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T. O. NO. 01-25-CJ-2
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ERECTION AND MAINTENANCE

INSTRUCTIONS

FOR

ARMY MODEL

P - 40E - 1

BRITISH MODEL

KITTYHAWK IA

Evans-Winter-Hobb inc., Detroit, Michigan. 1-44-17,000

AUGUST 15, 1942
REVISED JANUARY 15, 1944

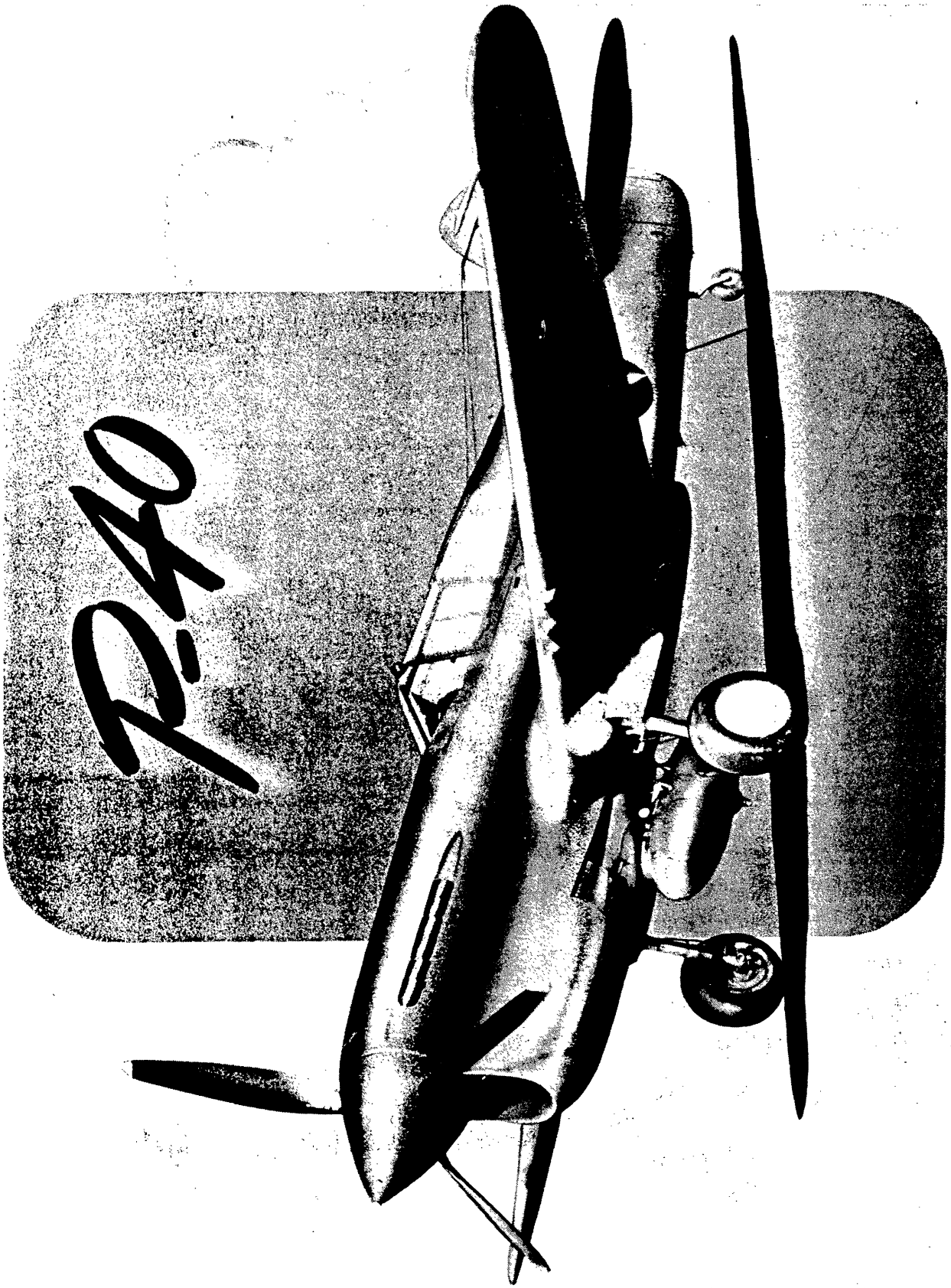


Figure 1—Complete Airplane, Three-Quarters-Front View

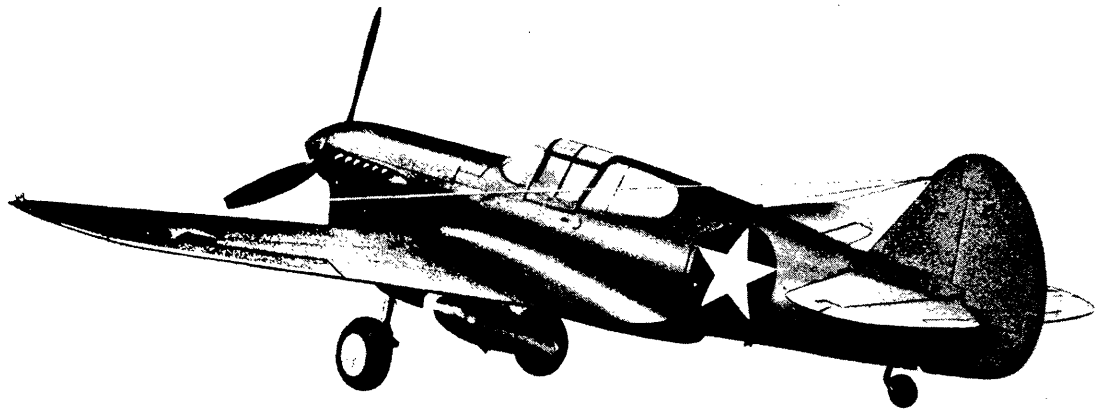
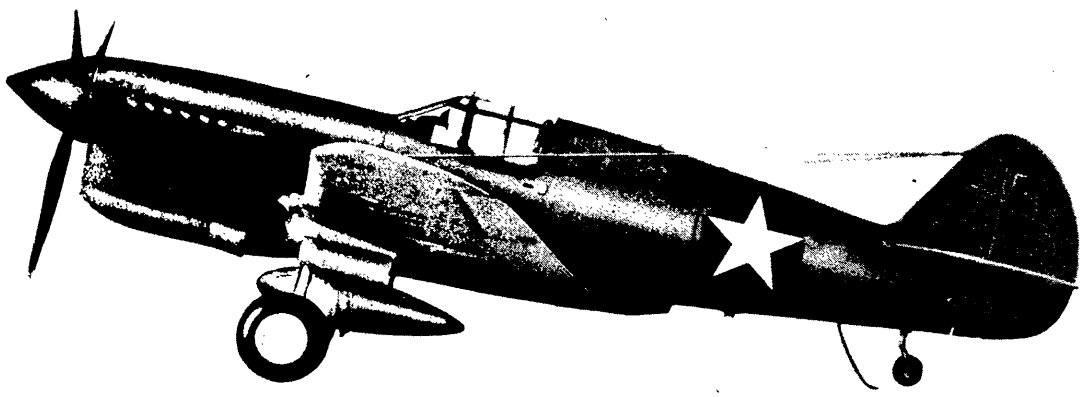


Figure 2—Complete Airplane, Three-Quarters-Rear View

Figure 3—Complete Airplane, Side View



T.O. No. 01-25CJ-2

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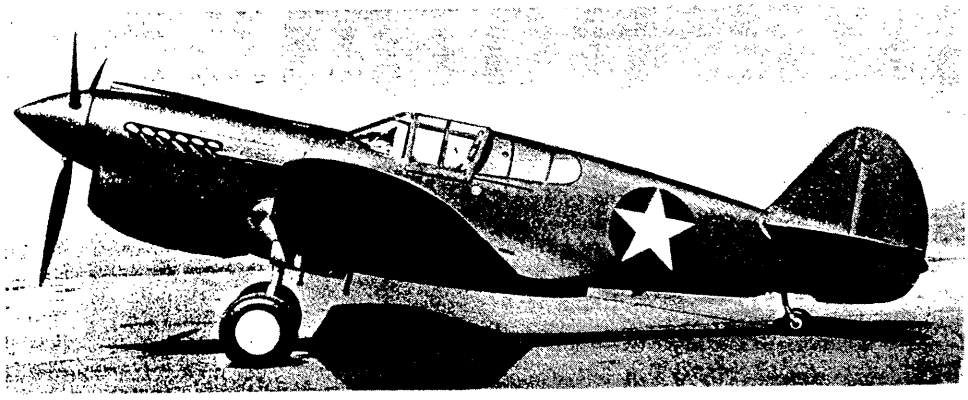


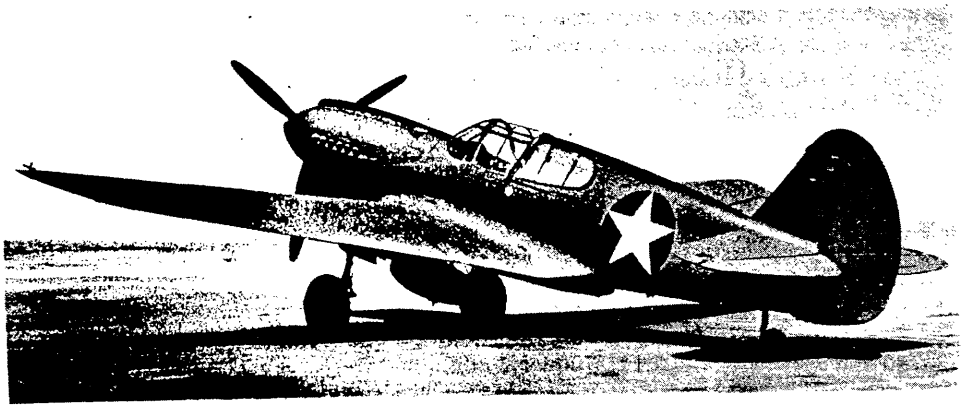
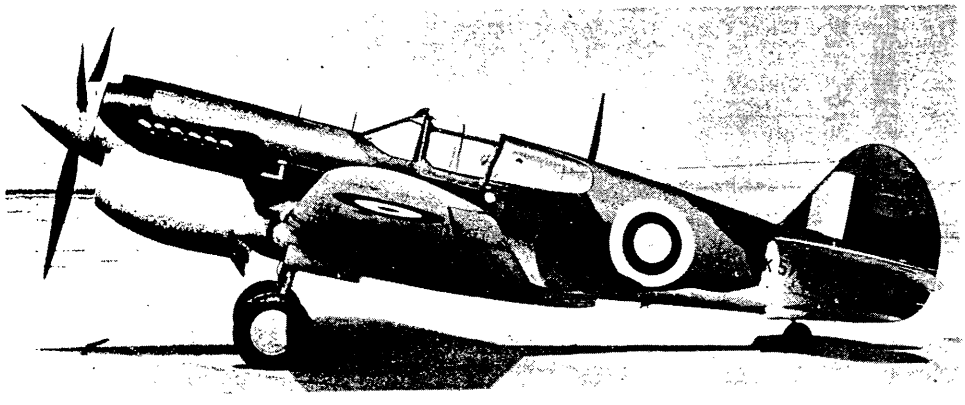


FIGURE 2 -
3/4 LEFT REAR VIEW
COMPLETE AIRPLANE

FIGURE 3 -
SIDE VIEW
COMPLETE AIRPLANE



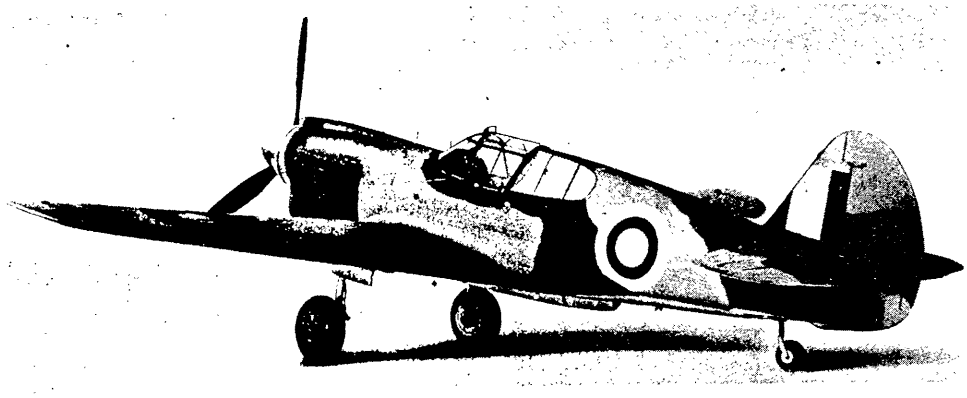


FIGURE 4 -
3/4 LEFT REAR VIEW
COMPLETE AIRPLANE

SECTION I

INTRODUCTION AND REFERENCES

1. This Technical Order is the Service Instructions for the Model P-40E-1 Fighter Airplane manufactured by Curtiss-Wright Corporation. Personnel who are required to service and maintain this equipment will read and be familiar with the information contained in T. O. No. 01-25CJ-1 which forms a part of the complete Service Instructions.

2. Reference has been made in this Handbook to the following Technical Orders which contain applicable data and instructions.

T. O. No.	Title
00-20A	The Visual Inspection System for Airplanes
00-25-3	Distribution of Air Corps Maintenance Publications
01-1-1	Cleaning of Aeronautical Equipment
01-1-26	Replacement of Frayed Control Cables
01-1-50	Towing, Mooring, and Handling of Airplanes
03-5B-1	Aircraft Storage Batteries
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01-25C-23	Wing Tank Fuel Level Gages
02-1-6	Periodic Inspection and Adjustment of Valve Mechanisms
02-1-29	Ground Operation Instructions for Aircraft Engines
02-5A	Operation and Flight Instructions for V-1710 Engines
03-1-2	Safety Belts
03-1-4	Overhaul of Accessory Pumps
03-5AA-1	Instructions - Generator and Control Box
03-5AA-3	Generator Control Panel
03-5CA-1	Starters and Starter Motors (Eclipse)
03-5CA-3	Starters and Starter Motors
03-5D-8	Double Magnetos Type DF
03-5E-1	Spark Plugs (Use and Reconditioning)
03-10-13	Operation and Inspection of Fuel Cock Controls
03-10-15	Operating Fuel Systems
03-10DA	Supercharger
03-10EA-1	Engine Driven Fuel Pumps
03-10G-1	Operation of Carburetor Mixture Controls
03-15-4	Repair and Cleaning of Radiators and Oil Temperature Regulators
03-20B-1	Operation and Flight Instructions Curtiss Controllable Propellers
03-20B-1	Service and Overhaul Instructions Curtiss Controllable Propellers
03-25A-1	Inspection and Lubrication of Anti-Friction Bearings (Tail Wheel)
03-25B-1	Landing Wheels (Hayes)
03-25B-2	Handbook of Instructions with Parts Catalog for Brakes (Hayes)
03-25E-1	Air Oil Shock Absorber Struts
03-30AA-1	Engine Driven Vacuum Pumps (Pesco)
03-30CA-2	Hydraulic Pumps, Motor Driven
03-20CB-1	Instructions for Motor Driven Oil Pumps
03-50-1C	Oxygen Equipment - Use of Oxygen
03-50A-1	Instructions for Oxygen Regulators
04-5-1	Shock Absorber Cord Inspection (Seat)
04-10-1	Aircraft Tire Pressure
04-10-2	Inspection of Aircraft Tires
05-1-1	Repair, Storage and Reinspection of Instruments
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05-15-2	Service and Overhaul Instructions Magnetic Compass
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05-20-3	Instructions - Flight Indicators
05-20-4	Instructions - Turn Indicators
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05-40-4	Preliminary Installation Instructions Type "A" Series Thermometers (Coolant Temperature)
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SECTION II

TABLE OF SPECIFICATIONS AND GENERAL INSTRUCTIONS

1. TABLE OF SPECIFICATIONS

a. Airplane, General:

Overall Span	37 ft.	3.5 in.
Overall Length	31 ft.	8.75 in.
Overall Height, Thrust Line Level, One Load		143.5 in.
		143.5 in.
Overall Height, at Rest, One Load		128.0 in.
Height, Propeller Hub, Thrust Line Level One Load		76.0 in.
Height, Propeller Hub at Rest, One Load		101.5 in.
Clearance, Propeller Tip, Thrust Line Level, One Load		10.0 in.

b. Wing.

Airfoil Section	NACA - Root 2215 and 2209 at 197 in. from ℄ of Fuselage
Total Area Including Ailerons	236 sq. ft.
Span (Total)	37 ft. 3.5 in.
Chord-M.A.C.	81.6 in.
Chord (Max.)	9′-0″
Dihedral	6°
Incidence	1°
Sweepback	1°-18′

c. Ailerons (Each)

Area to Hinge of Each Aileron	7.03 sq. ft.
Area to Balance of Each Aileron	2.12 sq. ft.
Area of Trim Tab Right-Hand	.11 sq. ft.
Area - Total Right-Hand Aileron	9.26 sq. ft.
Area - Total Left-Hand Aileron	9.15 sq. ft.

d. Flaps.

Area (Total)	34.8 sq. ft.
Chord (Max.)	21.125 in.
Span (Total)	244.000 in.

e. Empennage.

(1) Horizontal Stabilizer.

Chord-Maximum	42.75 in.
Overall Span	12 ft. 9.625 in.
Setting (Fixed)	2.0°
Area - Total	30.86 sq. ft.

(2) Elevators (Each).

Area Aft of Hinge Centerline (Including Tab)	6.82 sq. ft.
Area of Balance	1.9 sq. ft.
Area of Tab	.84 sq. ft.
Area - Total	8.72 sq. ft.

(3) Vertical Fin.

Area	7.0 sq. ft.
Setting (Fixed)	1.5°
Chord (Average)	23.2 in.
Span - Total	43.3/8 in.

(4) Rudder.

Area Aft of Hinge Centerline (Including Tab)	11.80 sq. ft.
Area of Balance	1.94 sq. ft.
Area of Tab	.55 sq. ft.
Area - Total	13.74 sq. ft.

f. Landing Gear.

Tread	98.125 in.
Axles Aft of Leading Edge of Wing	6.84 in.

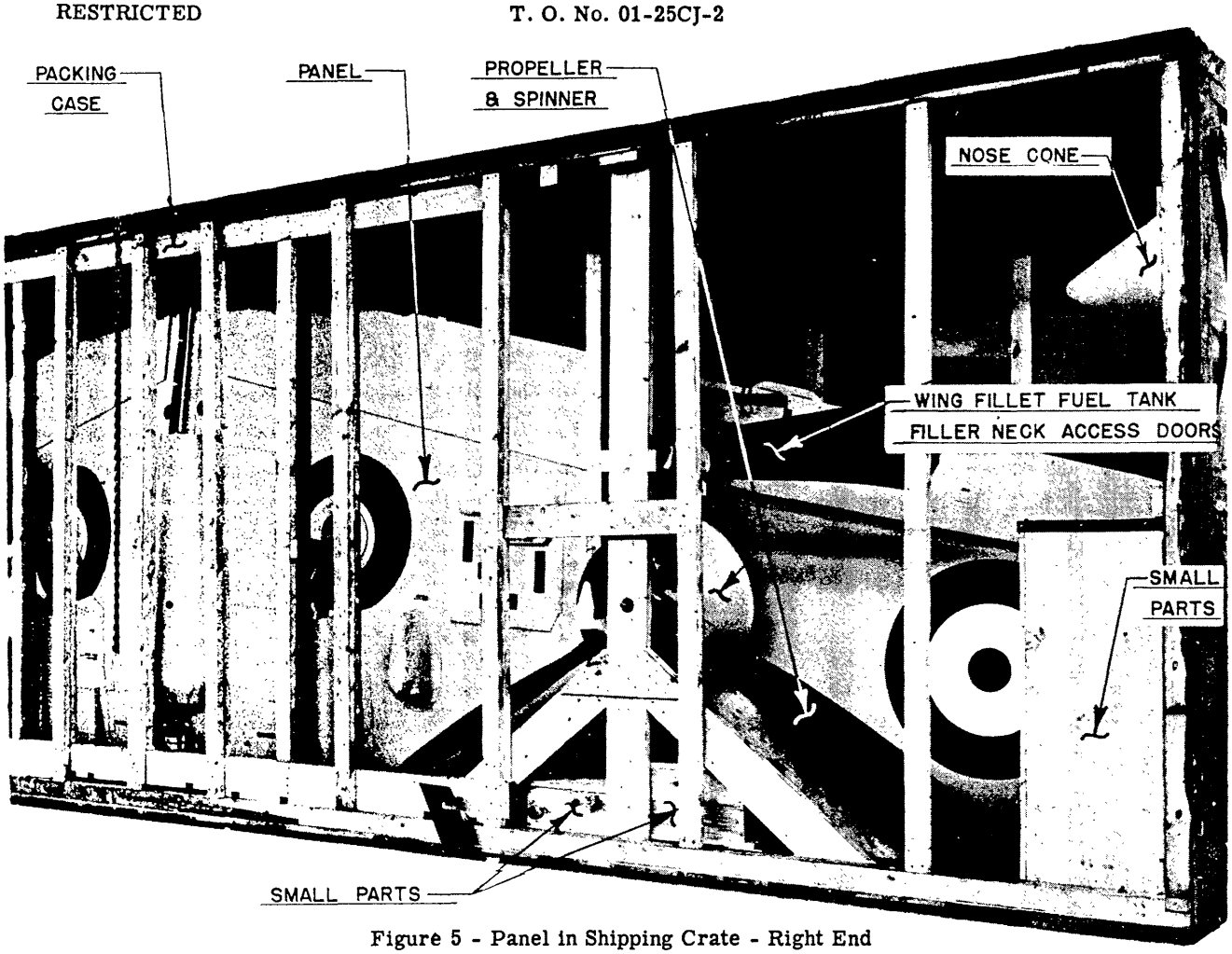


Figure 5 - Panel in Shipping Crate - Right End

2. Uncrating.

a. General. - Each airplane is shipped in two wooden crates. The larger crate (35 ft. 6 inches long; 4 ft. wide and 10 ft. high, displacing 1420 cubic feet) contains one complete wing panel with landing gear installed. (See figure 5 and figure 6.) After removing the side sections marked for first removal, a box of small parts including wing and stabilizer fillet units, small cowling sections and miscellaneous fittings will be found in the lower right end of the shipping crate. Directly above this box the nose cone of the propeller spinner is fastened to the end section of the crate. To the left of this box, strapped to two perpendicular frame members is the wing fillet section containing the two wing tank filler cap access doors. The propeller assembly is mounted to the left of this fillet in an inverted V-shaped cradle of 2 in. x 8 in. and perpendicularly braced by two 2 in. x 8 in. The propeller electric motor and other small parts to complete the propeller assembly are packed in two boxes at the base of the propeller cradle.

The two rear wing fillets are suspended from the top left-hand side of the shipping crate. Directly under the wing fillets, the pilot's seat is attached to the left end of the crate in an inverted position. The horizontal stabilizer is cradled in the lower left end of the crate, forward of the wing panel. Above this stabilizer the complete elevator assembly is supported by a cross member between vertical frame joists. The rudder is mounted between the horizontal stabilizer and wing panel, while to the right and directly behind the elevator, the vertical stabilizer is attached to the frame joists. The two wing tips are cradled aft of the wing panel, at the top center section of the crate.

The fuselage with engine installed, engine and radiator cowling attached, windshield and cockpit enclosure assembled, is mounted on a fuselage stand bolted to the floor of the smaller crate (29 ft. long, 5 ft. wide, 7 ft. 3 in. high, displacing 1086.2 cu. ft. (See figure 7.) After removing the sections of the box which are marked for first removal, a box of small parts, individually wrapped and packed, will be found in the lower right end of the crate. Under the fuselage, the machine guns, when not installed in the wing are packed in separate boxes minus chutes. The chutes are packed in other containers and placed in the shipping crate with the gun equipment.

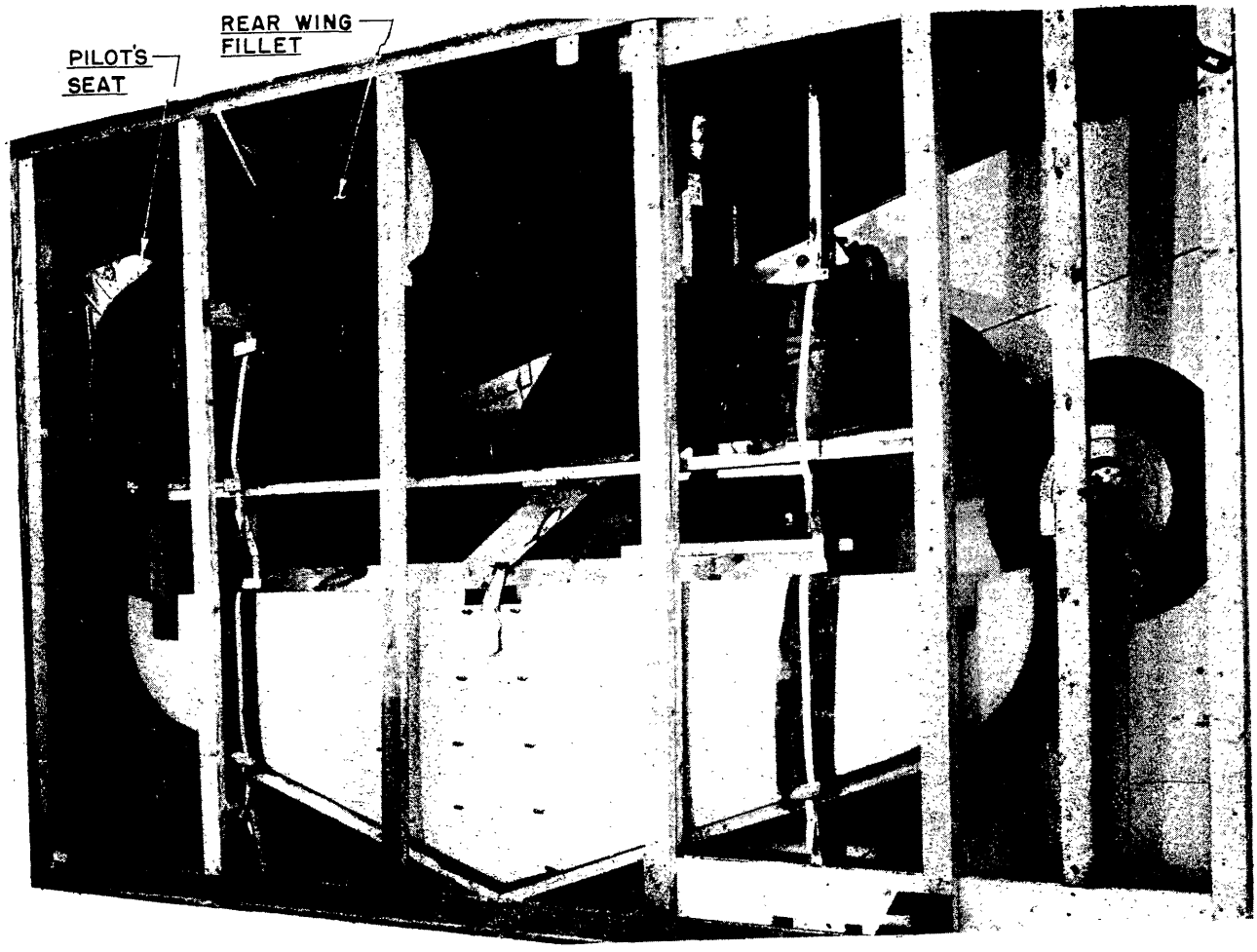


Figure 6 - Wing Panel Packing Crate - Left End

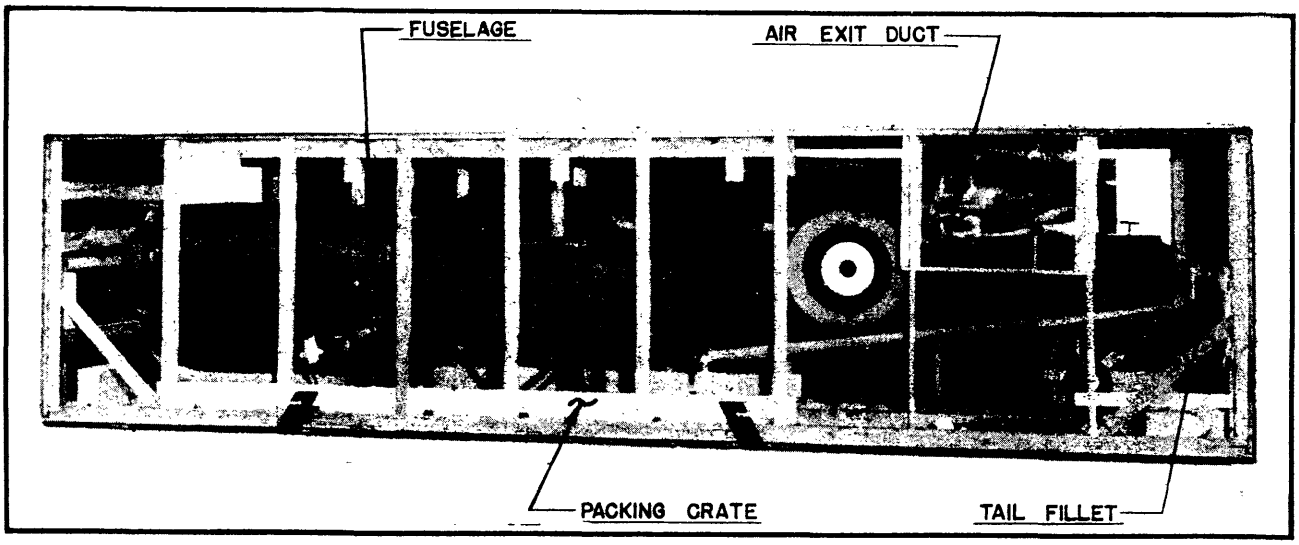


Figure 7 - Fuselage Shipping Crate

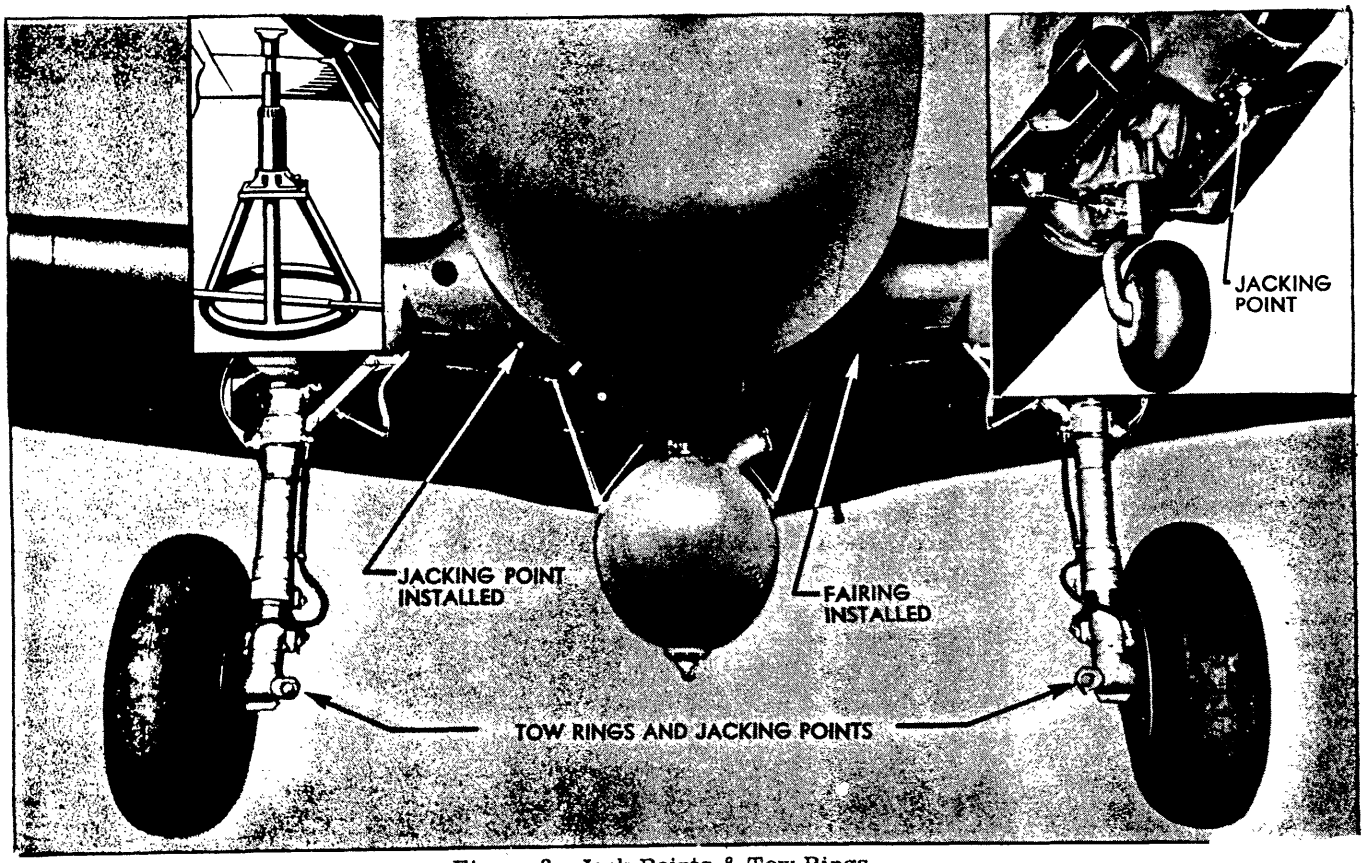


Figure 8 - Jack Points & Tow Rings

3. Uncrating the Panel Box.

The first crate to be dismantled is the wing panel crate. The ends, top and bottom are each a section but each side is built in two sections. The side section to be removed first is clearly marked. Remove the top section. The hoisting sling (drawing No. 87-88-509) and horizontal cradle wing truck furnished with the first airplane will be packed separately. Immediately after removing the top section of the panel box attach the hoisting sling to the panel. Support the panel with the hoist while removing the other units.

To attach the sling, secure the two sliding plates marked "Rear" to the rear ends of the tee sections on the panel. There are two studs in each of these plates. Match the stud marked "24th Hole" with the 24th hole from the front of the tee section as indicated in figure 9. Do not attach the other two plates marked "Front". Dismantle the remaining side sections and ends of the crate and remove the propeller, tail surfaces and other units, including all small parts boxes.

Remove the bolts securing the wing to the bottom of the crate and hoist it clear of the crate. With about ten men holding the leading edge, the wing may be lowered to a horizontal position and the two plates marked "Front" of the hoisting sling attached to their respective positions. The stud marked "4th Hole" should be inserted in the 4th hole from the front of the tee section. The wing assembly weight is approximately 1722 lbs.

With the wing resting in the horizontal position, raise it to clear the horizontal wing cradle truck. Move the truck to its proper position beneath the wing and lower the wing upon the supporting points. (See figure 10.)

4. Uncrating the Fuselage Box.

The ends, top and bottom are made in separate sections. The first section to be removed is clearly marked. Dismantle the crate and remove the small parts box and gunnery equipment units, if it is not already installed in the wing panels. Remove the top engine cowl and attach the front hoisting sling to the hoisting lugs on the engine mount. Insert a bar about 3-1/2 ft. long thru the lift tube at the rear of the fuselage, hang a 100 lb. weight on each end of the bar and attach the rear hoisting sling. Attach the front and rear hoisting slings to their respective traveling hoists and take up the slack in both sling assemblies. Remove the bolts attaching the fuselage to the metal fuselage stand and hoist the fuselage clear of the packing crate.

Two traveling hoists at least 18 ft. high should be available. The hoist at the front end of the fuselage should have a capacity of 2 tons if only the fuselage is

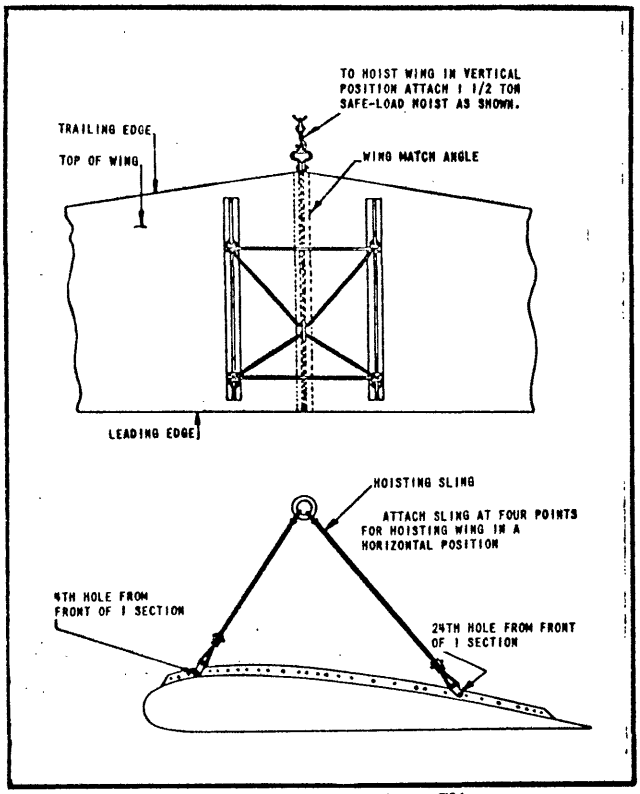


Figure 9 - Wing Hoisting Sling

to be hoisted and 4 tons if the complete airplane is later to be hoisted by it. The hoist at the rear end should have a capacity of one ton.

5. General Instructions.

a. Handling. (See T. O. No. 19-1-18.)

(1) There are three jacking points to support the airplane while checking the landing gear and tail wheel retracting mechanism. One jack point is located on the under surface of each wing panel inboard of the landing gear and one jack point on the bottom of the fuselage aft of the tail wheel. The two jack points on the under surface of the wings must be removed when the forward wing fillet extension is assembled on the airplane. These jack points are stowed in the tool kit when not in use. A decalcomania "JACK HERE" points to the hidden location of the jack points and is completely visible when all wing fillets are installed.

(2) Additional jacking points are located on the bottom of each towing ring, on the inboard side of the landing gear axle, to support the forward end of the airplane while servicing the wheel and brakes.

b. Hoisting.

(1) One front hoisting sling (87-88-020) is provided with every 9 airplanes. The forward end of the airplane may be raised by attaching the sling to lugs,

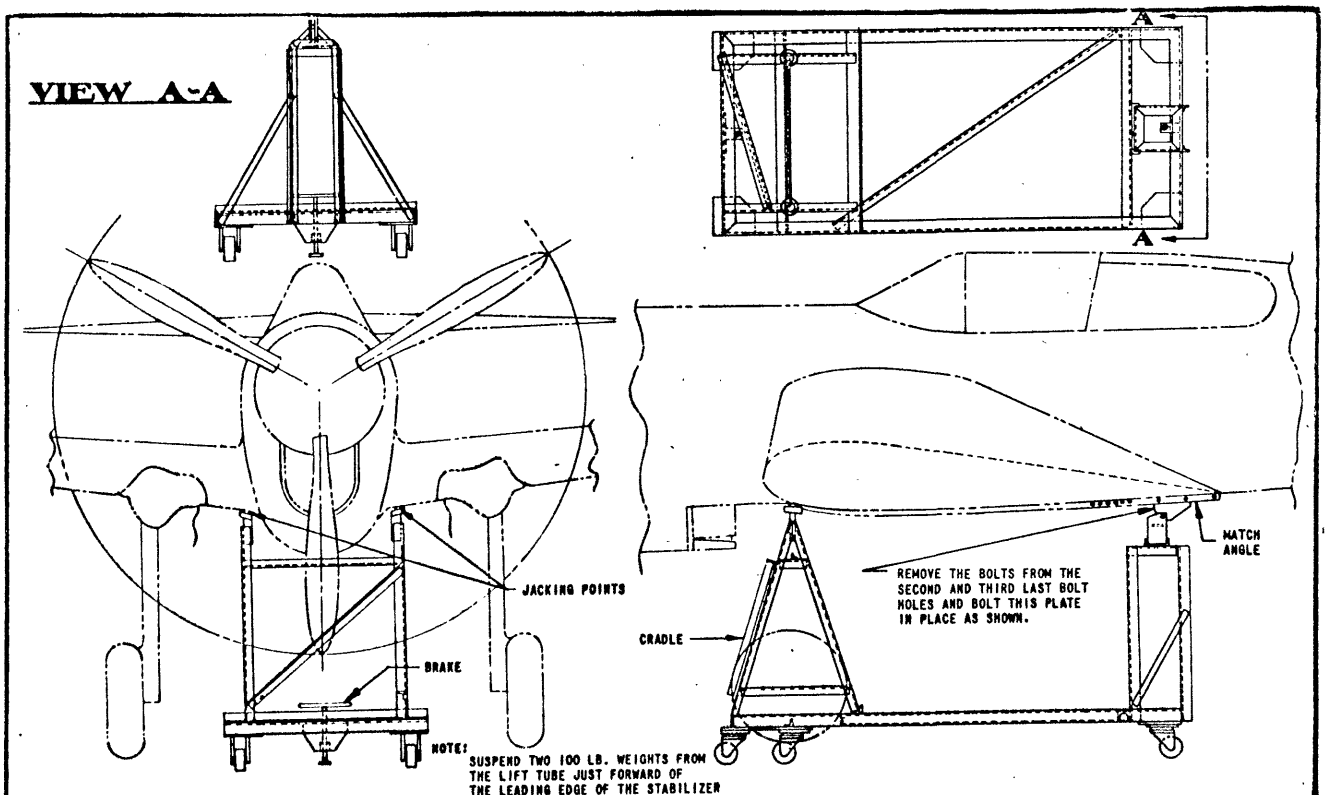


Figure 10 - Airplane Cradle

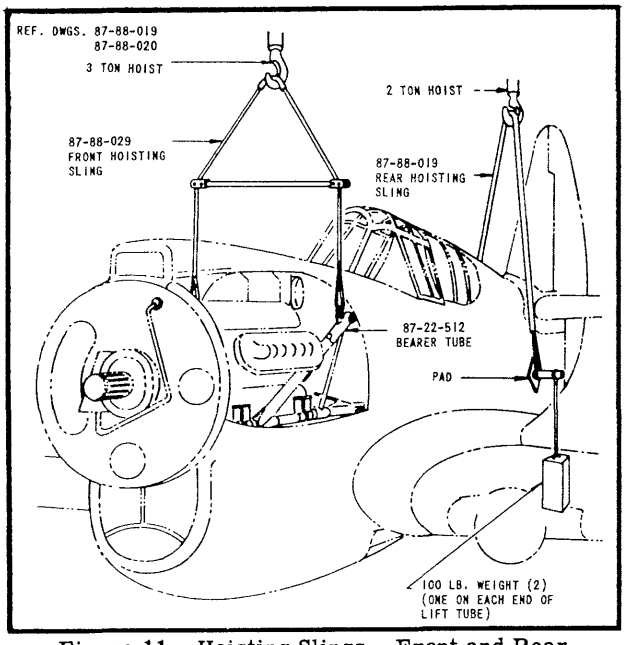


Figure 11 - Hoisting Slings - Front and Rear

provided on the engine mount, approximately 3 inches forward of the firewall, station 1. Remove the side sections of the engine cowl to expose the lugs. (See figure 11.)

(2) One wing hoisting sling (87-88-509) is provided with every 9 airplanes. The sling is attached to the wing as follows:

(a) Attach the short cables to bolt hole number 4 on each wing tee installation. (See figure 9.)

(b) Attach the long cables to bolt hole number 24 on each wing tee installation. (See figure 9.)

(c) Lift with a one-ton hoist attached to the ring on the hoisting sling.

(3) A tail hoisting sling (87-88-019) is also provided with every 9 airplanes. By attaching the sling to a tail lifting bar, passed through the lift tube, the aft end of the airplane may be raised. (See figure 11.)

WARNING: The tail lifting bar must be passed completely through the lift tube in the fuselage and the tail raised by lifting on both ends of this bar; otherwise serious strain and damage to the fuselage may occur.

NEVER use the horizontal stabilizer for lifting the aft end of the airplane.

If the tail is raised to flight position, two-one hundred pound weights should be hung on the lifting bar, one on each side of fuselage, as a precautionary measure.

(4) An engine hoisting sling is furnished by the engine manufacturer and by attaching the sling to the studs (which hold the cylinder heads to the crankcase) the engine may be raised.

Do not under any circumstances attempt to hoist the airplane by means of the engine hoisting sling attached to the engine. This sling is for installation and removal of the engine only.

c. Erection. - When assembling the fuselage to the wing (drawing 87-511) about six or eight men should be available. This operation should proceed slowly exercising great care not to damage any of the parts.

The inside surface of the tee sections on the wing should be coated with a light grease and the corresponding surface of the fuselage also greased before assembly.

One man should be placed on top of the wing and the fuselage lowered over him. He should watch the front and the rear to see that the various units in the cockpit are not damaged as the fuselage is lowered onto the wing.

Units to be watched very carefully are:

1. The hydraulic hand pump handle.
2. The flight control stick.
3. Electrical and hydraulic lines.
4. Firewall
5. Oil "Y" drain cock.
6. Fuel and oil lines.
7. Heating and ventilating intake ducts.

Lower the forward end of the fuselage slightly in advance of the rear so that the front fittings at station No. 1 may be engaged first, then align and insert the bolts. Next lower the fuselage until the remainder of the holes are aligned. Insert a pair of trailing edge bolts and the intermediate station (bulkhead) bolts. Insert and tighten evenly the remainder of the bolts. Insert the three bolts attaching the trailing edge of the wing to the fuselage (center). (See figures 14 and 15.)

NOTE: The last bolt hole in the fuselage immediately aft of station No. 6 has a nut retained by a special clip, therefore, the bolt must be screwed into place.

The tail of the airplane may now be supported from the lift tube bar by two stands, one on each side of the fuselage, leaving the weights in place and then removing the rear hoist. Next, the front hoist may be removed.

The following is a list of installations and connections to be made after the wing and fuselage are assembled:

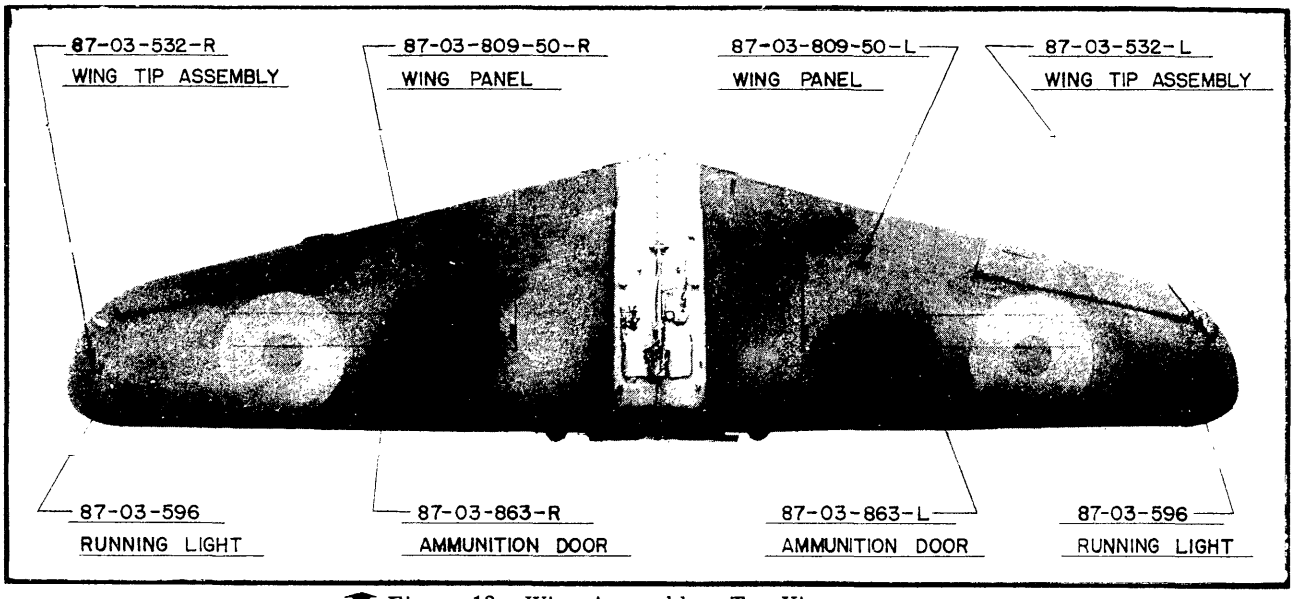
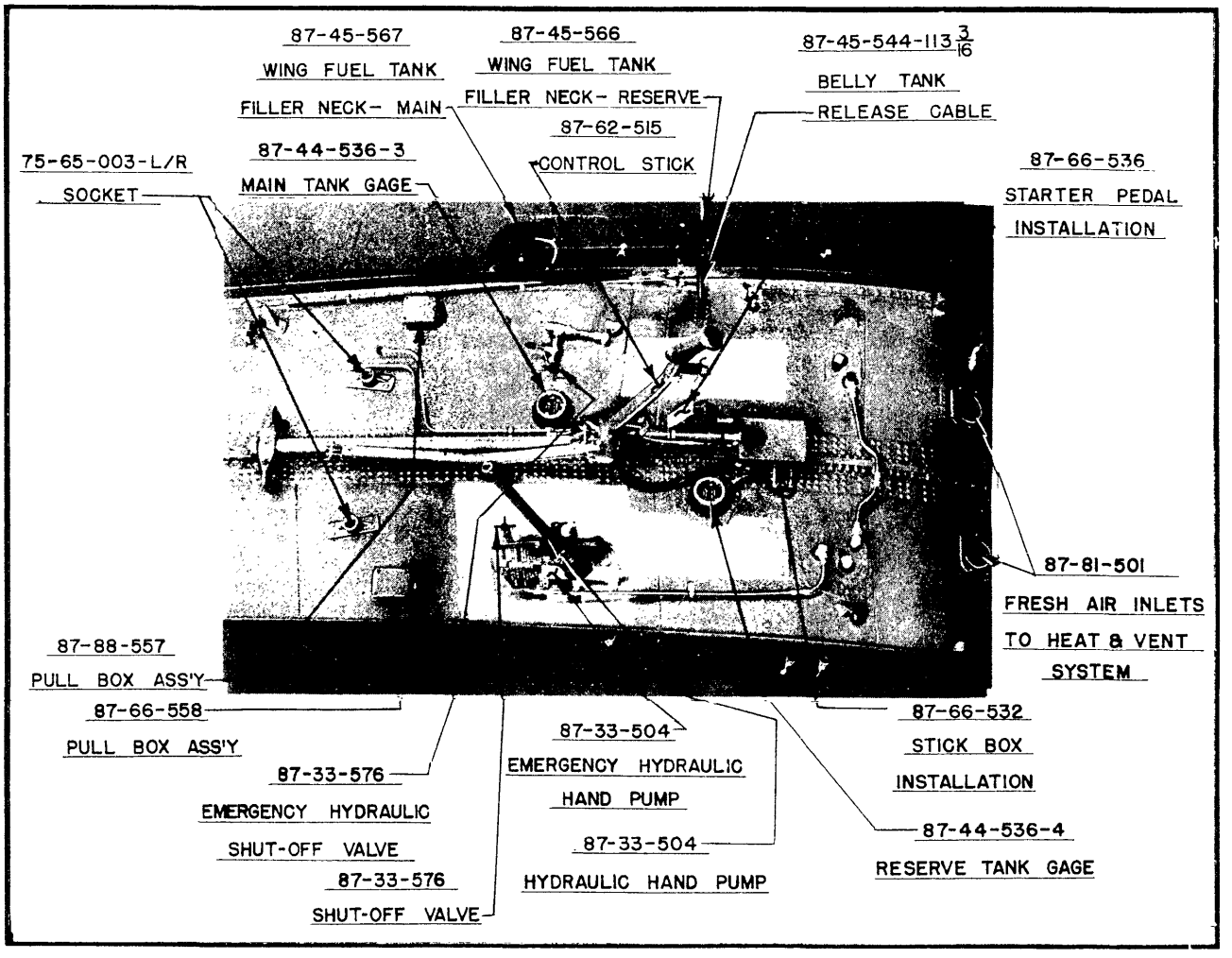


Figure 12 - Wing Assembly - Top View

Figure 13 - Wing Assembly - Top View - Ready for Installation



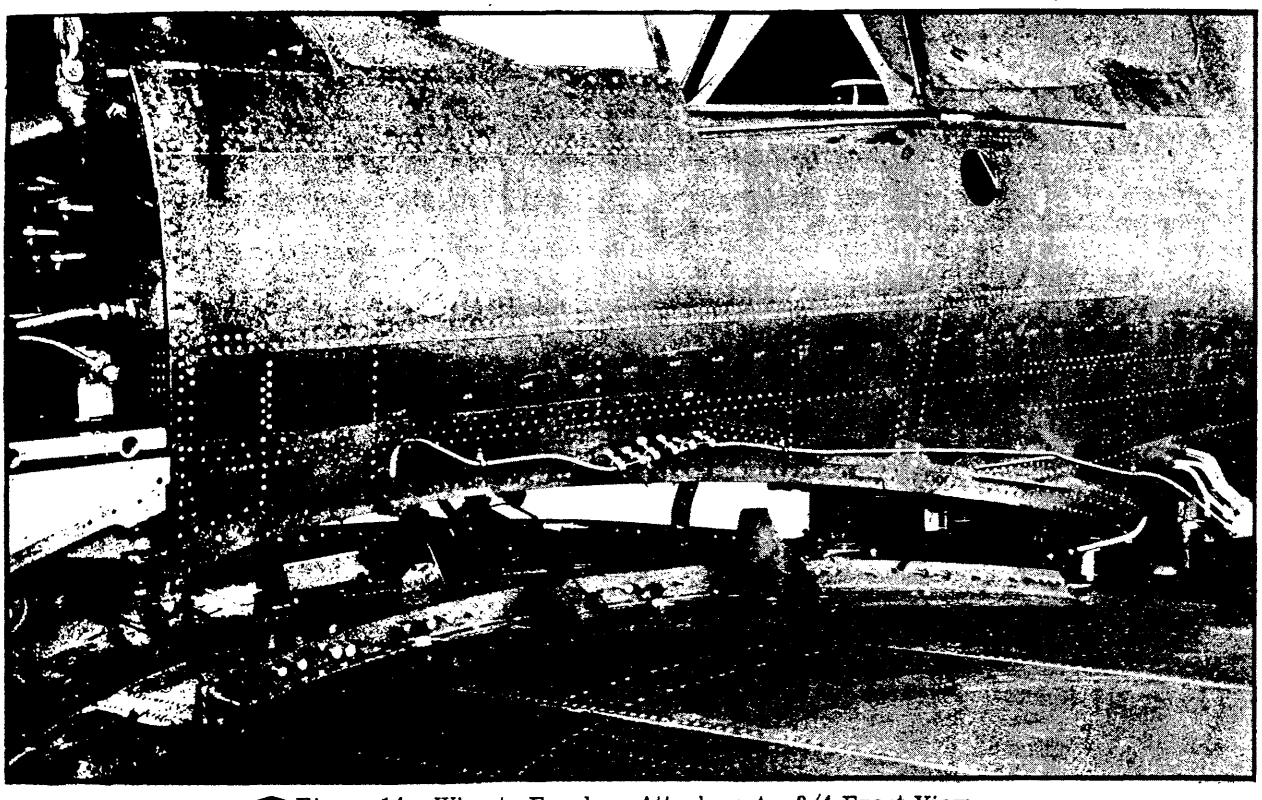
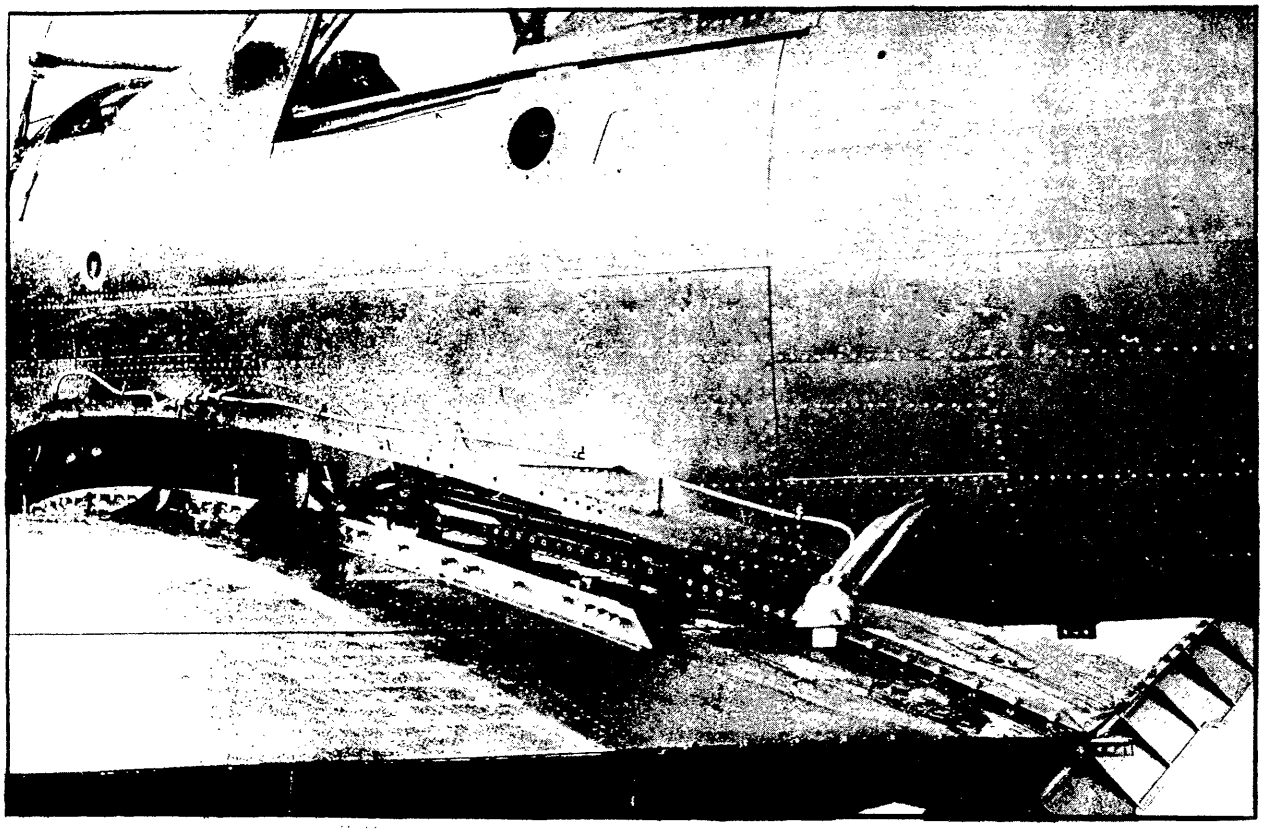


Figure 14 - Wing to Fuselage Attachment - 3/4 Front View
Figure 15 - Wing to Fuselage Attachment - 3/4 Rear View



(1) Install the horizontal and vertical stabilizers.

(2) Assemble the rudder and elevators.

(3) Connect the elevator and rudder cables.

(4) Connect the trim tab controls. For details of the above installation see section IV, 3. Empennage Assembly.

(5) Connect the vertical stabilizer navigation light wires.

(6) Check all cable tensions after rigging the tail surface controls.

(7) Connect the hydraulic lines to the hand pumps.

(8) Connect the hydraulic lines to the hydraulic system control valve.

(9) Connect the hydraulic lines from the master brake cylinders to the brakes.

(10) Connect the hydraulic lines from the control valve to the wheels and flap control.

(11) Fill the hydraulic system with Lockheed No. 5 fluid or equivalent. Substitutes may be a mixture of 50% castor oil and 50% butyl monohydroxy-ethyl ether or if not available use 50% castor oil and 50% diacetone alcohol.

(12) Check the landing gear and tail wheel retracting units.

(13) Make the electrical connections for the wing navigation lights - one on each side of the cockpit.

(14) Install the propeller - following the instructions given in section IV, paragraph 11. b.

(15) Connect the airspeed indicator.

(16) Install the pitot tube and make the necessary electrical connections.

(17) Install the fuel cock control rod through the nose of the wing panel.

(18) Connect the fuel cock connections in front of the firewall at the lower left-hand corner.

(19) Connect the aileron cables and check the cable tension and aileron travel. (See figure 25.)

(20) Install the wing tips.

(21) Install the tail fillets.

(22) Install the wing fillets.

(23) Install the guns. (See section IV, paragraph 25. j. Machine Gun Installation.)

(24) Connect the gun charging controls to the hydraulic charging cylinders.

(25) Remove the protective oil coating from the power plant with kerosene in a spray gun.

(26) Attach all the engine cowling.

(27) Attach the keel fairing beneath the wing.

(28) Give the airplane a complete "Pre-Flight", "25-Hour" and "50-Hour" inspection. (See section III.)

d. Rigging. - The following items need not be checked as they have to do with characteristics that are rigidly built into the structure and cannot be altered.

(1) Wing Rigging.

(a) Dihedral

(b) Incidence

(c) Sweepback

(2) Landing Gear Alignment To Compensate the Compass. - With the engine running, the lights "ON", the propeller in "AUTO" and the airplane in a "LEVEL" position, the following procedure may be followed in compensating the compass. Remove the top front cover of the compass exposing the compensating screws. Head the airplane to magnetic north, using a compass rose or pelorus. Note the reading of the compass and eliminate the error by turning the screw marked N.S. Now head the airplane East and remove the error by turning the screw marked E.W. Head the airplane South and note the error. Only half of this error should be removed by turning the N.S. screw. Now head the airplane West and remove half the error turning the E.W. screw. The compass is now compensated and the airplane should be swung at 30^{o} intervals and the readings recorded on the correction card.

e. Towing.

(1) Towing rings are provided on the inboard end of each landing gear axle.

(2) No provision is made for towing the airplane backwards.

f. Leveling.

(1) Six leveling lugs are located on the two longerons which form the cockpit sill. Two lugs for longitudinal leveling are located in the longeron on the right-hand side, and two lugs for gun leveling are similarly located on the left-hand side. The two lugs for lateral leveling are located on the sill, right-and left-hand sides immediately aft of the windshield. A 1/8 in. hole is drilled in the nose cone of the propeller

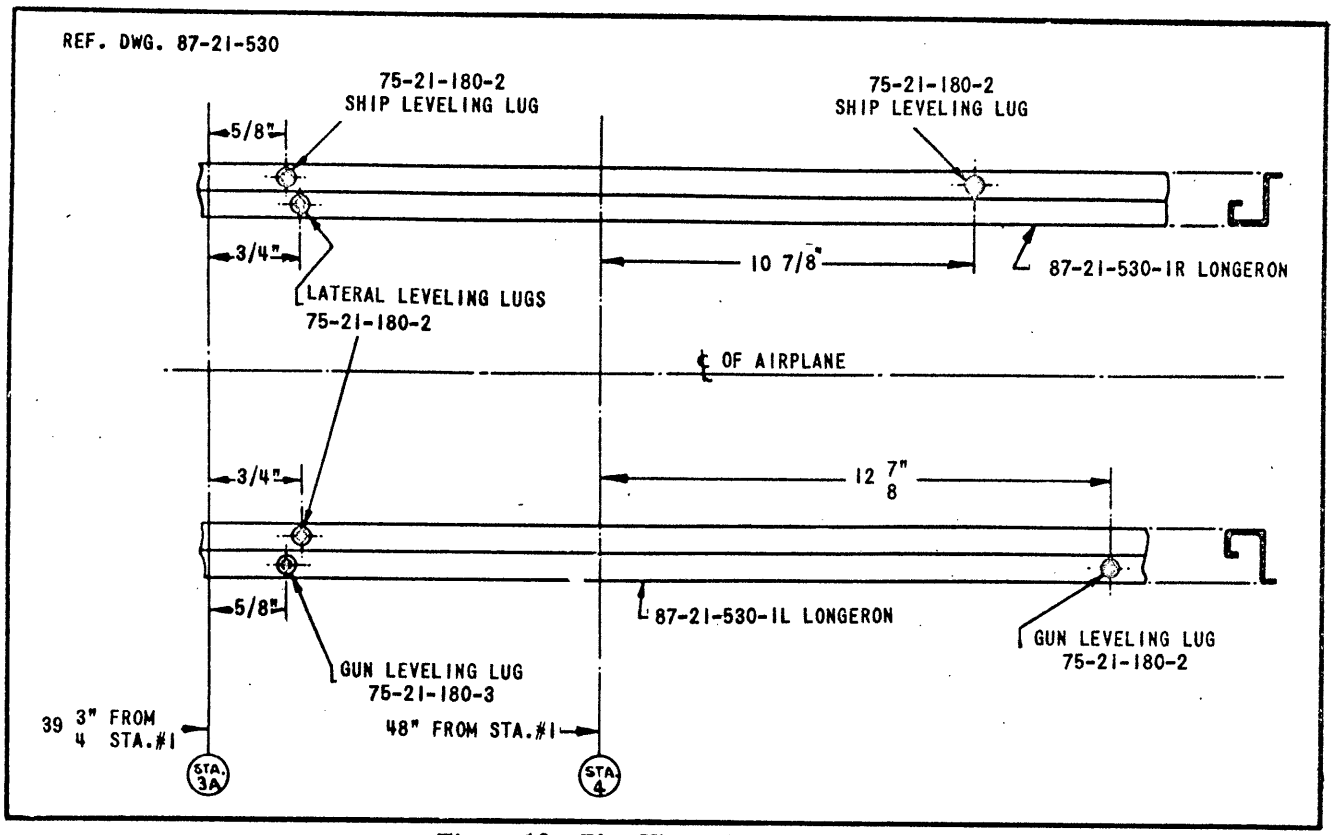


Figure 16 - Plan View - Leveling Lugs

spinner, concentric with the centerline of the spinner for a plumb bob attachment when sighting the guns.

g. Filling Fuel, Oil and Coolant Tanks.

(1) Fuel.

(a) Fuel is carried in four tanks; a reserve tank (in the fore part of the center section of the wing), a main tank (in the rear center section of the wing), a fuselage fuel tank which carries both main and alternate fuel loads (located immediately aft of the armor plate at station 5), and a 52 gallon auxiliary belly tank (located on the centerline of the airplane beneath the wing).

(b) Main and reserve tank filler caps are located inside the left-hand wing fillet and are accessible through doors in this fillet.

(c) The fuselage fuel tank filler cap is located on the left-hand side of the fuselage aft of station 5.

(d) The belly tank filler cap is located on the left-hand side of the tank.

(2) Oil.

(a) The oil tank is located immediately aft of the firewall and forward of the armor plate installation at station 2.

(b) The filler cap is located inside a door in the left-hand top side of the fuselage forward of the windshield, and aft of the engine cowling.

(3) Coolant.

(a) The coolant tank is located near the top on the forward side of the firewall at station 1.

(b) The filler cap is located inside a door at the rear of the top engine cowling.

h. Walkways.

(1) A partial walkway of 1/16 in. green "Aero-Floor" is provided on the trailing edge of the left wing to prevent slipping when stepping on or off the wing. Duck canvas throw-over pads are provided for servicing when it is necessary to walk outboard of the "NO-STEP" line painted on the top surface of the wings.

(2) A pad-panel, throw-over (87-88-524) for gun servicing is provided with every 9 airplanes.

i. Mooring. - Tie-down rings are located in the under surface of each wing between the outboard bulkhead and the removable wing tip. These rings are held in the retracted position in the wing by springs and are pulled down through slots by small tabs which

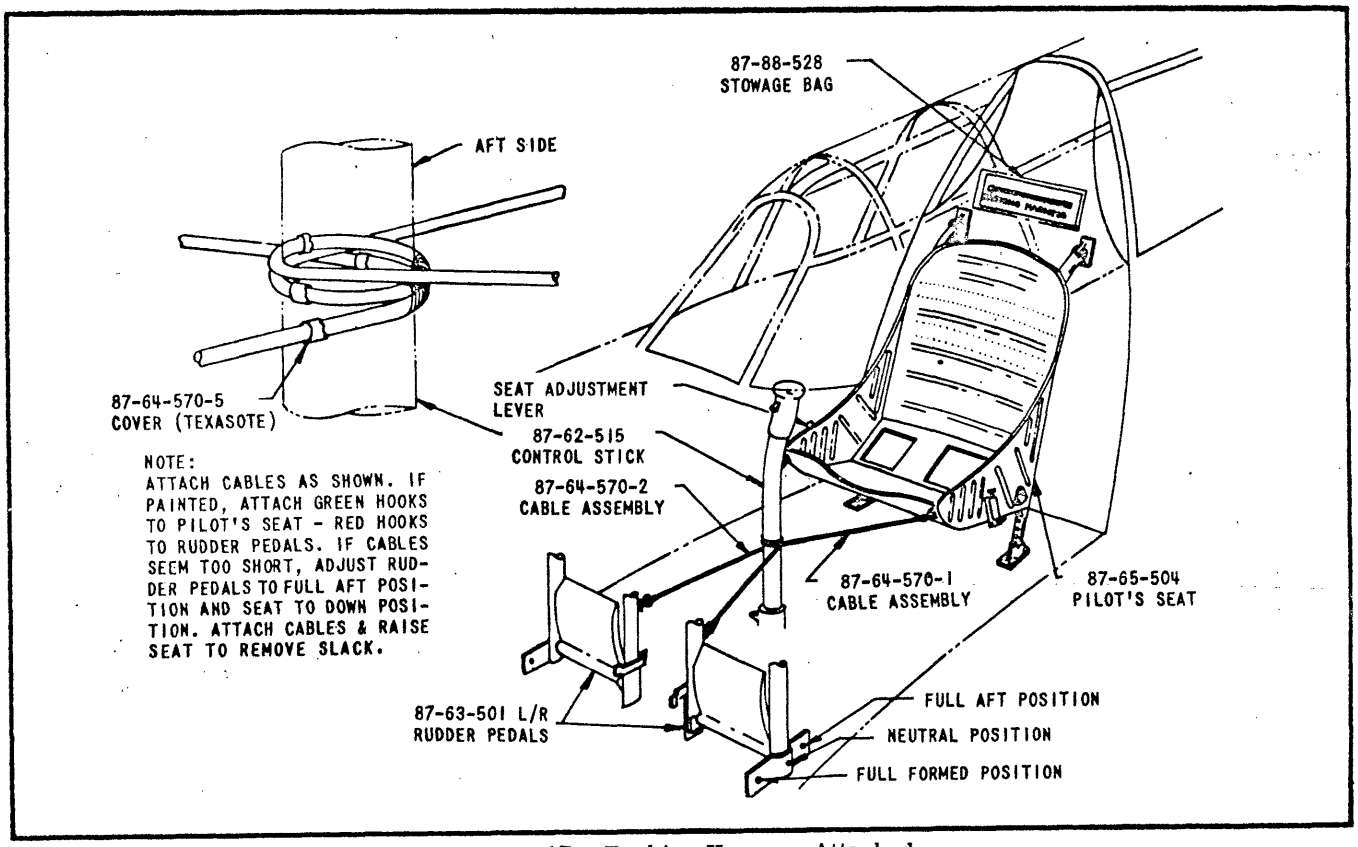


Figure 17 - Parking Harness Attached

protrude through the bottom surface of the wing. A decalcomania "TIE-DOWN" indicates the location of these tabs. T. O. No. 01-1-50 contains additional general information. Additional mooring equipment is carried on the duffle bag. The tail lifting bar may be passed through the lift tube at the aft end of the fuselage to tie down the aft portion of the airplane.

(1) For installation of wheel covers, see section IV, paragraph 7.d.(5)(c).

(2) A special sand cover is also provided for the cooling ducts. This cover is installed by inserting it in the opening in the bottom cowl.

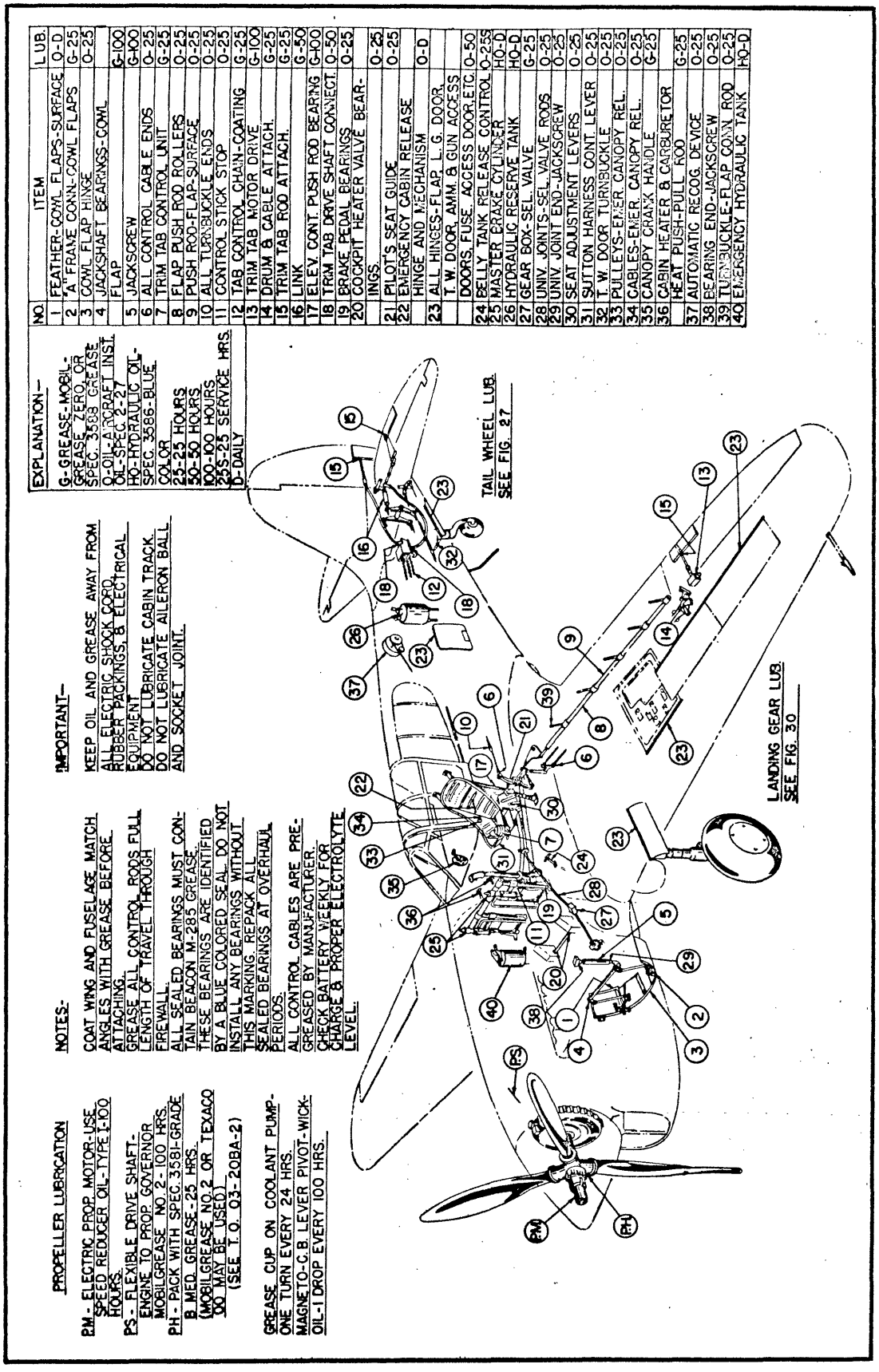
j. Parking Brakes and Surface Controls.

(1) The parking brakes are set by pulling on the parking brake control button located beneath the instrument panel on the left-hand side while holding both brake pedals depressed. Release the parking brakes by depressing the brake pedals.

(2) The control surfaces are locked by rigging the parking harness (87-64-570) around the control stick. Attach the cables as shown in figure 17. If the hooks are painted, attach the green hooks to the pilot's seat and the red hooks to the rudder pedals. If the cables seem too short, adjust the rudder pedals to the full aft position and the seat in the down position. Attach the cables and raise the seat to remove the slack. In some rare cases it may be necessary to wrap the harness around the stick below the electric conduit plug on the control to gain enough slack to engage all the hooks.

k. Starting the Engine. (See section III, T. O. No. 02-1-29 and T. O. No. 02-5A.)

l. Stopping the Engine. (See section III, T. O. No. 02-1-29 and T. O. No. 02-5A.)



NO.	ITEM	LUB.
1	FEATHER-COWL FLAPS-SURFACE	O-D
2	A FRAME CONN-COWL FLAPS	G-25
3	COWL FLAP HINGE	O-25
4	JACKSHAFT BEARINGS-COWL FLAP	G-100
5	JACKSCREW	G-100
6	ALL CONTROL CABLE ENDS	O-25
7	TRIM TAB CONTROL UNIT	G-25
8	FLAP PUSH ROD ROLLERS	O-25
9	PUSH ROD-FLAP-SURFACE	O-25
10	ALL TURNBUCKLE ENDS	O-25
11	CONTROL STICK STOP	O-25
12	TAB CONTROL CHAIN-COATING	G-25
13	TRIM TAB MOTOR DRIVE	G-100
14	DRUM & CABLE ATTACH.	G-25
15	TRIM TAB ROD ATTACH.	G-25
16	LINK	G-50
17	ELEV. CONT. PUSH ROD BEARING	G-100
18	TRIM TAB DRIVE SHAFT CONNECT.	O-50
19	BRAKE PEDAL BEARINGS	O-25
20	COCKPIT HEATER VALVE BEARINGS	O-25
21	PILOT'S SEAT GUIDE	O-25
22	EMERGENCY CABIN RELEASE HINGE AND MECHANISM	O-D
23	ALL HINGES-FLAP, L.G. DOOR, T.W. DOOR, AMM. & GUN ACCESS DOORS, FUSE. ACCESS DOOR, ETC.	O-50
24	BELLY TANK RELEASE CONTROL	O-25
25	MASTER BRAKE CYLINDER	HO-D
26	HYDRAULIC RESERVE TANK	HO-D
27	GEAR BOX-SEL. VALVE	G-25
28	UNIV. JOINTS-SEL. VALVE RODS	O-25
29	UNIV. JOINT END-JACKSCREW	O-25
30	SEAT ADJUSTMENT LEVERS	O-25
31	SUTTON HARNESS CONT. LEVER	O-25
32	T. W. DOOR TURNBUCKLE	O-25
33	PULLEYS-EMER. CANOPY REL.	O-25
34	CABLES-EMER. CANOPY REL.	O-25
35	CANOPY CRANK HANDLE	G-25
36	CABIN HEATER & CARBURETOR HEAT PUSH-PULL ROD	G-25
37	AUTOMATIC RECOG. DEVICE	O-25
38	BEARING END-JACKSCREW	O-25
39	TURNBUCKLE-FLAP CONN. ROD	O-25
40	EMERGENCY HYDRAULIC TANK	HO-D

Figure 18 - Lubrication Chart

SECTION III

SERVICE, INSPECTION AND MAINTENANCE
(Inspection, Cleaning, Servicing, Lubrication and Adjusting)

1. General.

a. The work outlined in this section is a normal function of the Operating Organizations at Army Air Forces Stations. In consists of the periodic inspection, cleaning, servicing, lubricating, adjusting and such maintenance work as the organization facilities will permit. These instructions will be used in lieu of inspections specified in T. O. No. 00-20A.

b. The lubrication requirements are noted in figure 18. (Also see T. O. No. 06-10-4.)

c. The following is a list of special airplane tools furnished by the contractor for use in connection with the work prescribed in this section.

Drawing No.	Description
87-88-019	Hoisting Sling Tail.
87-88-020	Hoisting Sling Front.
87-88-030	Wrench - Actuating Strut - Landing Gear and Flap
87-88-031	Wrench - Metering Pin - Landing Gear and Tail Wheel.
87-88-524	Pad - Panel Throw-Over Gun Servicing.
87-88-525 L/R	Pad - Throw-Over Walkway.
87-69-737	Ratchet Wrench - Gun Mounting.
A5585	Alemite Grease Gun.
A7393	High Pressure Hand Pump.

d. The inspection and maintenance given in the following paragraph is listed in the form and order of the current issue of T. O. No. 00-20A and reference to this Technical Order Handbook should be made under proper column headings on form 41A for all supplementary inspection and maintenance.

2. Inspection and Maintenance.

a. Column 12 - Gunnery Equipment.

(1) Machine Guns. - Inspect in accordance with Army Air Forces Circular and to T. O. No. 11-1-6D. In addition, the following inspection shall be performed.

Pre-Flight.

Check security and alignment of the blast tubes.

Special.

Check the link and case chutes for security and obstructions after each flight.

(2) Gun Camera.

(a) Army Air Forces Circular 15-45.

(b) Type G-45 Gun Camera. - Check for security of the camera fairing and the camera adapter in the fairing. (See section IV, 24. a. and b.)

b. Column 15 - Communicating Equipment. - Inspect in accordance with Army Air Forces Circular and T. O. Nos. 08-5-1 and 08-5-2.

c. Column 20 - Engine Controls.

Daily.

Inspect the operation, proper functioning and general condition of the following assemblies:

(1) Throttle

(2) Mixture

(3) Carburetor Air Heater

(4) Propeller Control

(5) Cowl Shutters.

25-Hour.

Inspection. - Inspect the entire control assemblies from the levers in the cockpit through all rods, their linkage, supporting brackets, guides, pulleys, and so forth.

Inspect for:

Free and full movement - controls should operate with uniform tension throughout their full range.

Lost motion. See that linkage is properly adjusted. Bent rods.

Loose or missing bolts, nuts, screws, cotter pins, and so forth.

See that all levers are adjusted to prevent creeping.

Lubrication. - Clean and lubricate all the moving connections and bell cranks with oil, Army Air Forces Spec. 2-27-E, with the exception of anti-friction bearings in rod ends, bell cranks, and so forth. Where anti-friction bearings are used, no lubrication is necessary between major overhauls.

50-Hour.

Lubricate the firewall guides with grease. Spec. Y-3588.

d. Column 21 - Engine Instruments.

Daily.

Check for operation, excessive pointer oscillation and note whether the proper indications are consistent with the stage of warm-up prescribed in T. O. No. 02-1-29. In the case of malfunction, reference should be made to the Technical Orders indicated below.

Engine Gage Unit - Type B-7 - The required fuel pressure, oil pressure, and oil temperature are given in T. O. No. 05-75-1.

Thermometer - Preston, Type A-23 - Refer to T. O. No. 05-40-3.
Tachometer - Type G-9 - Refer to T. O. No. 05-5C-1.
Manifold Pressure Gage - Type D-9 - Refer to T. O. No. 05-70C-1.

Suction Gage. - With the engine running at 1000 r. p.m., to maximum, adjust the vacuum relief valve to give a suction gage reading of 4.00 ± .25 inches of mercury. Adjust the vacuum regulating valve to give a reading through the Turn and Bank indicator of $1.9^{+.15}_{-.10}$ inches of mercury.

Special. - Inspect and maintain the following instruments as prescribed in the Technical Order indicated:

Engine Gage Unit, Type B-7, T. O. No. 05-75-1
Manifold Pressure Gage, Type D-9, T. O. No. 05-70D-1
Tachometer, Type C-9, T. O. No. 05-5C-1
Coolant Thermometer, Type A-23, T. O. No. 05-40-4
Suction Gage, Type F-3, T. O. No. 05-80-1
Compass, Type B-16, T. O. No. 05-15-2
Altimeter, Type C-12, T. O. No. 05-30-1
Clock, Type A-11, T. O. No. 05-1-9
Flap and Wheel Indicator, 8DJ4XAB, T. O. No. 05-55A-2
Fuel Quantity Gage, 8DJ11LAE, T. O. No. 05-55A-3
Airspeed, Type D-7, T. O. No. 05-10-2
Turn Indicator, Type A-5, T. O. No. 05-20-4
Turn and Bank Indicator, Type A-8, T. O. No. 05-20-2
Rate of Climb, Type C-2, T. O. No. 05-20-17
Flight Indicator, Type C-7, T. O. No. 05-20-3
Ammeter, Type F-1, Spec. 94-32284
Engine and Electrical Instruments, T. O. No. 05-1-17

e. Column 22 - Ignition and Electrical. - Inspect and maintain equipment listed below in accordance with the Technical Orders indicated:

Starter - T. O. Nos. 03-5CA-1 and 03-5CA-3
Generator - T. O. No. 03-5AA-1
Generator Control Panel - T. O. No. 03-5AA-3
Motor Drive Hydraulic Pump - T. O. No. 03-30CB-1.
Capacitors - T. O. No. 08-5-6

Inspect the spark plugs making sure that the spark plug elbows all point down and are in a vertical position.

Battery - Type G-1 or Exide 12-TAS-9

Weekly - Once Each Seven Days.

Inspect as prescribed in T. O. No. 03-5B-1. Also inspect the following:

Read the battery with a hydrometer and enter the reading of the lowest cell. This entry, on days when the battery is read, supplants the usual code symbol entries. Any defects found will be entered on Army Air Forces Form No. 41, Column 50, "Remarks".

The following are hydrometer readings for commonly used aircraft batteries:

Low (Discharged) - 1.200 and below
Medium (Partially discharged) - 1.250
High (Fully charged) - 1.275 to 1.300

If any cell is low, or if any cell is too high, the battery is developing trouble and will be turned into the battery room for complete inspection and repair.

Never add electrolyte or acid.

In addition to reading the battery, inspect as follows:

Battery leads for:

Condition of insulation
Security of attachment

Battery, for leakage of electrolyte, and corrosion. In case leakage is found, examine the airplane structure carefully for damage. Replace a leaking battery.

Battery box drain for cleanliness, security of attachment, freedom from corrosion, etc.

Check the battery vent system to insure that the vent lines are unobstructed and securely anchored.

WARNING: When using inflammable cleaning fluid to clean airplanes or engines, the precautions in T. O. No. 01-1-1 will always be observed.

In addition to the foregoing, the following inspection will be accomplished:

25-Hour.

Inspect the magneto - Breaker cover and breaker housing and magneto distributor. Spark Plugs - T. O. No. 03-5E-1.

50-Hour.

Inspect all wiring for:

Proper anchorage of the conduit nuts, bonding leads, and terminal box covers.

Condition of connections, terminals exposed ends and contacts, including ground connections.

See that no leads are anchored to the fuel lines or engine controls, or are swinging free in such a manner as to cause undue wear or fatigue.

Lubrication.

Lubricate the electric trim tab motor by first removing the cover plate on the top leading edge of the aileron and then removing the screw in the base of the motor. Lubricate every 100-hours with grease.

Adjustment.

To adjust the thermo switch in the coolant system loosen the conduit adapter and proceed as follows: Turn the adjusting screw clockwise to decrease the temperature setting and counterclockwise to increase the temperature setting. (For complete information, see section IV, paragraph 13. c. of this Handbook.)

f. Column 23 - Fuel System. - Inspect and maintain the equipment listed below in accordance with Technical Order indicated:

Fuel Pump, type G-9, T. O. No. 03-10EA-1

In addition to the foregoing, the following inspections will be accomplished:

Pre-Flight.

Turn the fuel cock one complete revolution to determine that it revolves freely.

CAUTION: Always set the fuel cock by "click and feel". (See T. O. No. 03-10-13.)

See that the fuel tank filler caps are properly secured.

Test the functioning of the engine on all fuel tanks. The required fuel pressure must be obtained when operating on each tank. The fuel cock must turn readily when shifting from one tank to another and the position of the fuel cock control must correspond with the setting indicated on the fuel selector dial. (See T. O. No. 05-15-2.)

Daily.

Drain the fuel tank sumps each time fuel is serviced to the tanks. (See figure 82.)

Resafety the drain cocks.

Drain the type C-3 fuel strainer.

See that the wing tank scupper drain and the fuel tank vent lines are clear.

Inspect the fuel system for evidence of leaks.

Check the primer for leaks when in the "OFF" position after pumping up the pressure with the electric pump.

25-Hour.

With the tanks full, fuel on, and pressure up (12 to 14 p. s. i.)

Inspect all self-sealing fuel tubes at their clamp fittings for breaks in the compound covering due to excessive tightening of the clamps.

NOTE: Hand tighten all clamp fittings. Never use pliers or other tools.

Security of line anchorage.

Wear due to vibration or chafing.

Inspect the type G-6 electric fuel pump for leaks.

Inspect all fuel overflow or drain lines for:

Security of mounting.

Kinks, breaks or stoppage.

Note whether overflow or drain lines extend beyond the cowling. This is necessary to avoid fuel vapors collecting inside the cowling or fuselage.

Remove and clean all fuel strainers, and inspect for breaks or tears.

50-Hour.

Inspect the fuel cock control as prescribed in T. O. No. 03-10-13.

g. Column 24 - Oil System. (See T. O. No. 06-10-1)

Daily.

Inspect for evidence of the engine throwing oil.

Inspect all drain plugs and drain cocks for safetying.

See that the oil tank scupper drain is clear.

During cold weather operation, drain the oil pressure gage line to the engine gage unit and refill as prescribed in T. O. No. 05-40-10. The following method of filling the tube is suggested:

(1) Disconnect the oil pressure gage line at the instrument and at the engine, and drain the oil. If compressed air is available, the line should be blown free.

(2) Solder a threaded fitting to connect the engine end of the line to the nozzle of a plunger type oil gun.

(3) With the oil gun filled with instrument oil (Spec. 3562) slowly force oil into the line until a small amount runs out at the instrument end. Then connect the line to the gage without withdrawing the pump plunger, and carefully tighten the nut.

(4) Remove the oil gun and connect the line to the engine.

Normally, the light oil mixes with the engine oil very slowly and 60 to 90 days may elapse before the gage again becomes sluggish in operation. When this sluggishness becomes apparent, repeat the draining and filling operation noted above.

25 Hour.

Inspect all oil lines for:
Leaks, particularly at connections and at passages through the firewall.
Security of anchorage.
Wear due to chafing or vibration.
Dents or cracks.

Inspect all connections for:
Security of clamps.
Loose nuts.
Proper location of clamps.
Condition of hose.

Inspect the oil temperature regulator (oil cooler) for:

Clogging of cores.
Dents and leaks.
Security of mounting.

50-Hour.

Drain the oil tank in accordance with provision of T. O. No. 06-10-1.

Inspect the oil tank for:
Security of mounting.
Signs of leakage, particularly at the seams.
Condition of the rubber padding and proper location of rubber padding between the tank and support.
Proper tension of the tie-down bolts.
Proper anchorage of all oil lines leading from this tank.

h. Column 25 - Coolant System.

Daily - (See T. O. No. 24-25-1.)

Inspect the radiators, expansion tank and hose connections for:

Leaks, particularly in radiator cores and at drain plugs.
Drain plugs safetied.

Inspect the operation, proper functioning and general condition of the radiator cowl shutters. See that the cowl shutters operate to their extreme positions (fully opened (45^{o}) and fully closed (25^{o}) from their neutral position flush with the bottom engine cowl.

Check the poppet type relief valve in the filler unit on the coolant expansion tank for freedom of motion.

25-Hour.

Inspection. - Make thorough inspection of the radiators and expansion tank.
Inspect the radiator mounting, supports and mounting brackets for breakage and security. Condition of the "Lord" mountings.

Carefully inspect the shutters for:
Bent or loose shutters and proper operation (open and shut).

Inspect lines for:
Evidence of leaks, particularly at connections and thermometer wells.
Security of anchorage.
Wear due to vibration or chafing.
Condition of hose connections.
Tightness, condition and location of clamps at the air duct seals.

Inspect the entire cowl shutter control assembly from the lever in the cockpit, through all rods, support brackets, guides, etc. Inspect for:

Free and full movement.

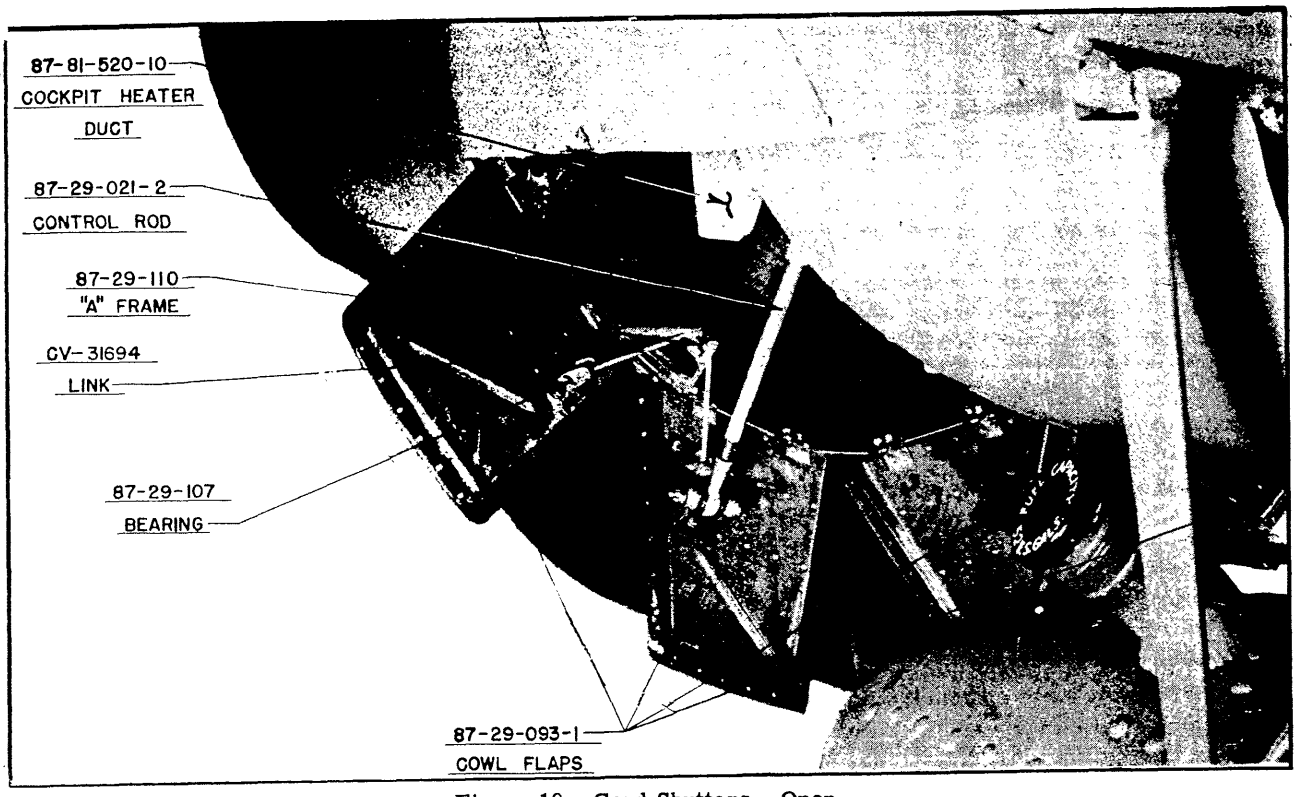


Figure 19 - Cowl Shutters - Open

See that flaps open wide and shut tightly. 45° open, 25° closed, from the flap neutral position, flush with the bottom engine cowl.

Lost motion. See that the linkage is properly adjusted.

Loose or missing bolts, nuts, screws, cotter pins, etc. (See figure 20.)

Lubrication. - Lubricate the cowl shutters and controls in accordance with figure 18.

50-Hour.

Remove the ball check valve from the filler unit on the expansion tank and inspect the ball for freedom of motion.

Servicing. - Drain and flush the coolant system. Drain plugs are on the bottom of the radiators.

Coolant will be drained into containers, strained and returned to the engine. (See T. O. No. 24-25-1.)

See that all drain plugs are properly safetied.

Special. - For every engine change, check the thermometers to determine whether they are correctly marked as prescribed in T. O. No. 05-1-16.

i. Column 26 - Valves. - Inspect and maintain the valves as prescribed in T. O. Nos. 02-5A and 02-1-6.

NOTE: When it is known in advance that an airplane engine will not be operated during a period of more than one week, the valves and valve mechanism will be treated to prevent corrosion. Engines installed in aircraft which are not in "in storage" status will be warmed up at least once each week, thus eliminating the necessity for spraying the valves and valve mechanism.

j. Column 27 - Manifolds and Superchargers. - Check manifolds for security of attachment, and for condition of the hose connections and expansion joints.

25-Hour.

Check the outboard face of the exhaust shrouds for the proper clearance from the flange on the cowling.

Check the bolts through the shroud for clearance on the exhaust stacks.

50-Hour.

Inspect intake and exhaust systems for damaged manifolds, loose stacks and retaining lugs, broken or loose studs and bolts, and blown gaskets. Lightly tap the exhaust stacks to loosen any scale formation, or brush out with a wire brush. Inspect exhaust pipes for cracks and condition of welds and fit of clamps at joints.

k. Column 28 - Propellers and Accessories. - Inspect and maintain propeller as prescribed in T. O. Nos. 03-20B-1 and 03-20B-2.

l. Column 29 - Power Plant.

General. - (For complete inspection and maintenance instructions for the V-1710-39 engine in this airplane, see T. O. No. 02-5AB-2. Inspect the shock absorber units on the engine mount at every removal of the engine for deterioration of the rubber and loosening of the rubber from the metal bushings.

Pre-Flight.

When practicable, before starting the engine the first time each day, and in all cases where the engine has not been run within the past seven days, turn the propeller by hand at least two or three complete revolutions before using the starter.

While Warming Up The Engine.

CAUTION: Specific instructions have been included in T. O. Nos. 02-1-29, 02-5A, 03-20B-1 and 06-10-1 covering the operation of propellers and engines on the ground and the method of stopping aircraft engines. Personnel shall be familiar with these instructions before warming up the engine:

The Ignition Switch will be tested as follows:

With the engine running at about one-third throttle, turn the ignition switch momentarily to the "OFF" position. If the engine does not entirely cease firing, defective functioning of the switches or connections, likely the ground connection, is indicated. For this test, the engine must not be excessively hot and the period during which the switch is "OFF" must be brief so that the engine does not slow down too much.

WARNING: If the engine does not cease firing when the switch is placed in the "OFF" position, it will be necessary to stop the engine by "turning off the gas." AFTER THE ENGINE STOPS, DO NOT TOUCH THE PROPELLER UNTIL THE DIFFICULTY HAS BEEN FOUND AND CORRECTED, AS THE ENGINE MAY START OR "KICK OVER", CAUSING DEATH OR SERIOUS INJURY.

Ammeter. - With the generator line switch "ON" and the engine running at cruising speed, note if the ammeter indicates a "Charge". (See Spec. No. 94-32191.)

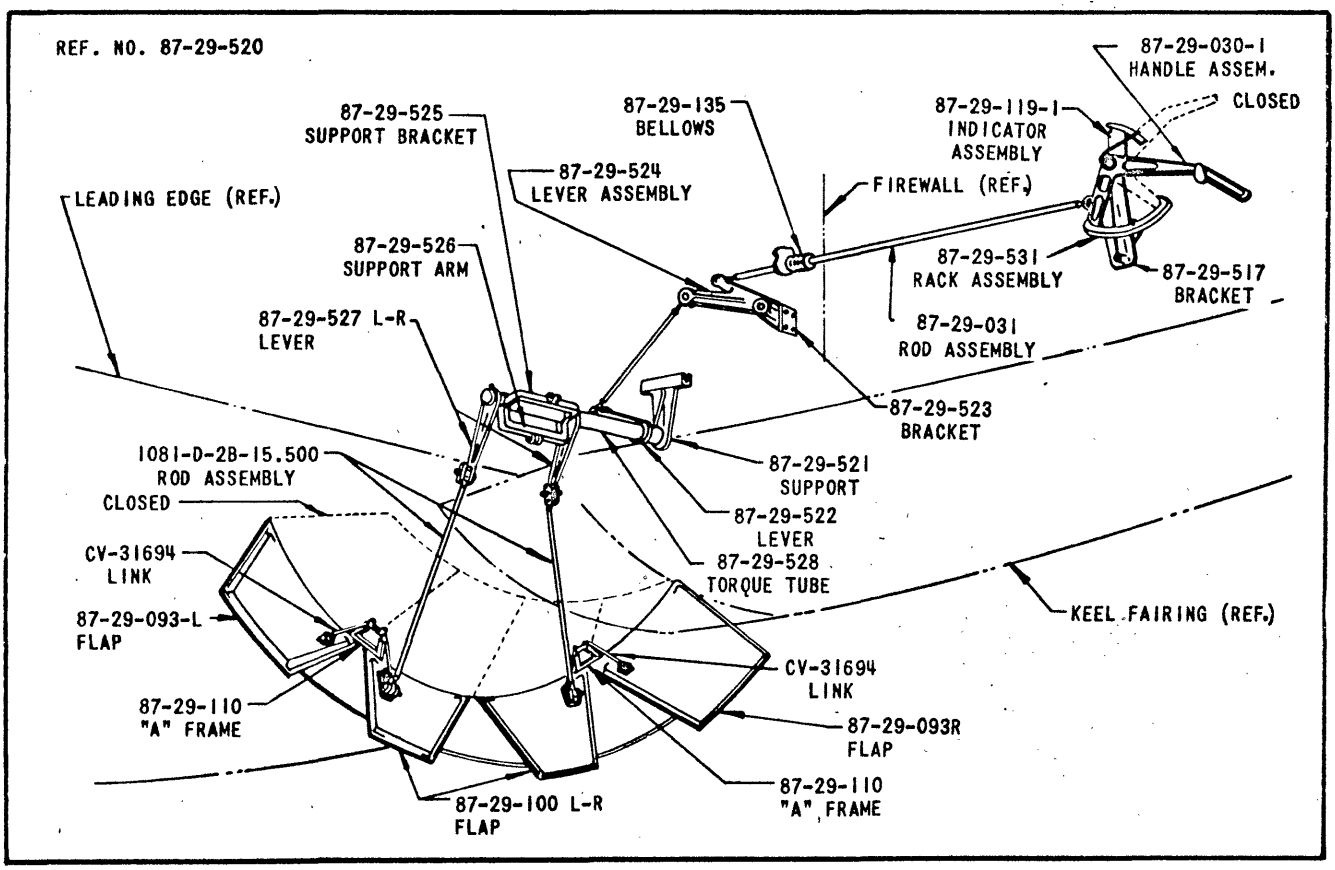


Figure 20 - Cowl Flap Shutter Controls Installation

Daily.

Inspect the engine cowling and the exposed portion of the mounting brackets for security of attachment, cracks, deformation and general condition of fasteners.

Inspect the exposed portions of the engine mount and mounting brackets for general conditions and security of attachment.

25-Hour.

Check the engine cowl forward bulkhead mounting bolts and engine mounting lugs for tightness of bolts and condition of rubber ("Lord") bushings.

Inspect the stud nuts, cylinder-head-to-coolant jacket, and crankcase to coolant jacket for looseness.

Nuts should be uniformly tightened.

50-Hour.

Inspect the engine mount for:

Cracks, particularly at welds.
Tightness of the mounting clamps and bolts.
Proper protective coating.
Condition of the rubber shock absorbing units.
Tightness of the rubber shock absorbing unit attaching bolts.
Condition of the stops above and below the rubber shock absorbing units.

m. Column 31 - Cockpits and Cabins.

Pre-Flight.

Check the condition of the static ground forward of the tail wheel.

Examine the airplane flight report for completeness. If incomplete, make the necessary entries to complete.

Note whether routine inspections are due. If due, make them. If they cannot be made, see that the proper symbols are entered to indicate omission of the inspection.

See that the windshield and windows are clean.

See that all flight controls operate freely; that there is nothing in the cockpit that will interfere with the proper functioning of these controls.

Daily.

Inspect the condition and functioning of the cockpit sliding enclosure.

25-Hour.

Inspection.

Inspect the pilot's seat for:

Security of attachment including supports and brackets.

Condition and functioning of the adjusting mechanism, including the rubber shock cord and the Sutton Harness adjustment controls.

Breaks or cracks, in the seat or back, which might foul the parachute harness or clothing.

Inspect the safety belts as prescribed in T. O. No. 03-1-2.

Inspect the windshield and cockpit enclosure for:

Condition of the frame and security of attachment.

Breaks or cracks in the glass or transparent sheets.

Condition and operation of the mechanism on the sliding section of the cockpit enclosure, including the proper operation of the emergency exit in the left-hand side of the sliding canopy and the emergency release for the sliding canopy.

Check to determine that canopy release mechanism is engaged with all lugs of canopy carriage, with special attention given to rear lugs. Check that locking wires (.025 maximum) are installed securing canopy release mechanism to roller assembly. Inspect canopy release mechanism to insure safe operation of the canopy.

Inspect the condition and operation of the cockpit heater and ventilator. Inspect the mixing chamber castings for cracks and leaks.

Lubrication.

Lubricate the bearing surfaces and working parts of the seat adjustment mechanism and the controls for the emergency exit, emergency canopy release, heating system and ventilator, with oil, Army Air Forces Spec. No. 2-27E. Lubricate the cockpit enclosure track in accordance with figure 21.

50-Hour.

Inspect the seat shock absorber cord as prescribed in T. O. No. 04-5-1.

Inspect the Sutton Harness control mechanism from the lever on the left of the pilot's seat to the releasing mechanism on the back of the seat.

Check the condition of the rubber stops at the aft end of the cockpit enclosure track.

Check the condition of the rubber seals on the cockpit enclosure.

n. Column 32 - Flight Control Mechanism. - (For inspection of the wing flap hydraulic system, see Column 33 of this section.)

Daily.

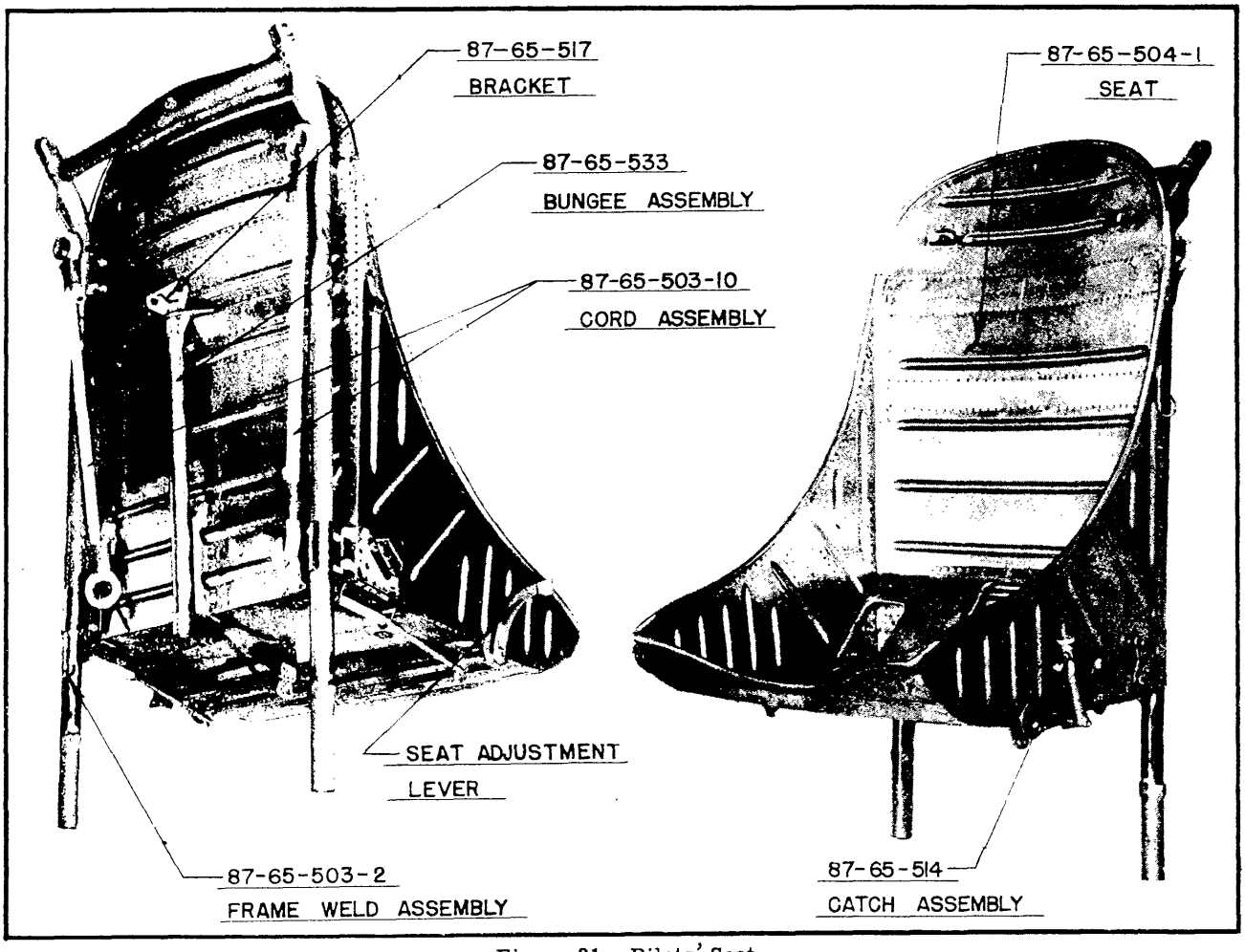


Figure 21 - Pilots' Seat

Inspect for freedom of operation.

25-Hour.

Inspection.

Rudder Controls. - Inspect the rudder pedal assemblies for:

Proper condition and functioning of all parts.
Proper throw of the rudder
Functioning of the pilot's pedal adjusting mechanism.
With pedals in the neutral position, see that the rudder is in the neutral position.
Bent connecting link.
Proper safetying of all attachments.
Freedom of interference between the rudder and elevators in their extreme positions of travel.
If lost motion exists, or if full movement of the rudder cannot be obtained without binding, rigidly inspect the entire system to locate and correct the trouble.

All accessible parts will be wiped clean. (See figure 22.)

Elevator and Aileron Controls. - Inspect the control stick assembly, including the torque tube, push-pull tube and forward jackshaft for:

Proper condition and functioning of all parts.
Proper throw of the elevator and aileron.
Security of the control stick in the socket.
Bent tubes or shaft.
Proper safetying of all attachments.
With the stick in the neutral position, see that the elevators are in the neutral position.
If lost motion exists, or if full movement of the elevators and ailerons can not be obtained without binding, rigidly inspect the entire system to locate and correct the trouble.

All accessible parts will be wiped clean.

Flight Control Linkage. - Inspect the flight control linkage (i.e., the rudder, elevator, aileron and tail wheel cables, pulley, drums, guides, and fittings,

also elevator rear jackshaft and link) for:

Proper safetying of all turnbuckles and attachments.

Frayed cables as prescribed in T. O. No. 01-1-26.

Bent jackshaft or link.

Proper tension of the cables.

Loose brackets and fittings.

Condition of the fairleads.

Broken or misaligned pulleys.

Proper alignment of all moving parts, particularly noting that cables, links and arms are not chafing structural members and are operating freely through openings in the fuselage or wing covering provided therefor.

All accessible parts will be wiped clean. (See figure 25.)

Rudder and Elevator Tab Controls and Linkage.

Proper condition and functioning of all parts. Note that the tab indicators show the position of the tabs.

Proper throw of the tabs on each surface.

Security, proper safetying and lubrication of gear boxes, chains, turnbuckles, rods and attachment parts.

Condition of chains and fairleads.

Bent rods.

Loose brackets and fittings.

Signs of interference with other parts or assemblies, noting particularly that rods to horns are operating freely through openings in the empennage coverings provided therefor.

If lost motion exists, or if full motion of the tabs can not be obtained without binding, rigidly inspect the entire systems to locate and correct the trouble.

See the instructions under "Adjustment" to co-ordinate the actuator units and the tabs.

All accessible parts will be wiped clean.

Rudder Trim Tab Actuating Mechanism. - The rudder trim tab actuating mechanism should be inspected for worn parts and screw threads, and elongated rivet and pin holes

The actuator hinge (87-14-553) should be inspected for wear, and a new part should be installed where it is required.

The hinge pins should be tightened into the actuator.

The actuator screw and screw jack should be inspected for worn threads and the unit replaced, if appreciable wear and lost motion is observed.

The rod ends of the tube should be inspected

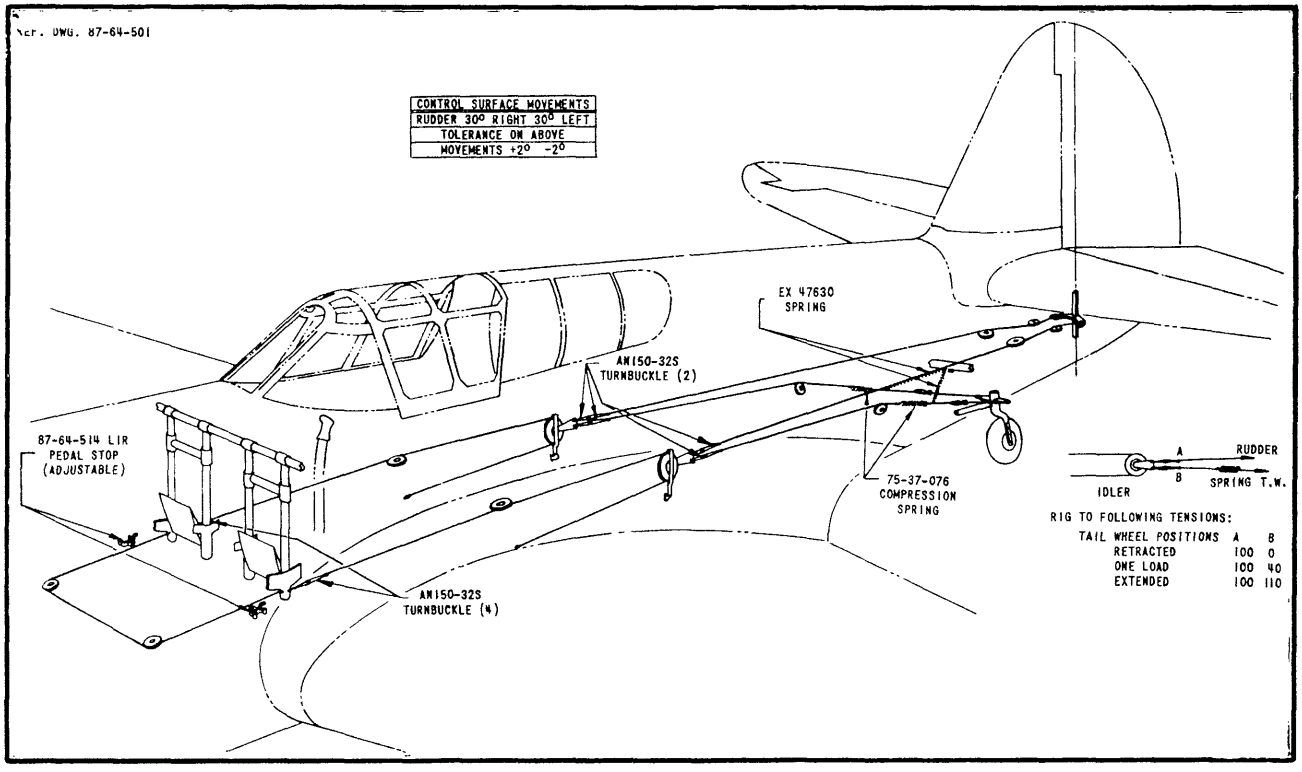


Figure 22 - Rudder Controls

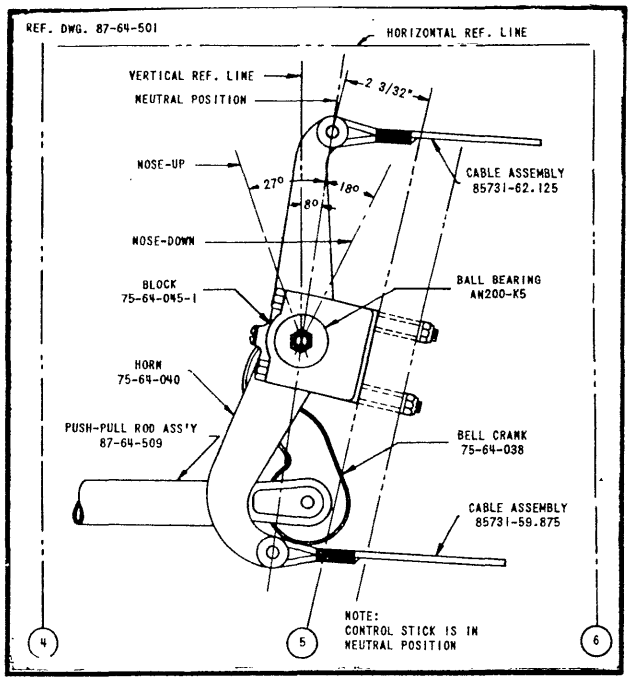


Figure 23 - Flight Controls Jackshaft Setting

for worn threads, and the rod ends replaced if necessary. (Care should be taken not to mutilate the rivet holes in the tube when removing the rod ends.)

The clevis end should be inspected for an elongated pin hole, and replaced if much wear is shown.

The trim tab horn should be inspected for an elongated pin hole. The horn may be rebushed, using a 1001D-4 - .250 bushing.

Aileron Tab and Control. - Inspect the electric trim tab control (left-hand aileron only) for:

Loose connections in the main switch box, wing panel junction box and at the motor.

Check for broken wiring or a defective switch.

See section III, paragraph 2. f. for the servicing of the electric trim tab control motor. (See figure 18.)

Wing Flap Control Mechanism. (See Column 43 for instructions concerning the hydraulic actuating strut and hydraulic lines) - Inspect for:

Proper condition of all parts.

Test functioning of the mechanism by operating the motor driven hydraulic pump and then test the mechanism by operating the auxiliary hand pump.

See that the position indicator in the cockpit indicates the position of the wing flaps.

Check the rollers and link pins. If wear is appreciable, replacements should be made.

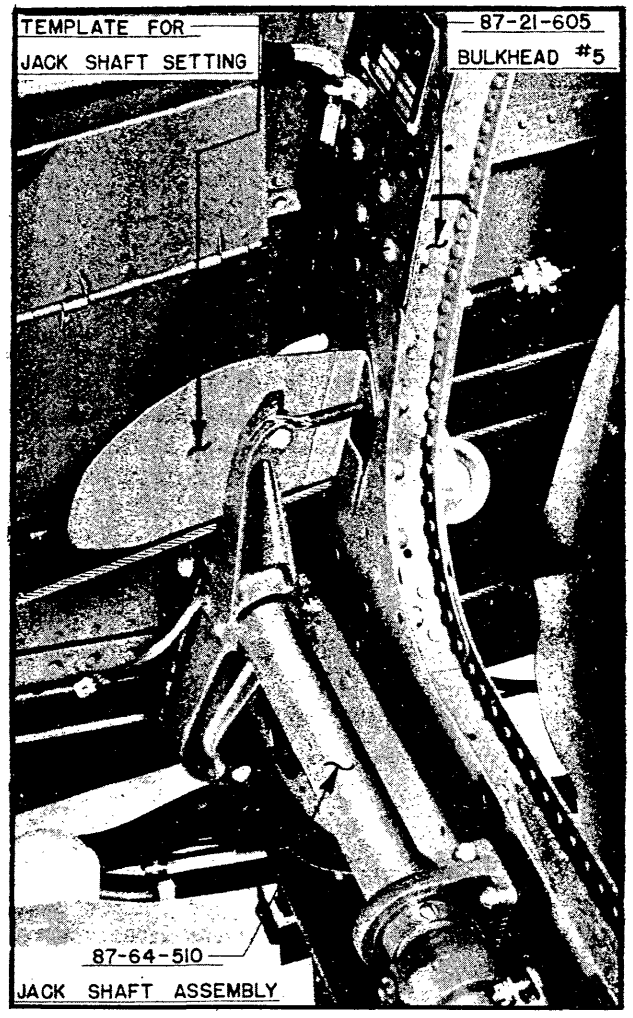


Figure 24 - Jackshaft Setting

Proper safetying of all rods, joints, connections, turnbuckles, and attachment parts.

Bent rods.

Loose brackets and fittings.

Signs of interference with other parts or assemblies.

If lost motion exists, or if full movement of the flaps can not be obtained without binding, rigidly inspect the entire system to locate and correct the trouble.

All accessible parts will be wiped clean.

Rigging Tensions. - Due to the high speed characteristics of this airplane, it is important that the control system be rigged to the cable tension loads specified in figure 22.

Rudder Control Stops. - (See paragraph 17. a. (3) (c) section IV.)

Rudder. - To align the rudder control system,

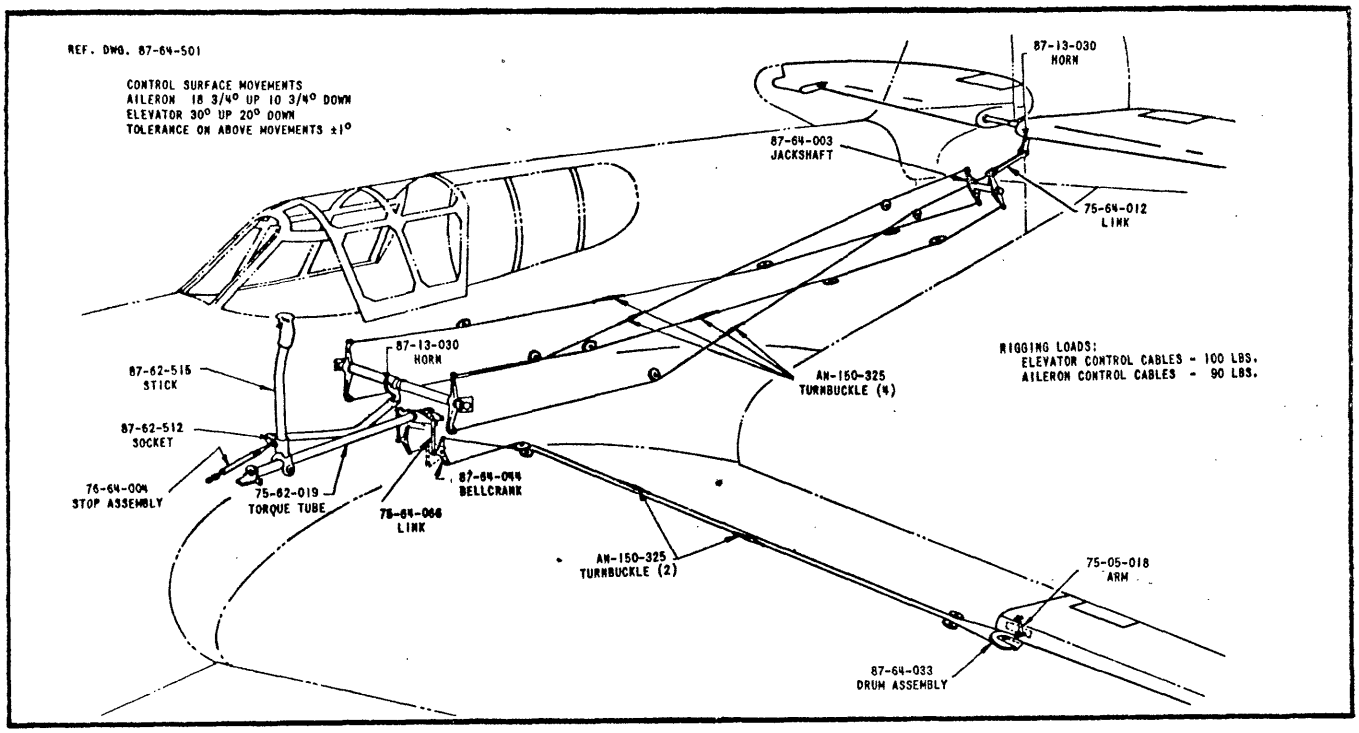


Figure 25 - Elevator and Aileron Controls

place the right-hand pedal in its extreme forward position, as indicated by the rudder stop and adjust the turnbuckle so that the arm holding the reduction pulley, when in its extreme forward position clears bulkhead No. 8 by approximately 1/8 of an inch. Repeat for the left pedal. Place the rudder pedals laterally opposite each other (neutral position) and through the fuselage access door in the left-hand side of the fuselage, adjust the cables to the rudder to align the rudder with the centerline of the airplane and adjust the cables to the tail wheel to align the tail wheel with the centerline of the airplane. Always maintain the correct rigging loads in the control cables.

Elevator Control Stop. - The length of the adjustable cylinder and piston unit (front of the control stick) is altered at the adjustable clevis end to control the "nose-down" position of the stick (17-1/2°); the "nose-up" position (26°) is controlled by loosening the check nut on the cylinder and adjusting the bushing through which the piston operates.

Elevator. - To align the elevator control system the control stick should be placed in the position where the lower (straight) portion of the stick is 1-1/2° aft of the perpendicular to the thrust line; then the control cables are adjusted to align the elevators with the horizontal stabilizer and to obtain correct rigging loads in the cables. For the front jackshaft setting, see figure 23 and figure 24.

Aileron Control Stops. - The heads of the stop bolts should be adjusted to limit the lateral motion of the control stick to 20-1/2° either side of the vertical centerline. The bolts are located in the rear jackshaft aft of the bulkhead of station No. 5 and are accessible by removing the pilot's seat, and the two cover plates attached to the lower side of bulkhead No. 5. The bolts are then accessible by reaching under station No. 5 bulkhead.

Ailerons. - The cable and link portions of the system are rigged to droop the ailerons 3/16 in. to 1/4 in. below the trailing edge of the wing, when the control stick is in the lateral neutral position.

To correct for an aileron position up or down on one side only, shorten one cable and lengthen the other by means of the turnbuckles which are accessible when the wing flaps are open.

To correct for one aileron up and the other down, adjust as closely as possible at the links, then complete the adjustment at the turnbuckles.

The normal aileron movement is 18-3/4° up and 10-3/4° down with a ± 2° tolerance. This movement can be obtained by adjusting the link and cables on one side at a time.

Trim Tabs. - The elevator trim tabs range from 3° above to 26° below the centerline of the elevator with a ± 2° tolerance. The elevator tab control wheel in the cockpit must be set to zero with the elevator tabs in their neutral position. The elevator tab control chains should be relocated around the sprocket, in back of the control wheel to give maximum up and down travel of the tabs. Final adjustment is made by means of the turnbuckles in the system. The elevator tabs must move up when the control wheel is rotated in a clockwise direction.

The combination balance and controllable rudder tab moves through a range of $15^{\circ} \pm 5^{\circ}_{-2^{\circ}}$ to either side of the rudder centerline. The cockpit control wheel must be set to zero when the tab is aligned with the centerline of the rudder. The rudder tab control chains should be located around the sprocket, underneath the control wheel to give maximum left and right travel to the tab. Final adjustment is made by means of the turnbuckles in the system. The rudder tab must move to the left when the control wheel is rotated in a clockwise direction.

Balance Action of the Tab. - When the tab is in its neutral position it will remain parallel to the centerline of the airplane throughout the full travel of the rudder ($30^{\circ} \pm 2^{\circ}$ either side of the airplanes centerline).

Controllable Action of the Tab. - When the trim tab is set at any given angle throughout its full travel ($15^{\circ}+5^{\circ}-2^{\circ}$ either side of the rudder centerline) by the control in the cockpit, the tab will maintain approximately at this set angle to the centerline of the airplane throughout the full travel of the rudder ($30^{\circ} \pm 2^{\circ}$ either side of the airplane centerline).

The aileron trim tab, on the left-hand aileron, moves through a range from 20° above to 20° below the centerline of the aileron. This trim tab is electrically operated and controlled from a switch in the cockpit. The switch is marked "LEFT WING UP", "LEFT WING DOWN" and "OFF"

Wing heaviness may be corrected on the ground by bending the right-hand aileron trim tab slightly (15° limit) "up" to create a right wing low condition, "down" to create a left wing low condition.

Adjustment. - If it is necessary to co-ordinate the actuator units and the tabs, the actuators are to be adjusted in accordance with the instructions given below and the rods from the bell crank, or lever, to the tab horns are to be adjusted by means of the adjustable rod ends:

The center of travel of the eye terminal of the actuator can be obtained by rotating it to the required position. This will not affect the cockpit control unit setting. The eye terminal may now be connected to the tab control bell crank, or lever, making sure that the connecting pin fits tightly in the holes. If a correction for the neutral setting is required after connection to the bell crank, or lever, is complete, this must be made by disconnecting the eye terminal from the bell crank, or lever, and rotating the terminal to the new setting. Care should be taken to make sure that the neutral setting is such that the travel is within the 1-3/4 in. maximum travel of the actuator.

Wing Flap Control - Linkage. - The flaps should seat perfectly into the wing contour at all times when in the "UP" position. If the flaps as a whole are not seated, the link connecting the bell crank and the push-pull tube should be shortened. If the flaps do not seat locally, shorten the turnbuckles near-

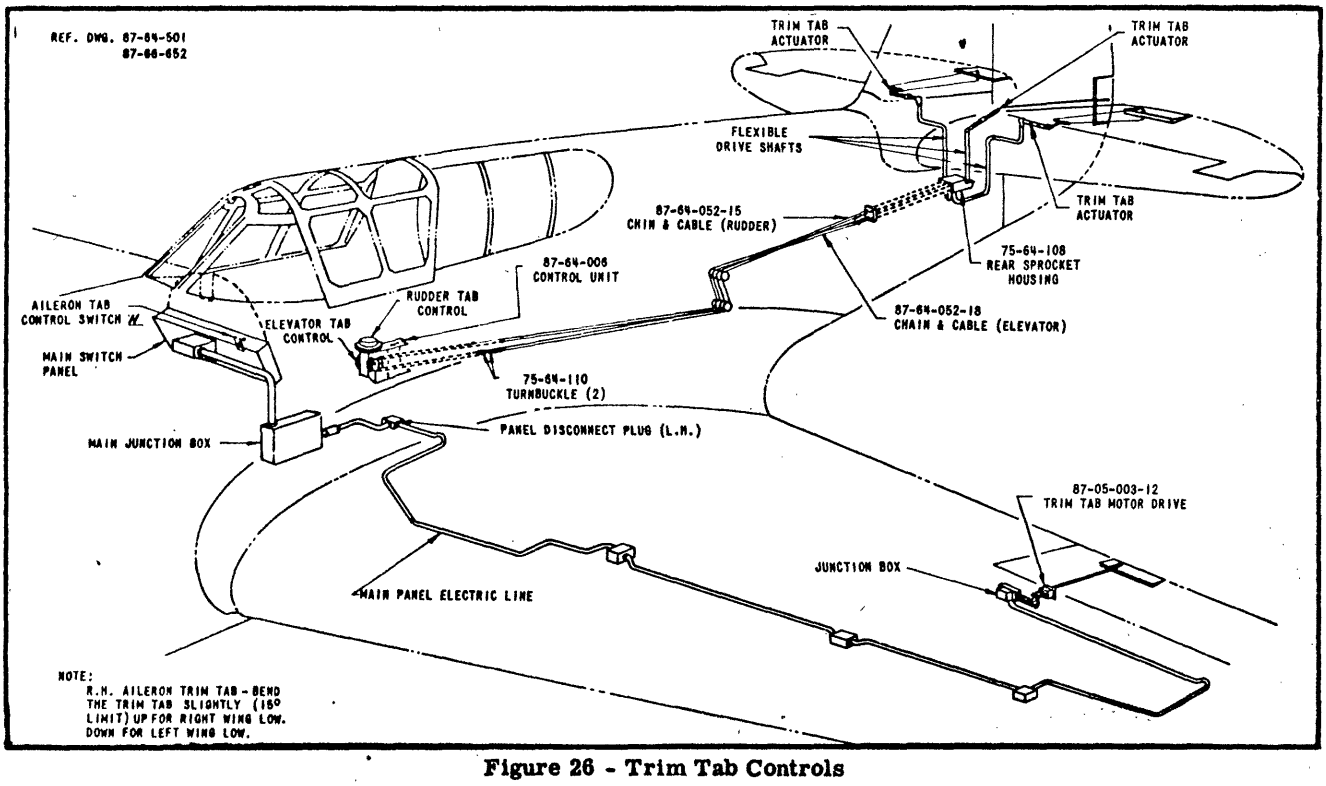


Figure 26 - Trim Tab Controls

est those points. The flaps should move downward simultaneously to a maximum opening of 45°.

Lubrication. - Lubricate the controls in accordance with figure 18.

50-Hour

Lubrication. - Lubricate the aileron control ball and socket joints in accordance with figure 18.

All cables will be cleaned where they pass over pulleys, or through fairleads and covered with heavy rust preventive compounds (Spec. 2-82.)

o. Column 33 - Moveable Surfaces.

Daily.

Inspect all surfaces for holes or other visible damage, and for general condition.

25-Hour.

Inspection.

Rudder, Elevators and Ailerons.

Inspect for:
Warping.
Broken ribs, or ribs loose on the spar.
Condition of the covering.

Inspect the horns and hinges for:
Bends and breaks.
Security of attachments.
Worn or loose hinge pins.
Safetying.

Tab and Flaps.

Inspect for:
Warping.
Broken ribs, or ribs loose on spar.
Condition of covering. Look for loose rivets in the rudder tab and wing flap coverings.

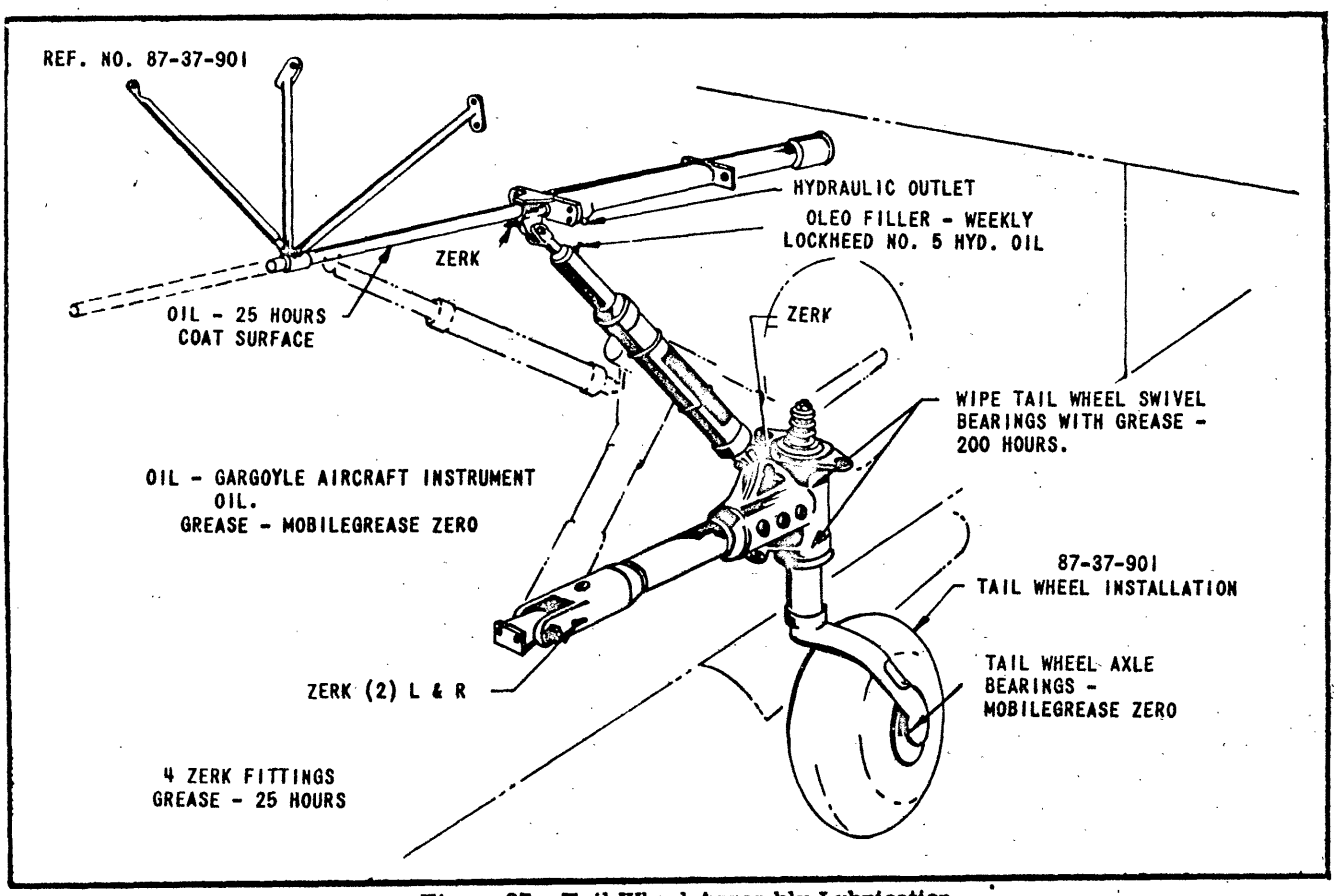


Figure 27 - Tail Wheel Assembly Lubrication

Inspect horns and hinges as prescribed under "Rudder, Elevators and Ailerons"

Lubrication. - Lubricate the wing flap hinges with "Gun Oil" Army Air Forces Spec. No. 2-27E, and wipe clean.

Adjustment. - For adjustment of the flap position indicator mechanism. (See paragraph 2.b. (7) of section IV.)

p. Column 34 - Fixed Surfaces.

Pre-Flight.

Check all screws which attach the wing tank doors to the bottom surface of the wing.

Check all screws which attach the wing tips to the wing for security of the fastening.

Daily.

Inspect the general condition of:
Metal skin.
Ribs, as indicated by displacement of the skin.

Inspect the fillets and keel fairing for security of attachment, cracks, dents, or bends.

Inspect for proper operation of all doors and the fasteners for the doors.

50-Hour.

Inspect the wings for:

Torn or loose skin.
Loose rivets, or rivets pulling through the skin.
Broken ribs.

Inspect the wing match angle at the centerline of airplane, also the wing to fuselage tee fitting, for:

Security of attachment.
Cracks.
Elongated holes.

Inspect the mounting of navigation lights in the wing tips and the condition of the sealing compound around the lights.

Inspect the horizontal and vertical stabilizers for:

Torn or loose skin.
Loose rivets, or rivets pulled through the skin.
Broken ribs, as indicated by distortion of the skin.

Inspect the mounting of the navigation light in the vertical stabilizer and the condition of the sealing compound around the light.

Inspect for proper operation of all doors and the fasteners for the doors.

q. Column 35 - Fuel Tanks.

Pre-Flight.

Check the quantities of fuel and oil in the tanks and enter the quantities on the airplane flight report.

NOTE: This check must be made on the day the airplane is to be flown, prior to the first flight of the day; checks made on a previous day cannot be considered part of the pre-flight inspection prescribed by these instructions.

See that the fuel and oil tank filler caps are properly secured.

50-Hour.

Inspect the fuel tanks for:

Security of mounting.
Condition of the padding and proper location of the padding between tank shells and straps and mounts.
Proper tension of the supporting straps.
Proper anchorage of all fuel lines leading from the fuel cells.

r. Column 36 - Tail Gear. - (For inspection of the tail wheel hydraulic retracting system, see Column 39, this section.) Inspect and maintain the following equipment in accordance with the Technical Orders indicated:

Air-Oil Shock Absorber Strut - T. O. Nos. 03-25E-1 and 06-1-2. For instructions covering operating and maintenance of High Pressure Hand Pumps, see T. O. No. 17-1-3. The proper amount of inflation will be obtained from the instruction plate on the strut. Tail Wheel Roller Bearings T. O. No. 03-25A-1. Tail Wheel Tire - T. O. No. 04-10-2.

Daily.

Inspect the tail wheel assembly for:

Freedom from mud, grass, etc.
Condition of the shock unit, i.e., supporting the tail in the proper position.

Inspect for proper air pressure in the tail wheel tire. The pressure in the tire will be maintained in accordance with T. O. No. 04-10-1.

Inspect the tail wheel door for:
Security of attachment.
Dents, bends, or cracks.

Inspect the tail wheel boot for general condition.

25-Hour.

Inspection. - Inspect the entire assembly for:
Cracks, bends or breaks, particularly at sharp angles and welds.
Cracked, bent or broken attachment fittings and brace members.

Inspect for proper operation of the swivel release mechanism.

Lubrication. - Lubricate in accordance with figure 27.

Lubricate the tail wheel door hinges and linkage with oil, and wipe the hinges clean.

50-Hour.

Inspection. - The airplane should be supported on jacks or cradles so that the landing gear and tail wheel retracting mechanism may be operated:

Test the functioning of the retracting and lowering mechanism by operating the motor driven pump, and then test the mechanism by operating the auxiliary and then the emergency hand pumps.

Inspect the tail wheel shimmy damper for the presence of oil, grease, or glaze on the friction discs. Remove grease or oil with suitable solvent and remove surface glaze, if present, by roughing with wire brush to restore friction qualities of discs. The shimmy damper is designed for dry operation and all excess lubricants in the vicinity of this unit should be removed.

See that the position indicator in the cockpit indicates the position of the landing gear.

Inspect the tail wheel doors for proper closing when the wheel is retracted.

Adjustment. - To adjust the tail wheel doors disconnect the turnbuckle on one side only. Retract the strut and adjust the opposite turnbuckle to close the door tightly. Then disconnect the turnbuckle at the upper end. Repeat this procedure with the other turnbuckle. Lower the tail wheel and attach both turnbuckles.

To adjust the tail wheel position transmitter, hoist the airplane so that the tail wheel can be retracted and extended. The transmitter is accessible through the hand hole on the right side of the fuselage immediately forward of the horizontal stabilizer. Loosen the lock nuts on the turnbuckle on the actuating arm of the transmitter and insert a pin in the hole drilled through the turnbuckle. Extend or retract the actuating arm by turning the turnbuckle until the indicator on the instrument panel shows the correct position of the tail wheel.

s. Column 37 - Landing Gear. - (For inspection of the landing gear hydraulic retracting system, see Column 39, this section.) Inspect and maintain the air-oil shock absorber strut in accordance with T. O. Nos. 03-25E-1 and 06-1-2. For instructions covering the operation and maintenance of high-pressure hand pumps, see T. O. No. 17-1-3. The proper amount of inflation will be obtained from the instruction plates on the struts.

After-Flight.

WARNING: After an abnormal or unusual hard landing is known to have been made, the upper retracting links, part Nos. 87-31-519-1 (LH) and 87-31-519-2 (RH), and the lower retracting links, part Nos. 87-31-524 (LH) and 87-31-524-1 (RH), on the main landing gear will be inspected to determine replacements that may be necessary to decrease the possibility of main landing gear collapse. Defective upper or lower retracting links will be replaced immediately by new links obtained from class 01-C stock.

Daily.

Inspect the general condition of:
Struts, braces and fittings.
Shock units as indicated by bottoming of the struts.

Inspect the landing gear fairing for:
Security of attachment.
Dents, bends, or cracks.

Inspect the landing gear fairing linkage on the movable sections for security of attachment and correct alignment.

25-Hour.

Inspection. - Inspect the entire assembly for:
Cracks.
Bends.
Security and condition of attachment fittings.
Elongated bolt holes.
Loose, missing or unsafetied bolts, nuts, cotters.

Inspect for security and condition of the fairing.

Lubrication. - Lubricate in accordance with figure 30.

Lubricate the linkage on the movable fairing with oil, Army Air Forces Spec. No. 2-27E. (See figure 18.)

50-Hour.

Inspection. - The airplane must be supported on jacks or cradles so that the landing gear and tail wheel retracting mechanism may be operated.

Thoroughly inspect all landing gear attachment fittings, bolts, bell cranks, arms, links, supports, etc.

Test the functioning of the retracting and lowering mechanism by operating the motor driven pump, and then test the mechanism by operating the auxiliary and emergency hand pumps. Refill the emergency hydraulic reserve tank after this test.

Check the functioning and general condition of the warning system. With the landing gear in the locked "Down" position move the selector valve handle to the "Up" position. With the main switch "On" and the throttle lever in the closed position the warning signal should not operate until pressure is applied to the system.

Inspect the condition of all hydraulic tubing, connections, couplings, etc.

See that the landing gear position indicator in the cockpit indicates the position of the landing gear correctly.

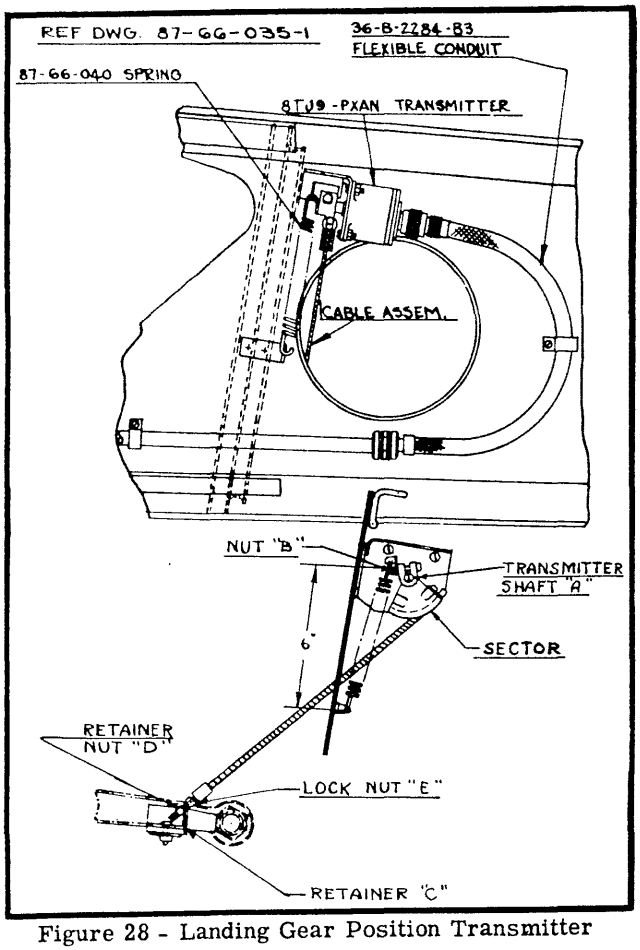


Figure 28 - Landing Gear Position Transmitter

Adjustment.

Landing Gear Warning System. - To adjust the cam on the throttle rod in the cockpit loosen the bolt which fastens the cam to the throttle rod. Slide the cam forward or aft as necessary in order to actuate the warning signal switch when the engine is throttled to 1000 r.p.m. and the landing gear is not locked down.

Landing Gear Position Indicator. - (See figure 29.) - To adjust the landing gear position indicator, hoist the airplane so that the landing gear mechanism can be raised and lowered. Proceed as follows:

With the landing gear in the locked "down" position and the battery line switch "ON," check the adjustments of the landing gear position indicator transmitter, which is mounted on web 3 inside each wheel pocket. With the landing gear in the locked "DOWN" position, the spring 87-66-040 should be distended so that the distance between the bearing areas on the clips is six inches. To obtain this distance, loosen nut "B" and by holding the transmitter shaft "A" with a screwdriver, turn the sector to the proper position. Tighten nut "B." If the indicator on the instrument panel does not show the landing gear in the down position, loosen nut "B" on the sector and turn the transmitter shaft "A" until it does. Tighten nut "B." Further adjustment for obtaining the proper travel of the image on the indicator is made at the screw end of the cable assembly. Remove the cable assembly from the retainer "C" attached to the bracket on the retracting arm and turn the retainer nut "D" on the screw end of the cable as required so that the image of the landing gear on the indicator is in the "DOWN" position. Retract the landing gear and check the position of the image on the indicator. If the image has undertraveled or overtraveled, correction may be made by turning the retainer nut "D" slightly, to shorten or to lengthen the cable as required. Try until the setting is correct. Tighten the lock nut "E" against the retainer nut "D."

NOTE: The retainer which is attached to the bracket on the landing gear retracting arm may be moved forward or aft to obtain the desired throw of the sector on the transmitter shaft.

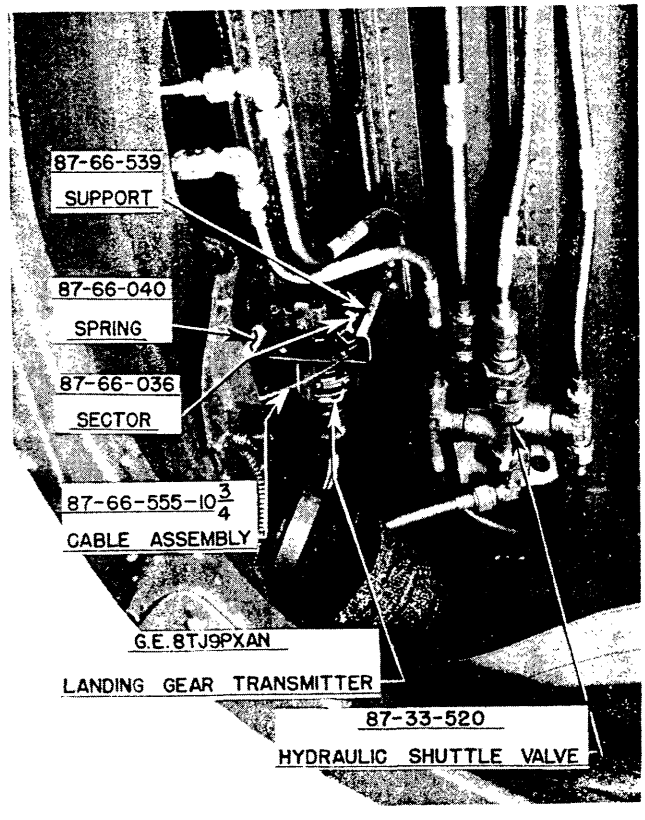


Figure 29 - Landing Gear Position Transmitter Installed

Lubrication. - Lubricate in accordance with figure 18 and in addition it is desired that the struts be filled in accordance with the following instructions to assure that a full quantity of oil is carried.

Method A - (To be used when airplane is suspended and landing gear is free.)

With the strut fully compressed, fill until the fluid overflows. Replace the filler plug and fully extend the strut several times. Compress the strut, remove the plug and it will be found that some seven or more additional cubic inches of fluid can be added. Fill to overflowing, reinstall the plug and inflate to the required air pressure.

Method B - (To be used when airplane is resting on its landing gear with full load.)

With the strut fully compressed, fill until the fluid overflows. Install the plug and apply air pressure. Bleed the air, then remove the plug and add additional fluid until the fluid overflows. This will assure that the fluid is at the proper level. Reinstall the plug and inflate with the proper air pressure until the strut is extended two inches.

t. Column 38 - Wheels and Brakes. - Inspect and maintain the following equipment in accordance with the Technical Orders indicated.

Wheels and Brakes - T. O. No. 03-25B-1
Landing Gear Tires - T. O. No. 04-10-2

Daily

Inspect the landing gear tires for the proper air pressure. The pressure in the tires will be maintained in accordance with T. O. No. 04-10-1.

Inspect the wheels for:
Bent or distorted rims.
Security of the retaining nuts, or bolts and cotters.

Check the operation of the brake pedal and parking brake controls. There must be sufficient slack in the parking brake control cables to allow full application of the brakes without locking the parking brakes.

25-Hour

Inspection. - Check the fluid level in the master brake cylinder unit on each rudder pedal with the brakes released. (Refer to figures 55 and 56 and section IV, paragraph 7. b. of this Handbook, for detailed information of the hydraulic brake system.) The system will be filled with Lockheed hydraulic brake fluid No. 5.

To Add Hydraulic Brake Fluid at Inspection.

NOTE: This procedure is to be followed if it is desired to bleed the hydraulic system.

(1) Remove the front fuselage inspection door for access to the master cylinder.

(2) The brake is not to be applied or parked during this operation.

(3) Be sure that Lockheed hydraulic brake fluid No. 5 is about to be added.

(4) Remove the upper level indicating screw and the filler opening plug and pour in the liquid until it reaches the level of the upper indicating screw. The lower indicating screw shows the lowest permissible level for the proper operation of the unit.

(5) Replace the level indicating screw and filler opening plug.

Inspect the hydraulic lines and connections for:
Deterioration of flexible tubing.
Leaks.
Kinks.
Twisted or damaged tube connections.

Adjustment - Brake Shoes. - Jack up the airplane until the wheels are clear of the ground, first making sure that there is no pressure on the brake system, and proceed as follows. First swing the four feeler gage covers to one side, exposing the inspection slots. These slots are 90° apart with two of them adjacent to a centerline through the oleo strut. Loosen the adjusting screw, nearest the toe of the brake shoe adjacent to the front slot, by turning counterclockwise to obtain a clearance of approximately .015 in. measured thru the feeler gage slot. The three remaining adjustment screws adjacent to the slots will be tightened until there is .008 in. clearance between the brake lining and the brake drum at each of these points. Return to the first adjusting screw nearest to the toe of the brake shoe and tighten to reduce the clearance from .015 to .008 in. After this point is adjusted it may be necessary to go over the adjustments again in the same order and slightly change each one to give the required clearance.

CAUTION: If the wheels are removed at the time of the brake adjustment, extreme care should be taken to see that the brakes are not applied with the wheels removed. Application of the brakes at this time causes distortion of the one-piece shoe rendering it unfit for further service.

Reinstall the wheels and adjust the brake control system.

Servicing the Master Cylinder Unit.

With the Brakes Applied. - Improper operation of the brake system in this condition may be due to

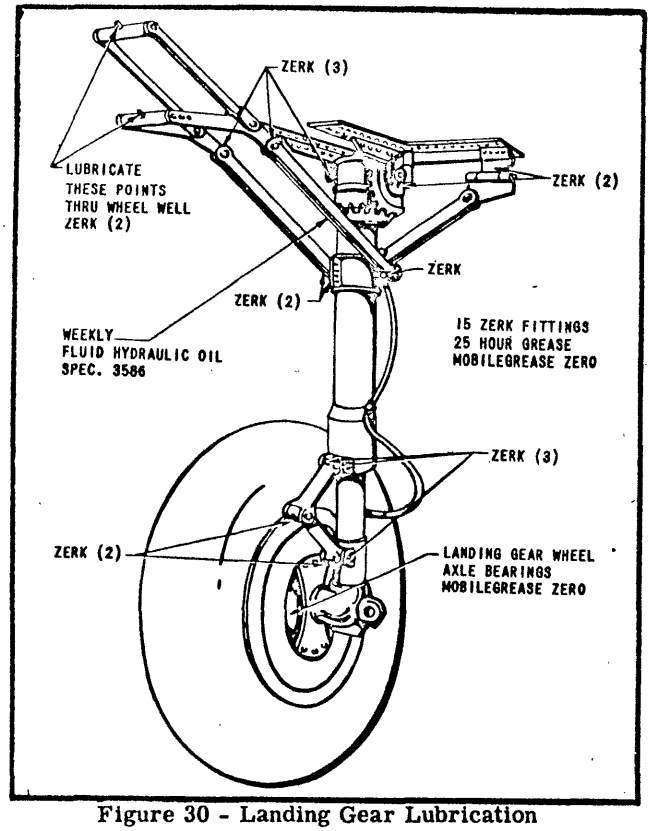


Figure 30 - Landing Gear Lubrication

any of the following reasons.

First - Incomplete filling and bleeding, causing air to be trapped in the system. The presence of air in the system can be detected by "soft" feeling of the brake pedals, which is due to the compression of the trapped air.

Second - The gasket under the transfer valve not holding tight due to the valve not being tightened sufficiently, or some dirt being lodged on the gasket.

Third - Some dirt being held on the compensating valve, holding it open.

The presence of a slight leak as described in the second and third reasons can be determined by the fact that the brake pedal feels solid when the brake is fully applied, but with continued constant pressure the pedal gives slowly, due to the fluid being forced through the leak. Under normal conditions these leakages can not be detected from the outside, as the fluid in either case returns to the reserve chamber.

A leaking gasket under the transfer valve assembly can be easily determined as follows: With the brake off, remove the lower, level-indicating screw and allow the fluid level in the reserve chamber to come down to this level. Replace the lower, level-indicating screw and remove the upper level-indicating screw. Move the rudder pedal either forward or backward as far as possible, so as to have the reserve chamber sufficiently low; no fluid will run out of this hole. Keep the rudder pedal in this position and apply the brake. If there is any leakage past the transfer valve gaskets, fluid will run out of the open, upper, level-indicating hole, which in this position, is lower than the passage to the reserve chamber. If this test shows that gasket to be tight and there is no leak elsewhere in the line or at the wheel cylinder, it is an indication that some dirt is lodged on the compensating valve seat inside the unit; this requires that the unit be disassembled and cleaned as per instructions in Section IV, paragraph 7. d. (6) and paragraph 7. d. (7) of this Handbook.

With the Brakes Parked. - The condition inside the cylinder is the same as when the brake is applied by pressure on the brake pedal. The difference is that now the force applying the brake is maintained by the parking spring and ratchet, instead of pressure on the brake pedal. The throw of the pedals is quite small and the parking brake usually will engage only in the first notch. The amount of parking spring deflection can be seen from the outside as it is represented by the gap between the yoke and the lower end fitting. This gap will vary with expansion and contraction of the fluid, and with the fluid losses due to leaks. If a brake has been parked and after some time the ratchet, of its own accord, jumps to the "OFF" position, it is an indication that there is a leak in the system which has consumed the entire reserve provided in the parking spring deflection. If not anywhere else in this system, this leak may be due and traced to any of the conditions explained above under, "With Brakes Applied".

Lubrication. - Lubricate the brake pedal bearings in accordance with figure 18.

50-Hour.

Inspect the parking brake control cables, guides and pulleys for:
General condition.
Security of attachments.
Proper safetying.

Inspect the wheels, hydraulic brakes and brake controls as prescribed in T. O. No. 03-25B-1.

Remove the tires and inspect the casings, inner tubes and rims as prescribed in T. O. No. 04-10-2.

u. Column 40 - Fuselage.

Pre-Flight.

See that all cowling, inspection doors and covers are properly fastened.

Daily.

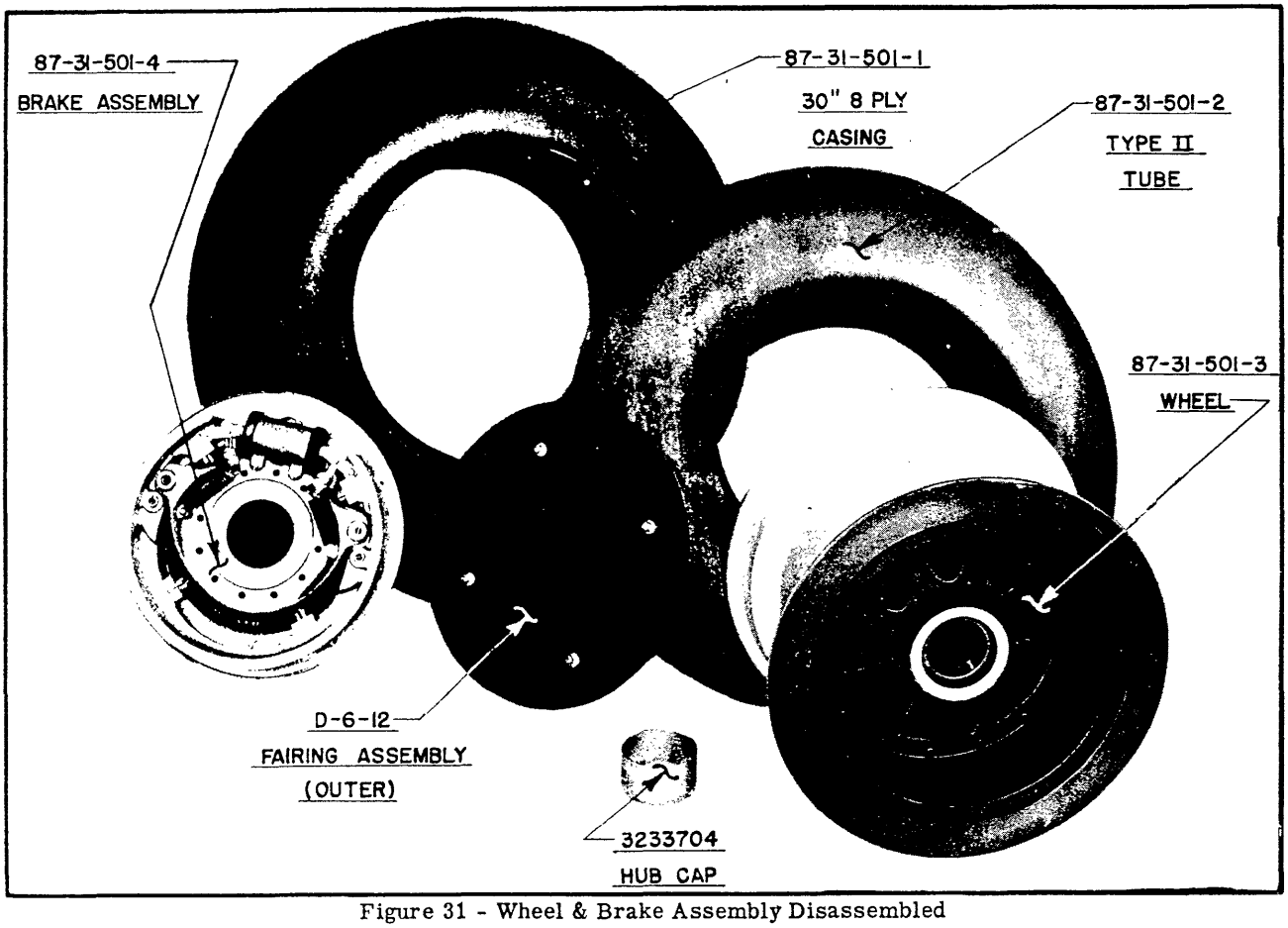


Figure 31 - Wheel & Brake Assembly Disassembled

Inspect the fuselage for:

General condition.

Tears or cuts in the skin.

Broken structural members as evidence by distortion of the skin.

Loose rivets.

Loose objects, foreign or otherwise likely to obstruct movement of the controls and flight control surfaces. (See T. O. No. 01-45-5.)

50-Hour.

Inspect all accessible parts of the exterior and interior of the fuselage for:

Bent longerons and braces.

Cracks in structural members, particularly at sharp bends and at welds.

Loose members, bolts or rivets.

Proper attachment of inspection doors, fairing and cowling.

Condition of the metal covering and protective coating, particularly when operated near salt water.

v. Column 41 - Oxygen Equipment.

Pre-Flight.

Inspect the oxygen equipment for proper installation and operation whenever flying is to be done at altitudes requiring oxygen. (See T. O. No. 03-50-1C for "Use of Oxygen" and T. O. No. 03-50A-1 for information on Oxygen Regulators.)

Daily.

The oxygen regulator will be closed and the mouth piece sterilized upon completion of each flight. Inspect the oxygen economizer for proper functioning and security of mounting.

25-Hour.

Check the relief valve mounted on the cross attached to the forward end of the cylinder for proper operation. Inspect the filler valve for proper operation. See that the oxygen regulator is in perfect working order.

Special.

Close the control valve and sterilize the mouth piece upon completion of each flight.

w. Column 42 - Night Flying Equipment.

Daily.

Inspect the functioning and condition of:
Cockpit Lights (Instrument Fluorescent Lighting System, etc.)
Lamp Rheostats.
Running Lights.
Formation Lights.
Landing Light.
Battery Generator.

x. Column 43 - Airplanes.

General. - Inspect and maintain the following equipment as prescribed in the Technical Orders indicated:

Vacuum Pump - T. O. No. 03-30AA-1.
Hydraulic Motor Driven Pump - T. O. No. 03-30CA-2.
Hydraulic Hand Operated Pump - T. O. No. 17-1-3.

Filling and Bleeding the Hydraulic System.

The airplane should be supported on jacks or cradles so that the landing gear and wing flaps can be operated.

Fill the system through the reserve tank in the fuselage with fluid in accordance with Army Air Forces Spec. 3586 - Grade "B". Fill the tank to the base of the cap opening, with the landing gear down and the flaps up. During the filling operation, operate the landing gear twice by hand and three or four times by power and operate the flaps several times always taking care that the reserve tank is kept full.

Any air in the system will be returned to the reserve tank and there vented overboard.

If the system still shows signs of air after the filling operation, it may be necessary to disconnect the hydraulic lines at the tail wheel retracting strut and bleed the system at that point.

Do not replace the filler cap until the filling operation is completed.

In addition to the foregoing, the following inspection will be accomplished:

NOTE: In cleaning the hydraulic system, use fluid specified in T. O. No. 06-1-2 for systems in which fluid Spec. 3586 - Grade "B" is used.

Daily.

Hydraulic System.

Inspect all hydraulic units for leakage and replace the packings as soon as leakage develops.

25-Hour.

Hydraulic System.

Inspection. - Check the fluid level in the reserve tank. Fill the tank with fluid, Spec. 3586 - Grade "B". Clean strainer in the top of the reserve tank. Do not use mineral oil.

Inspect the condition and functioning of the valves and actuating struts.

Inspect all lines and connections for leaks, kinks, security of anchorage, wear due to chafing or vibrations, dents, or cracks.

Lubrication. - Lubricate the tail wheel retracting strut guide in accordance with figure 27.

50-Hour.

Hydraulic System.

Inspect the cams and followers in the hydraulic control valve. Working surfaces must be smooth and bright. Clearances between the cams and followers must be between .005 and .015 inches, and minimum travel of any poppet valve must be .040 inch. This clearance is controlled by laminated brass shims under the cam followers.

Test the hydraulic relief valves as follows:

Install a test gage on the forward side of the hand pump. Tighten down the hand pump relief valve located in the lower left side of the fuselage forward of the baggage compartment. Pump up the system with the hand pump and set the hydraulic hand pump relief valve for about 2000 p.s.i.

Place the landing gear control valve in neutral and the flap control valve in the "UP" position. Test the flap relief valve for 1500 p.s.i.

Repeat this with the landing gear control valve in the neutral position and the flap control valve in the "DOWN" position.

Repeat this again with the flap control valve in the neutral position and the landing gear control valve in both the "UP" and "DOWN" positions. Check the landing gear relief valve for 1500 p.s.i.

The twin relief valve for the landing gear and flap controls is located on the lower left side of the fuselage forward of the fuselage access door.

Special.

Vibration Absorbers for the Engine.

The rubber vibration absorbers shown in fig-

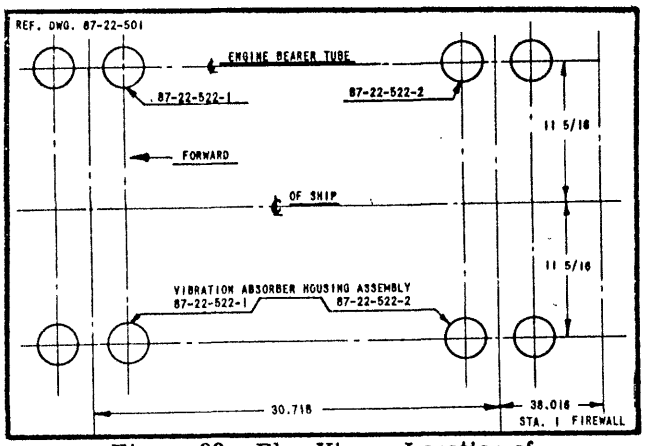


Figure 32 - Plan View - Location of Vibration Absorbers

ures 32, 33 and 34 will be inspected at engine change and replaced if there is any evidence of failure of the rubber bond or excessive disintegration of the rubber, from gasoline or oil.

Before installing the engine vibration absorber on the engine mount, the interior of the fittings, the metal spacer and the washer faces shall be lightly coated with castor oil, Spec. No. 2-8.

The vibration absorbers required for replacement shall be obtained from stock.

The left and right-hand forward housing assemblies are the same, and the left and right rear housing assemblies are identical. The forward and rear housing assemblies are different. The vibration absorber units shall be installed on the bearer tubes as shown in figure 32. The snubbers, stops and supports used in the assembly of the housing assemblies to the bearer tubes are different for each unit. See figure 33 and 34 for the correct parts and their order of assembly for each vibration absorber.

3. Any Additional Inspection and Line Maintenance Instructions will be Issued by The Army Air Forces.

y. Column 44 - Navigation and Flight Instruments. Inspect and maintain the following instruments as prescribed in the Technical Orders indicated:

General - T. O. No. 05-1-1
Airspeed Indicator, Type D-7, T. O. No. 05-10-2
Compass, Type B-16 - T. O. No. 05-15-2
Rate of Climb Indicator, Type C-2 - T. O. No. 05-80-1
Altimeter, Type C-12 - T. O. No. 05-30-1
Bank and Turn Indicator, Type A-3 - T. O. No. 05-20-2
Flight Indicator, Type C-7 - T. O. No. 05-20-4
Clock, Type A-11 - T. O. No. 05-1-9
Turn Indicator, Type A-5 - T. O. No. 05-20-4
Suction Gage, Type F-3 - T. O. No. 05-80-1
Pitot Static Tube, Type D-1 - T. O. No. 05-50-1
Position Indicator (Selsyn Type DJ-4) - T. O. No. 05-55A-2
Ammeter, Spec. 32191 - Type D-2

In addition to the foregoing, the following inspections will be accomplished:

Pre-Flight.

Instruments.

General. - Prior to starting the engine check all instruments for broken or loose cover glasses and other visible defects (particular attention will be given cover glasses that may have been marked to indicate proper operating limits; as prescribed in T. O. No. 05-1-17). Check the index marks and the cover glass to determine if there has been any apparent movement in the glass. The following inspection will also be given the instruments indicated:

Airspeed Indicator, Type D-7. - Remove the cover of the airspeed tube before checking the indicator. See that the pointer indicates zero or the value of the wind velocity component in direction of aircraft heading.

Rate of Climb Indicator, Type C-2. - See that pointer is set at zero.

Engine Gage Unit, Type B-7. - See that the oil pressure pointer is at zero.

Tachometer, Type C-9. - See that the pointer is at zero.

Flap and Wheel Indicator (Selsyn type 8DJ-4) Close the master switch and see that the images of the landing gear, tail wheel and flap appear and are in their proper positions.

Clean all instrument cover glasses with a clean cloth.

Inspect lamps in the instrument lighting system, including individually lighted instruments and replace those found defective.

Flight and Navigation Instruments - See that the clock is wound, is running and is correct according to operations office time.

Remove the protection cover from the pitot (airspeed) tube and see that the tube is clean and free from any obstruction. Check functioning of the airspeed tube heating unit. (See T. O. No. 05-50-1.)

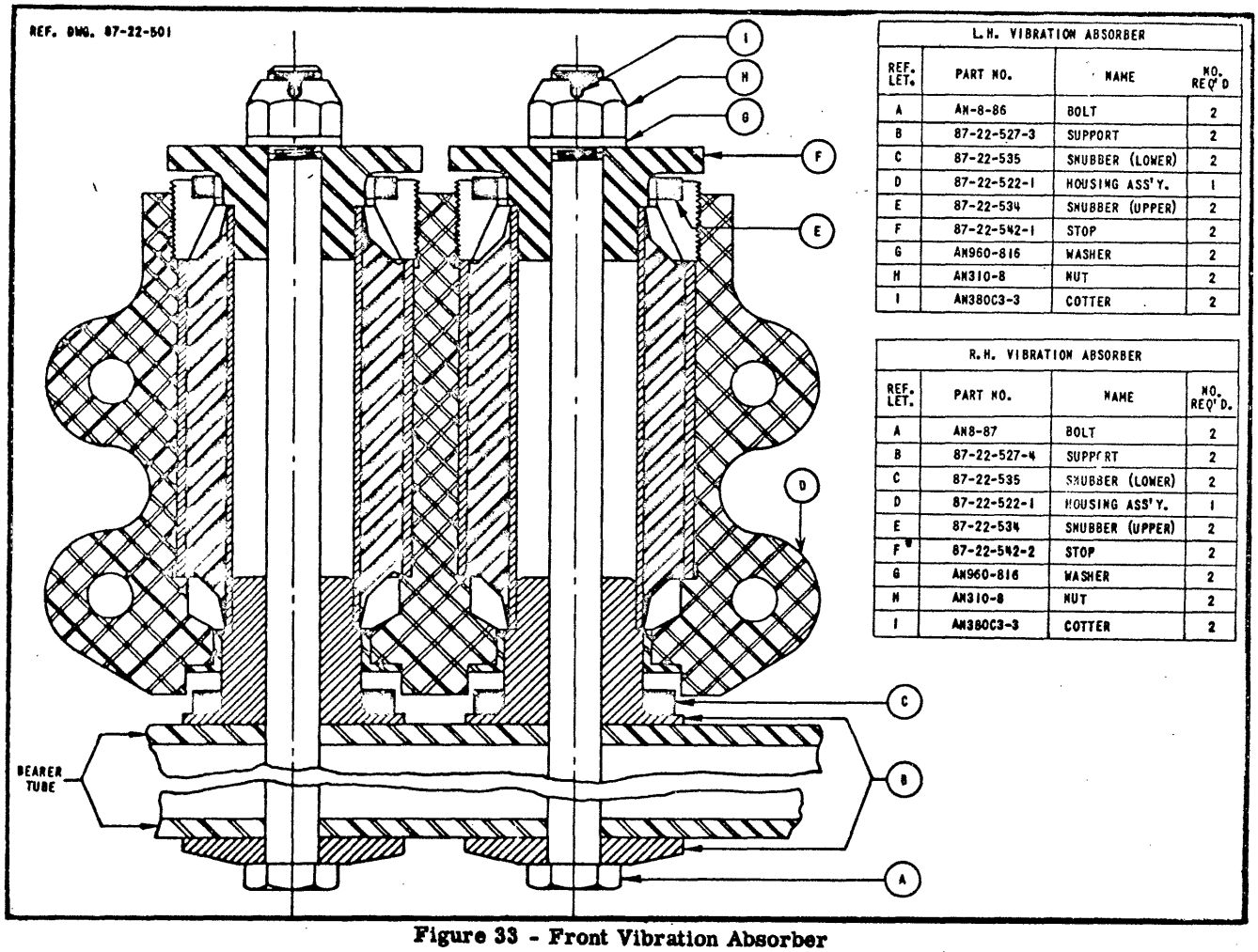
The type 1079S-940J "Crank" airspeed head is installed on airplanes AF-41-24776 through AF-41-

25195. The type D-1 "Spear Head" airspeed head (Spec. 27876) is installed on airplanes AF-41-35874 through AF-41-36953. These airspeed heads are not interchangeable because: first, the airspeed tubes are not the same length, and second, the heating unit is the airspeed head 1079S-940J has a one hole plug for the electric circuit, whereas, the heating unit of the type D-1 airspeed head has a two hole plug for the electric circuit. Both heating units require 24 volts for satisfactory operation.

50-Hour.

Check the instrument board for defective vibration absorbing units and support brackets.

Check the bonding of the board, lines and instruments as prescribed in T. O. No. 08-5-1.



L.H. VIBRATION ABSORBER

REF. LET.	PART NO.	NAME	NO. REQ'D
A	AN-8-86	BOLT	2
B	87-22-527-3	SUPPORT	2
C	87-22-535	SNUBBER (LOWER)	2
D	87-22-522-1	HOUSING ASS'Y.	1
E	87-22-534	SNUBBER (UPPER)	2
F	87-22-542-1	STOP	2
G	AN960-816	WASHER	2
H	AN310-8	NUT	2
I	AN380C3-3	COTTER	2

R.H. VIBRATION ABSORBER

REF. LET.	PART NO.	NAME	NO. REQ'D.
A	AN8-87	BOLT	2
B	87-22-527-4	SUPPORT	2
C	87-22-535	SNUBBER (LOWER)	2
D	87-22-522-1	HOUSING ASS'Y.	1
E	87-22-534	SNUBBER (UPPER)	2
F	87-22-542-2	STOP	2
G	AN960-816	WASHER	2
H	AN310-8	NUT	2
I	AN380C3-3	COTTER	2

Figure 33 - Front Vibration Absorber

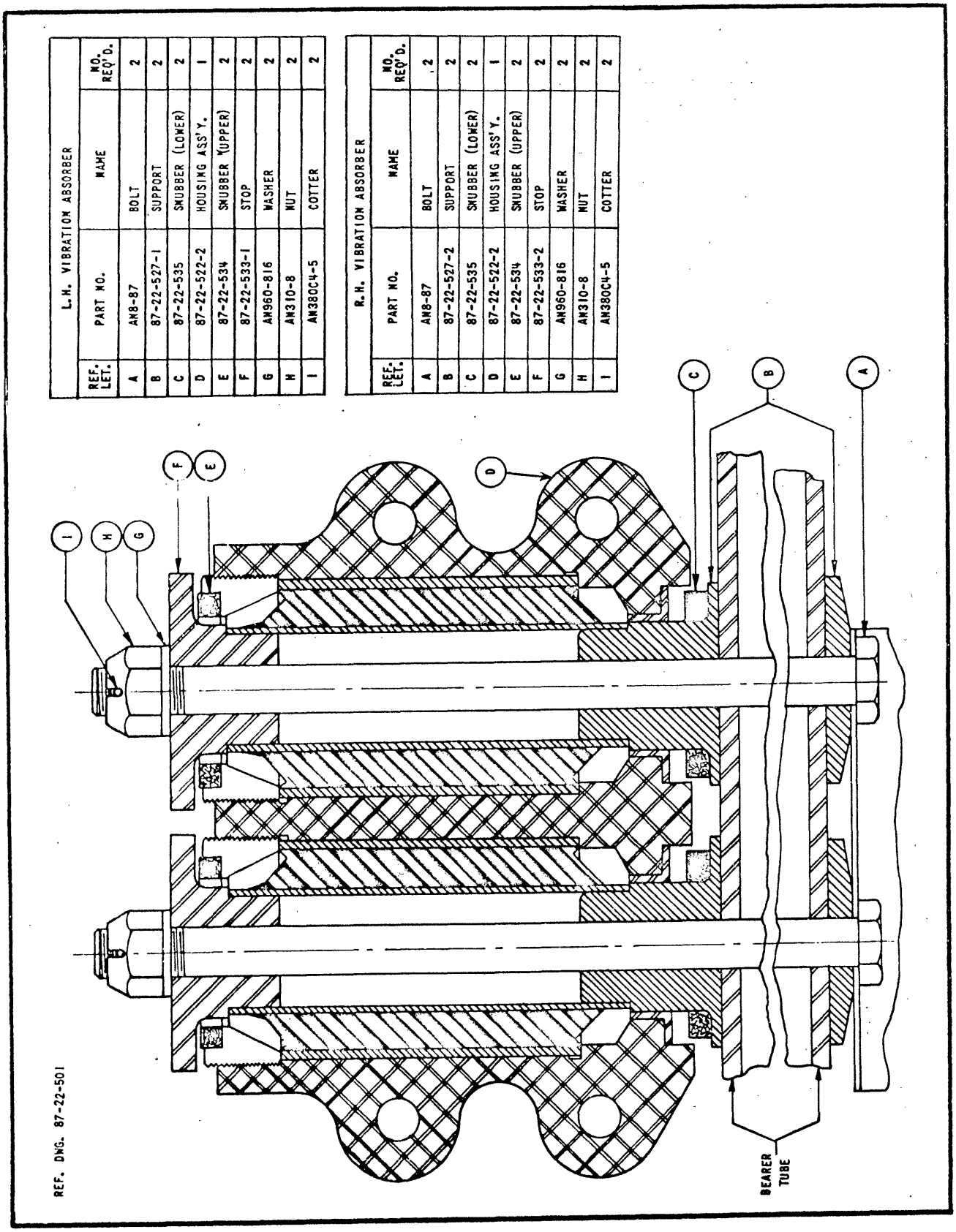


Figure 34 - Rear Vibration Absorber

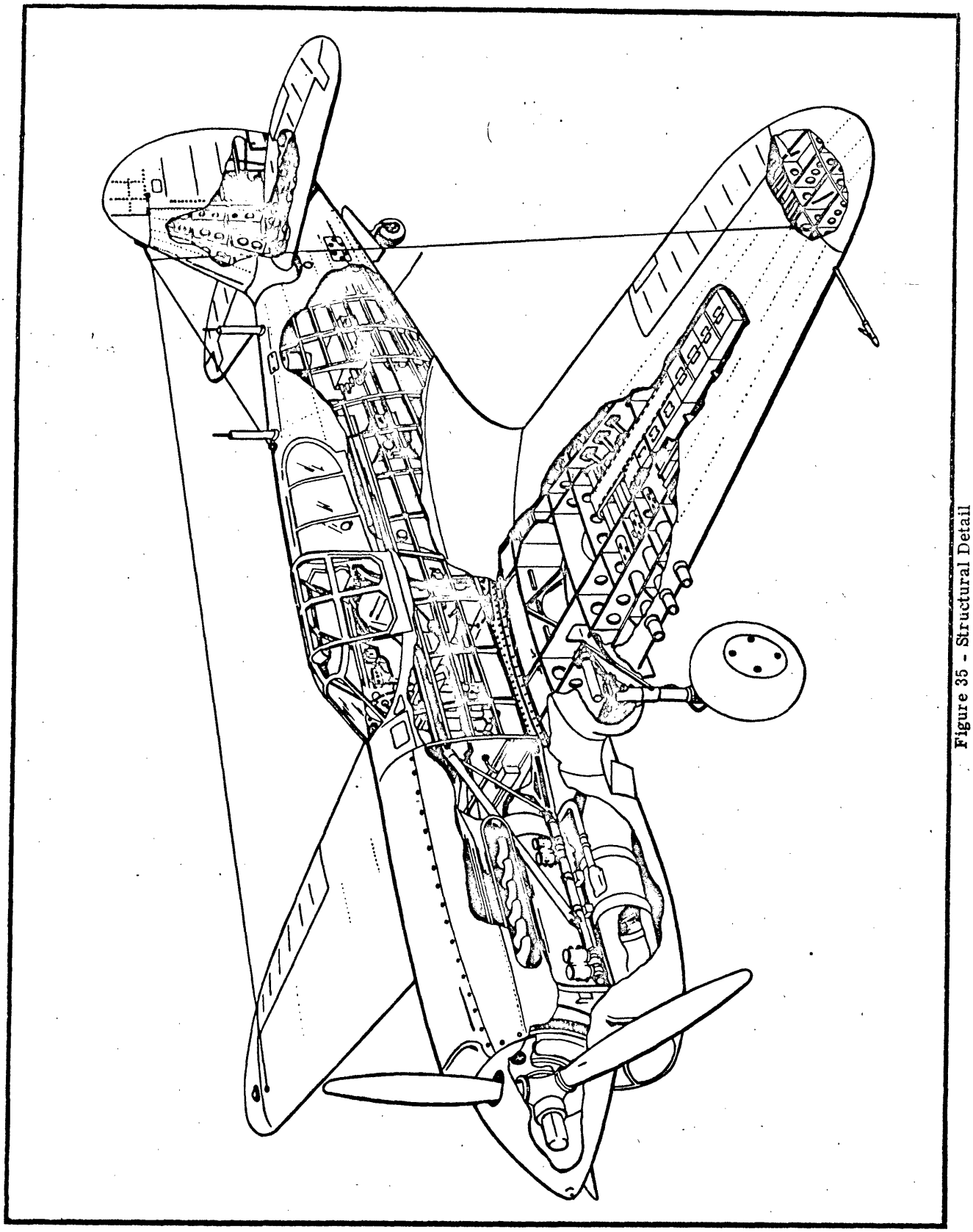


Figure 35 - Structural Detail

SECTION IV

INSTALLATION, MAINTENANCE, REPLACEMENT AND MINOR REPAIR

1. General Data.

a. The work outlined in this section can be performed with the facilities usually available at the Army Air Forces Stations, but is not normally a function of the operating organization.

b. The following is a list of special airplane tools furnished by the contractor for use in connection with the work prescribed in this section.

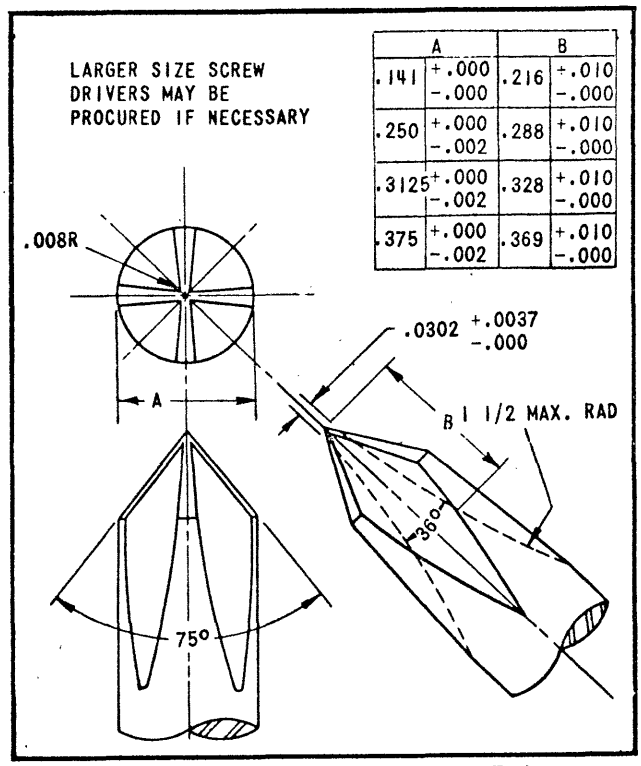
Drawing No.	Description
87-88-031	Wrench - Metering Pin - Landing Gear and Tail Wheel
87-88-030	Wrench - Actuating Strut - Landing Gear Wing Flap
87-88-032	Wrench - Hand Pump
87-88-019	Hoisting Sling - Tail
87-88-020	Hoisting Sling - Front
87-88-509	Hoisting Sling - Wing
87-88-587	Puller Assembly - Engine Mount Bolts
87-88-556	Bag - Duffle
87-88-524	Pad - Panel Throw Over - Gun Servicing
87-88-525R/L	Pad - Walkover (Wing)
87-64-570	Parking Harness
87-69-737	Ratchet Wrench - Gun Mounting
87-88-594	Locating Tool - Filler Opening - Wing Fuel Cells
87-88-595	Locating Tool - Gage Opening - Wing Fuel Cells
87-88-597	Wrench - Nut - Wing Fuel Cell
87-88-596	Wrench - Filler Cap - Wing Fuel Cell
87-03-531	Stud Assembly - Panel - Jacking
A 5585	Alemite Hydraulic Gun
A 7393	High Pressure Hand Pump (Cleveland Pneumatic Tool Company)

c. All countersunk, recessed head screws originally used on this airplane are of the Reed and Prince type. The use of any screwdriver other than the Reed and Prince type will result in mutilations of the screw head and are therefore not recommended. (See figure 36 for details of the Reed and Prince screwdriver head.)

2. Wings. (Drawing 87-06-803 and 87-03-809).

a. General.

(1) The wing is an internally braced, full cantilever, multi-cellular, stressed-skin type, built in two pieces and joined at the airplane centerline by a series of horizontal bolts through match angles riveted to the skin, and through a bulkhead between the panels. The fuselage connection is made by means of two tee sections on the upper surface which fit against angles on either side of the fuselage, through which a series of bolts complete the joint. Aluminum alloy 24SO and 24ST constitute the major materials used in the construction of this wing.



A		B	
.141	+.000 -.000	.216	+.010 -.000
.250	+.000 -.002	.288	+.010 -.000
.3125	+.000 -.002	.328	+.010 -.000
.375	+.000 -.002	.369	+.010 -.000

Figure 36 - Reed and Prince Screw Driver Head Dimensions

(2) The wing tips are detachable for replacement in the event of damage; these tips are attached to the wing by a series of flush type screws on the surface.

(3) Wells are built into the underside of the wing for the wing fuel tanks and landing gear wheels. The joint where the two wing sections connect together will serve as a skid in case of an emergency landing with the wheels retracted.

(4) The ailerons are built with Frise-type aerodynamic balance and are also dynamically balanced. The right-hand aileron trim tab is the fixed type. The left-hand aileron has an electrically controlled adjustable trim tab operated by a switch on the main switch panel. The ailerons are constructed of metal,

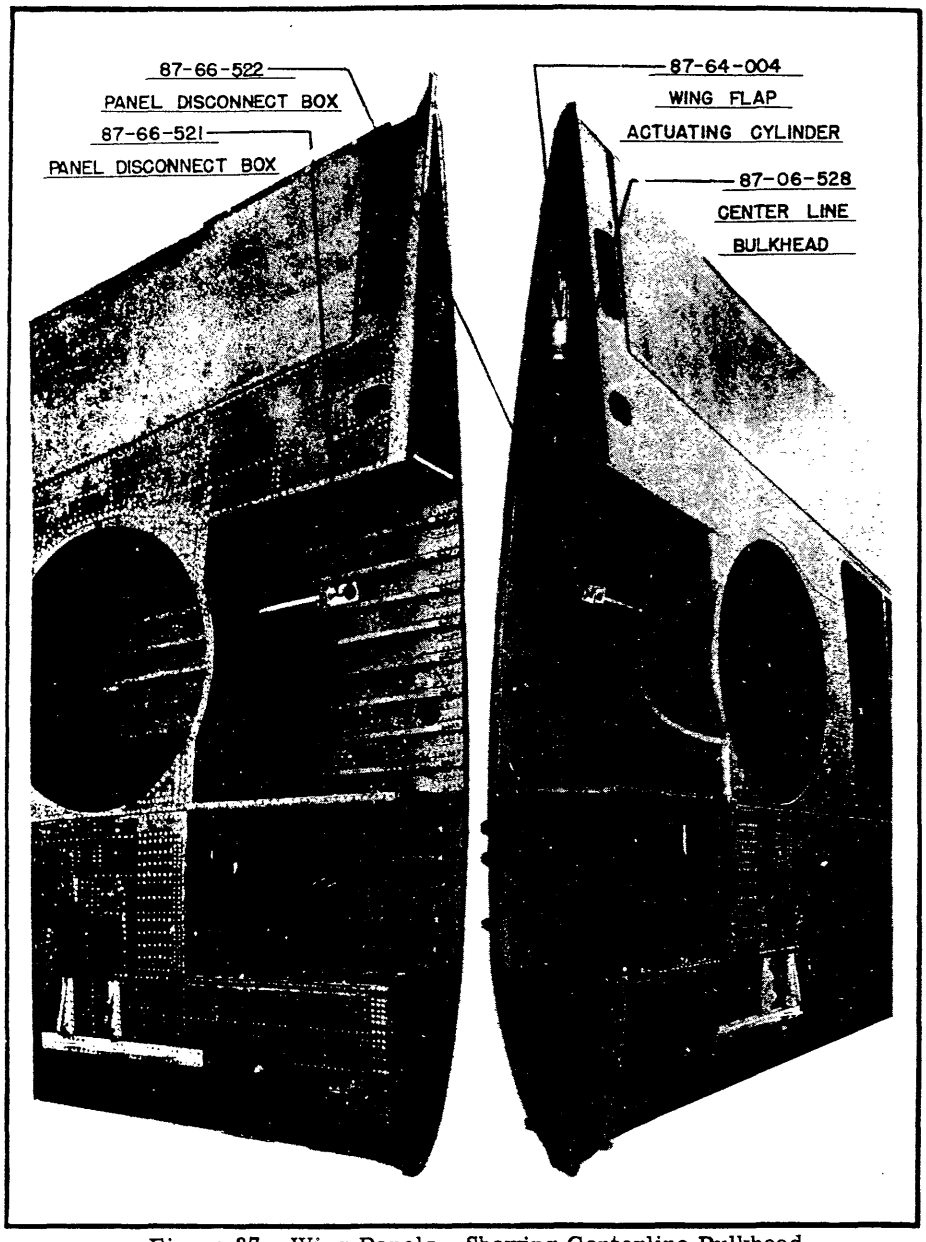


Figure 37 - Wing Panels - Showing Centerline Bulkhead

including a stressed skin leading edge and are fabric-covered. Three mounting bearings are provided on each aileron.

(5) Hydraulically-operated, trailing edge flaps extend from within a few inches of the airplane centerline to the inboard ends of the ailerons, on the under surface of the wing. They are attached to the wing by continuous hinges running the full length of each flap.

b. Removal and Disassembly.

(1) To Remove the Complete Wing. - The manufacturer recommends that a cradle such as shown in figure 10 be used for the support of the airplane and subsequently for the support of the wing after separation from the fuselage. If a cradle of this type is not available, then a padded chordwise support, at least five inches wide and curved to fit the underside of the wing, should be placed approximately eight feet-three inches outboard from the airplane centerline under each panel.

(a) Hoist the airplane onto the cradle or padded chordwise supports, by the forward and tail hoisting slings. Attach the former to the lugs on the engine mount and the latter to a bar passed through the lift tube in the rear of the fuselage. Disconnect the antenna at the outboard ends of the wing.

(b) Drain all the fuel tanks.

1. The drain cock for the fuselage tank is located on the bottom side of the fuselage aft of the trailing edge.

2. Drain cocks for the wing tanks are located under the wing on the left panel approximately five inches from the centerline.

3. The drain cock for the belly tank is on the bottom of the tank.

(c) Remove the lower engine cowling.

(d) Remove the belly tank, see paragraph 15.b. (1) in this section.

(e) Disconnect and remove the sway braces.

(f) Remove the keel fairing.

(g) Remove the wing fillets and fillet bulkheads attached to the wing and fuselage. The drain casting in the trailing edge of the left-hand fillet should be supported by a wire up to a temporary screw in one of the fillet nut plates in the fuselage after the removal of the fillet.

(h) Remove the cowl shutters by removing the cowl shutter support channel and the entire exit duct as one unit.

(i) Drain the oil system at the "Y" drain and at the drain plug located on the inboard side of the "Y" drain cock. This plug is on the end of the 1/2 in. O.D. drain line from the bottom rear of the oil tank. (The "Y" drain cock is located on the right-hand side 3 in. forward of the leading edge.)

(j) Disconnect the oil "Y" drain and support from the leading edge of the wing by unscrewing the two attaching screws.

(k) Disconnect the 1/2 in. O.D. oil tank drain line at the firewall connection.

(l) Disconnect the wing tank vent lines.

(m) Remove the section of the heater and ventilator ducts forward of the firewall. Remove the clamps holding the heater and ventilator ducts to their supports on the leading edge immediately forward of the firewall. Disconnect the flexible tube from the left-hand duct to the oil tank compartment at the duct.

(n) Remove the shutter torque shaft support attached to the leading edge on the center line of the airplane.

(o) Disconnect the fuel cock control at the joint below the gear box forward of the firewall.

(p) Disconnect the fuel line leading from the top of the electric pump.

(q) Drain the hydraulic brake system at the wheels.

(r) Remove the pilot's seat.

(s) Disconnect the elevator push-pull tube at its junction to the elevator controls, and tie to the control stick.

(t) Remove the armor plate immediately back of the pilot's seat.

(u) Drain the hydraulic reserve tank. (Aft of the fuselage access door.)

(v) Disconnect the vertical brace to the rudder pedal cross bar at the match angle.

(w) Disconnect the wing gun charging hydraulic lines at their connections to the hand control valves.

(x) Disconnect the two hydraulic brake lines at the cockpit floor aft of the firewall.

(y) Disconnect the airspeed lines at the upper surface of the left-hand wing panel.

(z) Disconnect the wing electrical system at the two plugs on the cockpit floor aft of station 4. One plug on each side of the cockpit.

(aa) Disconnect the two 5/16 in. hydraulic wing flap control lines at the elbows on the cockpit floor directly below the hydraulic control valve.

(ab) Disconnect the two 3/8 in. hydraulic landing gear lines at the elbows where they enter the wing.

(ac) Disconnect the two 3/8 in. hydraulic landing gear lines at the auxiliary hand pump, and at the connections on the trailing edge of the wing.

(ad) Disconnect the two 3/8 in. hydraulic landing gear lines at the inboard emergency hand pump, and at the tee fittings on the right-hand wing panel, forward of the instrument board.

(ae) Raise the airplane slightly to relieve the load on the fuselage wing bolts.

(af) Remove the three bolts attaching the rear end of the wing angle to the fuselage.

(ag) Remove the wing to the fuselage joint bolts.

(ah) Raise the fuselage approximately one inch, for the firewall to clear the match angle, and push forward about three inches to clear the oil lines to the engine.

(ai) Raise the fuselage slowly until all items attached to the top surface of the wing are cleared.

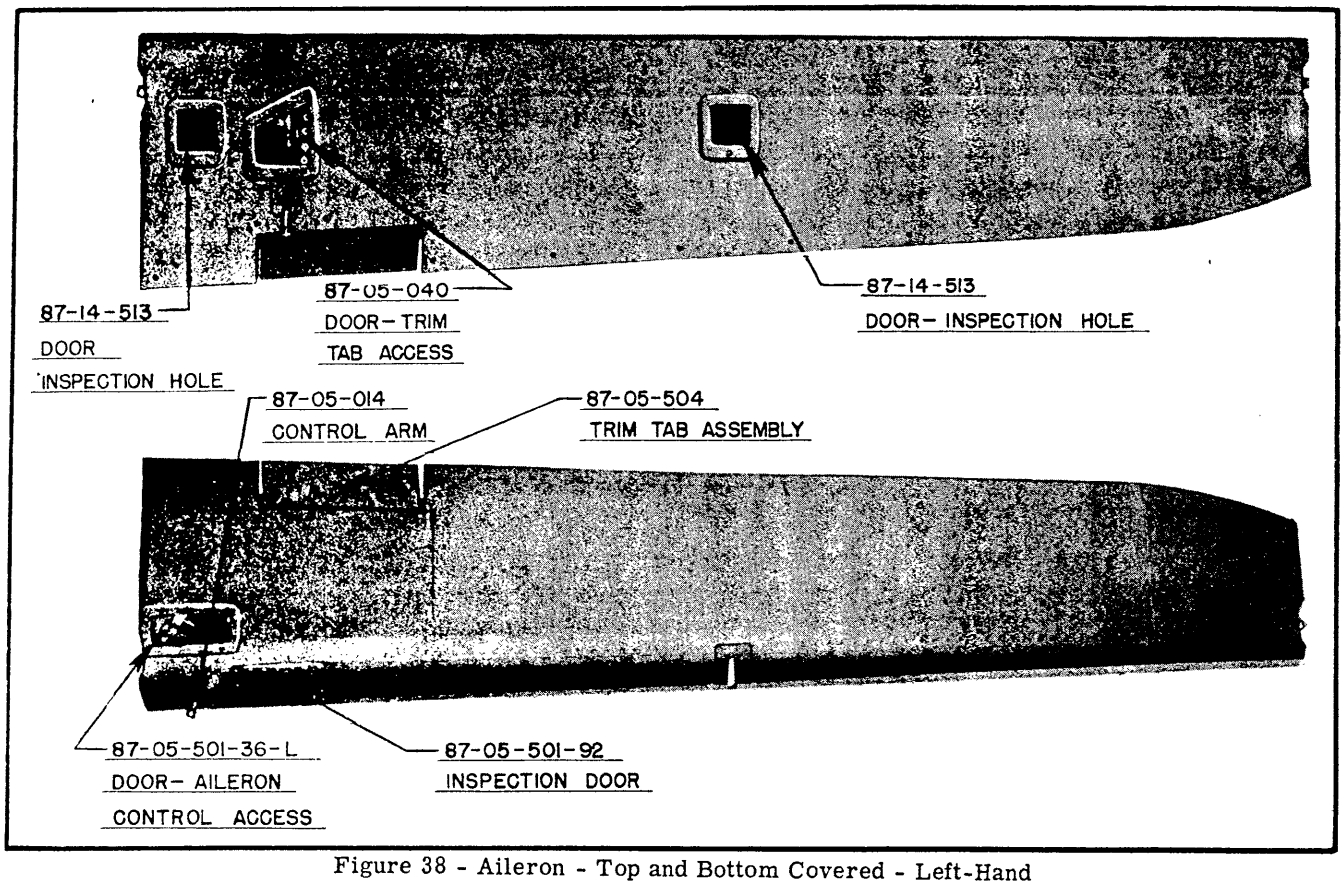


Figure 38 - Aileron - Top and Bottom Covered - Left-Hand

(2) To Disassemble the Complete Wing. - To separate the wing into individual panels:

(a) Remove the belly tank support rack at the match angle.

(b) Remove the rear, intermediate inboard landing gear fairing. (This is necessary in order to remove the wing tank doors.)

(c) Remove the drain and vent lines from the upper surface of the wing panel.

(d) Remove the electric fuel pump, strainer, and fuel cock from their supports, attached to the match angle at the leading edge.

(e) Remove the main fuel lines.

(f) Remove the two wing tank fuel gages. (See this section, paragraph 15. b. (3).)

(g) Remove the fuel tank doors as a single unit by removing all screws and bolts which attach the door to the wing, including the screws and six bolts through web No. 3.

(h) Remove the bonding and tank straps.

(i) Remove the fuel tank shell assemblies and fuel cells as outlined in paragraph 15. b. (2).

(j) Remove the screws in the plate across the centerline of the wing at the forward bottom edge of web No. 3.

(k) Disconnect the two 3/8 in. hydraulic lines at the tee fittings on the left wing panel, forward of the hydraulic landing gear control handle.

(l) Remove the link from the flap actuating cylinder to the bell crank in the left wing panel and disconnect the hydraulic lines to the actuating cylinder. (The cylinder is attached to the centerline bulkhead.)

(m) Remove the two bolts which attach the control stick torque tube rear fitting to the match angles.

(n) Disconnect the links at the aileron control arm on the torque tube.

(o) Remove the bonding from the control stick to the wing panel.

(p) Remove the bolt which attaches the lower end of the elevator stop to the match angle.

(q) Disconnect the gun trigger and hydraulic

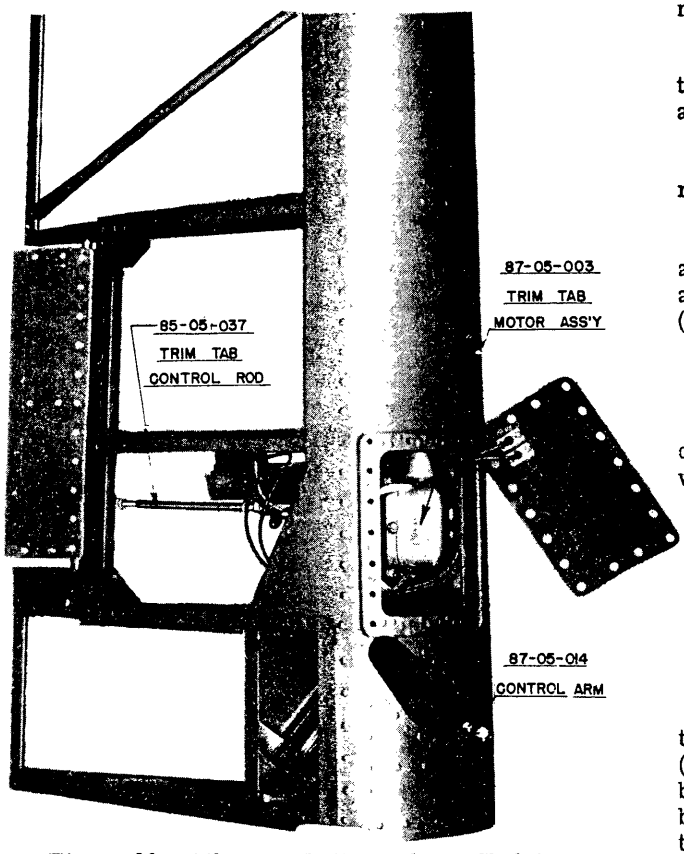


Figure 39 - Aileron - Left-Hand Top Skeleton With Electric Trim Tab Mechanism Installed

motor electrical conduit at base of the control stick.

(r) Remove the two bolts which attach the control stick torque tube forward fittings to the match angles and remove the control stick assembly.

(s) Remove the heating and ventilating control rod.

(t) Remove all bolts through the match angles and separate the wings. (The centerline bulkhead is attached to and will remain with the right-hand panel.) (See figure 37.)

(3) To Disassemble the Wing Panels.

(a) To Remove the Wing Tip. - Remove the row of screws around the contour at the inboard end of the wing tip.

NOTE: Pull the wing tip outboard until sufficient clearance can be obtained to disconnect the electrical wires to the navigation light.

(b) To Remove the Aileron.

1. Remove the bonding. Disconnect the electric trim tab control conduit on the left-hand aileron. (The right-hand trim tab is fixed.) Remove the one bolt at the center hinge and the cap from each end bearing. The control arm slips out of the socket on the control drum in the panel.

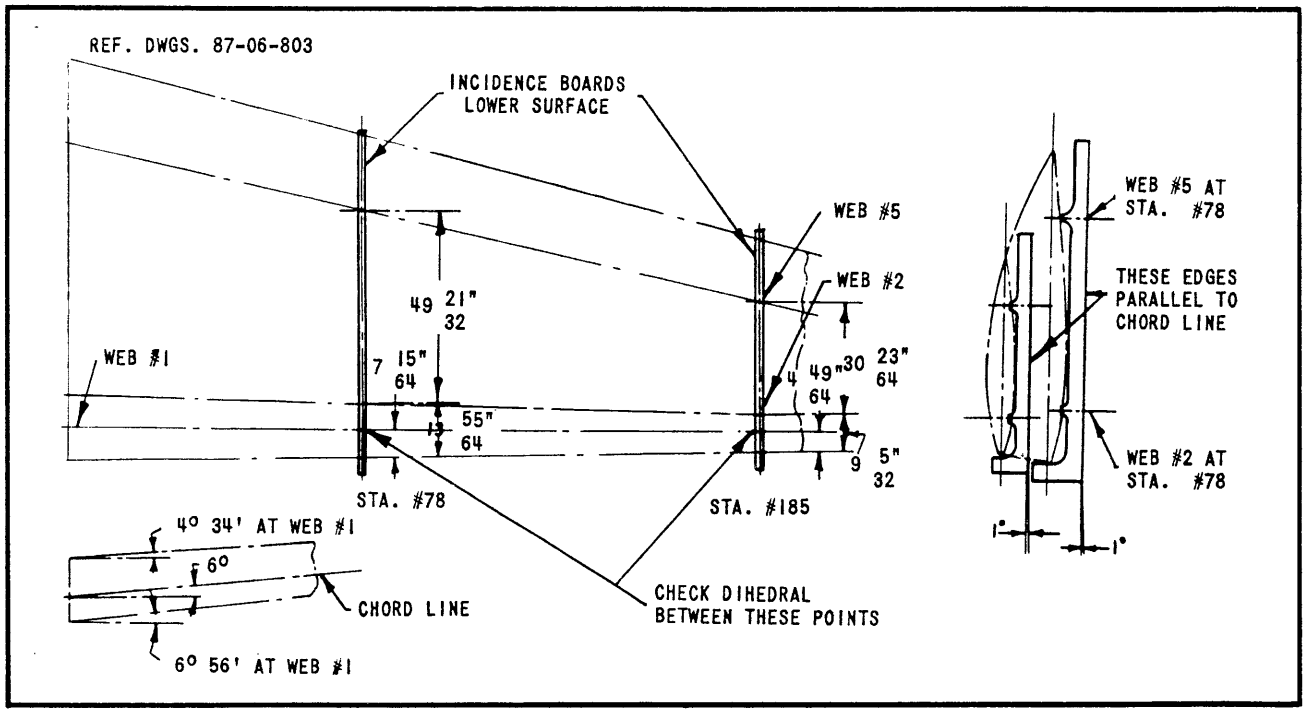


Figure 40 - Wing Rigging Diagram

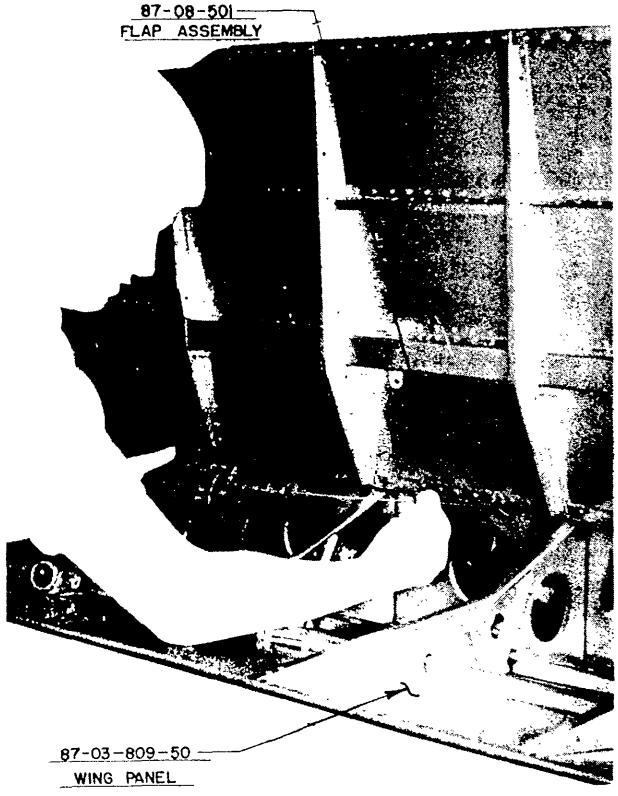


Figure 41 - Wing Flap Hinge Pin Installation

2. To remove the left-hand trim tab, disconnect the control arm from the horn, rotate the tab as far as possible from the neutral position and remove the two cap screws from the blocks on each end of the front face of the tab.

(c) To Remove the Wing Flaps. - Disconnect the flap position indicator linkage from the flap. This indicator transmitter is located in the left-hand panel, inside the wing, near the leading edge of the flap. Remove all bolts which connect the flap control turnbuckles to the flap. Then withdraw the two continuous hinge pins by pulling steadily on the hinge pin loops located near the spanwise center of the flap. (See figure 41.)

(4) To Install the Complete Wing. - (See figure 14.) Assembly of the wing to the fuselage is a reversal of the procedure listed in paragraph 2. b. of this section. Additional information is listed below:

(a) Before assembling the wing to the fuselage it is advisable to lubricate the mating surfaces of the wing-fuselage fittings with grease, Spec. 3588.

(b) In lowering the fuselage onto the wing, care must be taken not to damage the lower edge of the firewall, hydraulic lines, and other installations either on the wing or in the fuselage.

(c) Lower the forward end of the fuselage slightly in advance of the rear of the fuselage so that the front fittings at station No. 1 may be engaged first, then align and insert the bolts. Then lower the fuselage until the remainder of the holes are aligned. Install the proper size bolts with heads outward, working progressively from front to rear. Install the three bolts attaching the trailing edge of the wing to the fuselage (center).

NOTE: The last bolt hole in the fuselage immediately aft of station No. 6 has a nut retained by a special clip, therefore the bolt must be screwed into place.

(d) Due to the design of the wing there are no adjustments to be made for incidence, dihedral, wash-in or wash-out. The rigging diagram, figure 40, is furnished merely for checking these items after an accident or major repair.

(e) Fill the hydraulic system in accordance with the instructions in paragraph 2. y. of section III.

(f) Fill the brake system in accordance with the instructions in paragraph 2. v. of section III.

(g) If the fuel gages have been loosened or removed, readjust them (at the tanks) in accordance with instructions in paragraph 15. c. in this section.

(h) Drain out any condensate that may have accumulated in the airspeed lines. (See this section, paragraph 16. a. (4) (c).)

(5) To Install the Aileron. - Raise the aileron until the ball bearings on the ends of the ailerons are seated in the upper half of the split clamp fittings on the panel and the center hinge on the panel drops into place through a slot in the aileron leading edge. At the same time, it is necessary to guide the ball-end of the control arm into the socket of the drum in the panel. Clamp up and bolt the end hinges and bolt the center hinge through an access door in the lower aileron surface.

NOTE: Due to the design of the bearing retainers, an inboard cap is not interchangeable with an outboard cap, and vice versa.

Connect the bonding tabs. Connect the electric trim tab control conduit on the left-hand aileron.

(6) To Install the Wing Flaps. - Interlock the flap hinge and hold the flap in position while inserting the hinge pins. The loop ends of the hinge pin may be clamped in the chuck of a low r.p.m. portable electric drill; lubricate the hinge pin with engine oil, grade 77, and use the rotating motion of the drill to aid in feeding the hinge pin through the hinges. (See figure 41.)

(7) To Adjust the Flap Position Indicator Mechanism. - Follow the method outlined for the landing

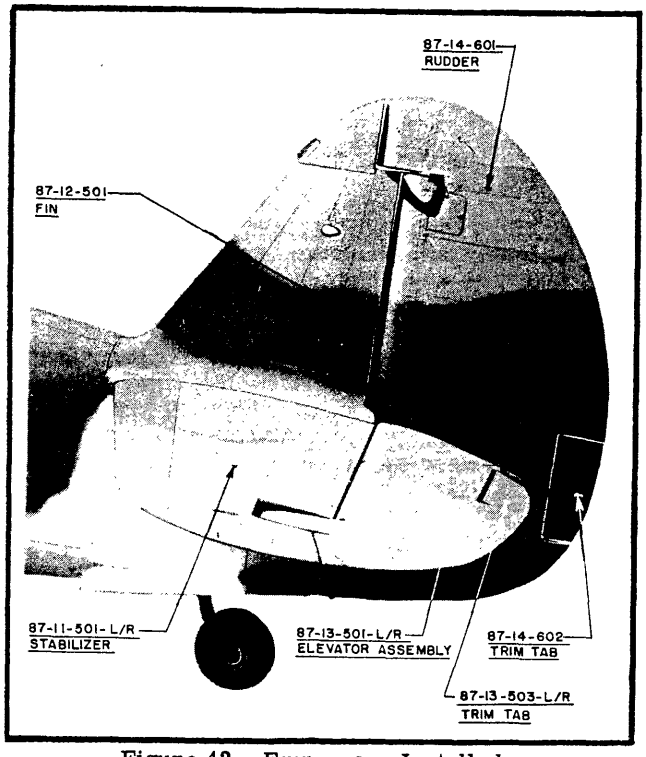


Figure 42 - Empennage Installed

gear in paragraph 2. u. section III. The transmitter is located just aft of the left flap hinge near the fuselage. It is accessible from the rear when the flap is lowered.

3. Empennage.

a. General.

(1) Stabilizers. - The horizontal and vertical stabilizers are aluminum alloy, multi-cellular construction, metal-covered. The horizontal stabilizer is made up as one piece and attached to the fuselage by a series of eight vertical bolts. The vertical stabilizer is attached to the horizontal stabilizer with eight horizontal bolts. These attachments are enclosed when the empennage fillets are installed. The vertical stabilizer has a fixed setting of 1-1/2° to the left of the fuselage centerline.

(2) Elevators and Rudder. - The elevators and rudder are of aluminum alloy construction and covered with cloth. They are both dynamically balanced and equipped with trimming tabs manually controlled from the cockpit.

b. Removal and Disassembly.

(1) To Remove the Rudder.

(a) Disconnect the rudder tab control unit at the rudder.

(b) Disconnect the rudder control cables at the rudder horn.

(c) Disconnect the bonding.

(d) Remove the top hinge bolt.

(e) Take off the upper and lower bearing caps by removing the two nuts in each, and remove the rudder.

(2) To Remove the Rudder Tab. - Disconnect the control rod from the horn, rotate the tab as far as possible from the neutral position and remove the two cap screws from the blocks on each end of the front face of the tab spar.

(3) To Remove the Stabilizers and Elevators as a Unit.

(a) Remove the empennage fillets.

(b) Disconnect the electrical conduit at the plug

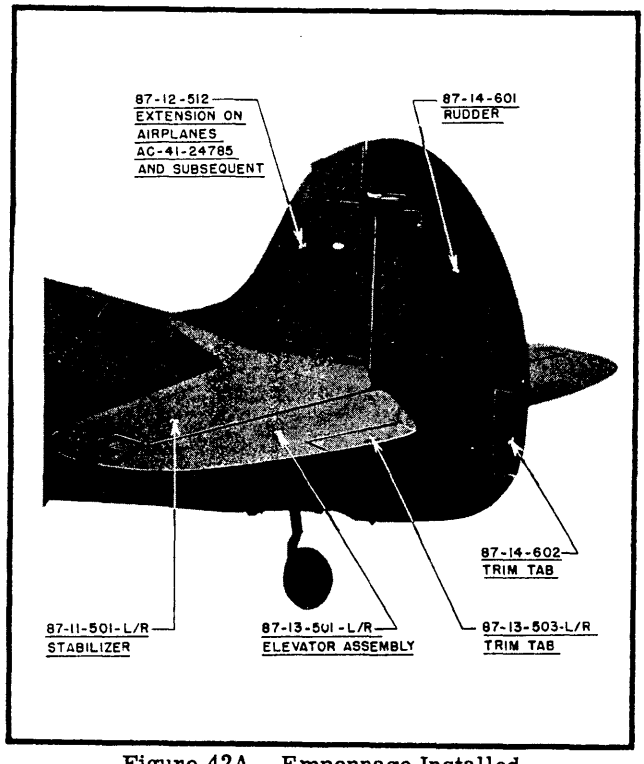


Figure 42A - Empennage Installed
(AC41-24785 and Subsequent)

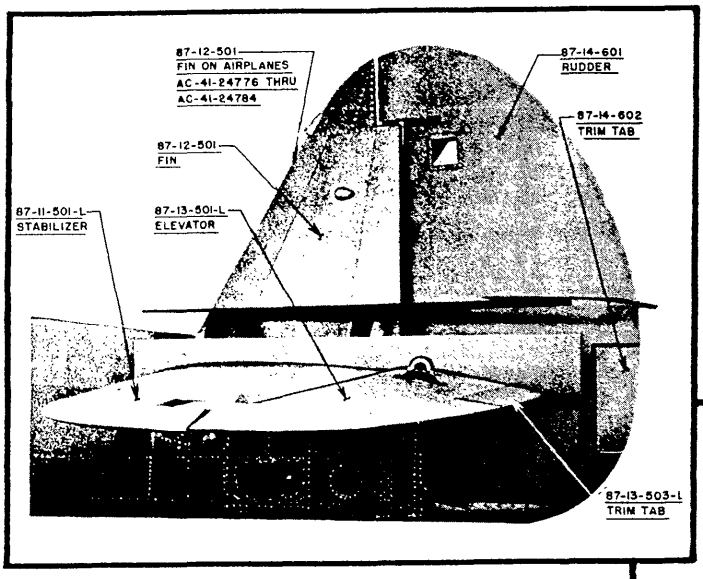


Figure 43 - Tail Erection with Throw Jigs

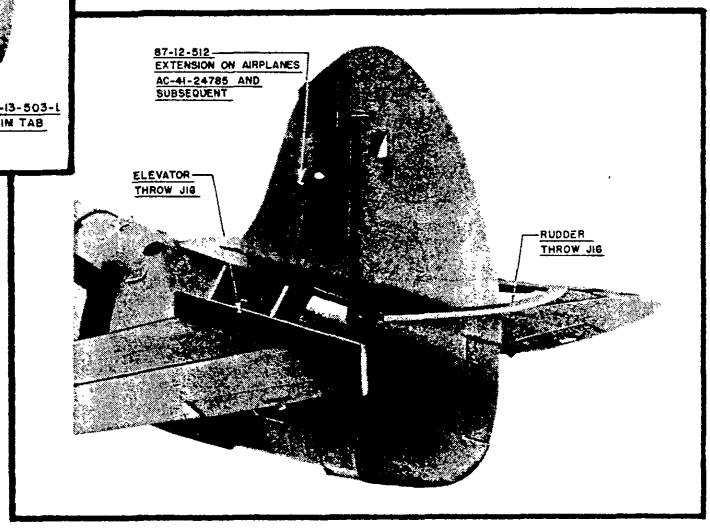


Figure 43A - Tail Erection with Throw Jigs (AC-41-24785 and Subsequent)

in the forward base of the vertical stabilizer.

(c) Disconnect the bonding.

(d) Disconnect the two elevator tab control units at the control surfaces.

(e) Disconnect the elevator control at the link attached to the horn.

(f) Remove the eight bolts and nuts at the horizontal stabilizer to fuselage fittings and remove the unit.

(4) To Remove the Elevators.

(a) Disconnect the bonding tabs.

(b) Disconnect the trim tab control at the hinge on the inboard end of the elevator.

(c) Remove the four outboard hinge bolts.

(d) Take off the center hinge caps by removing the four bolts, and remove the elevators.

(e) Either elevator may be removed without removing the rudder by the following steps:

1. Disconnect the trim tab control at the hinge on the inboard end of the elevator.

2. Disconnect the two outboard hinge bolts.

3. Disconnect the two bolts on the inboard end of the elevator.

(5) To Remove the Elevator Trim Tab. - Disconnect the control rods from the tab horn, rotate the tab as far as possible from the neutral position and remove the two cap screws from the block on the outboard end of the front face of the tab spar. Pull the tab outward and downward until the hinge shaft on the inboard end of the tab is free.

(6) To Remove the Vertical Stabilizer. - Remove the eight nuts at the horizontal stabilizer fittings and remove the vertical stabilizer.

c. Assembly and Installation.

(1) To Install the Complete Empennage. - Assemble the elevators to the stabilizers and then assemble the stabilizers to the fuselage.

(a) Assemble the vertical stabilizer to the horizontal stabilizer.

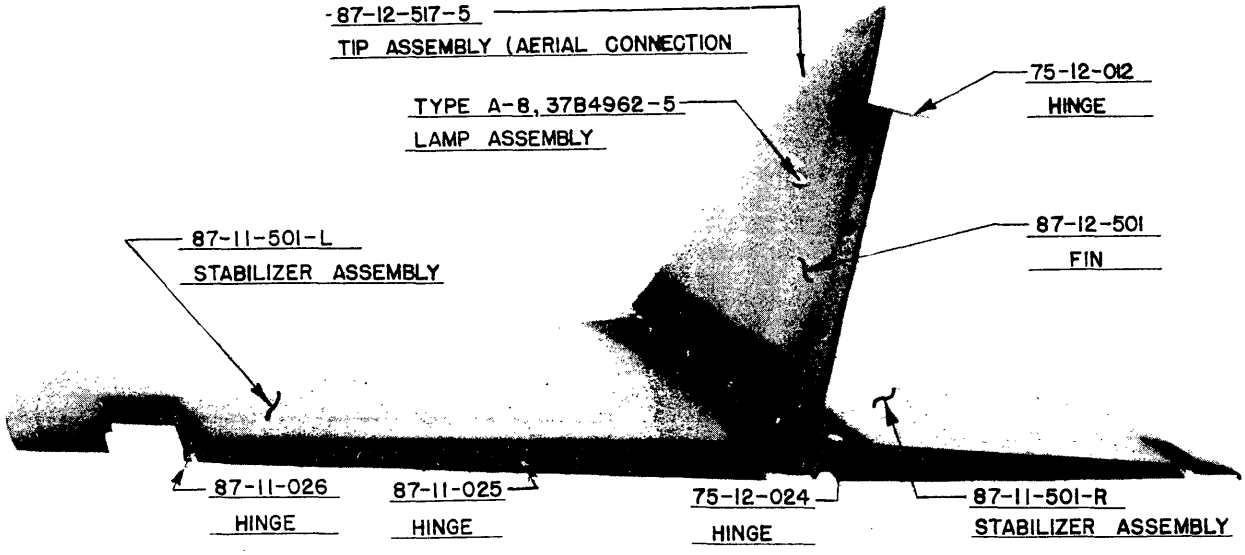


Figure 44 - Stabilizers Complete

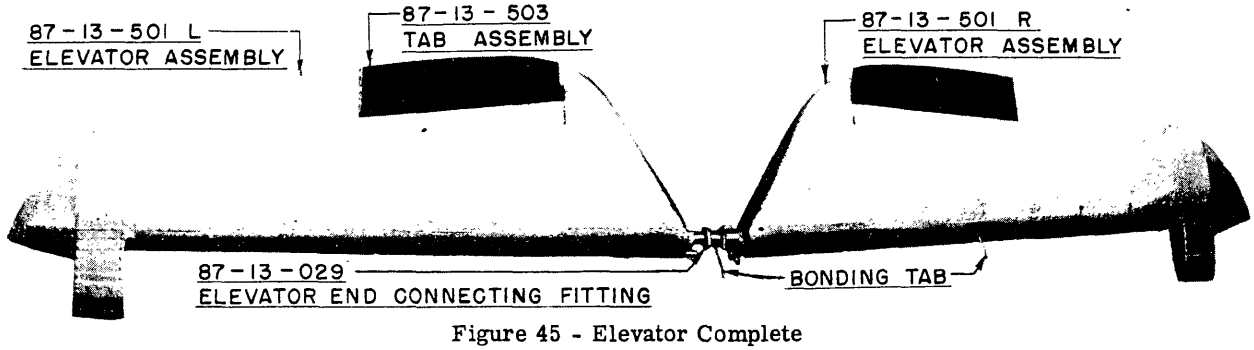


Figure 45 - Elevator Complete

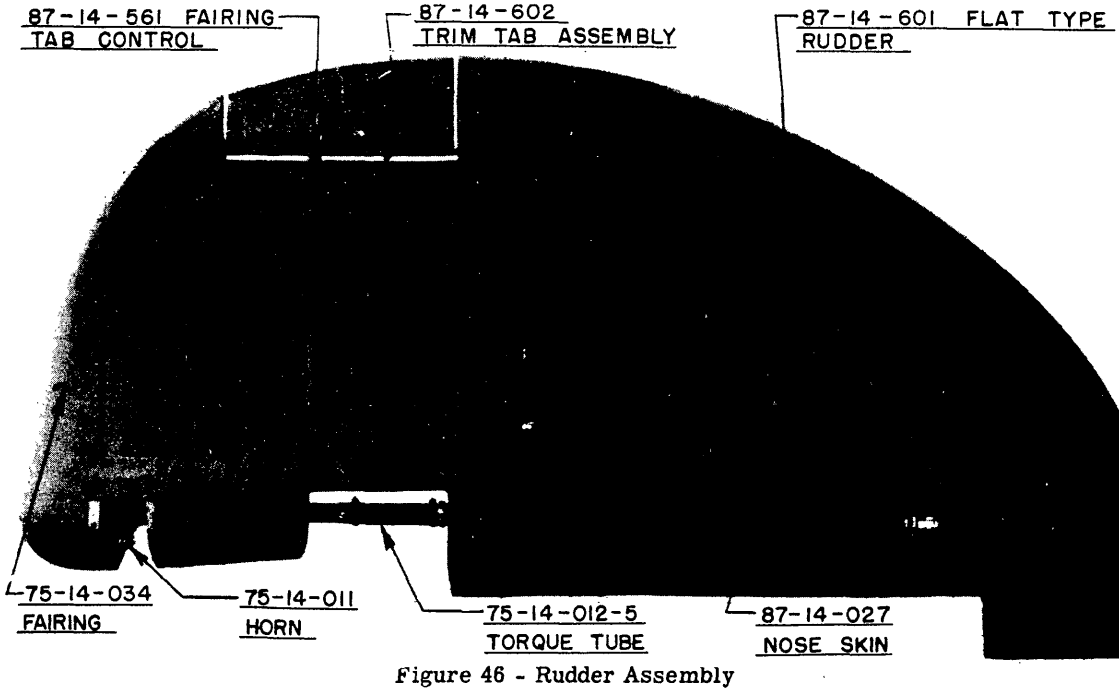
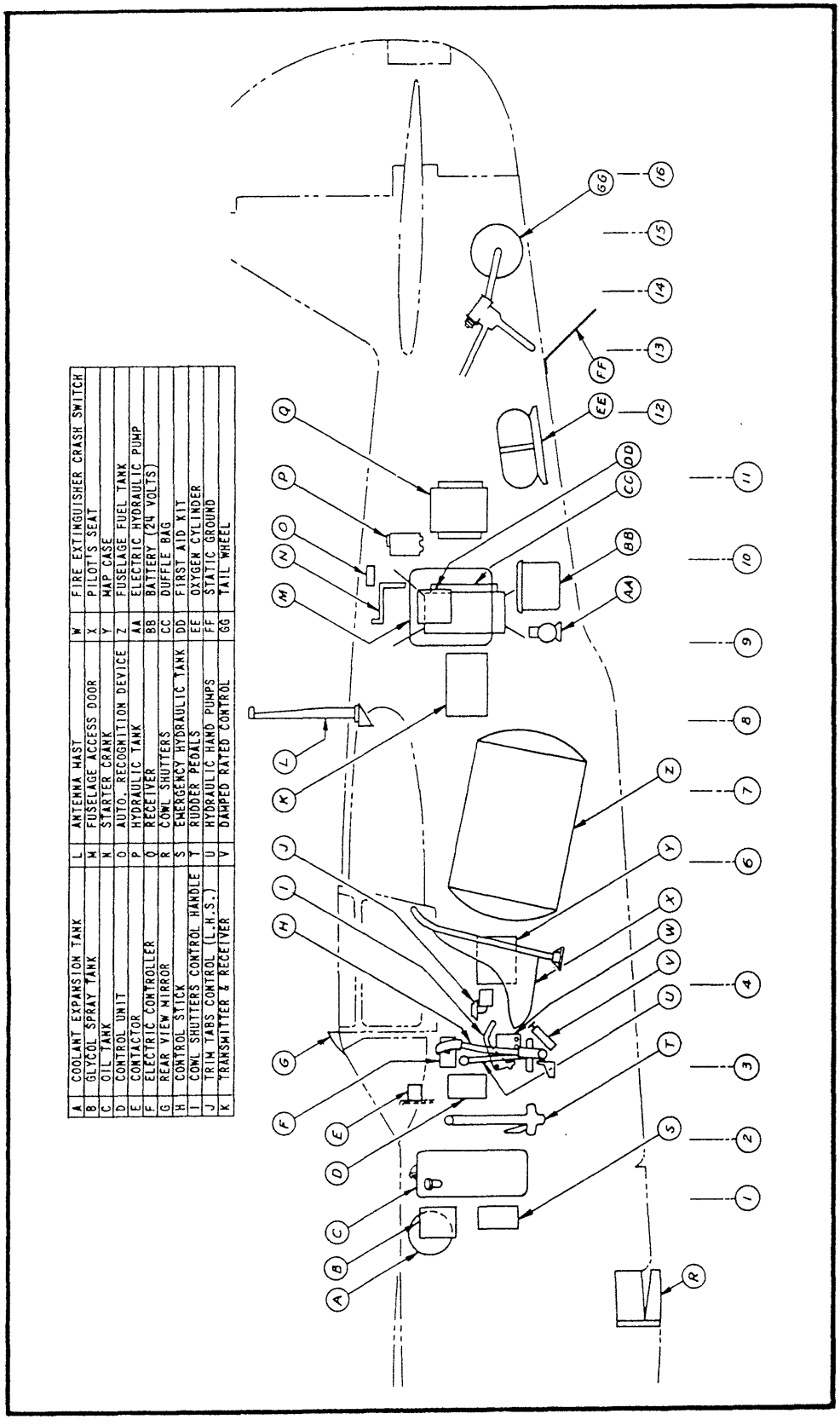


Figure 46 - Rudder Assembly



A	COOLANT EXPANSION TANK	L	ANTENNA MAST	W	FIRE EXTINGUISHER CRASH SWITCH
B	GLYCOL SPRAY TANK	M	FUSELAGE ACCESS DOOR	X	PILOT'S SEAT
C	OIL TANK	N	STARTER CRANK	Y	MAP CASE
D	CONTROL UNIT	O	AUTO. RECOGNITION DEVICE	Z	FUSELAGE FUEL TANK
E	CONTACTOR	P	HYDRAULIC TANK	AA	ELECTRIC HYDRAULIC PUMP
F	ELECTRIC CONTROLLER	Q	RECEIVER	BB	BATTERY (24 VOLTS)
G	REAR VIEW MIRROR	R	COWL SHUTTERS	CC	DUFFLE BAG
H	CONTROL STICK	S	EMERGENCY HYDRAULIC TANK	DD	FIRST AID KIT
I	COWL SHUTTERS CONTROL HANDLE	T	RUDDER PEDALS	EE	OXYGEN CYLINDER
J	TRIM TABS CONTROL (L.H.S.)	U	HYDRAULIC HAND PUMPS	FF	STATIC GROUND
K	TRANSMITTER & RECEIVER	V	DAMPED RATED CONTROL	GG	TAIL WHEEL

Figure 47 - Fuselage Contents

(b) Attach the elevators to the horizontal stabilizer and bolt on the center bearing caps securely.

(c) Connect the push-pull link to the elevator horn.

(d) Connect the flexible drive-shaft for the elevator and rudder trim tabs to the correct tab control units.

(e) Insert a plumb bob on a bar through the rudder fittings on the vertical stabilizer and fuselage, to check the alignment before installing the rudder. Incorrect tension of the vertical stabilizer-to-horizontal stabilizer and the horizontal stabilizer-to-fuselage bolts may cause misalignment. When installing the lower rudder bearing cap, be careful to seat the thrust washer and dust shields in their proper grooves.

(f) Install the rudder and connect the rudder cables to the rudder horn.

(g) Instruction on adjustment of the flight control system and surfaces are given in paragraph 2. o. section III. If the angular throw of the surfaces is to be checked by the use of rigging boards, (see figure 43), it must be done before the tail fillets are installed.

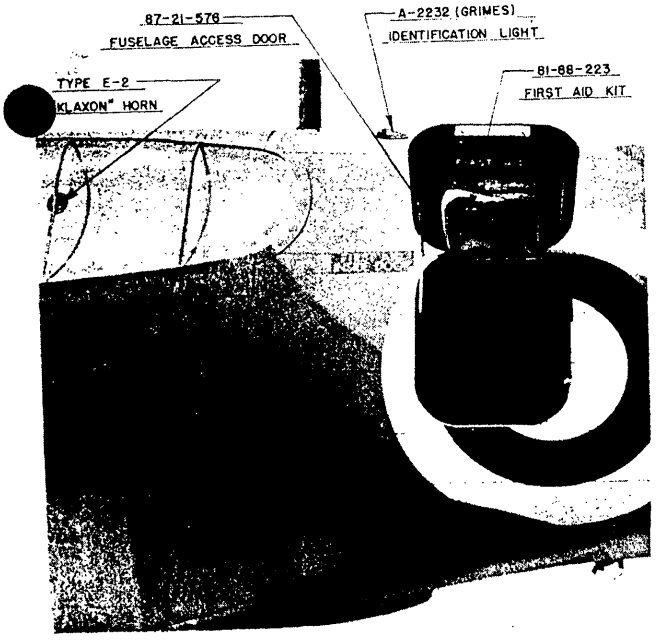


Figure 48 - Fuselage - Side View - Access Door - Open

4. Fuselage and Engine Mount.

General.

a. Fuselage. - (Drawing 87-21-705)

(1) The fuselage proper is monocoque construction with bulb stringers, channel-section bulkheads and aluminum alloy 24ST smooth skin. Aluminum alloy (A17ST) flush head rivets are used on all exterior surfaces. The bulkhead behind the pilot's seat, station 5, is designed to protect the pilot in the event of a complete nose-over. The jackpoint aft of the tail wheel is designed to protect the fuselage in case the tail wheel collapses.

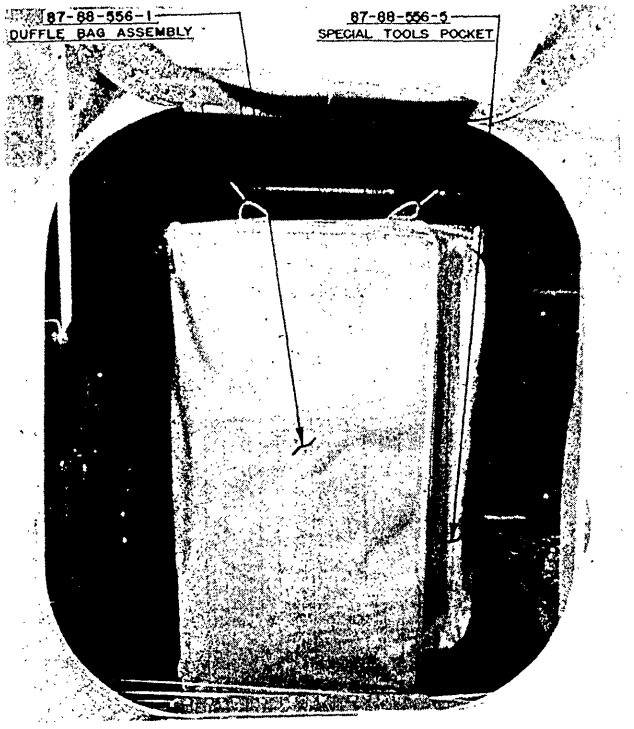


Figure 49 - Duffle Bag Installation

(2) Duffle Bag. - (87-88-556) The duffle bag is located thru an access door on the left-hand side of the fuselage between stations No. 9 and 10. Provisions have been made in the duffle bag for the stowage of desert equipment consisting of the following: Water bottle, water container, ration box and emergency ration box.

(3) Special Tools and Equipment. - These are stored in a pocket on the right-hand of the duffle bag.

(4) The starter crank and crank extension are located on the right side of the fuselage directly opposite the access door.

(5) The parking harness is enclosed in a stowage bag below the pilot's headrest. (See figure 17.)

(6) The map case is located in the cockpit on the right-hand side of the pilot's seat.

(7) A canvas container with a zipper fastener is installed on the inboard side of the fuselage access door to accomodate a first aid kit.

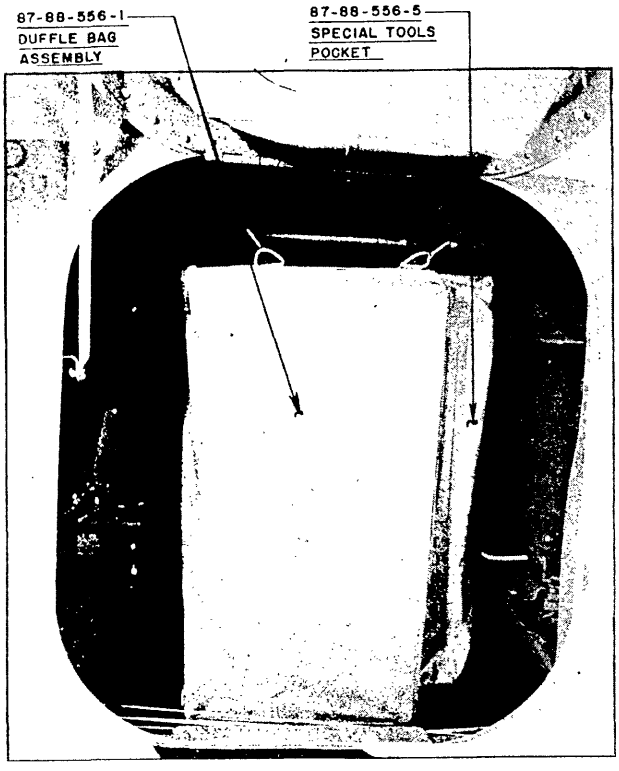


Figure 50 - Desert Equipment

b. Engine Mount. - (Drawing 87-22-501)

The engine mount is of steel tube construction, employing both bolted and rigid joints. Major portions of it are heat treated to 150,000 p.s.i. tensile strength.

5. Cowling. - (Drawing 87-23-705)

a. All cowl sections are spot welded or riveted aluminum alloy construction with exception of the cowl immediately adjacent to the exhaust stacks. The shroud cowl is stainless steel construction.

b. The fuselage cowl between station No. 1 and No. 2 is designed to permit ready access to the oil tank installation.

c. Cowls which must be frequently removed for servicing, such as the engine and fuselage cowls are attached with Dzus fasteners. The semi-permanent cowl is attached with machine screws and bolts.

6. Spinner Assembly. (Drawing 87-42-503)

a. The spinner assembly consists of two parts; a nose cone and a base. The nose cone is fastened to the base by means of three studs and two locating dowel pins. These studs are accessible from either side of the engine, through hand holes in the engine cowl bulkhead attached to the propeller reduction gear housing, after the engine cowling has been removed.

b. The spinner base is comprised of three parts; a detachable sheet metal rear bulkhead, a forged steel forward bulkhead and a sheet metal shell. The sheet metal shell is riveted to the forward bulkhead. Each section (nose cone and base) is statically balanced and the complete assembly is statically and dynamically balanced. In no case shall any part of one spinner assembly be interchanged with the same part of

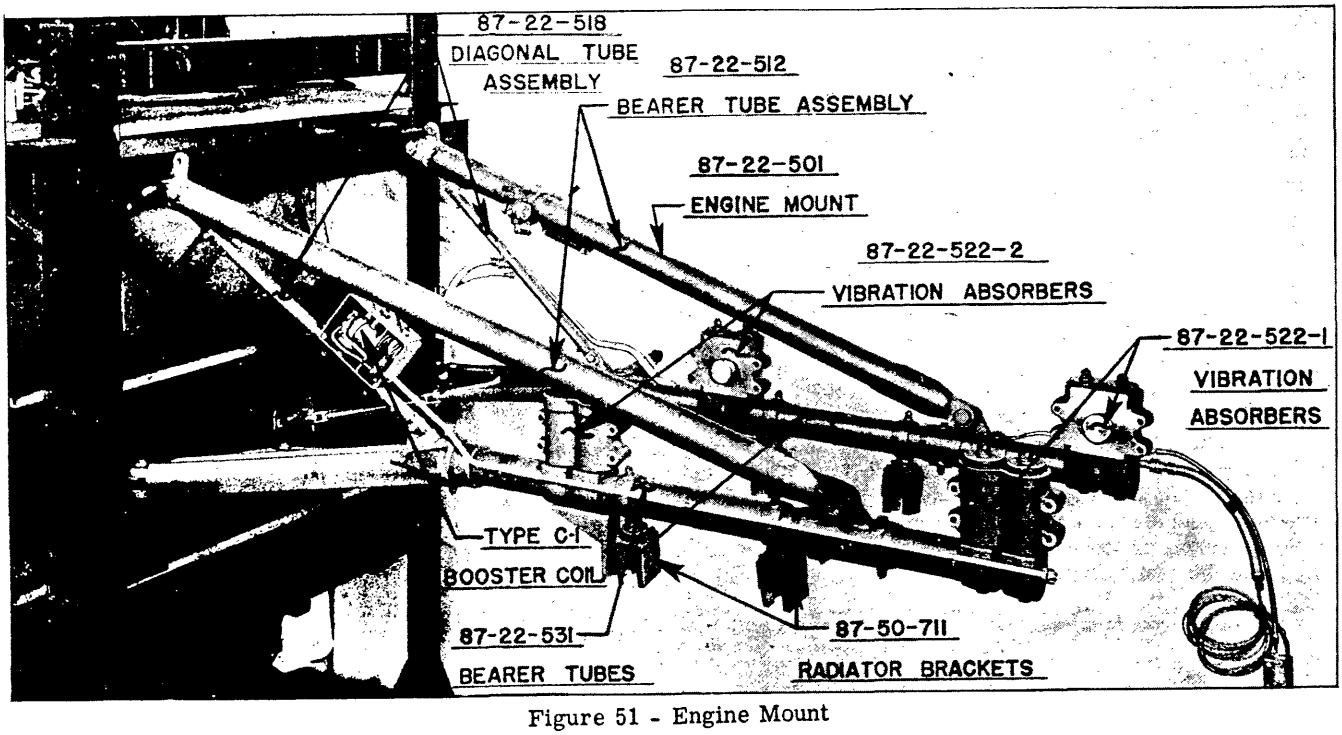


Figure 51 - Engine Mount

another assembly unless the complete assembly is again dynamically balanced.

c. To Remove the Spinner Assembly.

(1) Remove the section of the engine cowl around the exhaust stacks.

(2) Working through the hand holes in the bulkhead, supporting the front end of the engine cowl, remove the three elastic stop nuts holding the nose section to the base.

(3) Remove the nose by pulling forward.

(4) Remove the three covers for the propeller blade cut-outs by unscrewing the ten flush head screws attaching each cover to the spinner base.

(5) Remove the outer row of screws from the rear bulkhead. (DO NOT TOUCH the inner circle of balance screws.)

(6) Remove the propeller power unit assembly.

(7) Remove the spinner base by pulling it forward.

d. To install the spinner assembly reverse the above procedure. When assembling the spinner be sure that the indicator arrow on the rear bulkhead coincides with the arrow on the aft part of the spinner to insure the proper balance of the assembly. The dowel pins on the nose cone must be greased with No. 78 medium grease every time the cone is assembled to the base.

7. Landing Gear. (Drawing 87-31-501)

a. General.

(1) Struts. - The two landing gear main wheels are installed in an identical manner on the under surface of each wing. Each landing gear has an air-oil shock absorber strut (87-31-510) which rotates aft about trunnions on the top of the strut. (For general instructions covering air-oil shock absorber struts, see T. O. No. 03-25E-1.) During retraction, bevel gears rotate the strut approximately 90° so that the wheel lies flush in the wing. The landing gear has a retracting assembly and one side brace link per side. The upper set of retracting links are attached to the retracting strut, the lower set and side brace to the swivel trunnion. The bevel gears at the upper end of the oleo strut serve as structural members as well as rotating the strut during retraction. Torque loads on the piston are transmitted through the scissors links to the cylinder and the bevel gears in turn transmit this torque from the cylinder to the landing gear fittings on the wing. An idler link connects the joint at the junction of the upper and lower links to a fitting in the bottom surface of the wing.

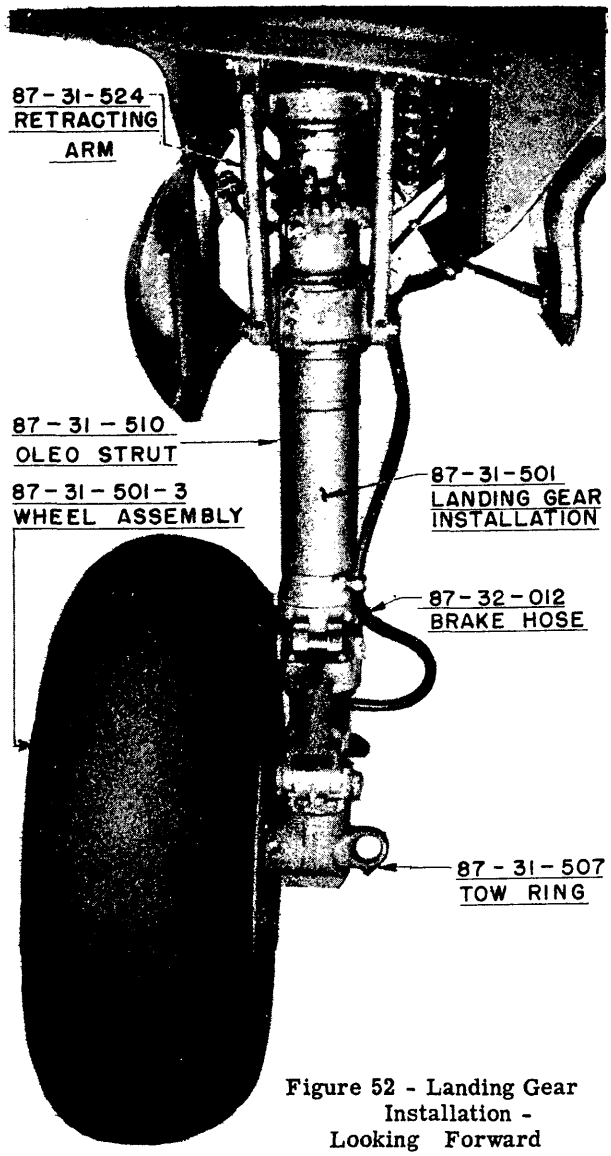


Figure 52 - Landing Gear Installation - Looking Forward

(2) Retracting Mechanism. - The retracting mechanism consists of a pair of hydraulically operated retracting struts (one in each wing panel directly forward of the wheel pocket, see paragraph 18. a. (8) this section. Extension of the retracting strut causes the landing gear to retract into the lower surface of the wing.

WARNING: When operating the hydraulic system to lower the landing gear, care must be taken to see that the hydraulic gun charging valve handles are locked in the "Out" position. If this is not done, the landing gear cannot be lowered due to the fact that the pressure required to lower the gear is being diverted to charge the guns.

(3) Warning System. - The locks inside the retracting strut actuate an electrical switch through a

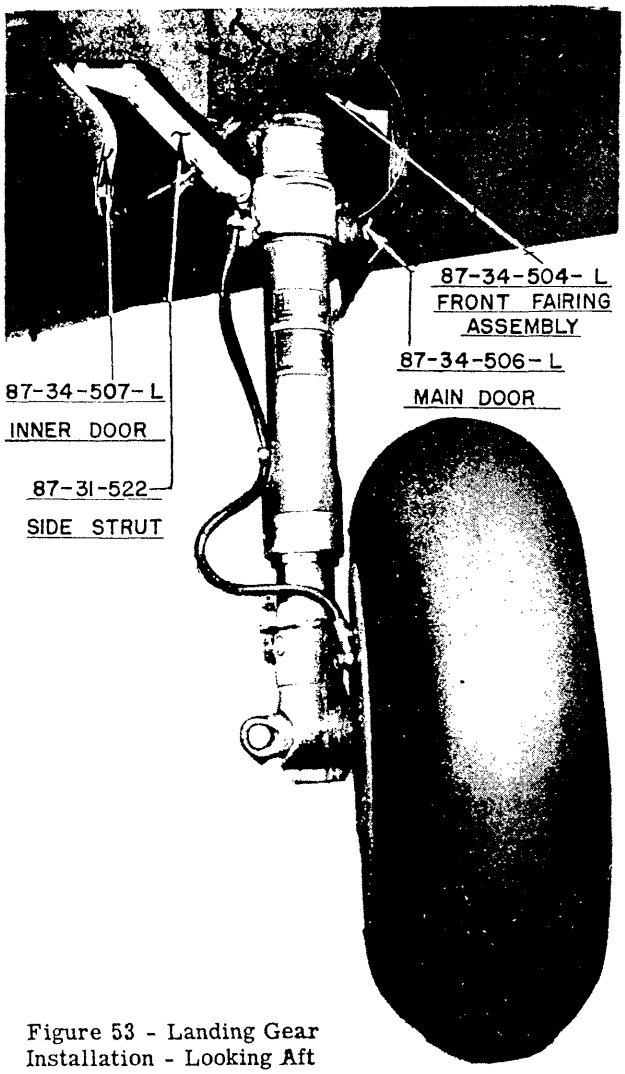


Figure 53 - Landing Gear Installation - Looking Aft

plunger and a bellcrank thereby controlling the operation of a "KLAXON" warning signal in the cockpit, and the landing gear warning light on the instrument panel. A cam on the throttle control rod in the cockpit actuates another electrical switch in the landing gear warning system. Position indicator transmitters, connected to the retracting mechanism in each panel, are located in the wheel pockets. These transmitters are electrically connected to the position indicator on the instrument panel. (See paragraph 16. a., (3) (n), Engine and Aeromautical Instruments, of section IV.)

b. Wheels and Brakes.

(1) General. - The landing gear is equipped with 8 ply rayon 30 inch diameter smooth contour casings, and puncture proof Type II tubes. The wheel is a 30 inch smooth contour type provided with a 12 x 3-1/4 inch hydraulic brake. Applicable instructions for wheels and brakes are contained in T. O. No. 03-25B-1 and T. O. No. 03-25B-2. The brake installation drawing is 87-32-501.

(2) A description of the adjustment of the brake treadle angle is given in figure 54.

(3) Master Cylinder Unit.

(a) General. - The brakes are actuated by the hydraulic brake master cylinders mounted on and actuated by the rudder pedals in the cockpit. The brake cylinders and master cylinders are connected by flexible rubber hose and 5/16 O.D. "Everdur" tubing.

(b) Detailed Operation of the Master Cylinder Unit. - The views of figure 55 show the operation of the master cylinder unit when following the filling and bleeding procedure recommended by the manufacturer of the unit. A description of the different views follows:

Reading from left to right -

First View - Unit in off (released) position after being properly filled and bled, with the transfer valve closed.

Second View - Unit with the brake applied and with pressure in the system.

Third View - Unit in the parked position with the system under pressure. Same as fourth view, except the force is maintained by the parking spring and ratchet instead of the pressure on the brake pedal.

c. Filling and Bleeding the Hydraulic Brake System. - Figure 56 gives the method for filling and bleeding the brake system recommended by the master cylinder manufacturer.

d. Installation and Disassembly.

(1) To Remove the Landing Gear Assembly from the Wing Panel.

(a) Remove the landing gear fairing.

(b) Working through the wheel pocket:

1. Remove the canvas wheel pocket lining.

2. Partially retract the landing gear so that the link and retracting strut connection is accessible through the wheel pocket.

3. Disconnect the landing gear position indicator linkage at the lower end.

4. Remove the through bolt which connects the retracting strut to the upper link.

5. Return the retracting strut piston completely into the strut and disconnect the hydraulic lines.

6. Remove the three nuts which attach the retracting strut to its support in the wing.

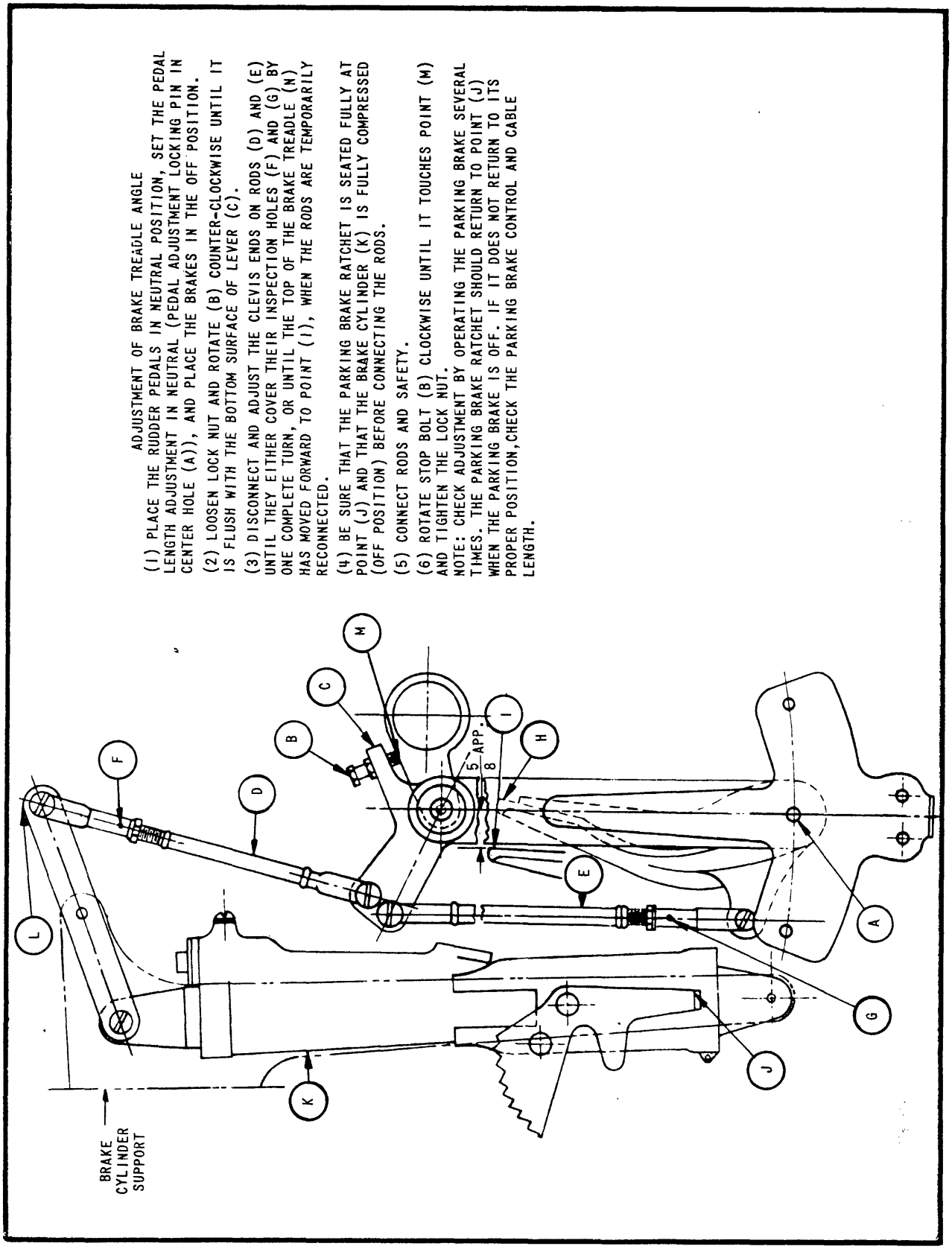


Figure 54 - Brake Treadle Adjustment

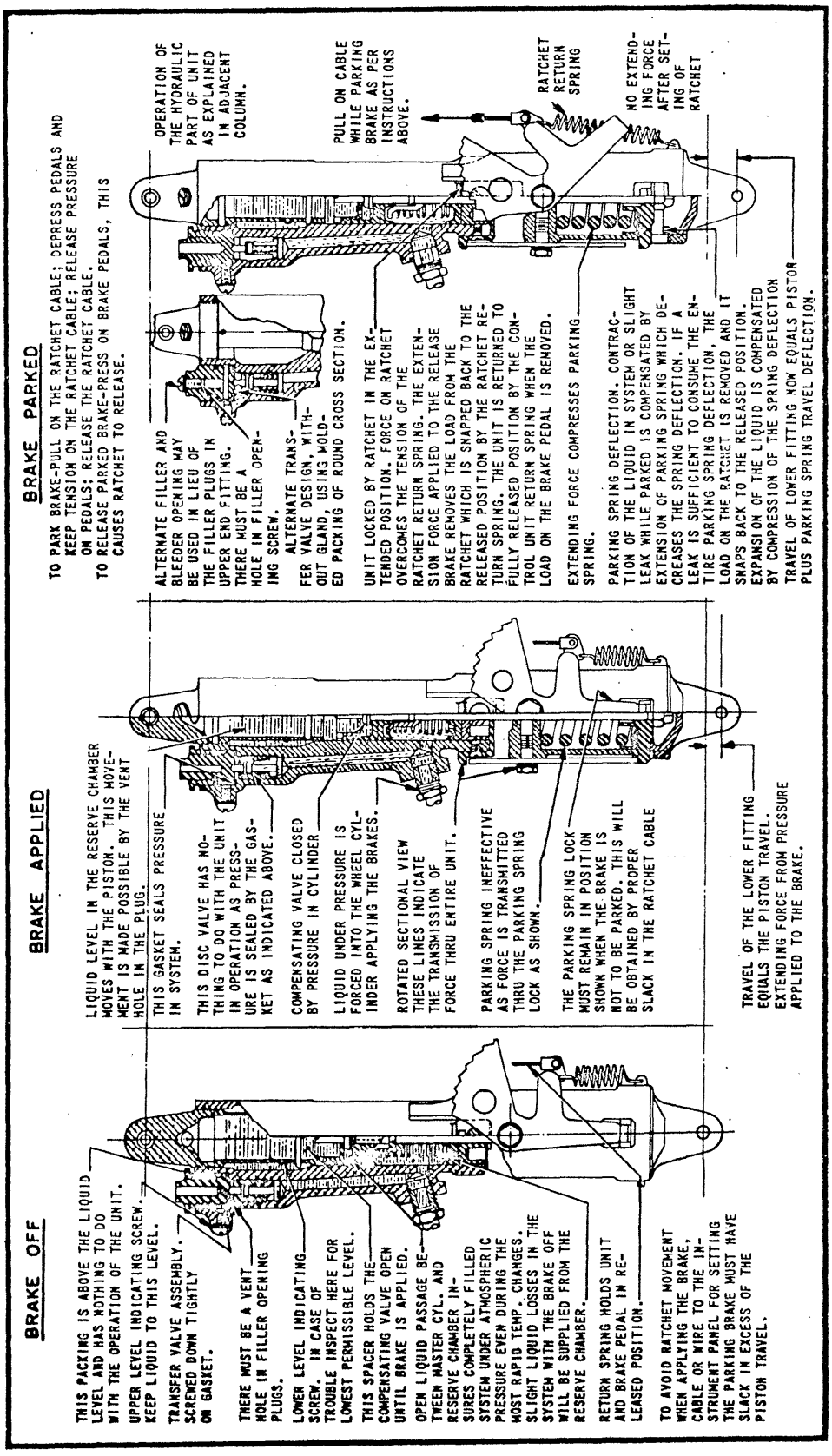


Figure 55 - Operation Brake Master Cylinder

FILLING AND BLEEDING INSTRUCTIONS FOR HYDRAULIC BRAKE CONTROL UNIT

BEFORE STARTING TO FILL AND BLEED THE SYSTEM THE FOLLOWING PRECAUTIONS SHOULD BE TAKEN.

1. BE SURE THAT THE PROPER LIQUID IS USED (LOCKHEED BRAKE FLUID 5 OR EQUIVALENT).
2. BE SURE THAT THE LIQUID IS CLEAN AND FREE FROM CHIPS. STRAIN IF NECESSARY.
3. DO NOT LEAVE THE BRAKE FLUID UNCOVERED. THE BUTYL ALCOHOL OR ETHER WILL EVAPORATE CAUSING A HIGHER CONCENTRATION OF CASTOR OIL, WHICH MAY CAUSE IMPROPER FUNCTIONING, ESPECIALLY IN COLD WEATHER.
4. WHENEVER THE TRANSFER VALVE IS LOOSENED OR TIGHTENED, HOLD THE UNIT FIRMLY, AS THE END FITTINGS ARE NOT DESIGNED FOR TWISTING LOADS.

TO FILL AND BLEED THE ENTIRE SYSTEM UPON INSTALLATION

1. ATTACH EMPTY CAN TO FILLER OPENING OF CONTROL UNIT
2. ATTACH FLUID LINE FROM TANK UNDER 6 TO 9 P.S.I. PRESSURE TO WHEEL BLEEDER OPENING.
3. OPEN TRANSFER VALVE BY UNSCREWING IT 5 COMPLETE TURNS (SEE NOTE 4 ABOVE)
4. OPEN THE WHEEL BLEEDER AND ALLOW THE LIQUID, UNDER PRESSURE, FROM THE TANK TO FILL THE SYSTEM AND THE EMPTY CAN, ATTACHED TO THE FILLER OPENING ON THE CONTROL UNIT. WHEN SUFFICIENT LIQUID IS IN THE CAN, ATTACHED TO THE FILLER OPENING, THE UNIT SHOULD BE PUMPED, AS DESCRIBED BELOW, MAINTAINING THE 6 TO 9 P.S.I. PRESSURE ON THE WHEEL BLEEDER TO PREVENT AIR FROM BEING TRAPPED IN THE BRAKE CYLINDER.
5. PUMP THE LIQUID INTO THE SYSTEM BY DEPRESSING THE BRAKE PEDAL RAPIDLY, BUT ALLOWING IT TO RETURN VERY SLOWLY UNTIL THE LIQUID EXPELLED AT THE WHEEL BLEEDER IS FREE OF AIR BUBBLES.
6. CLOSE THE WHEEL BLEEDER WHILE PEDAL IS IN NORMAL (BRAKE OFF) POSITION AND REMOVE PRESSURE LINE FROM WHEEL BLEEDER OPENING
7. WHEN APPLYING THE BRAKE AFTER CLOSING THE SYSTEM, EXCESSIVE PEDAL TRAVEL WILL BE OBSERVED. AFTER APPLYING THE BRAKE SEVERAL TIMES, NORMAL PEDAL TRAVEL WILL BE OBTAINED DUE TO RESIDUAL AIR BEING EXPELLED FROM THE CONTROL UNIT BY THESE APPLICATIONS OF THE BRAKE. IF ABNORMAL TRAVEL STILL EXISTS, IT INDICATES AIR BEING TRAPPED IN THE SYSTEM OR EXCESSIVE LINING CLEARANCE
8. REMOVE THE FILLING CAN AND REPLACE THE FILLER OPENING PLUG OR SCREW. BE SURE THE FILLER PLUG OR SCREW HAS A VENT HOLE.
9. REMOVE UPPER LEVEL INDICATING SCREW AND ALLOW LIQUID TO RUN OUT UNTIL IT REACHES HOLE LEVEL. REPLACE LEVEL INDICATING SCREW. KEEP FEET OFF BRAKE DURING THIS OPERATION.
10. CHECK THE ENTIRE SYSTEM FOR LEAKS BY PARKING THE BRAKES AND WATCHING THE POSITION OF THE PARKING SPRING YOKE AS EXPLAINED IN THE ADJACENT LOWER CONTROL UNIT VIEW.

IF THERE IS A LEAK ANYWHERE IN THE SYSTEM, IT MANIFESTS ITSELF BY A DOWNWARD MOVEMENT OF THE YOKE. A DOWNWARD MOVEMENT OF APPROXIMATELY 1/16" MAY BE NOTICED IMMEDIATELY AFTER FILLING AND BLEEDING. IF THE SYSTEM IS PARKED FOR 12 HOURS OR MORE A MOVEMENT OF 1/16" TO 1/8" IS TO BE EXPECTED, IF THERE IS NO EXPANSION OR CONTRACTION DUE TO TEMPERATURE CHANGES. IF AN EXTERNAL LEAK IS DISCOVERED IT SHOULD BE ELIMINATED AS SOON AS POSSIBLE AND LIQUID SHOULD BE ADDED TO BRING IT TO THE PROPER LEVEL IN THE RESERVE CHAMBER.

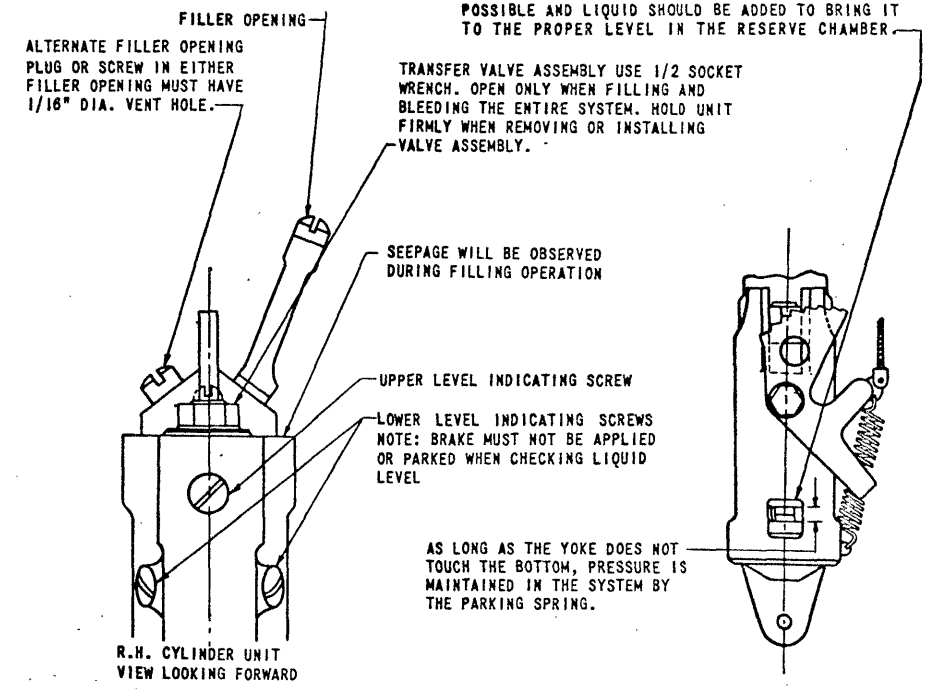


Figure 56 - Hydraulic Brake Control Unit - Service Instructions

7. Remove the through bolts which attach the retracting arms to the wing panel at the remote pivot points.

(c) Working Under the Wing Panel.

1. Remove the bolts which connect the lower links to the retracting arms; these bolts are immediately below the bottom surface of the wing panel when the retracting mechanism is disconnected from the wing panel and from the retracting cylinder.

2. Disconnect the side brace link at either end.

3. Disconnect the hydraulic brake line.

4. Removal of the bolts from the upper trunnion oleo strut bearings will permit the freeing of the oleo strut from the wing.

NOTE: To facilitate the alignment and assembly of the trunnion, it is recommended that the parts be kept and re-installed in sets. If these parts are replaced by new fittings, it is suggested that the fittings be stocked and installed in sets, also.

(d) Remove the retracting arms and upper links through the wheel pocket.

(e) The bellcrank which operates the switch in the warning horn circuit is accessible through a hole in the wing immediately forward of the upper trunnion bearings. It may be removed by disconnecting the retaining spring and pushing the arm upward and forward.

(2) To Install and Adjust the Landing Gear. - This installation is a reversal of the procedure outlined above. Since all links are of fixed lengths there are no adjustments to be made for camber, caster, toe-in, etc. The only adjustment possible is that of reducing the back lash between the bevel gear and the pinion; this is accomplished by removing the shims from between the top flange on the cylinder and the pinion, and replacing them between the lower flange on the cylinder and the pinion. This procedure will set the pinion closer to the bevel gear which will result in less lost motion between the gear teeth.

(3) To Adjust the Warning System.

(a) Landing Gear Switch. - This switch needs to be adjusted after installation of the retracting strut. The adjustable bolt at the bottom of the bellcrank on each retracting strut should be set to move the switch to the open or "Off" position when the locks are fully engaged.

(b) Throttle Switch. - The location of the actuating cam on the throttle rod in the cockpit should be adjusted to actuate the warning signal when the engine is throttled to 1000 r.p.m. and the gear is not locked down.

(4) To Remove the Shock Absorber Strut. - If it is desired to remove only the shock strut and wheel from the airplane:

(a) Remove the landing gear fairing.

(b) Disconnect the retracting link and side link at the strut.

(c) Disconnect the hydraulic brake line.

(d) Retract the strut sufficiently to allow the removal of a one-inch nut recessed into the top of the strut, which will then free the strut from the remainder of the landing gear.

(5) To Disassemble and Assemble the Shock Absorber Strut.

(a) To disassemble the shock absorber strut, first remove the AN28-54 bolt which holds the axle assembly in the bottom end of the piston. The axle can now be pulled free of the piston. Next, remove the bolts which hold the pinion, the two segments, and the support for the landing gear door cable to the flanges of the upper part of the cylinder, and remove these parts. The bevel gear (75-31-036) may now be removed from the landing gear hinge fitting (87-31-506-6). Next, vent the air pressure; then remove the Schrader plug and drain the fluid from the cylinder. Disconnect the scissor links from the cylinder and piston, remove the brake hose, remove the screw (95593) in the lower part of the cylinder which safeties the cylinder bearing nut and turn the cylinder bearing nut completely out of the cylinder. Now, remove the piston assembly. The packing, ring, and sleeve will come out with the piston.

(b) To assemble the shock absorber strut: The assembly of the oleo strut may be facilitated by following the alphabetical order of assembly shown in the parts block of figure 57. The cylinder assembly should proceed through step (I) (cylinder and plunger) and then the complete piston assembly should be installed. Care must be exercised, in tightening the cylinder bearing nut, to avoid compression of the packing gland.

The oleo strut should be tested for leakage at this stage of the assembly. The test should be accomplished by filling the cylinder with approximately two quarts of 50/50 castor oil and diaceton alcohol, and subjecting the strut to a pressure of 2800 lbs./sq. in. for ten minutes. The cylinder is filled through a hole, provided for the Schrader valve in the upper side of the cylinder. The piston is in the retracted position at the start of the filling, but is slowly extended by hand, as the fluid flows into the cylinder. This helps to eliminate air that may become trapped in the cylinder, if it were left extended while being filled. A high pressure gage is screwed into the Scharder valve hole, and a compressive force is applied on the piston end of the strut, until the gage reads 2800 lbs./sq. in.

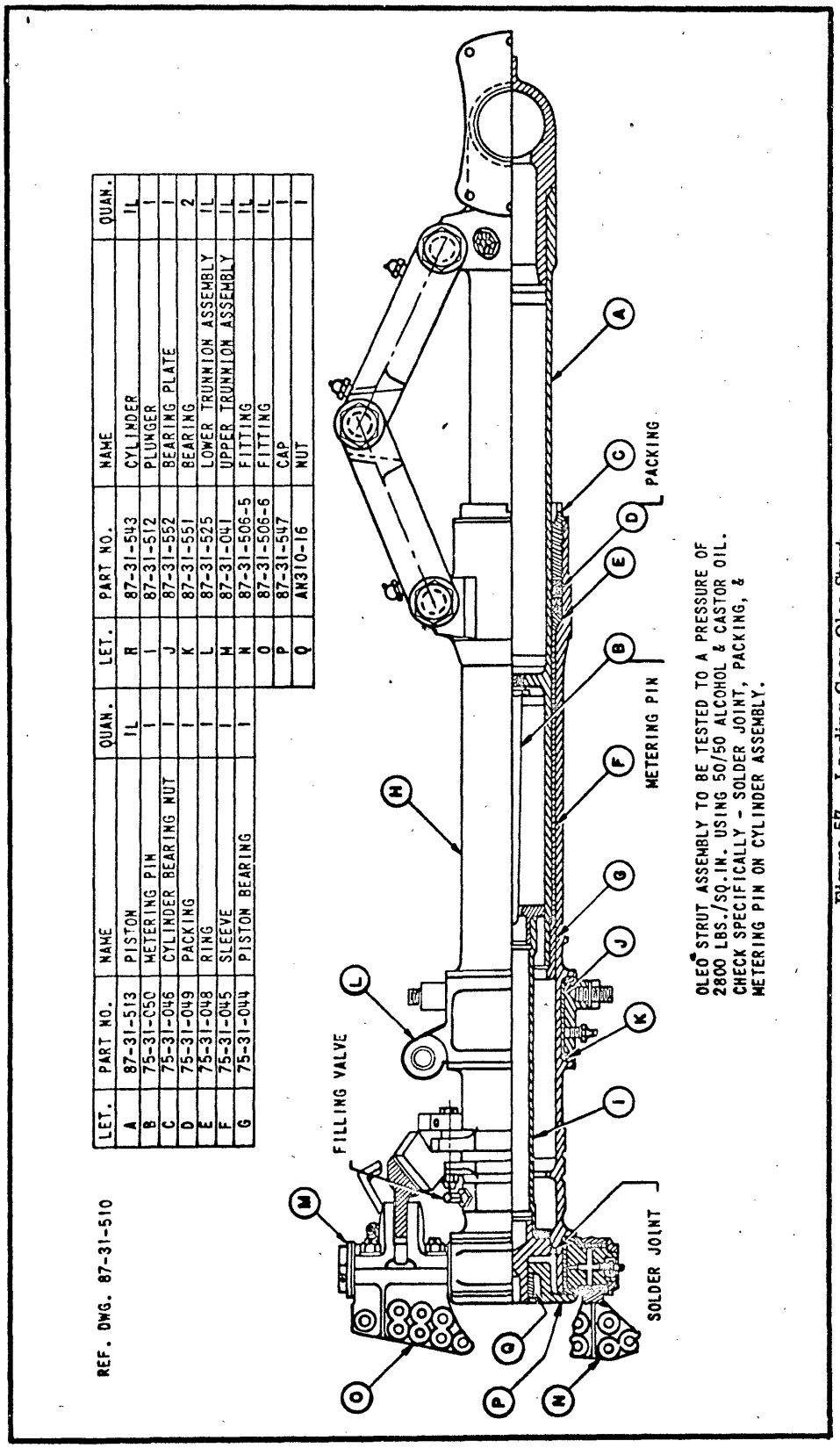


Figure 57 - Landing Gear Oleo Strut

At the end of ten minutes, the force is released, and the strut examined for leakage of fluid - about the solder joint at the top of the cylinder assembly where the plunger is screwed into the cylinder, at the packing gland near the cylinder bearing nut, and at the metering pin where it is screwed into the piston. Leakage at the metering pin can be seen by looking into the bottom end of the piston.

Another test should be conducted on the oleo strut after it has passed the test described above. Approximately one-quart of the fluid should be withdrawn from the cylinder, and air forced in until a pressure of 204 lbs./sq. in. is indicated on the gage. The strut should be put aside in an upright position, with the piston end down. At the end of eight hours, the oleo strut should be examined as in the first test.

The assembly of the oleo strut should be continued in the alphabetical order ("J" through "Q") shown in the parts block of figure 57, after the leakage tests have been satisfactorily completed. Following this assembly, the bevel gear (75-31-036) should be placed between the two flanges provided for it on the landing gear hinge fitting (87-31-506-6). It should be shimmed (to a snug fit) only between the gear and the outer flange (in respect to the strut centerline of the hinge fitting. The pinion (75-31-035-1) should be fitted between the flanges of the cylinder, so that the backlash between the teeth of the bevel gear and the pinion is from .000 inch to .002 inch. Shims, 75-31-072, 75-31-073, 75-31-076, 87-31-051, and 87-31-052 may be used as required for the installation of the gear and the pinion. A left-hand and a right-hand segment (87-31-574 L/R) is placed on either side of the two flanges which hold the pinion. The landing gear door cable support (87-34-530) is placed adjacent to the bottom segment. The support, segments, and the pinion are assembled to the cylinder flanges with two AN6-25 bolts, two AN6-20 bolts, four AN960-D-616 washers, four AN310-6 nuts and four AN380C3-3 cotters.

Each of the scissors links (87-31-526-1 and 87-31-526-2) is attached to the lugs on the cylinder and the piston with a 75-31-054 bolt, 75-31-056 spacer, AN960-1016 washer, AN320-10 nut, and a AN380-C4-4 cotter. The two links are joined by a 75-31-055 bolt, AN960-916 washer, AN320-9 nut and a AN380-C4-4 cotter. The 87-31-526-1 link is attached to the cylinder, and the 87-31-526-2 link is attached to the piston.

NOTE: Before installing the scissors links inspect bolts (75-31-054) for a radius of .005 in. minimum or .015 in. maximum radius in the two places shown in drawing No. 75-31-054). If the radius is greater than .015, the bolts must be reworked or replaced to obtain the correct tolerance.

Inspect the floating spacer (75-31-056) for wear and scoring. Badly worn or scored spacers are to be replaced. Thoroughly clean the links and inspect the bushings for wear and scoring. Badly worn or scored bushings are to be replaced. When these bushings are replaced it will be necessary to drill a new grease passage hole in the bushing to align with the grease passage in the link. Inspect the links for grease passages from the grease fitting down through to the bushing. If any grease passages are found that have not been drilled, they shall be drilled to align with the vertical grease passage on both sides which are fitted with zerk fittings. By means of a grease gun, force some grease through each of the grease fittings to assure proper lubrication action. Coat the surfaces of the bushings, spacers and bolts with grease before reinstalling the scissors links on the oleo strut. Snug up the nuts and then back them off one castellation and install the cotters. It is very important that the bolts are not drawn up tight to avoid binding of the bushing and spacers. Periodic inspections and greasing of the scissors links are required to assure satisfactory operation of the parts at all times.

Finally, the axle assembly (87-31-520) is installed on the bottom end of the piston and is secured by two bolts (AN-28-54), nut (AN320-8), and cotter (AN380-3C-4). The piston and axle assembly must butt together with no clearance. The clip (87-34-038) may be added to the assembly when the landing gear is installed on the wing panel.

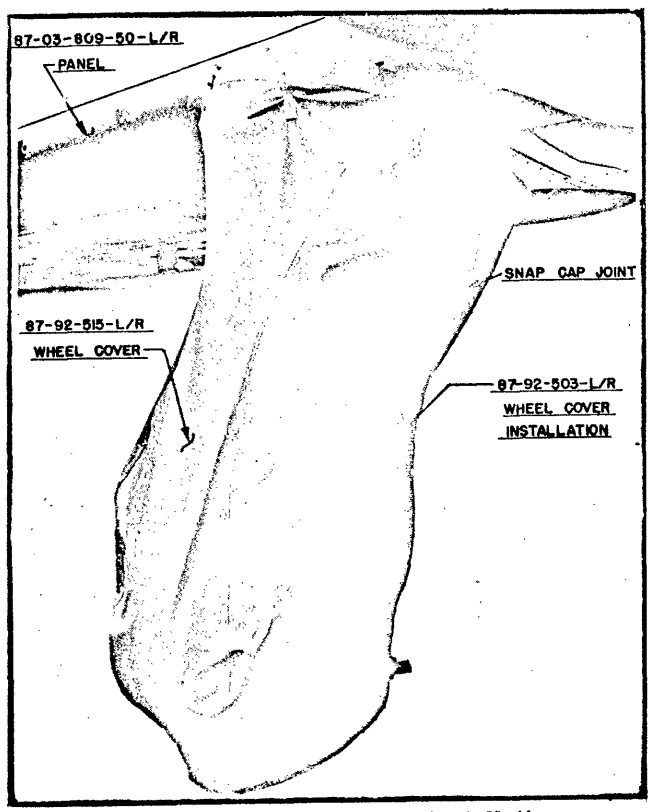


Figure 58 - Wheel Cover Installation

(c) When the airplane is moored in the desert or any other place where there is an excess of dirt, sand, or foreign material blowing through the atmosphere, the special wheel cover assemblies should be installed to protect the oleo strut piston surface from being scratched and pitted by sand or dirt and grit that might work its way in between the piston and cylinder surfaces. To attach the wheel cover installation, insert the seven hooks in the eyes provided on the flush head screws which fasten the landing gear fairing to the leading edge and under surface of the wing. Close the cover with the ten snaps on the lap joint.

(6) To Disassemble the Master Brake Cylinder Units.

(a) Remove the transfer valve assembly using a 7/16 wrench. Then unscrew the disc retainer at the inner end of the transfer valve assembly with a 7/16 wrench. Remove the disc, wash, blow out, and clean all parts.

(b) Remove the lock screws, locating the upper and lower end fittings. In the manufacture of the unit, the end fittings are lined up and machined together with the housing or cylinder to which they belong. If disassembling more than one unit at a time, it is important to keep the parts of the different units separate. Remove, by unscrewing, both end fittings, turn the unit upside down and remove the cotter pin and nut, which will be found at the lower end. If the piston rod turns with the nut, insert a clean wooden hammer handle into the open end of the cylinder, which is now pointing down, and press on the handle. This will force the piston rod with the nut up and offer a chance to hold the rod under the nut. After the nut has been removed, the two halves of the unit can be pulled apart. One half is the "Housing Complete Assembly" containing the parking spring and ratchet; the other is the "Cylinder - Complete Assembly" and "Transfer Valve Assembly" containing all parts which have to do with the hydraulic operation of the unit. Proceed with the disassembling of the cylinder assembly as follows:

Pushing gently on the piston rod protruding from the cylinder assembly, the rod and piston assembly can be pushed out of the cylinder. The lower rubber cup will either come out with the rod or stay in the cylinder, either of which is satisfactory. After the lower rubber cup, lower spring washer, and return spring have been removed, hold the assembly by the upper spring washer, which partly extends into the upper rubber cup, and tap the end of the piston rod gently on a wooden board if necessary. This will cause the washer to slide off and then the "U" retainer which fits into the groove of the rod can be removed. Next, pull off the rubber cup. After this has been done, remove the cotter pin at the opposite end of the piston rod which retains a small washer and light spring and remove both. Next, hold the piston tightly in a vice with copper covered jaws to prevent marring. Grip it only at the head end of the piston to prevent distortion, which would cause binding of the threads, when removing the piston rod retaining nut, screwed into the piston. After that has been done, the rod can be pulled out of the piston, and the seat formed by the shoulder of the rod and the inside of the piston can be inspected and cleaned. If the seat is found badly damaged due to a hard particle in the fluid, it is recommended that the rod and piston be replaced by a new piston rod lapping assembly which includes the rod, piston, and retaining nut. While the rod is out, inspect the drilled passages in it for obstructions by blowing through them.

(c) It will normally not be found necessary to remove the parking spring from the housing - complete assembly. If for some reason it is desired, proceed as follows: Remove the ratchet return springs, place a 1-5/8 diam. by 2 in. long bar on end on the table of an arbor press and set the housing, with the slotted guides pointing downward, over it. By doing so the load, when applied, will not be taken on the slender guides extending downward. Cut two 3/4 in. wide by 1 in. deep slots at one end of an approximately 6 in. long piece of 1-3/4 in. diameter tubing. Place this piece on the spring guide with the slots straddling the yoke. Turn the ratchet to allow the yoke to move down, apply pressure with the arbor press to deflect the parking spring until the top face of the spring is flush with the bottom of the "windows" in the housing, through which the yoke extends. While holding the spring in this position, lift the yoke and pull it out sideways through the "window". The spring and guide can then be removed.

(d) Any parts found worn should be replaced by new parts.

(7) To Assemble the Master Brake Cylinder.

(a) When reassembling the master brake cylinder, hold the transfer valve assembly upside down, drop in the disc and make sure it lies flat on its seat to avoid damaging it when screwing in the retainer. Before reinstalling the transfer valve assembly, make sure that the gasket is in place at the bottom of the well in the cylinder and that it is in good shape. This gasket has nothing to do with the filling and bleeding of the system, but must hold tight against the pressure in the system when the unit is in operation. It may be easier to reinstall the valve assembly if the gland and the two packings are removed from the valve before it is screwed in part way, so that the start of the thread is approximately flush with the top surface. The two packings are then installed into the well, one at a time, and the gland nut is screwed on.

(b) Before assembling, grease the entire inside of the housing with heavy grease of high melting point, preferably rocker arm lubricant, A.F. Spec. 3560, for corrosion protection. When installing the parking spring, be careful not to let the spring snap up against the light bridge on the casting as this may damage the part.

(c) The assembling operation is an exact reverse of the disassembling operation and is briefly outlined below:

1. Insert the piston rod into the piston, then assemble and tighten the retaining nut. Install the light valve spring, washer and cotter pin. Next, slip the upper rubber cup over the rod. Do not forget the "U" retainer under the upper spring washer since the unit will not operate if it is left out. After this washer is in place, hold the piston end down (long end up), place the return spring on the washer and then the lower washer on the spring. If the lower cup came out of the cylinder, slip it over the rod next. Holding the valve in this upside down position, to insure proper position of the return spring on the washers, put some brake fluid on the cups to facilitate their sliding into the cylinder, and then slide the cylinder over the rod assembly, looking through the hole in the opposite end of the cylinder to properly line up the rod. A gentle push on the rod will cause the cups to slip into the bore. Next, slip the housing complete assembly over the rod protruding from the cylinder. Insert a clean wooden hammer handle into the open end of the cylinder and press on it. This will cause the rod to come through the housing assembly so that the nut can be installed. The shaft should protrude not more than 1/32 to 3/64 in. over the nut as it would otherwise hit the end fitting. After a cotter pin has been inserted, grease the threads and end face of the lower fitting with heavy grease and screw it on, until the holes for the locating screw line up. During the last few turns the heavy parking spring is being depressed and causes considerable drag. Use some heavy grease on the threads of the upper end fitting and locating screw, as this will protect the threads from corrosion and seal them against slight seepage during the filling and bleeding operation. If desired, a non-hardening sealing compound, such as key paste, may be used. Apply sparingly to keep the grease or compound away from the brake fluid which is in contact with the upper end fitting.

2. If the nipple or elbow installed in the 1/4 in. pipe tapped hole in the cylinder has been removed, or if it is being installed in a new replacement unit, thread lubricant, A.F. Spec. 3571, should be used on the threads.

e. To Adjust Landing Gear Position Indicator Mechanism. (See figure 28.) - For additional information, see "Adjustment", paragraph 2. u. section III.

8. Tail Wheel Assembly. (Drawing 87-37-901)

a. General.

(1) The tail wheel assembly consists of a standard steerable knuckle unit, equipped with a wheel and a 12-1/2 in. diameter, 4 ply rayon, smooth contour casing, statically grounded and a pneudraulic strut. The wheel disengages its steering splines at $30^{\circ} \pm 2^{\circ}$ and will then castor through 360°. The cables connecting the horn to the pedals are equipped with springs to reduce taxiing shocks in the pedals and the control system. When retracted, the tail wheel is enclosed by clam shell shaped doors, which form the under surface of the fuselage about the wheel. The tire should be inflated to 60 lbs./sq.in. pressure.

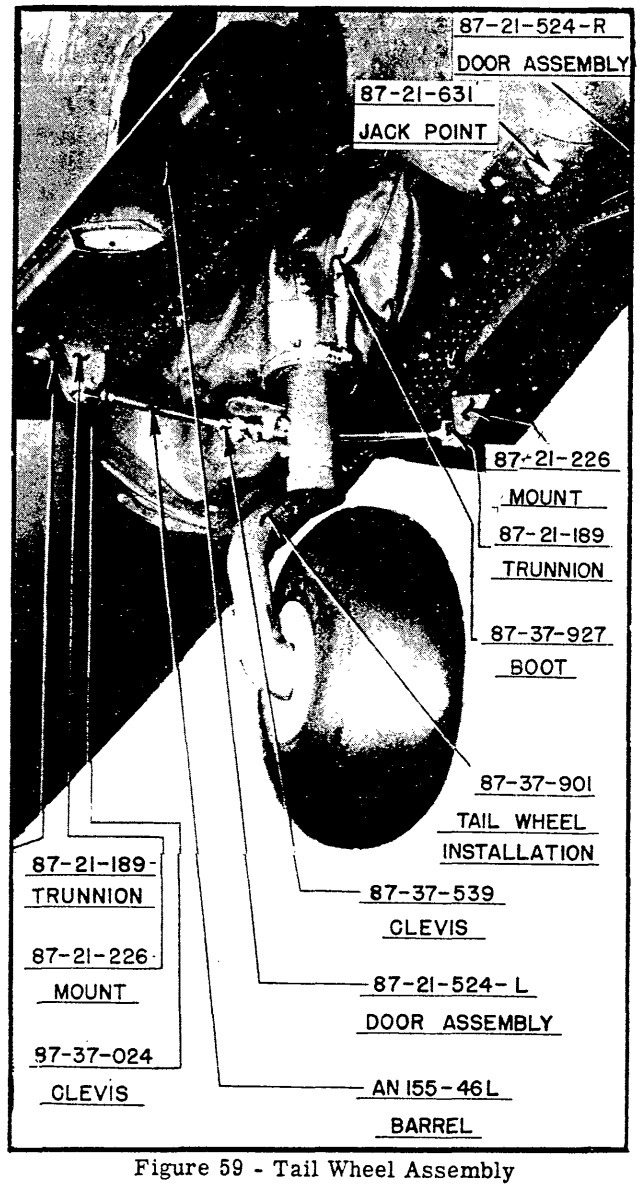


Figure 59 - Tail Wheel Assembly

(2) The retracting mechanism consists of a hydraulic retracting strut (87-37-905) mounted on the fuselage frames No. 13 and No. 14. (See figure 61.) The piston rod extends forward from the cylinder and carries a lug to which the upper end of the oleo strut is attached by a bolt. A long piston rod guide rod extends forward of station No. 11 and is supported by braces from stations No. 11 and No. 12. During retraction, the piston and rod are forced forward carrying the upper oleo support with it. The oleo strut

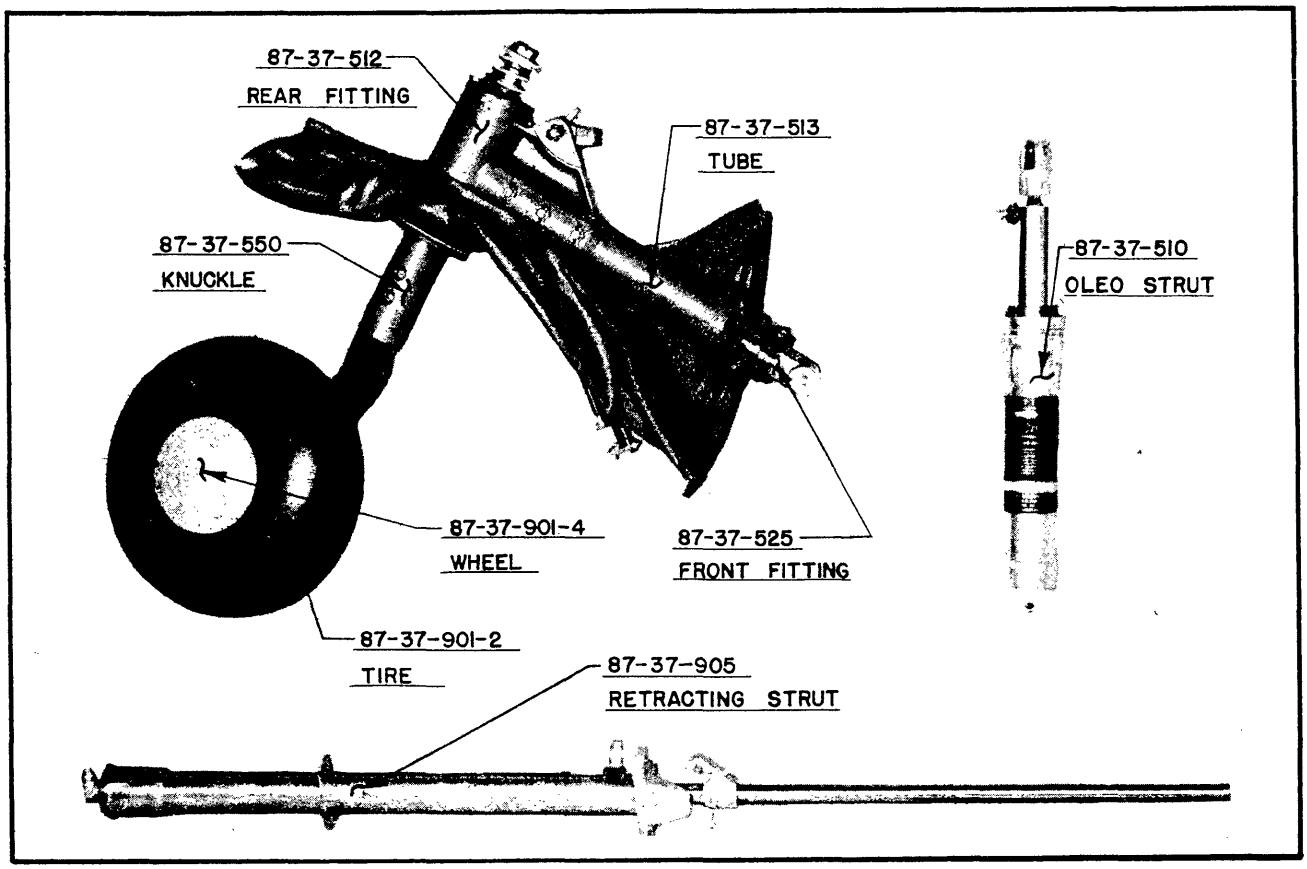


Figure 60 - Tail Wheel Assembly Disassembled

(87-37-510) is attached by a 3/8 in. diameter bolt directly to the lug on the retracting strut piston. For general instructions covering air-oil shock absorber struts, see T. O. No. 03-25E-1. For information on the operation of the retracting strut and mechanical lock, see paragraph 18. a. (8) of this section. The position indicator transmitter, connected electrically to the position indicator instrument on the instrument panel, is mounted just aft of station No. 12.

b. Installation and Disassembly.

(1) To Remove the Tail Wheel Assembly.

(a) Disconnect the tail wheel door turnbuckles at the doors.

(b) Remove the screws around the edges of the boot.

(c) Disconnect the tail wheel steering cables.

(d) Disconnect the oleo strut at the lower end.

(e) Disconnect the drag link from the fuselage by removing the two hinge bolts at the forward end.

(f) Remove the tail wheel and drag link thru the tail wheel door opening.

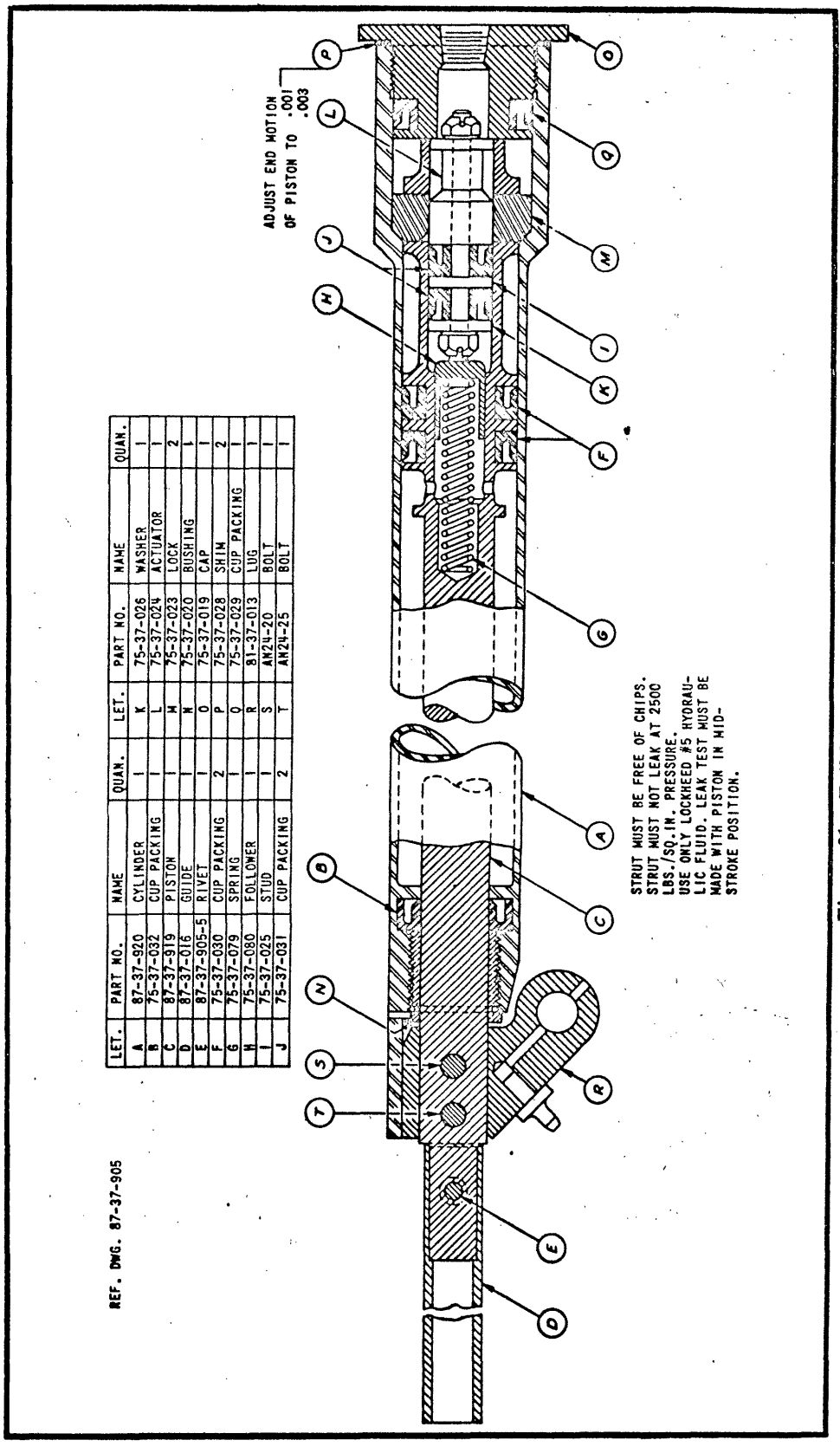
(g) Remove the bolt at the upper end of the oleo strut and remove the strut through the door opening.

(h) Disconnect the hydraulic lines to the retracting strut, and disconnect the position indicator link.

(i) Remove the two bolts at the front and two bolts at the center of the strut with the piston held in the full aft position, lower the rear end of the strut, at the same time moving it aft until the piston rod is free from the guide.

(2) To Assemble the Shock Absorber Strut. - In assembling the oleo strut, care must be taken in screwing the packing gland nut into the cylinder. Under no condition shall the gland be tightened so as to compress the packing excessively. A pressure test at 2500 lb./sq.in. must show no sign of leakage.

c. Adjustment of the Tail Wheel Doors Upon Installation. - After the tail wheel shock absorber strut is installed in the airplane, the adjustable links to the tail wheel doors must be adjusted. With the tail wheel in the retracted position, install the turnbuckle on one side only; attach to the door and adjust the turnbuckle and then disconnect the upper end. Repeat for the opposite side. Lower the tail wheel and attach the turnbuckles.



LET.	PART NO.	NAME	QUAN.
A	87-37-920	CYLINDER	1
B	75-37-032	CUP PACKING	1
C	87-37-919	PISTON	1
D	87-37-016	GUIDE	1
E	87-37-905-5	RIVET	1
F	75-37-030	CUP PACKING	2
G	75-37-079	SPRING	1
H	75-37-080	FOLLOWER	1
I	75-37-025	STUD	1
J	75-37-031	CUP PACKING	2
K	75-37-026	WASHER	1
L	75-37-024	ACTUATOR	1
M	75-37-023	LOCK	2
N	75-37-020	BUSHING	1
O	75-37-019	CAP	1
P	75-37-028	SHIM	2
Q	75-37-029	CUP PACKING	1
R	81-37-013	LUG	1
S	AN24-20	BOLT	1
T	AN24-25	BOLT	1

Figure 61 - Tail Wheel Retracting Strut

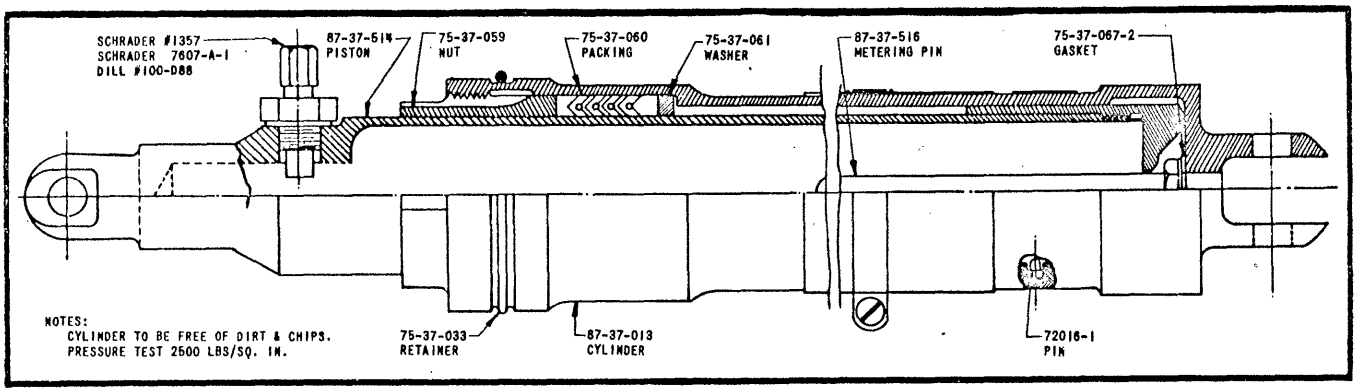


Figure 62 - Tail Wheel Oleo Strut

d. To Adjust the Tail Wheel Position Indicator Mechanism. - Follow the method outlined for the landing gear in paragraph 2. u. of section III. The length of the actuating arm at the transmitter shaft may have to be changed, more for a corresponding change in image travel than for the landing gear mechanism. The transmitter is accessible through the hand hole on the right side of the fuselage immediately forward of the horizontal stabilizer.

9. Engine and Accessories.

a. Engine.

(1) General. - The V-1710-39 engine is attached to vibration absorbers at sixteen points, and the vibration absorbers are, in turn, attached to the engine mount frame at eight points. (See figure 33 and 34.)

(2) Exhaust System. - The anti-glare, flame-dampening exhaust stacks project directly out from the cylinders through the cowling and exhaust into the slip stream.

(3) Carburetor Air Intake System. (Drawing 87-29-713). The carburetor cold air intake is a scoop built into the top of the engine cowl. Two butterfly valves, controlled by the same push-pull handle in the cockpit, limit the flow of hot and cold air into the carburetor, as desired. The cold air valve is located in the scoop assembly forward of the scoop elbow to the carburetor attachment. The hot air valve is located in the aft wall of the scoop elbow at the entrance of the hot air duct into the scoop, just above the carburetor. Hot air is taken from the radiator exit duct and transmitted through a large flexible tube up to the cold air scoop. When the handle in the cockpit is pushed in, it opens the cold air valve and closes the hot air valve. When the control handle is pulled out, it shuts off the cold air and releases the hot air. Any intermediate position of the control handle will produce a mixture of both hot and cold air. A carburetor air screen is installed to prevent the passage of any foreign matter into the carburetor. The carburetor air control should always be in the cold position when starting the engine. For a diagram of the carburetor air intake control. (See figure 69.)

a. A sand cover is provided with the special tools and equipment. This sand cover is made of cork and is two inches thick. The cap is plugged into the air scoop front casting opening, to prevent sand and other foreign material from entering the scoop, when the airplane is moored in the open. There are two finger holes bored into the cork at a 30° angle, 3 inches apart and 1-1/4 inches deep, to facilitate the removal of the cap when the airplane is prepared for flight.

(4) Rubber Seals. - Since the carburetor, oil temperature regulator and coolant radiator air intake systems are of the ramming type, it is essential that rubber seals be used to close the gaps between sections of the intake systems and to absorb vibration.

b. Ice Guard. - Provision has been made for installing an ice guard at the carburetor air scoop forward end casting. It is inserted into the casting and held in place by four screws.

WARNING: Ice guards should not be used except where absolutely necessary, as the critical altitude of the airplane is drastically affected.

c. Accessories. - All power plant accessories may be removed without removing the engine or any part of the airplane structure. The accessories mounted on the engine are as follows:

(1) Starter - Eclipse - Type F-2

(2) Generator - Eclipse - Type M-2 - T. O. No. 03-5AA-1

(3) Vacuum Pump - Type B-6

(4) Fuel Pump - Type G-9

(5) Tachometer 27930

(6) Propeller Governor 100,006-1

d. Removal and Disassembly.

(1) To Replace the Complete Power Plant Assembly - The following instructions are given for the removal of the power plant, including the mount and the accessories attached to it:

(a) Remove all engine cowling.

(b) Drain the following:

1. Coolant System

Figure 63 - Tail Wheel Position Transmitter

2. Oil System

3. Fuel System (Excluding the Tanks)

(c) The propeller and spinner should be removed. (See paragraph 11.b. this section.)

(d) Remove the cowl shutters and shutter former as a single unit.

(e) Remove the oil inlet temperature capillary bulb, coil capillary and attach to the firewall.

(f) Disconnect the following on the right-hand side of the airplane, forward of the firewall.

1. Cowl Shutter Control Assembly.

a. Remove the push-pull rods from the bell crank on the firewall.

b. Disconnect the brace from the lower right-hand engine mount by removing the two attaching bolts.

c. Detach the inboard support assembly, on the leading edge at the wing match angle, by removing the two attaching bolts.

2. The 1-1/2 in. O.D. oil return line from the oil regulator on the right-hand forward side of the coolant tank.

3. The 1-1/2 in. O.D. oil inlet line at the hose connection on the right-hand bottom side, forward of "Y" drain cock. (On the right leading edge.)

4. The 1/2 in. O.D. coolant vent line at the top of the expansion tank. (Tank to cylinder heads.)

5. Disconnect the coolant overflow line on the right-hand side of the coolant tank.

6. Disconnect the conduit to the booster coil box at the plug on its inboard side.

(g) Disconnect the following on the right side of the airplane at the firewall:

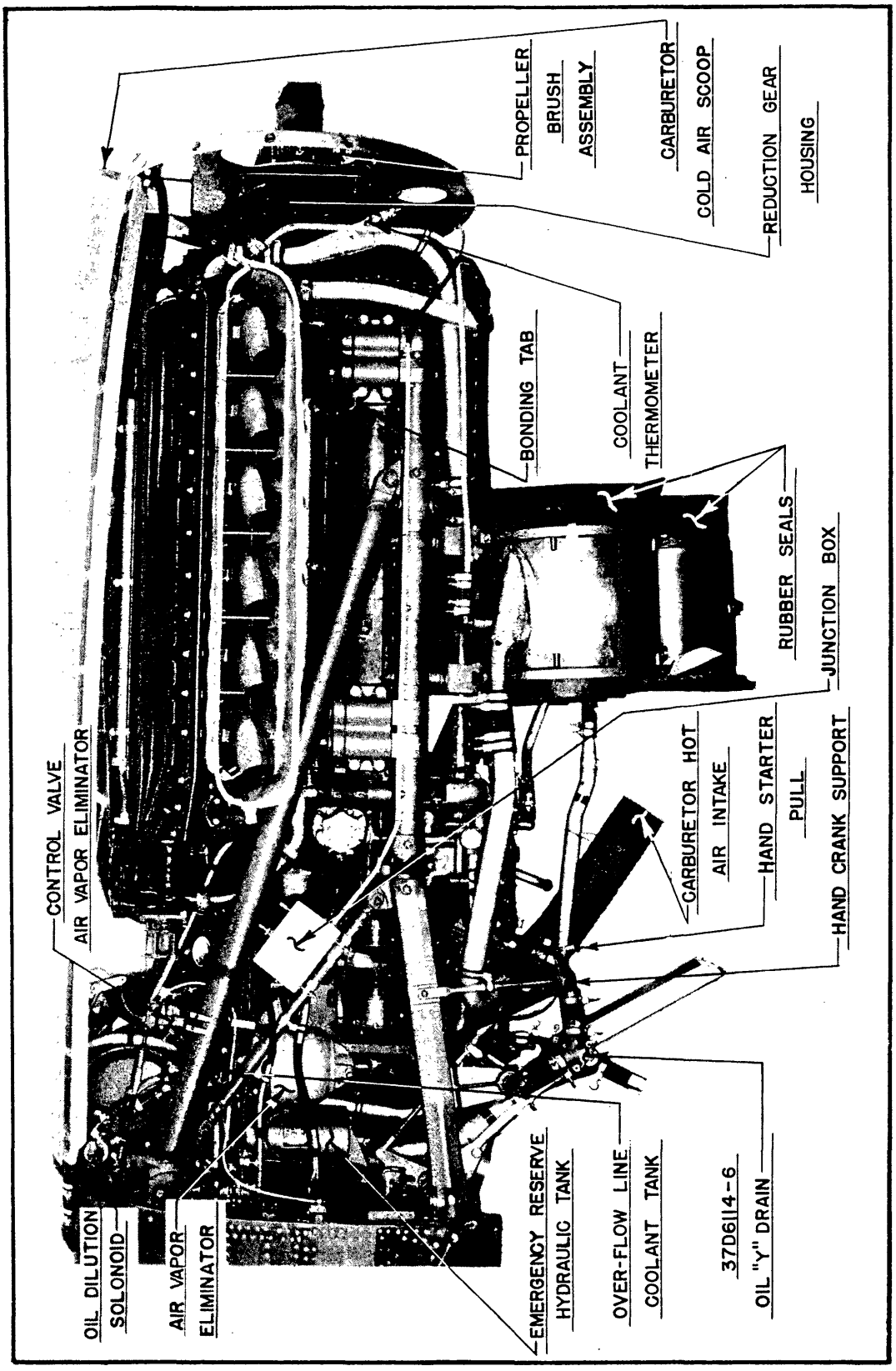


Figure 64 - Power Plant - Right-Hand Side

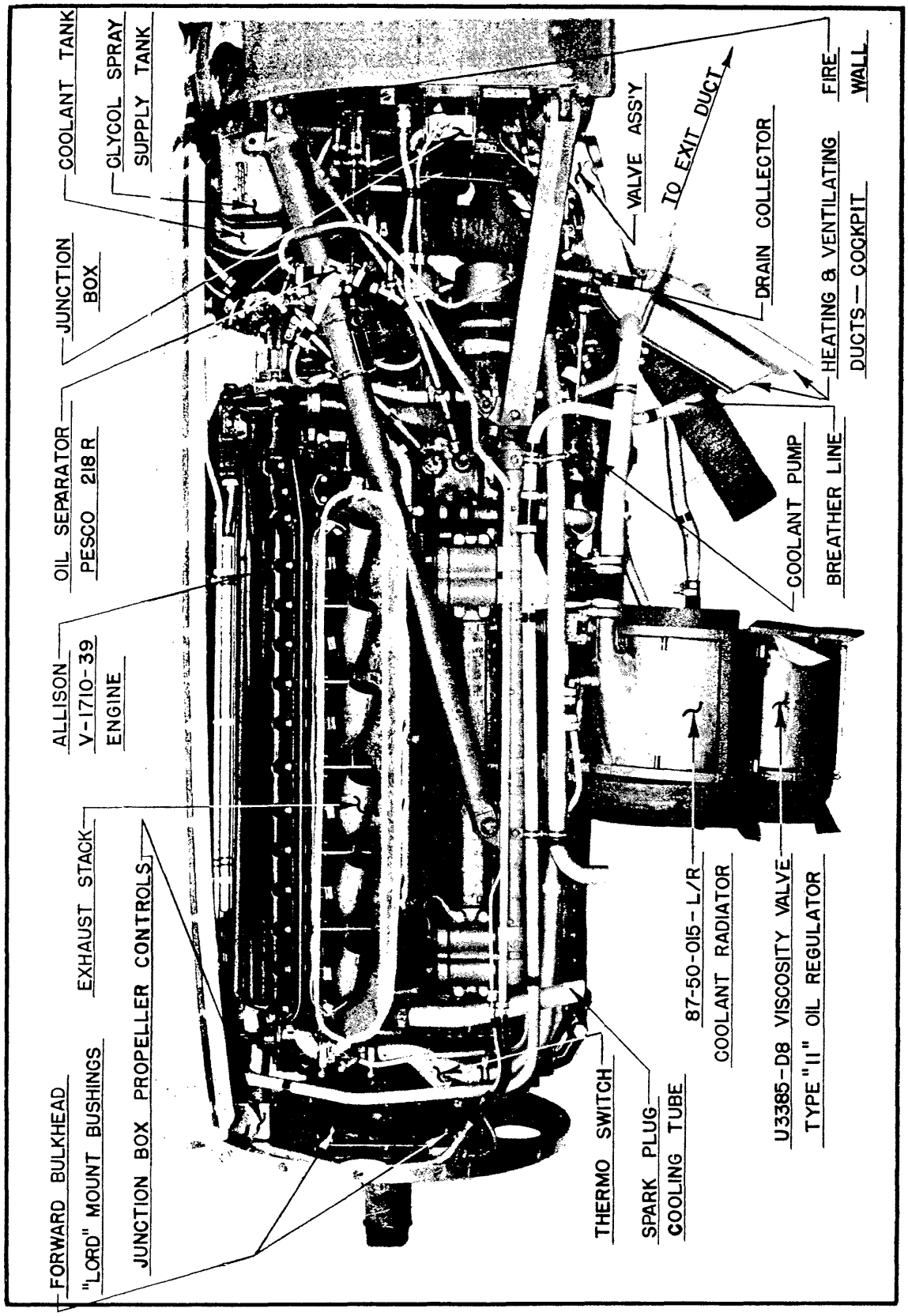


Figure 65 - Power Plant - Left-Hand Side

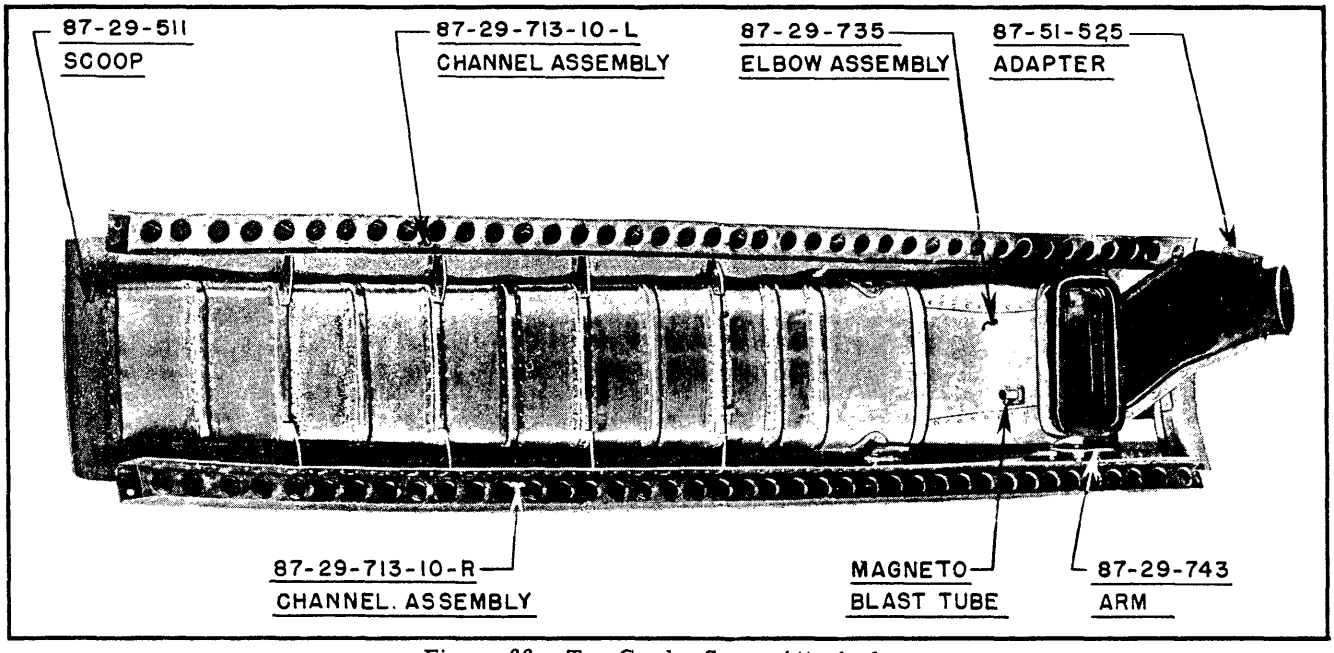


Figure 66 - Top Cowl - Scoop Attached

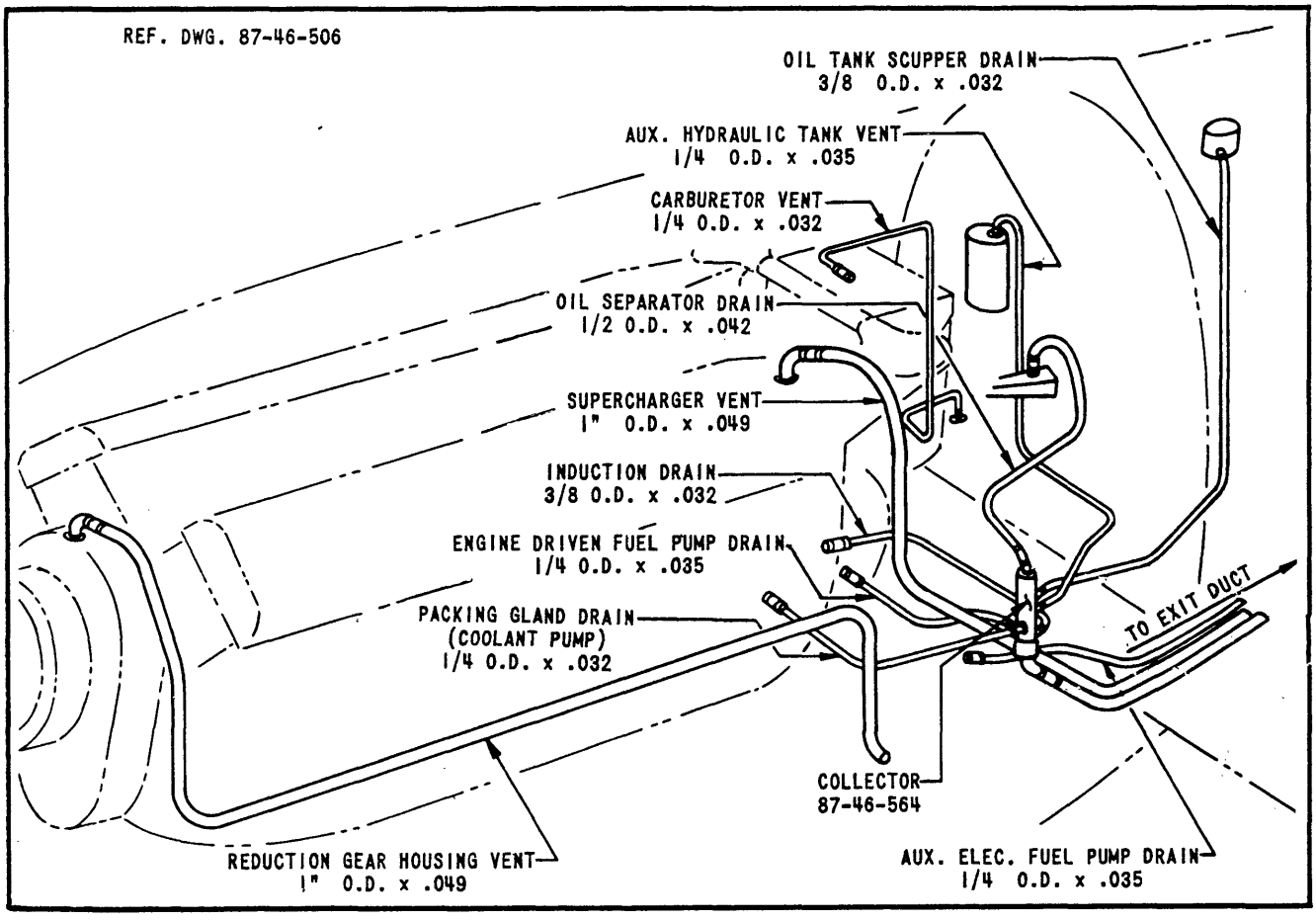


Figure 67 - Breather and Vent Installation

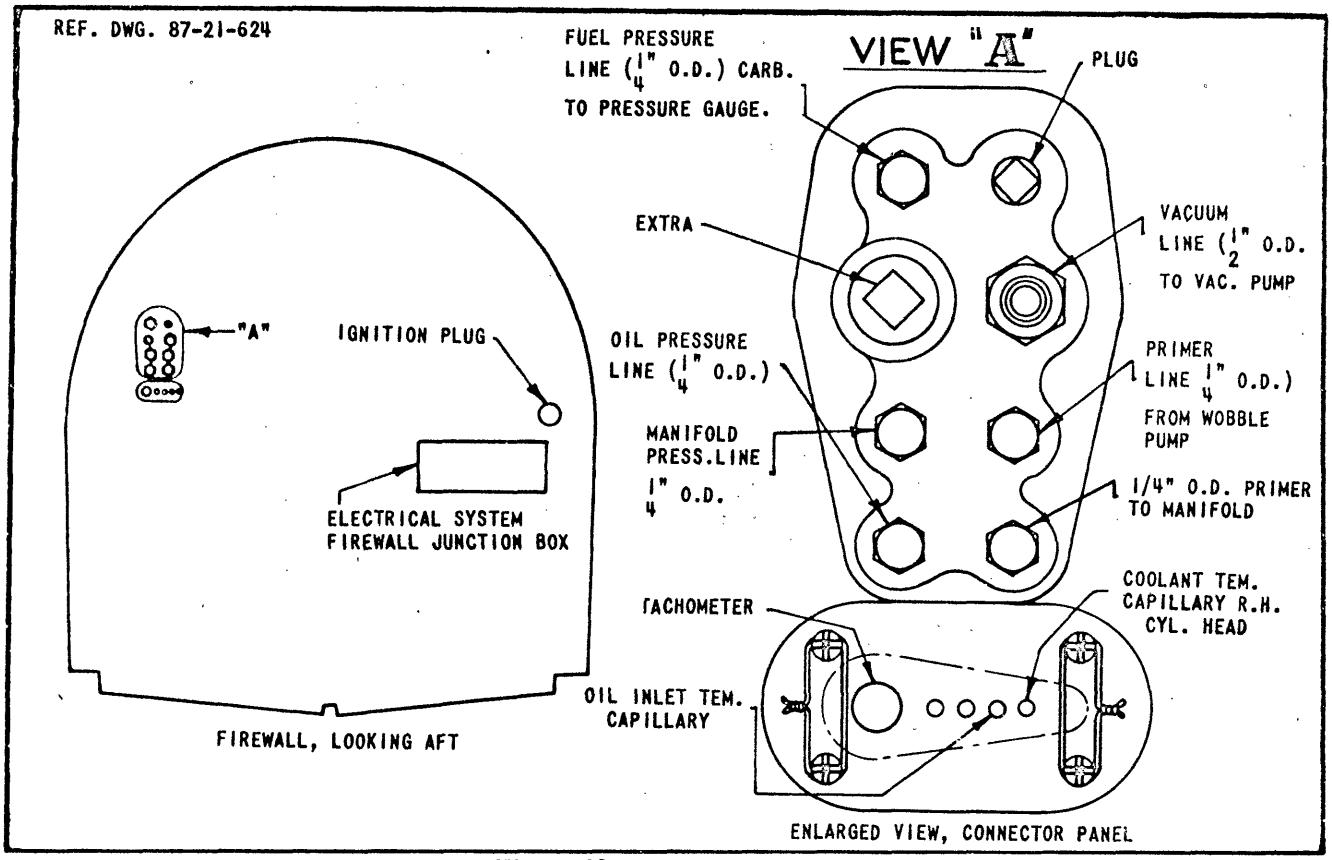


Figure 68 - Connector Panel

1. The 1/4 in. O.D. oil dilution "IN" line at the hose connection above the oil dilution valve.

2. The 1/4 in. O.D. oil pressure line at the connector panel, (lower outboard connection) on right top of the firewall.

3. The 1/4 in. O.D. mainfold line at the connector panel. (Second lowest outboard connection.)

4. The 1/4 in. O.D. fuel pressure line at the connector panel. (Top outboard connection.)

5. The 1/2 in. vacuum line at the connector panel. (Second top inboard connection.)

6. The 1/4 in. O.D. primer line at connector panel. (Bottom inboard connection.)

7. The 1/4 in. O.D. primer line at the connector panel. (Second bottom inboard connection.)

8. The tachometer line at the connector panel. (Bottom group of connections outboard.)

9. Carburetor air intake valve control at the firewall bell crank.

10. Remove the right-hand heating duct at the junction to the valve housing assembly.

(h) Disconnect the following on the left-hand side of the airplane forward of the firewall.

1. The 1/2 in. O.D. oil vent lines at the tee connection on the left-hand top forward side of the coolant tank.

2. Remove the fuel line to the engine fuel pump at the electric auxiliary pump.

3. Disconnect the propeller governor control rod at the bell crank forward of the firewall.

(i) Disconnect the following on the left-hand side of the airplane at the firewall.

1. Break all electrical connections at the junction box:

a. The engine coolant outlet temperature conduit (outboard connection).

b. The generator conduit (top outboard connection).

c. The starter conduit (center top connection).

d. The carburetor heat control conduit (inboard top connection).

e. The fuel air thermometer conduit at the junction to the engine.

2. The propeller governor and pitch control conduit at the firewall, (outboard and above the junction box).

3. The ignition cable at the firewall, (inboard of the propeller governor control connection). Ground the plug in the special socket provided on the engine mount.

4. Disconnect the throttle control at the bell crank forward of the firewall.

5. Disconnect the mixture control at the bell crank forward of the firewall.

6. Disconnect the propeller control at the bell crank on the firewall.

7. Disconnect the hose from the left-hand cockpit heating duct to the oil tank compartment, and remove the heating duct at the junction to the valve housing assembly.

8. Disconnect the 1 in. O.D. breather line, from the top of the supercharger housing to the exit duct at the hose connection, inboard of the engine mount truss assembly.

9. Disconnect the 3/4 in. O.D. line from the drain collector on the engine mount truss assembly to the exit duct at the elbow below the collector.

10. Disconnect the 1/4 in. O.D. vent line from the auxiliary hydraulic tank on the firewall to the drain collector, at the collector.

11. Disconnect the 3/8 in. O.D. oil tank scupper drain line at the drain collector.

(j) At the centerline of the airplane:

1. Disconnect the carburetor vent line at the top, rear of the carburetor.

2. Remove the coolant line between the expansion tank and the coolant pump. (Connection on the bottom of the tank.)

(k) Attach the engine hoisting sling to the engine and relieve the strain on the engine mount attaching bolts.

(l) Remove the two 3/4 in. bolts, one on the left and one on the right, which hold the lower engine mount casting to the fuselage frame.

(m) Remove the two 1/2 in. bolts, one on the left and one on the right, which hold the top engine mount to the fuselage.

(n) Remove the two 5/16 in. bolts which attach the engine mount "V" brace to the firewall at the bottom on the centerline.

(o) The power plant must be moved directly forward, without being raised or lowered, until the parts remaining on the fuselage have been cleared.

e. To Reinstall the Power Plant Assembly. - Reverse the procedure outlined above for the removal of the power plant.

f. To Remove the Power Plant from the Mount. - Follow the procedure outlined in item (a) to (k) in paragraph c. (1) of this section, then proceed as follows:

(1) Remove the following connections on the right-hand side of the engine.

(a) The coolant temperature line at the junction to the coolant tube, forward of the right-hand cylinder bank.

(b) The 1-3/4 in. O.D. engine outlet coolant tube, at the hose connection preceding its entrance into the right-hand cylinder bank, at the front of the engine.

(c) The 1/2 in. O.D. vent line to the right-hand cooler, at the connection on the forward right side of the cylinder bank. Remove the tube by breaking the connection at the cooler.

(d) Remove the booster coil box on the engine mount brace by breaking the connections on the top and inboard side. Remove the clips holding the oil temperature line to the lower mount, and remove the conduit and box as one unit.

(e) The carburetor heat control rod at the connection to the bell crank on the carburetor air intake.

(f) The 1/4 in. oil pressure line at the connection to the engine on the rear lower side.

(g) The 1/2 in. O.D. oil vent line at its connection aft of the right cylinder bank.

(h) The 1/4 in. vent line at the connection to the carburetor on the top right-hand side.

(i) The spark plug air cooling line from the right air intake duct.

(j) Remove 3/4 in. fuel line from the fuel pump to the air vapor eliminator.

(k) Remove 3/4 in. fuel line from the air vapor eliminator to the carburetor.

(l) Remove the air vapor eliminator assembly by removing the four bolts attaching its support at the top to the engine mount, and one bolt attaching it at the bottom.

(2) Remove the following connections on the left-hand side of the engine.

(a) The 1-3/4 in. engine outlet coolant tube, at the connection preceding its entrance into the left-hand cylinder bank, at the front of the engine.

(b) The coolant temperature line at its junction with the coolant tube, at the forward end of the engine.

(c) The 1/2 in. O.D. vent to the cooler at the connection on the left side of the cylinder bank. Remove the tube by breaking the connection at the left-hand cooler.

(d) The 1/4 in. O.D. drain line at the fuel pump. Break the line at the drain collector and remove.

(e) The 1/2 in. O.D. oil vent line at its connection aft of the left-hand cylinder bank.

(f) The 1/4 in. line at the engine connection in the rear. Break the connection at the bottom of the oil separator and remove the tube.

(g) The 1/2 in. vacuum gage line at the outboard connection on the vacuum pump.

(h) The mixture control rod at the connection on left-hand side of carburetor.

(i) The throttle control rod at the connection on the left-hand side of the carburetor.

(j) The propeller control rod at the bell crank connection aft of the left-hand cylinder bank. Remove the push-pull rod.

(k) The spark plug air cooling line from the left air intake duct to the left cylinder bank.

(l) The fuel air intake from the left air intake duct.

(3) Remove the following connections on top of the engine.

(a) The electrical propeller control conduit at its connection to the propeller governor.

(b) The 1 in. O.D. front breather line at the hose connection on top of the engine, forward of the cylinder banks, and remove the tube and clips attached to the lower engine mount.

(c) The 1/4 in. O.D. primer line at the connection on top of the engine.

(d) The 1 in. O.D. rear breather line at the connection to the rear of the engine between the end of the cylinder banks. Break the connection at the drain collector and remove the tube.

(e) The 5/8 in. supercharger vent line at the connection adjacent to the rear breather connection.

(f) The two 1/4 in. O.D. distributor drain lines at their rear inboard connection to the engine, on the right and left cylinder banks.

(g) The 1/4 in. O.D. fuel pressure line at the connection to the carburetor.

(h) The ignition cable at its cross connection, at the rear of the engine, in front of the carburetor air intake.

(4) Remove the following connections on the bottom of the engine.

(a) The 1 in. O.D. oil outlet line. Break the hose connection at the engine outlet on the rear of the engine, and at the hose connection to the top of the oil regulator, and remove the tube.

(b) The 1-3/4 in. O.D. tube on the left-hand coolant pump inlet, at the hose connection to the pump on the rear of the engine.

(c) The 1-3/4 in. O.D. tube, right-hand coolant pump inlet at the hose connection to the pump on the rear of the engine.

(d) The 1 in. O.D. drain line at the hose connection on the rear of the engine at the coolant pump inlet.

(e) The 1 in. O.D. expansion tank outlet at the hose connection on the rear of the engine, at the coolant pump inlet.

(f) The 1/4 in. O.D. tube, coolant pump packing gland drain, on the left-hand side. Coolant pump to collector drain.

(g) The 1-1/2 in. O.D. oil inlet line at the connection to the engine on the right-hand side.

(h) The 1-1/2 in. O.D. oil return line. Break at the hose connection on the oil regulator.

(i) Remove the air inlet ducts from the coolant and oil radiators, by disconnecting the clamps which hold the duct seals to the radiators.

(j) Remove the oil and coolant radiators as one unit, by removing the 8 bolts attaching the support installation to the fittings on the lower engine mount.

(5) Remove the following connections at the back of the engine.

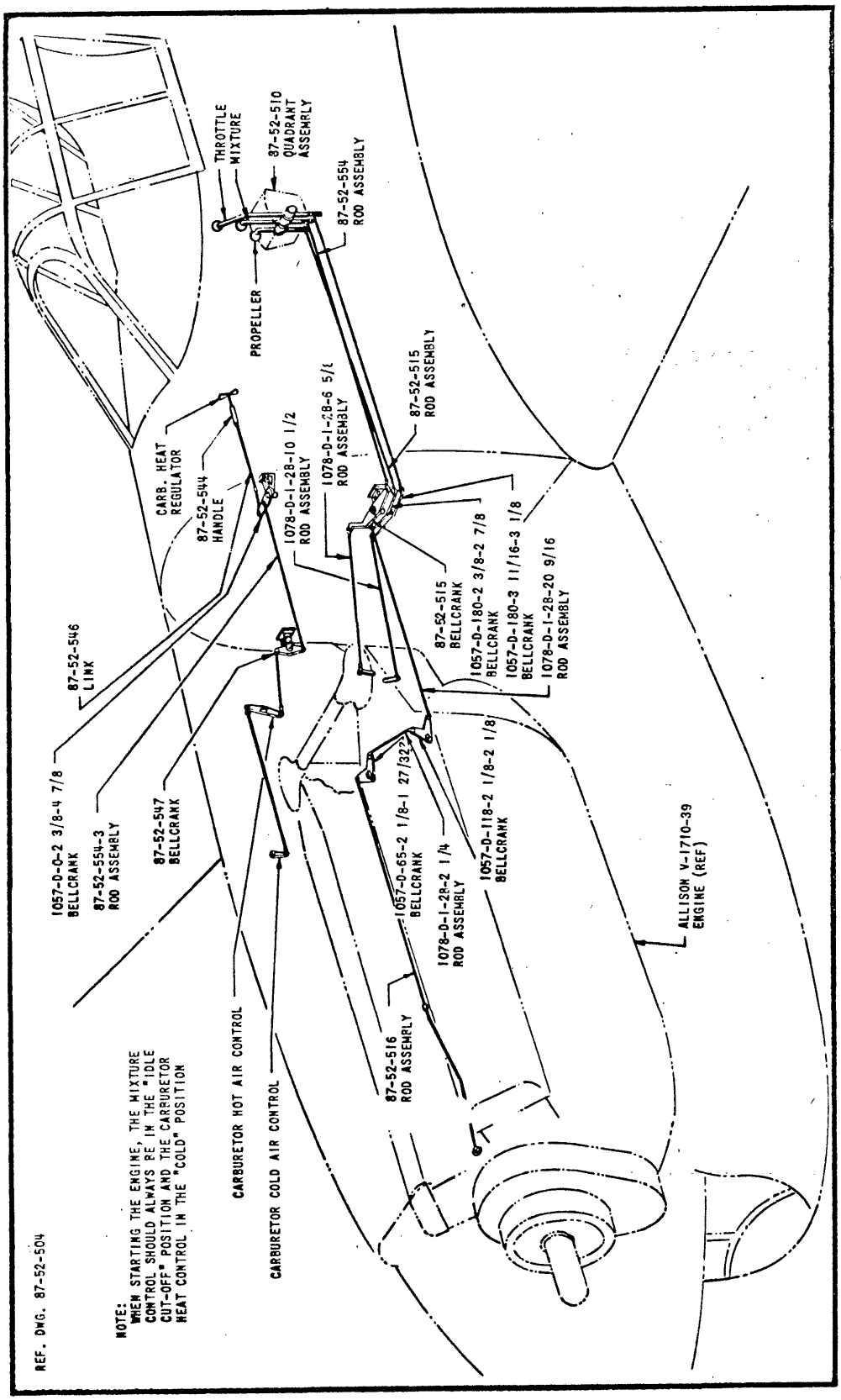


Figure 69 - Engine Controls

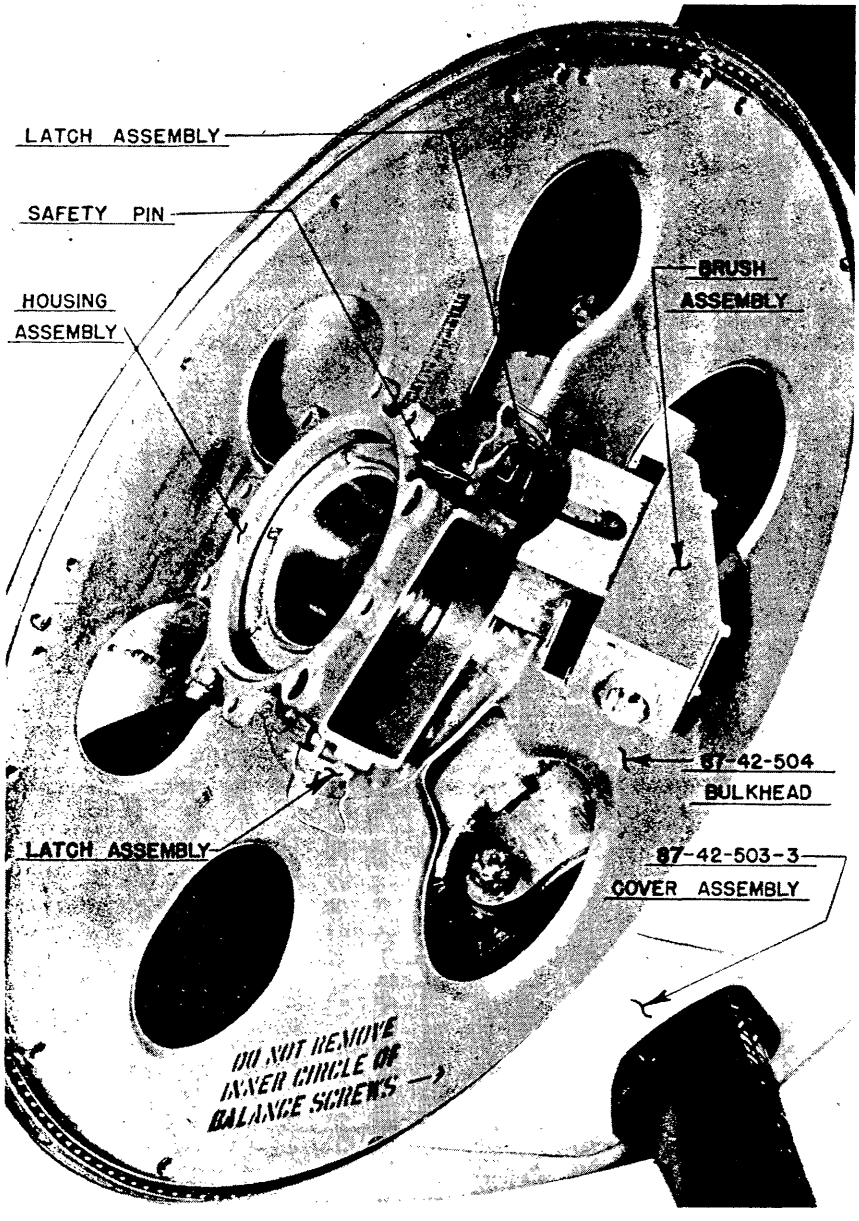


Figure 70 - Propeller Assembly Brush Holder Removed

(a) The 1/4 in. oil dilution line at the connection to the oil dilution "Y" at the back of the carburetor.

(b) The generator cable at the connection on top of the generator.

(c) The 3/4 in. I.D. fuel line at the outboard connection on the fuel pump. Break the connection at the tee connection to the electric auxiliary pump and remove the tube.

(d) The starter conduit at the junction to the starter box.

(e) Remove the following connections at the front of the engine.

(a) Break all connections to the propeller junction box mounted on the aft side (top center) of the forward engine bulkhead.

(b) Remove the forward engine bulkhead.

(7) Remove the sixteen bolts attaching the engine vibration absorbers to the engine, and remove the mount sideways.

9a. To Effect Interchangeable Installation of Allison Engines V1710-39 Standard and V1710-73 Alternate.

The following procedure will be followed:

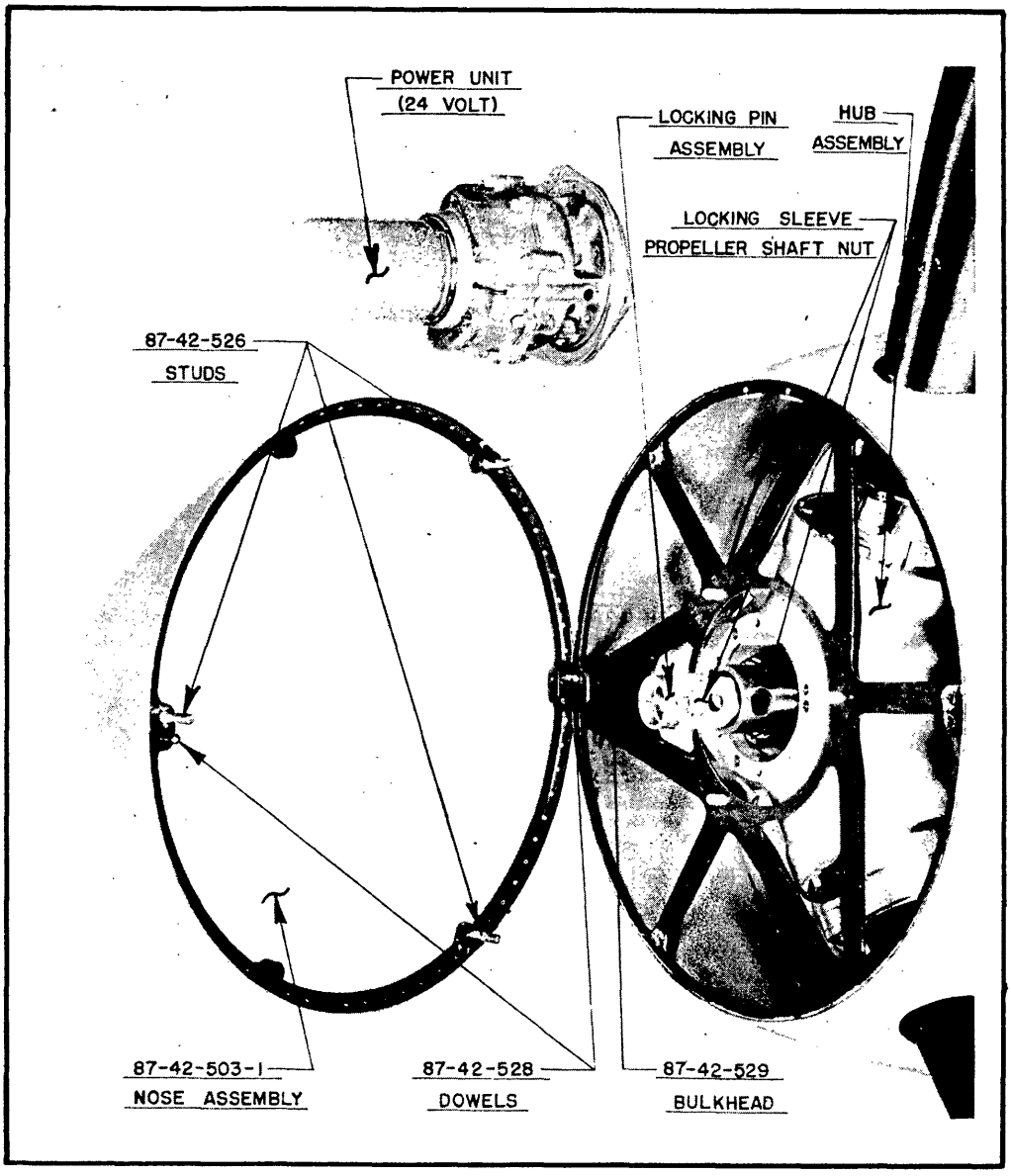


Figure 71 - Propeller Assembly - Power Unit & Locking Devices

a. Remove the Allison V1710-39 engine from the airplane in accordance with paragraph 9.d.(1) of this Handbook.

b. Install the Allison V1710-73 engine in the airplane, reversing the procedure outlined for the removal of the power plant, in accordance with paragraph 9.d.(1) of this Handbook.

NOTE: Engine controls, wiring, oil, coolant, and vent lines are interchangeable except for the following:

c. Install the new 87-46-712 gasket and the new 87-46-577 elbow to the oil pressure pump. Remove the AN771-1 drain cock from the oil pressure pump elbow of the removed V1710-39 engine and install the drain cock to the 87-46-577 oil pressure pump elbow on the V1710-73 engine.

d. Install the new 851-16 elbow to the front breather exit of the V1710-73 engine. The front engine breather line from the removed V1710-39 engine connects to the new 851-16 installed elbow, with the 884-16-14 hose and two FBA-14 clamps.

e. Remove all clamps, hose, tubes and fittings except the oil pressure pump elbow and the front engine breather elbow from the removed V1710-39 engine, and install them on the V1710-73 engine.

NOTE: No. 1. The 87-46-501-1 oil outlet line when installed on the V1710-73 engine must be removed to get access to the oil drain plug, when it is necessary to pre-oil the engine.

NOTE: No. 2. If the V1710-73 engine is equipped with automatic manifold pressure regulator, the engine can only be installed in an airplane with engine controls for the regu-

lator. Where the airplane has no controls for the automatic manifold pressure regulator, the regulator shall be removed from the engine before installation or engine controls be installed in the airplane in accordance with the T. O. No. 01-25C-112, Installation of Automatic Pressure Regulator. If it is necessary to remove the automatic manifold pressure regulator from the engine, the following operations are necessary:

1. Remove the 3/8 in. N.P.T. tee from the lower hole on the left side of the accessories drive housing and install a 3/8 in. N.P.T. pipe plug in its place.

2. If the accessories drive housing contains a pressure oilhole located in a boss just below the front corner of the electric tachometer drive mounting pad, on the left side, the 1/4 in. N.P.T. 3/8 in. oil pressure elbow shall be removed and a 1/4 in. N.P.T. plug installed in its place.

3. Remove the 90 degree 1/8 in. elbow, located on top of the larger center manifold just back of the manifold tee, and install a 1/8 in. pipe plug in its place.

4. Install one new AN73-3 drilled head bolt with one new 960-B10 washer at the supercharger air pressure inlet passage, located just below the middle stud of the regulator mounting pad which is on the left side of the accessories drive housing.

10. Engine Controls. (Drawing 87-52-504)

Engine and propeller controls are described in the Handbook of Operation and Flight Instructions, T. O. No. 03-20B-1. (See figure 69.)

11. Propeller.

a. Installation, maintenance and repair instructions for the Curtiss electrically controlled, three blade, Dural, constant speed, controllable pitch propeller and governor, installed on this airplane, are contained in T. O. No. 03-20B-1.

b. To Remove the Propeller and Spinner Assembly.

(1) Operate the propeller to maximum low pitch.

(2) Remove the right-hand section of the engine cowl, and work through the hand holes in the forward engine cowl bulkhead.

(3) Disconnect the flexible conduit from the brush holder cap assembly.

(4) Remove the safety pin from the top and bottom brush holder latch assembly.

(5) Raise the brush holder latches and remove the brush holder cap carefully, to avoid damage to the brushes.

(6) Remove the three elastic stop nuts, attaching the spinner nose cone to the aft section, and remove the nose cone.

(7) Remove the cap screws and the three nuts from

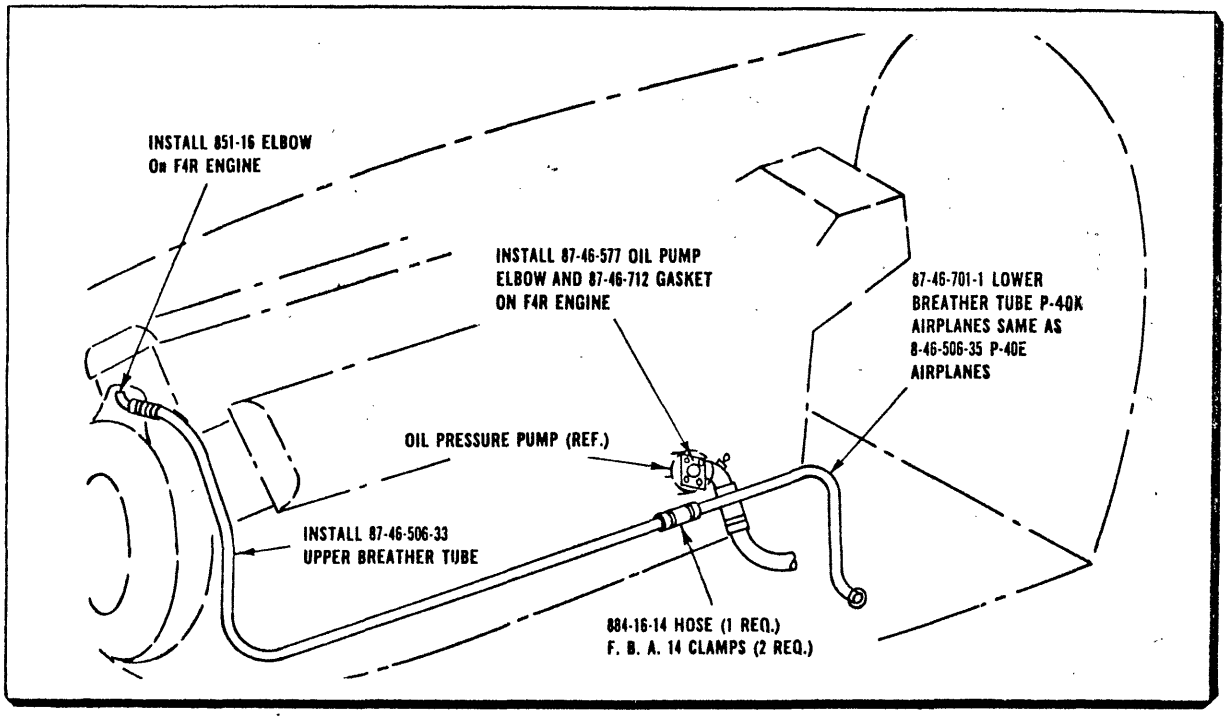


Figure 71A - Interchangeable Installation V1710-39 & V1710-73 Allison Engines

the flange of the propeller power unit assembly; remove the power unit assembly, the neoprene seal, and the grease seal from the propeller.

(8) Remove the locking pin assembly, the locking sleeve, and insert a bar completely through the two holes in the propeller shaft nut and turn the nut off.

(9) The propeller may now be removed from the propeller shaft. Exercise extreme care when removing the propeller, to avoid damage to the propeller shaft threads. The propeller weighs approximately 375 pounds. Therefore, it is advisable to use at least three men to remove this assembly. Place the propeller in a suitable buck. NEVER allow the blades to support the weight of the propeller. (See figure 70 and 71.)

c. To Remove the Aft Section of the Propeller Spinner From the Propeller Hub.

(1) Remove the screws from the three cover assemblies, on the outer surface of the spinner aft section, and remove the covers.

(2) Remove the outer circle of screws from the rear of the aft bulkhead. DO NOT DISTURB THE INNER CIRCLE OF BALANCE SCREWS.

d. To Remove the Aft Bulkhead From the Propeller Hub.

(1) Remove the nine nuts and bolts from the inner flange of the propeller hub and lift the bulkhead from the hub.

e. To Assemble the Aft Bulkhead to the Propeller Hub. - Reverse the procedure noted in paragraph d.

f. To Assemble the Aft Section of the Propeller Spinner to the Propeller Hub. - Reverse procedure as noted in paragraph c.

g. To Assemble the Propeller and Spinner on the Propeller Shaft. - Reverse the procedure as noted in paragraph b.(1) through (9).

CAUTION: The propeller spinner assembly on each airplane has been statically and dynamically balanced. After any damage whatever to a spinner which may have destroyed the balance, it must be rebalanced, or replaced by a correctly balanced spinner.

12. Starting System.

a. The engine is cranked by a hand electric inertia

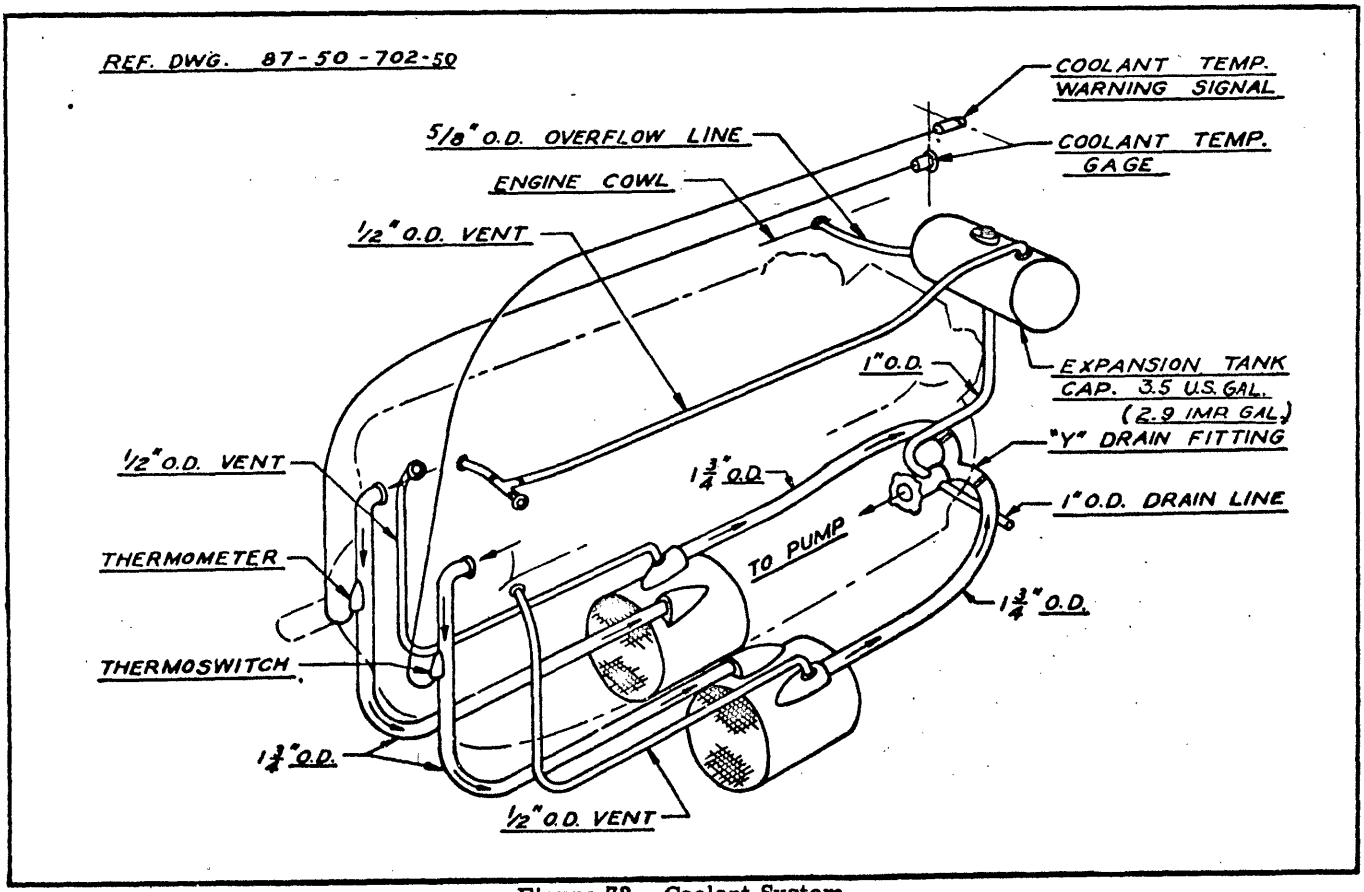


Figure 72 - Coolant System

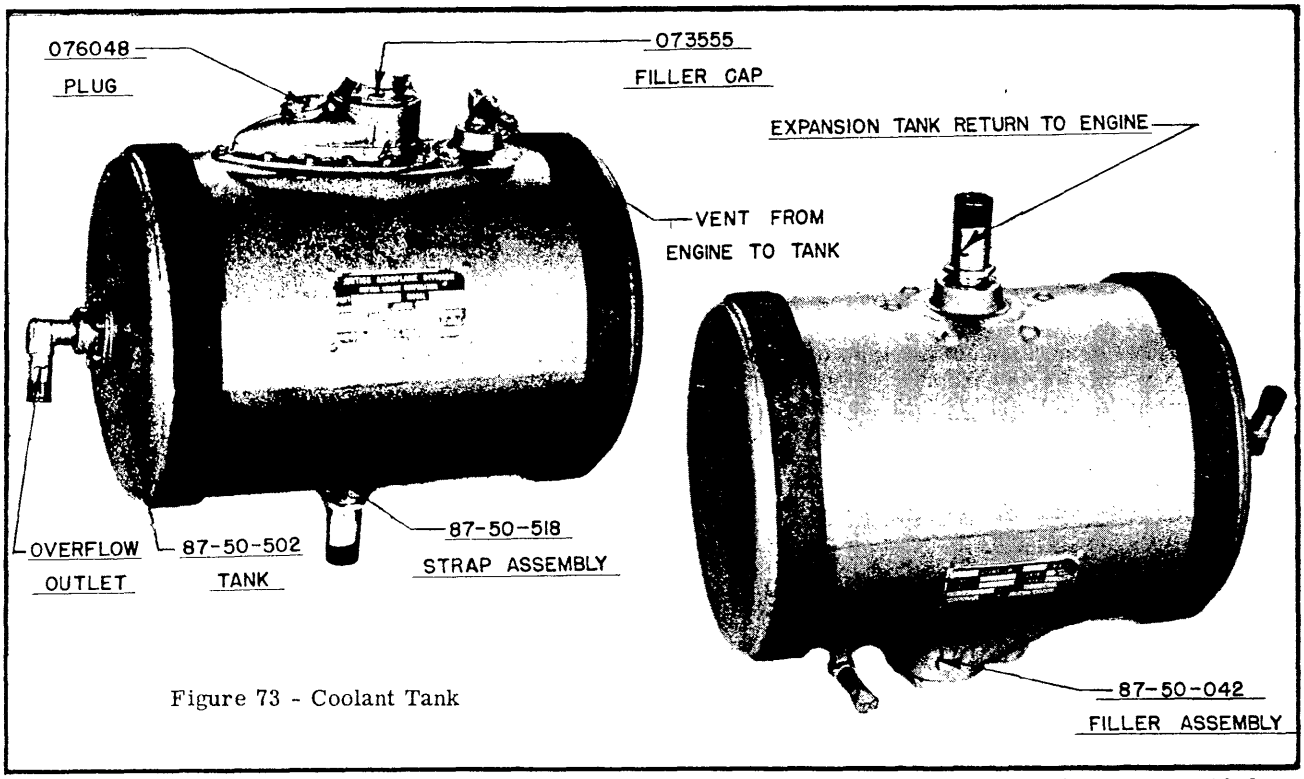


Figure 73 - Coolant Tank

starter, Type F-2. A foot treadle on the cockpit floor is pushed back to operate a Type B-11 starter switch which allows a direct flow of current from the battery to the starter motor. When the starter has reached the desired speed, the foot treadle is pushed forward, actuating a Type C-1 starter meshing solenoid and cuts in the booster coil; also, by the same movement of the foot treadle, the starter switch contact is broken. The first few impulses of the engine is starting will automatically disengage the starter.

b. In case of a battery failure, the starter may be cranked by hand with the crank and extension provided for this purpose. (The crank and extension shaft are stowed in the baggage compartment.) (See figure 47.) The engagement of the starter will then be accomplished by a pull on the hand starter button, located immediately below the crank opening on the right-hand engine cowl.

CAUTION: The starter crank and extension must be removed immediately after cranking, and before actuating the starter pull.

13. Coolant System. (Drawing 87-50-702-50)

a. General. - The engine is liquid cooled. A centrifugal coolant pump is mounted on the bottom of the accessory housing. The two pump outlets are connected by pipes to manifold cast along the cylinder jackets. From these manifolds the coolant is metered by orifices to each cylinder. Individual steel sleeves direct the flow up each cylinder barrel to the hottest portions of the cylinder head. Outlets are provided on each end of the cylinder blocks. For a diagram of the coolant system, see figure 72. The filler cap is in the top of the expansion tank, and is accessible through a door in the top engine cowl. The expansion tank contains a relief valve which opens when pressure in the system exceeds atmospheric pressure by 3 lbs., allowing a mixture of coolant and air to pass through the overflow line. A small check-valve, connecting the vent passage directly to the tank, opens when atmospheric pressure exceeds tank pressure by 1/2 lb. The top forward part of each cylinder jacket is vented directly to the expansion tank. Additional vent lines containing restrictions are installed between the outboard, forward boss on the cylinder jackets and the coolant radiators.

b. To Fill the Coolant System.

(1) A certain amount of air will be left in the forward cylinder jackets when filling the coolant system in the three-point position, consequently the expansion tank must be filled to the top. The system will hold approximately 15 gallons and two quarts (12.1 Imperial gallons) when filled in accordance with the following recommended procedure, which requires ten minutes. With the system completely drained, pour in the coolant, taking care that none flows into and thru the overflow, until the liquid rises in the filler neck. This operation requires five minutes to add approximately 12 gallons (9.6 Imperial gallons) of liquid. Add the remaining three gallons over a period of five minutes. Start the engine and operate until the coolant reaches

a temperature of 85° C. (1850° F.). Stop the engine, wait five minutes and investigate the coolant level; If necessary, make additions to bring it up to the proper level.

c. Thermo-Switch. - The thermo-switch (87-66-233) is located in the coolant return line, above and slightly forward of the front face of the left-hand coolant radiator. The switch should be adjusted to actuate the coolant warning light at a temperature of 120° C. ±2° (248° F.). The switch may be adjusted while the engine is running as follows:

(1) Remove the left-hand engine cowling.

(2) Remove the locking wire.

(3) Remove the thermo-switch bulb.

(a) Unscrew the knurled conduit nut.

(b) Unscrew the aluminum alloy hexagonal nut from the bulb. Hold the hexagonal of the bulb, during this operation, to prevent rotation of the bulb.

(4) The adjusting screw is in the center of the bulb and may be turned with a screwdriver. Clockwise rotation lowers the temperature, and counterclockwise raised the temperature. (Example: If the warning light functions at 110° C. (230° F.), turn adjustment screws counterclockwise until it functions at 120° C. (248° F.).

(5) The amount of rotation for a given temperature difference varies with the individual bulb. Therefore, it will be necessary to turn the screw one complete revolution, place the assembly in the coolant line, and determine the change in the reading. Then knowing the change a full turn will produce, the amount of turns to produce the required setting may be computed.

(6) Upon completion of the adjustment reinstall, and tighten both nuts on the assembly.

d. Repair of Radiator Cores. (See T. O. No. 03-15-4)

e. To Drain the Coolant System.

(1) Remove all the engine cowling with the exception of the top center cowl.

NOTE: If the cowling is removed from more than one airplane at a time, it is recommended that the cowl be marked with the serial number of the airplane from which it was removed. This procedure will avoid confusion and delay when reinstalling the cowling.

(2) Open the expansion tank filler cap access door and remove the filler cap.

(3) Remove the lockwire from the drain plugs at the aft underside of each radiator.

(4) Remove the drain plugs and allow the liquid to drain into suitable containers.

CAUTION: When reinstalling the drain plugs after draining the system, be certain that the plugs are safetied with lockwire.

NOTE: The coolant is not expendable; therefore, it should be strained and returned to the coolant system in the airplane.

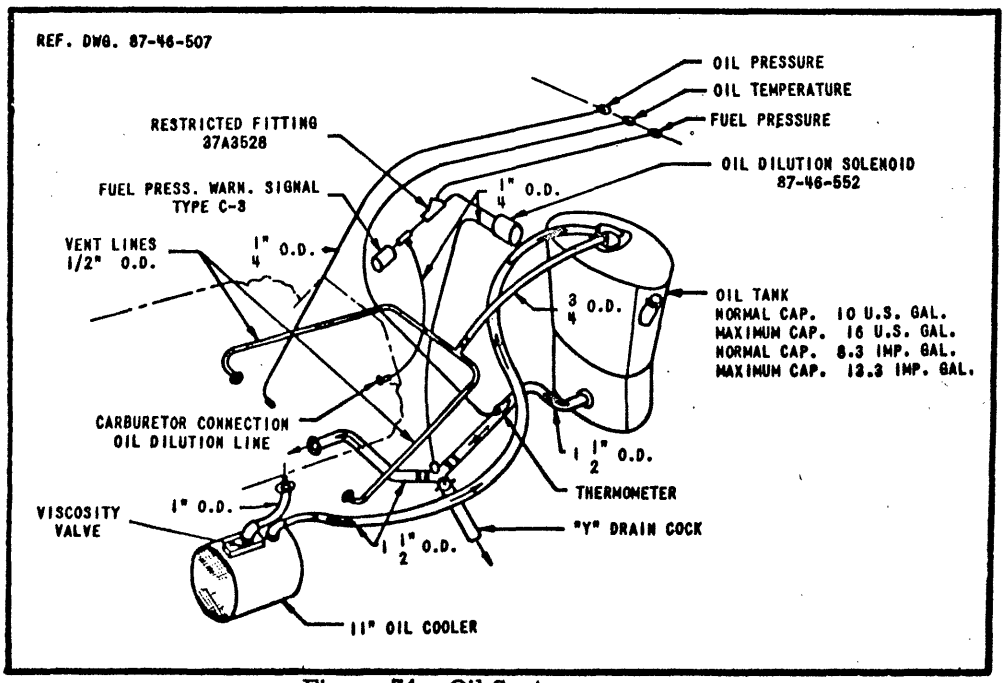


Figure 74 - Oil System

14. Oil System. (Drawing 87-46-507)

a. General.

(1) Oil flows from the bottom of the oil tank through a line in which is incorporated the "Y" drain cock, to the oil inlet connection on engine, where it is circulated by one pressure and two scavenging pumps of the simple gear type. The pressure and main scavenging pumps are arranged in the unit at the right of the accessory housing. The oil supply is delivered from the oil tank to the exterior of the "Cuno" strainer, through a check valve, which arranged to prevent oil entering the stopped engine from the oil tank,

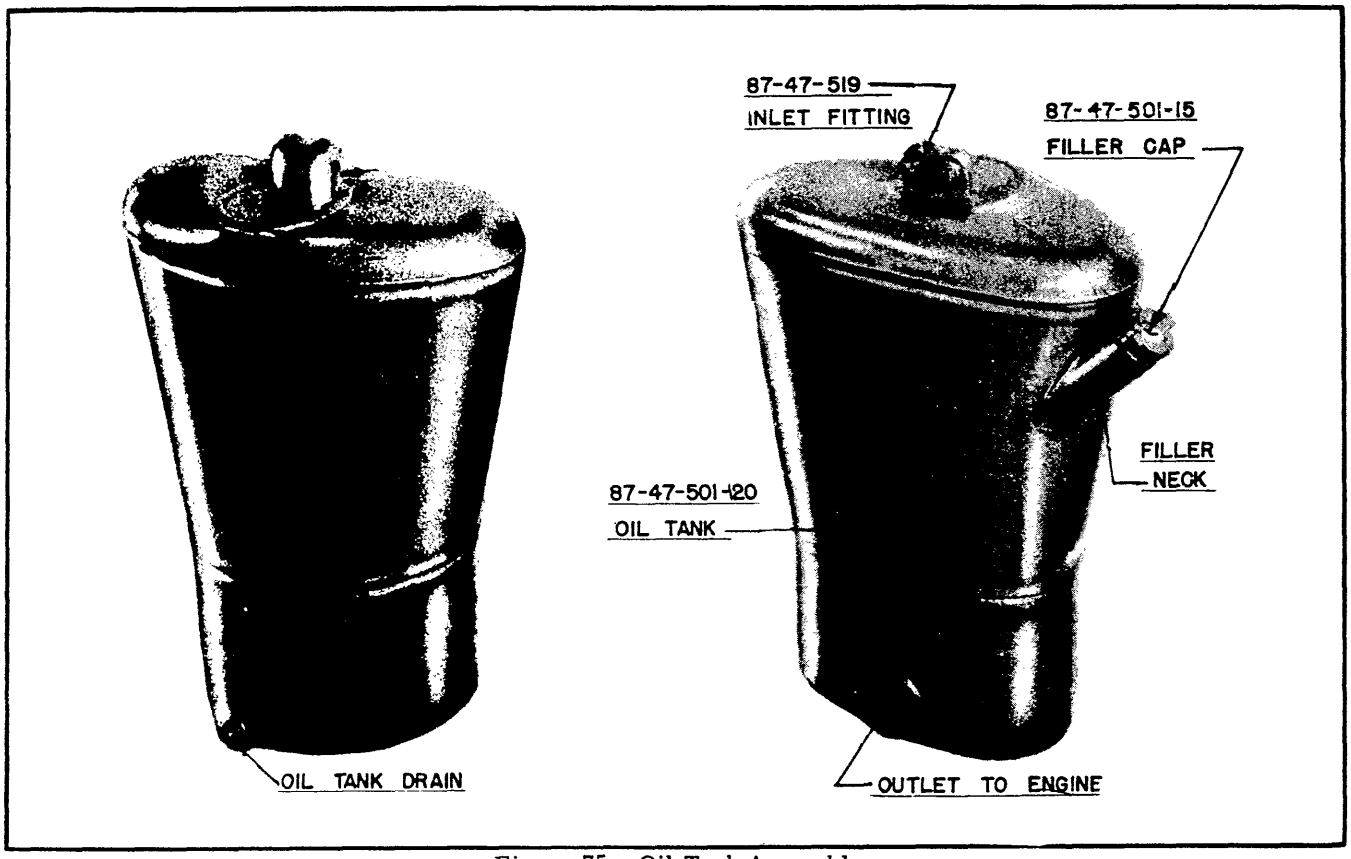


Figure 75 - Oil Tank Assembly

unless a head of 3 lbs./sq.in. pressure is exceeded. The "Cuno" strainer is equipped with a safety-by-pass valve set to open at a pressure drop exceeding 100 lbs./sq. in. Oil pressure at the outlet of the "Cuno" strainer is transmitted to the piston of a spring-opposed relief valve, which by-passes excess oil directly from the outlet to the inlet of the pressure pump. This arrangement maintains a constant oil pressure at the strainer outlet, with increasing strainer restriction, within the limit of the pump capacity. The relief valve is accessible for cleaning or adjusting to change the oil pressure, without removal of the oil pump.

(2) The oil tank is located aft of the firewall and forward of the armor plate installation, at station No. 2, and is accessible by removing the fuselage cover between the firewall and windshield. The oil tank contains a hopper having a capacity of 1.5 U.S. gallons (1.2 Imperial gallons). The normal tank capacity is 10 U.S. gallons (8.3 Imperial gallons) and the maximum capacity is 16 gallons (12.8 Imperial gallons). The filler cap is reached by means of an access door on the left top of the fuselage forward of the windshield. The normal oil level in a cold system can be obtained by using the rivet that extends through the filler neck as a reference line and servicing the tank approximately three (3) inches below the pin level. Two 1/2 in. O.D. vent tubes, one from the right and the other from the left side of the engine, drain to the tank. All discharge lines in the oil system are collected in one drain collector, mounted on the left-hand engine mount truss assembly. Climbs up to 60° and dives up to 90° will be performed only with 1/3 or more of the maximum oil capacity. The oil tank is equipped with a pendulum assembly at the oil outlet, which has a travel vertically of 75° and horizontally of 15° either side of the pendulum centerline. When the oil tank is removed from the fuselage, the pendulum may be removed from the tank for inspection, by following the procedure outlined in paragraph c.

(3) An oil temperature regulator is installed in the return line from the engine to the tank. Incorporated in the regulator is a viscosity type by-pass valve, which controls the flow of oil through the cooler core and the jacket of the cooler, as required to maintain the correct oil inlet temperature to the engine. This "Viscosity" valve is entirely automatic, and no adjustment is to be made except by the manufacturer. A flexible tube from the left-hand cockpit heating duct to the oil tank compartment helps to maintain a normal temperature in the tank compartment, and guards against a too heavy oil viscosity due to low temperatures encountered in high altitude flying.

(4) For easier starting in cold weather, an oil dilution system is used, which introduces a quantity

of gasoline into the oil inlet line at the "Y" drain cock, before stopping the engine. The flow is controlled by a valve which is actuated by a solenoid, and is energized by a switch in the cockpit. (For instructions on oil dilution, see T. O. No. 02-1-29.)

NOTE: For ground temperatures below -9.4°C. (15° F), the 4-inch plywood discs should be installed.

(5) Supercharger Drain Line. - The supercharger vent line, on the rear side of the motor adjacent to the rear breather line, drains into the drain collector.

(6) Distributor Drain Lines. - The distributor housing drain lines are provided from the distributor housing to the drain collector, on the left-hand engine mount truss assembly.

(7) There are no strainers in the oil system except the "Cuno" filter installed in the engine.

b. To Remove the Oil Tank.

(1) Drain the oil system at the "Y" drain cock and the plug on the end of the 1/2 in. O.D. oil tank drain line, inboard of the "Y" drain.

(2) Disconnect the two lines at the top of the oil tank. (Oil return line and vent line.)

(3) Disconnect the engine inlet line at the tank.

(4) Disconnect the oil tank drain on the bottom of the rear of the tank.

(5) Remove the cover on top of the fuselage between stations 1 and 2.

(6) Detach the upper cradle assembly by removing the four bolts holding it to the fuselage.

(7) Disconnect the scupper drain line at the fitting below the scupper.

(8) Remove the tank from the rubber mountings in the lower cradle by raising straight up.

c. To Remove and Disassemble the Oil Tank Pendulum Assembly.

(1) Remove the ten screws that fasten the bottom inspection cover to the tank plate and remove the cover.

(2) Hold the pendulum assembly with one hand, through the bottom inspection hole, while removing the six screws which attach the pendulum assembly to the oil outlet plate.

(3) Carefully remove the pendulum assembly through the inspection hole.

(4) The pendulum may now be disassembled by removing the three nuts that fasten the base to the pendulum.

NOTE: When more than one pendulum is disassembled at a time, be sure to keep the parts of each assembly together, because of the close tolerance of the parts. This will insure a snug fit of the base to the pendulum, and free rotation in the socket without binding, through its full travel as noted in paragraph 14. a. (2) of this section.

d. To Assemble the Pendulum in the Oil Tank. - The pendulum may be reassembled and installed in the oil tank by reversing the procedure as noted in paragraph c. above.

e. To Install the Oil Tank. - Reverse the above procedure, b. (1) through (8).

f. To Fill the Oil System. - After the oil system has been completely drained, the following procedure is recommended. Fill the tank to approximately three (3) inches below the filler neck pin level for normal load. Start the engine and run until the oil temperature is approximately 70°C (158°F), wait five minutes and then check the oil level. If necessary, make additions to bring the level up to approximately three (3) inches below the pin level.

15. Fuel System (drawing No. 87-44-506).

a. General.

(1) Tanks. - There are three self-sealing fuel cells and one belly tank, with a total capacity of 200 U.S. gallons (160 Imperial gallons). (See figure 76). The fuselage tank (62.5 U.S. gallons, (51.5 Imperial gallons) with a 5% expansion space) is located aft of the pilot, and forward of the stowage compartment door. The reserve tank (35 U.S. gallons, (29.2 Imperial gallons) with a 3% expansion space) and the main tank (50.5 U.S. gallons, (42.1 Imperial gallons) with a 3% expansion space) are located in the wing under the fuselage. The former forward of the latter. The belly tank, 52 U.S. gallons (42.8 Imperial gallons) is slung under the wing parallel to the airplane centerline. It may be released in flight by a L-21 Bomb Release Handle, actuated in the cockpit. All tanks are vented to the atmosphere. The wing tanks have main vent lines connected to the right end of each tank, and auxiliary lines on the left end. The wing and fuselage vent lines drain at an outlet assembly in the wing fillet, on the left side of the ship. This drain outlet has a scoop assembly (drawing 87-44-575) attached to its lower extremity, which helps to increase the pressure in the fuel cells at high altitudes. A vent line connects the carburetor fuel chamber and air vapor eliminator to the top of the wing reserve tank. The air vapor eliminator, type A-6, removes air trapped in the fuel before it flows into the carburetor. The carburetor fuel chamber vent line allows air to be expelled from the chamber when it is being filled, and prevents vapor lock. The passage is closed by a check valve when the chamber is full. All fuel tanks contain an internal division system to trap fuel, in a bank or side slip, assuring ample fuel available in such maneuvers.

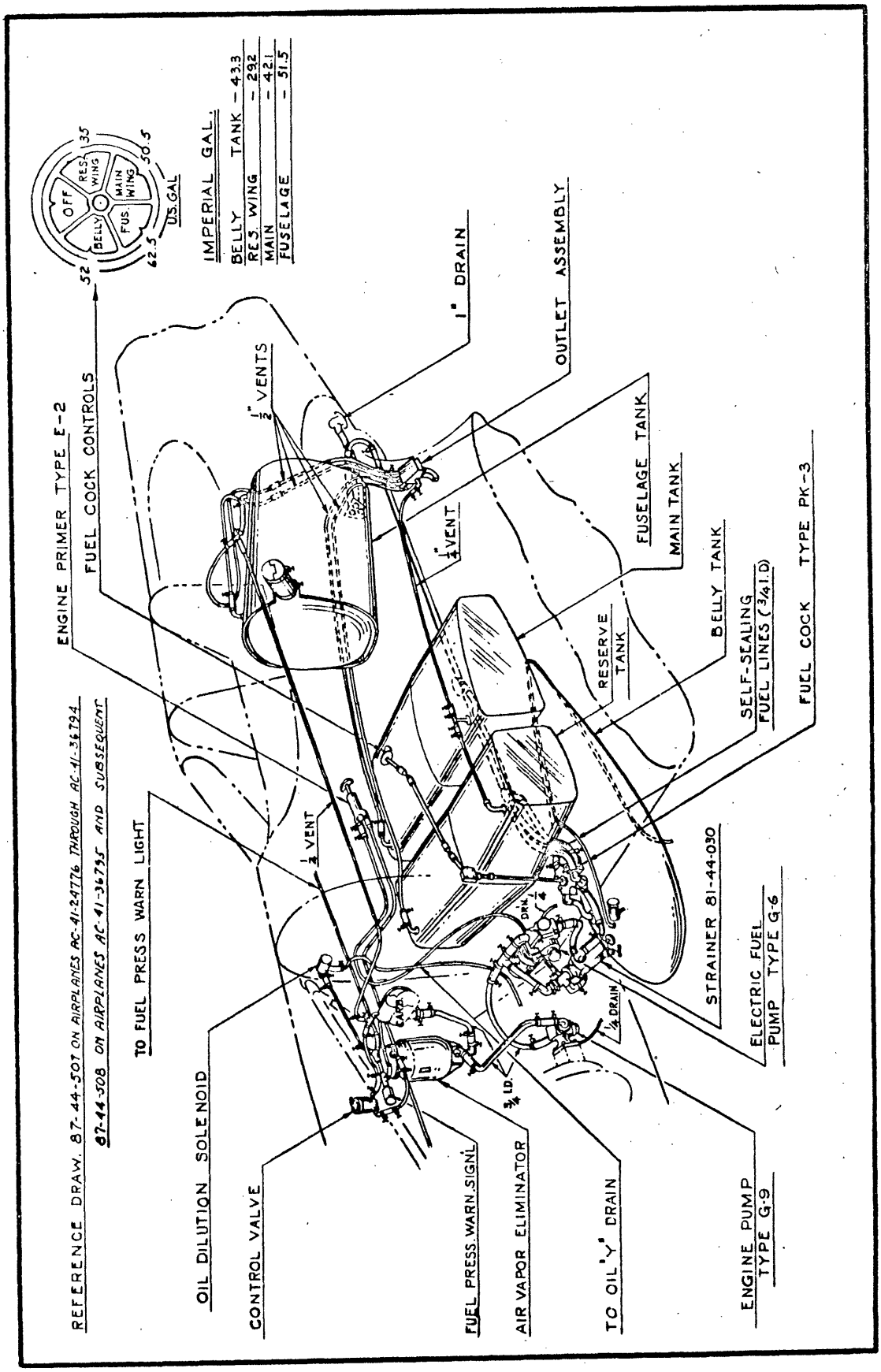


Figure 76 - Fuel System

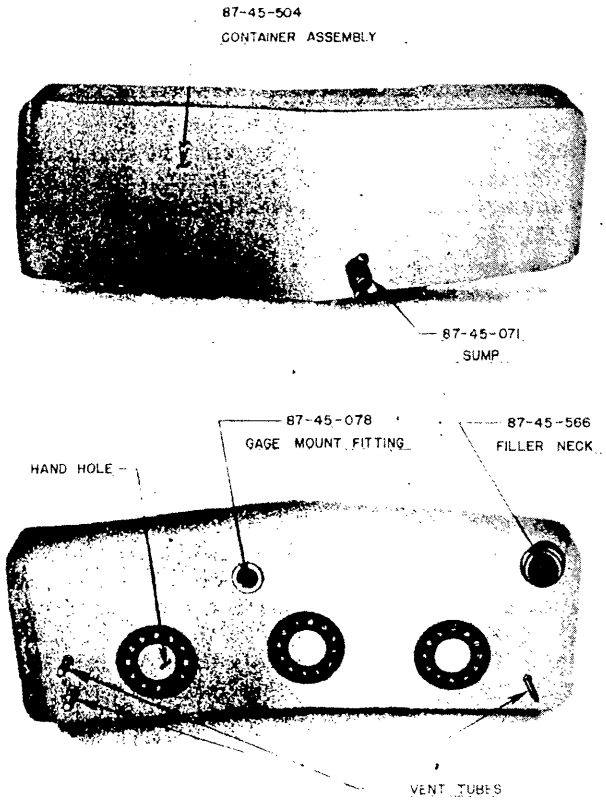


Figure 77 - Wing Fuel Cell - Front Reserve

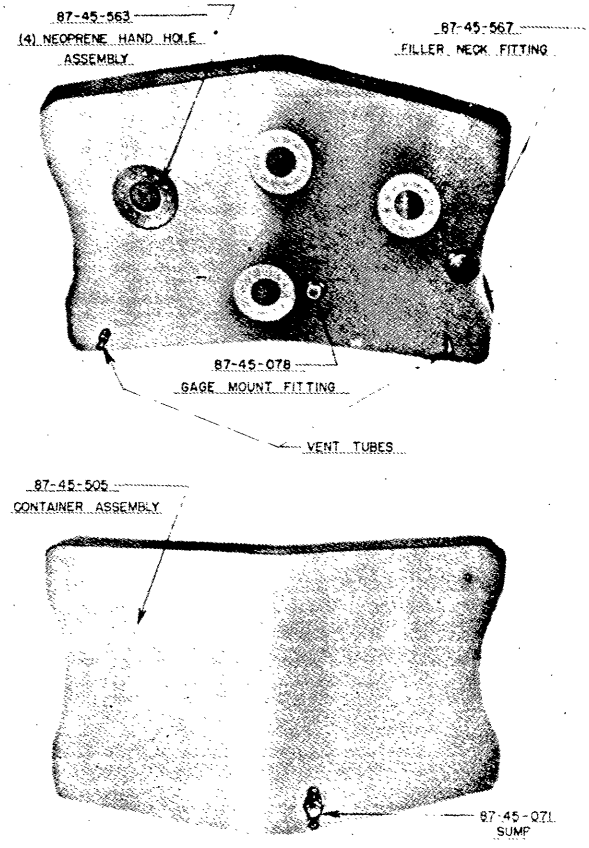


Figure 78 - Wing Fuel Cell - Rear Main

All fuel lines are gun-fire protected, self-sealing tubes. These self-sealing fuel lines are made up of a seamless compound inner tube, layers of self-sealing material, plies of reinforcement, and a compound cover. The fuel lines will seal completely within 2 minutes after firing at a temperature of minus 4° to 38°C (25° to 100°F), and will seal within 4 minutes after firing at a temperature of minus 29°C (minus 20°F). Clamps for aromatic resistant self-sealing hose will be tightened by adjusting the clamp to finger tightness, then applying 2 to 2-1/2 turns. After installation, hose clamps will be inspected daily for proper tightness until the hose ceases to "cold-flow" and the hose clamp remains tight. The clamp will be installed approximately 1/4 in. inside the bead height.

Fuel is pumped from the tanks to the injection type Stromberg Bendix carburetor by a type G-9 engine driven fuel pump. An electric fuel pump is incorporated in the suction line, between the engine driven fuel pump and the fuel cock. The electric pump consists of an integral explosion-proof electric motor, and a small centrifugal pump. This pump does not replace the engine driven pump, but it is used in conjunction with it.

The electric fuel pump switch should be "ON" for all engine operations. The electric fuel pump is controlled by a switch on the left-hand side of the main switch panel and has two positions, "ON" and "OFF."

On airplanes AC41-24776 through AC41-36794, aromatic fuels should not be used as no provision for such fuels has been made. On airplanes AC41-36795 and subsequent, the fuel tanks have provisions for use of aromatic fuels.

Sloshed fuel cells are indicated by a broken red line painted on the access door or on the filler cap. There is also a note by the filler cap access door "SLOSHED FOR AROMATIC FUELS," and the date.

Aromatic resistant fuel tanks are indicated by a solid red line, painted in a similar position as above, with a stenciled note "SUITABLE FOR AROMATIC FUELS," and the date. Notation has also been made on the fuel cell itself.

NOTE: When the Stromberg Bendix carburetor is first used after installation, or has been drained, this procedure should be followed: Open the fuel cock, set the mixture control at "AUTOMATIC RICH" and the throttle half open. Switch on the electric auxiliary fuel pump to raise the fuel pressure to 4 p.s.i. Allow the auxiliary pump to operate until a small amount of fuel runs from the supercharger drain. A special condition exists when the carburetor is partly filled with air. The rate at which the fuel may enter the sec-

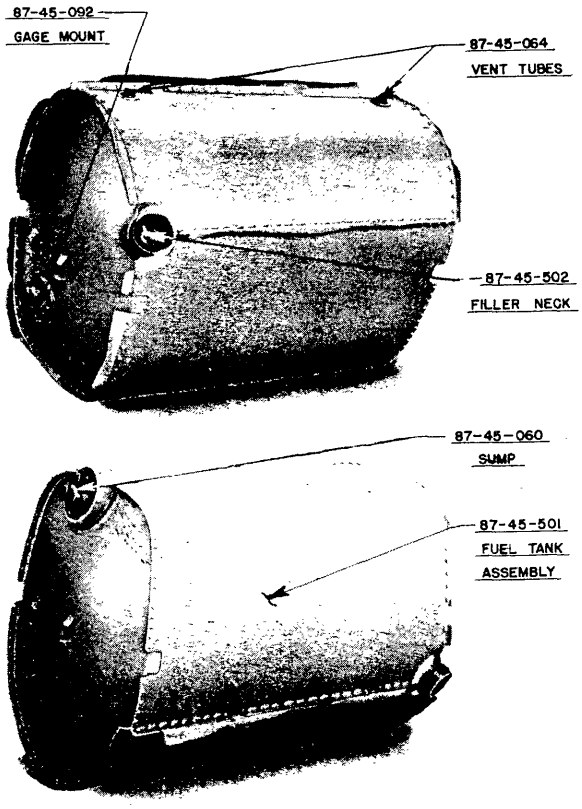


Figure 79 - Fuselage Fuel Tank Assembly

ond "regulator chamber" and the "fuel control body" is held to idling rate, causing the carburetor to fill slowly. Since there are no vents in the system beyond the "second regulator chamber", all imprisoned air must escape through the nozzles causing the engine to stop after being started. To eliminate this condition, remove the vent plug from the "second regulator chamber" and operate the fuel pump until the fuel is level with the plug opening. Replace the plug. One minute is the usual elapsed time for filling of the carburetor.

(2) Strainers and Tank Drains.

(a) In the bottom of each tank is a sump fitting in which is installed the tank finger strainer, fuel line outlet, and the drain plug. (See figures 81, 82, and 83.) All drain plugs incorporate a drain cock for the removal of water. The drain plug is installed directly in the sump fitting in the wing and belly tanks, and a remote drain is provided for the fuselage tank. The tank sumps are designed to permit the settling of water to the sump, and the removal of this water from the sump, without draining the entire tank. Access to the wing tank sumps and drains is through doors in the keel fairing. The drain assembly for the fuselage tank is under the fuselage, to the right of the keel fairing and aft of the trailing edge of the wing, and is accessible through a door. The belly tank drain and sump are located on the bottom of the tank.

(b) Besides the finger strainers in each tank

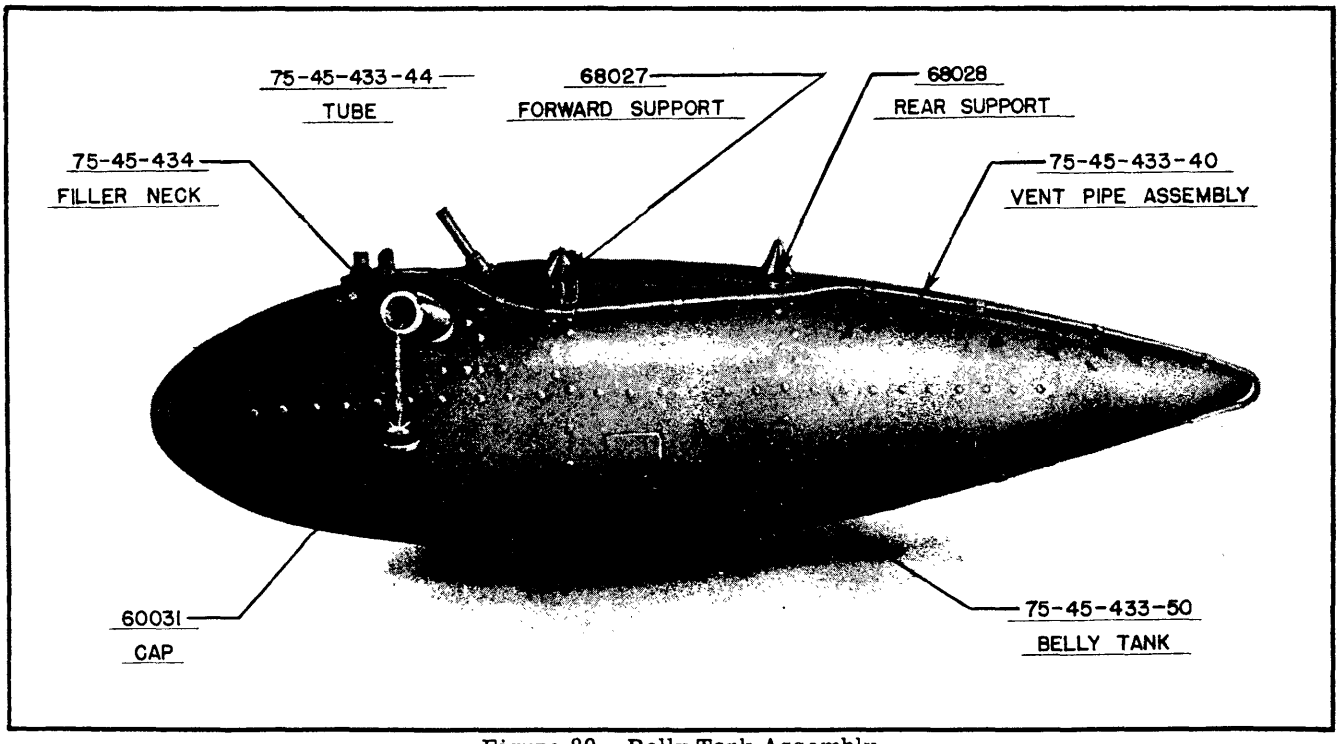


Figure 80 - Belly Tank Assembly

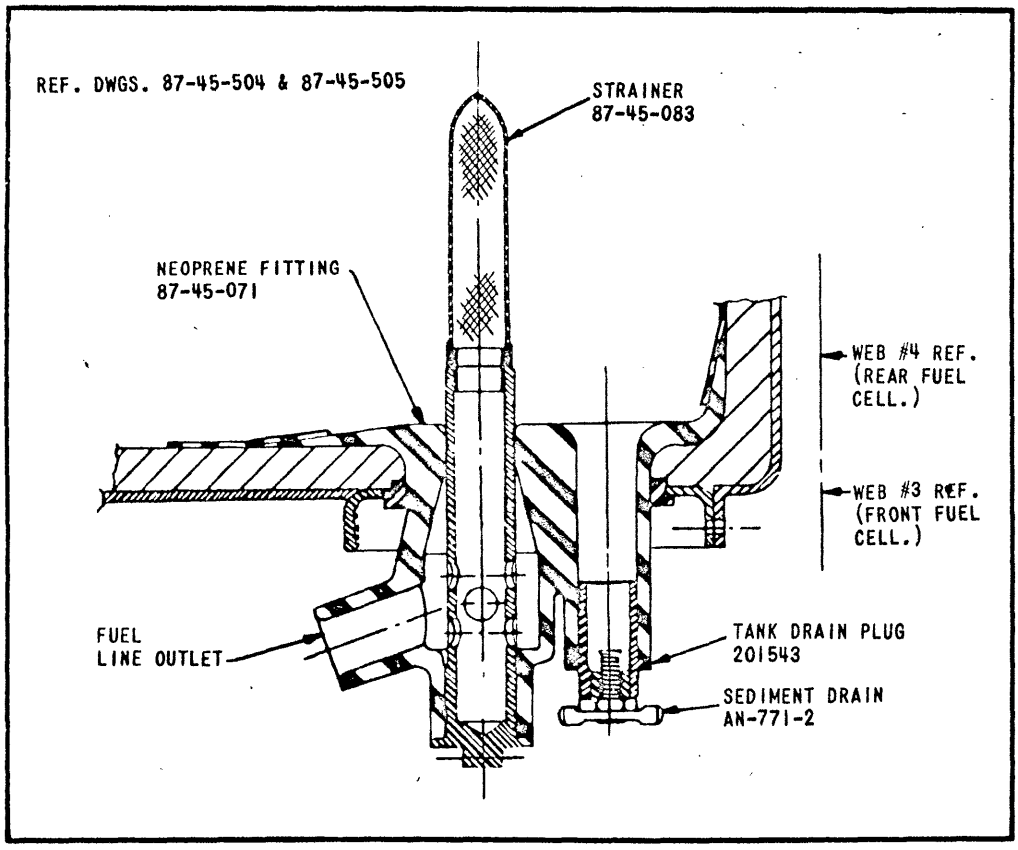


Figure 81 - Sump Arrangement - Wing Fuel Tank

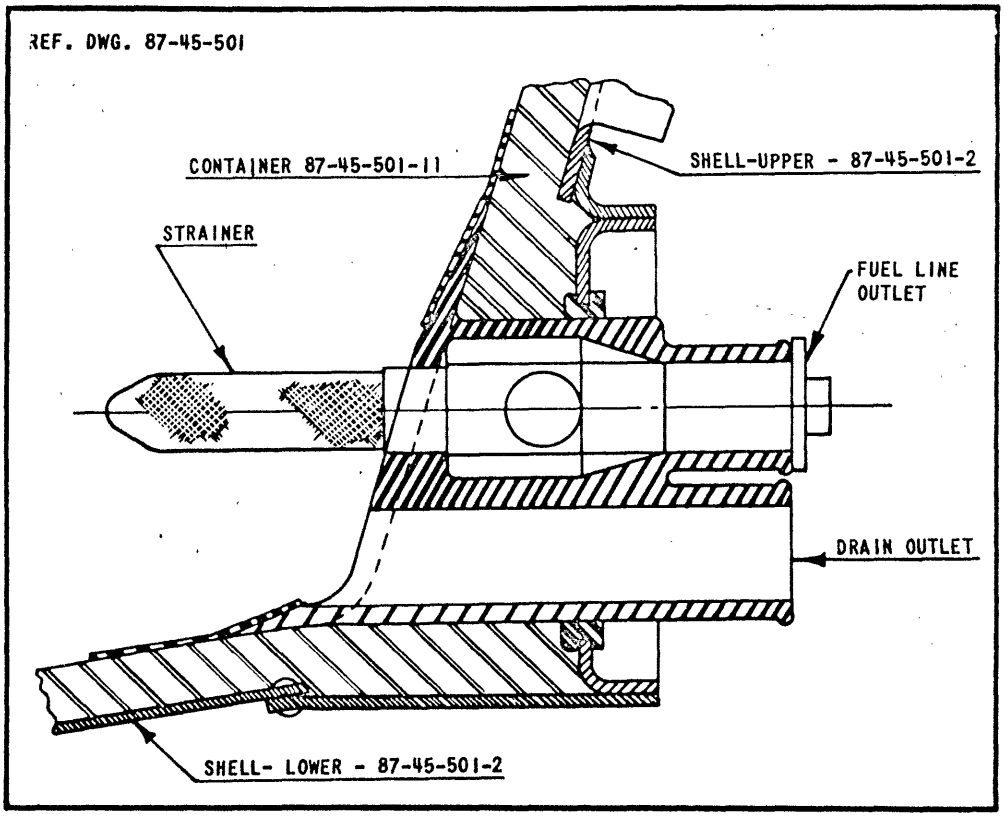


Figure 82 - Fuselage Tank - Sump and Drain

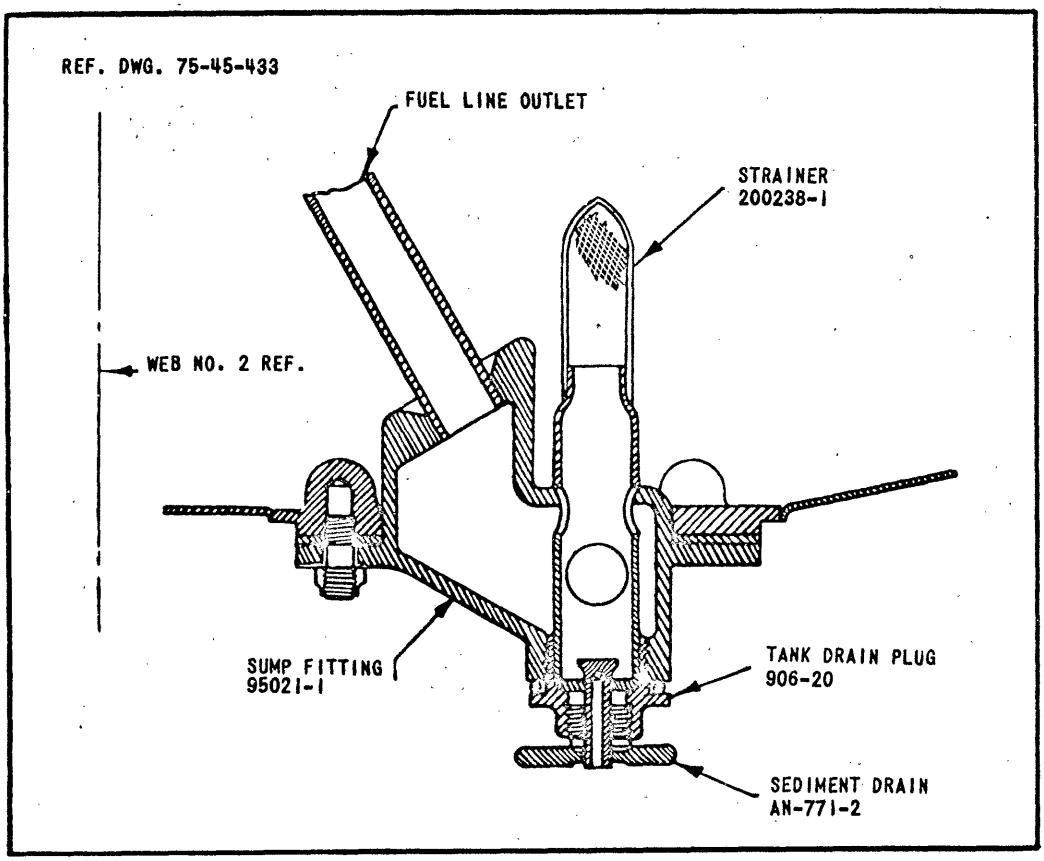


Figure 83 - Belly Tank Sump and Drain

there is a type C-3 fuel strainer in the main fuel line, between the fuel cock and the electric fuel pump. Access to this strainer is gained through the rear engine cowl aft of the cowl shutters. There is also a strainer in the carburetor.

(3) Fuel Tank Gages. - Each wing tank is equipped with a float-type sight-gage, mounted in the top of the tank with the dial head protruding through the floor of the cockpit, The fuselage tank is equipped with a General Electric D. C. Selsyn Type (8TJ13LAH) Gage Transmitter, which is connected electrically to a fuel quantity indicator on the instrument board. (See paragraph 16. a. (3) (c) of this section.

(4) Fuel Pressure Gage. (See paragraph 16. a. (3) (m) of this section.) The fuel warning signal is located on the top left side of the instrument panel.

(5) Primer. - The engine primer system consists of a supply line from the electric fuel pump to the Parker Type E-2 Primer, located just below the main switch panel in the cockpit, and a line from the primer to the engine intake manifolds. The priming system on the engine is independent of carburetor, and pumping the carburetor throttle will not discharge fuel into the engine.

(6) Scupper Drain. - The wing tank scupper in the left-hand wing fillet are provided with drain lines passing downward through the lower wing skin just to the left of the tank door.

b. Removal.

(1) To Remove the Belly Tank

(a) Drain the belly tank by means of the stopcock at the bottom of the tank.

(b) Break the fuel line at the belly tank connection to the fuel cock line.

(c) Release the tank from the trigger mechanism by the control actuated in the cockpit.

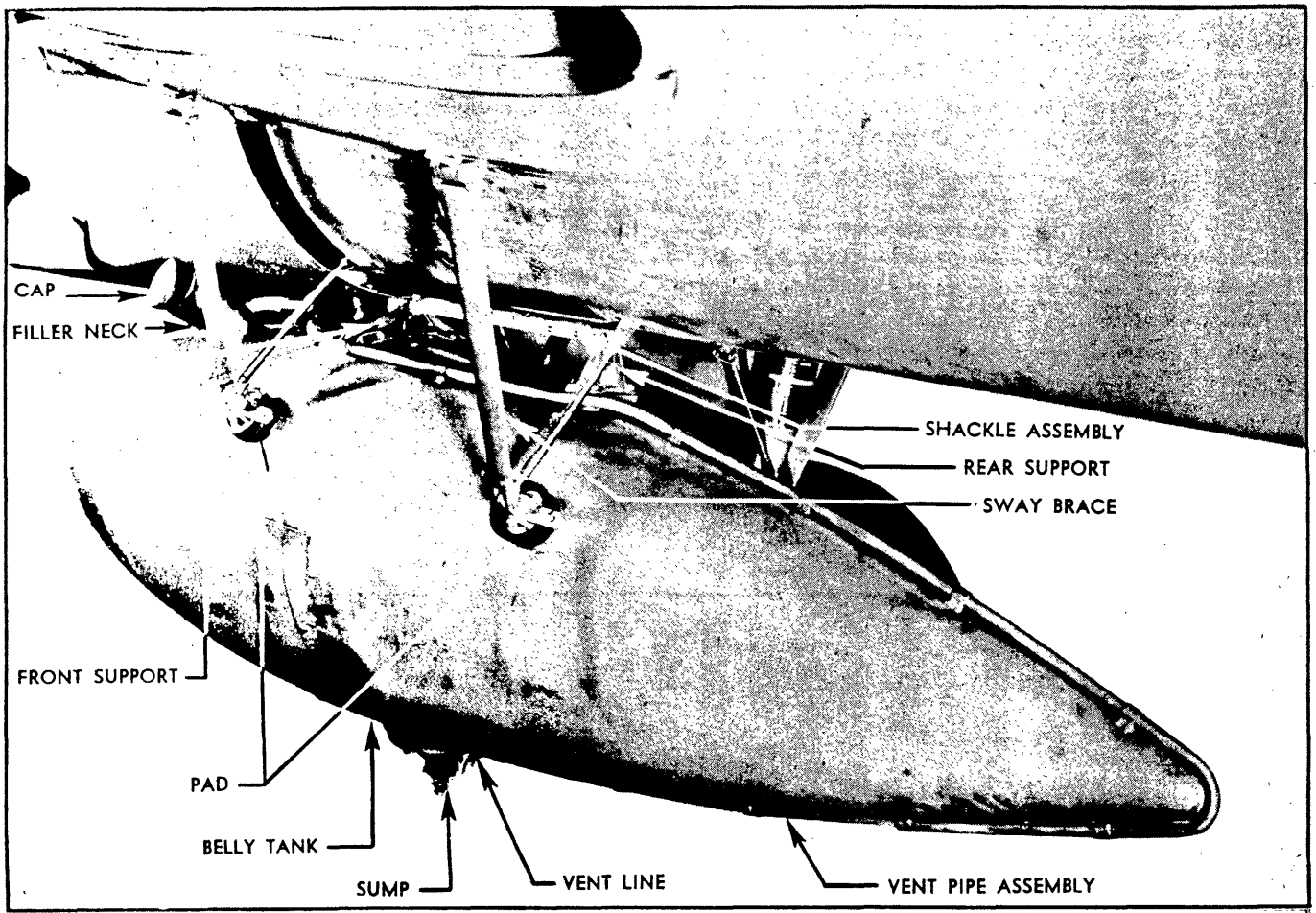
(d) Install the neoprene cover cap (87-44-566 stowed in the duffle bag) on the end of the fuel cock line, whenever the tank is not installed.

(2) To Remove Either Wing Fuel Cell.

(a) Remove the inboard, fixed landing gear fairing.

(b) Disconnect and remove the belly tank sway braces.

(c) Remove the keel fairing.



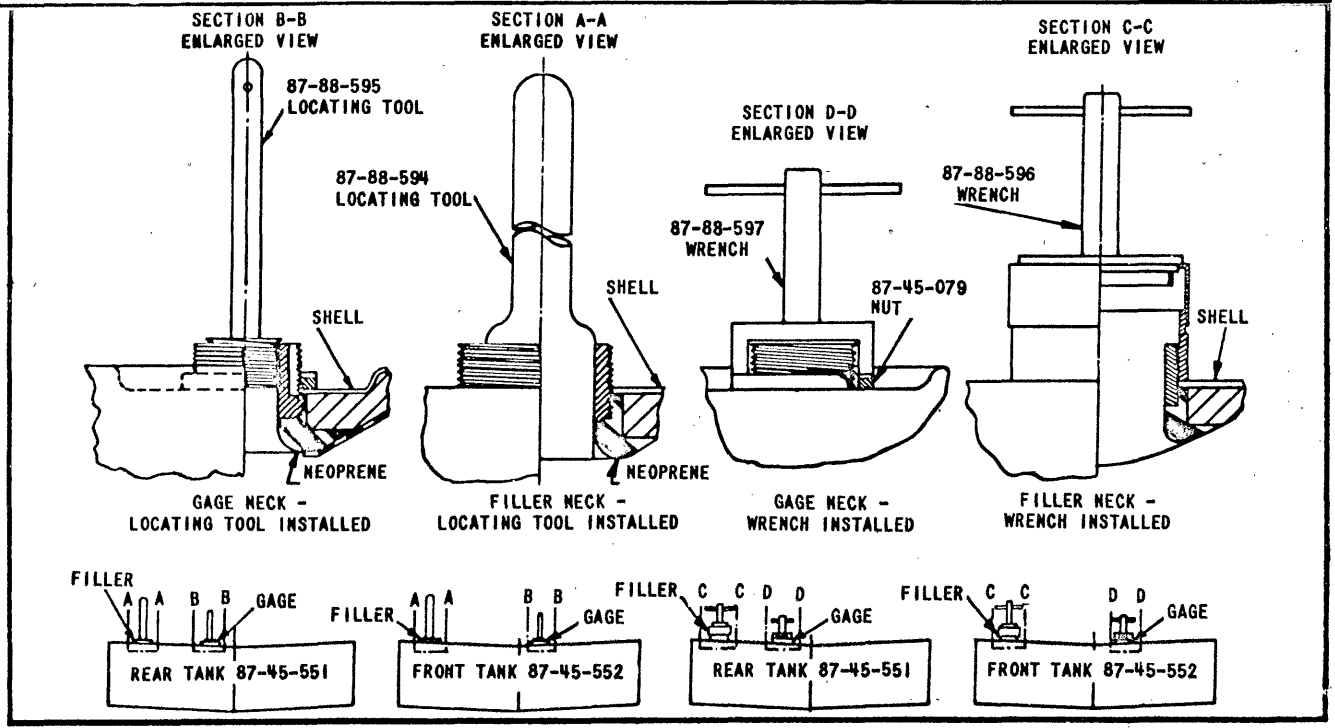


Figure 85 - Wing Tank Installation Tools

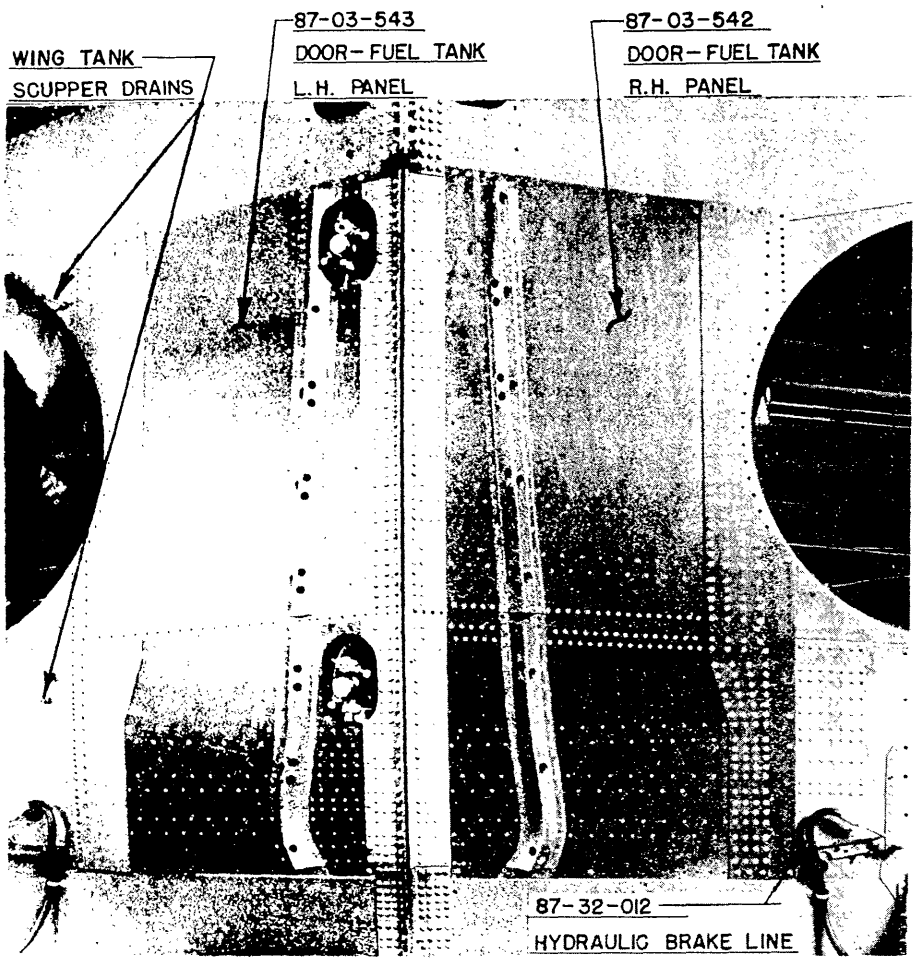


Figure 86 - Wing Fuel Tanks Doors Installed

(d) Remove the wing fillets.

(e) Drain the fuel cells.

(f) Disconnect the vent lines at the top of the fuel cells.

(g) Remove the fuel lines, fuel gages and filler caps.

NOTE: Break all the connections to the fuel cells otherwise the cells will be torn at the fittings.

(h) Remove the fuel tank doors in the bottom of the wing as a single unit as follows:

1. Disconnect and remove the belly tank control cable.

2. Remove all screws and bolts which attach the doors to the wing, including the screws and bolts through web No. 3.

(i) Remove the bonding.

(j) Remove the tank straps and the lower portion of the tanks shell (pan assembly).

(k) Remove the fuel cell from the top shell assembly taking care that no damage occurs to the filler neck, gage, and vent line fittings which extend through the shell.

(3) To Remove the Fuselage Tank.

(a) Remove the pilot's seats.

(b) Remove the pilot's headrest.

(c) Remove the armor plate at station No. 5.

(d) Remove the filler neck.

(e) Remove the tank pipe fittings.

(f) Remove the tank gage.

(g) Push the handle of the hydraulic hand pumps to its extreme forward position.

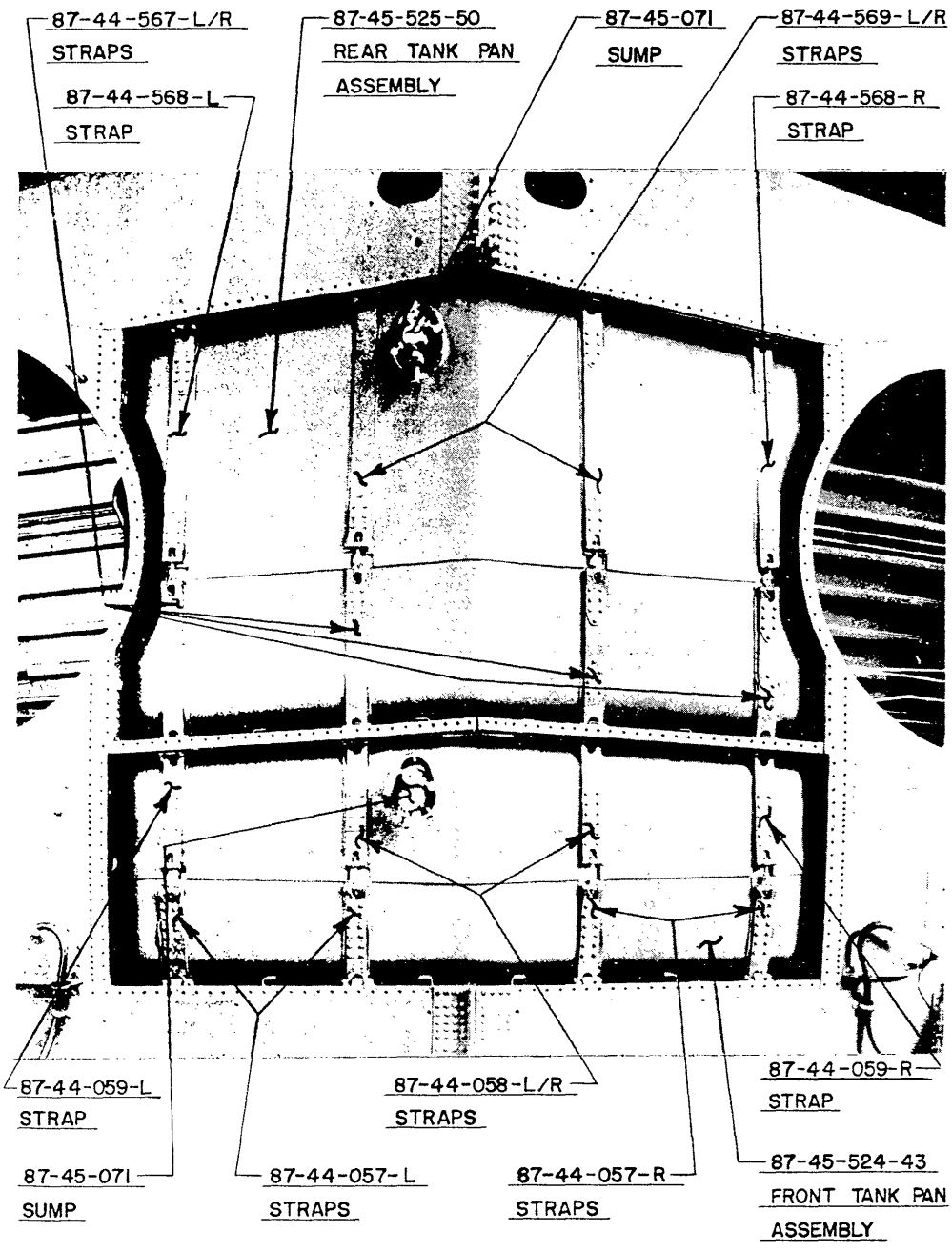


Figure 87— Wing Fuel Tanks Installed Doors Removed

(h) Remove the control stick.

(i) Remove the oxygen economizer.

(j) Remove the tank through station No. 5 bulkhead and raise the tank straight up.

(k) Remove the fuselage fuel cell from the shell as follows:

1. Remove the bolts through the flanges attaching the top segment of the shell to the remainder. Remove the segment, taking care not to damage the vent line fittings.

2. Remove the bolts attaching the front end to the shell. Push the gage fitting through and remove the end.

3. Remove the fuel cell from the remaining portion of the shell, taking care not to damage any of the fittings.

(4) To Install the Fuel Tanks.

(a) Belly Tanks. - Reverse the procedure outlined in b. (1) above.

(b) Wing Fuel Cells.

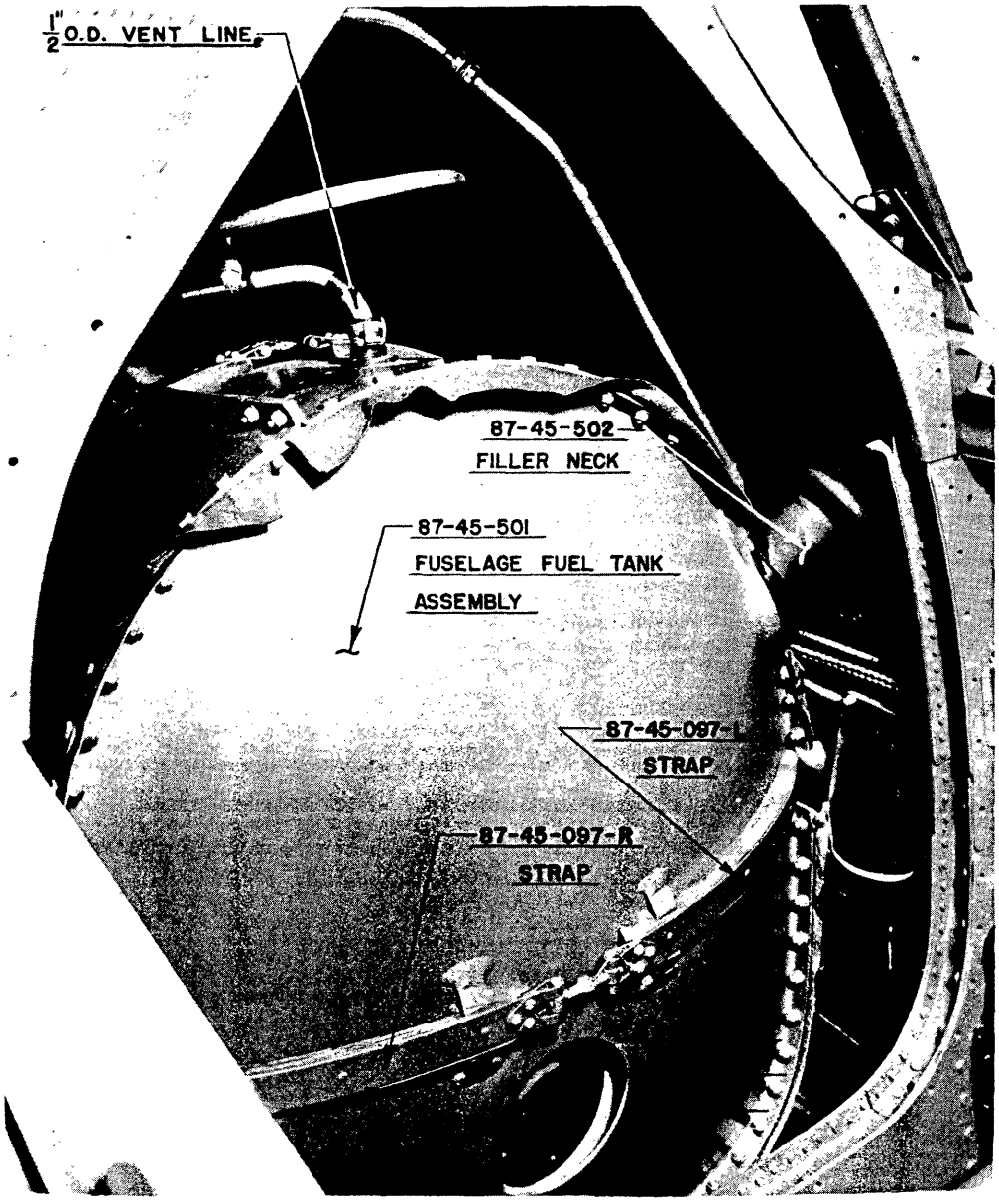


Figure 88 - Fuselage Fuel Tank Installation

1. The installation of the wing fuel cells may be facilitated by the use of the two locating tools, one for the filler neck and the other for the gage neck. The tools are used to guide the filler and gage necks into their respective holes in the wing surface.

2. Install the fuel cells in the wing, and pull the filler and gage necks through their respective openings in the wing. Install the bottom shell.

3. Remove the gage and filler neck locating tools. Install the gage and filler neck and other fittings.

4. Reverse the procedure outlined in b. (2) from (a) to (s) inclusive.

(c) Fuselage Tank. - Reverse the procedure outlined in paragraph b. (3).

(5) To Remove the Fuselage Tank Fuel Quantity Gage.

NOTE: Never remove the fuel quantity gages from the fuselage tanks unless it is absolutely necessary.

To remove the tank portion of any fuel quantity gage:

(a) Remove the six flange screws and remove the transmitter. Take care to keep magnetic particles away from the transmitter magnet, and also away from the inside of the cup.

(b) Lift the cup from the socket enough to hold it from turning, and unscrew the cast adapter from the tank. If the cup is allowed to turn, the float stem is liable to be broken off.

(c) Lift the entire unit including the float from the tank. Care should be taken when removing the float, as it will come out only when the major axis of the float is perpendicular to the mounting flange.

(6) To Remove the Wing Tank Quantity Gage (see T. O. No. 01-25C-23).

(7) To Install Fuselage Tank Fuel Quantity Gage.

Reverse the procedure given above. Be sure that the float is installed in the right position, both with respect to the gage and to the tank. See that the cup does not turn when the adapter is screwed into place, and that index mark on the flange of the cup is in the plane of the float circle. Locate the index so that for a rising float, the pinion rotates counterclockwise, when viewed from the pinion end of the shaft.

c. To Adjust the Fuselage Tank Quantity Gage.

(1) The tank must be empty so that the float will rest on the bottom of the tank.

(2) Loosen the four screws on top of the transmitter and rotate the large diameter disc to the mid position of travel.

(3) Connect the transmitter to the indicator and battery, and replace the transmitter in the cup so that the screw holes align, and so that the conduit connector points are in the desired direction. Note the indicator pointer deflection, remove the transmitter from the cup, and rotate the magnet to obtain the same deflection. Grasp the transmitter and push the magnet against the spring, maintaining the angular position of the magnet with respect to the transmitter. Now rotate the shaft, until the cross pin aligns with the notches which make the indicator read nearest to zero, then release the magnet. This is the rough zero adjustment.

(4) Replace the transmitter in the cup and secure in place with the six flange screws. Now rotate the large diameter disc until the indicator reads exactly zero, and tighten the four screws to hold it in place.

(5) Caution Fuselage Fuel Quantity Gage Indicator. - Under no condition shall a pointer on the fuel quantity gage indicator on the instrument board be removed, except by the manufacturer. Reason: The exact position of the pointer on its shaft is very critical, and a slight error in replacing the pointer will cause the gage to read incorrectly, even through the zero reading be corrected by adjusting the transmitter at the tank. (The dial cannot be removed without removing the pointer.)

d. Repair of Self-Sealing Fuel Cells. - A fuel cell damaged enough to necessitate repairs should be replaced and sent to a repair depot.

(1) Fuel Tanks. - The fuel tank consists of three main parts:

(a) The cell, which is fuel tight, and forms the actual fuel tank.

(b) The self-sealing element.

(c) The metal container into which the liner fits.

(2) The fuel cell consists of two sheets of balloon cloth impregnated with Thiokol, and cemented together with neoprene cement, to form a two ply sheet .017 inches thick. This rubberized fabric is a commercial product and can be purchased as the finished article. The pipe fittings, filler neck, gage fittings and inspection hole fittings are all made of molded neoprene. They have flanges which are cemented to the inside of the cell and covered with a patch of balloon cloth. The baffles are of rubberized webbing with neoprene flanges molded on.

The self-sealing element consists of two .015 inch sheets of latex gun on either side of a .250 inch sponge rubber sheet. The latex sheets are protected on the outside by a .078 inch sheet of grained steerhide leather and on the inside by a .060 inch sheet of split steerhide. Bostick M-40 cement is used to attach the split steerhide to the cell, while neoprene cement is used to attach the successive layers of the latex gum, sponge rubber and leather. The neoprene cement is applied to both surfaces and allowed to dry for twenty to thirty minutes.

The pipe fittings and inspection holes are not attached to the self-sealing element, and are quite free except for the attachment of the flanges to the inside of the cell.

The inside of the cell is brushed with TL-284 zinc chromate slushing compound. This coat is not applied to prevent leakage through the cell, its sole purpose is to reduce permeation and to comply with specifications.

The container is a pressed aluminum shell, made in two halves and bolted together. On the fuselage tank, extensions of the leather covering of the liner are bolted between the flanges of the container.

(3) To Repair a Self-Sealing Fuel Cell. - Remove the cell from the aluminum container and remove the inspection hole covers which are nearest the damaged areas. The number of inspection holes in each tank is as follows:

Fuselage Cell	1 Inspection Hole
Front Wing Cell	3 Inspection Holes
Rear Wing Cell	4 Inspection Holes

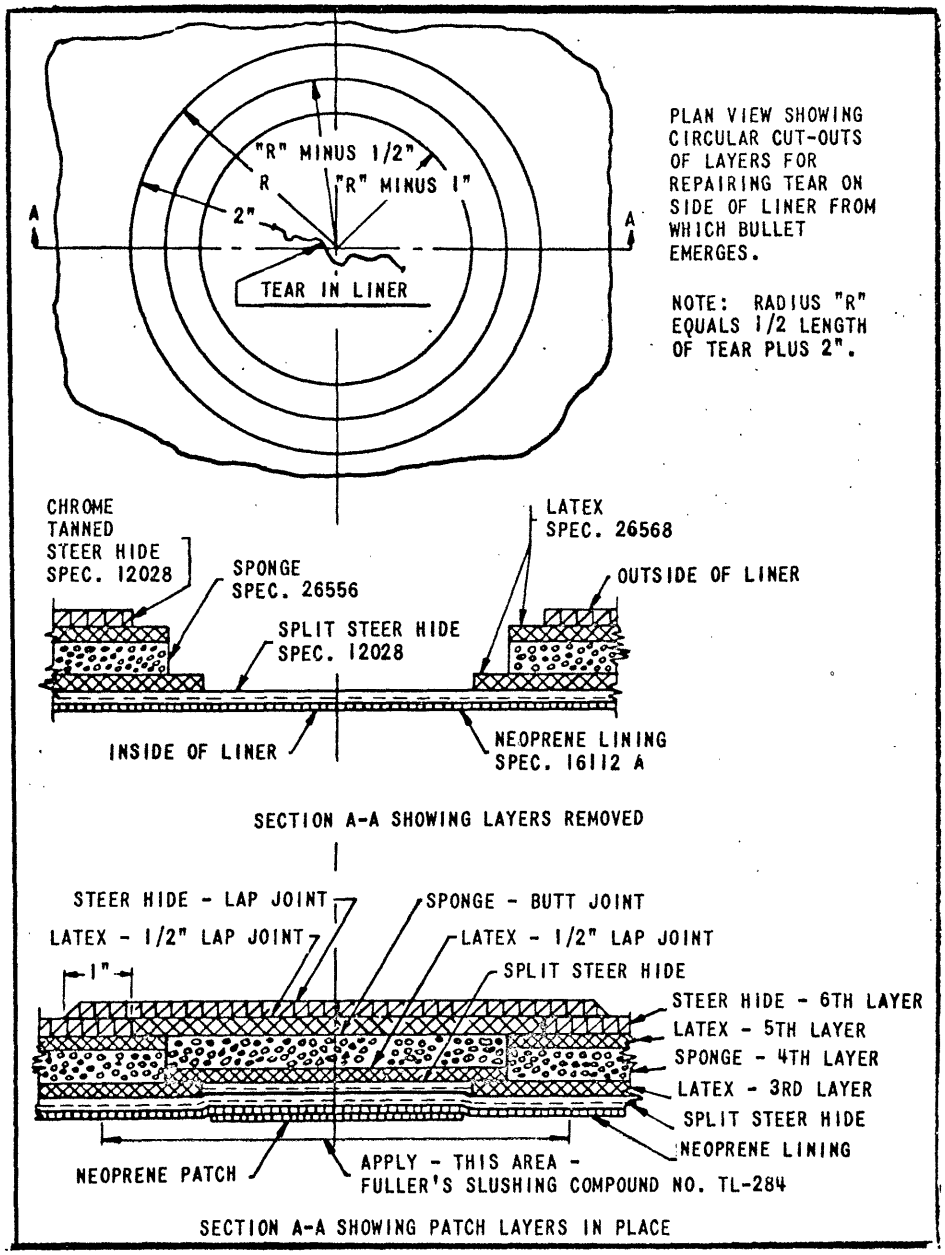


Figure 89 - Repair to Fuel Cell Liner

e. Repair of the Fuel Cell on the Entrance Side of the Bullet.

(1) Clean the neoprene balloon cloth lining around the bullet hole with ethyl acetate, to remove the zinc chromate slushing compound. Allow to dry and buff lightly where the patch will fit. Use two coats of Bostick M-40 cement, on both the neoprene fabric patch and the liner of the cell. The patch should extend at least one inch beyond the damaged area in all directions.

(2) Brush on TL-284 zinc chromate slushing compound so that the repaired area is completely covered.

(3) Rough up the steerhide leather on the outside of the cell with card cloth around the damaged area. Cement the leather surface with two coats of M-40 cement and allow to dry fifteen minutes.

(4) Prepare a patch by cementing the flesh side of the steerhide leather with two coats of M-40 cement. Allow to dry, and apply the leather patch to the prepared area and hand-roll thoroughly.

f. Repair of Self-Sealing Fuel Cells on the Exit Side of the Bullet.

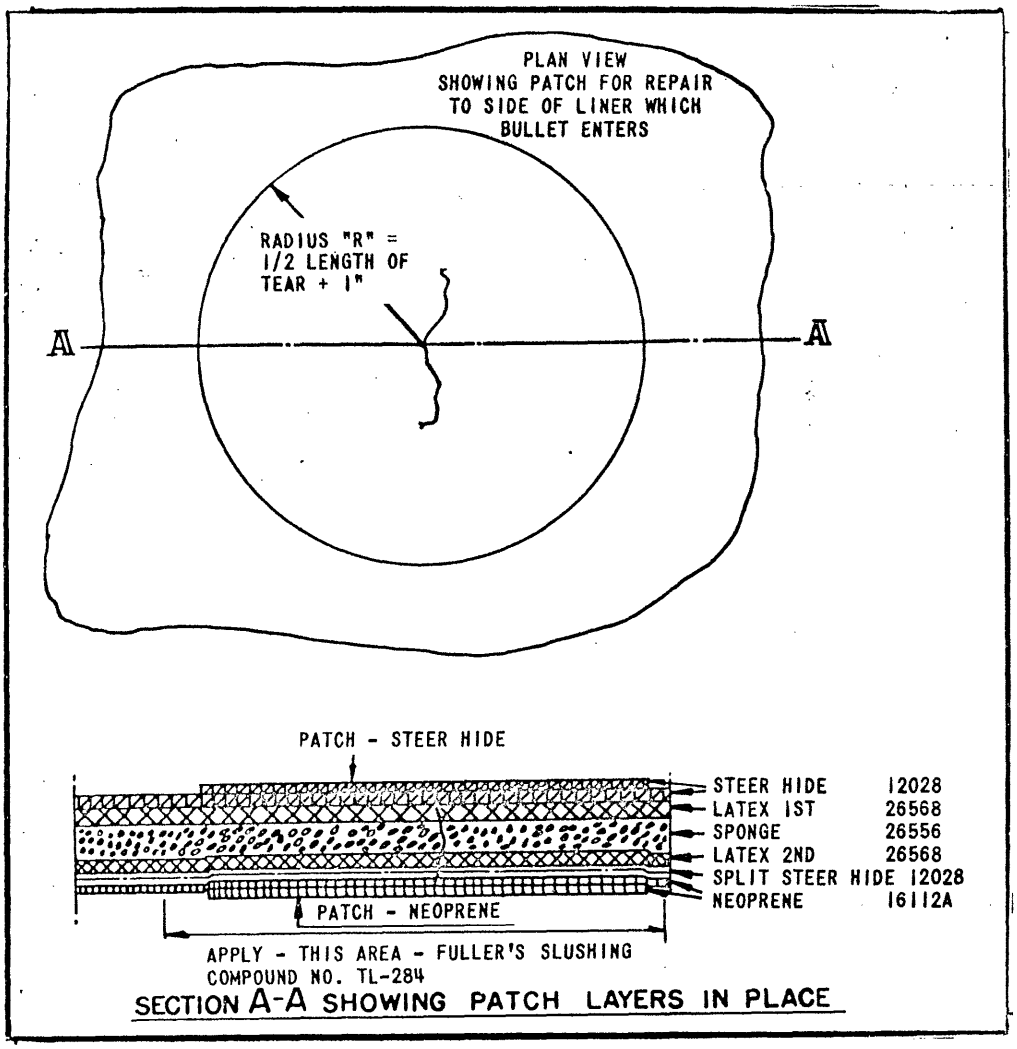


Figure 90 - Repair to Fuel Cell Liner

(1) Repair the inner neoprene lining in the same manner as detailed above.

(2) On the outside leather surface draw a circle around the damaged area, so that no part of the circle will fall closer than two inches to any part of the damaged area. Remove this section of the steerhide leather using benzol and a knife.

(3) Remove the outer layer of the latex and sponge from a concentric circle having a 1/2 inch smaller radius than the previously removed steerhide.

NOTE: The latex and sponge are removed simultaneously over an equal area.

(4) Remove the inner layer of latex from a concentric circle having one inch smaller radius than the previously removed steerhide.

(5) Remove any loose particles of the split steerhide.

(6) Cut patches of steerhide, latex sheet, sponge and split steerhide. These patches should be large enough to make a lap joint on each step of this repair. See figure 89, except in the case of the sponge patch, where a butt joint should be used instead of a lap joint. Each lap is 1/2 inch except the outer layer of steerhide which should lap one inch. Use two coats of Bostick M-40 cement on each surface.

(7) Fuel cells should be repaired as soon as possible after damage occurs, because the latex gum swells at the rate of 2000% in 48 hours, when saturated with 100 octane fuel. The area affected will spread rapidly, and unless the cell is repaired immediately, the tank may have to be scrapped.

(8) Temporary repairs, made by merely patching the inside of the inner lining, have proved quite effective where the tear has been as long as four inches, provided the aluminum container was hammered back into shape to support the self-sealing element where it was damaged.

(9) Leaking or damaged pipe fittings may be easily repaired. Remove the cell from its container and remove the inspection hole covers. Loosen the defective fittings by pouring Benzol or Toluol down the outside of the pipe, so that it seeps between the flange of the fitting and the balloon cloth in the cell. The fitting when loosened, may be pushed into the cell and removed through the inspection hole.

(a) The jointing surfaces must be cleared of a zinc chromate slushing compound before applying the Bostick M-40 cement. A balloon patch should be cemented to the flange before the fitting is cemented inside the cell. Care should be exercised to work from the center out when attaching the fittings or patches so that no air will be trapped between the surfaces.

(10) Bostick M-40 cement should be used to repair self-sealing fuel cells. This is a self-vulcanizing cement and tends to vulcanize and deteriorate if stored for long periods. It is, therefore, advisable to order supplies in small quantities as it is necessary to mix the cement with a curing fluid before use, and once mixed, starts to vulcanize rapidly. It is, therefore, important that only sufficient cement be mixed to do the job in hand, and that previously mixed M-40 cement never be used. Benzol or Toluol may be used as a cement thinner. Both these solvents have severe toxic effects; Toluol, being less harmful than Benzol, is used in the new M-40 Bostick cement.

IMPORTANT: Because of the severe toxic effects of these solvents, it is extremely important that sufficient ventilation is employed, so that the workmen suffer no serious effects while making these repairs.

g. A Description of the Materials and Tools Required. - The raw materials required for the repair of self-sealing fuel cells are as follows:

(1) Neoprene synthetic rubber fabric liner, Spec. 16112-A.

(2) Uncured latex sheet gum, Spec. 26568.

(3) Cellular sponge, Spec. 26556.

(4) Chrome tanned steerhide leather, type 1 and type 2. Spec. 12028.

(5) M-40 neoprene cement with liquid accelerator.

(6) TL-284 Fuller's Slushing Compound.

(7) Tools required for the repair kit are:

(a) One set of No. 50 emery paper.

(b) One bevel stitcher 2 in. x 2-1/2 in. x 1/4 in.

(c) One hand roller, 2 in.

(d) One round handled turn-over knife.

(e) One steel knife for cutting rubber, type 1 in. x 4 in.

(f) Several 1 in. brushes for cement and slushing compound.

h. Repair of Tank Shells.

(1) Cleaning procedure: (Refer to T. O. No. 03-1-12).

(2) Army Air Forces repair and manufacturing practices for aluminum alloys are outlined in T. O. No. 23-15-1.

(3) Failures in the fuel tank shells can usually be repaired by simply welding up the crack. The paint coatings should first be removed for a distance of at least 3 in, all around the crack. This can be done by the application of paint remover which should then be thoroughly washed off with hot water.

(4) A small hole (3/64 in. or 1/16 in. diameter) should then be drilled at each end of the crack to prevent its progression under the welding heat or after the tank is again in service. The welding can then be accomplished using an oxyhydrogen flame. The flame should be adjusted to a neutral condition with the hydrogen gage set about 5 lbs. above the oxygen gage. A filler rod of the same material as the tank can be used, although a 4% silicon rod, if available, is generally easier to handle and gives better results in complicated welds. United States Aluminum Company Flux No. 22, or equivalent, should be used. It is mixed to a paste condition with water and the part to be welded is coated with it and the rod is dipped in it. Enough heat should be applied to form a bead on the inside of the joint being welded, but care should be exercised to prevent melting holes in the material. A good practice to follow is to weld from each end of a crack toward the center, to prevent the crack progressing ahead of the flame.

(5) Cracks in the shell around rivets can be repaired in the manner described above. It is more desirable in this case to use a silicon rod if available.

i. Testing Tanks After Repairs. - Before installing the coolant or oil tanks in the airplane, they must be tested under water to the following air pressures:

(1) Oil Tank - 5 p.s.i.

(2) Coolant Tank - 20 p.s.i.

16. Engine and Aeronautical Instruments (drawing 87-61-502).

a. General.

(1) Instrument Board. - The instrument board is mounted on two supports at the bottom and braced by

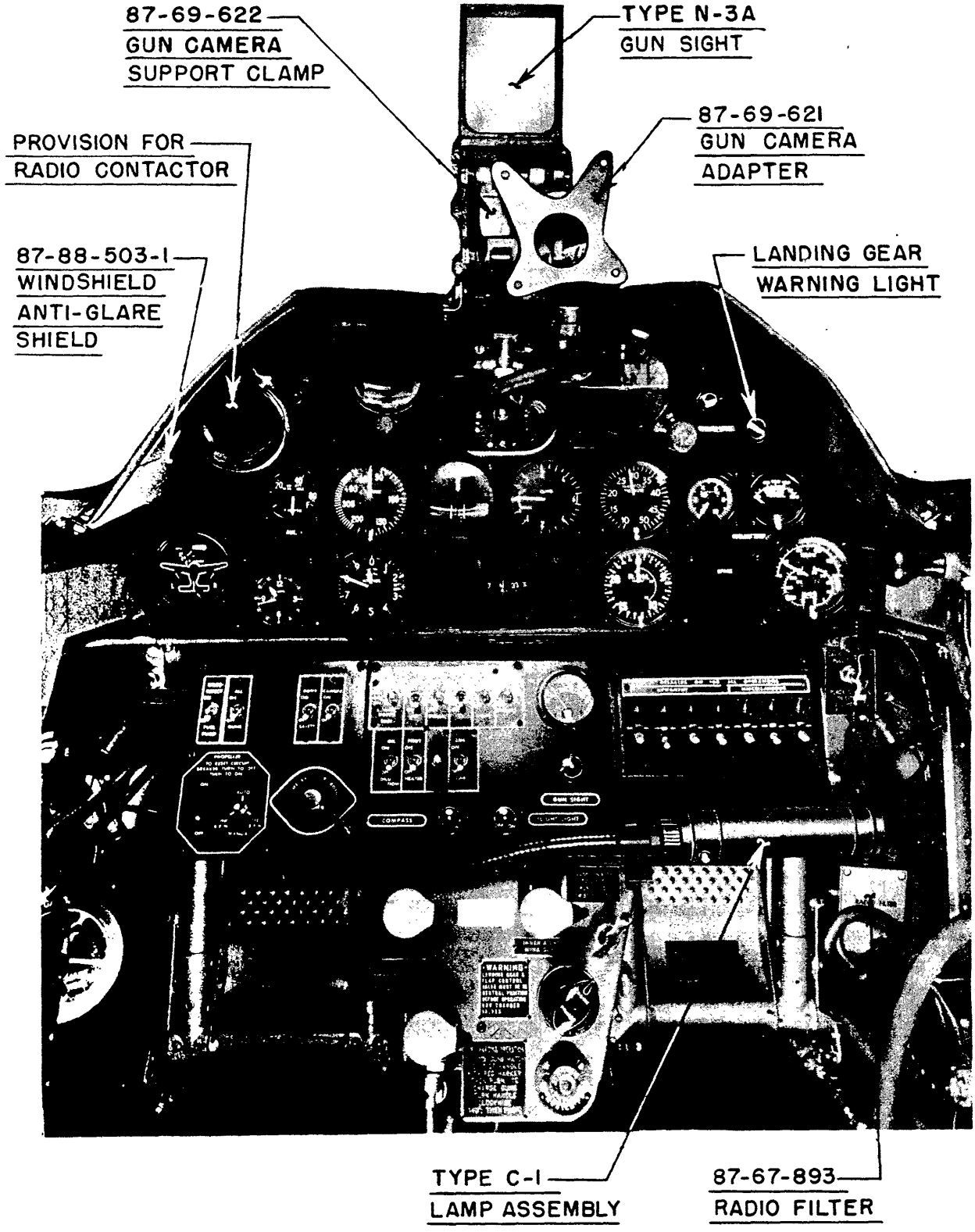


Figure 91 - Cockpit - Arrangement and Controls - View Forward

two rods at the top which are attached to the armor plate at station 2A. The supports and braces are mounted on bushings. The support bushings are 150 P20 (monel) and are installed with the load rated sides toward each other. The upper mountings are installed with EX34115-56 washers. Replacement of these bushings and washers should coincide exactly with the original installation.

(2) Lighting.

(a) Instruments. - The dial, indicators and controls are painted with fluorescent paint, which becomes luminous under light from a fluorescent lamp (type C-1). The lamp is attached to a semi-flexible shaft and may be moved to light up any portion of the panel. The compass is individually lighted.

(b) Cockpit. - The wing fuel gages on the cockpit floor are individually lighted. Two small spot lights having 24-28V, 6 cp-SC type G-6 bulbs and a swivel base are located in the cockpit, one on each side.

(c) Formation Lights. - The formation lights are mounted on each side of the fuselage above the leading edge of the wing, and are controlled by a rheostat on the main switch panel. The lens may be taken out by removing the five screws, accessible from the outside of the fuselage, attaching it to the lamp base. The bulb is accessible when the lens is removed. The complete lamp assembly may be taken out by removing six screws attaching the flange to the reinforcing plate, pulling the lamp assembly out and disconnecting the electrical connection on the inboard side.

(d) Landing Light.

1. The shield type landing light is 315 candle power, 15 ampere and is rated as a 50-hour lamp.

2. Landing lights should not be burned longer than a three minute period. Burning the light longer than three minutes in case of an emergency, may cause the light to smoke the reflector and cut down its effeciency. The reflectors are silver plated and very easily scratched. To clean the reflector, wash it with a piece of cotton saturated with kerosene and then thoroughly dry. The inside of the reflector should not be touched with the hands after cleaning.

3. The landing light is set to open 75°; however, it is adjustable between 65° and 80°. To change the angle, it is necessary to remove the light, put it in the open position, and loosen the two screws under the electric motor. This will allow the power unit to slide in either direction desired.

4. Lubrication. - If the lights are used every day, inject 10 or 15 drops of pyroil in the gear box and a small amount of Mobilgrease Zero in the arm slide twice a year.

(e) Fluorescent Lighting.

1. General. - The fluorescent lighting installation consists of an inverter, lamp assembly, and fluorescent paint on the dials. The lamp assembly is mounted on a semi-flexible extension arm extending from beneath the instrument panel. The lamp may be moved to illuminate any portion of the instrument panel. The adjustable filter, when it covers the illuminating slot, removes the white light emitted and permits the shorter rays to pass through. These rays cause the salts in the paint on the dials to fluoresce, thus making them visible.

2. Inverter. - The inverter receives power from the battery at 24 volts and transforms it to 110 volts. A.C.

3. Lamp Assembly. - The lamp assembly consists of a vapor tube filled with filaments at each end and an automatic switch. Closure of the lamp switch permits current to flow from the battery, through the inverter, to the filaments in the lamp. The filaments rapidly become incandescent, which causes the automatic switch to open. The opening of this switch allows a large surge of voltage to arc the length of the tube from one filament to the other. The filaments then become poles for the arc, which by means of the vapor, forms the source of illumination.

(f) Switches and Rheostats. - The switches and rheostats for the instruments and spotlights are on the electrical control panel. The spotlights are controlled by a switch having three positions: "ON", "OFF", and momentary contact "ON" for check purpose. Both the instrument lights and spotlights are controlled by rheostats.

(3) Instruments. - The following instruments are mounted on the instrument board:

(a) Rate of Climb Indicator, type C-2, T. O. No. 05-20-17.

(b) Turn Indicator, type A-5, T. O. No. 05-20-4.

(c) Flight Indicator, type C-7, T. O. No. 05-20-3.

(d) Bank and Turn Indicator, type A-8, T. O. No. 05-20-2.

(e) Airspeed Indicator, type D-7, T. O. No. 05-10-2.

(f) Compass, type B-16, T. O. No. 05-15-2.

(g) Altimeter, type C-12, T. O. No. 05-30-1.

(h) Suction Gage, type F-3, T. O. No. 05-80-1.

(i) Clock, type A-11, T. O. No. 05-1-9.

(j) Manifold Pressure Gage, type D-9, T. O. No. 05-70-1.

(k) Tachometer, type C-9, T. O. No. 05-5C-1.

(l) Thermometer, Coolant, type A-23, T. O. No. 05-40-4.

(m) Engine Gage Unit, type B-7, T. O. No. 05-75-1.

(n) Flap and Wheel Indicator (Selsyn, type 8DJ-4PXAB), T. O. No. 05-55A-2. This is an electrically controlled landing gear, tail wheel and flap position indicator. In operation, the motion of the wheels and flaps is followed by the respective images on the indicator. Wheels and flaps in the "UP" position complete the luminous outline of the airplane. The images disappear entirely from view, leaving a gap in the luminous outline, when the electrical power is off.

(o) Fuel Quantity Indicator.

1. The fuel quantity indicator for the fuselage tank is of the magnetic coupling type. G. E. 8DJ11LAE (drawing 87-45-554) T. O. No. 05-65A-1.

2. The fuel quantity indicators for the main and reserve wing tanks are of the magnetic float type, (drawing 87-45-079) and are located in the floor of the cockpit. These gages are both individually lighted and are controlled from a switch on the main switch panel.

(p) Ammeter - Spec. 94-32284, type F-1.

(4) Vacuum System (drawing 87-54-501).

(a) The gyro instruments are operated by a Pesco type B-6, engine-driven vacuum pump. This is a dry sump pump and is designed to eliminate the necessity of feeding lubricating oil into the pump proper. The pump consists essentially of a pair of involute type impellers mounted on steel shafts supported by ball bearings within an aluminum alloy housing. A pair of driving gears pinned to the impeller shafts keeps the impellers properly meshed. Lubrication of the driving gears is accomplished by supplying engine oil to the pump under pressure through an opening in the mounting flange. Inside the pump oil passes through a special metering device directly into the gears. Used oil drains back into the engine through a line connection from the drain hole in the front cover of the pump. The pump has a capacity rating of 600 ft. of free air per minute at 1500 r.p.m. with 4 inches of mercury suction and 1 inch of mercury pressure.

(b) One relief valve Pesco No. 195 is installed in the vacuum pump intake line, located on the left-hand side in the engine compartment inboard of the oil separator. This relief valve maintains constant suction, through out varying pump speeds and flight

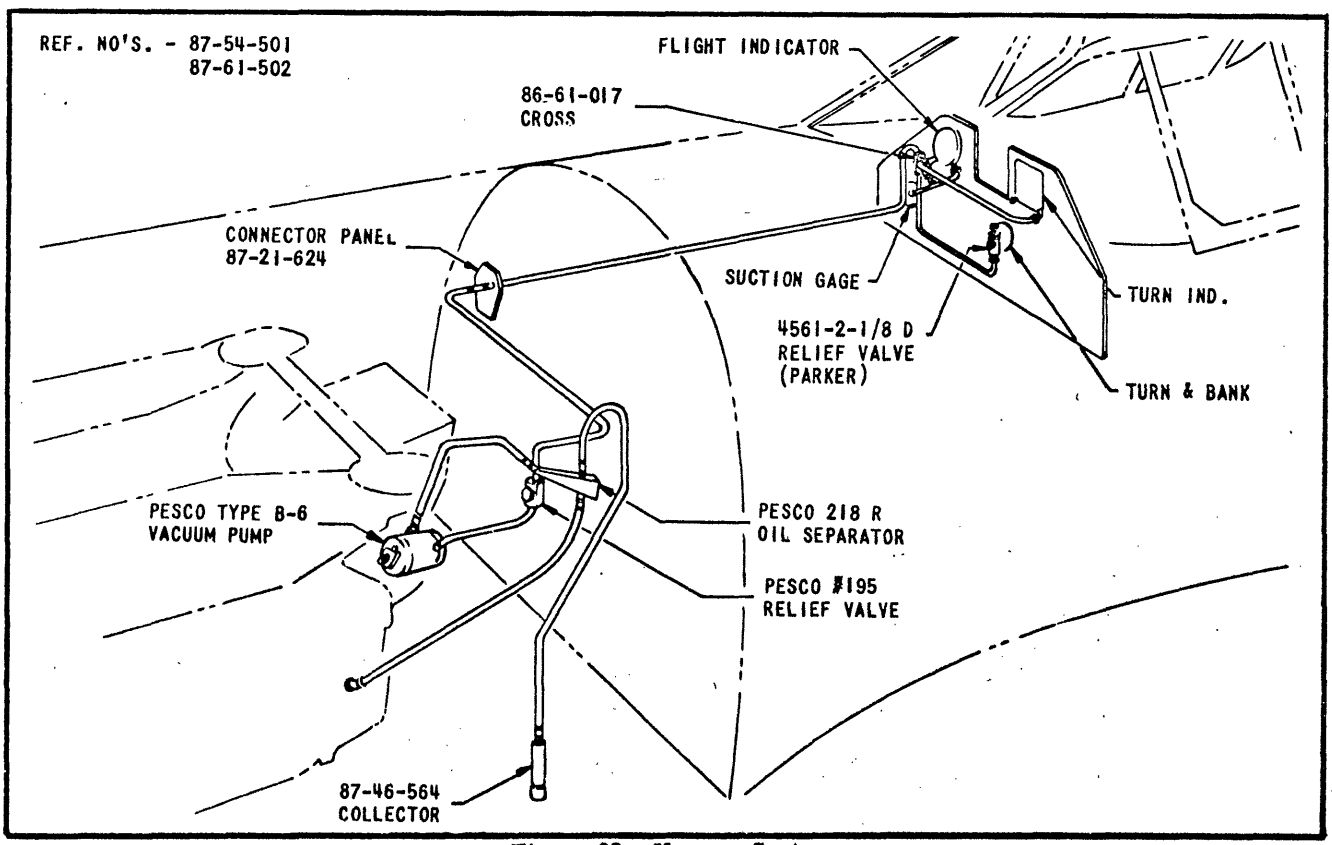


Figure 92 - Vacuum System

conditions. It is an adjustable, spring loaded disc type valve contained in a heat-treated aluminum alloy body and is designed for a minimum of restriction. The control valve is a bakelite disc contained in the end of a valve guide. A control spring holds the valve against a seat protected by a screen. The tension of this spring can be modified by means of an adjusting screw on the outside of the valve body to provide a range of suction adjustment of 3 to 8 inches of mercury. At 25-hour inspection periods clean the screen and check the connections. At regular engine overhaul periods remove the screened valve seat from the assembly and take out the bakelite disc. Inspect the disc and correct any slight wear by passing it lightly over a flat oilstone. If the wear is excessive, replace the part. See that the valve seat and the adjusting lock nut are fastened by means of safety wire. A Parker 4561-2-1/8 D relief valve is installed on the back of the instrument panel in the line to the Turn and Bank Indicator.

(c) An oil separator, Pesco No. 218R is installed in the discharge line on the left-hand side in the engine compartment. The oil drain line runs to the left-hand side of the engine crankcase; the discharge line from the separator connects to the drain collector on the left-hand engine mount truss.

b. Pitot Static Tube (Electrically Heated). - An electrically heated type 1079S-940J "crank" airspeed head is installed on the left wing on airplanes AF-41-24776 through AF-41-25195. The type D-1 "spear head" (Spec. 27876) is installed on airplanes AF-41-35874 through AF-41-36953. These airspeed heads are not interchangeable because: First, the airspeed tubes are not the same length, and second, because the heating unit in the airspeed head 1079S-940J has a one hole plug for the electric circuit, whereas, the heating unit of the type D-1 airspeed head has a two hole plug for the electric circuit. Both heating units require 24 volts for satisfactory operation. Airspeed lines are of 1/4 O.D. aluminum alloy tubing, with triple solderless fittings.

c. Drains. - Drain plugs for the airspeed lines are located in the bottom surface of the wing, inside the landing gear fairing.

17. Surface Controls (drawing 87-64-501).

a. General.

(1) Aileron Control. - The control stick and aileron control torque tube are supported as a unit by two bearings bolted to the wing match angle. Each aileron system consists of an adjustable link connected to an arm on the control stick torque shaft, and extending down through the wing to a bell crank; cables run aft from the bell crank and then outboard to a drum which operates the aileron through an eccentric arm.

(a) The movement of the stick for full aileron control is 20-1/2°, either side of the centerline of the airplane. The turnbuckles on the cables are accessible through the inboard trailing edge of the wing when the flaps are lowered.

(b) The adjustments on the links are located above the upper wing skin at the aft end of the control torque shaft.

(c) All cables requiring specified tension are tested for correct loading by a tensionmeter.

(d) The following tensions are specified:

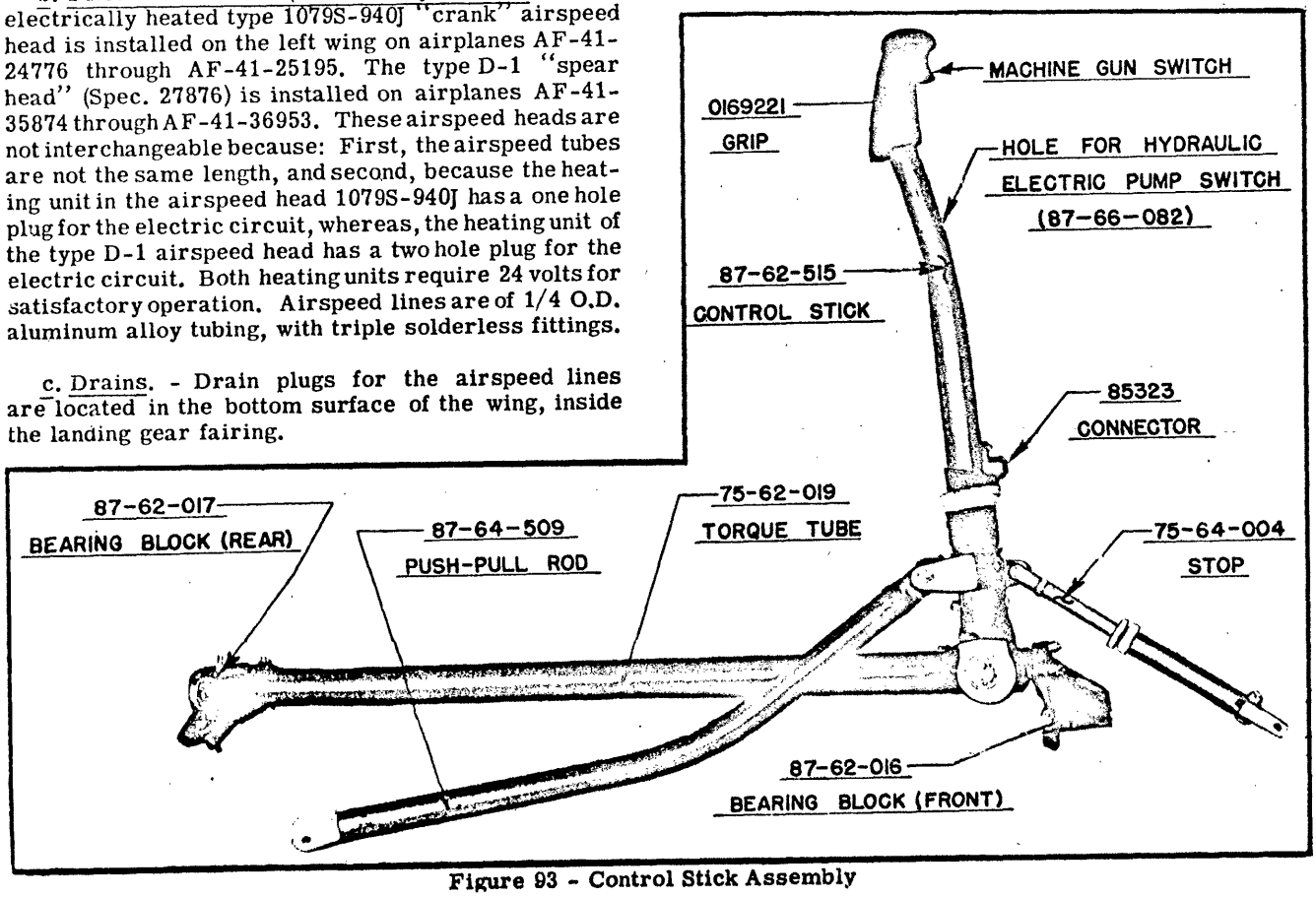


Figure 93 - Control Stick Assembly

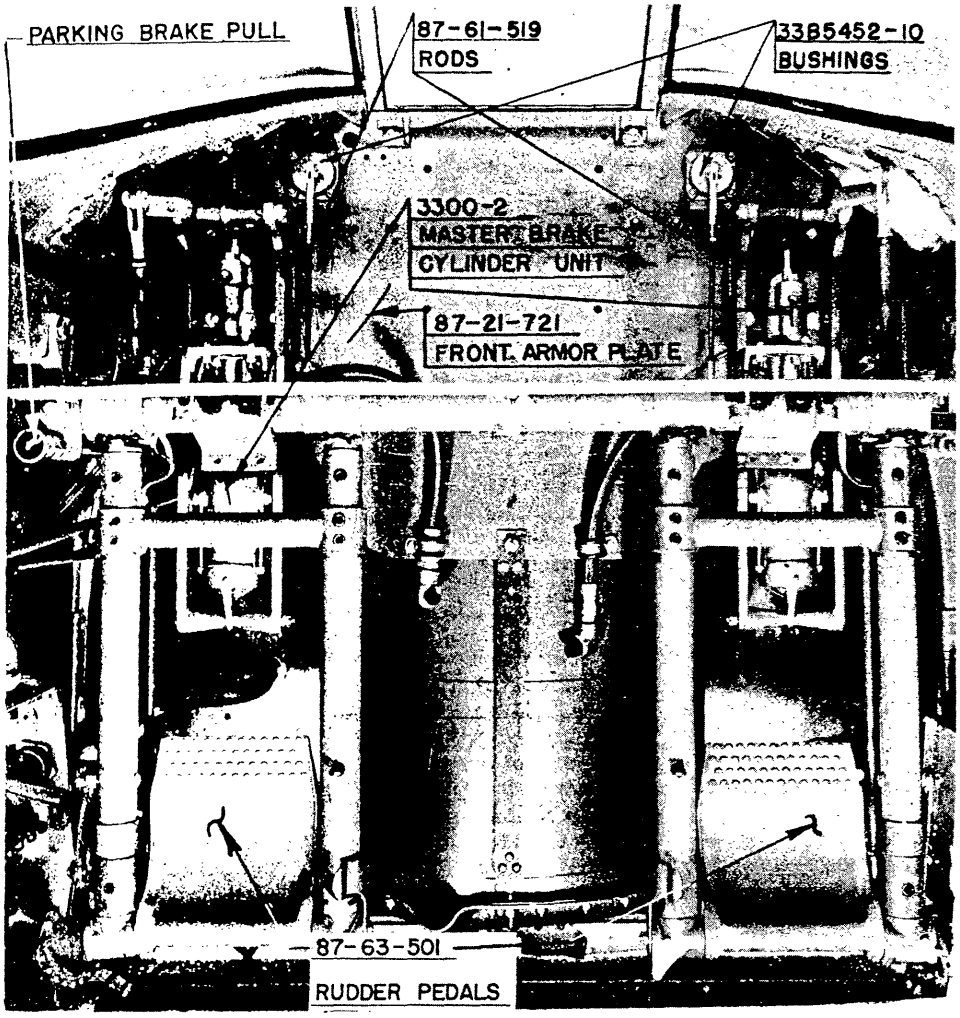


Figure 94 - Rudder Pedals and Brake Master Cylinder

Elevator Cables. . . . . .100 lbs.
Rudder Cables. . . . . .100 lbs.
Tail Wheel Cables (Retracted). . . . . 0 lbs.
Tail Wheel Cables (One Load). . . . . 40 lbs.
Tail Wheel Cables (Extended). . . . . .110 lbs.
Aileron Cables. . . . . 90 lbs.

(2) Elevator Control.

(a) The stick is connected to the elevator control by a push-pull tube to a lever on the front jackshaft at station No. 5. Bell cranks on the jackshaft at station No. 5 are connected by two pairs of cables to bell cranks on a rear jackshaft at station No. 16. From a single short push-pull link connects to the elevator horn. The cables are crossed between bell cranks. The cables are accessible through the rear fuselage inspection doors. (See figure 25.)

(b) The stop for the elevator system is an adjustable cylinder and piston unit, attached to the front of the wing control stick and leading forward and down to attach the wing match angle.

(c) The stops for the aileron system are bolts through the arms of the aft end of the torque shaft.

(3) Rudder and Tail Wheel Controls.

(a) The rudder system consists of a cable running aft from the rudder pedal, which passes around a reduction pulley mounted on an arm at station No. 8. Two cables attached to the reduction pulley by turnbuckles, lead aft, one connecting to the rudder horn, and the other to the tail wheel horn. (See figure 22.)

These turnbuckles are accessible for adjustment through the door in the left side of the fuselage. Turnbuckles are also located at the rudder pedals, and adjustments may be made from the cockpit. A run-around cable runs from one pedal, forward around two pulleys to the opposite pedal.

(b) Each tail wheel control cable passes through a pair of guide pulleys at station No. 13. Slack in the cable is avoided by the use of two coil tension springs,

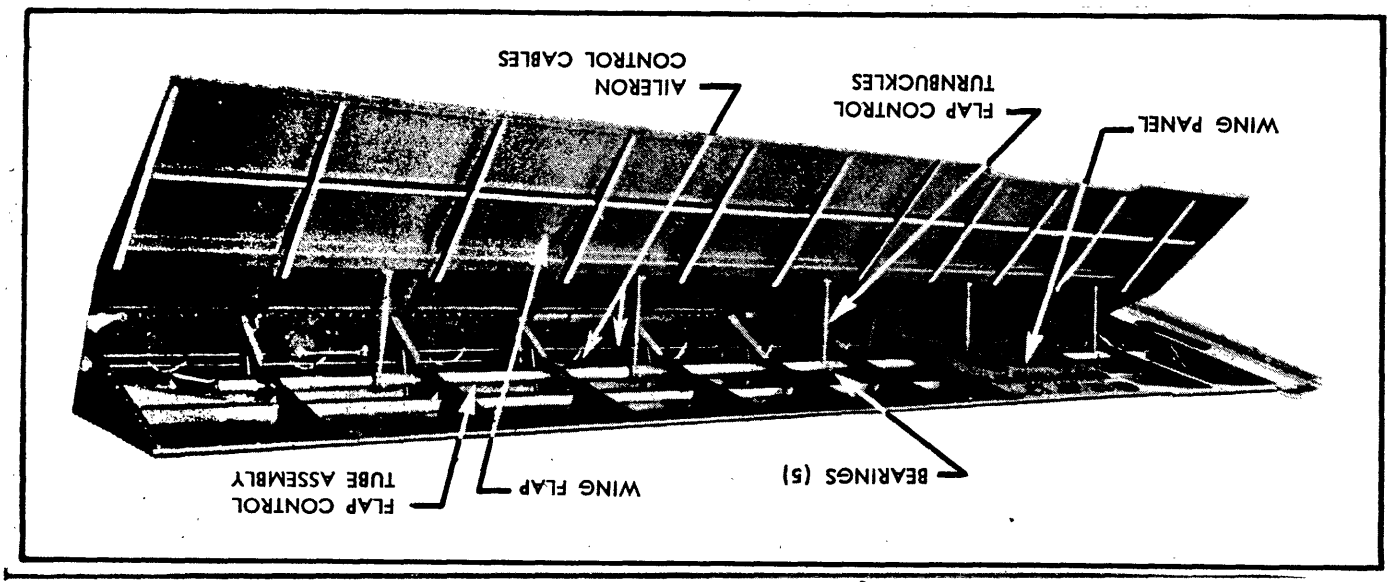


Figure 95 - Wing Flap - Open 45°

attached to the lift tube at the centerline of the fuselage, and to the cable at station No. 12. The cable also incorporates a compression spring to avoid transmitting taxiing shock to the rudder pedals.

(c) The rudder pedal stops are small castings mounted on the fuselage-wing attachment angle, on both sides of the cockpit near the floor. The rudder pedal in the full forward position strikes the adjustable stop screw head.

(4) Flap Controls. - The flap control system consists of a hydraulic actuating strut, mounted on the airplane centerline bulkhead inside the wing near the trailing edge. The motion is transmitted through bellcranks to spanwise push-pull tubes in the wing. Five links with turnbuckles connect each flap to the push-pull tubes. For adjustment purposes, the links and turnbuckles may be reached through the trailing edge of the wing when the flaps are lowered.

(5) Trim Tab Controls.

(a) The elevator and rudder trim tab controls are mounted on the left side of the cockpit. Motion is transmitted by a chain and sprocket drive to the gear box, mounted just forward of the rear elevator jackshaft. From this box three flexible shafts, (2 for the elevator, 1 for the rudder) transmit motion to the tab control actuator unit. Short tie rods connect these actuators to the tabs on the elevators, and a longer rod enclosed in a fairing on the right-hand side of the rudder, controls the rudder tab. Control chain tension is adjustable by turnbuckles, accessible through the baggage compartment door.

(b) The rudder trim tab setting is made with the rudder in neutral flight position. The rudder pedals are maintained in the neutral position by clamping the two pedals to a straight metal bar.

In the assembly of the trim tab actuating arm (87-14-558), 7/8 $\pm^{0}$ -1/32 inch is allowed between the end of the actuator screw jack, and the end of the tube. The lock nut is tightened against the actuator, and the actuator and tube end are jointly drilled and cottered. The actuator is extended to 3-5/8 ± 1/32 inches (measured from the center of the hinge pin holes to the end of the actuator screw jack), to assure proper throw of the trim tab. The clevis end can be adjusted so that the distance between the hinge pin center on the actuator and clevis end bolt hole center is approximately 23-25/32 inches.

The rudder tab actuating arm fairing located on the right side of the rudder is removed, and the actuating arm assembly is installed. The rudder tab control, located at the left of the pilot's seat, is set at 0^{0} before the flexible shaft is attached to the rudder tab actuator.

Final adjustment of the trim tab is attained by turning the clevis end of the actuating arm assembly as required, to align the trim tab centerline with the rudder centerline. The lock nut is tightened against the clevis end, and the clevis end and tube end are jointly drilled and cottered.

(c) The electric aileron trim tab on the left-hand aileron, is controlled by means of an electric motor mounted in the leading edge of the aileron. The momentary contact operating switch, for the motor, is located on the main switch panel, beneath the instrument panel.

b. To Remove the Elevator Control Jackshafts.

(1) To remove the forward jackshaft, disconnect the push-pull tube from its arm, and the four cables from the horns. Remove the eight bolts attaching the three bearing supports to the bulkhead and remove the

shaft and bearing supports. Then the bearing supports may be removed, if desired, by removing the nuts at the end of the shaft.

(2) The rear jackshaft may be removed by disconnecting the cables and link, and then removing the four bolts which attach the bearings to their supports.

c. To Remove the Wing Flap Control Mechanism. The flap actuating strut and bell crank may be removed through doors in the bottom surface of the wing near the trailing edge, after the keel fairing has been removed. To remove a push-pull tube it is necessary to separate the panels at the centerline, remove the bolts which attach the turnbuckle fittings to the tube, and withdraw the tube inboard while sliding the fittings off the tube.

(1) To Disassemble the Hydraulic Actuating Cylinder. - When the wing panel is separated at the center bulkhead, the flap actuating cylinder may be easily removed for inspection and disassembly. First disconnect the two hydraulic lines at the cylinder. (See figure 96.) Next remove the two bolts attaching the bell crank arms to the piston shaft end "D". Remove the four bolts in the clamp assemblies which attach the cylinder to the center bulkhead. Place the cylinder "A" in wooden block clamps and insert in a vice. If block clamps are not available, use a vice with aluminum or copper covered jaws. With cylinder "A" held firm, unscrew the end plug "C", using the spanner wrench (drawing 87-88-030), which is carried in the tool compartment of the duffle bag. Pull the two cotter pins "H" and unscrew the nuts "G". Remove the washers "F" and pull bolts "E" which attach end "D" to the piston shaft "B". Remove piston assembly "B" from the cylinder through the uncapped end. The rubber piston cups "I" may now be inspected and replaced if necessary. Also inspect the rubber cup on the end plug "C", and the cup in the forward end of cylinder "A". If worn, replace with new cups.

(2) To Assemble the Hydraulic Actuating Cylinder. - Before assembling the cylinder be sure that no dirt or foreign matter of any kind is on the parts to be assembled. To assemble reverse the procedure outlined above for disassembly.

18. Hydraulics (drawing 87-33-901).

a. General.

NOTE: All hydraulic system tube fittings stamped 150 are heat-treated to 150,000 pounds per square inch. (See nameplate in the cockpit.)

(1) Hydraulic System.

(a) The hydraulic controls consists of an electrically driven hydraulic pump, for operating the retractable landing gear, tail wheel, and wing flaps, two hand pumps for emergency operation; a toggle switch, mounted just below the grip on the control stick for operating the electric pump; a reserve tank assembly, aft of the fuselage access door on the left-hand side of the fuselage, for hydraulic fluid, an emergency hydraulic reserve tank, mounted forward of the firewall and a hydraulic valve with two handles, on the left

LETTER	PART NO.	NAME	NO. REQ'D.	LETTER	PART NO.	NAME	NO. REQ'D.	LETTER	PART NO.	NAME	NO. REQ'D.
A	75-64-071	CYLINDER	1	N	AN380-C2-2	COTTER	2	I	99179	CUP	2
B	75-64-072	PISTON ASSEMBLY	1	G	AN320-3	NUT	2	J	99178	CUP	1
C	75-64-073	PLUG	1	F	AN960D10	WASHER	2	K	99180	CUP	1
D	87-64-024	END ASSEMBLY	1	E	AN23-23	BOLT	2	L	106D-1-20	PIN	1

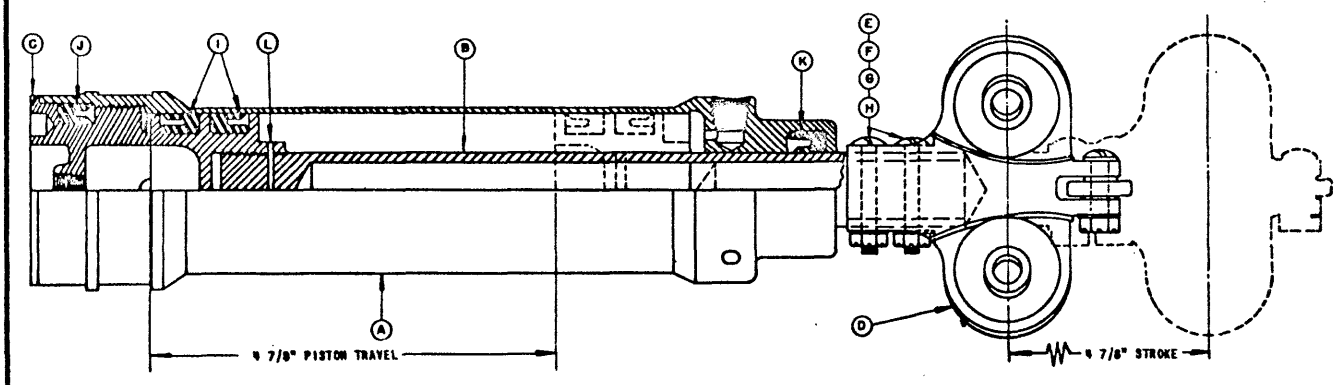


Figure 96 - Wing Flap Actuating Cylinder

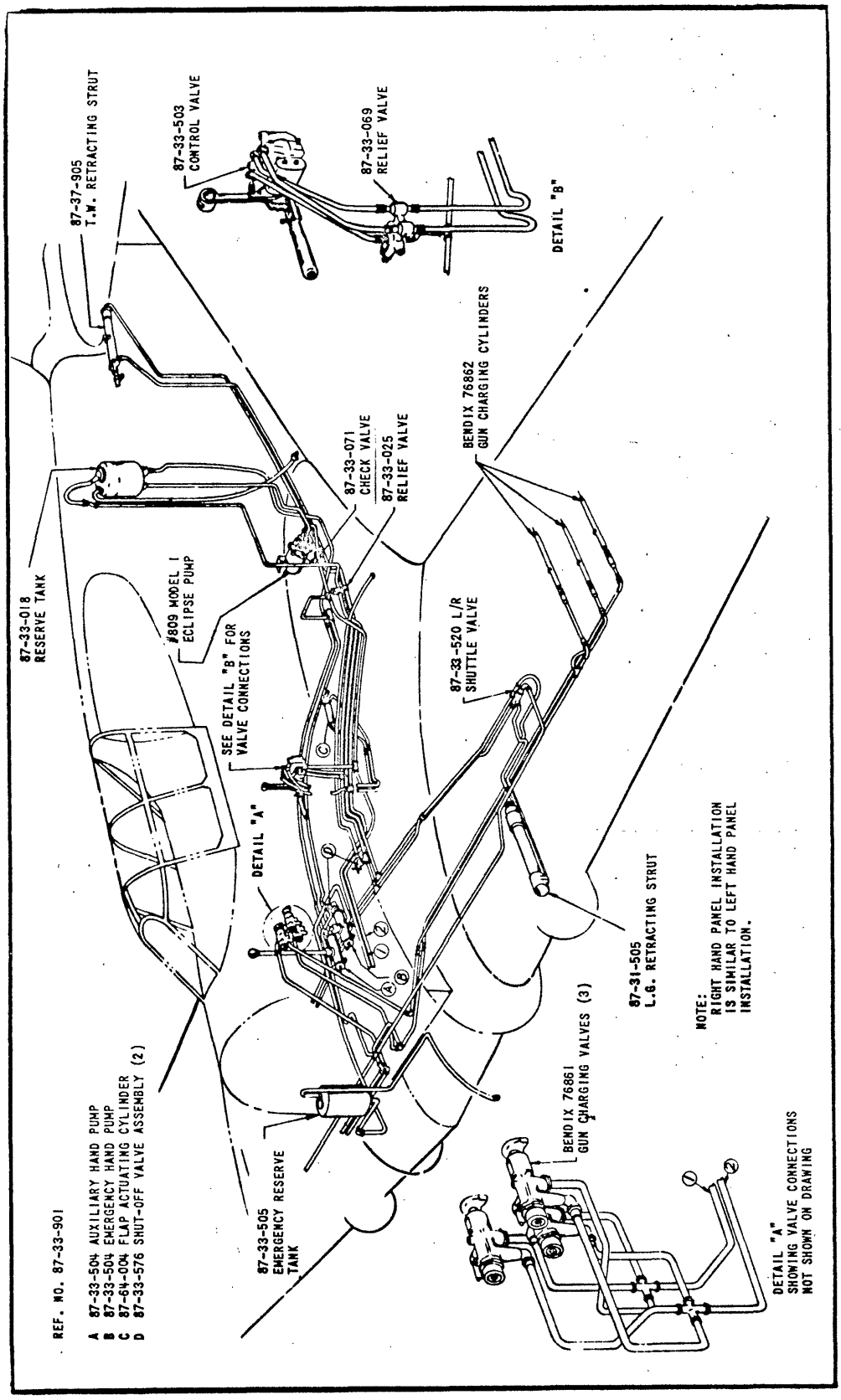


Figure 97 - Hydraulic System

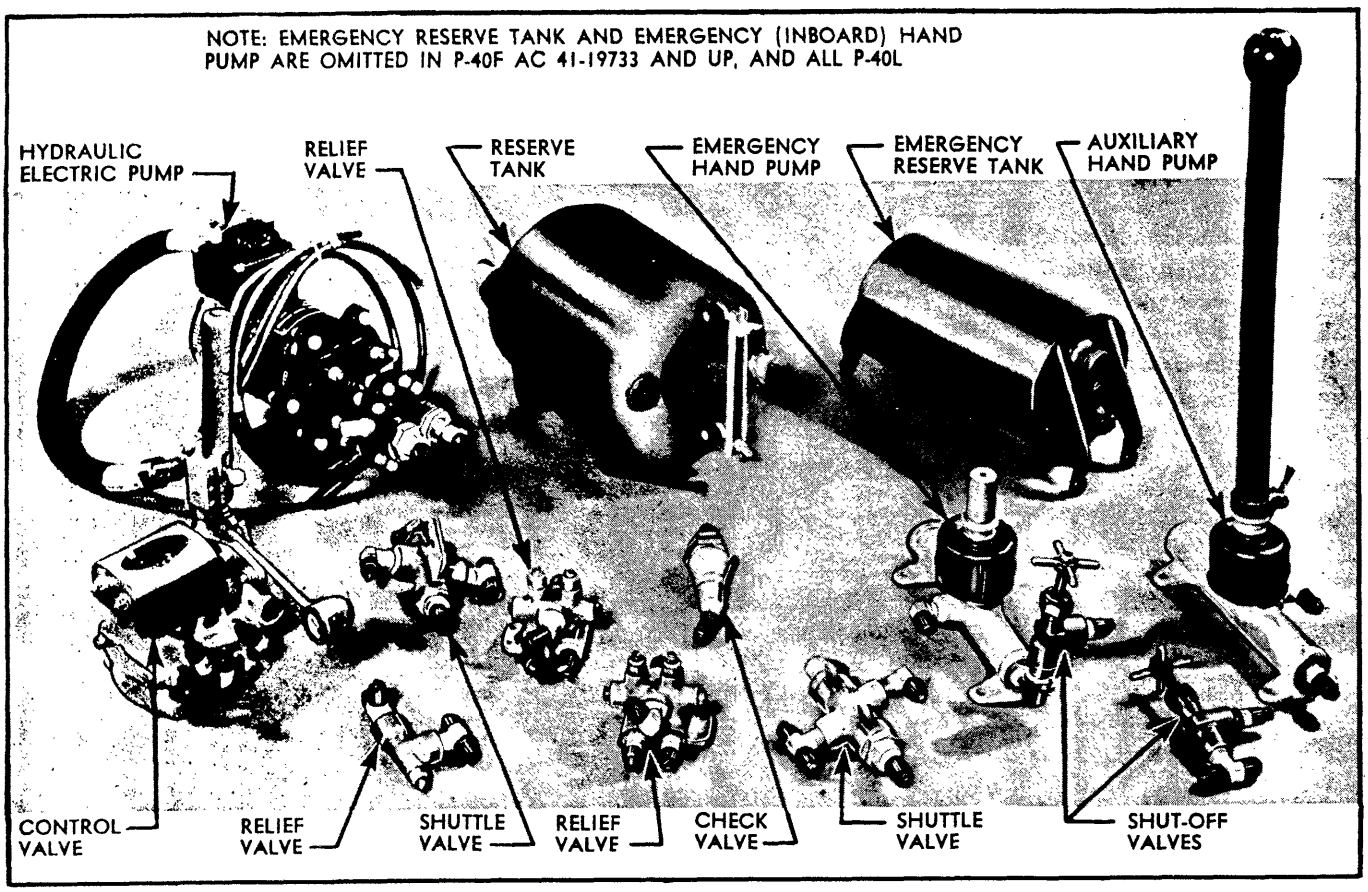


Figure 98 - Hydraulic Operating Units

side of the cockpit, and two shut-off valves (87-33-576) painted red, in the emergency hand pump system, one on the pump outlet line directly aft of the pump cylinder, and the other in the return line from the landing gear retracting strut on the left side of the cockpit floor, forward of the hydraulic control valve. These valves should always be closed, except when the emergency hand pump is being operated. The valve on the floor on the left-hand side of the cockpit, allows the hydraulic fluid in the landing gear retracting strut to be vented overboard, thus relieving any back pressure that might be built up in the retracting strut when the emergency hand pump is in operation. The tubing material in the hydraulic controls is "Everdur", or stainless steel tubing (Spec. 57-180-3) throughout, except vent and drain lines, which are aluminum alloy. (See figure 97.)

(b) The hydraulic lines for operating the landing gear are accessible for servicing through the wheel compartment or the fuel tank compartment. Removable plates are provided where lines pass through the wing surface.

(c) The lines for operating the flap cylinder are accessible through the lower surface door near the inboard end of the left flap, or the hand holes immediately forward of this door.

(2) Motor Driven Hydraulic Pump. - The electric pump assembly is the Eclipse Aviation pump and motor assembly type 809, model No. 1. The pump is equipped with an integral relief (by-pass) valve adjusted to 1000 lbs. per square inch. For data applicable to this pump refer to T. O. No. 03-20CB-1.

(3) Hydraulic Hand Pumps. - (drawing 87-33-504). There are two hydraulic hand pumps, attached to the floor of the cockpit on the right-hand side. Each one is a single cylinder, reciprocating, double action pump. The outboard pump is an auxiliary pump, and is used to maintain pressure in the hydraulic system in case of failure of the electric pump. The inboard pump is connected separately to the landing gear only, and is fed from a tank mounted on the firewall. This pump is for emergency use only, and is used after failure of the rest of the system. Information applicable to this pump may be found in T. O. No. 17-1-3.

(a) To Disassemble the Hand Pumps. - Removal: The hand pumps may be removed from the floor of the

REF	PART NO.	NAME OF PART	NO REQD
A	87-33-067	BODY	1
		PISTON ASSEMBLY	
B	87-33-048	PISTON	1
C	87-33-064	PACKING	4
D	87-33-063	PACKING RING	2
E	87-33-504-1	HARDENED STEEL BALL	2
F	87-33-058-2	SPRING	2
G	87-33-062	RETAINER	1
H	87-33-504-2	#10-32 ALLEN SET SCREW	2
		VALVE ASSEMBLY	1
I	87-33-049	VALVE	1
J	87-33-059	CUP-PACKING	4
K	87-33-504-1	HARDENED STEEL BALL	2
L	87-33-058-1	SPRING	2
M	87-33-055	RETAINER	2
N	87-33-070	SNAP RING	2
O	895-71	PLUG	3
		BALL INSTALLATION	
P	87-33-054	PACKING	1
Q	87-33-528	BALL-PISTON END	1
R	87-33-053	SHIM	1

REF	PART NO.	NAME OF PART	NO REQD
S	87-33-052	NUT	1
T	87-33-051	BOOT	1
U	87-33-052	PLUG	2
V	87-33-057	PIN	2

TEST PROCEDURE:
1. PUMP MUST DELIVER ONE QUART FOR 80 STROKES (40 CYCLES) MAX. AT 500 P.S.I. PRESSURE
2. PLUG PORT "B" APPLY 2500 P.S.I. PRESSURE AT PORT "A" PUMP MUST NOT LEAK MORE THAN 5 DROPS PER MINUTE.
3. PLUG PORT "A" AND "B" APPLY 2500 P.S.I. PRESSURE AT PORT "C" PUMP MUST NOT LEAK MORE THAN 5 DROPS PER MINUTE.
4. USE ONLY HYDRAULIC BRAKE FLUID FOR TEST. DO NOT USE MINERAL OIL.

REF. DWG. 87-33-504

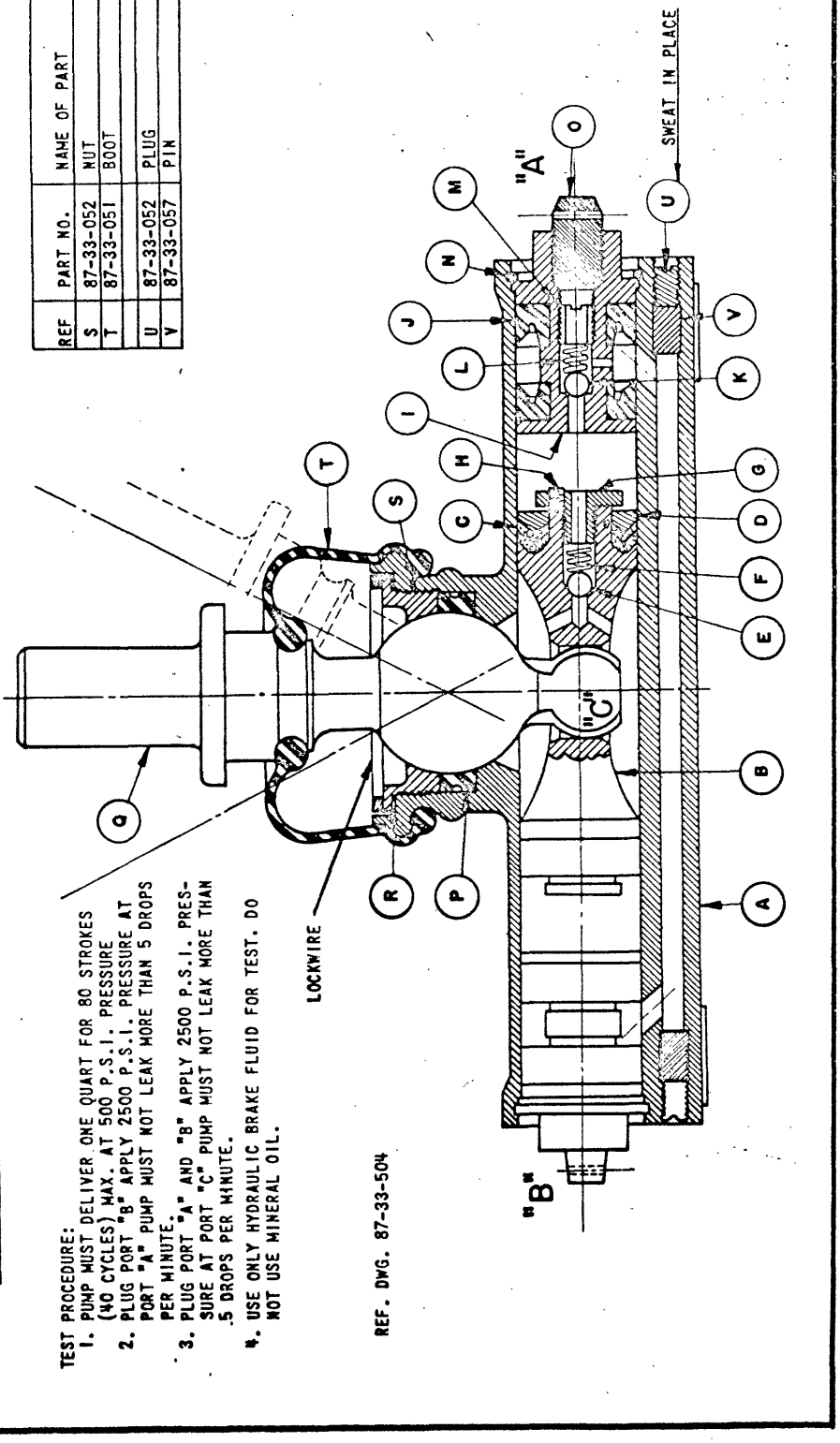
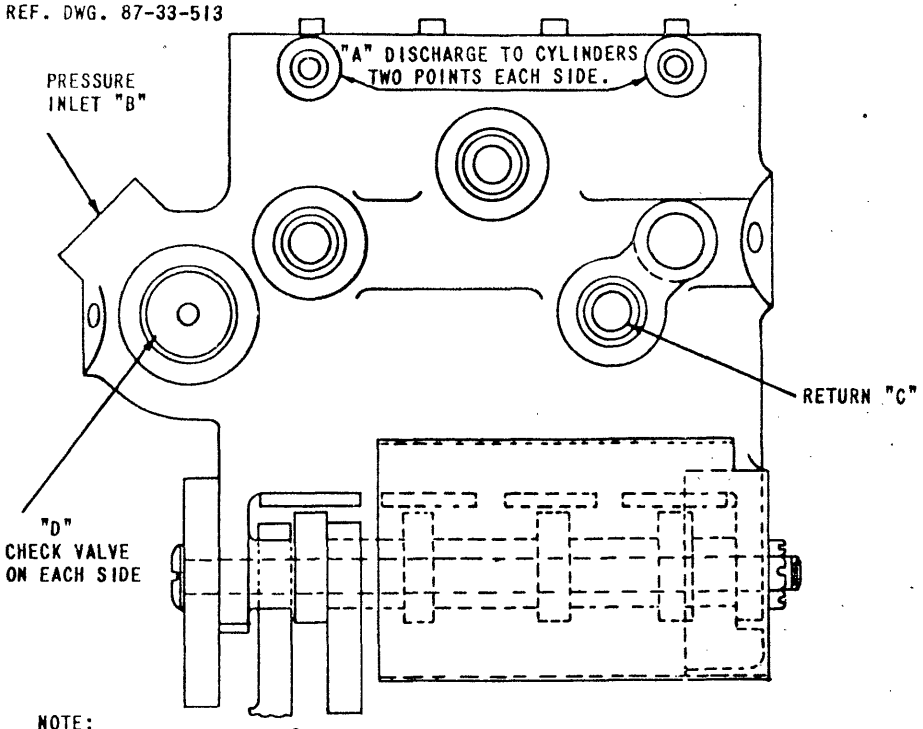


Figure 99 - Hydraulic Hand Pump

REF. DWG. 87-33-513

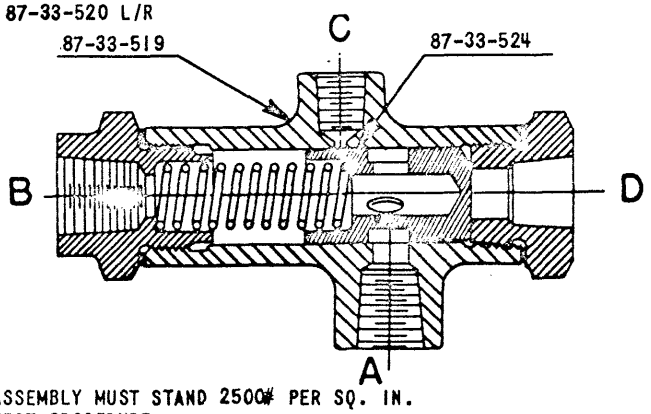


NOTE:
1. TEST AT 2500 #/IN^2 (SEE TEST NOTES BELOW)
2. MINIMUM VALVE TRAVEL TO BE .040"
3. ALL PASSAGES MUST BE CLEAN AND FREE FROM DUST, GRIT AND FOREIGN MATTER.

TEST:
BOOST WITH HAND PRESSURE AT 2500 #/IN^2 AS FOLLOWS$\frac{1}{2}$
A. WITH VALVES IN NEUTRAL POSITION APPLY PRESSURE THRU EACH OF FOUR POINTS "A" SEPARATELY. THERE SHOULD BE NO LEAKAGE AT "B", "C", "D".
B. WITH VALVE IN NEUTRAL POSITION APPLY PRESSURE AT "B" & "C" SEPARATELY. THERE SHOULD BE NO LEAKAGE AT ANY OF FOUR POINTS "A".

Figure 100 - Hydraulic Control Valve - Pressure Test Data

REF. DWG. 87-33-520 L/R



ASSEMBLY MUST STAND 2500# PER SQ. IN.
TEST PROCEDURE
#1 - PORT "B"
PLUG ALL OTHER PORTS: APPLY PRESSURE.
#2 - PORT "B"
PLUG PORTS "A" & "D", LEAVE PORT "C" OPEN. APPLY PRESSURE. PORT "C" SHOULD NOT LEAK MORE THAN 5 DROPS PER MINUTE.
#3 - PORT "D"
FILL WITH HYDRAULIC FLUID AT PORT "B", THEN PLUG PORT "B". APPLY PRESSURE TO PROVE OPERATION OF SHUTTLE AS FOLLOWS: SHUTTLE SHOULD MOVE AGAINST SPRING TO ALLOW NORMAL FLOW OF FLUID OUT OF PORT "A". THERE WILL BE A SMALL CONTINUOUS FLOW FROM PORT "C". FREE AND UNRESTRICTED SLIDING FIT MUST BE MAINTAINED BETWEEN 87-33-524 & 87-33-519 THROUGHOUT THE ENTIRE STROKE.
#4 - THIS TEST MUST BE RUN WITH ALL HYDRAULIC FITTINGS INSTALLED AS SHOWN ON 87-33-501 & 87-33-701

Figure 101 - Test Procedure - Hydraulic Shuttle Valve

cockpit by disconnecting all hydraulic lines and removing the eight hold-down bolts, four on each pump.

To disassemble the hand pumps, refer to figure 99, for the alphabetical listing of parts. First remove the rubber boot "T" and unscrew the gland retaining nut "S" with the wrench provided in the tool kit. Remove the pump handle shaft "Q". Only one end of cylinder need be opened to remove the piston. Release the snap ring "N" which retains the discharge check and double seal packings, after which the piston "B" should pull out freely. The ball check at both ends of the piston may be disassembled by removing the set screw "H" and unscrewing the retainer "G". The packing ring "D" and packing "C" may be removed, if necessary, for replacement, and the spring "F" and hardened steel check ball "E" may also be removed. The ball check and spring may be removed from the discharge check and double seal packing assembly, by unscrewing the retainer "M". The piston and retainers should be pulled straight out to prevent scoring the cylinder wall, as the packings will in turn be scored when reassembled in the cylinder.

(b) To Assemble the Hand Pumps. - To assemble the hand pumps, reverse the procedure noted above. Before the ball checks are reseated, clean both the ball and seat thoroughly, place ball on the seat and tap lightly. In assembling the rubber packings, care must be taken not to damage the feather edges of the packings, for a small cut will cause unsatisfactory pump performance. The best results for installing packings will be obtained by thoroughly wetting the packings and mating the parts with Lockheed Hydraulic Fluid No. 5 or equivalent. (See section III, a. 11.) Test the hand pumps after assembly as follows: Pumps must deliver one quart for 80 strokes (40 cycles) maximum at 500 p.s.i. pressure. When a pressure of 2500 p.s.i. is applied to either of the three ports with the other ports plugged, the pump must not leak more than 5 drops per minute.

NOTE: Use only Lockheed Hydraulic Fluid No. 5 or its equivalent (section III, a. 11) for this test.

(4) Control Valve. - The control valve assembly consists of two operating handles on two cam shafts which operate a series of poppet valves for the control of the fluid flow.

(5) Restricted Fittings and Check Valves.

(a) A restricted fitting is installed in the landing gear hydraulic system, to eliminate the pressure differentials and consequent undesirable flow characteristics, resulting from unequal piston displacements in the landing gear and tail wheel retracting cylinders. This fitting is installed in the tee-fitting, at the junction of the landing gear and tail wheel return lines, directly below the control valve. If this fitting was not installed, the larger volume of returned fluid, flowing through one side of this tee-fitting from the landing gear cylinders, would prevent the smaller volume of returned fluid from the tail wheel from flowing into the other side of the tee.

A restricted fitting is installed in the flap system in the control valve boss from the return line. When the flaps are being raised, owing to the air loads on the flaps in the "down" position, they will go up automatically as soon as the control valve is moved to the "up" position. The 3/64 inch diameter orifice in the restricted fitting, controls the flow of oil in this condition and regulates the rate at which the flaps move upward.

(b) A check valve is installed in the pressure line from the motor-driven pump in the fuselage; this valve is located on the left side of the airplane, and may be reached through the stowage compartment door. Its purpose in the system is to prevent by-passing the hand pump pressure through the electric hydro pump when the hand pump is operated.

(6) Relief Valves. - The single relief valve for the hydraulic hand pump and the twin relief valve for the landing gear and flap controls are located in the lower left side of the fuselage forward of the stowage compartment. (See paragraph 2. y. in section III for testing information.)

(7) Shuttle Valve. - A shuttle valve 87-33-520 is installed between the retracting strut and the main hydraulic system. This valve permits by-passing of the main hydraulic system when the emergency hand pump is operated. The valve is located inside of the wheel pocket, aft of the landing gear position transmitter. (See figure 101 for testing information.)

(8) Landing Gear Retracting Struts.

(a) The retracting struts (drawing 87-31-505) each have a stroke of 11-1/16 inches. Both struts are equipped with two sets of hydraulically operated locks, which are operated by over-travel of an internal sliding actuator. The locks consist of two sets of radial segments, retained in square broached holes in the piston, which are positively cammed into and out of the locked position.

(b) Figure 102 shows a section through the upper half of the retracting strut with the piston and pawl at the left or forward end (landing gear down), and a section through the lower half with the piston and pawl to the right or rear (landing gear up).

(c) Considering the upper half with the landing gear down, oil pressure in the aft end of the cylinder holds the piston "D" and pawl 75-33-021 forward. Locks 75-33-027, which are retained in the piston, are held out preventing the piston from moving aft. When retraction of the gear takes place, pressure at the aft end of the cylinder is relieved and pressure is built up at the forward end, forcing the pawl 75-33-021

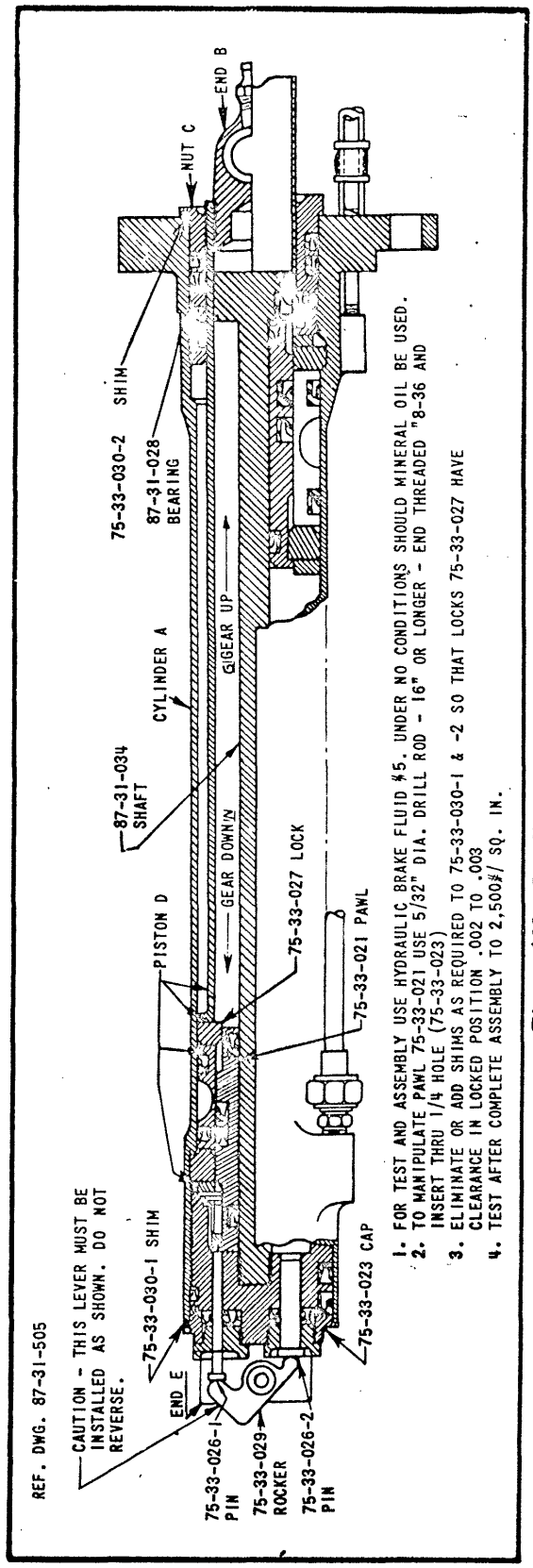


Figure 102 - Landing Gear Retracting Strut

aft with respect to the piston and cylinder until locks 75-33-207 are released. The pressure then forces the piston aft, the locks being moved inward by the beveled shoulder of the cylinder wall.

(d) At the other end of the stroke, the piston is finally stopped by bearing 87-31-028. The pawl continues to move aft, forcing the locks 75-33-207 out into the recess in the cylinder, thereby locking the landing gear in the "up" position.

(e) At the beginning of this retracting stroke, as soon as the pawl leaves the forward end of the cylinder, the 3/16 diameter pin 75-33-026-1 is free to move aft, and oil pressure forces the 3/8 diameter pin 75-33-026-2 forward, rotating the rocker 75-33-029 which operates a bell crank to close the warning horn switch.

(9) Tail Gear Retracting Strut (figure 61). - The principle of operation is the same for this strut as that described above for the landing gear retracting strut, except that no provision is made for locking the tail gear in the "Up" position. However, a lock is provided for the "Down" position. This lock is not connected to the landing gear lock warning system operating the electrical horn.

A compression spring, "G" holds the actuator "L" in the locked down position in case the hydraulic locking pressure should be reduced by leakage. The tail wheel is held in the "Up" position merely by hydraulic pressure on the piston.

(10) Wing Flap Actuating Strut. - This strut consists of a simple hydraulic cylinder and piston located as described in this section, paragraph 17. a. (4).

b. Filling and Bleeding the Hydraulic System (see paragraph 2. y. in section III).

c. Installation and Disassembly.

(1) To Remove the Motor Driven Pump. - This pump is accessible through the baggage compartment door, and may be removed as a unit by disconnecting the hydraulic lines and electric wires, and removing the motor pump unit mounting bolts.

(2) To Remove the Hydraulic Hand Pumps. - The hand pumps may be removed from the floor of the cockpit by disconnecting all hydraulic lines and removing the eight hold-down screws.

(3) To Remove the Hydraulic Control Unit.

(a) Disconnect the two hydraulic lines at the bottom of the unit, one on the inboard side and three at the top.

(b) Remove the four bolts holding the selector valve on to the mounting casting and remove the valve from the airplane.

(4) To Disassemble the Control Valve. - To disassemble the valve proper: First, withdraw the two through bolts which act as cam shafts for the actuating cams. Next, pull out the cam followers by inserting a small hooked rod in the holes provided. Remove the snap ring on the bottom of each poppet valve and withdraw the packing retainer, packing and spring, being careful not to move the valve off its seat, as the upper packings may be damaged if this occurs. Insert screw driver in the slot in the valve stem, and hold the valve firmly against the seat while removing the nut on the head of each poppet valve, then withdraw the poppet valve.

NOTE: Each poppet valve should be tagged to indicate its location in the valve body, as the poppet valves are lapped into their respective seats.

(5) To Assemble the Control Valve. - In assembling the control valve, care should be taken to insert the poppet valves in the proper location, especially if the valves are not to be lapped into the seats. In assembling the rubber packings, care must be taken not to damage the feather edges of the packings, for a small cut will cause leaks. Best results for installing packings will be obtained by thoroughly wetting the packings and mating the parts with hydraulic brake fluid. Note that all internal passages must be free from grit, dirt, or other foreign matter. With cams in neutral and poppet valves closed, adjust the clearance between the cams and followers to .005 and .015 inch. Check travel of each poppet valve. This should be a minimum of .040 inch. Clearance between cams and followers may be adjusted by means of the brass laminated shims under the followers. Before installing the valve in an airplane, it must be tested in accordance with instructions given in figure 100.

(6) To Disassemble and Assemble the Landing Gear Retracting Strut.

(a) To disassemble the retracting strut, see figure 102, remove the piston end "B". Then remove the warning switch actuating rocker 75-33-209, so that a bar may be inserted in the slot to unscrew the cylinder cap 75-33-023. The cylinder cap, piston and all internal parts should then be removed together. Care must be taken in pulling out shaft 87-31-034, from the inside of piston that the packings are not fouled in the square broached holes.

(b) At assembly the retracting strut should be adjusted for between .001 and .003 backlash at both ends. This can be done by inserting a No. 8-36 threaded rod in the 1/4 inch hole in the cylinder cap 75-33-023 to actuate the pawl.

(c) A pressure test at 2500 lbs./sq.in. must show no signs of leakage. Use Lockheed Hydraulic Brake Fluid No. 5. Under no condition should mineral oil be used.

(7) To Disassemble and Assemble the Tail Wheel Retracting Strut.

(a) To disassemble the strut, (see figure 61) remove lug "R". By removing the two attaching shear bolts "S" and "T" connecting the lug to the piston and unscrew cylinder cap "O". This should allow the piston and actuator to drop out freely.

(b) Upon assembly of the strut, adjust the piston backlash from .001 tight to .003 loose.

(c) A pressure test at 2500 lbs./sq.in. must show no signs of leakage.

(8) To Remove the Wing Flap Actuating Cylinder (see paragraph 17. c. (Surface Controls), this section).

19. Ignition and Electrical System (drawing 87-66-651).

a. General. - The electrical system is a single-wire grounded negative installation, including the wiring and equipment for ignition, generator, starter, electrical instruments, type A-8 running lights, instrument and cockpit lights, gunnery equipment, landing gear retracting, position and warning systems, and the electrically controlled propeller. For data on the instrument board lights, see paragraph 16. a. (2) of this section. All electrical cables are carried in aluminum or flexible conduit. Junction boxes or disconnect plugs are provided at all points of juncture of the electrical wiring, to facilitate connection and replacement of the wiring.

b. Ignition System. - The type A-9 (32226) ignition switch is mounted on the left side of the instrument board. For data applicable to the Scintilla type DF magnetos, see T. O. No. 03-5D-8.

c. Generator System. - Power is supplied to the electrical system by a type M-2, generator, mounted on the left rear of the motor. The generator voltage regulator and voltmeter are accessible through the fuselage access door. The generator circuit is controlled by a switching relay and B-5A switch on the main switch panel.

d. Hydraulic Pump Motor. - The pump for the hydraulic system is driven by an Eclipse 24-volt motor. For additional data on this motor, see paragraph 18. a. (2) of this section.

e. Switches and Rheostats (see figure 91). - For Battery and Generator switches see section II, paragraph 2. m. of T. O. No. 03-5B-1. The propeller switch circuit breaker (100602-1) and the three way switch (102911) are located on the lower left-hand side of the main switch panel. The gun switch, type B-5A, is on the left-hand side of the main switch board, and the gun trigger switch, type B-4, is located on the grip of the control stick. The hydraulic electric motor switch, type B-6B, is located beneath the gun trigger switch. The landing gear warning horn switch, type AN3016 (B-6B), is actuated by a lever attached to the throttle rod. The horn may be cut off by pulling out the lever and releasing the switch. The switch and lever will automatically return into place when the throttle is pushed forward. The following switches, rheostats and instruments are also installed on the main switch panel below the instrument board.

(1) Emergency Fuel Pump Switch (B-6B)
(2) Gun Safety Switch (B-5A)
(3) Gun Camera Switch AN3015 (B-5A)
(4) Ignition Switch 32226 (A-9)
(5) L.H. Aileron Electric Trim Tab Control Switch AN3019-(B-11)
(6) Spot Light Switch AN3015 (B-5A)
(7) Running and Signal Light Switch AN3017 (B-7A)
(8) Fluorescent Lights Switch AN3015 (B-5A)
(9) Wing Fuel Gage Lights AN3017 (B-7A)
(10) Landing Light Switch AN3018 (B-9A)
(11) Oil Dilution Switch AN3016 (B-6B)
(12) Pitot Heater Switch AN3015 (B-5A)
(13) Coolant and Fuel Pressure Test Switch AN3019 (B-11)
(14) Generator Line Switch AN3015 (B-5A)
(15) Gun Sight Rheostat Type O-1A, Spec. 94-3229 (60 Ohms)
(16) Compass Light Rheostat (75-66-666-25) Type O-1 (25 Ohms)
(17) Formation Light Rheostat (75-66-666-50) Type O-1 (50 Ohms) Formation Light on airplanes AC41-24776 through AC41-25027 only.
(18) Ammeter Spec. 32191
(19) Inboard Gun Circuit Breaker (87-66-570-30)
(20) Outboard Gun Circuit Breaker(87-66-570-35)
(21) Gun Camera Circuit Breaker (87-66-570-30)
(22) Gun Sight Circuit Breaker (87-66-570-15)
(23) One Extra Circuit Breaker (87-66-570-15)
(24) One Extra Circuit Breaker (87-66-570-20)
(25) One Extra Circuit Breaker (87-66-570-2)

f. Electrical Bonding. - All parts are bonded according to specification, and replacement should be made with clamps, bolts, metal strips, pig tails, etc., similar to those provided in the original installation.

g. Battery. - An Exide, 12-TAS-9, battery or equivalent with a capacity of 24 volts, 34 ampere hours, supplies the electrical power. It is accessible through the baggage compartment door. Provisions are made for the installation of either the British type battery ground plug, type E-1, or the United States Army Air Forces type plug.

h. Circuits Passing Through the Ignition Switch. The ignition battery switch, which actuates the battery solenoid, has to be closed before power can flow through the electrical system.

20. Fuselage Equipment.

a. General.

(1) The pilot's seat installation (drawing 87-65-

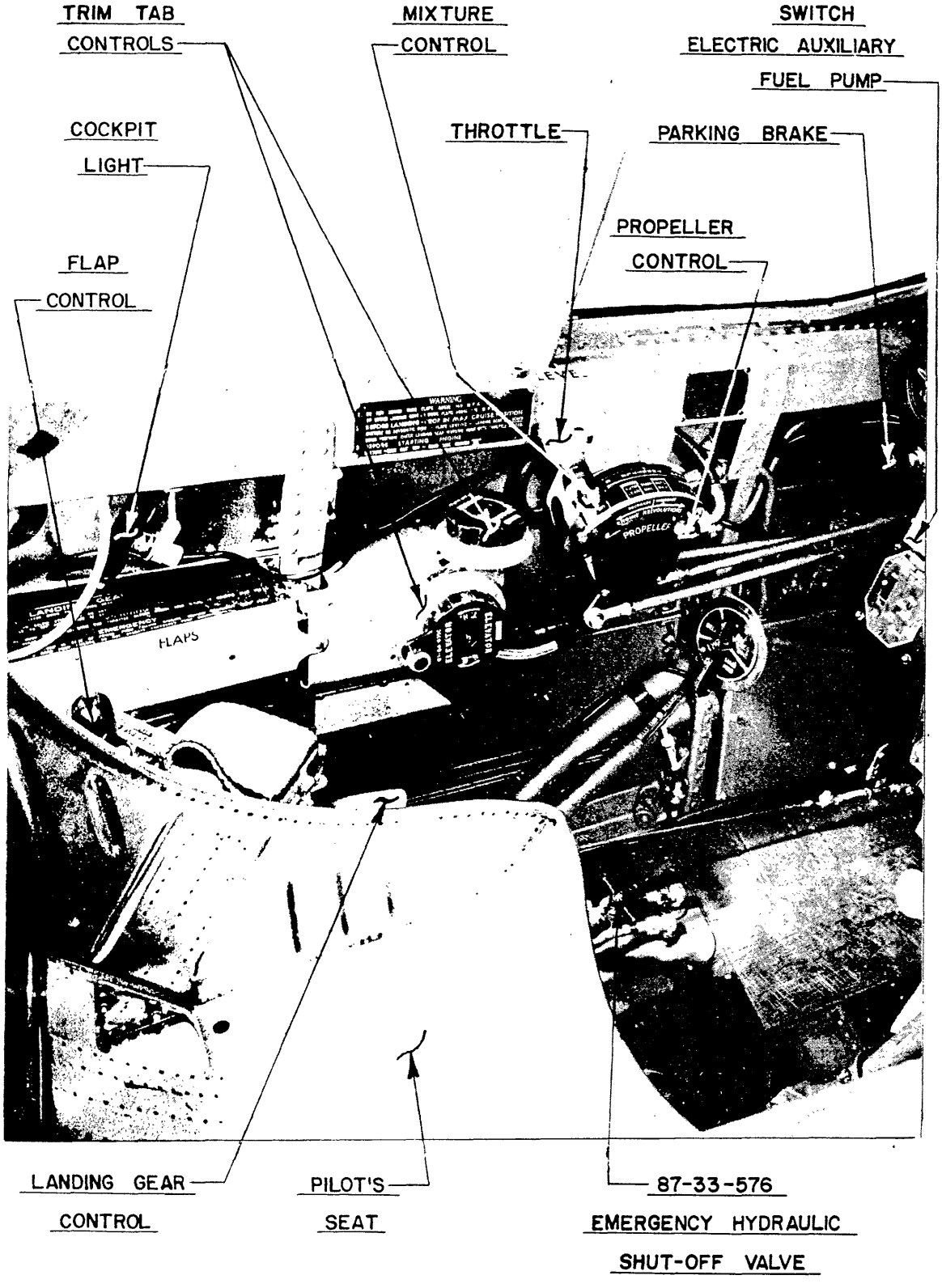


Figure 103 - Cockpit Arrangement and Controls - Left Side

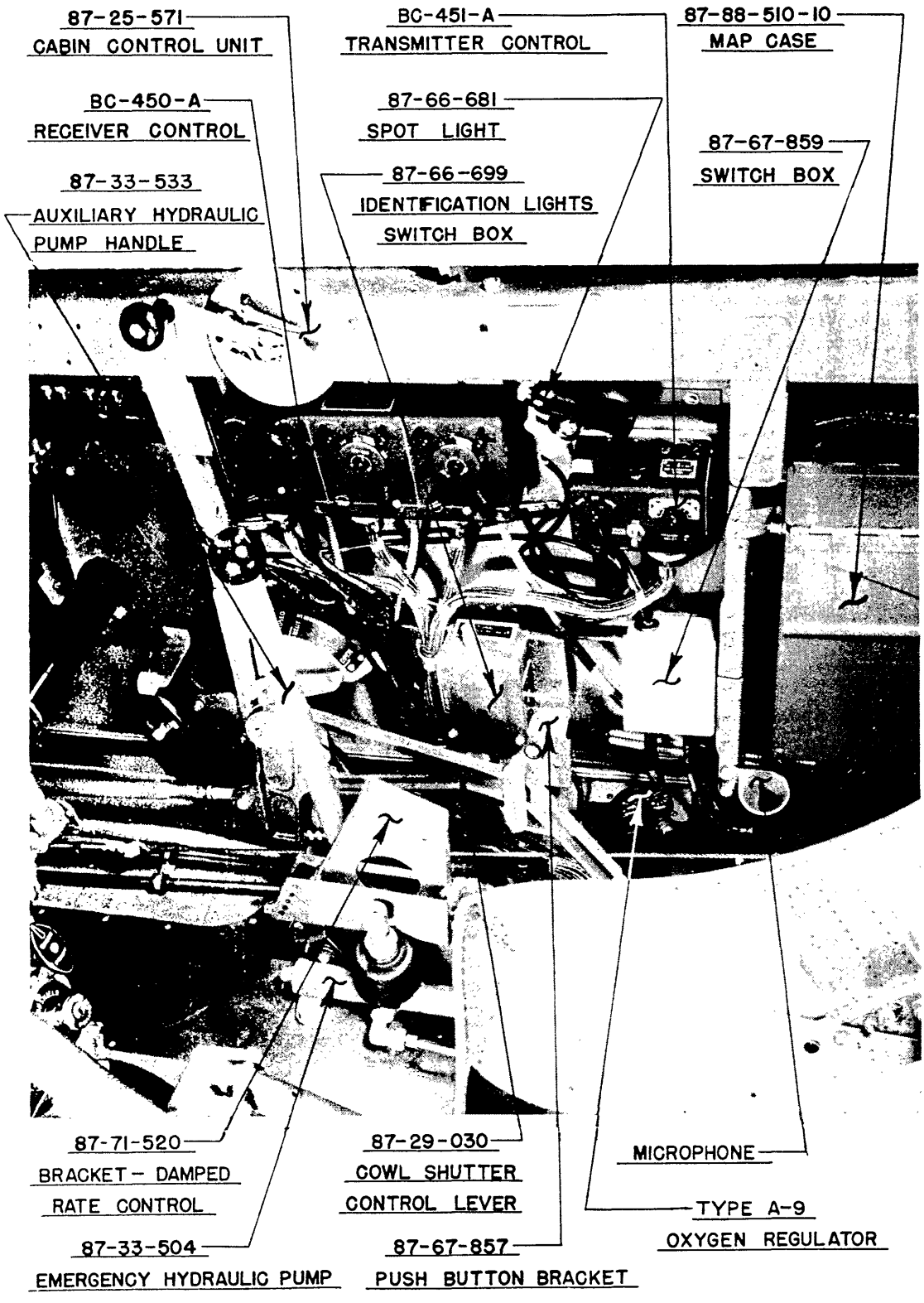


Figure 104 - Cockpit Arrangements and Controls - Right Side

504) is supported by two fittings on the cockpit floor, and is adjustable for height. The pilot's seat also incorporates a non-skid type pad in the seat to prevent the pilot's parachute from slipping forward. (See figure 21.)

(2) Sutton Harness. - A type S.I.S. 445 Sutton Harness is attached to the seat rack, which is bolted in place with cottered, castellated nuts. The harness is also bolted to the bracket at the top of the bungee assembly which controls the movements of the shoulder harness. The release and locking control assembly handle for the Sutton Harness is located on the left side of the pilot's seat. This control lever will release the locking pin in the bungee assembly, and permit freedom of forward motion with only the bungee spring acting as a retaining force. To release the locking pin, push the button control down and pull the handle back until it is locked in its aft position. To lock the harness, return the bungee spring to its retracted position, release the control handle from its aft position and pull forward until it is again locked in the forward position. (See figure 21.) The back cushion of the pilot's seat, type A-3, may be used as a life preserver.

(3) Stowage Compartment (see paragraphs (4) (a) 2, 3, 4, and 5 of this section).

(4) (Drawing 87-26-503) The windshield is made of 1/4 laminated plate glass, with the exception of a central panel. This central panel consists of two plates, separated by a 5/32 inch air space. The top plate is three ply 9/32 inch laminated plate glass and

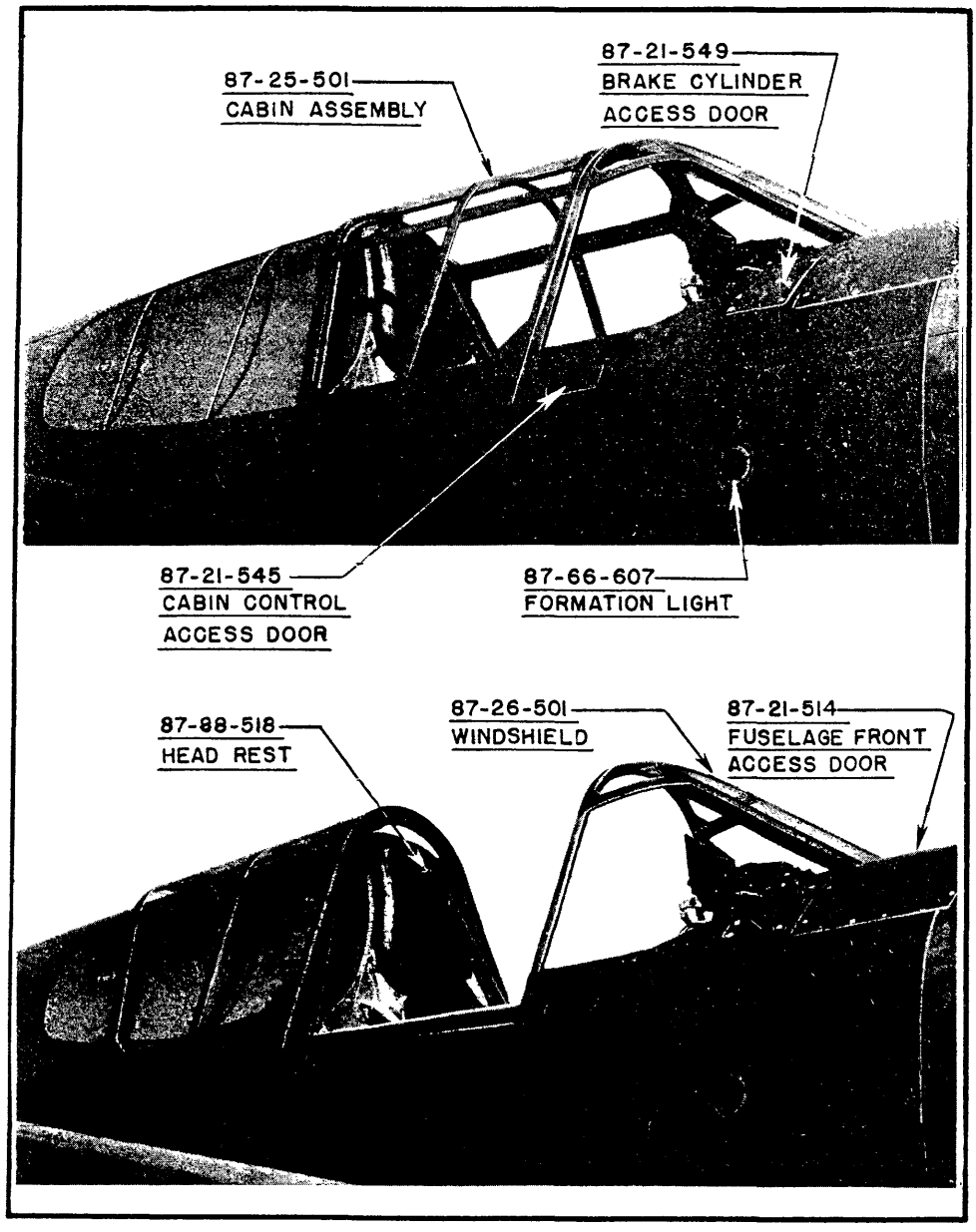


Figure 105 - Cabin - Open and Closed

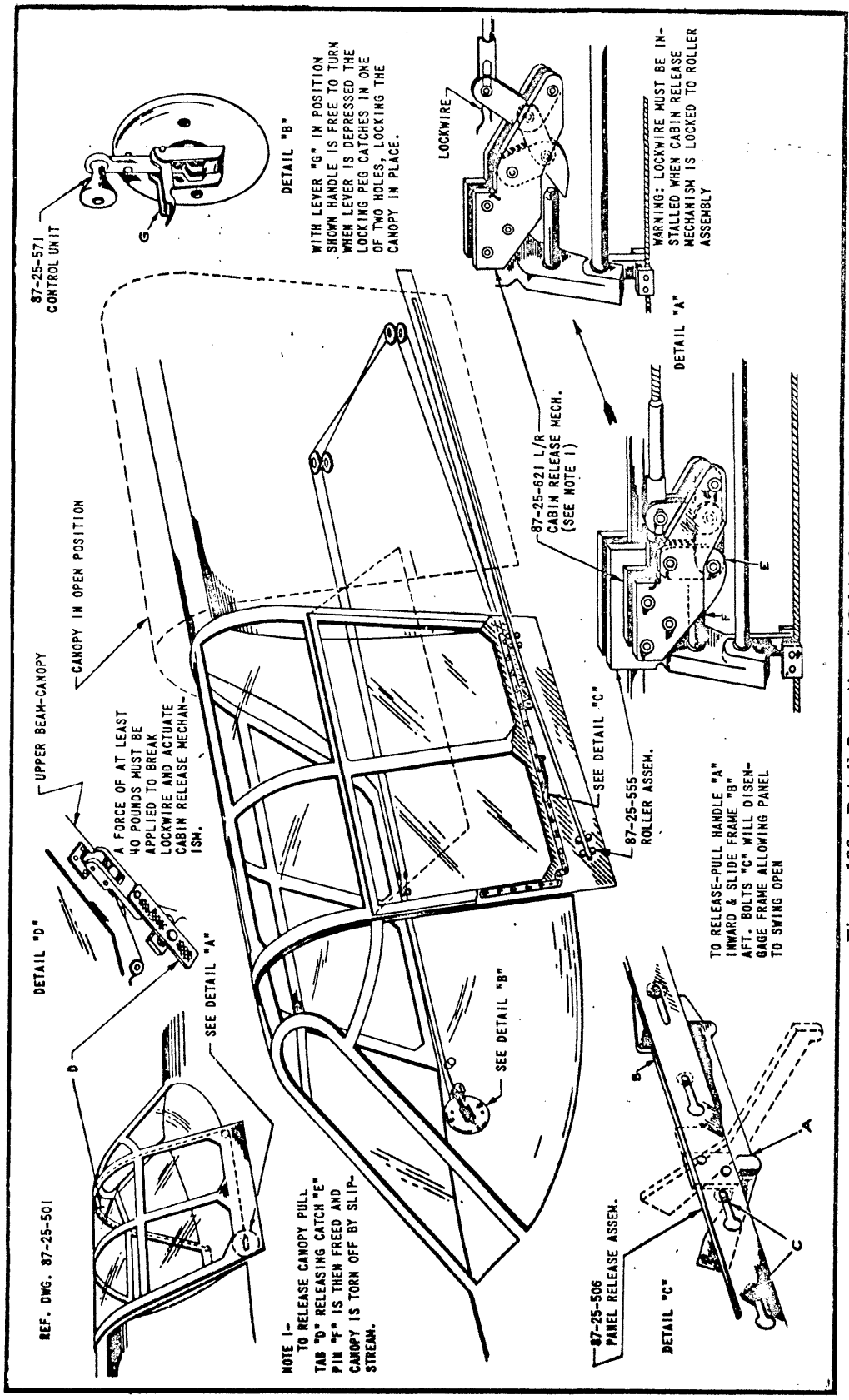


Figure 106 - Detail Operation of Cabin Controls

the lower plate is 1-1/2 inch bullet resistant glass. The frame is assembled to the fuselage by flush-head screws in fibre nuts and may be attached or removed as one unit.

(5) Windshield Defroster. - The glycol spray installation consists of a tank, jet tube, and pump connected by 3/16 inch copper tubing. The tank is mounted on the front, left top of the firewall. The filler can is located on top of the tank, and is accessible when the left top engine cowling is removed. The tank capacity is 3.2 quarts. A 3/16 copper tube connects the tank to the pump, which is hand operated, and is mounted directly below the engine primer. The pump is connected to the jet tube by a 3/16 inch copper line. The jet tube is mounted at the base of the windshield and extends approximately six inches along the periphery of the fuselage.

(6) Cockpit Enclosure (drawing 87-25-501). The cockpit enclosure is made of eight pieces of "Plexiglas", supported in an aluminum alloy frame. The frame is mounted on four ball bearing roller assemblies, which travel on tracks on each side of the fuselage. It may be moved to the desired fore and aft position by a handcrank located on the forward right-hand side of the cockpit. (See detail "B", figure 106.) This crank may be disengaged, in case of emergency, by pulling the lever "G" to a horizontal position, as shown in detail "B". The canopy can then be moved forward or aft by hand. The emergency canopy release "D" is located on the forward part of the upper beam in the canopy. The complete canopy may be released from the roller assemblies in flight by pulling release tab "D" with a force of at least forty pounds, which actuates the canopy release mechanism, breaking the lock wires as shown in detail "A". It is imperative that these lock wires are installed, and the canopy release mechanism should be inspected before each flight, to insure the safe operation of the canopy. If the lock wires are not installed, the canopy might be torn off by the slipstream, causing serious damage to the airplane. In the event of a turn-over on the ground, pull the handle "A" (detail "C") inward and aft to allow the escape panel to swing open. This emergency exit may also be opened from the outside by means of a handle located on the lower left-hand enclosure frame. (See detail "C".) When the airplane is parked, the cockpit enclosure may be locked by tipping the lever in the lower, rear, left-hand corner of the enclosure frame and inserting a padlock in the hole provided.

b. Miscellaneous Equipment.

(1) Map Case. - A map case is installed on the right-hand side of the cockpit adjacent to the pilot's seat.

(2) Special Tools and Equipment. - These are carried in a pocket on the right-hand side of the duffle bag. Two pockets are attached to the front of the duffle bag to support the mooring kit installation.

(3) Parking Harness. - The parking harness 87-64-570 is stowed in the parking harness bag 87-88-528 located immediately below the pilot's headrest.

(4) Headrest. - The pilot's headrest is mounted on the armor plate at station 5.

(5) Relief Tube. - A relief tube (drawing 87-88-516) is installed on the under surface of the pilot's seat.

(6) Rear Vision Mirror. - A rear vision mirror is mounted in an aluminum alloy fairing, bolted to the top of the windshield, at the left of the center line.

(7) Armor Plate. - There are three installations of armor plate in the fuselage. The first installation is on the forward half of the coolant expansion tank, on the front side of the firewall at station 1. The second installation is a non-magnetic armor plate at station 24, between the oil tank and the instrument panel. The third installation is at station 5 directly aft of the pilot's seat and headrest.

(8) Static Ground (drawing 87-88-046-10). - A static ground assembly is fastened to the bottom of the fuselage, on the airplane's centerline, forward of the tail wheel door by two screws. The static ground assembly is made up of a .100 steel wire and 13 inches of .031 closely wound steel spring. The spring is slipped over the wire for a distance of one inch, and is fastened to the wire with a solder joint. The static ground assembly is set at a $60^{\circ} \pm 5^{\circ}$ angle to the under surface of the fuselage. (See figure 47.)

(9) First Aid Kit. - Provision is made for the installation of a S.I.S. - 1742 type First Aid Kit in the canvas container installed on the inboard surface of the fuselage access door. (See figure 48.)

c. Removal and Disassembly.

(1) Windshield Glass. - The 1-1/2 in. bullet resistant glass may be taken out by removing the lower support and top metal strip. The rest of the glass may be taken out by removing the sealing and support strips held to the frame by flush head screws in fibre locks.

(2) Cockpit Enclosure. - The cockpit enclosure may be removed by pulling the emergency release, lifting the canopy off the airplane, and leaving the roller assemblies on the track.

(3) Rear Vision Window. - The rear vision window may be taken out by removing the support straps and metal retaining strip at its forward edge. Slide the Plexiglas sheet forward and out of the frame. Care must be taken in the removal of the Plexiglas to prevent marring its soft surface.

d. Assembly and Installation.

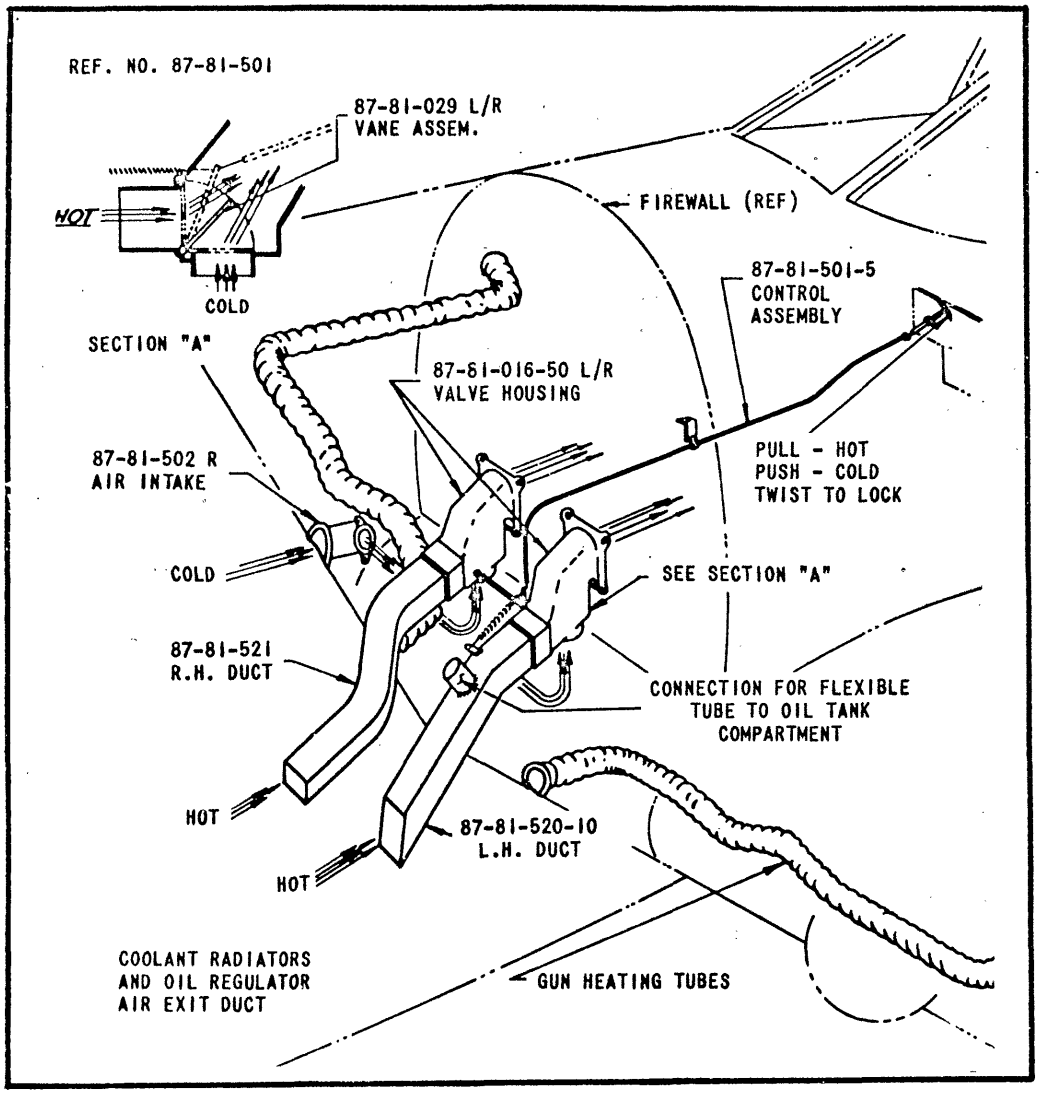


Figure 107 - Cockpit Heating and Ventilating System

(1) To Install Windshield Glass. - To install the windshield reverse the procedure related above in paragraph 20. c. (1). When the glass is reinstalled, seal the joints on the assembly with a good grade of automobile top sealer.

e. Care of the Transparent Sheets (see T. O. No. 01-1-1 for Army Air Forces cleaner and polisher).

(1) Slight surface scratches are easily removed by rubbing the transparent sheet by hand with a soft cloth, moistened with a turpentine-chalk mixture.

(2) The surface may be cleaned with varnoline, which in turn may be removed with warm water, then wipe lightly with a soft, wet cloth. Grease and oil may be removed with carbon tetrachloride, alcohols (simple and polyhydric) or ethers. Note that the transparent sheet is soluble in ketones, lower esters, aromatic hydrocarbons, phenols, arylhalides, aliphatic acids, chlorhydrins, acetals, chloroform, ethylene dichloride, propylene dichloride and tetrachloroethylene.

f. Identification Lights. - On airplanes AC-41-35978 through AC-41-36293 there is a "One Down" identification light installation. On airplanes AC-41-36294 through AC-41-36953 there is a "One Up and Three Down" identification light installation.

21. Heating and Ventilating System.

a. General (drawing 87-81-501). - The heating and ventilating of the cockpit is accomplished by means of two ducts, inserted into the radiator and oil cooler air exit duct. The cold air is taken into the duct, formed by the sealing of web No. 1, nose rib No. 27 and the leading edge nose section of the wing, through an opening in the leading edge of the right wing and wing fillet. A flapper valve, operated by a push-pull control, at the junction of the hot and cold air intake ducts governs the mixture of the hot and cold air passed into the cockpit. The ducts feed air into both the right- and left-hand sides of the cockpit at the floor line. (See figure 107.)

b. The hot air for heating the cockpit is obtained from the radiator and oil cooler air exit duct.

c. The cold air for cooling the cockpit is obtained through an opening in the leading edge of the right wing and wing fillet.

d. The ventilator control, located below the instrument panel adjacent to, and outboard of, the engine primer, closes the cold air intake ducts when in the "OUT" position. The control may be locked in any position by twisting the handle clockwise, thus, any desired mixture of hot and cold air may be obtained.

e. See the nameplates in the cockpit adjacent to the control.

f. Wing Gun Heater. - The wing guns are heated through two openings in the leading edge of the wing in the radiator and oil cooler air exit duct. A flexible hose conveys the hot air to the gun installations. (See figure 107.)

22. Oxygen Equipment (87-83-505).

a. General. - The oxygen installation is a low pressure system operating at approximately 425 lbs./sq.in. The installation consists of a type F-1 cylinder (Spec. 40330), with a cross connection on its forward end, an oxygen and filler line of 5/16 inch O.D. copper tube (Spec. WW-T-799) or aluminum alloy, soft temper (Spec. 57-187-3), a type A-9 regulator (Spec. 40319), a British type economizer, a spring loaded relief valve, and one way filler valve. (See figure 108.)

b. Oxygen Cylinder. - The oxygen cylinder has a capacity of 1,000 cu. in. and will withstand approximately 750 lbs./sq.in. pressure. It rests on rubber padding, in a cradle installation, mounted on the center line of bulkheads eleven and twelve at the bottom of the fuselage. The cylinder is anchored in the cradle by a rubber lined strap, and may be removed through the fuselage access door by disconnecting the oxygen and filler lines at the cross forward of the cylinder, and releasing the retaining strap by means of the turnbuckle.

c. Cross. - The cross connection has a relief valve which will open at a pressure of 525 to 645 lbs./sq.in. One line goes to the oxygen regulator and the other to the filler valve.

d. Oxygen Regulator. - The type A-9 oxygen regulator is located near the floor of the cockpit, on the right-hand side of the airplane, adjacent to the pilot's seat.

e. Oxygen Economizer. - The Mark II Oxygen economizer is mounted on the left side of the fuselage forward of station 5 with one bolt through the longeron, and two bolts through the trim tab adjusting mechanism guard. A tube extends from the oxygen regulator under the pilot's seat to the economizer. Another tube runs from the economizer between the pilot's seat and headrest and connects to the oxygen mouthpiece, which is stowed in a clip on the right-hand side of the cockpit, between stations 4 and 5, when not in use.

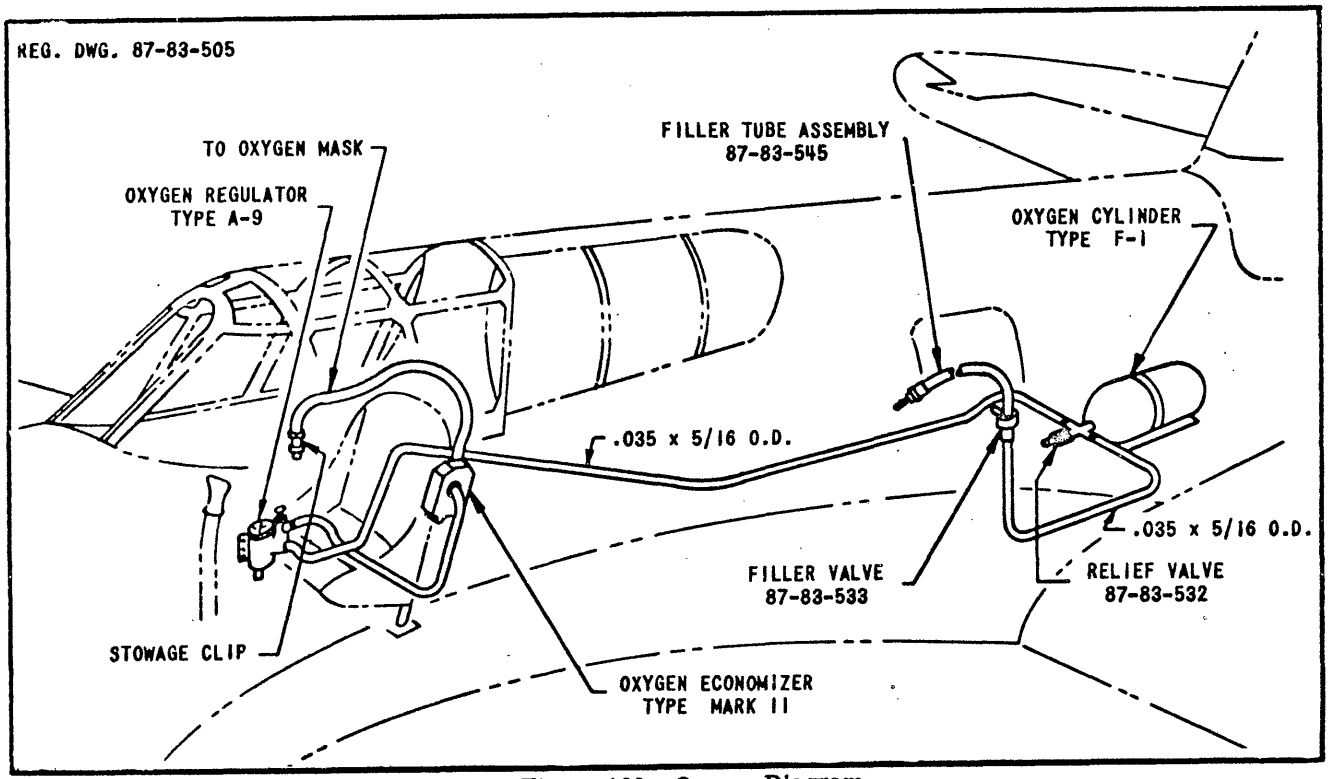


Figure 108 - Oxygen Diagram

f. Filling of the Oxygen Cylinder. - First remove the hose extension from the tool kit on the duffle bag and attach to the filler line connection, located inside at the lower right-hand corner of the fuselage access door. The filler line connection contains a one-way valve which permits flow through the filler line only in the direction of the cylinder. Fill the oxygen cylinder to a pressure of 425 lbs./sq.in.; do not exceed 450 lbs./sq.in. Close the filler valve, disconnect the hose extension and stow in the tool kit.

WARNING: The entire system shall be completely free of:

1. Oil and grease, to avoid the danger of spontaneous combustion and explosion when in contact with high pressure oxygen.

2. Water, to prevent the freezing of the oxygen equipment at low temperatures.

3. Other foreign matter, to prevent the contamination of the oxygen with dust and odors.

23. Communications Equipment.

General (drawing No. 87-67-851). - The radio equipment in this airplane is an alternate installation of either the SCR-522-A transmitter and receiver or the SCR-274-N transmitter and receiver and the SCR-515-A receiver units. This equipment provides for two-way communication.

a. On the SCR-522-A installation, the control unit is located on the right side of the cockpit, directly forward of station 3. The BC-602-A electric controller unit is also on the right side of the cockpit, just aft of station 3. The microphone and head phones plug-in box is on the right side aft of station 4. A fire extinguisher crash switch is located below the electric controller unit. A BC-608 contactor is located on the upper left-hand side of the instrument panel. (See figure 109.)

b. The SCR-522-A transmitter and receiver unit is mounted on a shelf above the centerline of the fuselage between stations 8 and 9. The type PE-94-A, H42D3114 dynamotor unit is mounted on a shelf, directly above the transmitter receiver unit. The receiver is mounted on a shelf above the fuselage centerline between stations 10 and 11. All units are readily accessible through the fuselage access door. (See figure 110.)

One JB-29-A and one 87-67-882 junction box is mounted on the left-hand fuselage wall between stations 8 and 9 above the fuselage centerline.

c. The SCR-522-A radio installation is equipped with a "Broad Arrow Antenna".

d. The BC-453-A, BC-454-A, and BC-455-A receivers are mounted on a shelf at the centerline of the fuselage between stations 8 and 9. Directly above, the BC-457-A and BC-458-A transmitters are installed on another shelf. On the top right side of the fuselage the BC-442-A antenna relay box is mounted. A BC-616 relay box is mounted on the right side of the fuselage, midway between stations 8 and 9, above the fuselage centerline. The PE-101-A dynamotor is mounted near the bottom of the fuselage just forward of station 9. The BC-645-A transmitter and receiver unit is mounted above the centerline of the fuselage on a shelf between stations 10 and 11.

e. An AN-40-A receiver antenna is installed on the top of the fuselage just off the centerline to the left, at station 9. An AN-40-A transmitter antenna is installed in the same manner as the receiver antenna, immediately forward of station 12. A "Broad Arrow Antenna" may also be employed with the SCR-274-N radio installation.

f. A type T-30A microphone is installed for use with the SCR-274-N radio installation together with a type JK-48 jack, which is located on the right-side of the fuselage at station 4.

g. To Install the SCR-274-N Radio. - This radio set consists basically of a group of three radio receivers, and two radio transmitters, each with its special rack and mounting. In addition there is a modulator unit, with a high-voltage dynamotor, an antenna relay unit, and separate radio control boxes for the group of receivers and transmitters. (See figure 109.)

(1) To Install the Receivers and Transmitters. Slide each unit into its proper rack compartment as far as it will go, slip the locking lugs, located on the rack under each unit, over the conical shaped studs on each unit. The knurled nuts, which hold these lugs in place, should now be hand-tightened, and then safety-wired, to insure good electrical and ground connections at all times. Always allow enough clearance around units so that under the maximum possible amplitude of vibration, the units will not strike anything. Allow plenty of slack in cords near the points of attachment to the units.

(2) It will be necessary to change receivers and transmitters occasionally, and to tune them up.

(3) To attach plugs, "feel" for the proper orientation before using any considerable pressure on the plugs. The locking rings should be hand-tightened.

(4) Safety-wire the snapslides which lock the several units to their mountings. Safety-wire the snapslides holding the tube covers on the transmitters and modulator unit. (This makes accidental access to the high-voltage plate leads of Tube VT-136 on the modulator more difficult.)

(5) Set each receiver radio control box dial to correspond with the dial of the receiver connected thereto. Each radio control box dial may be adjusted to a

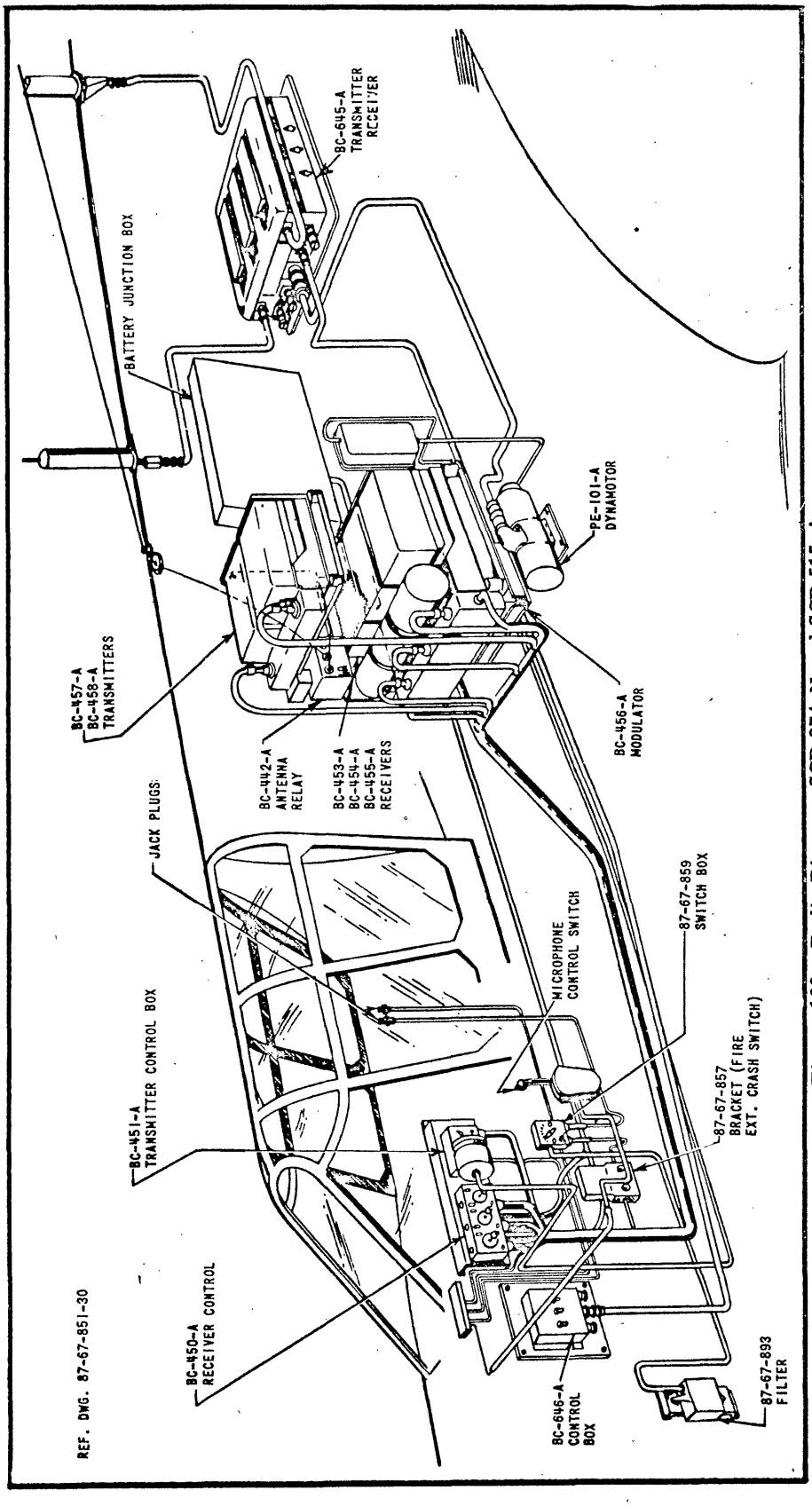


Figure 109 - Radio Diagram SCR 274-N and SCR 515-A

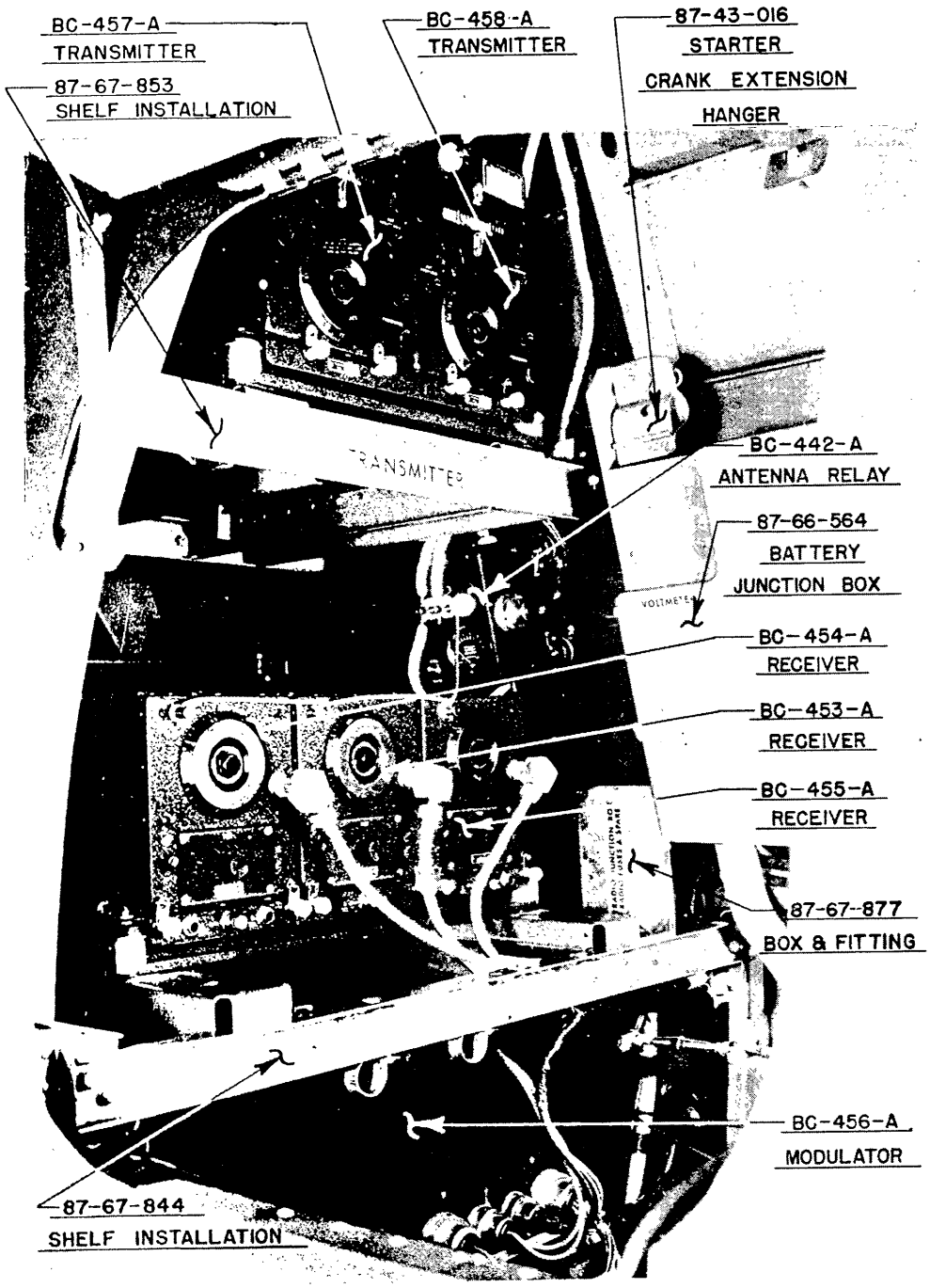


Figure 110 - Radio Installation

predetermined position by first loosening the knurled screw in the center, and then rotating the dial to the desired reading. Hand-tighten the knurled screw, do **not** use pliers or other tools for this operation.

h. Safety Notice. - It is very important that the following safety precautions be rigidly observed before turning on the power for the radio equipment.

(1) The dynamotor DM-33-A, on the modulator unit of this set, generates 600 volts, D.C. This is sufficient to cause severe shock, or death. Be sure that the dynamotor is not running before making any adjustments whatever, except tuning up the radio transmitters. Do not depend upon hearing the dynamotor or upon the position of the control switch, "FEEL" the dynamotor for running vibration.

(2) In tuning up the antenna circuit of the transmitter, be careful to avoid touching the antenna when the power is on. Warn anyone who may be working near the antenna of your intentions when turning on the power.

(3) Fire. - If the radio compartment has been exposed to gasoline vapor, be sure it is aired well before turning on the power.

(4) The dynamotor DM-32-A, on each radio receiver unit, generates 250 volts, D.C. Do not expose anyone to this voltage. Be sure that all dynamotors are "OFF" before adjusting any equipment other than the antenna alignment.

i. Antenna Circuit Alignment of the Receiver. - Alignment of the circuit should be accomplished as follows:

(1) Set the "CW-OFF-MCW" power switch controlling the first receiver to "CW"

(2) Set the "A TEL-B TEL" switch of the same control box section to "A TEL"

(3) Connect a headset to any "A TEL" jack.

(4) Set the gain control knob to the maximum gain position.

(5) Tune the receiver to the highest frequency.

(6) Trim the antenna input circuit for maximum background noise, using the "Align In-Put" knob on front of the receiver.

(7) Switch this receiver "OFF"

(8) Perform the same operation on the other two receivers in turn.

(9) It is good practice to repeat the alignment operation on all receivers for optimum results, even though the improvement may seem slight.

j. Tuning Up the Transmitters. - There are three controls on the front of each transmitter.

(1) The frequency control knob in the lower right corner marked "Frequency"

(2) The Antenna tuning inductance control in the upper right section marked "Ant. Inductance"

(3) The Coupling control in the middle left section marked "Ant. Coupling"

All receivers and transmitters should be connected to the Antenna Relay Unit BC-442-A, and the antenna connected thereto, before the transmitters are tuned up. Transmitters must be tuned up with the emission switch of the Radio Control Box BC-451-A in the "CW" position and must not be retrimmed after switching to "TONE" or "VOICE". Such retrimming would result in greater antenna current, but the transmitter would be incapable of being modulated properly.

(4) Tune up the transmitter as follows.

(a) Set the "Frequency" control dial to the desired transmitting frequency. If the calibration accuracy of this transmitter has not been checked, read paragraph (q) before continuing.

(b) Set the "Ant. Coupling" Control to about 3 on its scale.

(c) Throw the toggle switch on Antenna Relay Unit BC-442-A to "Local"

(d) Set Radio Control Box BC-451-A Emission switch to "CW"

(e) Set Radio Control Box BC-451-A transmitter selector switch to No. 1 or No. 2 depending on whether the left or right transmitter is being tuned.

(f) After making sure that neither the microphone button nor the key is closed, set "Trans. Power" switch to "ON" The dynamotor DM-33-A should start.

(g) Allow 15 seconds for the tubes to heat up.

(h) Lock the "Built-in" key on top of the radio control box BC-451-A by rotating it clockwise.

(i) Resonate the Antenna circuit by adjusting the "Ant. Inductance" for maximum antenna current.

(j) Vary the "Ant. Coupling" until the maximum antenna current is obtained. This setting must be accurately made.

(k) Retrim the "Ant. Inductance" tuning.

(l) Check the Antenna current on "VOICE" and "TONE". On "VOICE" it will be considerably less than for "CW" and for "TONE" it will be between the values of "CW" and "VOICE"

(m) The second transmitter should be tuned up following the same procedure. Then return to the first transmitter and retrim the "Ant. Inductance" control on "CW"

(n) Lock the controls of each transmitter by rotating the "LOCK" knob one half turn clockwise to a stop, in which position the engraving "LOCK" on the knob will read right side up.

(o) If desired, mark the frequency to which each transmitter has been tuned, in a soft pencil, in the blank spaces on the plate above the "TRANSMITTER SELECTION" switch. Record the transmitter tuning data on the "write-in" plate on the front of each transmitter.

(p) Each transmitter is supplied with a special frequency-checking circuit which includes a plug-in crystal resonator. This crystal circuit is used in checking the frequency at one point on the dial; it does not

control the frequency. The frequencies of the crystals supplied with the different transmitters are as follows:

Radio Transmitter	Crystal Frequency
BC-457-A(4-5.3 MC)	4.6 MC
BC-458-A(5-7.3 MC)	6.2 MC

Tube VT-138 in each transmitter is used as an indicator of resonance, between the crystal and the transmitting frequency. When a transmitter is operated at, or near, the frequency of the crystal which is in that transmitter, a dark three-cornered shadow appears in the round spot of green light on the screen of tube VT-138. This shadow "opens" as the transmitting frequency passes through the frequency of the crystal. Operation at exact resonance with the crystal frequency is indicated by a sharp maximum in the width of this shadow. When a transmitter is first put in service, the frequency calibration should be checked as follows:

Open the hinged cover, at the top rear of the transmitter, to such an angle that the reflection of the entire resonance indicator screen of tube VT-138 may be seen.

Tune the transmitter to the lowest frequency which will open the shadow on the resonance indicator. The indicated dial frequency should now correspond with that of the crystal. If it does not, set the dial exactly on the nominal frequency of the crystal, and trim the master-oscillator capacitor to make it conform. This trimmer may be adjusted with a small metal screw driver inserted through the hole in the top of the transmitter which is covered by a metal slide. A clockwise rotation of this trimming control lowers the transmitter frequency. Adjust the "FREQUENCY" control again to make sure that the crystal is resonating at its lowest frequency, and that no "opening" of the resonance indicator is observed for any indicated dial frequency below that corresponding to the value shown on the crystal holder. The calibration engraved on the frequency dial of the transmitter will then be correct at other parts of the dial.

NOTE: Always recheck the frequency calibration as described above after any tube is replaced in the transmitter; this is particularly important when a new master oscillation tube VT-137 is installed.

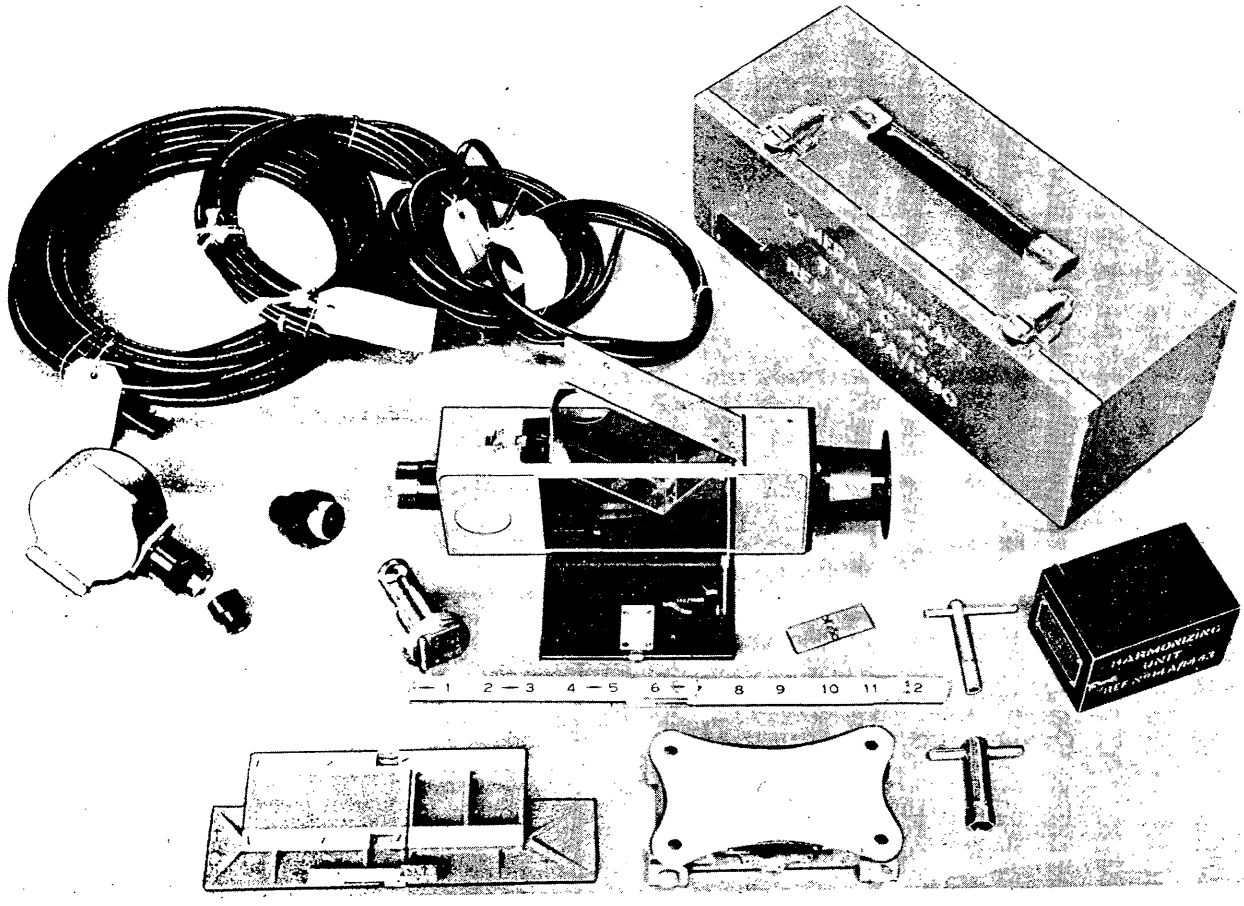


Figure 111 - G-45 Camera - Open

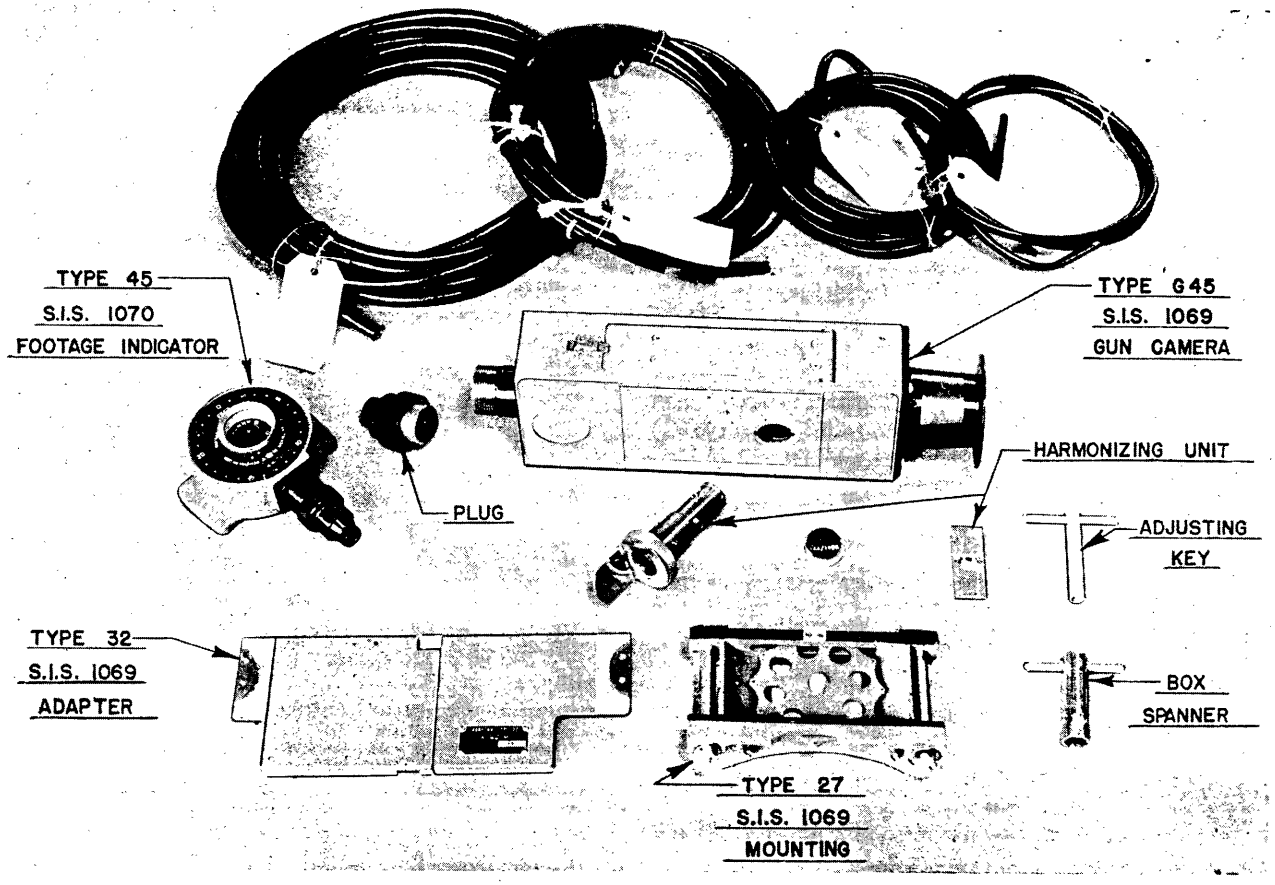


Figure 112 - G-45 Camera - Closed

24. Gun Camera.

a. General. - A government furnished G.S.A.P. type N-2 gun camera may be mounted on the rear of the N-3A gun sight. Provisions have also been made for the mounting of a type G-45 gun camera on the under surface of the right wing panel. Attach the camera fairing at the nut plates on the bracket assembly, indicated by an arrow, on the under surface of the wing. For details of the type G-45 gun camera, see figures 111 and 112.

b. Gun Camera Removal. - Type N-2 - To remove the gun camera, withdraw the two bolts attaching it to the gun sight. Type G-45 - To remove the type G-45 gun camera it will be necessary to remove the camera fairing from the wing by unscrewing the nine attaching screws. Remove the four bolts which attach the camera mount adapter to the shelf in the bottom of the camera fairing.

c. Gun Camera Installation. - Reverse the above procedure.

d. Adjustment. - Type N-2 - The camera may be adjusted by loosening two bolts which tightened the collar assembly on the adapter ball. Type G-45 - To adjust the type G-45 camera laterally or vertically, unbutton the four Dzus fasteners on the fairing access door on the right side of the fairing. Allowance is made for a total vertical adjustment of 6° (3° up or 3° down) from the camera centerline parallel to the thrust line. Allowance is also made for a horizontal adjustment of 3° or $1^{\circ}30'$ either side of the camera centerline. (See figures 111 and 112.)

e. Crash Pad. - The type N-2 gun camera may be replaced by a crash pad while in flight. Detach the electrical connection from the camera, press the plunger down, and pull the camera out of the mounting socket. Place the camera in the cockpit stowage and substitute the crash pad on the camera mount. The gun camera adjustment is not affected by this operation.

25. Gunnery Equipment (see T. O. No. 11-1-6D).

a. General. - The gunnery equipment consists of a modified N-3A gun sight and six .50 caliber wing guns with 1410 rounds of .50 caliber ammunition as normal load and 1686 rounds as overload.

b. Gun Sight.

(1) General. - The gun sight, a modified type N-3A, is supported by a casting mounted on the forward armor plate at station No. 2A. The sight is above the instrument panel on the centerline of the airplane. It may be removed without disturbing the setting, by removing the bolt attaching the yoke assembly to the base assembly.

(2) Sight Adjustment. - The sight assembly may be adjusted in a rotational, horizontal or vertical direction. Rotational adjustment may be accomplished by means of two adjustment bolts, on the top side of the connection between the yoke assembly and base assembly, forward of the instrument panel. Four screws, 90° apart, beneath the sight assembly, regulate the horizontal and vertical adjustment. The top and bottom screws control the vertical adjustment, and the right and left horizontal adjustment.

(3) Lens Adjustment. - The lens may be adjusted by a set screw. The sight should be so adjusted that the reticle image, when viewed as reflected on the mirror, and superimposed on a target approximately 500 yards distant, does not change in relation to the target as the head is moved over the field of vision.

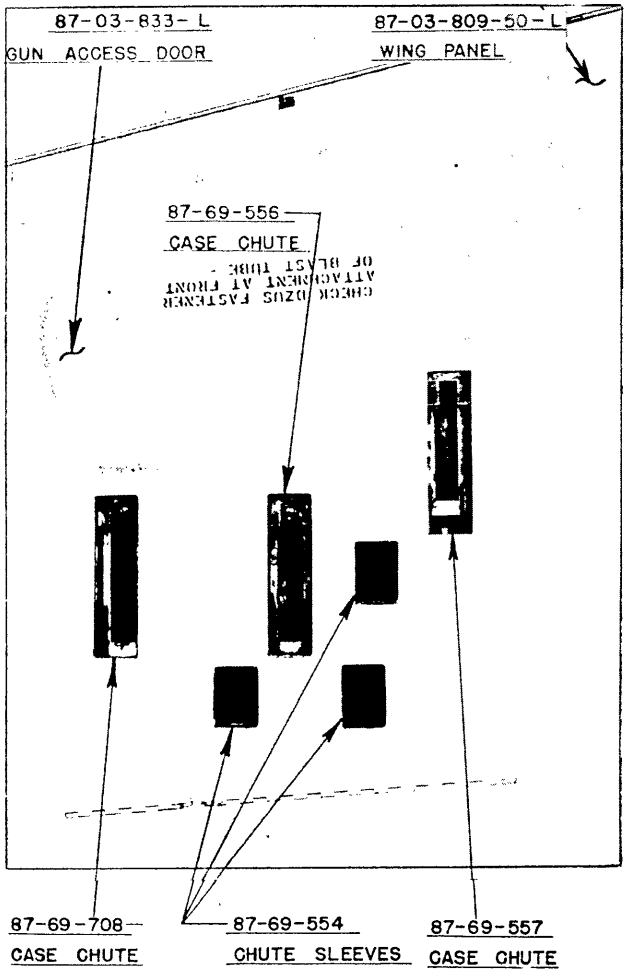


Figure 113 - Wing Guns - Bottom View - Guns Access Door Open

c. Gun Installation.

(1) The gun installation (drawing 87-69-701) consists of three .50 caliber model M-2 aircraft machine guns, mounted in each wing panel. The guns fire clear of the propeller disc.

d. Ammunition Boxes.

(1) The ammunition installation consists of two single and two double stainless steel ammunition boxes in each wing panel. (See figure 115.) The normal capacity is 235 rounds per gun. The two leading outboard compartments serve the center gun. The two trailing outboard compartments serve the inboard gun, and the two inboard boxes serve the outboard gun. The ammunition boxes are accessible through doors on the top surface of the wing. The feed chute to the center gun must be removed before the two inboard ammunition boxes can be removed. Instructions for loading the boxes are on instruction plates mounted on their tops.

(2) To Load the Guns. - To load the guns, push the end of the link belt, with cartridges installed, through the feed opening to the gun as far as it will go and release. Pull the operating slide to the rear as far as possible and release. Repeat this operation and the gun is loaded. BE SURE that the first cartridge and link are properly engaged by the belt holding pawl.

e. Chutes. - All feed and ejection chutes are made of stainless steel. Empty cases are guided from the bottom of the gun through the wing by a case chute under each gun. The links are ejected from the side of the gun, and are guided to, and through, the bottom of the wing by link chutes.

f. Gun Mount. - The guns are mounted in the wing by front and rear adapters. The front adapter is attached to a support on web No. 3 by one bolt and the rear adapter is attached to a support on web No. 5 by one bolt.

g. Gun Adjustment. - Horizontal and vertical gun adjustments are made at the rear gun mount. Vertical adjustments are made by loosening the rear gun attaching bolt, and two locking bolts, which clamp the serrated locking plates in position. Move the gun up or down to the desired setting, and tighten nuts to clamp in position. Horizontal adjustments are made by loosening the two set screws holding the rear gun mount adapter in place on the bushing. Loosen nut on the installation bolt, and turn bolt until the required setting is obtained. Hold in position by tightening set screws. The guns may be adjusted ver-

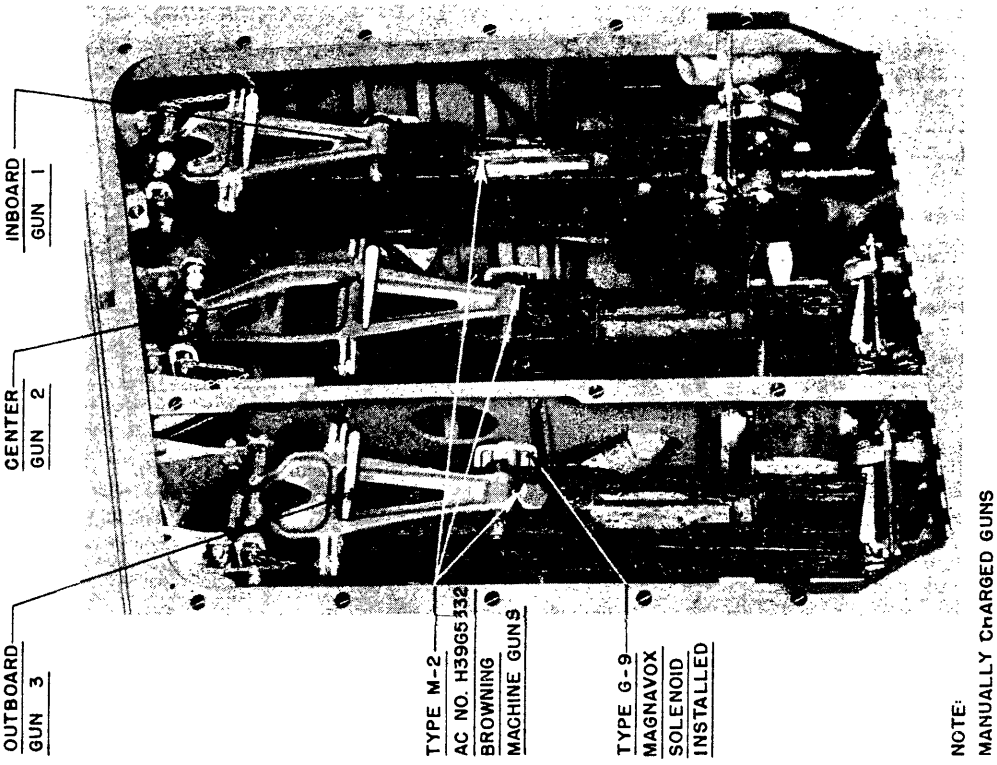


Figure 114A - Wing Guns - Bottom View
(AC-41-36903, AC-41-36905, and Subsequent)

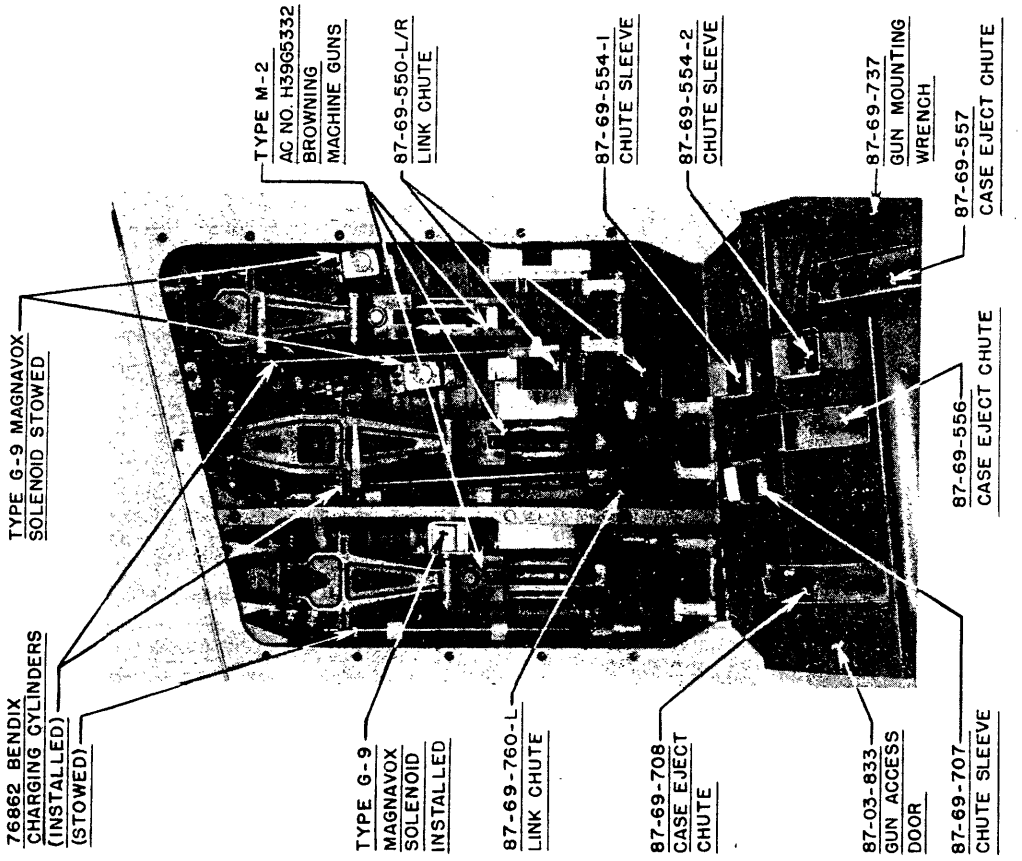


Figure 114 - Wing Guns - Bottom View - Gun Access Door Open

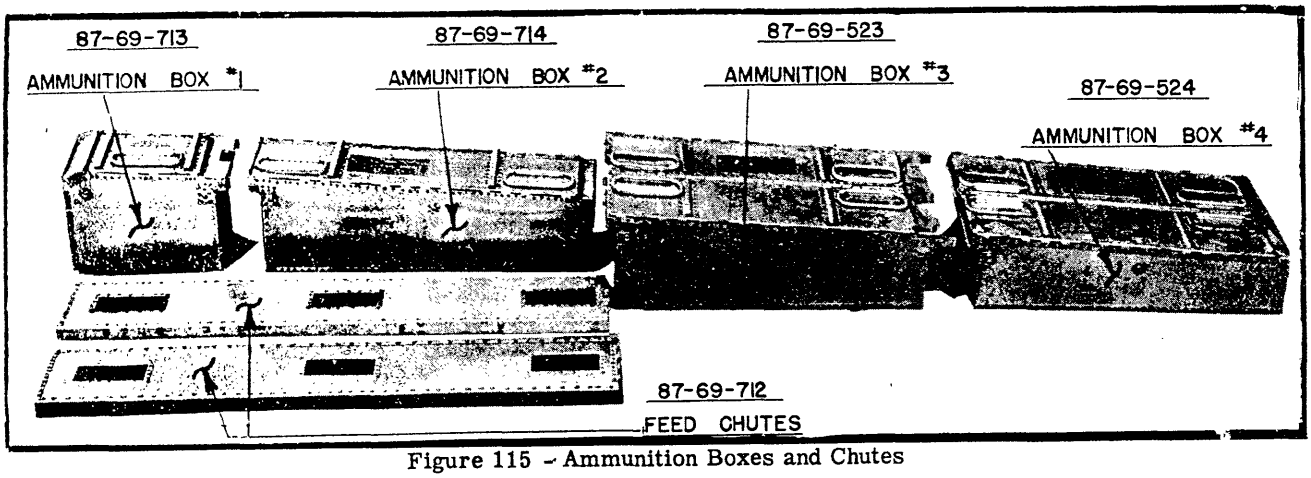


Figure 115 - Ammunition Boxes and Chutes

tically from parallel to the line of flight of the airplane at high speed at the best performing altitude with full load less 1/2 of the fuel load to parallel to the line of flight at 25% below the high speed under the same conditions. All settings are corrected in accordance with H39G3939. The vertical gun settings, angles with respect to the gun leveling lugs are 100% high speed muzzle up $0^{o}35'$, and 75% high speed muzzle down $1^{o}14'$. The lateral setting is for convergence of fire at 200 yards with equal adjustment outboard, or approximately $0^{o}37'$ inboard and outboard from a line parallel to the centerline of the fuselage. The adjustments for various flying conditions are given on the gun sighting chart figure 119.

h. Controls.

(1) The guns are hydraulically charged by gun charging cylinders Bendix 76862 which are controlled by gun charging valves Bendix 76861. The gun charging handles are located below the instru-

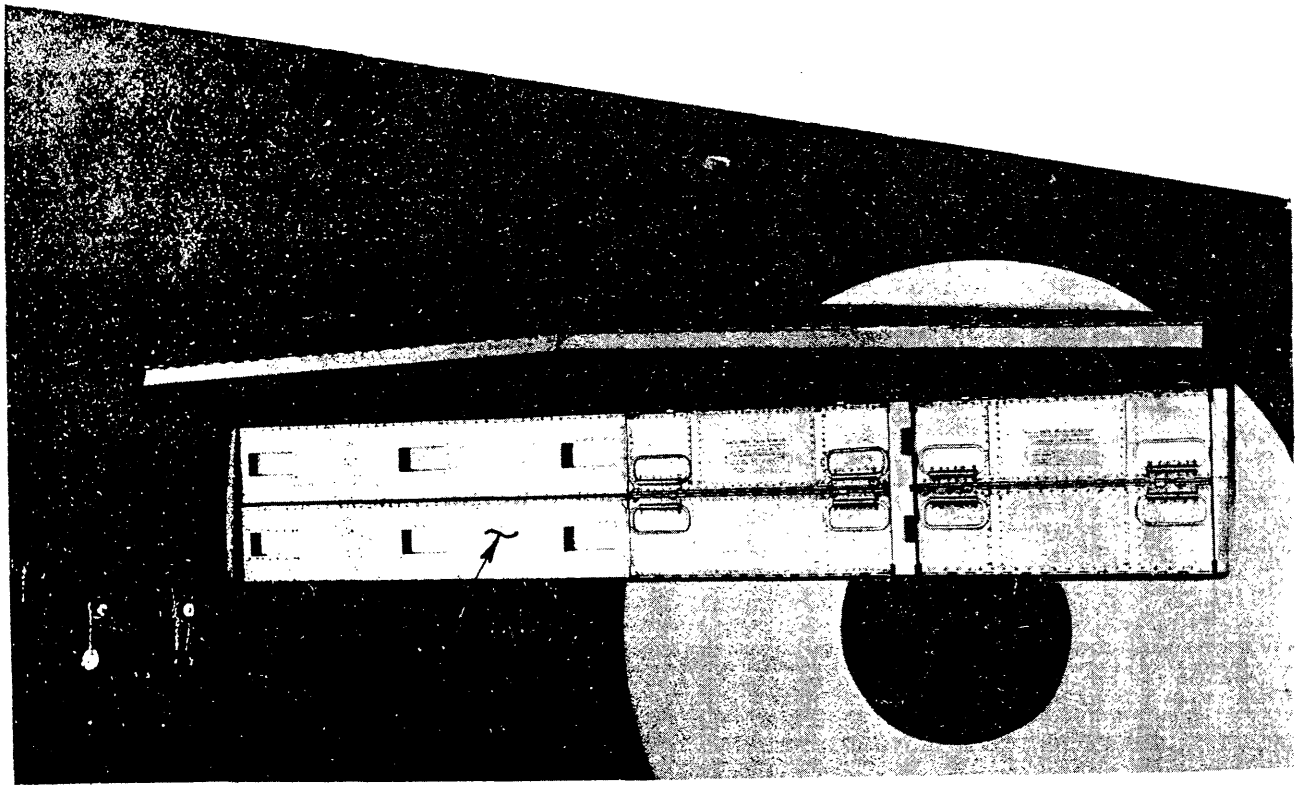


Figure 116 - Wing Guns - Plan View Ammunition Boxes & Chutes Installed

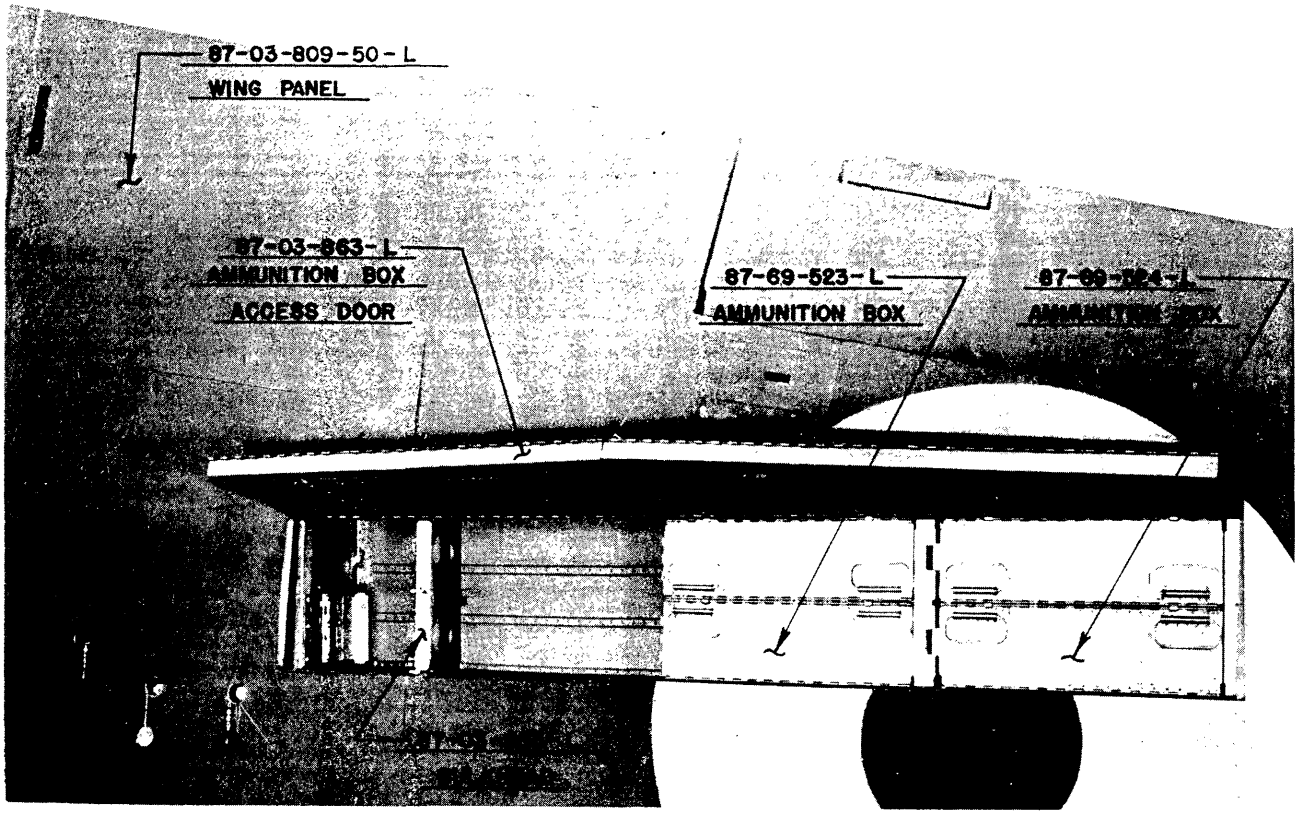
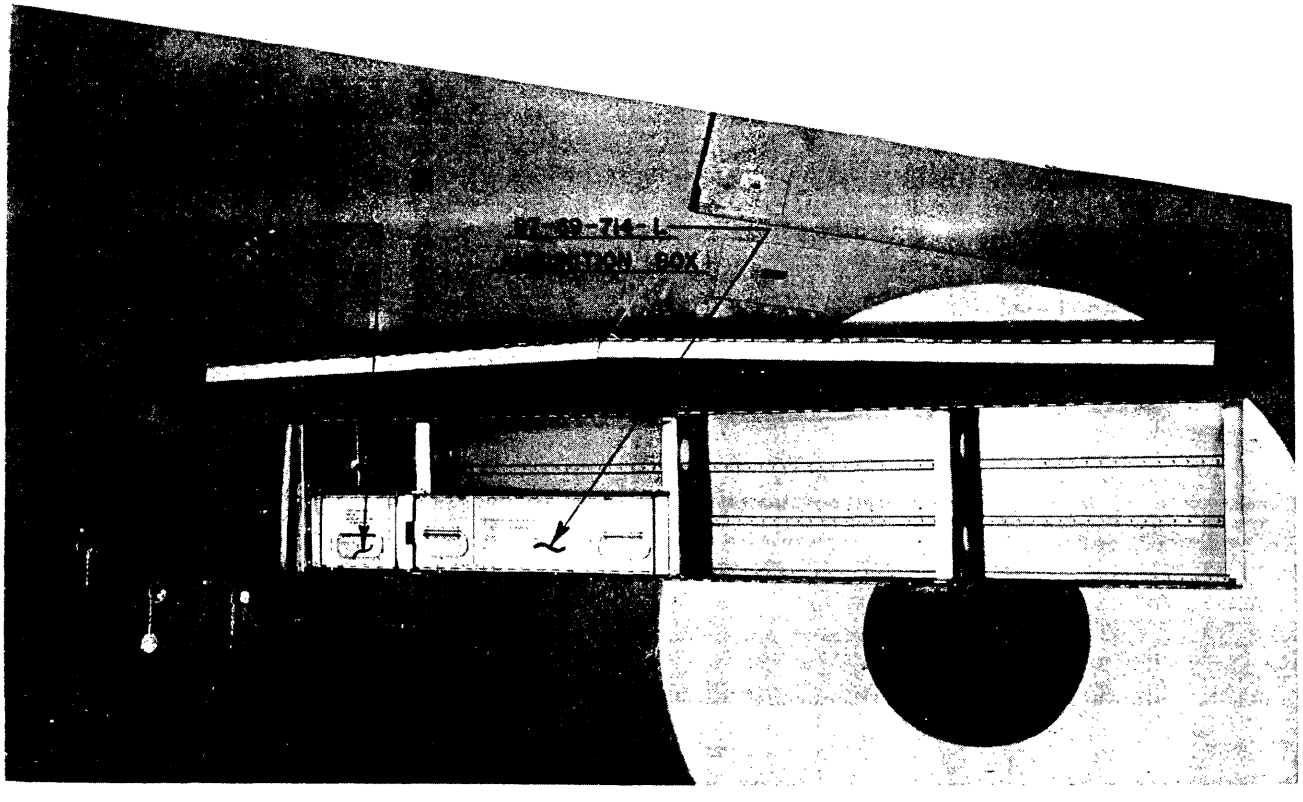


Figure 117 - Wing Guns Plan View - Two Inboard Ammunition Boxes Removed

Figure 118 - Wing Guns Plan View - Two Outboard Ammunition Boxes Removed



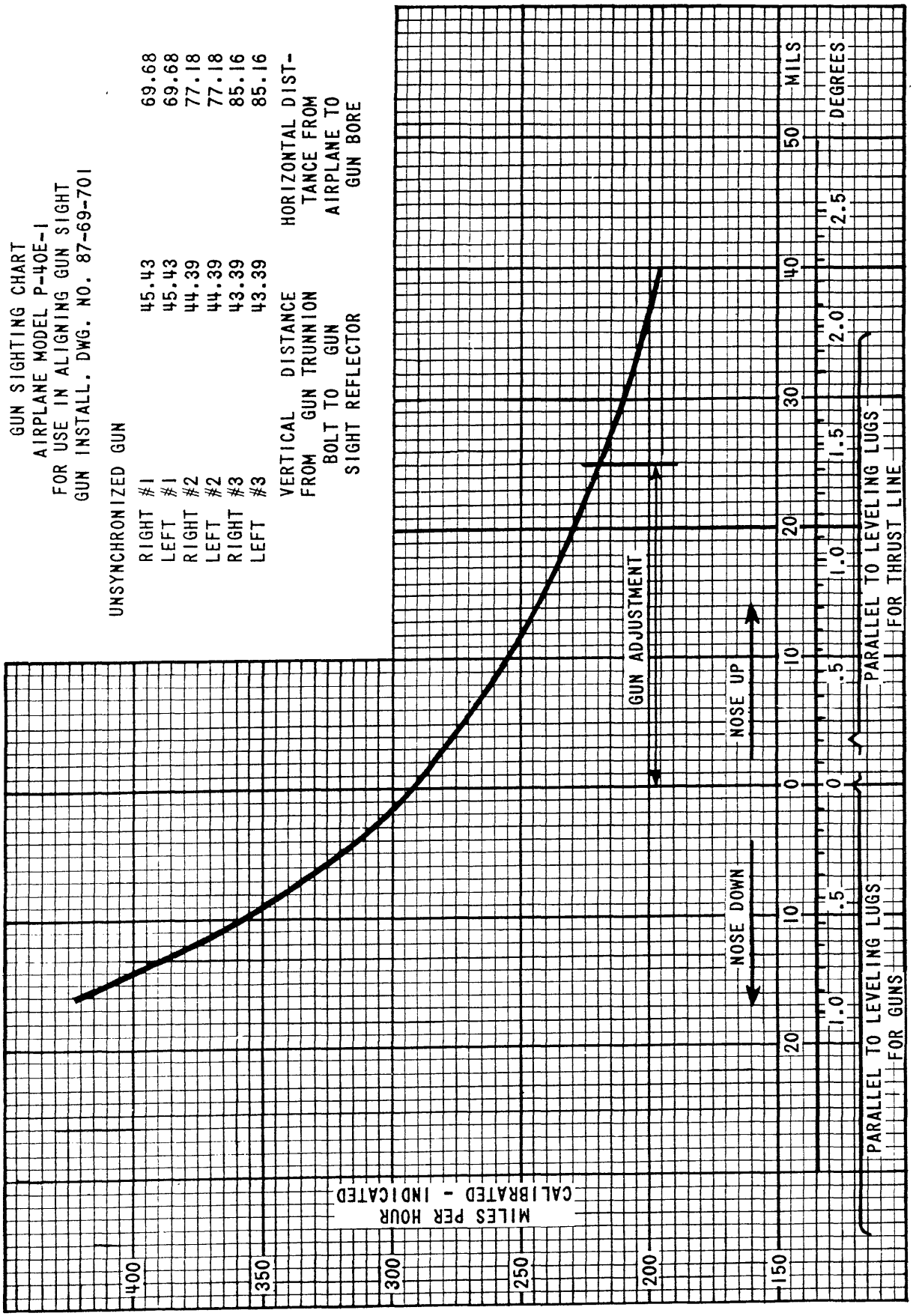


Figure 119- Gun Sighting Chart

ment panel, at the center of the cockpit adjacent to the engine primer. The left handle controls the two inboard guns in the left wing panel, and the right handle controls the two inboard guns in the right wing panel. The center handle controls the outboard guns in both wing panels.

WARNING: The landing gear and flap control valve must be in the neutral position before operating the gun charging valves.

(2) To Charge the Guns Manually (For airplanes AC-41-36903, and AC-41036905 and subsequent). - The ground charger assembly 87-69-988 is used to charge the guns when the airplane is on the ground. The guns cannot be charged while in flight. The ground charger assembly consists of a pulley and a cable assembly. A fitting which has a tapered hole so that it will hold tightly to the bolt stud on the gun, when the gun is being charged, is attached to one end of the cable assembly. A handle is attached to the opposite end of the cable. To charge the guns, proceed as follows:

(a) Unbutton the gun access door.

(b) Remove the door brace from the stowed position on the access door and secure it by the Dzus fastener to the wing panel.

(c) Mount the ground charger on the outboard side of the gun.

1. Slip the hook on the pulley bracket over the spring on the rear gun mount.

2. Slip the fitting at the end of the charging cable, over the bolt stud on the gun.

(d) Pull down on the handle of the charger cable and the gun action will be drawn back, and the gun will be charged.

WARNING: When a gun is charged, a round of ammunition is placed in the firing chamber of the gun. BE SURE that the gun safety switch, which is marked "ALL GUNS" is "OFF" during all gun charging operations.

(3) To unload the guns, proceed as follows:

(a) Mount the charger as outlined above.

(b) Open the gun cover.

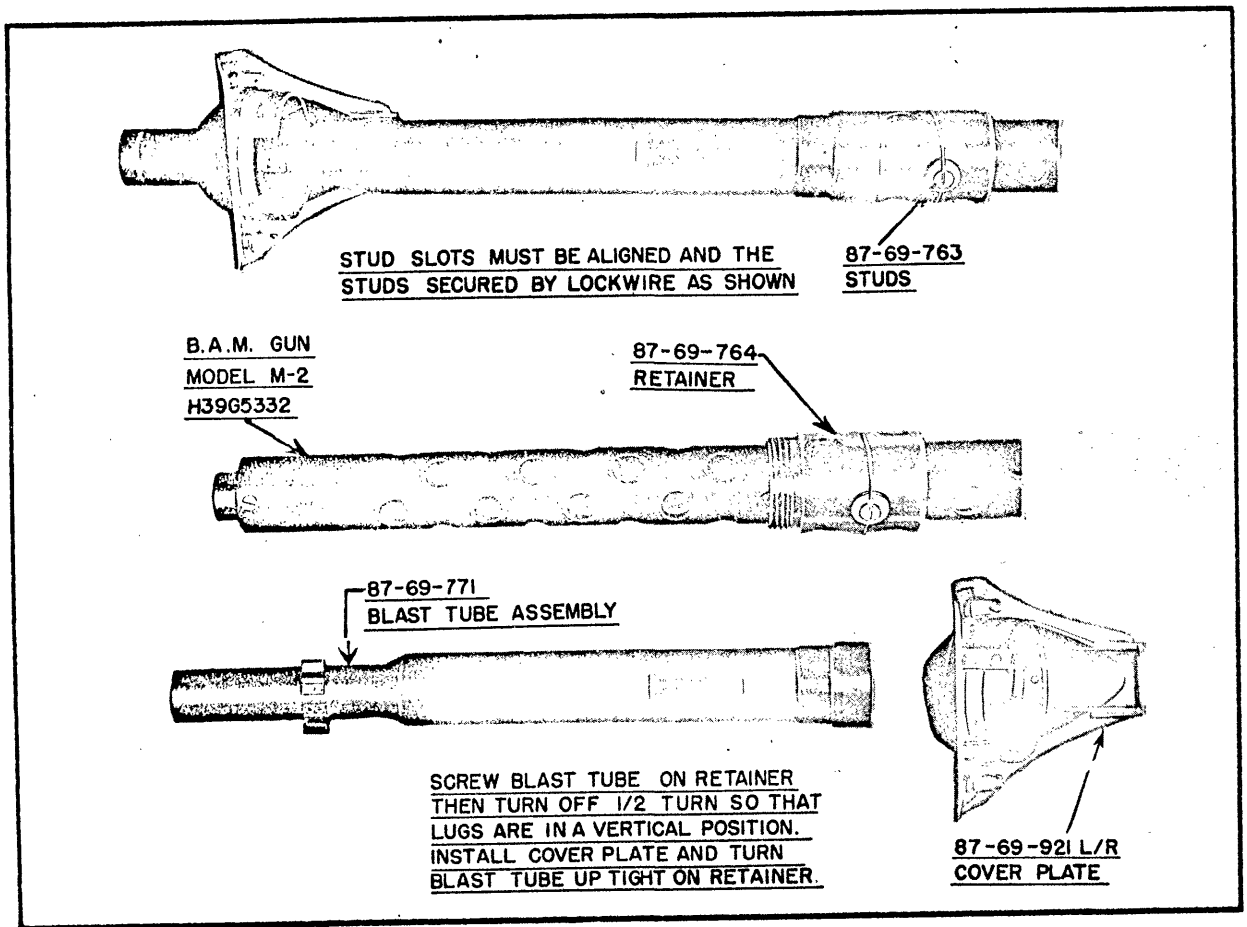


Figure 120 - Blast Tube Assembly

(c) Charge the action back and hold it there by holding the handle.

(4) Remove the ammunition belt from the feedway of the gun.

(5) Allow the gun action to come forward, then charge the action again to remove the last round from the chamber of the barrel.

NOTE: An instruction plate for ground charging the guns is mounted on the inside of the gun access door in each wing panel.

(6) The guns are electrically fired by a B-4 trigger switch on the control stick, which actuates a G-9 Magnavox solenoid attached to the inboard side of the gun, and controlled through the safety switch mounted on the left-hand side of the main switch panel. The safety switch has two positions, all guns either "ON" or "OFF."

i. Doors and Covers. - The long, hinged double door aft of web No. 3 in the top surface of the wing panel is provided for access to the ammunition boxes. The gun access door is in the lower surface of the wing aft of web No. 3. It is installed with a hinge on its leading edge, and Dzus fasteners around the remaining portion of its perimeter. It may be removed from the panel for extensive gun adjustments by removing the hinge pins, or it may be propped forward out of the way. Cover plates are provided for the leading edge of the wing, and may be installed by Dzus fasteners when the blast tubes are removed.

j. Wing Gun Installation. - See Curtiss Wing Gun Erection Instruction Manual.

k. Wing Bomb Installation. - Airplanes AC-41-36554 and subsequent.

General. - The wing bomb installation consists of a Type L-21A control quadrant in the cockpit, two Type Q-2 bomb racks and doors, twelve front sway braces and six rear sway braces. Each bomb rack will support three twenty pound, Type M42, or three thirty pound, Type M5 fragmentation bombs, or three twenty pound, M45 practice bombs.

l. To Install the Type Q-2 Bomb Rack.

(1) Assemble the attaching angles to the bomb rack operating bar with the bolts provided. Note that the bolt heads are on the inboard side of the assembly.

(2) Assemble the bomb rack to the bomb rack door with four bolts, two main attaching bolts and one bolt at each end of the bomb rack. It is imperative that the heads of the two main attaching bolts are on the correct side of the bomb rack, otherwise they will foul the operating cams on the rack.

(3) Attach the two tension springs, one on either side of the bomb rack. Attach one end to the inboard hole on the attaching angle and the other end to the cocking lever support. Attach the third spring, which is shorter to the hole in the cupped part of the cocking lever and to the small tab on the door assembly.

(4) Remove the bomb rack compartment cover plate from the under surface of the wing, outboard of the wing guns near the leading edge.

(5) Disconnect the control cables from the bellcranks on the inboard side of the wing gun compartment and pull out the outboard clevis ends of the control cables through the wing bomb compartment opening far enough to lock the clevis ends into the remaining hole on the two attaching angles on the operating bars. Be sure that the cable clevis ends are attached to the proper attaching angle so that the cables do not cross.

(6) Remove the electrical disconnect plug from the stowage clip in the bomb rack compartment and make the connection to the plug on the bomb rack solenoid.

NOTE: (5) and (6) cannot be accomplished after the bomb rack is installed in the wing.

(7) As the bomb rack unit is lifted into position for attachment to the wing, push the control cables out of the bomb rack compartment to prevent any entanglement of the cables around the bomb rack as it is installed in the compartment. Align the holes in the bomb rack door with those in the wing and secure the door to the wing tentatively with six screws.

(8) Attach the control cables to the bellcranks in the gun compartment.

(9) Place the bomb control handle on the quadrant in the "Lock" position, the arming control handle in the "Safe" position and check for slack in the control cables, adjustment should be made with the turnbuckles at the bellcrank in the gun compartments. After adjustments have been made to the controls be sure that the turnbuckles on the rods in the wheel pocket and those in the gun compartment are secured by lockwires.

m. To Install the Wing Bomb Sway Braces.

Remove the sway braces from the tool kit in the duffle bag and screw the front braces into the holes provided in the under surface of the wing just forward of the bomb rack door. Install each aft sway brace with two bolts and washers in the holes provided in the wing aft of the bomb rack door. The bomb rack is now ready for a preliminary test.

n. Testing the Bomb Rack Installation.

(1) Place the release handle in the "Salvo" position and the arming handle in the "Safe" position.

(2) Cock the bomb rack with a Phillips or Reed and Prince type screw driver.

(3) Move the release handle to the "Selective" position.

(4) Latch the carrying hooks.

(5) Throw the circuit breakers and the bomb switch to the "ON" position and turn the battery switch to "BAT."

(6) Actuate the bomb rack releasing mechanism electrically by pressing the button on the top of the grip on the control stick three times. TURN OFF THE BATTERY SWITCH.

(7) After the operation outlined in (6) has been completed the carrying hooks on the bomb rack should all be open. The arming hooks should be in the unlocked condition and may be opened with the fingers.

(8) Test the bomb rack for Salvo release as follows:

(a) Place the release handle in the "Salvo" position and the arming handle in the "Arm" position.

(b) Cock the bomb rack.

(c) Place the release handle in the "Selective" position.

(d) Latch the carrying hooks.

(e) Place the release handle in the "Salvo" position.

(f) All carrying hooks on the bomb rack should be open. Arming hooks should be locked closed.

(9) Test the bomb rack for the lock condition as follows: Place the release handle in the "Lock" position and test the carrying hooks. All hooks should be locked either open or closed depending on their position prior to placing the release handle in the "Lock" position. The bomb rack will not release electrically when the release handle is in the "Lock" position.

(10) After this preliminary test has been made, install all remaining screws in the bomb rack door and tighten. The bomb rack is now ready for loading.

o. To Load the Wing Bomb Rack.

(1) Place the release handle on the quadrant in the "Salvo" position, then insert a screw driver of the Reed and Prince or Phillips type, in the hole at the outboard end of the bomb rack door and push up on the cocking lever as far as possible. This will cock the bomb rack for selective release of the bombs. After the rack has been cocked, pull the release control handle backward to "Selective" and place the arming control in the "Safe" position.

(2) Screw the front sway braces in as far as possible.

(3) Raise the first bomb up to the rack and insert the carrying hook on the rack into the lug on the bomb. Then by pushing upward on the bomb, the carrying hook will snap into the latched position securely holding the bomb. Be sure that the fins on the aft end of the bomb are properly engaged by the rear sway brace. A decided click will be heard when the latch is locked.

(4) Adjust the front sway braces until they hold the bomb rigidly. Do not tighten excessively or the rack will not function. Tighten the locking nuts on the sway braces.

(5) Follow this same procedure for the remainder of the bombs until all bombs are loaded.

(6) Pull the arming hook on the rack inboard to the open position and attach the looped end of the arming wire over the hook, then release. The hook will snap to the closed position retaining the arming wire.

p. To Unload the Wing Bomb Racks.

(1) Be sure that the arming control lever is in the "Safe" or fully aft position at all times when unloading.

(2) Place the release handle in the "Selective" position and one man can then unload the bombs.

(3) Grasp the bomb firmly in one hand and trip the carrying hook latch on the rack with a screw driver. Repeat this procedure until all bombs are unloaded.

(4) If the airplane is to be flown minus bombs under the wings, remove both the front and aft sway braces and stow them in the duffle bag. The bomb racks may be removed and the bomb rack compartment cover plates installed. When the airplane is flown minus a bomb load with the racks installed it is advisable to cover the rack opening with masking tape to safeguard the rack mechanism against grit, dirt, and other foreign matter which might impair the efficiency of the rack mechanism.

26. Pyrotechnic Installation.

a. Provision for a recognition device with six flares (Drawing 87-71-502) is installed in the baggage compartment on brackets attached to the top section of station 10 bulkhead. (See figure 121.) A cable runs from the recognition device to the damped rate control lever in the cockpit. This damped rate control lever is attached to the floor with a bracket on the right-hand side of the cockpit between the two hydraulic hand pump cylinders. When the damped rate control handle is pulled upward and then released the automatic recognition device discharges a signal flare through the top of the fuselage. The recognition devise is accessible through the fuselage access door.

b. To install the automatic recognition device, remove the brackets 87-71-512 and 87-71-511 and mount the recognition device on the brackets. Install the completed assembly on the bulkhead at station 10 and connect the damped rate control cable.

c. To remove the automatic recognition device: Reverse the above procedure.

Conversion Chart

The following is a list of color band designs for marking the various systems installed in the P-40E-1 airplane:

System	British Color Design	Army Color Design
Fuel lines and vent	1 Broad Red Band	Red Band
Oil lines and vent	1 Broad Black Band	Yellow Band
Prestone lines and vent	1 Broad Blue Band	White Band on each side of Black Band
Oxygen lines	1 Narrow White Band 1 Narrow Blue Band	Light Green Band
Hydraulic Lines	1 Narrow White Band	Light Blue Band on each side of Yellow Band
Manifold Pressure Lines	No color	Alternate bands of White and Light Blue
Vacuum Lines	1 Narrow White Band 1 Narrow Black Band	Alternate bands of White and Light Green
Pitot Pressure		
Air Speed Lines	No Color	Black Band
Pitot Static	No Color	Alternate Black and Light Green

NOTE: (a) All British lines up to 7/16 inch O.D. are designated by broad bands of approximately 3/8 inch and narrow bands of approximately 1/8 inch spacing. All British lines of 1/2 inch O.D. and up are designated by broad bands of approximately 3/4 inch and narrow bands of approximately 1/4 inch with 1/4 inch spacing.

(b) All Army bands are approximately 1/2 inch in width.

Tank Capacities

	British Imp. Units	U.S. Units
Fuel Tanks		
Front Wing (Reserve)	29.2 Gal.	35 Gal.
Rear Wing (Main)	42.1 Gal.	50.5 Gal.
Fuselage	51.5 Gal.	62.5 Gal.
Belly (Auxiliary)	43.3 Gal.	52 Gal.
Oil Tank		
Normal	10.8 Gal.	13 Gal.
Overload	13.3 Gal.	16 Gal.
Coolant System	12.9 Gal.	15.5 Gal.
Coolant Expansion Tank	2.9 Gal	3.5 Gal.
Glycol Spray Tank	2.6 Quarts	3.2 Quarts

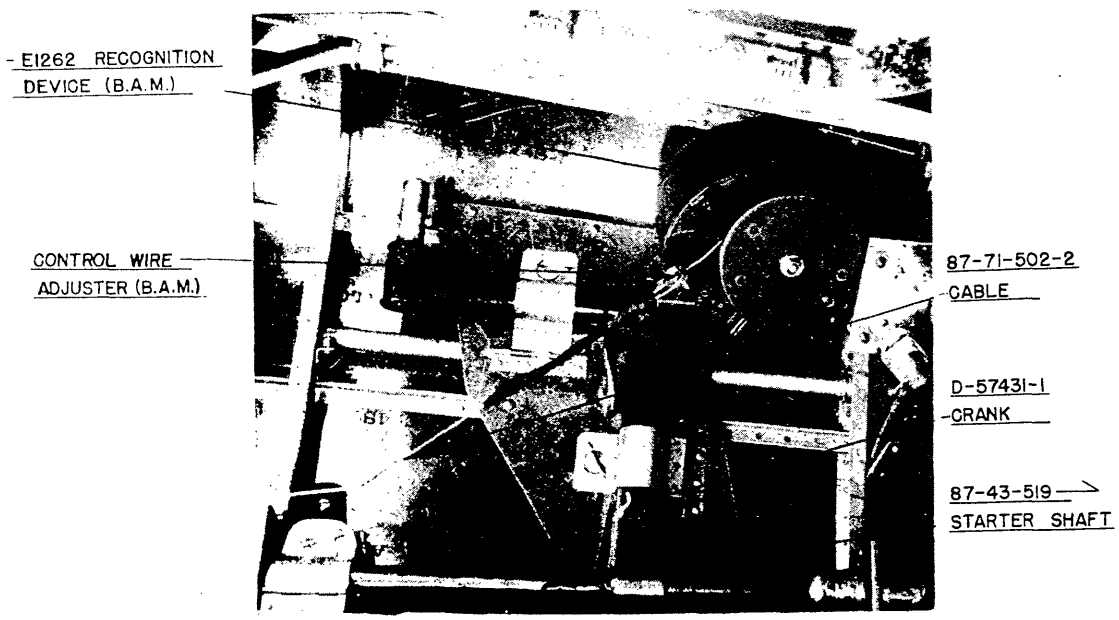


Figure 121 - Automatic Recognition Device Installation