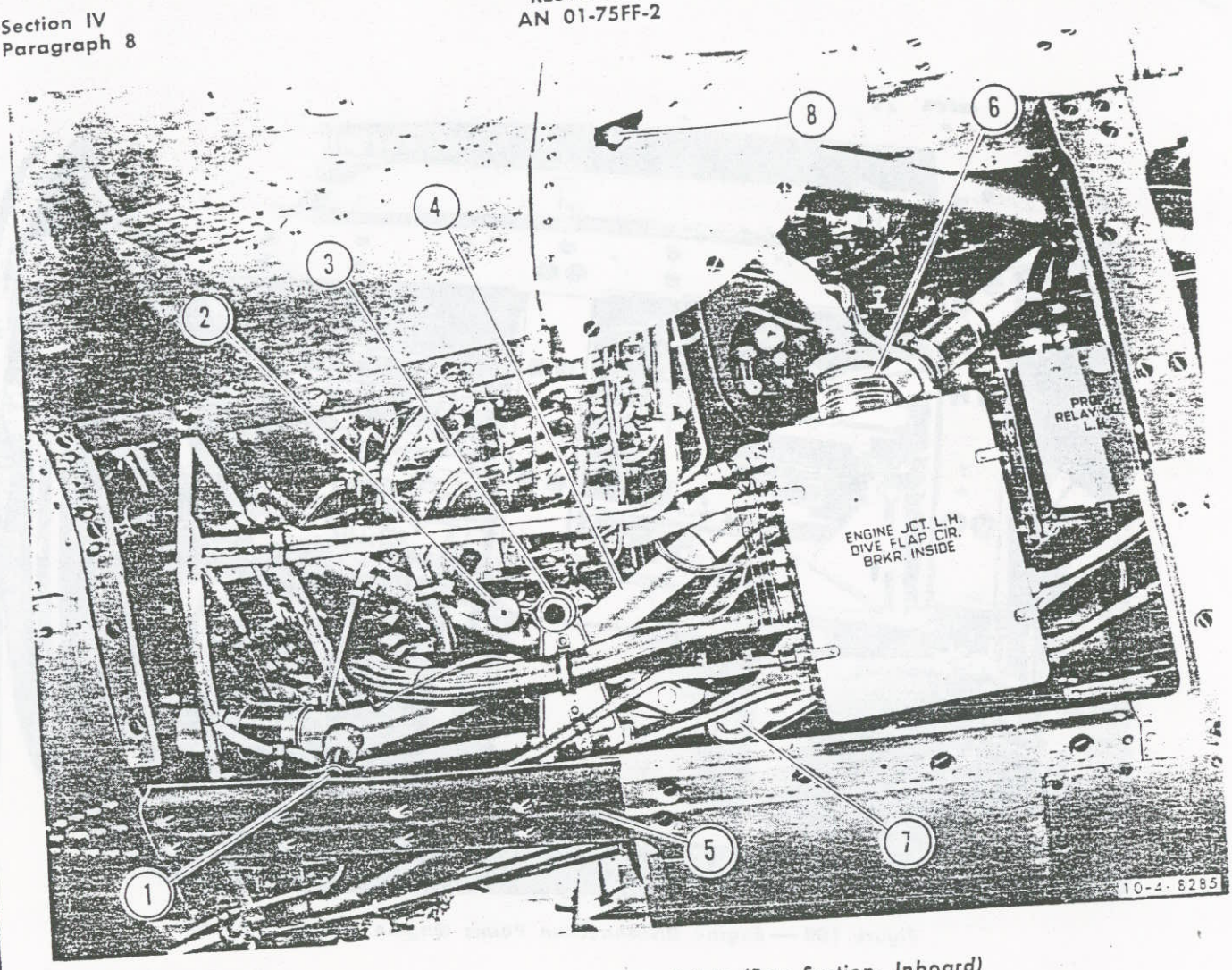


Figure 99 — Engine Disconnection Points (Bay Section, Inboard)

(5) ENGINE DISCONNECTION POINTS (OUTBOARD).

(a) Remove air ducts between intercooler and carburetor "1" and "4" (figure 102).

(b) Remove air duct between fire wall and intercooler "2" (figure 102).

(c) Disconnect and remove coolant line "4" (figure 101).

(d) Disconnect generator cooling air blast tube at generator.

(e) Remove bay section lower cowl support "1" (figure 101).

(f) Disconnect intercooler flap actuating arm at the bell crank.

(g) Remove bay section top cowl support "1" (figure 103).

(h) Remove propeller pitch control rod between fire wall and top center engine cowl support, item "2" (figure 103).

(i) Disconnect throttle and mixture control rods at carburetor.

(j) Remove tail pipe shrouds "1," "2," "3," and "4" (figure 190).

(k) Disconnect tail pipe "5" and "6" (figure 190).

(l) Disconnect all remaining tubes, electrical conduit, and bonding strips which are accessible from the outboard side of the engine, or as close to the bay section as possible.

Note

It is not necessary to disconnect or remove any tubing, conduit, controls, or fair-leads attached to, or in the vicinity of the center section front beam web.

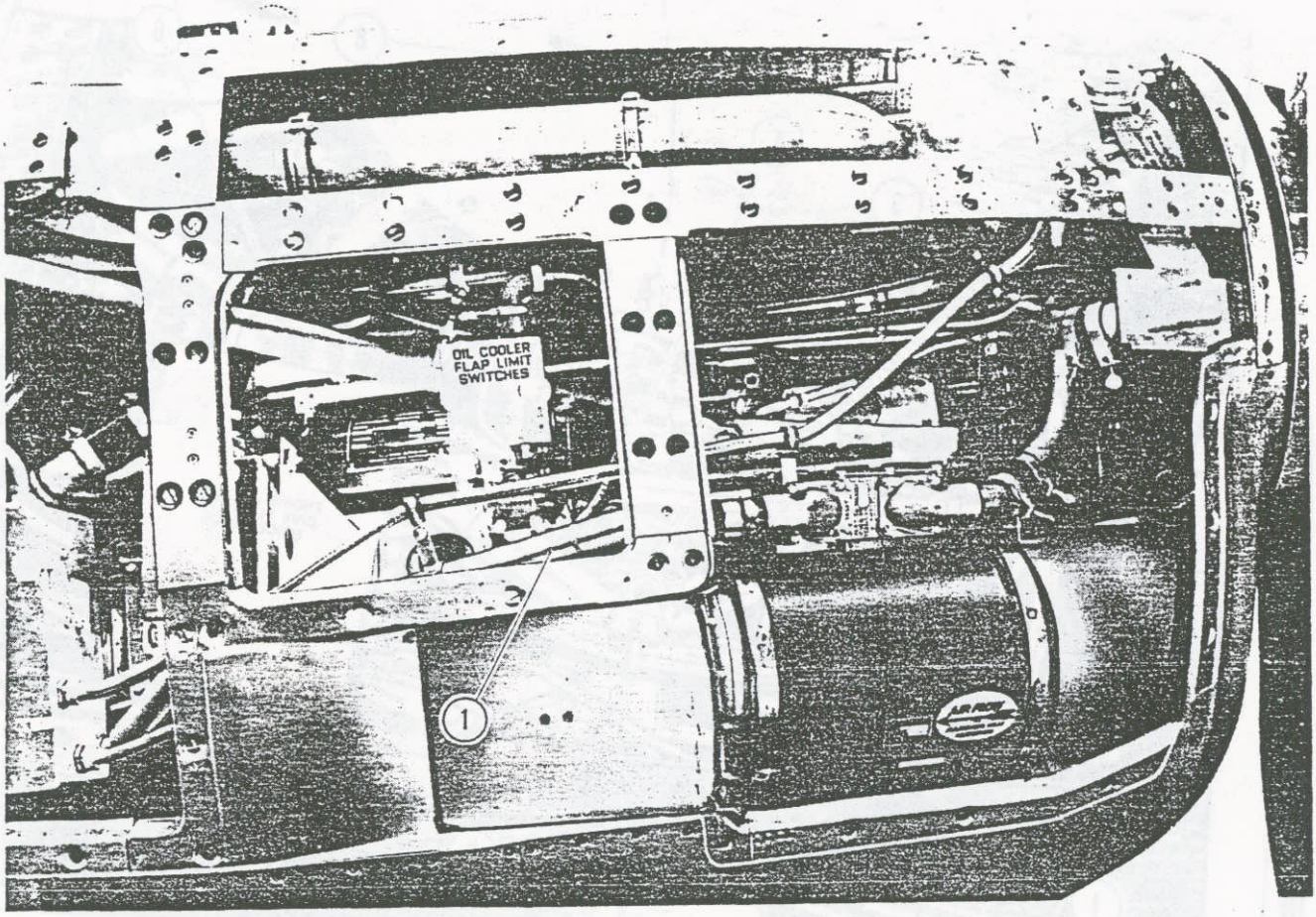


Figure 100 — Engine Disconnection Points (Engine Section, Inboard)

(6) HOISTING AND ATTACHING.

(a) Attach hoisting sling as illustrated in figure 104.

(b) Relieve load on engine mounting bolts by taking up load with the hoist.

(c) Remove the bolts that attach the right- and left-hand engine mount side truss to the support bay forging "7" (figure 99) and "2" (figure 101).

(d) Remove the bolts attaching the main right and left-hand tubular diagonal members to the wing fittings "8" (figure 99) and "3" (figure 101).

(e) Move engine slightly forward and upward with hoist.

(f) Be sure all connections have been severed and that nothing remains to interfere with removal of the engine.

(g) Hoist engine clear.

(7) PREPARATION FOR STORAGE.

(a) GENERAL.—Prepare engine as directed in Section II, paragraph 1 *b*, *e*, and *f*.

Note

The procedures given in the references in paragraph *(a)* preceding apply to the storage of engines which are installed in airplanes. The following additional steps must be taken when preparing engines for storage apart from the airplane.

(b) Blow out coolant system with dry air and seal openings.

Note

Mixture 1, referred to throughout this section, is one part Spec. AN-VV-C-576 to three parts of aircraft engine lubricating oil, Spec. AN-VV-O-446. When Spec. AN-VV-C-576 and Spec.

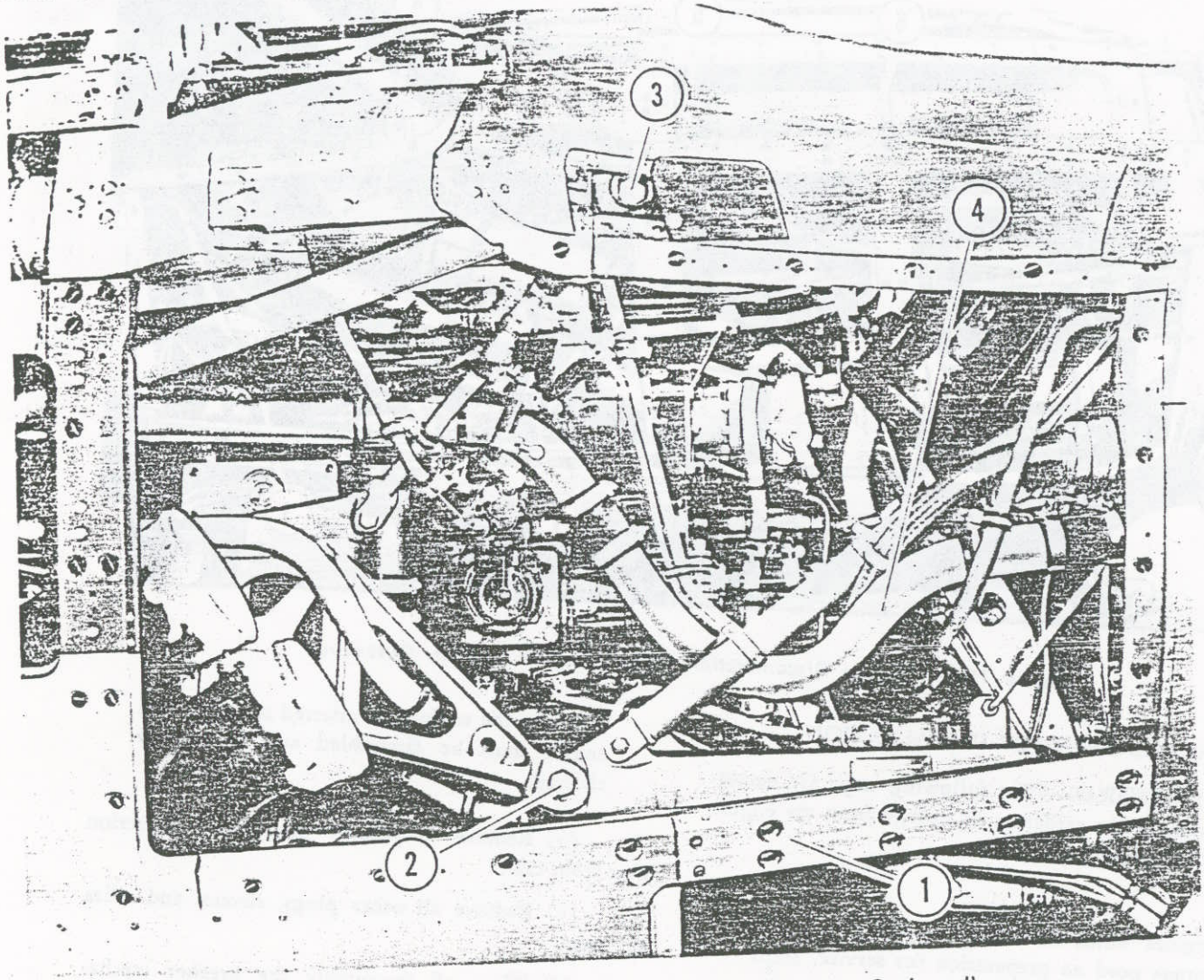


Figure 101 — Engine Disconnection Points (Bay Section, Outboard)

AN-VV-O-446 mixture is compounded the oil must be heated to approximately 93°C (200° F), then Spec. AN-VV-C-576 mixed in, and mixture heated to approximately 121°C (250° F) to get complete mixing.

(c) Remove propeller shaft thrust-bearing cover plate, spray thrust bearing with mixture 1, and replace cover plate. Clean propeller shaft with solvent and wipe dry. Install spline protector and secure in place with threaded plastic cap.

(d) When accessories have been removed, spray a small quantity of mixture 1 inside the engine drives and install the accessory drive covers with gaskets. These covers include starter, generator, fuel pump, vacuum pump, hydraulic pump, and propeller governor.

(e) Seal the following openings with standard shipping parts:

1. Coolant outlet elbows.
2. Coolant inlet flange.
3. 1/4 in. Coolant pump drain nipple.
4. Oil pump inlet flange.
5. Oil pump outlet flange.
6. Install metal carburetor cover (secure a silica gel bag in carburetor throttle unit under cover).
7. Cover or plug all distributor housing vents and openings.
8. Close all other fittings and connections that have been removed with the appropriate size standard pipe plugs.

(f) Wipe engine dry.

(g) Touch up crankcase split line and other painted surfaces where necessary with touch-up lacquer.

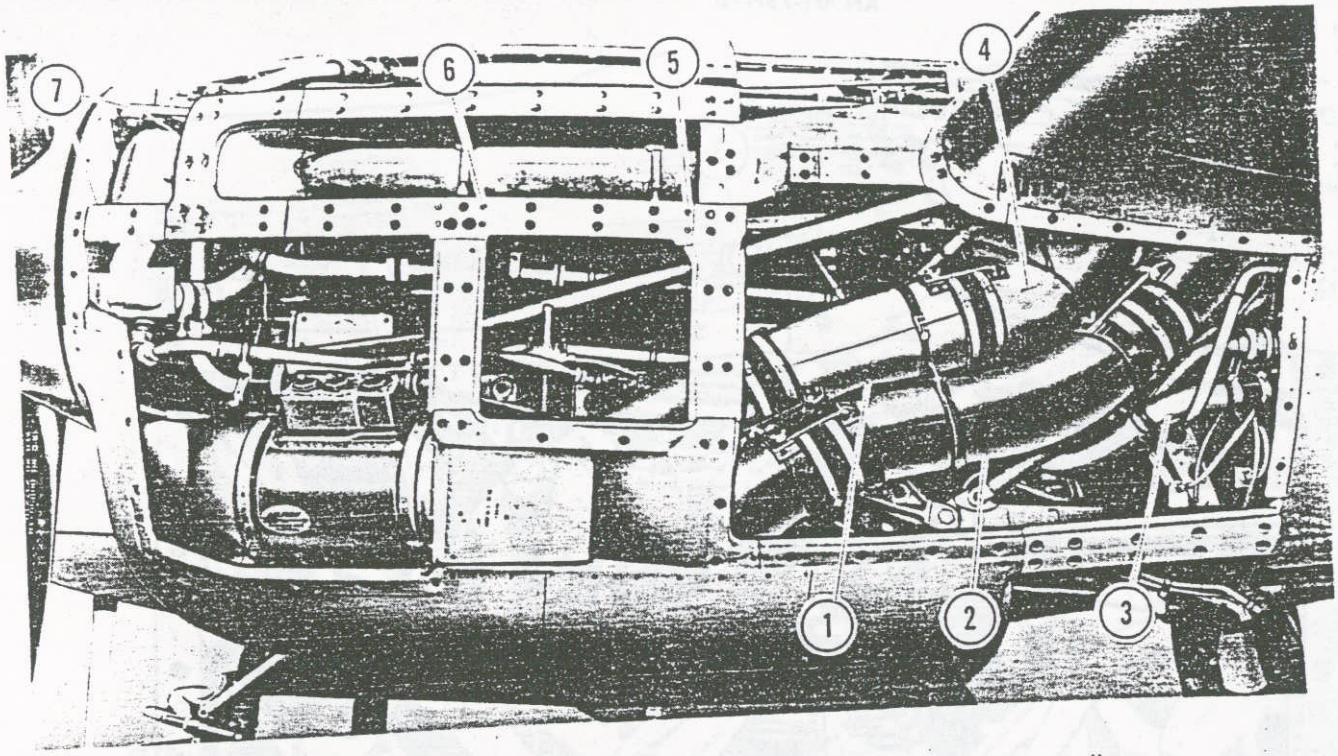


Figure 102 — Engine Disconnection Points (Engine Section, Outboard)

e. PREPARATION FOR INSTALLATION.

(1) GENERAL.—The following steps are necessary to remove the evidences of storage from the engine prior to installation.

Note

Engines which have been prepared for short storage need no preparation for service. Steps *(a)* through *(f)* following can be more conveniently accomplished before the engine is installed in the airplane.

(a) Remove cylinder bore dehydrator plugs from the spark plug holes. Before installing the spark plugs slowly rotate the crankshaft and observe for proper operation of the valve mechanism. Any valves that are found to be sticking shall have their stems generously lubricated with a mixture of unleaded gasoline and engine lubricating oil. Continue to turn the engine over by hand until all evidence of sticking valves has been eliminated. Make certain that no excess of mixture is present in the cylinders.

CAUTION

Exercise care in removing the dehydrating plugs. If any break and the silica gel therefrom falls into the engine, the affected section of the engine must be dissembled and thoroughly cleaned.

(b) Remove dehydrator plug from reduction gear front case.

(c) Remove all other plugs, covers, and silica gel bags.

(d) Wipe off thoroughly the breaker mechanism and lubricate magneto and breaker mechanism with light engine oil.

(e) Remove the oil strainer, and clean as directed in paragraph 15 *f*, this section.

(f) Remove, clean in gasoline, dry, and re-oil both front and rear oil drain elbow screens.

(g) Place engine on quick change engine stand similar to that shown in figure 113.

Note

First attach engine mount side trusses and diagonals so there will be a bed on which to mount the engine.

(h) Change all accessories, fittings, and equipment from the old engine to the replacement engine.