RESTRICTED

TECHNICAL ORDER
No. 01-25CH-2

HANDBOOK OF SERVICE INSTRUCTIONS

FOR THE

MODEL P-40F FIGHTER AIRPLANE

MANUFACTURED BY

CURTISS AEROPLANE DIVISION

CURTISS-WRIGHT CORP.

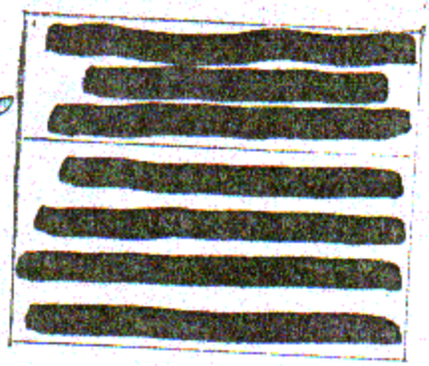
BUFFALO, N. Y.

Contract W535 ac-15802 (C. O. 4200)
W535 ac-18685

Specification 7437

NOTE: The periodic inspection specified in Section III will be entered, where applicable, on Army Air Forces Form 41-A.

This Technical Order replaces T. O. No. 01-25CH-2, dated 1-20-42.



PUBLISHED BY AUTHORITY

OF

THE COMMANDING GENERAL, ARMY AIR FORCES

BY

THE AIR SERVICE COMMAND

AIR FORCE SECTION
WRIGHT FIELD
DAYTON, OHIO

JULY 20, 1942

TABLE OF CONTENTS

TABLE OF CONTENTS

ILLUSTRATIONS

ILLUSTRATIONS

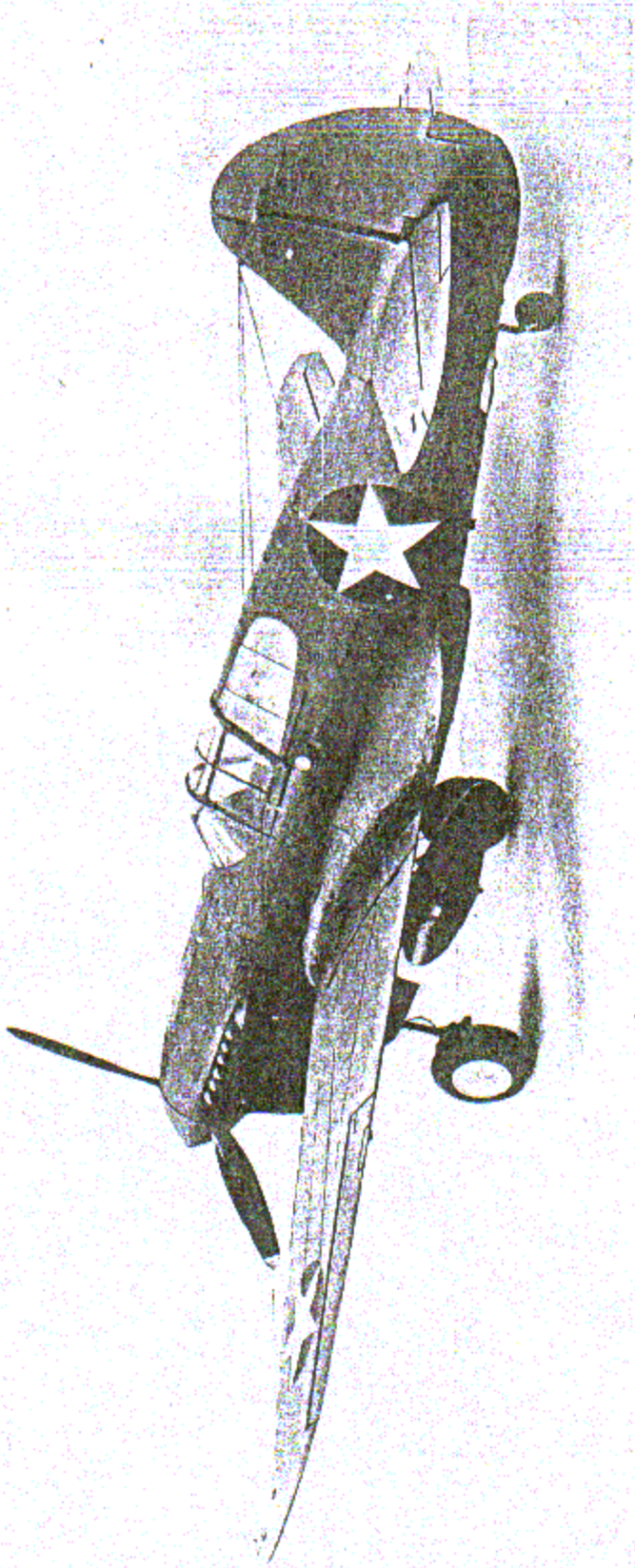


Fig. 1 - Three quarter rear view of complete airplane.

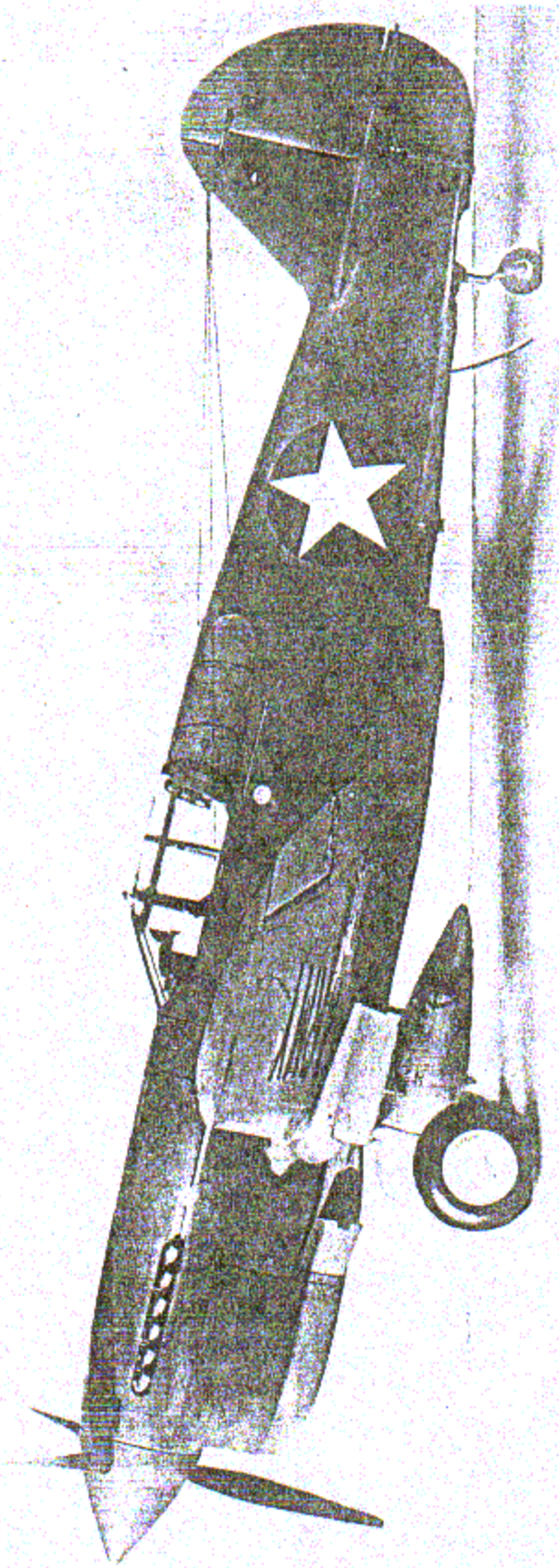


Fig. 2 - Side view - complete airplane.

SECTION I

INTRODUCTION AND REFERENCES

1. This Technical Order is the Handbook of Service Instructions for the Model P-40F Pursuit Airplane. Personnel who are required to service and maintain this equipment will read and be familiar with the information contained in T. O. No. 01-25CH-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.	
00-1	Index of Technical Instructions and Information
00-25-3	Distribution of Air Corps Maintenance Publications
00-25-4	Depot Inspection & Repair of Aircraft & Overhaul of Engines
01-1-1	Cleaning of Aeronautical Equipment
01-1-2	Anti-Corrosion Treatment for Airplanes Operating in Salt Water
01-1-26	Replacement of Frayed Control Cables
01-1-50	Towing, Mooring & Handling of Airplanes
01-1-109	Precautions Against Fouling Controls
01-1B-1	Aircraft Storage Batteries
01-1E-26	Repair & Cleaning of Fuel & Oil Tanks
01-25C-23	Wing Tank Fuel Level Gages - P-36A, P-36B, P-36C & XP-40
01-25CH-1	Operation & Flight Instructions
02-1-1	Preparation of Engines for Storage
02-1-29	Ground Operation Instructions for Aircraft Engines
02-55AA-1	Operation & Flight Instructions
02-55AA-2	Service Instructions
03-1-2	Safety Belts
03-1-4	Overhaul of Accessory Pumps
03-1-14	Handbook of Instructions with Parts Catalog for the Pressure Coolant Thermostat
03-55AA-1	Generators & Control Box
03-55AA-3	Generator Control Panels, Types B-1 & B-2
03-5CA-1	Starters & Starter Motors (Eclipse)
03-5AD-2	G.E. Voltage Regulator and Current Control Switch Relay
03-5CA-2	Electric Starters, Direct Cranking (Eclipse Type E-160)
03-10-13	Operation & Inspection of Fuel Cock Controls
03-10-15	Operating Fuel Systems
03-10-22	Fuel Cocks (Pesco)
03-10-23	Air Vapor Control Valve
03-10EA-1	Fuel Pumps, Engine Driven (Pesco)
03-15-4	Repair & Cleaning of Radiators & Oil Temperature Regulators
03-15-10	Cleaning of Oil System
03-20-5	Overhaul Period for Propellers
03-20BA-1	Operation & Flight Instructions - Controllable Propellers
03-20BA-2	Preliminary Service & Overhaul Instructions With Parts Catalog for Controllable Propellers
03-25A-1	Inspection & Lubrication of Anti-Friction Bearings
03-25B-1	Landing Wheels (Hayes)
03-25B-2	Brakes (Hayes)
03-25E-1	Air-Oil Shock Absorber Struts
03-30AA-1	Engine Driven Vacuum Pumps (Pesco)
03-30CA-2	Motor Driven Hydraulic Pumps
03-50-1	Use of Oxygen
03-50A-1	Oxygen Regulators, Type A-6 & A-8
04-5-1	Shock Absorber Cord - Inspection, Installation & Testing
04-10-1	Aircraft Tire Pressures
04-10-2	Maintenance & Inspection - Tires, Tubes & Wheel Rims
05-1-1	Inspection, Maintenance, Storage & Shipment of Instruments
05-1-9	Aircraft Clocks
05-1-12	Service Instructions - Voltmeters, Ammeters, & Volt-Ammeters
05-1-16	Identification of Aircraft Thermometers
05-1-17	Marking of Aircraft Instruments
05-5C-1	Chronometric Tachometers, Types C-2 & C-7 (Jaegar)
05-10-2	Service & Overhaul Instructions - Airspeed Indicators
05-15-2	Service & Overhaul Instructions - Magnetic Compasses
05-20-2	Bank & Turn Indicators (Pioneer)
05-20-3	Flight Indicators, Types C-1, C-3, C-4 & C-5
05-20-4	Turn Indicators (Sperry)
05-20-6	Suction Gages, Type F
05-20-26	Rate of Climb Indicator, Type A-6 (Kollsman)
05-30-1	Operation & Service Instructions - Altimeter Assemblies (Kollsman)
05-40-3	Thermocouple Thermometers, Types B-6, B-7 & B-8
05-40-10	Cold Weather Operation of Oil Pressure Gages

T. O. No.	
05-50-1	Airspeed Tubes
05-55A-2	Position Indicators (D-C Selsyn)- Models 8DJ4A1, 8DJ4Y8 & 8DJ4PWD5 Indicators; Models 8TJ9A1, 8TJ9PWB3, 8TJ9PWB19 & 8TJ9PWE10 Transmitters
05-55A-3	Fuel Level Gages (D-C Selsyn) - Model 8DJ3EAB-2 Indicator; Models 8TJ13LAA40, 8TJ13LAB40 & 8TJ13LAC40 Transmitters
05-70-1	Manifold Pressure Gage, Types D-1 & D-2
05-75-1	Engine Gage Units, Types B-1, B-2 & B-7
06-10-1	Aircraft Engine Lubricating Oil, Grades & Use
06-10-4	General Aircraft Use
08-5-1	Shielding & Bonding of Aircraft

T. O. No.	
08-5-2	Installation & Inspection
08-5-6	Testing Capacitors
10-10-2	Gun Camera, Type G-4
10-10-7	Aircraft Gun Camera, Type H-1
11-35-5	Fixed Gun Sights - Installation, Inspection & Use
11-1-6D	Machine Gun Installations - Tactical Airplanes
17-1-3	Operation & Maintenance Instructions - High Pressure Hand Pump (Bendix)
19-1-18	Hydraulic Airplane Jacks - Airplane Hoisting Precautions
23-15-1A	Repair & Manufacturing Practices, Aluminum Alloys
24-25-1	Anti-Freeze Solutions
29-1-3	Cleaning, Inspection & Lubrication of Anti-Friction Bearings

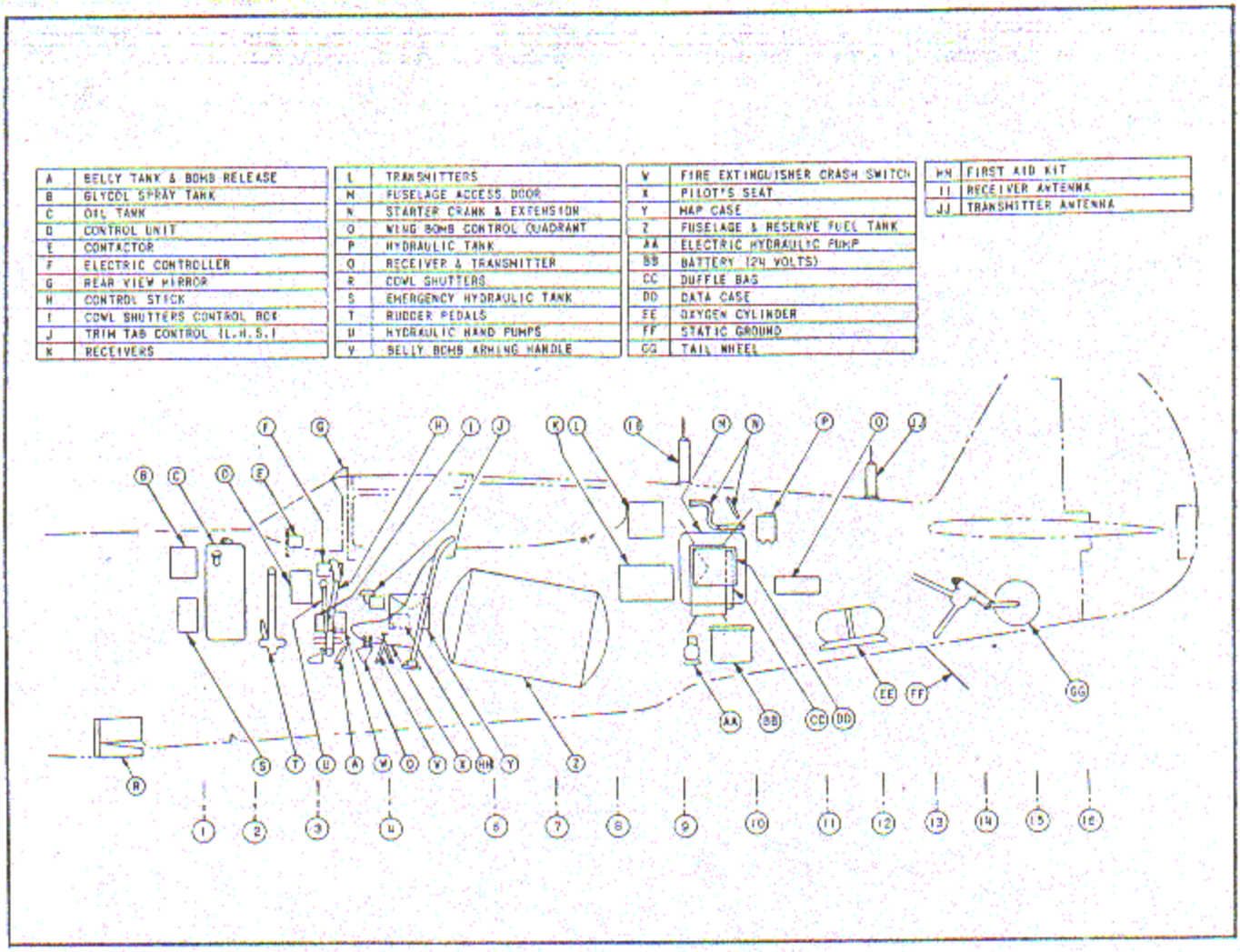


Fig. 3 - Fuselage contents diagram.

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. 7.75 in.
Overall Height, Thrust Line Level, One Load	143.5 in.
Overall Height, at Rest, One Load	127.78 in.
Height, Propeller Hub, Thrust Line Level, One Load	75.45 in.
Height, Propeller Hub, at Rest, One Load	107.2 in.
Clearance, Propeller Tip, Thrust Line Level, One Load	10. in.

b. Wing. -

Airfoil Section	NACA-Root 2215 and 2209 at 197" 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. 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)	7.78 sq. ft.
Area of Balance	.94 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. -

Thread	98.125 in.
Axles aft of Leading Edge of Wing	6.84 in.

2. General Instructions.

a. Handling (See T. O. No. 19-1-18). - (1) Three jacking points to support the airplane while checking the landing gear and tail wheel retracting mechanism, are located as follows: one on the under surface of each wing panel inboard of the landing gear; the third on the bottom of the fuselage aft of the tail wheel doors. The two jacking points on the under surface of the wing panel must be removed when the keel fairing is installed. These jacking points should be carried in the tool kit.

(2) Additional jacking points are located on the bottom of each towing ring on the landing gear axle for supporting the forward end of the airplane while servicing the wheels and the brakes.

b. Hoisting. - (1) The forward end of the airplane may be raised by attaching the sling 87-88-020 to the lugs, provided on the engine mount, which are located approximately 3 inches forward of fuselage Station I. Remove the top sections of the engine cowl to gain access to the lugs.

(2) The wing is hoisted by attaching the wing hoisting sling (87-88-509).

(a) Attach the short cable to bolt hole No. 4, on the wing-to-fuselage attaching tee installation.

(b) Attach the long cable to bolt hole No. 24, on the wing-to-fuselage attaching tee installation.

(c) Lift with one ton hoist attached to ring.

(3) The tail is hoisted by attaching the tail hoisting sling (87-88-019) to the tail lifting bar inserted in the tube in the aft end of the fuselage. See Figure 4.

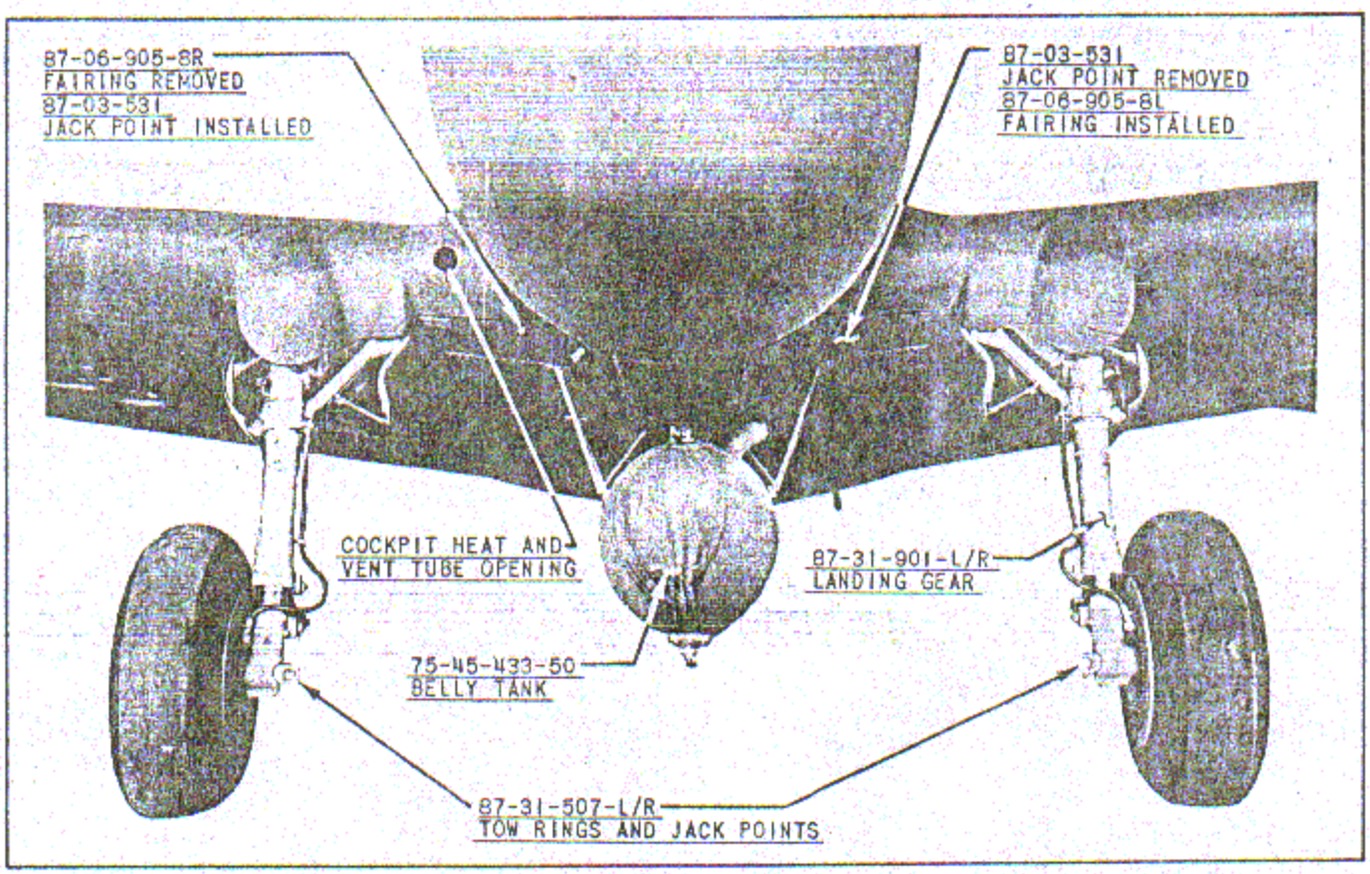


Fig. 4 - Jackpoints and tow rings.

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

Do not use the horizontal stabilizer for lifting the aft end of the airplane.

When the tail is raised to flight position, a one hundred pound weight should be hung on the lifting bar at each side of the fuselage as a precautionary measure.

(4) The engine hoisting sling (Packard, Drawing 607003) is furnished by the engine manufacturer. To hoist the engine, attach the short cable of the sling to the slinging eye, at the forward end of the engine (between the cylinder blocks); and each of the long cables to the sling boss on each of the two rear engine feet.

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 engine only.

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

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

d. Leveling. - Six leveling lugs are located on the two longerons which form the cockpit sill. The two lugs for longitudinal leveling are located in the longeron on the right side, and the two lugs for gun leveling are similarly located on the left side. The two lugs for lateral leveling are located on the sill, right and left sides, immediately aft of the windshield.

e. Filling Fuel, Oil and Coolant Tanks. -

(1) Fuel: (a) Fuel is carried in four tanks; a front wing tank within the forward center of the wing; a rear wing tank within the rear center of the wing; a fuselage and reserve fuel tank located immediately behind the cockpit; and a 52 gallon auxiliary belly tank located on the center line of the airplane beneath the wing.

(b) The front and rear wing fuel tank filler caps are located beneath the left hand wing fillet and are accessible through doors in the fillet.

(c) The fuselage and reserve fuel tank filler cap is located on the left side of the fuselage aft of fuselage Station 5.

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

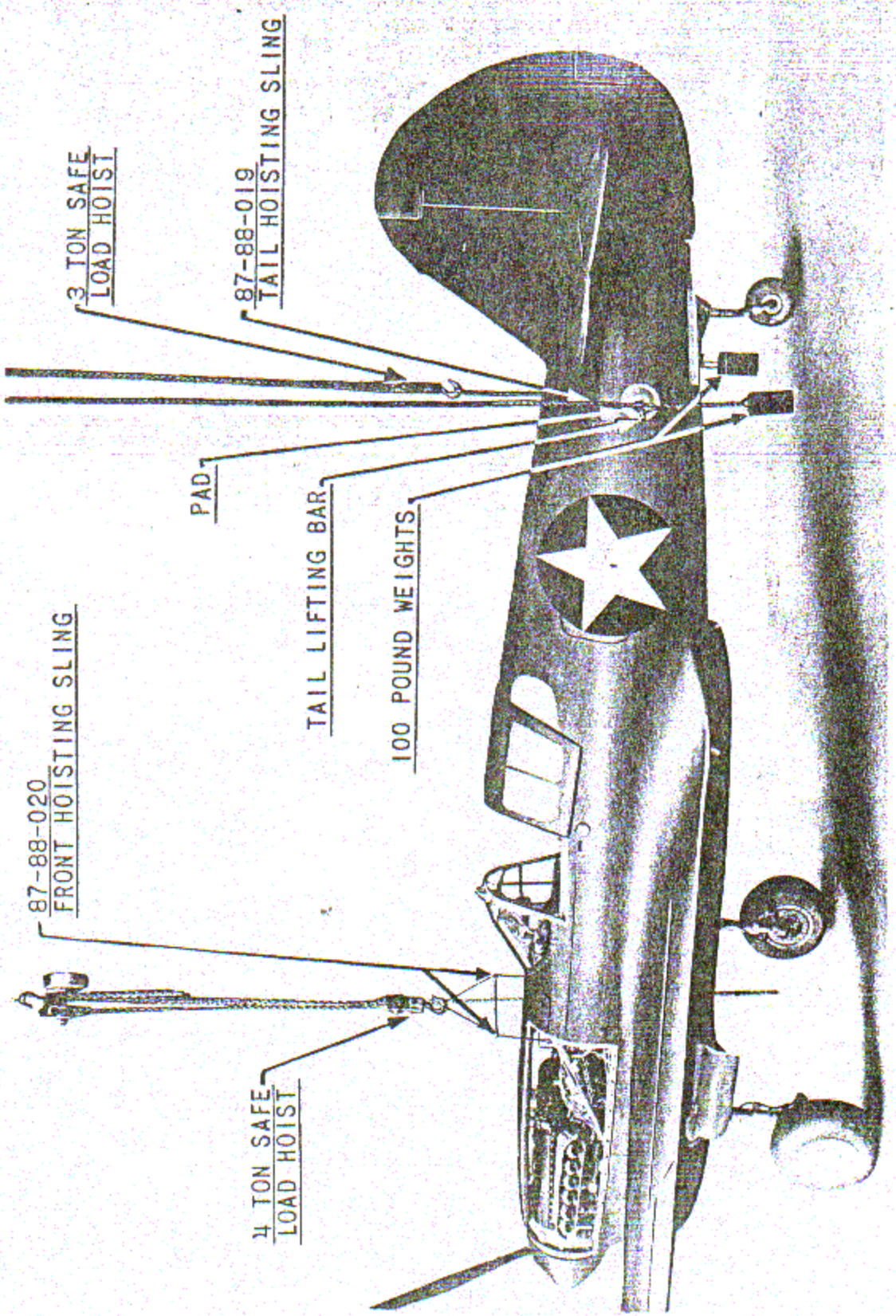


Fig. 5 - Hoisting slings - front & rear - attached.

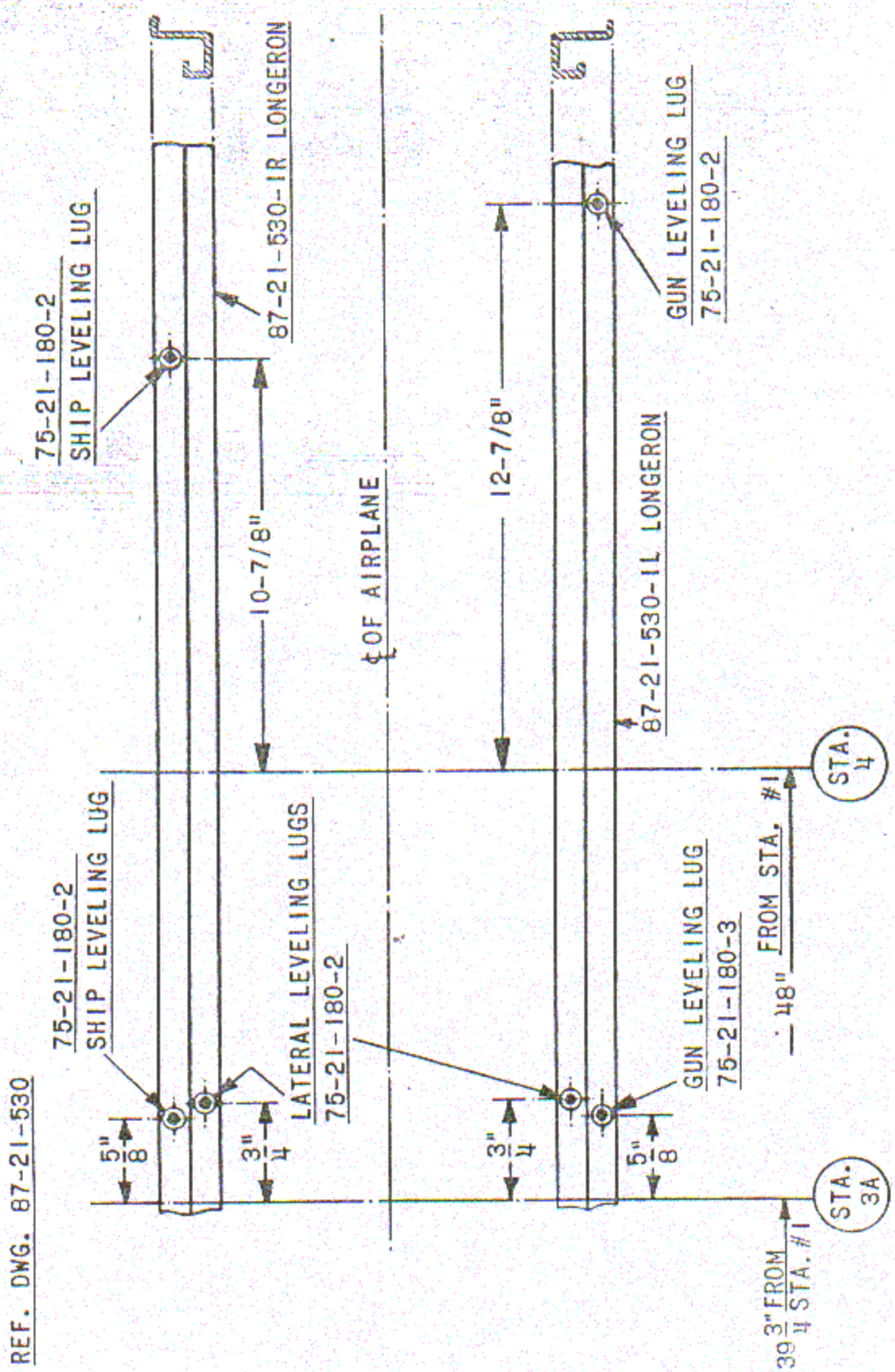


Fig. 6 - Leveling lugs - plan view.

(2) Oil: (a) The oil supply tank is located immediately aft of the firewall and forward of the armor plate installation at fuselage Station 2.

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

(3) Coolant: (a) The coolant header tank is of a semi-circular shape and is located at the forward end of the engine. It is attached by two brackets which are bolted to four bosses on the propeller reduction gear housing.

(b) The coolant system header tank filler cap is accessible through a door on the left side of the engine cowling.

f. Walkways. - (1) A walkway step is attached near the trailing edge of the left wing panel.

(2) One set of duck canvas throw-over strips to protect the wing panels when servicing the airplane are furnished with each nine airplanes.

(3) A throw-over type wing panel pad which is furnished with each nine airplanes, is used when servicing the guns.

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

A mooring kit is stowed in the duffle bag within the airplane.

h. Parking Brakes. - The parking brakes are set by pulling the button type control located beneath the left side of the instrument panel while holding both brake pedals depressed. The brakes are released from the parked position by depressing the brake pedals.

i. Surface Control Parking Harness. - The flight control surfaces are locked by rigging the parking harness (87-64-570) around the control stick. The parking harness is stowed in a small compartment below the pilot's head rest. The method of attaching the parking harness is shown in Figure 7.

j. Starting Engine. - See T. O. No. 02-1-29 and T. O. No. 01-25CH-1.

k. Stopping Engine. - See T. O. No. 02-1-29 and T. O. No. 01-25CH-1.

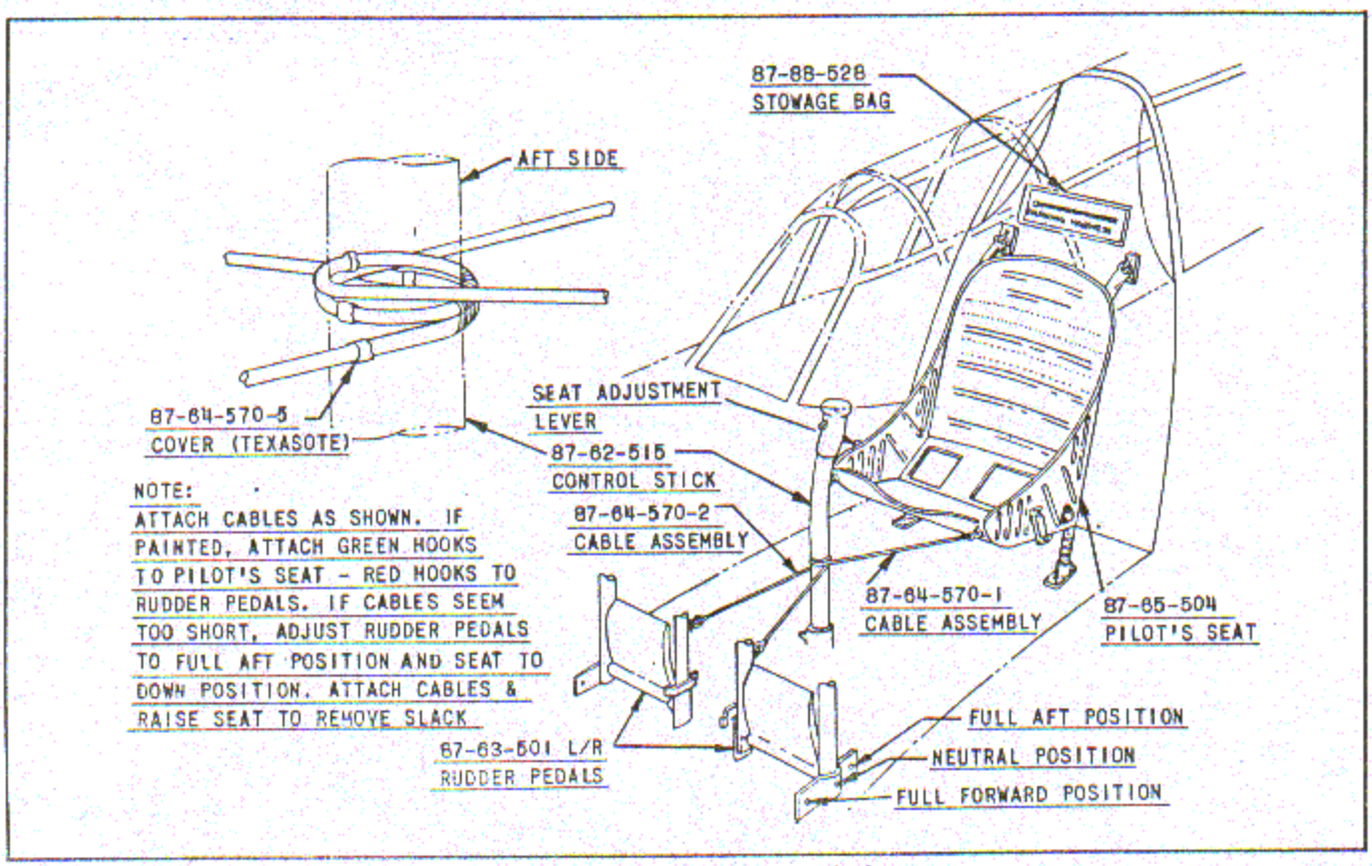


Fig. 7 - Parking harness attached.

SECTION III

SERVICE, INSPECTION AND MAINTENANCE

(Inspection, Cleaning, Servicing, Lubricating and Adjusting)

1. General.

a. The work outlined in this section is a normal function of the Operating Organizations at Air Corps Stations. It consists of the periodic inspection, cleaning, servicing, lubricating, adjusting and such maintenance work as the organization facilities will permit.

b. The lubrication requirements are noted on Figures 8, 16 & 17. Refer also to 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
87-88-509	Hoisting Sling, Wing
87-88-587	Puller Assembly, Engine Mount Bolts
87-88-594	Locating Tool, Filler Opening, Wing Fuel Cell
87-88-595	Locating Tool, Gage Opening, Wing Fuel Cell
87-88-596	Wrench, nut, Gage Mount, Wing Fuel Cell
87-88-597	Wrench, nut, Filler Cap, Wing Fuel Cell
87-88-031	Wrench Metering Pin, Landing Gear and Tail Wheel
87-88-030	Wrench, Actuating Strut, Flap and Landing Gear
87-88-032	Wrench, Hydraulic Hand Pump
87-70-555	Screwdriver, Bomb Rack, Cocking and Removal
87-88-525L/R	Pad, Throw-Over Walkway
87-88-524	Pad, Wing Throw-Over, Gun Servicing
87-69-737	Wrench, Rachet Gun Mounting
87-03-531	Stud, Panel Jacking
87-88 915	Wrench, Propeller Adjusting

d. Reference to the inspection and maintenance given in the following paragraph should be made under proper column headings on Form 41A for all supplementary inspection and maintenance.

2. Inspection and Maintenance.

a. Column 10 - Preflight Inspection.

Before Starting the Engine.

General.

Check condition of static ground forward of tail wheel doors.

See that wheel chocks are in proper position.

Examine the Airplane Flight Report for completeness, and if incomplete, make the necessary entries to complete it. Note whether routine inspections are due. If so, make them. If they cannot be made, see that the proper symbols are entered to indicate the omission of the inspections.

Gunnery Equipment.

If ammunition boxes are loaded, inspect to see that the rounds counters indicate the quantity of ammunition in the respective boxes.

Check security of attachment and alignment of blast tubes.

Communications Equipment.

Prior to the first flight each day, a visual inspection is to be made of the radio equipment to determine the general condition. Check for aggravated condition, maladjustments, breaks, etc. Check the condition of all radio batteries.

Perform operating check (including frequency) on radio equipment. Check Column 15, Form 41A, with Form 1 to see that they check.

NOTE: Installed radio transmitters will not be operated (dynamotor running) if any point of the antenna system is nearer than one foot to any other object (refer to T. O. No. 08-5-2A). Do not use pliers on any part of the antenna wires.

Check microphone, connector cords, etc., for proper anchorage in accordance with T. O. No. 01-1-109.

Photographic Equipment.

This inspection is a check of the camera mount supports, and is designed to ascertain that the camera and its accessories can be readily mounted and satisfactorily used in the airplane. Refer to T. O. Nos. 10-10-2 and 10-10-7.

Engine Instruments.

Clean all instrument cover glasses with a clean cloth. Special care should be exercised with the individually lighted instruments, as scratches, finger prints, etc., on the cover glasses disturb the lighting.

Inspect the lamps in the instrument lighting system, and replace those found defective.

Check the 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. The following inspections will also be given the instruments indicated.

G- GREASE-MOBILGREASE "ZERO"
O- OIL-GARGOYLE AIRCRAFT INSTRUMENT OIL
HO- HYDRAULIC OIL-LOCKHEED NO. 5
25- 25 HOURS
50- 50 HOURS
100- 100 HOURS
D- DAILY
25S- 25 SERVICE HOURS
50S- 50 SERVICE HOURS

NO.	PART	LUBR.	NO.	PART	LUBR	NO.	PART	LUBR
1	"FEATHER"-COAT SURFACE	O-D	13	TAB CONTROL CHAIN-COATING	G-25	24	HINGES-FLAP, LANDING GEAR DOOR, TAIL WHEEL DOOR, AMMUNITION AND GUN ACCESS DOORS, FUSELAGE ACCESS DOOR	O-50
2	"A" FRAME CONNECTIONS	G-25	14	TRIM TAB MOTOR DRIVE	G-100			
3	COWL FLAP HINGE	O-25	15	AILERON DRUM-CABLE ATTACHMENTS	G-25			
4	JACKSHAFT BEARINGS	G-100	16	TRIM TAB ROD ATTACHMENTS	G-25	25	BELLY TANK SHACKLE	O-25S
5	JACKSCREW	G-100	17	LINK-(ELEV. HORN TO JACKSHAFT)	G-50	26	BELLY TANK RELEASE CONTROL	O-25S
6	ALL CONTROL CABLE ENDS	O-25	18	ELEV. CONTROL PUSH ROD BEARING	G-100	27	SWAY BRACES	G-50S
7	TRIM TAB CONTROL UNIT	O-25	19	TRIM TAB DRIVE SHAFT CONNECTIONS	O-50	28	MASTER BRAKE CYLINDER	HO-25
8	FLAP PUSH ROD ROLLERS	O-25	20	BRAKE PEDAL BEARINGS	O-25	29	HYDRAULIC RESERVE TANK	HO
9	PUSH ROD-COAT SURFACE	O-25	21	COCKPIT HEAT SYSTEM VALVE BEARINGS	O-25			
10	ALL TURNBUCKLE ENDS	O-25	22	PILOT'S SEAT GUIDE	O-25			
11	CONTROL STICK STOP	O-25	23	EMERGENCY CABIN RELEASE-HINGE AND MECHANISM				
12	BALL AND SOCKET JOINT-AILERON	G-25						

GREASE ALL CONTROL RODS FULL LENGTH OF TRAVEL THRU FIREWALL

ALL SEALED BEARINGS TO BE LUBRICATED AT OVERHAUL PERIODS.

CHECK BATTERY WEEKLY FOR CHARGE AND PROPER ELECTROLYTE LEVEL

PM-CURTISS ELECTRIC PROPELLER MOTOR-SPEED REDUCER OIL TYPE I-100 HOURS
PS-FLEXIBLE DRIVE SHAFT-ENGINE TO GOVERNOR-MOBILGREASE NO. 2-100 HOURS
PH-PROPELLER HUB-SPEC. 3581 GREASE-B MEDIUM-25 HOURS
(SEE T.O. 03-20BA-2, COVERING PROPELLER)

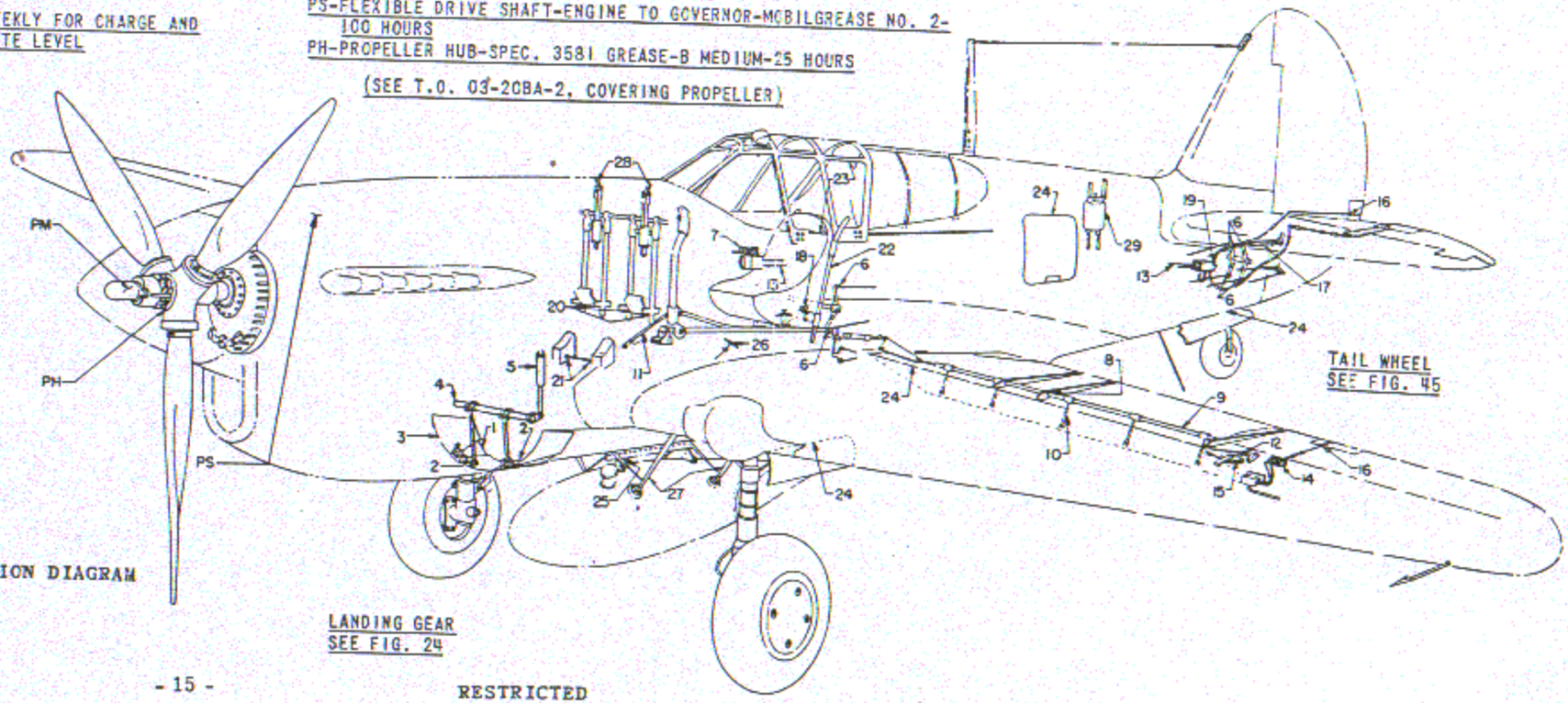


FIG. 8 - LUBRICATION DIAGRAM GENERAL

Tachometer: See that pointer is set at zero.

Thermometer, Coolant: Inspect fastenings for anchorage. Be sure that bulb or capillary will not work loose.

Ignition & Electrical Equipment.

Verify that ignition switch is "OFF".

Check for presence of hand starter crank.

Fuel & Oil Systems.

Check the quantities of fuel and oil in the tanks, and enter the quantities on the Airplane Flight Report, Form No. 1.

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 Preflight inspection by these instructions.

See that tank caps are secured after filling the tanks.

Drain all accessible fuel strainers (including tank drains), making sure that all drain cocks and plugs are properly resafetied. See that wing tank scupper drains are clear.

Turn fuel cock control handles one complete revolution to determine that they turn freely.

CAUTION: Always set fuel cock by "click and feel" method. Should any pronounced binding be indicated, the connecting linkage, if any, will be checked for correct alignment. Refer to T. O. Nos. 03-10-13 and 03-10-22.

Cooling System.

See that radiator is filled to the proper level. If anti-freeze solution is required, check the solution to see that the desired protection against freezing is provided (refer to T. O. No. 24-25-1). See that radiator filler plug or cap is replaced and properly tightened.

Propellers & Accessories.

See that the propeller is properly installed and that all exposed screws, pins, bolts, etc., are tight and safetied.

The exterior of all parts of the propeller will be examined for cracks or other failures and for bends, nicks, and other damage as prescribed in T. O. No. 03-20BA-2.

Cockpits & Cabins.

See that windshield and windows are clean and that sliding enclosure functions properly.

Flight Controls Mechanism.

See that flight controls operate freely, and that there is nothing in the cockpit that will interfere with the controls.

Check proper functioning of wing flap system before starting engine. If flaps operate briskly after airplane has been idle for twenty-four hours or more, the system is in proper operating condition.

See that the flight controls are unlocked.

See that all trim tabs are in their proper positions.

Surfaces.

Inspect wings, ailerons, elevators, rudder and stabilizers for damage or obvious defects.

Check all screws which attach wing fuel tank doors to the bottom surface of the wing, for security of fastening.

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

Tail or Nose Gear.

Inspect tail wheel for condition of tire and for proper inflation of tire and shock strut.

Landing Gear.

Inspect for damage and for obvious defects. Inspect wheels for condition. Inspect for proper inflation of shock strut.

Wheels & Brakes.

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

Inspect for distorted rim flanges and rims, security of retaining nuts, bolts, and cotter pins, and for security of lock ring on Type II wheels.

Hydraulic System.

Check the proper level of the fluid in the reservoir. Fill, if necessary, with fluid, Spec. 3586, Grade B.

Fuselage, Hull & Floats.

Inspect for damage and obvious defects.

Oxygen Equipment.

Whenever flying is to be done at altitudes requiring oxygen, the equipment will be checked for completeness and for proper operation. Refer to T. O. Nos. 03-50-1 and 03-50A-1.

Night Flying Equipment.

Inspect running, landing and spot lights for proper operation and replace any defective lamps.

Airplane General.

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

Navigation Instruments.

Check 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. The following inspections will also be given the instruments indicated:

Airspeed indicator: See that pointer indicates zero, or value of wind velocity component in direction that aircraft is heading.

Rate of climb indicator: See that pointer is set at zero. Check by tapping instrument lightly with fingers to eliminate possible friction.

Altimeter: Refer to T. O. No. 05-1-1.

Position indicator: Close master switch and see that images of landing gear, tail gear and flap appear and are in their proper positions.

Compass: Check for discoloration of liquid and for evidence of bubbles.

Clock: See that it is wound, is running and is correct according to Operations Office time (T. O. No. 05-1-9).

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

Drain the airspeed lines.

Check the shock-proof instrument boards for flexibility.

Clean all instrument cover glasses with a clean cloth. Special care will be exercised with the individually lighted instruments, as scratches, finger prints, etc., on the cover glasses disturb the lighting.

Inspect lamps in the instrument lighting system, and replace those found defective.

During Engine Warm-Up.

General.

When practicable, before starting the engine the first time each day, pull the propeller through at least four complete revolutions by hand before using the starter.

CAUTION: Specific instructions have been included in T. O. Nos. 01-25CH-1, 02-55AA-1, and 03-20BA-1 covering the operation of controllable propellers, the R.P.M.'s to be avoided or passed through as quickly as possible and the method of stopping aircraft engines. Personnel shall be familiar with these instructions before warming up the engine.

Engine Instruments.

Check engine instruments for proper operation, excessive pointer oscillation, and note whether the pointer indications are consistent with the stage of warm-up, as prescribed in T. O. No. 02-55AA-2.

Check engine gage unit for excessive pointer oscillation.

Check manifold pressure gage (T. O. No. 05-70-1) by gunning the engine. Needle should move freely to left. Check against a barometer if practicable. Check all connections for leaks.

Ignition & Electrical Equipment.

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 switch 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 moving the mixture control to "IDLE CUT OFF". 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 "CHARGE". Refer to Specification 94-32191 (T. O. No. 05-1-12).

Fuel System.

Test functioning of engine on all fuel tanks. Refer to T. O. No. 03-10-15. The required fuel pressure must be obtained when operating on each tank. The fuel selector valve must turn readily when shifting from one tank to another, and the position of the indicator in the fuel selector control must correspond with the setting indicated on the fuel selector dial. Refer to T. O. No. 03-10-13.

Propellers & Accessories.

With the engine warmed up to operating temperature, check full range and free operation of controls.

CAUTION: Since the propeller blade pitch angle is controlled electrically there is a greater possibility of leaving the ignition switch in the "ON" position than there is with hydraulically controlled propellers. Therefore, determine that the ignition switch is definitely "OFF" before attempting to rotate the propeller by hand.

NOTE: Do NOT operate the propeller blade pitch angle changing controls unnecessarily while the engine is not running.

Navigation Instruments.

Check for adequate suction from vacuum pump. With the flight and turn indicators uncaged, and the gyro operating under rated suction, the horizon bar and card should settle to indicate the attitude of the airplane sitting on the ground within two minutes after suction is turned on.

After-Flight Inspection.

Gunnery Equipment.

Clear the machine guns. Remove the groups. Check to see that there is no ammunition left in the boxes.

Check the ejection chutes for jams and for alignment with the guns. Detail strip the groups.

Check the parts for wear, burrs and for breakage. Clean and lubricate the guns, then reassemble them, check the head space, and test the firing mechanisms.

Power Plant General.

Sufficient cowling will be removed in order to check for fuel and oil leaks within the engine section and for other failures of wires, lines, connections, attachments of exhaust pipes and collectors.

Fuel & Oil Systems.

All fuel and oil tanks will be serviced to the normal supply after the day's flying is completed.

Propellers & Accessories.

At the end of the day's flying, clean the propeller, inspect it, and coat it with clean lubricating oil.

NOTE: Coating of metallic propeller blades and hubs with engine oil protects the exposed surfaces of the propeller from rust and corrosion. The oil also seeps into cracks that exist in the blade or hub, making otherwise obscure cracks stand out thus facilitating inspection.

Propellers installed on aircraft operating near salt water will be flushed off with fresh water, dried, and coated with engine lubricating oil (T. O. No. 01-1-2).

Oxygen Equipment.

At completion of flights involving the use of oxygen, mouthpieces will be sterilized, and the valve on the cylinder will be closed tight to release pressure on the regulator.

Navigation Instruments.

See that airspeed head protection cover is installed.

b. Column 12 - Gunnery Equipment.

25-Hour.

Inspect gun controls to determine serviceability and proper relation of control equipment to gun and gun mount.

50-Hour.

Make a complete inspection of gun mounts, and thoroughly clean and inspect solenoids and other related accessories for security of attachment and operation (refer to T. O. No. 11-1-6D).

c. Column 15 - Communications Equipment.

50-Hour.

Test radio capacitation for short circuits or open circuits and inspect all wiring (High and low tension) for general condition as prescribed in T. O. No. 08-5-6.

NOTE: During periods of intensive use of radio equipment, the inspection periods will be reduced to 25-Hours.

Inspect shielding, bonding and metallizing.

Inspect radio equipment as prescribed in T. O. No. 08-5-2.

d. Column 19 - Daily Inspections - Power Plant.

Engine Controls.

Inspect throttle, mixture, supercharger change speed control, automatic boost control lever, carburetor air heater, propeller governor control, and cowl flaps control assemblies for proper functioning, operating range, tightness, proper safetying, and for general condition.

Engine Instruments.

Check all cover glasses for looseness and cracks.

Check engine gage unit for pointer tolerances at zero. Tolerance for fuel pressure gage; $\pm$0.2 lb.; tolerance for oil pressure gage; $\pm$5.0 lb.; tolerance for thermometer; $\pm 3^{\circ}$ of existing engine temperature. If excessive errors exist, replace with spare unit from stock, (T. O. No. 05-75-1).

Check cover glass of tachometer for looseness and cracks. Check for correct and discernible operating markings. Check pointer for tolerance at zero (-15 R.P.M.).

Ignition & Electrical Equipment.

The functioning of the various parts of the starting, ignition and electrical systems is checked when starting and warming up the engine incident to the accomplishment of the Preflight Inspection. If functioning is found to be unsatisfactory, detailed inspection will be made to detect the cause of malfunctioning.

Inspect starters, generators, coils, switches and solenoids for cracked housings or flanges, for security of mounting, tightness of housing bolts, safetying of all attaching or connecting bolts. Replace starters if cracks appear in housings or flanges and tighten or safety bolts as required.

The presence of engine oil in the starter gear case and around the flywheel often results in starter failure, particularly in cold weather. When, during inspection, this condition is found to exist, the starter should be removed and replaced with one from stock. Before installing the new starter, refer to starter Handbook (T. O. Nos. 03-5CA-1 and 03-5CA-2).

Fuel System.

With the fuel "ON", and pressure built up, inspect carburetor and fuel line connections for leakage, particularly at drain plugs, passage plugs, and parting surface of body castings. Check primer for leaks when in the "OFF" position.

Inspect fuel pumps for security of mounting, and for proper safetying. Drain tank sumps each time fuel is serviced to the tanks.

Oil System.

Inspect oil temperature regulator for security of mounting and for proper blanketing according to weather conditions as prescribed in T. O. No. 06-10-1.

During cold weather operation (below +32°F.), drain the oil pressure gage line and refill with instrument oil as prescribed in T. O. No. 05-40-10.

Cooling System.

Inspect radiator, header tank and hose connection for leaks, particularly in radiator core and at drain cocks. Check safetying of drain cocks.

Inspect operation, proper functioning and general condition of radiator cowl flaps. See that the cowl flaps operate to extreme positions (fully open and fully closed).

Check the thermostatic relief valve on the header tank for proper functioning.

General.

Determine whether engine is due for overhaul (T. O. No. 00-25-4).

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

Inspect exposed portions of the engine mount and mounting brackets for general condition and security of attachment to the fuselage.

e. Column 20 - Engine Controls.

25-Hour.

Inspect entire control installation from the levers in the cockpit through all rods, levers, bellcranks, linkage, support brackets and torque shaft. Inspect for full and free movement. Controls should operate with uniform tension throughout their full range.

Inspect for lost motion. See that linkage is properly adjusted. Inspect for bent rods, loose or missing bolts, nuts, screws, cotter pins, etc.

See that all levers are adjusted to prevent creeping.

Inspect the "Lear" electricamotor assembly for the positive operation of the cowl flaps and the security of attachment to the engine mount. Check the automatic and manual control switches on the shutter control box in the cockpit for proper functioning. Check the cowl flap shutter position indicator for proper indication.

Clean and lubricate all moving connections and bellcranks with oil, Spec. 2-27E, with the exception of anti-friction bearings in rod ends, bellcranks, etc. Where the anti-friction bearings are used, no lubrication is necessary between major overhauls.

50-Hour.

Lubricate firewall guides with grease (Mobilgrease zero).

f. Column 21 - Engine Instruments.

50-Hour.

Check marking of engine instruments as prescribed in T. O. No. 05-1-17.

Inspect instruments for chipped luminous markings, security of mountings and tightness of connections. Check electrical instruments for tightness and condition of electrical connections and for condition of insulation.

Check the indicator of the thermocouple thermometer as to zero position. Open the circuit and adjust as prescribed in Section IV of T. O. No. 05-40-3. To open the circuit, refer to Section III of T. O. No. 05-40-3.

Check the flexible drive shaft of the tachometer for proper anchorage and for tightness of connections at engine and instrument. Check dial and pointer for luminosity (T. O. No. 05-5C-1).

Check the reading of the manifold pressure gage with station barometer. If the reading differs by more than 0.4" of mercury from that of the station barometer, remove the instrument for bench test and for resetting of pointer (T. O. No. 05-70-1).

Check engine gage unit and lines for security of mounting. Inspect all lines and connections for proper anchorage, flexibility, and leaks. Check dial and pointer for luminosity. Check for correct and discernible operation markings (T. O. No. 05-1-17).

Engine Change.

Each installed aircraft thermometer will be inspected to determine for which of the purposes listed in paragraph 1. b. of T. O. No. 05-1-16 it is being used. If not already clearly identified, by the use of one of the applicable phrases used in the above-mentioned paragraph, the thermometer indicator will be properly identified, using for that purpose either Plates - name and data, Drawing No. 0153316-1 or Aircraft Enamel, Spec. 3-98.

g. Column 22 - Ignition & Electrical Equipment.

50-Hour.

Hand Crank.

Check for security of mounting.

Wiring.

Inspect all wiring for proper anchorage of conduit nuts, bonding leads and terminal box covers, condition of connections and insulation, 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.

Starter. (T. O. Nos. 03-5CA-1 and 03-5CA-2).

Check for loose electrical connections.

Inspect motor brushes to see that they are bearing on commutator and do not bind the brush holders. Worn brushes should be replaced.

Inspect brush springs for proper tension.

Inspect commutator for evidence of dust or roughness, and clean if necessary.

See that safety wiring is installed where necessary.

Generator & Control Box (T. O. No. 03-5AA-1).

Remove window strap and inspect for security of mounting, excessive arcing, dirty or loose connections, condition of terminals, worn or binding brushes. See that safety wiring is installed where necessary.

Clean and tighten all connections and replace any defective wiring. The maximum permissible wear of the brushes is 5/16" from a new length of 7/8", or where the amount of brush remaining is 9/16". However, brushes should be replaced before their maximum wear limit is reached in order to assure proper operation until the next 50-hour inspection period. When replacing a worn brush, the new brush should be properly seated by inserting a strip of #000 sandpaper between the brush and the commutator with the sanded side next to the brush and, pulling in the direction of rotation, being careful that the sandpaper is kept in the same contour as the commutator. The operation should be repeated until the brush is fully seated. Binding brushes should be wiped clean with a gasoline moistened cloth. (Use only gasoline without ethyl content).

If the commutator is rough or dirty, smooth with #000 sandpaper. For badly scored commutator, refer to Section IX of T. O. No. 03-5AA-1.

If the generator front head screws are loose, unsafety, tighten and safety. Be sure that in tightening, the screws do not bottom in the yoke.

Generator Control Panel (T. O. No. 03-5AA-3 or T. O. No. 03-5AD-2).

Inspect for security of mounting, excessive arcing, cleanliness, condition of contact points, proper safetying, etc. Inspect terminals, cables, connections for condition and security of attachment. Clean contact points, if necessary, as prescribed in T. O. No. 03-5AA-3 or T. O. No. 03-5AD-2.

Check the voltage regulator element for proper voltage setting with no load, as set for initial installation. Adjust, if necessary, as prescribed in T. O. No. 03-5AA-3 and T. O. No. 03-5AD-2.

Inspection of Coolant System Thermo Switches:

Inspect the high limit and low limit thermo switches for security of safety wire.

Inspect area of coolant header tank adjacent to the thermo switch bulb well.

Adjustment of the Coolant System Thermo Switches:

To adjust the high limit or the low limit of the thermo switches in the coolant system header tank, refer to section IV, paragraph 12, of this Handbook for complete information.

100-Hour (Aileron Trim Tab Motor)

To lubricate the aileron trim tab electric motor, remove the cover plate on the top of the aileron leading edge, then remove the screw in the base of the motor. Lubricate using only mobilgrease zero.

h. Column 23 - Fuel System.

General.

When the engine driven fuel pump is first installed, the seal chamber of the pump should be half filled with grease, lubricating, cup, medium Spec. VV-G-681. Grease may be applied through an Alemite or Zerk fitting in one of the 1/8" pipe tapped connections next to the mounting pad (T. O. No. 03-10EA-1).

25-Hour.

With fuel "ON" and pressure built up, (12 to 16 p.s.i.), inspect all fuel lines for; leaks, particularly at connections and sharp bends; cracks, security of line anchorage, wear due to loose clamps, and vibration or chafing. Inspect for tightness and condition of hose connections and hose clamps.

Inspect by-pass valves for leaks and proper operation.

Inspect the vent opening in the relief valve upper body or cover plug by inserting the appropriate sized drill or wire into the vent opening. Inspect for leaks, proper operation and security of mounting.

Remove and clean all fuel strainers. Inspect for breaks and tears. Flush out water and sediment by allowing fuel to flow through the strainers and drain plug drains. Clean the strainer bodies. Replace the strainers, plugs and drain valves and resafety.

50-Hour.

Inspect fuel selector controls for conditions that would cause binding or excessive backlash, general condition of universal joints, cock-stem yokes, yoke pins, and dial and handle assemblies. Check for interference with other parts. Permissible backlash is 15^{0} for short controls, with one universal joint, and 30^{0} for more complicated systems.

100-Hour.

Inspect fuel cocks equipped with friction release mechanism, for proper clearance as prescribed in paragraph 2. c. (2) of T. O. No. 03-10-13.

Fill the seal chamber of the engine driven fuel pump as prescribed in General above.

Engine Change.

Remove fuel pump for overhaul as prescribed in T. O. No. 03-1-4.

i. Column 24 - Oil System.

25-Hour.

Inspect oil lines for leaks, particularly at connections and at passage through firewall or other structure. Inspect for security of attachment, dents, cracks, chafing, etc. Inspect hose connections and hose clamps for general condition and for proper location of clamps.

50-Hour.

Inspect oil coolers for security of mounting, general condition and for evidence of clogging.

Check the operation of the oil dilution system. Disconnect the dilution line from the oil line and with the fuel pressure maintained by the electric fuel pump, operate the switches on the instrument board. When the switches are open, there should be no leakage through the solenoid valve.

Inspect oil tank for security of mounting, signs of leakage, particularly at seams, condition of padding and straps and proper anchorage of oil lines leading from the tank.

Engine Change.

Clean and inspect and repair tank and oil cooler as prescribed in T. O. Nos. 01-1E-26 and 03-15-4, respectively.

Drain oil system as prescribed in T. O. No. 06-10-1.

At each fourth Engine Change, or at the discretion of the local Engineering Officer at any intermediate Engine Change and at all Engine Changes made necessary by internal engine failure, the oil tank, if of a removable type, will be removed and cleaned. Cleaning and flushing will be accomplished with kerosene or steam. On the nonremovable type oil tanks, every effort will be made to remove all foreign matter and to clean the tanks as thoroughly as possible (T. O. No. 03-15-10).

CAUTION: When using kerosene in the cleaning operation, precautions against fire hazard contained in T. O. No. 01-1-1 will be observed at all times. In the event of an Engine Change resulting from an internal engine failure, the oil coolers will be replaced.

j. Column 25 - Cooling System.

25-Hour.

Make a thorough inspection of the radiator and header tank for leaks and security of attachment.

Inspect the radiator mounting, supports and mounting brackets for breaks and security of attachment and condition of the flexible vibration absorbing units.

Carefully inspect cowl flaps for bent or loose flaps and for proper operation (open wide and shut tightly)

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; and tightness; condition and location of clamps at air ducts seals.

50-Hour.

Drain and flush the coolant system. Prestone, or coolant, will be drained into containers, strained and returned to the engine. Refer to T. O. No. 24-25-1.

See that drain plug is properly resafetied.

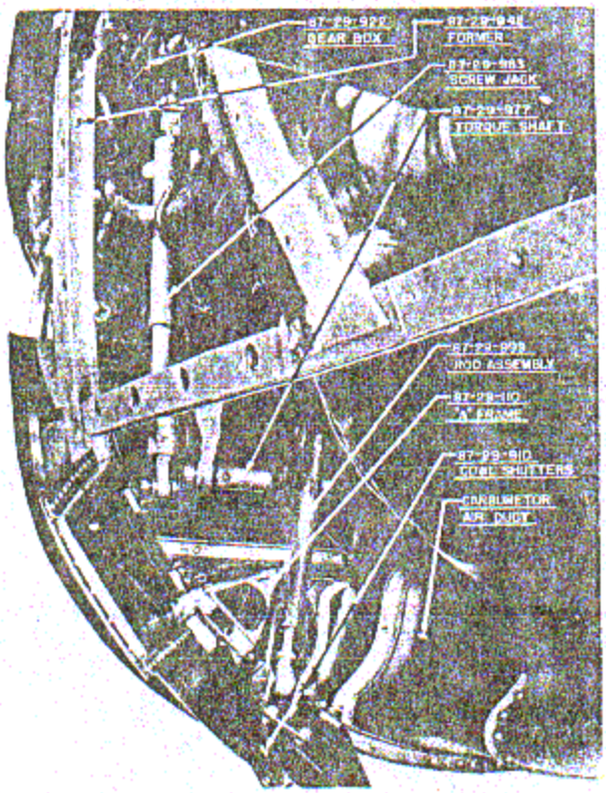


Fig. 9 - Coolant radiator & oil cooler cowl exit duct shutters.

k. Column 28 - Propellers & Accessories.

25-Hour.

As a limit has been set on the operating time of the propeller between overhauls, or "disassembly inspections", check to see whether or not the propeller is due for overhaul or disassembly.

Check spinners for security of attachment, dents and cracks.

50-Hour.

Remove brush holder assembly from the housing. Examine brushes to see if proper contact is being maintained. If the brushes protrude 3/8" or less from the brush holder, they should be replaced. Clean oil and carbon dust from brush holder, brush housing, brushes and slip rings with cleaning fluid and dry with compressed air. Cleaning fluid must not contain carbon tetrachloride. Check brush springs for smooth action.

NOTE: Provision is made for four sets of brushes (eight brushes). All of these brushes are used on propellers equipped and wired for feathering. Propellers not so equipped use only three sets (six brushes).

Where used, examine the seals in the brush holder to relay box conduit and replace if necessary.

Check for deterioration of markings on both the blades and hub. Propeller hubs having the identification marks stamped into the metal will be carefully examined for cracks around markings.

Check the relay for broken terminals, free action of arm, and smoothness of contact points, as prescribed in paragraph 1. a. (2). (a). 7. of Section VI of T. O. No. 03-20BA-2.

Check propeller hub and retaining nut for looseness on shaft. If repeated tightening of the hub retaining nut is necessary to maintain a proper tightness, the propeller will be removed and the cause ascertained. Check for condition of lubricant in power unit and hub, and refill if necessary as outlined in Section V of T. O. No. 03-20BA-2.

Check the magnetic brake and governor assembly as prescribed in paragraph 1. a. (2) of Section VI, T. O. No. 03-20BA-2.

Inspect governor drive shaft and drive shaft adapter for excessive wear.

Inspect governor, controls, electrical connections, etc., for security of mounting.

Engine Change.

At each Engine Change within the allowable propeller operating time given in T. O. No. 03-20-5, the propeller assembly, if visual inspection warrants, may be reinstalled without overhaul provided the total propeller time since last overhaul plus the maximum possible operating time for the replacement engine will not exceed the maximum time specified.

Special.

Inspect as prescribed in paragraph 1. a. (3) of Section VI of T. O. No. 03-20BA-2.

l. Column 29 - Power Plant - General.

General.

For complete inspection and maintenance instructions for the V-1650-1 type engine in this airplane, refer to T. O. No. 02-55AA-2.

25-Hour.

Check the engine cowl spinner bulkhead mounting bolts for tightness and condition of the flexible vibration absorbing units. Also check the armor plate forward of the coolant header tank for security of attachment and general condition.

50-Hour.

Check all clamps, bonding, taping and safetying of all lines, and all rods within the engine section.

Inspect the engine mount for cracks, particularly at welds, tightness of mounting clamps and bolts, and for condition of protective coating.

Inspect for condition of the rubber and the "Ferobestos" material between the engine feet and the engine mount.

Engine Change.

Inspect engine mount for deterioration of the rubber and the "Ferobestos" pads between the engine feet and the engine mount. Check engine hold down bolts using torque wrench. Torque values are given in paragraph 8. f. in Section IV of this Handbook.

When replacement pumps are available, all accessory pumps (except those with less than 100 hours since last overhaul) will be replaced. This includes electric motor driven pumps, fuel, hydraulic, vacuum, and similar power driven units (T. O. No. 03-1-4).

Special: Pre-Oiling of Engine.

The following procedure should be followed in pre-oiling the V-1650-1 (Packard Built Rolls Royce) engine, (Refer to paragraphs 4. a. (4) (a) and 4. a. (4) (e) of T. O. No. 02-1-1, relating to preparation of engines for service after treatment in storage):

Fill oil tank as follows:

Initial Installation: Prior to ground testing the engine, or engines, a sufficient quantity of oil will be placed in the oil tank to insure completion of the ground test. This quantity will be a minimum of 12 gallons. After the engine has been ground tested, the lubricating oil will be drained from the oil system and refilled with new oil. The drained oil is not suitable for further use in aircraft engines, since the corrosion preventive compound in the oil promotes rapid sludging with consequent sticking of piston rings.

At Oil Change: Service oil tank to proper level.

Disconnect the oil line at the pressure oil sump inlet port and drain approximately one gallon of oil.

Reinstall oil line to the inlet port of the oil pressure pump.

Remove all the spark plugs from the exhaust side of each bank of cylinders.

Place fuel valve control in "OFF" position.

Make certain ignition switch is in "OFF" position.

Remove 1/8" pipe plug for oil pressure gage connection from the pressure relief valve assembly on the right side of the engine and install a union fitting.

Connect an oil pump to the union and force two gallons of hot oil at 50° C. to 70° C. (122° F. to 154° F.) grade 1100, into the engine to fill the crankshaft and prime the bearings. The crankshaft should be rotated two or three revolutions, turning the propeller directly by hand or by use of the hand-turning gear, to insure that the oil is fed to the bearings.

Disconnect the oil pump and remove the union. Turn engine over by hand until sufficient oil is expelled through the 1/8" pressure gage fitting to indicate that no air remains in the oil inlet line or pump.

Reinstall 1/8" pipe plug.

Reservice the oil tank to proper level.

Reinstall spark plugs.

Make normal engine start.

m. Column 30 - Daily Inspections - Airplane.

General.

Determine whether airplane is due for Depot Inspection or reconditioning (T. O. No. 00-25-4).

Care must be exercised not to wash off rust protective coating from control cables.

Cockpits and Cabins.

Inspect for cleanliness, condition and functioning of mechanisms on sliding enclosure, emergency exits, including proper operation of latches and locking devices.

Visually inspect the installed safety belts and replace if there is any indication of defects or deterioration. Check the fabric and leather parts carefully for cuts or fraying. Check the latching device for free operation and bent or damaged parts.

Check all attaching parts and fittings for security of fastening.

Check the date the belt was last tested (refer to paragraph 8. a. of T. O. No. 03-1-2), and if over the required six months period for Type A-1, A-3, B-6, B-10 and commercial type safety belts, and 12 months period for Type B-11 safety belt, the belt will be removed and tested, or replaced by one tested within the specified time period.

Movable Surfaces.

Inspect for holes or other visible damage and for general condition.

Fixed Surfaces.

Inspect for general condition of covering and ribs as indicated by displacement of covering.

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

Inspect for proper operation and security of attachment of inspection doors.

Check the screws which attach the wing tips to the wing panels.

Fuel Tanks.

Each time fuel is serviced to a tank or compartment open the drains in order to remove any accumulation of foreign matter and water from the sump.

Resafety drains in the closed position.

Tail or Nose Gear.

Inspect tail wheel assembly for freedom from mud, grass, etc., worn or loose shoe, and condition of shock strut; i.e., whether tail is supported in the proper position.

Inspect the shock absorber strut for evidence of leakage of fluid or for loss of pressure (T. O. No. 03-25E-1).

Inspect for proper air pressure in the tail wheel tire (T. O. No. 04-10-1).

Inspect tail wheel doors for security of attachment, dents, bends or cracks. Inspect tail wheel boot for general condition.

Landing Gear.

Check condition of shock unit as indicated by bottoming or struts.

Inspect shock absorber struts for evidences of fluid leaks, or loss of pressure as evidenced by abnormal deflection.

Inspect fairing for cleanliness, security of attachment, dents, bends or cracks.

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

Inspect for general condition of struts, drag links, retracting mechanism, and fittings and braces.

Wheels and Brakes.

Inspect wheels for freedom from mud, grass, etc., distorted rim flanges and rims, security of retaining nuts, bolts, and cotter pins, and for security of lock ring on Type II wheels.

Hydraulic System.

Inspect hydraulic units for leakage and replace packing as soon as leakage develops.

Fuselage, Hull and Floats.

Inspect for loose objects, foreign or otherwise, likely to obstruct movement of controls and flight control surfaces.

Inspect for general condition, tears or cuts in metal covering, dents, evidence of leaks, broken structural members as evidenced by distortion of covering and abrasions to paint or protective coating. Abrasions should be retouched immediately to prevent corrosion.

Night Flying Equipment.

Inspect functioning and condition of cockpit lights (instrument fluorescent lighting system, etc.), lamp rheostats, running, and landing lights.

Airplane General.

Inspect vacuum pump for security of mounting and for proper safety wiring. Inspect lines for tightness of joints, security of anchorage and for general condition.

Check contents of aircraft data case against T. O. No. 00-1 to determine whether latest issues are on hand (T. O. No. 00-25-3). Check case for security of cover fastenings to avoid spilling of contents during maneuvers.

n. Column 31 - Cockpits & Cabins.

25-Hour.

Seat.

Inspect for security of attachment, including supports and brackets, condition and functioning of adjusting mechanism and breaks or cracks in the seat or back which might foul the parachute harness or clothing.

Inspect for condition of shock cord.

Safety Belt (T. O. No. 03-1-2).

Visually inspect the installed belt and replace if there is any indication of defects or deterioration. Check the fabric and leather parts carefully for cuts or fraying.

Check the latching device for free operation and for bent or damaged parts. Check all attaching parts and fittings for security of fastening.

Check the date the belt was last tested (refer to paragraph 8. a. of T. O. No. 03-1-2), and if over the time limit for the type of belt, the belt will be removed and tested, or replaced by one tested within the specified time period.

Inspect the chest type safety belt release mechanism.

Windshield, Cockpit Enclosure.

Inspect for condition of frame and security of attachment, breaks or cracks in glass or transparent sheet.

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

Lubrication.

Lubricate bearing surfaces and working parts of seat adjustment mechanism and the controls for emergency exit, emergency canopy release, heating system and ventilator, with oil, Spec. 2-27E.

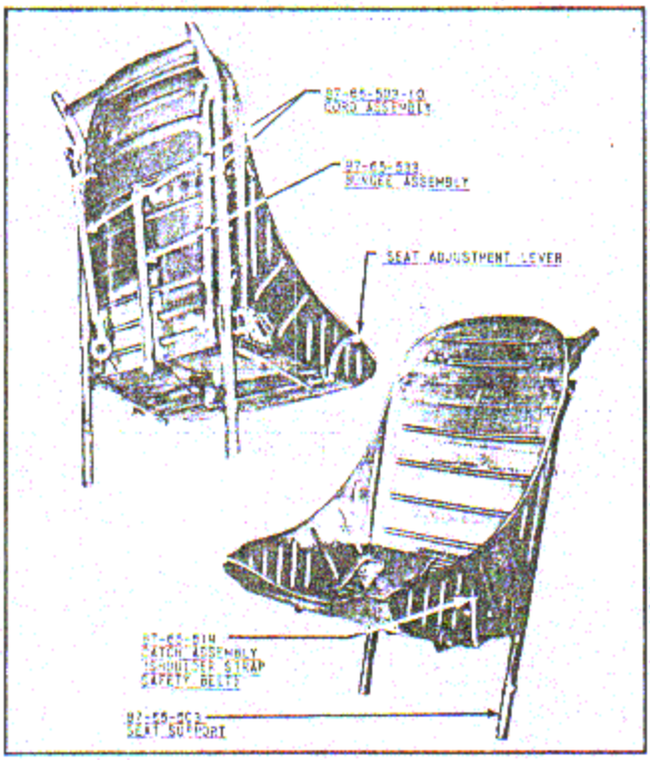


Fig. 10 - Pilot's seat.

50-Hour.

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

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

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

Special.

Check the condition of the rubber seals on the cockpit enclosure. It is recommended that M-6103 Anti-Adhesive Crayon (Manufactured by U. S. Rubber Company) is applied to the rubber seals of the cockpit enclosure after every 10 hours of flight. It is recommended that all rubber or neoprene seals used around other frequently opened doors, receive an application of the Anti-Adhesive Crayon after every 10 hours of flight. This treatment prevents the rubber or neoprene seals from sticking to the parts of the airplane in which they come in contact.

o. Column 32 - Flight Control Mechanism.

25-Hour.

Rudder Controls.

Inspect rudder pedal assemblies for proper condition and functioning of all parts, proper rudder travel, and proper functioning of the rudder pedal adjusting mechanism.

With rudder pedals laterally opposite each other (in neutral position), see that the rudder is in neutral.

Inspect for bent connecting link, proper safetying of all attachments and freedom of interference between rudder and elevators in 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 should be wiped clean.

Elevator and Aileron Controls.

Inspect the control stick assembly, including torque tube, push-pull tube and forward jack-shaft for proper condition and functioning of all parts, proper travel of control stick, elevators and ailerons, security of control stick in socket, bent tubes or shaft, and proper safetying of all attachments.

With control stick in neutral, see that the elevators are in neutral.

If lost motion exists, or if full movement of the control stick, elevators, or ailerons cannot be obtained without binding, rigidly inspect the entire system to locate and correct the trouble.

All accessible parts should be wiped clean.

Flight Control Linkage.

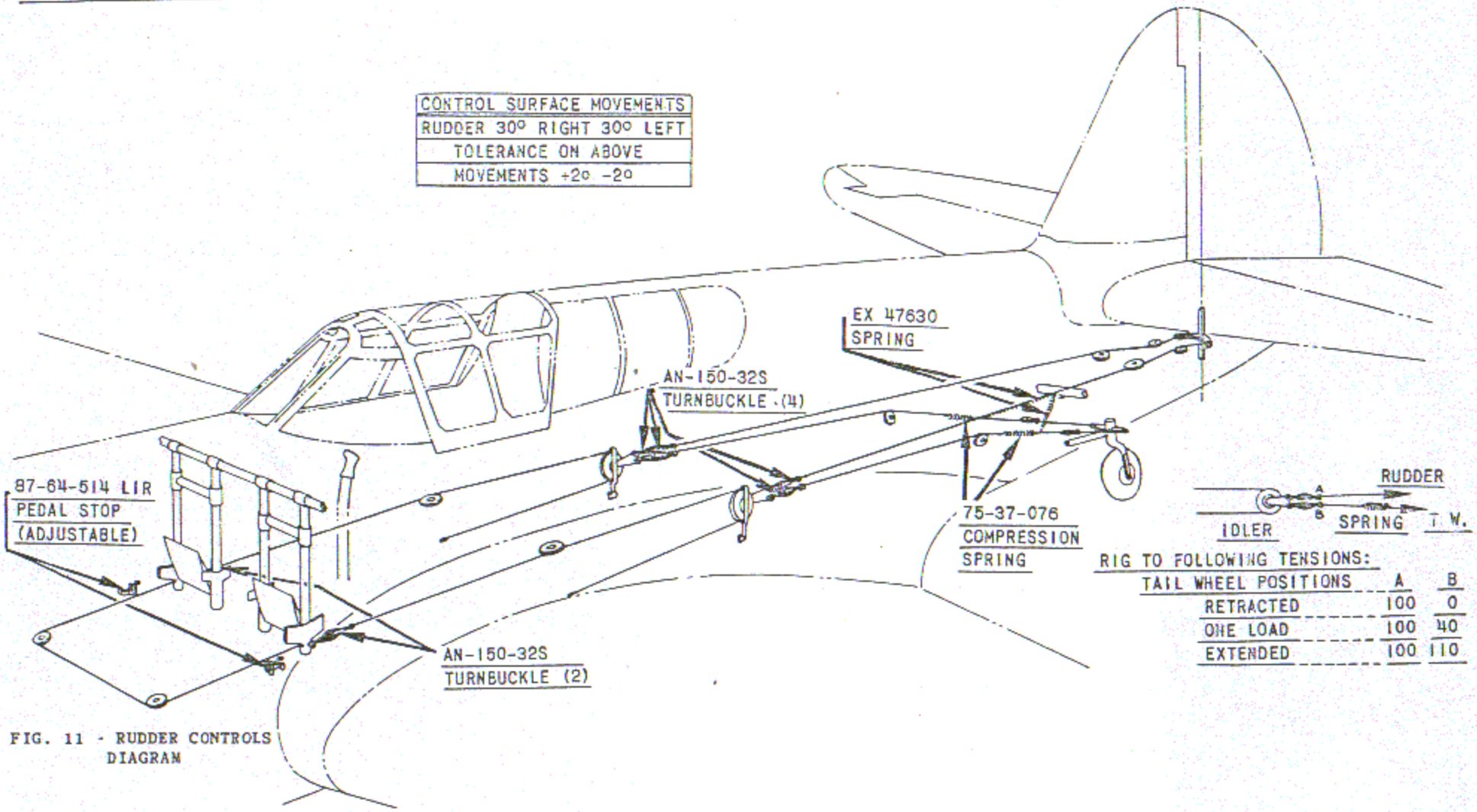
Inspect rudder, elevator, aileron, tail wheel cables, pulleys, drums, guides, fittings, elevator rear jack-shaft and link for proper safety of all turnbuckles and attachments, frayed cables, as prescribed in T. O. No. 01-1-26, bent jack-shaft or link, proper tension of cables, loose brackets and fittings, condition of fairleads, and broken or misaligned pulleys.

Inspect for 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 fuselage or wing covering provided therefore.

All accessible parts should be wiped clean.

REF. DWG. 87-64-501

CONTROL SURFACE MOVEMENTS
RUDDER 30° RIGHT 30° LEFT
TOLERANCE ON ABOVE
MOVEMENTS +2° -2°



RIG TO FOLLOWING TENSIONS:

TAIL WHEEL POSITIONS	A	B
RETRACTED	100	0
ONE LOAD	100	40
EXTENDED	100	110

FIG. 11 - RUDDER CONTROLS DIAGRAM

REF. DWG. 87-64-501

CONTROL SURFACE MOVEMENTS
AILERON 18-3/4" UP 10-3/4" DOWN
ELEVATOR 30° UP 20° DOWN
TOLERANCE ON ABOVE MOVEMENTS 1°

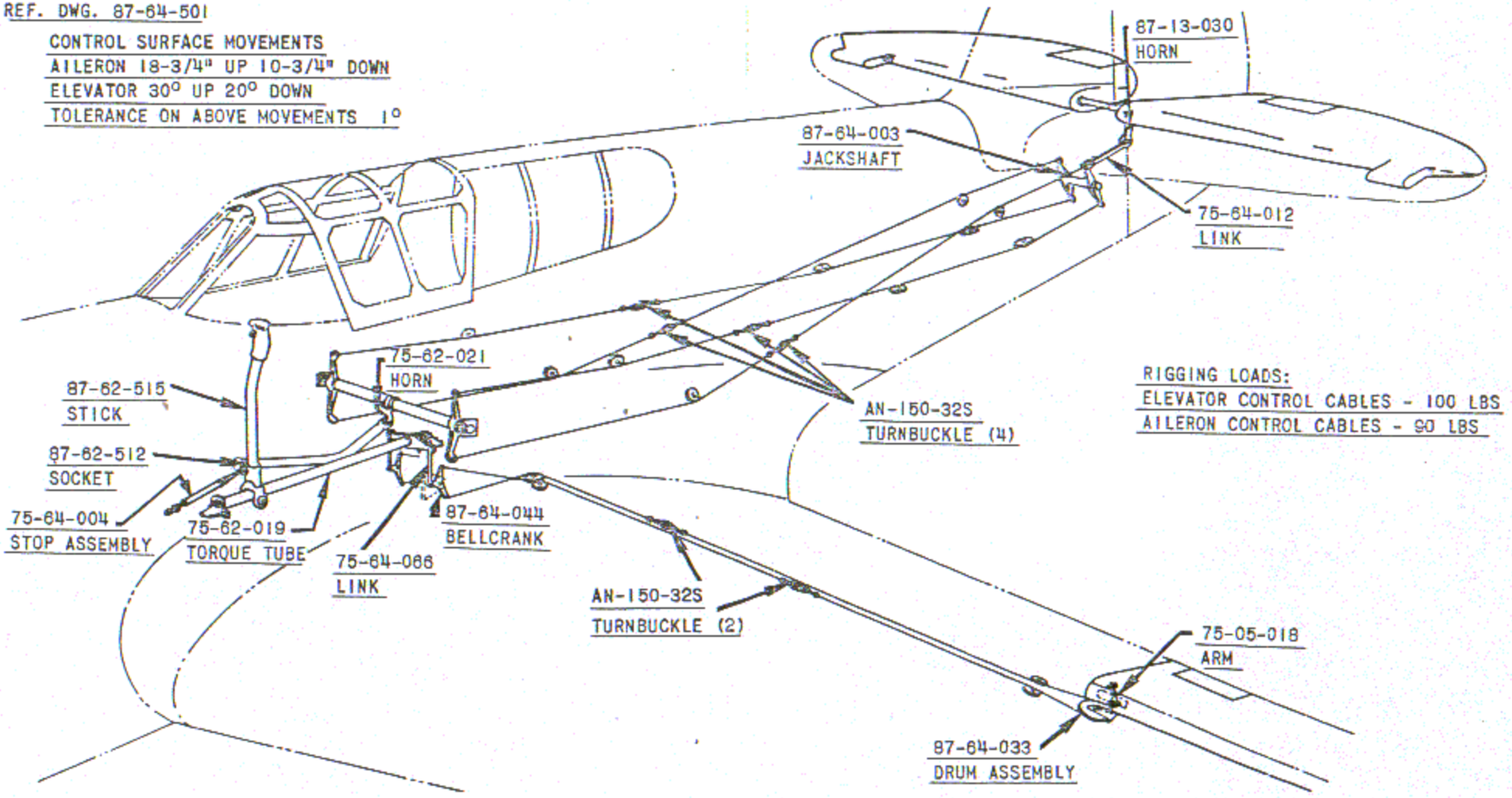


FIG. 12 - ELEVATOR AND AILERON CONTROL DIAGRAM

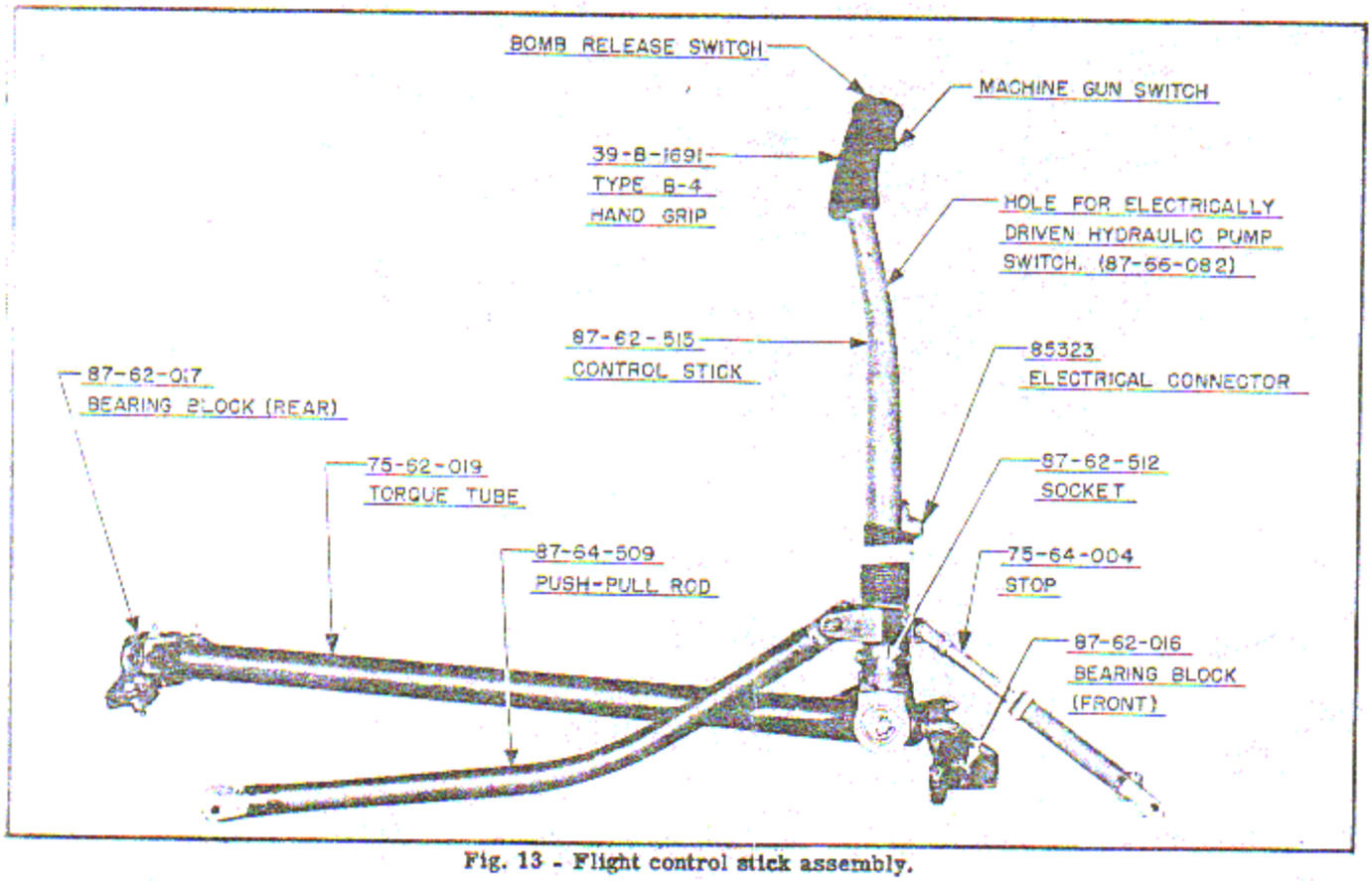


Fig. 13 - Flight control stick assembly.

Rudder & Elevator Tab Controls & Linkage.

Inspect for proper condition and functioning of all parts, proper travel of trim tab on each surface, and security of safety devices.

Inspect for proper tension of trim tab control cables, proper lubrication of gear boxes, chains, turnbuckles, rods and attachment parts, condition of chains and fairleads, bent rods, loose brackets and fittings, and signs of interference with other parts or assemblies, noting particularly that rods to horns are operating freely through the openings provided in the empennage coverings.

Inspect rudder trim tab actuating mechanism for worn parts in the actuator hinge (87-14-553), loose actuator hinge pins, worn threads and lost motion in the actuator screw and screw jack, worn threads on the tube rod ends, elongated rivet holes in the tube, and elongated pin hole in the clevis end and trim tab horn.

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

To co-ordinate the actuator units and the tabs, refer to instructions under "Adjustments" of this section.

All accessible parts should be wiped clean.

Aileron Tab and Control.

Inspect the electric trim tab control (for 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 defective switch.

Refer to Column 22 of this Section for the servicing of the electric trim tab control motor.

Wing Flap Control Mechanism.

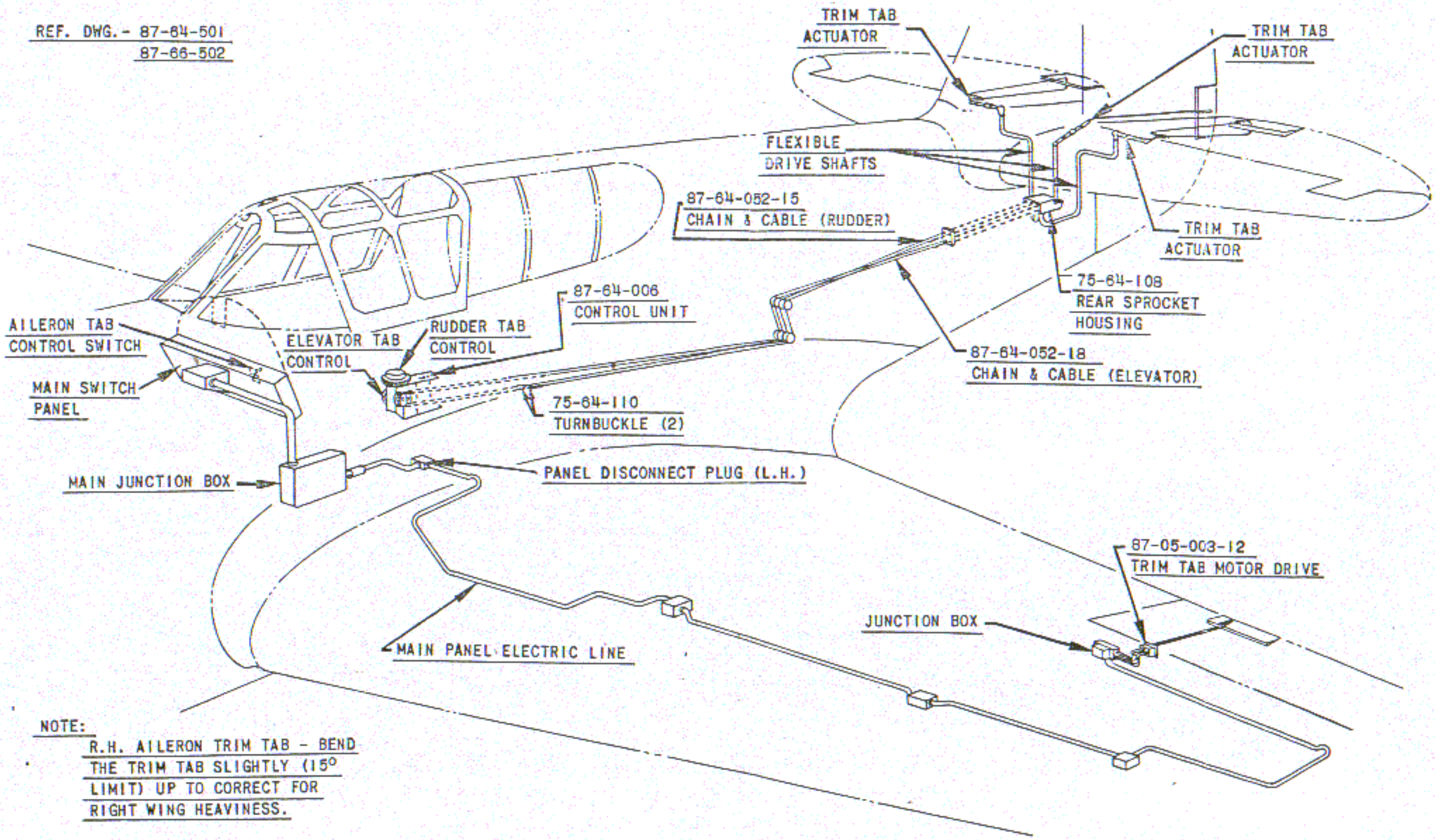
For instructions concerning the hydraulically actuated cylinder and hydraulic lines, refer to Column 39.

Inspect for proper condition of all parts, bent rods, loose brackets and fittings, proper safetying of all rods, joints, connections, turnbuckles and attachment parts.

Test the functioning of the mechanism by operating the electrically driven hydraulic pump and then test the mechanism by use of the manually operated auxiliary hydraulic pump.

See that the pointer in the wheel and flap position indicator in the cockpit indicates correctly the position of the flaps.

REF. DWG.- 87-64-501
87-66-502



NOTE:
R.H. AILERON TRIM TAB - BEND THE TRIM TAB SLIGHTLY (15° LIMIT) UP TO CORRECT FOR RIGHT WING HEAVINESS.

FIG. 14 - TRIM TAB CONTROLS DIAGRAM

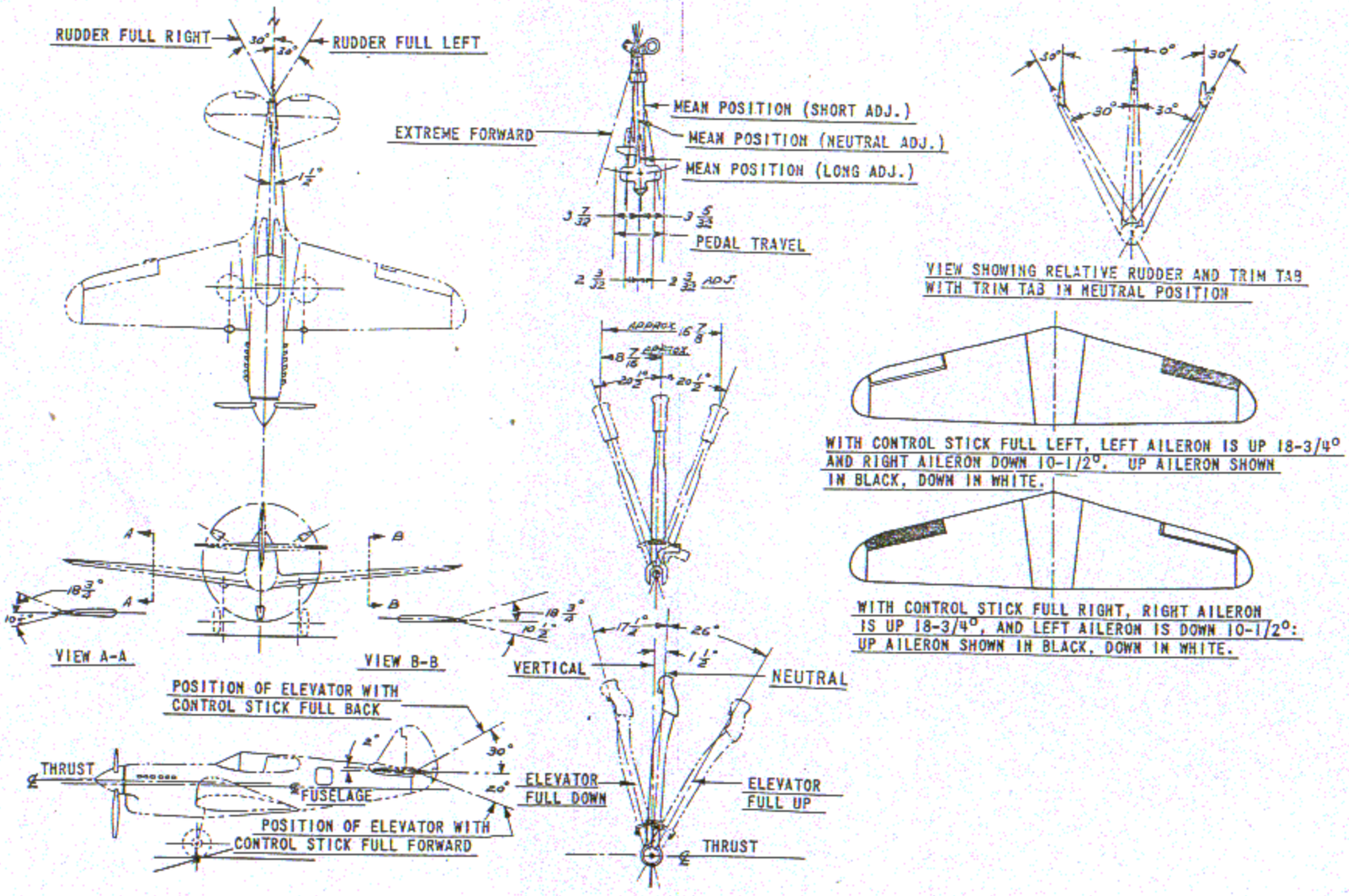


FIG. 15 - ANGLES OF ADJUSTMENT OF FLIGHT CONTROLS

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

Inspect for signs of interference with other parts or assemblies.

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

All accessible parts should 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 Figures 11 and 14.

Adjustments.

Rudder Control System: To align the rudder control system, place the right pedal in the extreme forward position as indicated by the rudder pedal stop and adjust the turnbuckle so that the arm holding the reduction pulley, when in the extreme forward position clears bulkhead #8 approximately 1/8 of an inch. Repeat for the left pedal. Place the rudder pedals laterally opposite each other (in neutral) and through the fuselage access door in the left side of the fuselage adjust the cables to the rudder to align the rudder with the center line of the airplane and adjust the cables to the tail wheel to align the tail wheel with the centerline of the airplane. Always maintain correct cable tension loads in all control cables. Refer to Figure 11 for correct cable tension data.

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

Elevator Control System: To align the elevator control system, the control stick should be placed in the position where the lower (straight) portion of the stick is $1\text{-}1/2^{\circ}$ aft of a line perpendicular to the ground line; the control cables are adjusted to align the elevators with the horizontal stabilizer and to obtain correct tension loads in the cables.

Control Stick Stop (Aileron Travel): The heads of the stop bolts should be adjusted to limit the lateral motion of the control stick to $20\text{-}1/2^{\circ}$ to either side of the vertical centerline. The bolts are located in the horn on the rear end of the control stick torque shaft aft of the bulkhead at Station #5, and accessible by removing the pilot's seat, and the armor plate attached to bulkhead #5.

Aileron Control System: The cables and links of the aileron control system are rigged to permit the ailerons to droop 3/16" to 1/2" 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 only one side, shorten one cable and lengthen the other by means of the turnbuckles which are accessible when the wing flaps are extended. To correct for one aileron up and the other down, adjust as closely as possible at links, then complete adjustment at the turnbuckles.

The normal aileron movement is $18\text{-}3/4^{\circ}$ up and $10\text{-}3/4^{\circ}$ down, with a $\pm 2^{\circ}$ tolerance. This movement can be obtained by adjusting the link and cables on one side at a time.

Trim Tab Adjustment.

Elevator Trim Tabs: The range of travel of the elevator trim tabs is from 3° above, to 26° below a centerline through the trim tab hinge axis with a $\pm 2^{\circ}$ tolerance. The elevator trim tab control knob in the cockpit must be set to zero with the elevator tabs in 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 for correcting a tail heavy condition.

To Remove Elevator Trim Tab: Disconnect control rods from the trim tab horn, rotate the tab up as far as possible from 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 outboard and downward until the hinge rod on the inboard end of the trim tab is free.

Rudder Trim Tab: The range of rudder trim tab travel is 15° ($+5^{\circ}$, -2°) from either side of the rudder centerline. The rudder trim tab control knob in the cockpit must be set to zero when the tab is aligned with the rudder. The rudder tab control chains should be relocated around the sprocket, underneath the control knob to give maximum left and right travel of the tab. Final adjustment is made by adjusting the turnbuckles in the system. The rudder trim tab must move to the left when the control wheel is rotated in a clockwise direction.

To Remove Rudder Trim Tab: Disconnect the control rods from the trim tab horn, rotate the tab as far as possible from either side of neutral and remove the two cap screws from the blocks on both ends of the front face of the tab spar.

Aileron Trim Tab: The range of travel of the trim tab on the left aileron is 20° above to 20° below the horizontal centerline through the aileron trim tab hinge axis. 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".

Removal of Aileron Trim Tab: To remove the trim tab from the left-hand aileron, disconnect the control rod from the trim tab horn and rotate the tab as far as possible from the neutral position. Remove the two cap screws from the blocks on both ends of the front face of the tab spar. Tab is then free and may be removed from the aileron.

Coordination: If it is necessary to co-ordinate the actuator units and the tabs, the actuators are to be adjusted in accordance with the following instructions and the rods from the bellcrank, 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 bellcrank making sure that the connecting pin fits tightly in the holes. If a correction for the neutral setting is required after connection to the bellcrank, is made, this must be made by disconnecting the eye terminal from the bellcrank and rotating the terminal to the new setting. Care must be taken to make sure that the neutral setting is such that the travel is within the 1-3/4" 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 bellcrank and the push-pull tube should be shortened. If the flaps do not seat locally, shorten the turnbuckles near these points. The flaps should move downward simultaneously to a maximum opening of 45°.

Lubrication:

Lubricate controls in accordance with Figure 8.

50-Hour.

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

100-Hour.

Check flight control cables for rigging tension. Refer to Adjustment, 25-Hour, above for rigging data and also Figures 11, 14 and 15.

p. Column 33 - Movable Surfaces.

25-Hour.

Rudder, Elevators, ailerons, tabs and flaps.

Inspect for free and full movement, warping, broken ribs or ribs loose on spars, and condition of covering. Check for loose rivets and tears around rivets.

Inspect horns and hinges for bends and breaks, security of attachment, worn or loose hinge pins, and proper safetying.

Lubricate wing flap hinges with oil, Spec. 2-27E, and wipe clean.

Adjustment of flap position indicator mechanism is contained in Section IV of this Handbook.

q. Column 34 - Fixed Surfaces.

50-Hour.

Wings.

Inspect for torn or loose coverings, loose rivets, or rivets pulling through metal covering, and broken ribs.

Inspect wing joint at centerline of airplane and wing-to-fuselage fitting for security of attachment, cracks, and elongated holes.

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

Horizontal and Vertical Stabilizers.

Inspect for torn or loose metal coverings, loose rivets or rivets pulled through the covering, and broken ribs, as indicated by distortion of metal.

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

r. Column 35 - Fuel Tanks.

50-Hour.

Inspect for security of mounting, signs of leakage, particularly at seams, condition of padding and proper location of padding between tank shells and straps and mounts, proper tension of support straps, and proper anchorage of fuel lines leading from the tanks.

Check general condition of gaskets at access doors, filler flanges, fuel gage tapping rings, tank drain flanges and sump castings, fuel line support tube backing plate, vent line fittings, drain line fittings and sump fairing attaching brackets.

100-Hour.

Drain the fuel tanks and remove the sumps. Clean the interior of the fuel compartments, noting particularly that the small holes in the strainers are unobstructed.

WARNING: Before repairs are made, thoroughly dry the interior of the fuel tank by directing a blast of air into the interior of the tank for several hours, preferably overnight. This will evaporate the highly inflamable fumes. Examine tank structure and fittings for corrosion and damage. Replace sumps and access covers, using new gaskets and sealing compound. Before filling, test the tanks.

300-Hour.

Drain the fuel compartments and remove all access covers and sumps for a thorough inspection.

WARNING: Allow fumes to dissipate from fuel tanks for at least ten minutes after removing access doors before beginning inspection. If repairs are to be made, dry interior by directing a blast of air into the interior of the tank for several hours, preferably overnight. This will evaporate the highly inflamable fumes.

Examine compartment structure and fittings for corrosion and damage. Replace sumps and access covers, using new gaskets and sealing compound. Before filling, test compartment.

s. Column 36 - Tail or Nose Gear.

General.

For inspection of tail wheel hydraulic retracting system, refer to Column 39, this Section. For instructions covering operation and maintenance of the High Pressure Hand Pump, refer to T. O. No. 17-1-3.

25-Hour.

Inspect entire assembly for cracks, bends, breaks, particularly at sharp angles and welds, and cracked, bent or broken attachment fittings and brace members.

Inspect for proper operation of the swivel release mechanism.

Inspect shock-strut assembly for general condition.

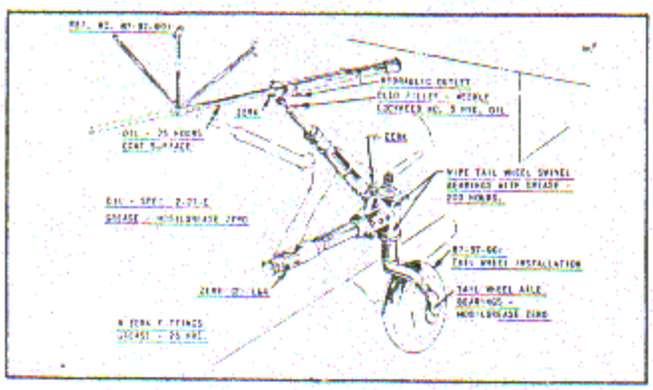


Fig. 16 - Lubrication diagram - tail gear.

Check for proper operation of the tail gear latch and centering lock.

Lubricate tail wheel door hinges and linkage with oil, Spec. 2-27-E.

50-Hour.

At the time of landing gear inspection, with the airplane supported free from the ground, test the functioning of the retracting and lowering mechanism by operating independently with both the motor-driven pump and the hand pump.

Check the fluid level of the shock strut by backing off the filler plug slightly and allowing the air to excape slowly past the copper gasket at the plug seat. This will prevent damage to the valve core caused by the sudden rush of high pressure air past its seat. Do not attempt to remove the filler plug without first completely deflating the strut in this manner.

Back off the filler plug slightly, until all "fizzing" of air and fluid ceases. In some struts the air valve also serves as a filler plug.

Remove the filler plug and check the fluid level, which should be flush with the filler plug hole when the strut is fully collapsed and the airplane is in normal taxiing position.

Fill the strut, if necessary, with fluid, Spec. 3586, as prescribed in paragraph 3 of T. O. No. 03-25E-1. Check by extending and collapsing the strut several times.

Inspect tail wheel doors for proper operation. See that the position indicator in the cockpit indicates position of tail gear correctly.

For adjustment of tail wheel position indicator mechanism, refer to Section IV, paragraph 8. d.

For lubrication of tail gear, refer to Figure 16.

200-Hour.

Tail wheel roller bearings will be cleaned, inspected for condition and repacked. (T. O. No. 03-25A-1).

t. Column 37 - Landing Gear.

General.

For inspection of landing gear hydraulic retracting system, refer to Column 39 of this Section.

For instructions covering the operation and maintenance of high pressure hand pump, refer to T. O. No. 17-1-3. The proper amount of inflation of shock strut can be obtained from the instruction plates on the struts.

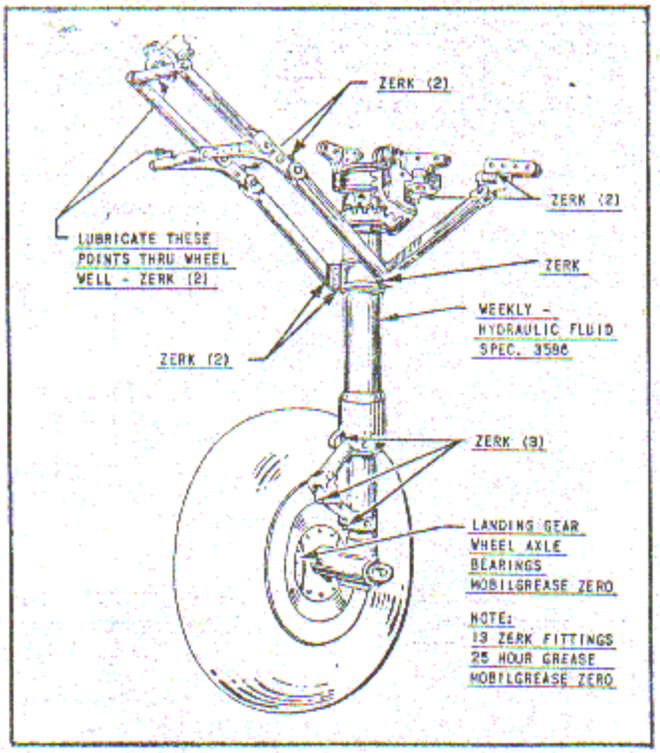


Fig. 17 - Lubrication diagram - landing gear.

25-Hour.

Inspect struts, braces, drag links, retracting mechanism and fittings for cracks, bends, security and condition of attachment fittings, elongated bolt holes, and loose, missing or unsafetied bolts, nuts and cotter pins.

Lubricate in accordance with Figure 17.

50-Hour.

With the airplane supported free of the ground, test the functioning of the retracting and lowering mechanism by operating the gear independently with both the motor-driven pump and the auxiliary hand pump.

Thoroughly inspect all attachment fittings, bolts, bellcranks, arms, links, and supports for condition.

Check the functioning and general condition of the landing gear warning system. With the landing gear in the locked "Down" position, move the landing gear control valve handle to the "Up" position. With the lever of the ignition switch in "BAT" position and the throttle lever in the closed position, the warning horn should not sound until pressure is applied to the system.

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

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

Adjustment.

Landing Gear Warning System: To adjust the lever on the throttle rod in the cockpit, loosen the bolt which fastens the lever to the throttle rod. Slide the lever forward or aft as necessary in order to actuate the warning signal switch with throttle lever set to approximately 1000 R.P.M. or less.

Landing Gear Position Indicator: Refer to Figures 18, 36, and 45. To adjust the landing gear position indicator, hoist the airplane so that the landing gear can be raised and lowered.

With the landing gear down and the lever of the ignition switch in the "BAT" position, loosen nut A and with a screwdriver turn the transmitter shaft B until the image of the wheel on the indicator on the instrument panel is in the down position. Tighten nut A.

Retract the landing gear and check the position of the image. If the image has undertraveled or overtraveled, correction may be made by tightening or loosening nut D slightly. Repeat this procedure until setting is correct.

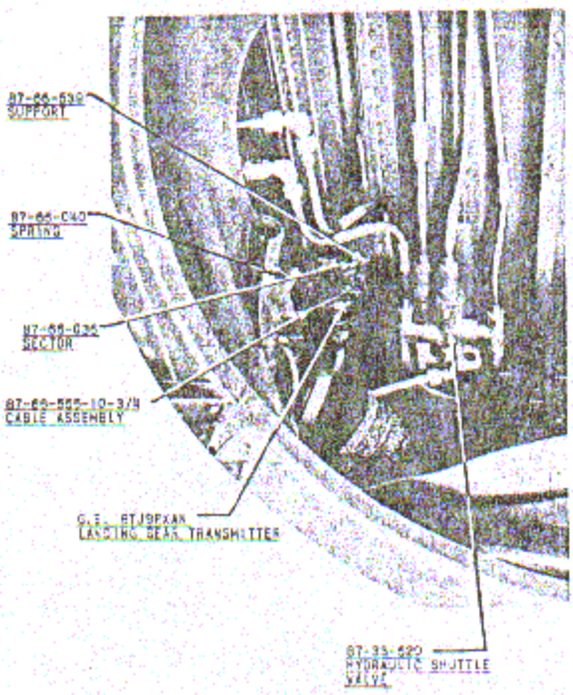


Fig. 18 - Landing gear position transmitter - installed.

Lubrication.

Lubricate in accordance with Figure 17. To assure a full quantity of oil in the shock struts, fill the struts in accordance with the following instructions. Use only Lockheed fluid #5, A.C. Spec. 3586, when filling the struts.

Method A (To be used when airplane is suspended and landing gear is free): With the strut fully compressed, release the air, remove the filler plug and fill until the oil overflows. Install the filler plug and fully extend the strut several times. Compress the strut, remove the plug and put in more oil. Fill until overflowing, reinstall plug and incorporate required air pressure.

Method B (To be used when airplane is resting on the landing gear): With the strut fully compressed, remove the filler plug and fill until oil overflows. Install plug and apply air pressure. Bleed air, then remove plug and incorporate additional oil until the oil overflows. This will assure that as much oil as possible has been added. Reinstall plug and supply proper air pressure until strut is extended two inches.

u. Column 38 - Wheels and Brakes.

25-Hour.

Make wheel bearing inspection only in event that brake inspection indicates proper brake adjustment cannot be made.

Visually inspect the hydraulic brakes for seepage of fluid. Inspect fairings for interference between the backing plate and wheels (T. O. No. 03-25B-2).

With the parking brake applied, inspect the entire brake system from reservoir to wheel cylinder for leaks, condition of attaching clips and flexible connections.

Check the fluid level in the brake master cylinder unit on each rudder pedal with brakes released. Refer to Figures 42 and 43 for more information.

50-Hour.

Wheels.

Inspect for evidence of corrosion of the visible portion of rim. Clean and paint as prescribed in paragraph 5 of T. O. No. 04-10-2. If evidence of damage to wheel rim edges is found, remove casing and inspect.

Inspect for evidence of damage to wheel rim edges due to hard landings. Remove casing. Clean rim, if corroded. Examine rim for cracks or damage due to careless use of tire mounting tools or impact from any object. Renew protective coating of paint if worn through.

Inspect valve stem washers for snug fit on tires with metal valves, (T. O. No. 03-25B-1).

Tires.

Inspect inside of carcass of casing for ruptures or breaks. Inspect beads for physical damage extending through the outside rubberized chafer fabric. Inspect sidewalls, both inside and out for breaks, cuts, blisters, loose cords or other serious physical damage.

Inspect tread for cuts through or exposing the fabric carcass to moisture or dirt, and inspect for tread wear exposing the fabric carcass of the casing (T. O. No. 04-10-2).

Brakes.

Check and adjust the clearance between the brake lining and the brake drum, with a feeler gage.

Brake Shoe Adjustment: With wheels of the airplane free of the ground, and no pressure on the brake system, 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" measured through the feeler gage slot. The three remaining adjustment screws adjacent to the slots will be tightened until there is .008" 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". 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 wheels are removed at the time of the brake adjustment, extreme care should be taken to see that the brakes are not applied. Application of the brakes at this time causes distortion of the one-piece shoe rendering it unfit for further service.

Adjust the brake control system.

100-Hour.

Wheels.

Remove the wheels, clean and inspect the wheel bearings in accordance with T. O. No. 29-1-3. Check for cracked or loose bearing cups. Check for scored or cracked brake drum liners. For heat checks, refer to Section V, paragraph 1, of T. O. No. 03-25B-1. Inspect the felt grease retainer for the inboard bearing. If grease soaked, replace with a new retainer.

Lubricate roller bearings as follows:

Summer Use: Grease, lubricate, aluminum soap, grade B, Spec. 3581.

Winter Use: Grease, lubricate, high melting point, grade 375 (soft) or grade 295 (soft, medium), Spec. 3560.

Bearing Adjustment.

Install wheel and wheel bearing adjusting nut on axle.

Be sure there is no brake drag. Then with the wheel spinning, tighten the adjusting nut slowly until a bearing drag on the spinning wheel is noticed. Back off the nut to the next castellation and lock in position with a cotter pin. Brake drag should not be confused with bearing tightness while rotating the wheel during bearing adjustment. Check for side play. Bearings will not be adjusted too tightly as cracked bearing cups may result.

Brakes (T. O. No. 03-25B-2).

With wheel removed, inspect the entire brake assembly for corrosion and broken or distorted parts. Inspect mechanical and hydraulic brakes for cracked or worn linings, and for loose rivets. Inspect to see that grease from the inboard wheel bearings or fluid from the brake cylinder has not come in contact with the lining.

Inspect expander tube brake for broken lining springs and worn lining. Inspect for uneven wear of lining. Inspect for security of nuts, bolts, and cotter pins.

v. Column 39 - Hydraulic System.

General.

Filling and Bleeding the System.

Support the airplane on jacks or cradles so that the landing gear and wing flaps may be operated.

Fill system through the reserve tank in the fuselage with fluid, Spec. 3586, grade B. Fill tank to base of cap opening, with landing gear down and wing flaps up. During the filling operation, retract and extend the landing gear twice by use of the manually operated hydraulic pump and operate the wing flaps several times, always taking care that the fluid reserve tank is kept full.

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

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 cylinder and bleed the system from that point.

Do not replace filler cap until filling operation is completed.

25-Hour.

Check fluid level in fluid reserve tank. Fill tank with fluid, Spec. 3586, grade B. Do not use mineral oil. Clean strainer in top of reserve tank.

Inspect condition and functioning of valves and actuating cylinders.

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

Lubricate tail wheel retracting cylinder guide in accordance with Figure 17.

50-Hour.

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

Test hydraulic lines relief valves as follows:

Install a test gage on the forward side of the manually operated auxiliary hydraulic pump. Tighten down the (auxiliary) hydraulic pump relief valve located in the lower left side of the fuselage forward of the baggage compartment. Pump up the system with the auxiliary hydraulic pump and set the (auxiliary) hydraulic pump relief valve to relieve at approximately 2000 p.s.i.

Place the landing gear control valve in neutral and the wing flap control valve in the "UP" position. Test the wing flap relief valve to relieve at approximately 1500 p.s.i.

Repeat this procedure with the landing gear control valve in the "NEUTRAL" position and the wing flap control valve in the "DOWN" position.

Repeat this procedure again with the wing 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 approximately 1500 p.s.i.

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

Motor Driven Hydraulic Pump -
T. O. No. 03-30CA-2.

Clean and tighten all loose connections.

If air enters the inlet line as evidenced by erratic and noisy operation, the system should be checked in the following manner: With the pump operating, check each fitting joint and relief valve cap by flowing oil around it. When point of leakage is reached, pressure and output will immediately smooth out. Rework fitting or point so that it is airtight.

Engine Change.

Remove hydraulic pump for overhaul as specified in T. O. No. 03-1-4.

w. Column 40 - Fuselage, Hull & Floats.

50-Hour.

Inspect all accessible parts of exterior and interior of 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, and condition of metal covering and protective coating, particularly where operated in or near salt water.

x. Column 43 - Airplane General.

General.

For anti-corrosion treatment of airplanes operating near salt water, refer to T. O. No. 01-1-2.

100-Hour.

Vacuum Pump, Engine-Driven
(T. O. No. 03-30AA-1).

Check pump for security of mounting. Examine relief valve screen, and if dirty, remove the valve and loosen the screen assembly with a wrench. Clean screen in gasoline and replace.

Safety Valve: Remove the valve guide and wash in a suitable cleaning fluid. If the valve disc is worn, dress it carefully with a flat oilstone. Test the spring tension by measuring the force required to compress it to 1-1/8" long. The force must be at least 3.7 lb.

Clean the oil separator (if removable screen) by removing oil outlet fitting, removing screen, and cleaning in a suitable cleaning solution. If without removable screen, remove the entire separator, thoroughly clean and dry with compressed air and reinstall. For solvent, refer to T. O. No. 01-1-1.

If the pump is intended for internal venting, remove the special hex-head plug marked PRES located near the mounting flange and clean the air passages in the plug.

Engine Change.

Remove engine driven vacuum pump for overhaul as prescribed in T. O. No. 03-1-4.

Special.

Inspect the "Ferobestos" and the rubber pads between the engine mounting feet and the engine mount for excessive disintegration from gasoline or oil. Replace pads where necessary.

y. Column 44 - Navigation Instruments.

Daily.

Compass (T. O. No. 05-15-2).

Check for broken or loose cover glass and other visible defects.

Clean cover glass with a clean cloth. Special care must be exercised where individually lighted instruments are employed as scratches, fingerprints, etc., on the cover glass disturb the lighting.

Inspect visually for discoloration of liquid, evidence of bubbles, and for defective lamp.

Suction Gage (T. O. No. 05-20-6).

Inspect for security of mounting, broken or loose cover glass, loose dial and loose pointer.

Altimeter (T. O. No. 05-30-1).

Refer to T. O. No. 05-1-1.

50-Hour.

Check marking of navigation instruments as prescribed in T. O. No. 05-1-17.

Inspect all instruments (including clock) for chipped luminous markings, security of mounting and for tightness of connections (including electrical connections where used).

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

Check the installation of the rate of climb indicator for loose attachment of indicator and tank, and tubing connections in static line from the indicator to the tank for tightness (T. O. No. 05-20-26).

Inspect airspeed lines for security of mounting, and for tightness of connections. Drain the airspeed lines. Check the airspeed head for security of mounting and for general condition. Clean the holes in airspeed head with soft copper wire. Check the electrical heating element. The voltage at the terminals of the airspeed tube should not be less than the amount prescribed in T. O. No. 05-50-1.

Remove the bank and turn indicator. Remove plug under word "Oil" on the right side of the case. With a fine wire (.015") to guide the oil, lubricate with 8 drops of oil, gyro instrument, Spec. 3563 if above freezing. If below freezing, use 8 drops of a mixture of 1/3 compass liquid, Spec. 2-57 and 2/3 oil, gyro instrument, Spec. 3563. Remove drain plug at bottom of instrument near the front and drain accumulation of oil and water. Clean the screen. Reinstall instrument and test suction which should be 1.80" to 2.05" (T. O. No. 05-20-2).

Check instrument panels for defective vibration absorbing units and support brackets.

Check position indicator for electrical connections and transmitter actuating linkage (T. O. No. 05-55A-2).

The compass will be inspected for security of mounting, leakage of liquid, unbalanced card, or any defect which impairs the visibility or might render the compass inoperative.

For information on the altimeter, refer to T. O. No. 05-1-1.

100-Hour.

Compass will be compensated and the reading recorded at the end of each period of 100 flying hours and at Engine Change period, change of guns or electrical equipment likely to affect the compass, or at least once during each three month period. However, if at any time the compass is suspected of being in error, it should be checked and compensated if found necessary. For complete instructions on the compensation of aircraft compasses, refer to Section V of T. O. No. 05-15-2.

Check installation of airspeed indicator for loose glass, pointer, dial and pitot and static connections. If the check of the airspeed tube installation (required in Section VII of T. O. No. 05-50-1) for leaks, discloses a leak in the indicator, test the instrument separately in accordance with the individual type leak test in Section IX of T. O. No. 05-10-2.

500-Hour.

The frequency of cleaning intake screens and air filters of flight indicators will depend upon service conditions; however, this maintenance should be accomplished approximately every 500 hours or at "Depot Inspection" of the airplane. When found necessary, as determined through experience at the various stations, this work will be accomplished at more frequent intervals. To clean the intake screen at the rear of the flight indicator case, remove the screen guard and lift out the screen with a scribe. Clean the screen with benzine, dry, and replace.

CAUTION: In replacing cover plate be sure to replace all five screws. Failure to do this causes air to leak into the instrument through the screen holes, with a subsequent loss of vacuum. (T. O. No. 05-20-3).

The frequency of cleaning intake screens and air filters of turn indicators will depend upon service conditions; however, maintenance should be accomplished approximately every 500 hours or at "Depot Inspection" of the airplane. When found necessary as determined through experience at the various stations, this work will be accomplished at more frequent intervals. To clean the intake screen on the bottom of the case, lift out the snap ring and screen with a scribe. DO NOT REMOVE ANY SCREWS. Clean the screen with benzine, dry and replace (T. O. No. 05-20-4).

Engine Change.

Remove fuel gages for inspection at the first evidence of malfunctioning and at the 300-Hour period when the fuel tanks are removed for cleaning, inspection and repair.

Inspect the gage mechanism for security of connections and ease of operation, corrosion and worn parts, and general condition of floats.

When reinstalling the gages, dry and calibrate them. Use a new gasket and seal the gasket with "Sealtube" or equivalent. Handle with care after they are calibrated as dropping the gage floats will distort the float connecting rods.

For information on compensating compass, refer to Section V of T. O. No. 05-15-2.

z. Column 46 - Battery.

50-Hour.

Remove cover and if felt pads are covered with a white flaky deposit, remove them, wash in clean water and saturate with bicarbonate of soda solution before replacing.

Weekly - Once Each Seven Days.

Test battery with a hydrometer and enter the reading of the lowest cell. This entry, on days when the battery is tested, supplants the usual code symbol entries. Any defect found will be entered on A.A.F. Form 41, under "Remarks" (T. O. No. 01-1B-1).

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 1.3.

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

After taking the reading, return the electrolyte to the cell from which drawn. Check for proper levels of the electrolyte and add distilled water to the cells if necessary. Never add electrolyte or acid.

Inspect the battery leads for condition of insulation and for security of attachment.

Inspect terminals for security of connections and for corrosion. If dirty or showing signs of corrosion, disconnect, scrape clean and reconnect, and then smear vaseline lightly over the metal surfaces (except terminals of shielded batteries not exposed to battery gases).

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

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

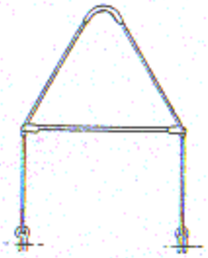
When it is known in advance that an airplane is to be idle for seven days or more, the battery will be immediately removed and turned in to the battery room.

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

3. Additional Inspection and Line Maintenance Instructions Issued by the Air Corps:

(To Be Issued When Available)

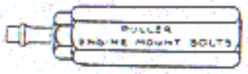
REFERENCE DRAWINGS NOTED



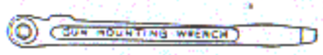
87-88-020
FRONT HOISTING SLING

87-64-570
PARKING HARNESS

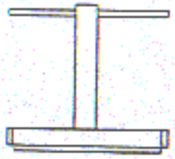
87-88-594 LOCATING TOOL
FILLER OPENING-WING FUEL CELLS



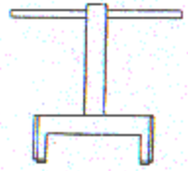
87-88-587
PULLER ASSEMBLY-ENGINE MOUNT BOLTS



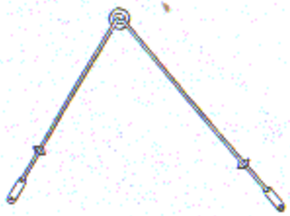
87-69-737
GUN MOUNTING RATCHET WRENCH



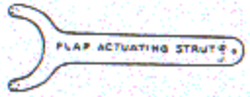
87-88-596
WRENCH-FILLER CAP-WING FUEL CELLS



87-88-597
WRENCH-GAGE MOUNT-WING FUEL CELLS

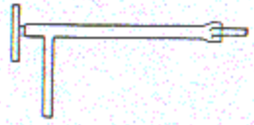


87-88-509
WING HOIST SLING

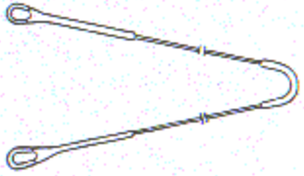


87-88-030
WRENCH-ACTUATING STRUT-FLAP & L G

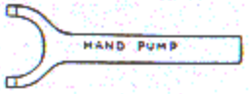
87-88-595
LOCATING TOOL-GAGE OPENING-WING FUEL CELLS



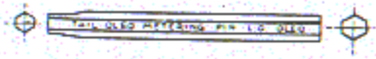
87-88-915
ADJUSTING WRENCH-PROPELLER GOVERNOR



87-88-019
TAIL HOISTING SLING



87-88-032
WRENCH-HAND PUMP



87-88-031
WRENCH-METERING PIN-L G. & TAIL WHEEL

87-03-531
PANEL JACK STUD

FIG. 19 - SERVICE TOOLS

ONE EACH OF THE FOLLOWING IS FURNISHED WITH EVERY AIRPLANE: 87-69-737, 87-88-030, 87-88-031, 87-88-032, 87-64-570, 87-88-915. TWO EACH OF 87-03-531 IS FURNISHED WITH EVERY AIRPLANE. THE PARKING HARNESS (87-64-570) IS STOWED BELOW THE PILOT'S HEADREST. THE GUN MOUNTING WRENCH IS STOWED IN A SPECIAL CASE ON THE L. H. GUN ACCESS DOOR. THE OTHERS ARE CARRIED IN THE TOOL KIT ON DUFFLE BAG. ONE EACH OF THE FOLLOWING IS FURNISHED WITH EVERY NINTH AIRPLANE: 87-88-594, 87-88-595, 87-88-596, 87-88-597, 87-88-587, 87-88-020, 87-88-509, 87-88-019.

SECTION IV

INSTALLATION, MAINTENANCE, REPLACEMENT AND MINOR REPAIR

General Data.

a. The work outlined in this section can be performed with the facilities usually available at the Air Corps, 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
87-88-505-2	Wrench - Metering Pin - Landing Gear and Tail Wheel
87-88-505-3	Wrench - Actuating Cylinder - Landing Gear and Wing Flap
87-88-505-4	Wrench - Hand Pump
87-88-505-5	Hoisting Sling - Tail
87-88-506-6	Hoisting Sling - Front
87-88-505-7	Hoisting Sling - Wing
87-88-505-8	Puller Assembly - Engine Mount Bolts
87-88-505-9	Screw Driver - Bomb Rack, Cocking and Removal
87-88-505-10	Pad - Panel Throw Over - Gun Servicing
87-88-505-11	Pad - Throw Over Walkway
87-69-737	Wrench - Ratchet Gun Mounting
87-88-594	Locating Tool - Filler Opening - Wing Fuel Cell
87-88-595	Locating Tool - Gage Opening - Wing Fuel Cell
87-88-597	Wrench - Nut Wing Fuel Cell Gage Mount
87-88-596	Wrench - Filler Cap - Fuel Cell
87-03-531	Stud - Panel Jacking
87-88-915	Wrench - Propeller Governor Adjusting

c. All countersunk, recessed head screws originally used on this airplane are of the Reed and Prince type. The use of any screw driver other than the Reed and Prince type will mutilate the screw head.

Wing. (Drawings 87-06-901 and 87-03-901)

a. General. - (1) The wing is an internally-braced, full cantilever, multi-cellular, stressed-skin type, consisting of two panels joined at the airplane center line 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 a tee section on the upper surface of each wing panel which fits against an angle on 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 the wing.

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

(3) Wells in the underside of the wing accomodate the fuel tanks and landing gear wheels. The joint where the two wing panels are joined will serve as a skid in an emergency landing with the wheels retracted.

(4) The ailerons are dynamically balanced incorporating Frise-type aerodynamic balance. The right hand aileron trim tab is the fixed type. The left hand aileron has an electrically operated adjustable trim tab controlled by a switch on the main switch panel. The ailerons are constructed of metal, including a stressed skin leading edge, and are fabric covered. Three mounting hinge bearings are provided on each aileron.

(5) Hydraulically-operated, split-trailing edge type wing flaps extend from within a few inches of the airplane center line to the inboard end of the ailerons. They are attached to the wing by a continuous piano type hinge running the full length of each flap leading edge.

b. Removal and Disassembly. - (1) To Remove the Complete Wing: It is recommended that a cradle similar to the one shown in Figure 23 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 center line under each wing panel.

(a) Suspend the airplane by the forward and tail hoisting slings. Attach the forward hoisting sling to the lugs on the engine mount and the tail hoisting sling to a bar inserted completely through the lift tube provided near the aft end of the fuselage.

(b) Drain all fuel tanks.

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

2. The drain cocks for the wing fuel tanks are located under the wing on the left panel approximately five inches from the center line of the airplane.

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

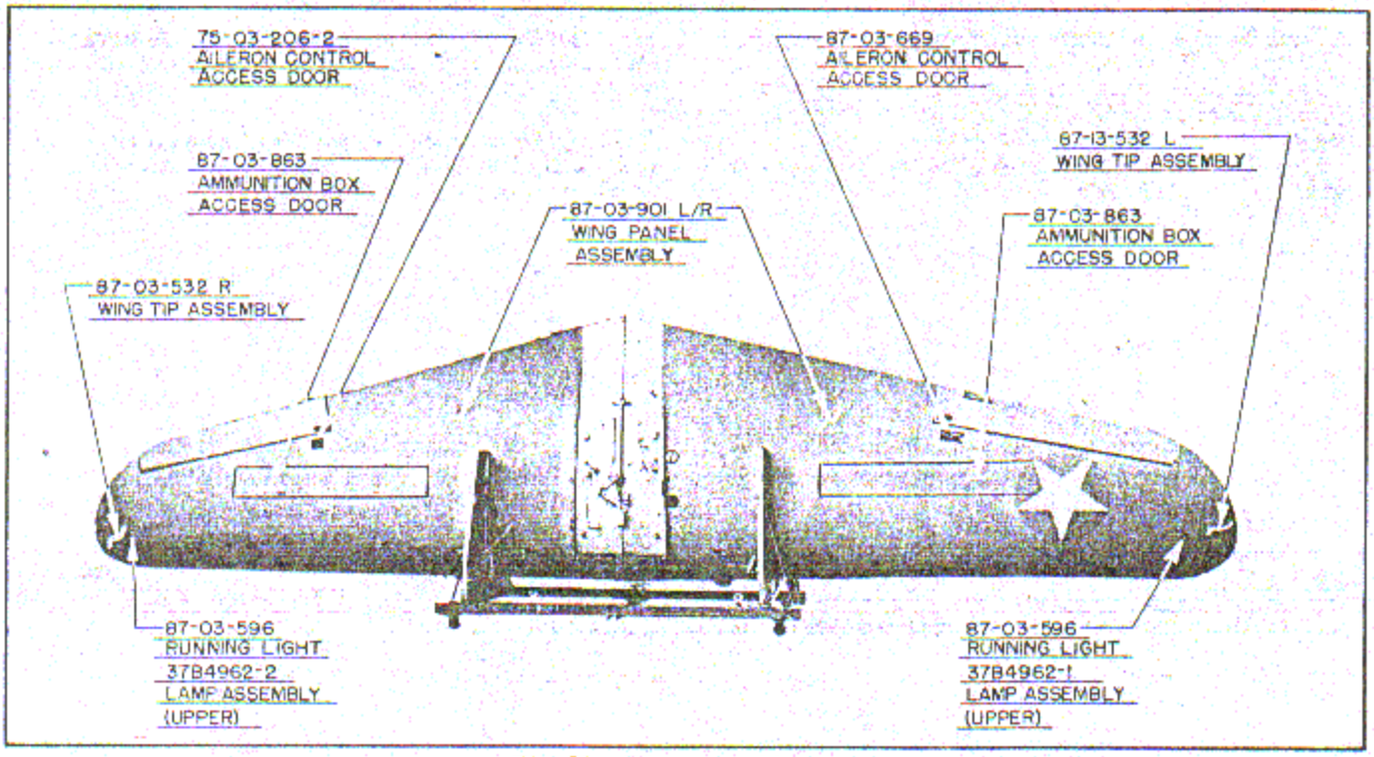


Fig. 20 - Wing assembly - top.

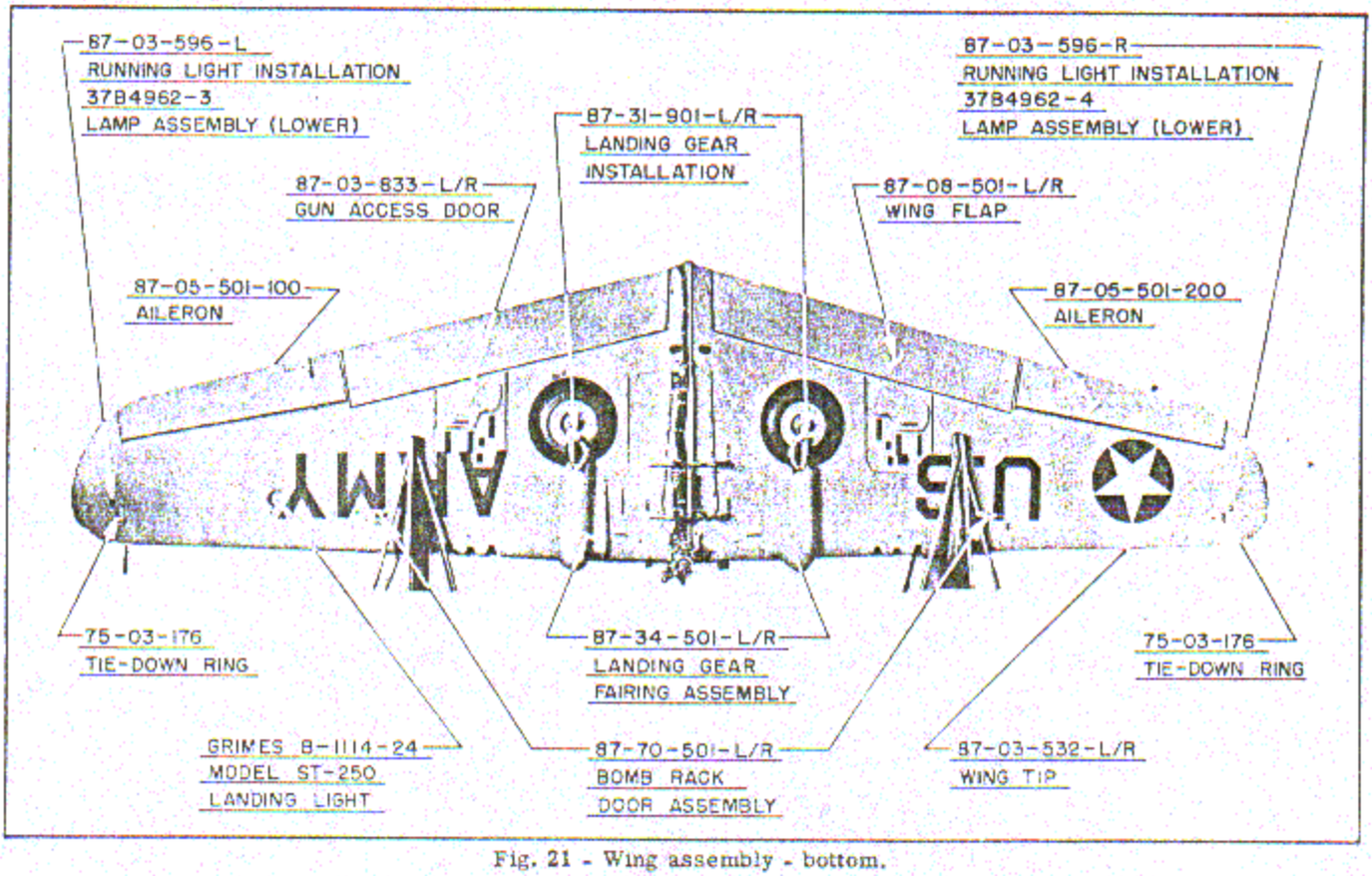


Fig. 21 - Wing assembly - bottom.

(c) Remove the lower engine cowling.

(d) Remove the belly tank.(Refer to paragraph 15, in this section.)

(e) Disconnect and remove the belly tank sway braces.

(f) Remove the keel fairing.

(g) Remove the radiator cowl shutters by disconnecting the control rods and removing six screws which fasten each end of the shutter former to the engine mount. Remove the shutters and formers as one unit.

(h) Drain the oil system. The drain cock is located on the right side of the fuselage 3" forward of the leading edge of the wing.

(i) Disconnect the oil line at the leading edge of the wing.

(j) Disconnect the two fuel lines attached to the electrically-driven fuel boost pump.

(k) Disconnect the wing fuel tank vent lines.

(l) Remove the section of the heater and ventilator ducts forward of firewall.

(m) Disconnect the fuel selector control at the joint below the gear box forward of the firewall.

(n) Drain the hydraulic brake system. (At the wheels)

(o) Disconnect the drain collector at the hose connection.

(p) Remove the pilot's seat.

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

(r) Remove the armor plate aft of the pilot's seat.

(s) Drain the hydraulic system fluid tank. (Aft of fuselage access door)

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

(u) Disconnect the wing gun charging hydraulic lines at connection to control valves.

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

(w) Disconnect the airspeed lines at the upper surfaces of the wing within the cockpit.

(x) Disconnect the wing electrical system at the disconnect plugs located on the cockpit floor aft of Station 4. One plug on each side of the cockpit.

(y) Disconnect the two 5/16" hydraulic flap control lines at the elbows on the cockpit floor directly below the hydraulic selector control valve.

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

(aa) Disconnect the two 3/8" landing gear hydraulic lines at the manually operated auxiliary hydraulic pump, and at connections on the trailing edge of the wing.

(bb) Disconnect the two 3/8" landing gear hydraulic lines at the inboard manually operated emergency hydraulic pump.

(cc) Disconnect the two 3/8" inboard hydraulic lines at the tee connection under the landing gear control box.

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

(ee) Remove two bolts attaching rear end of wing angle to the fuselage.

(ff) Remove the wing-to-fuselage joint bolts.

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

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

(2) To Disassemble the Complete Wing: To separate the wing panels:

(a) Remove the belly tank support at the match angles.

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

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

(d) Remove the electric fuel boost pump, strainer and fuel selector valve from the support, which is attached to the match angle.

(e) Remove the belly tank support and control wire for belly tank supports which are attached to the wing match angle.

(f) Remove the main fuel lines.

(g) Remove the oil lines.

(h) Remove the two wing fuel tank gages. See paragraph 15. this section.

(i) Remove the wing fuel tank doors as a single unit by removing all screws and bolts which attach the doors to the wing, including screws and six bolts through web #3.

(j) Remove the bonding and the fuel tank straps.

(k) Remove the pan assemblies and fuel cells as outlined in paragraph 15.

(l) Remove the screws in the plate across the center line of the wing at forward bottom edge of web #3.

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

(n) Disconnect the 3/8" hydraulic control line, from the inboard manually operated emergency hydraulic pump, at the tee connection on the right wing panel forward of the instrument panel.

(o) Remove the link from the wing flap actuating cylinder to the bellcrank in the left wing panel and disconnect the hydraulic lines to the actuating cylinder. (The cylinder is attached to the center line bulkhead.)

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

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

(r) Remove the bonding from the control stick to the wing.

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

(t) Disconnect the gun trigger switch and the hydraulic system electric motor conduits (from the control stick junction box) on the cockpit floor near the base of the control stick.

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

(v) Remove the heating and ventilating control shaft.

(w) Remove all bolts through the wing match angles and separate the wing panels. (The center line bulkhead is attached to, and will remain with the right wing panel.)

(3) To Disassemble the Wing Panels: (a) To Remove the Wing Tips: Remove the row of screws entirely around the contour of each wing panel 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 Ailerons: 1. Remove bonding. Disconnect the electric trim tab control conduit on the left hand aileron (the trim tab on the right aileron is fixed). Remove 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 wing panel.

2. To remove trim tab from the left aileron, disconnect the control arm from the aileron 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 beam.

(c) To Remove the Wing Flaps: Disconnect the flap position indicator linkage from the flap. The position indicator transmitter is located within the left panel, near the forward edge of the wing flap. Remove all the bolts which connect the wing flap control turnbuckles to the flap. The two continuous hinge pins are withdrawn by pulling steadily on the hinge pin loops which are located near the spanwise center of the flap. (See Figure 25.)

(4) To Install the Complete Wing (See Figure 21): Assembly of the wing to the fuselage is reversal of the procedure listed in paragraph 2., b. of this section. Additional information follows:

(a) Before assembling the wing to the fuselage lubricate the mating surfaces of the wing-to-fuselage fittings with grease, Spec. Mobilgrease Zero.

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

(c) Lower the forward end of the fuselage slightly in advance of the rear end of the fuselage so that the front fittings at Station #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 the bolt heads outward, working progressively from the front to the rear. Install the three bolts attaching the trailing edge of the wing to the fuselage (center).

NOTE: The last bolt hole in the joint immediately aft of Station #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.

(e) Fill the hydraulic system in accordance with the instructions in paragraph 2., v., of Section III.

(f) Fill the brake system in accordance with the instructions in paragraph 2., u., of Section III.

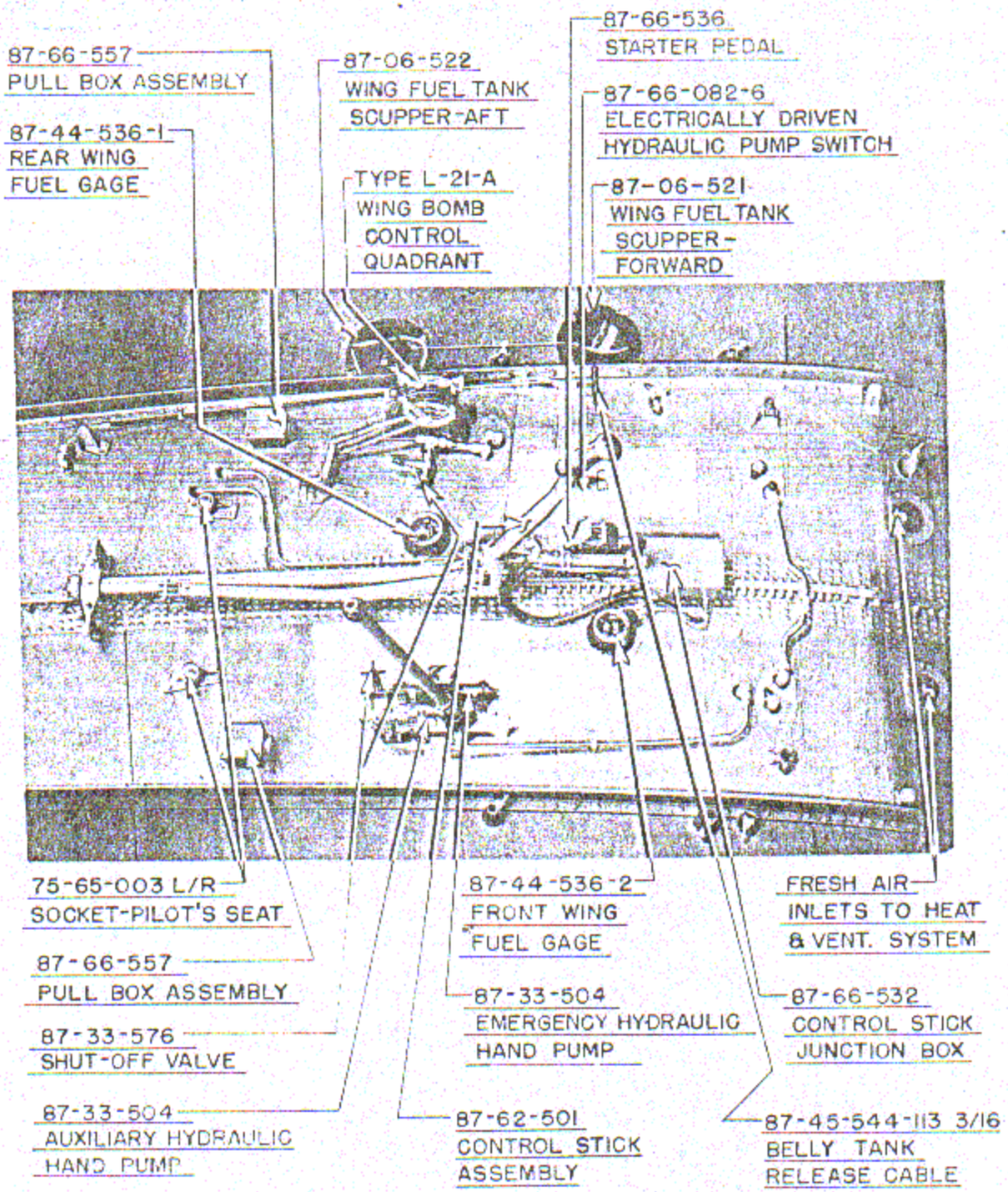


Fig. 22 - Wing assembly - top - ready for installation.

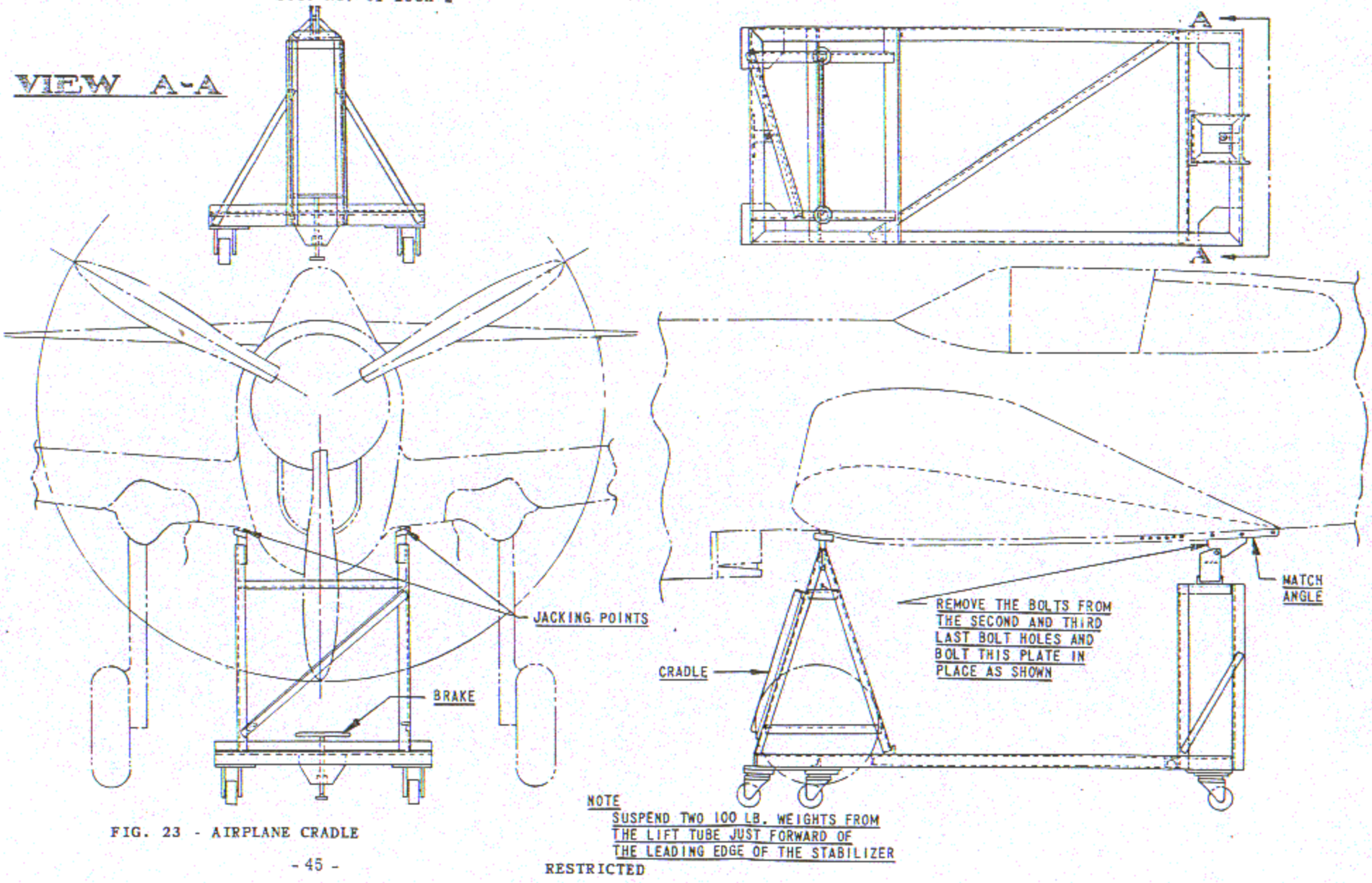


FIG. 23 - AIRPLANE CRADLE

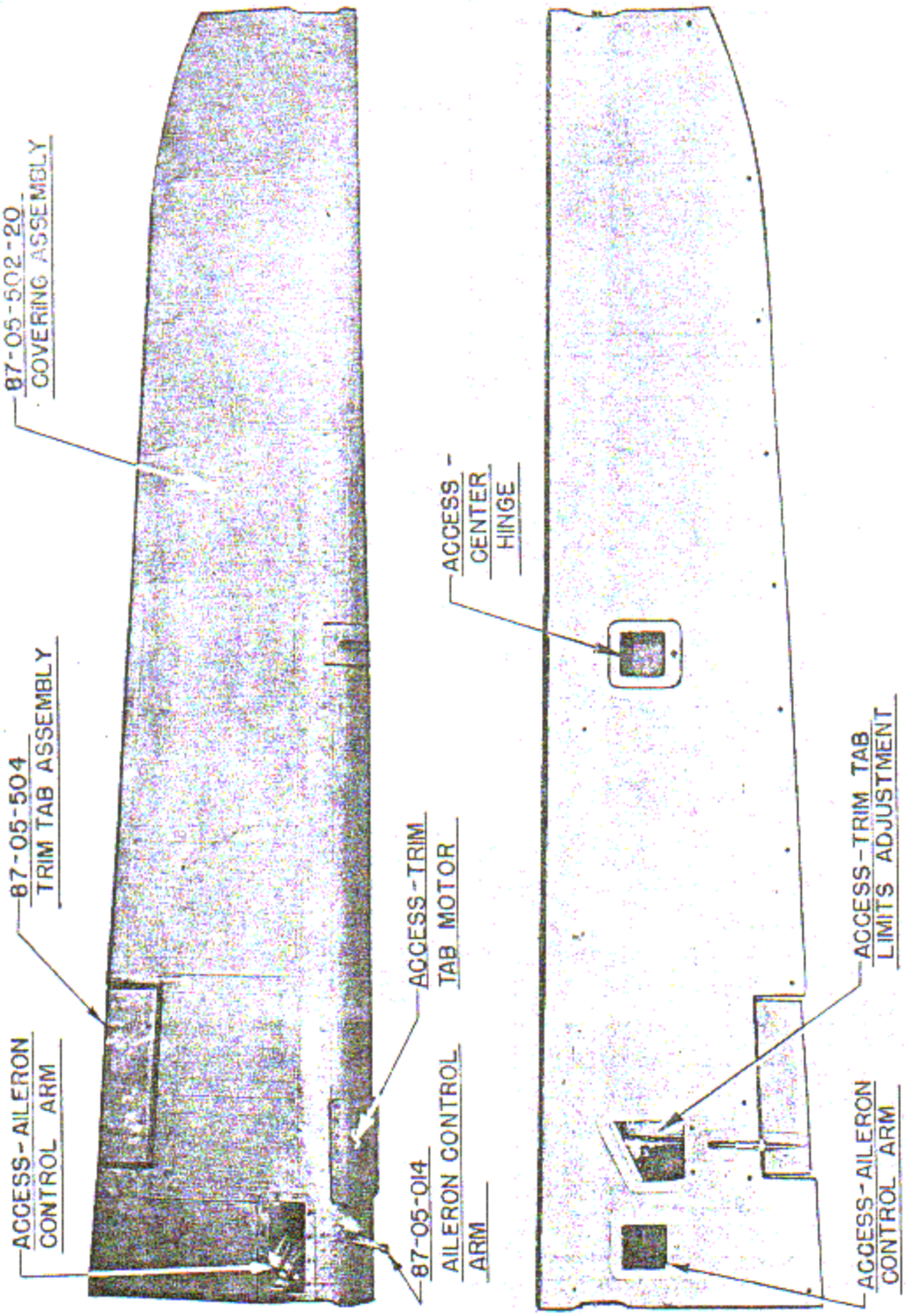


Fig. 24 - Aileron, left - top and bottom - covered.

(g) If the fuel gages have been loosened or removed, re-adjust them (at 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 paragraph 16., a., 6., this section.

(5) To Install 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 wing and the center hinge on the wing 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 aileron drum control assembly located in the wing.

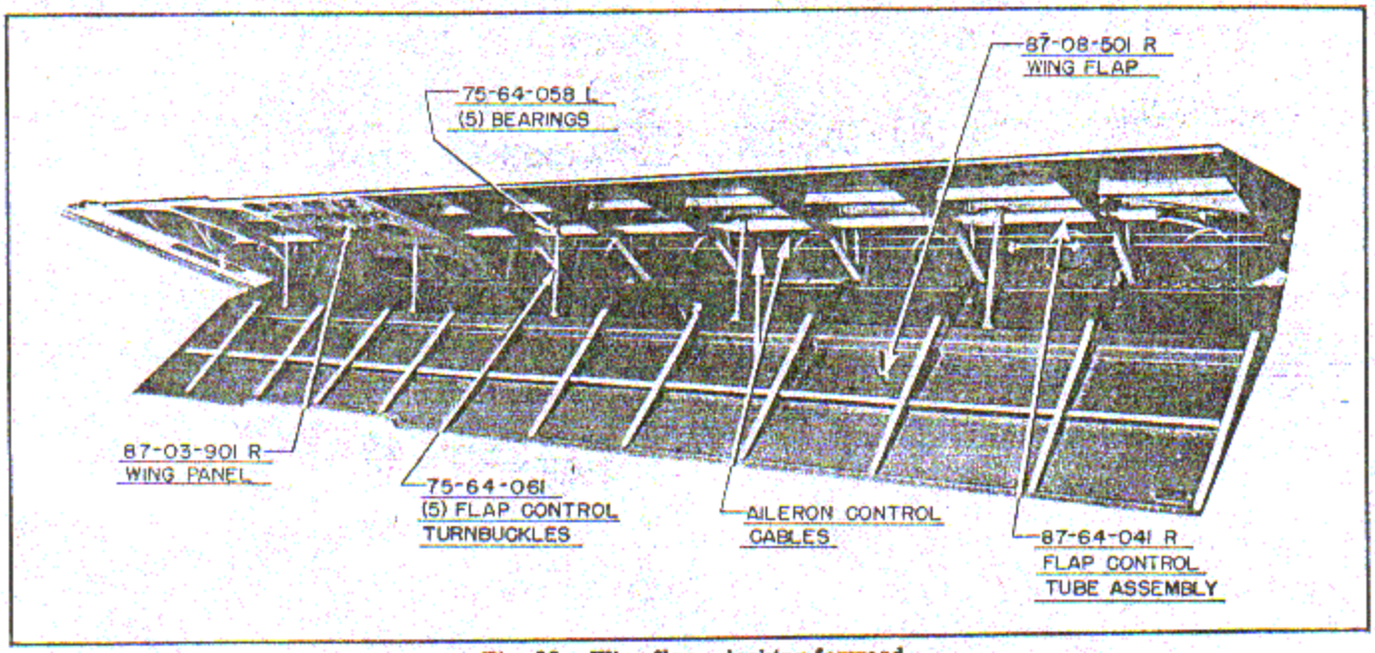


Fig. 25 - Wing flap - looking forward.

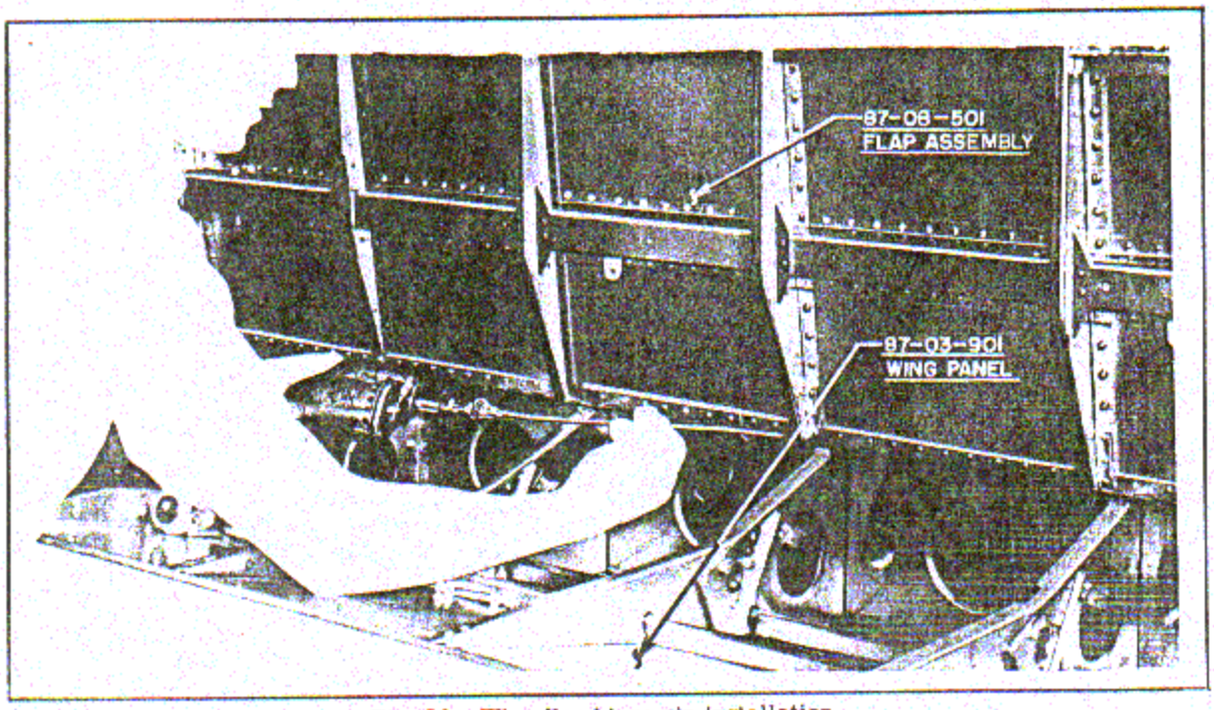


Fig. 26 - Wing flap hinge pin installation.

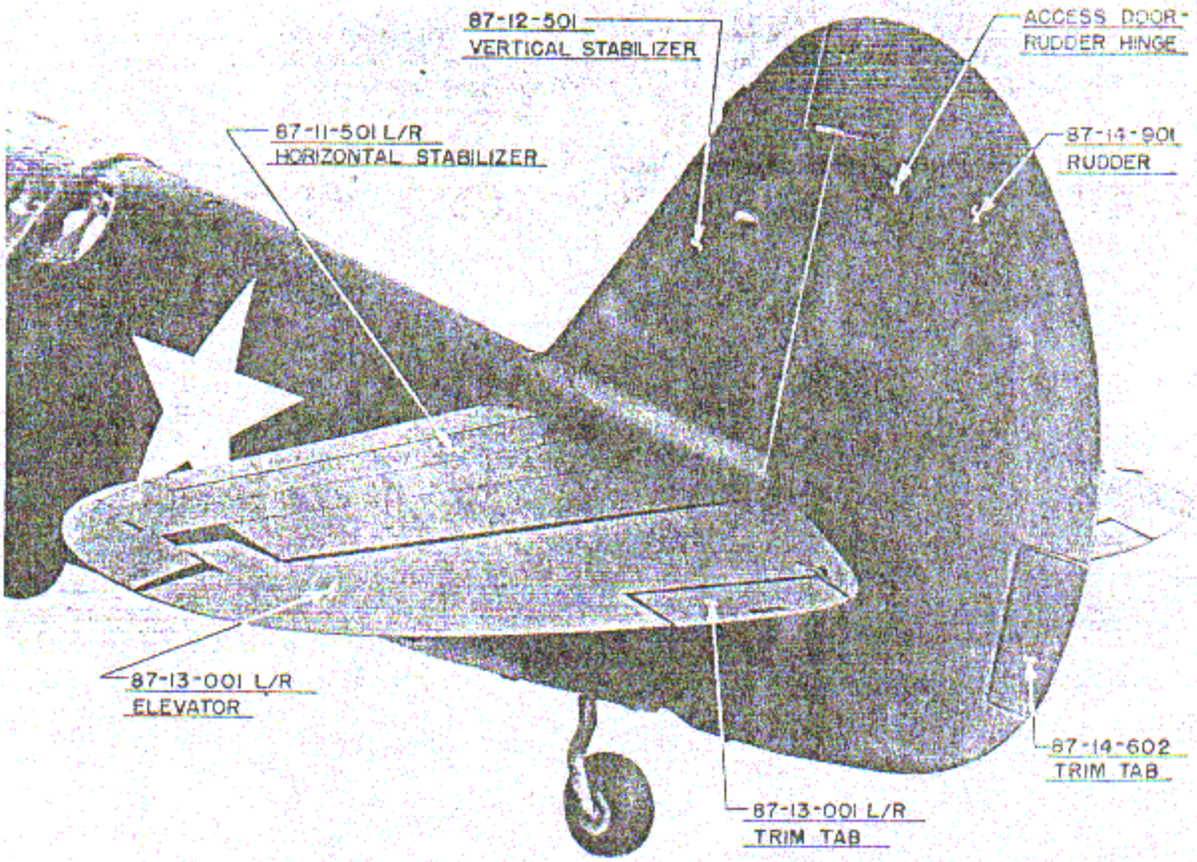


Fig. 27 - Empennage assembly.

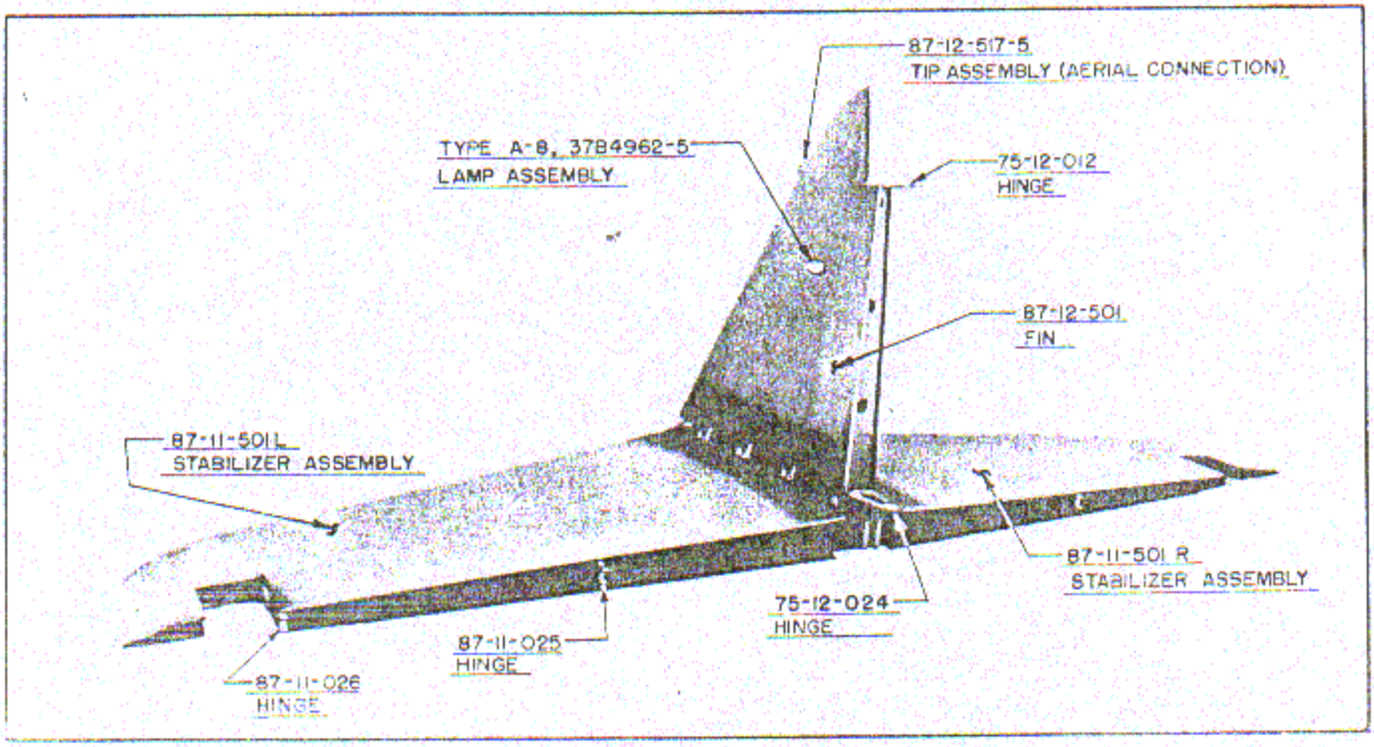


Fig. 28 - Stabilizers complete.

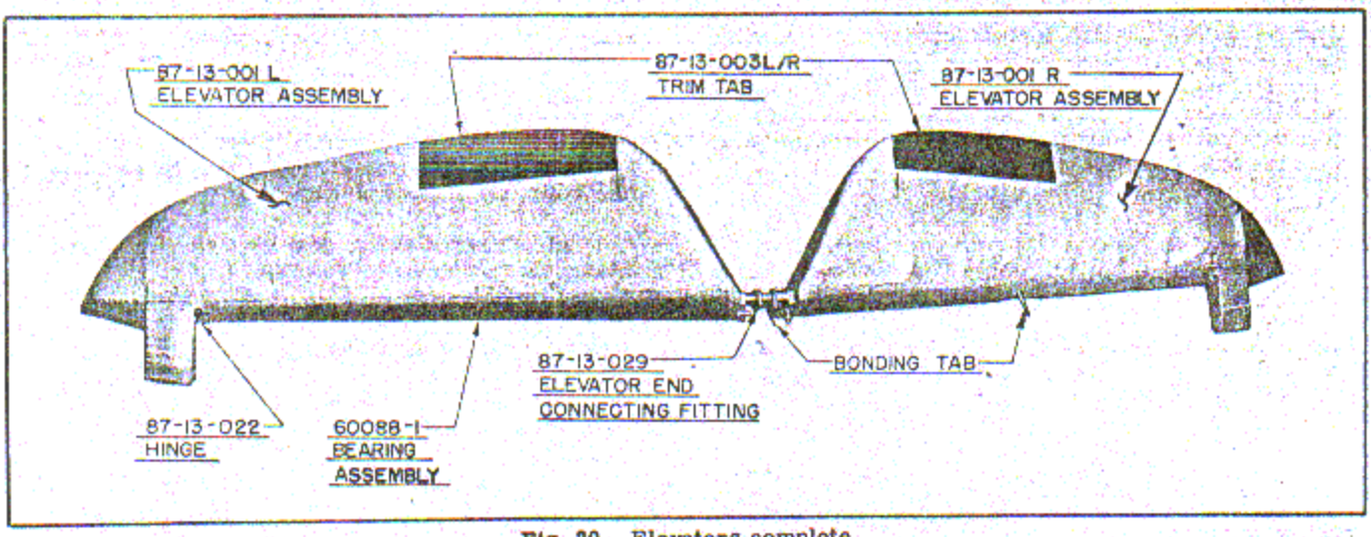


Fig. 29 - Elevators complete.

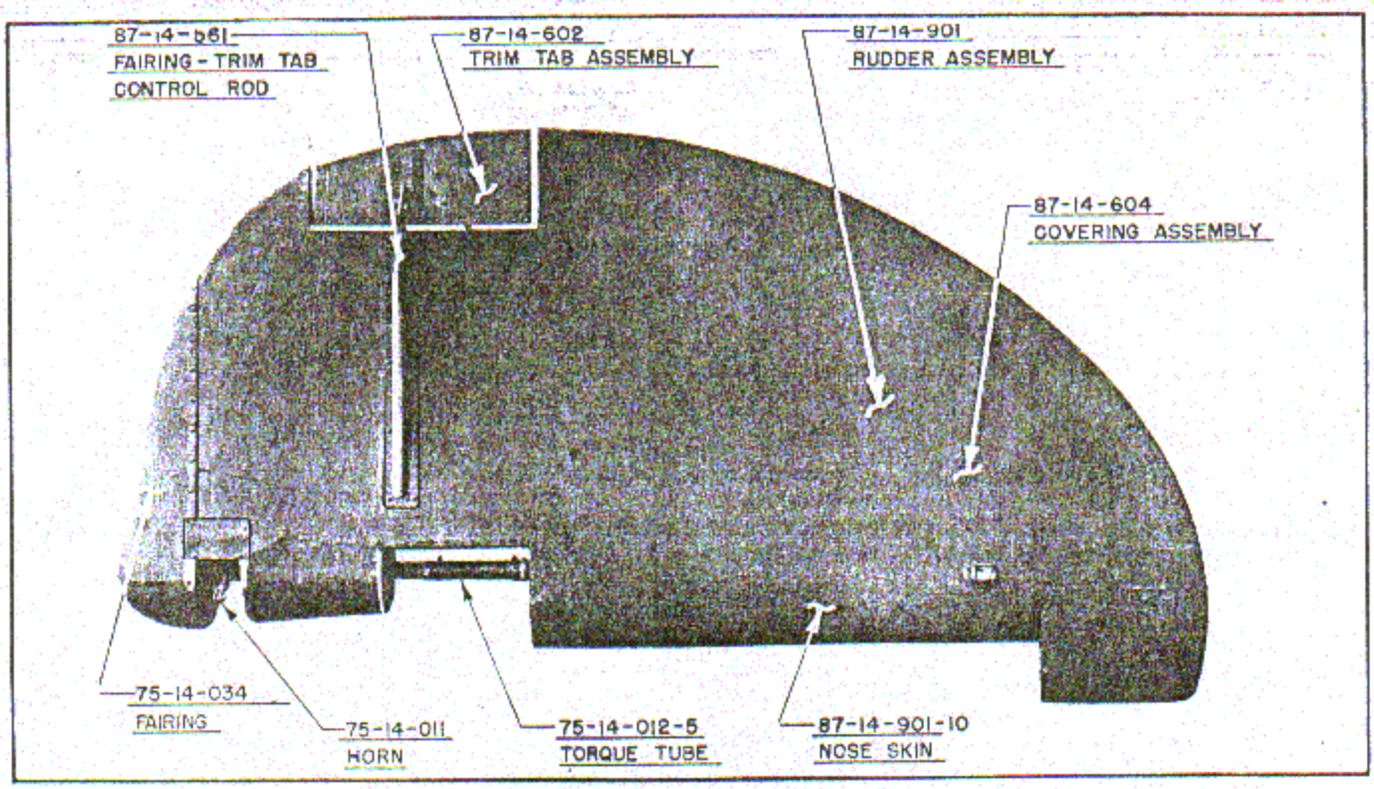


Fig. 30 - Rudder complete.

NOTE: A slightly tapered, impregnated fabric bushing (75-64-026) must be installed with the larger end, first, on the ball of the control arm, before the preceding operation can be accomplished.

Clamp up and bolt the end hinges, and bolt the center hinge through an access door in the lower surface of the aileron. Connect the bonding tabs. Connect the conduit of the electric trim tab control within the left aileron.

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

(6) To Install the Wing Flaps: Interlock the wing flap hinge and hold the flap in position while inserting the hinge pins. The loop end 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 hinge loops. See Figure 26.

(7) To Adjust the Wing Flap Position Indicator Mechanism: Follow the method outlined for adjusting the landing gear position indicating mechanism in paragraph 2. Column 37, Section III. The transmitter is located at the inboard end near the forward edge of the left wing flap, and is accessible from the rear of the wing when the wing flap is lowered.

3. Empennage.

a. General. - (1) Stabilizers: The horizontal and vertical stabilizers are of 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 vertical bolts. The vertical stabilizer is attached to the horizontal stabilizer in the same manner.

(2) Elevators and Rudder: The elevators and rudder are of aluminum alloy construction and covered with fabric. Both elevators are dynamically balanced and are equipped with trim tabs which are manually controlled from the cockpit.

b. Removal and Disassembly. -

(1) To Remove Rudder: (a) Disconnect the rudder trim tab control unit at the rudder.

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

(c) Disconnect bonding.

(d) Remove the upper hinge bolt.

(e) Remove the two nuts from both the upper and the lower rudder hinge bearing caps and remove the rudder.

(2) To Remove the Rudder 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 blocks on each end of the front face of the tab beam.

(3) To Remove Stabilizer and Elevators as a Unit:

(a) Remove the empennage fillets.

(b) Disconnect the electrical conduit at the plug in the forward base of vertical stabilizer.

(c) Disconnect bonding.

(d) Disconnect the two elevator trim tab control units from the elevators.

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

(f) Remove the eight nuts attaching the horizontal stabilizer to the fuselage fittings. Remove the vertical and horizontal stabilizers and the elevators as a unit.

(4) To Remove Elevators: (a) Disconnect bonding tabs.

(b) Remove the two bolts from each elevator outboard hinge.

(c) Remove the center hinge caps by removing the four bolts, and remove elevators.

(d) Either elevator may be removed without removing the rudder by the following procedure:

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

2. Disconnect the two bolts from the outboard hinge of the elevator.

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

(5) To Remove the Elevator Trim Tab: Disconnect the control rods from the trim tab horn, rotate the trim 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 beam. Pull the tab outward and downward until the hinge rod on the inboard end of the front face of the tab beam 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. - To Install Complete Empennage: Assemble elevators to the horizontal stabilizer and then attach the elevator and horizontal stabilizer assembly to the fuselage.

Assemble the vertical stabilizer to the horizontal stabilizer.

Attach the elevators to the horizontal stabilizer and bolt on the elevator center bearing caps securely.

Connect the push-pull link to the elevator horn.

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

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 vertical stabilizer-to-horizontal stabilizer and horizontal stabilizer-to-fuselage bolts may cause misalignment of the empennage assembly. When installing the rudder lower bearing cap, be careful to seat thrust washer and dust shields in the proper grooves.

Install the rudder and connect the rudder cables to the rudder horn.

Instructions on adjustment of flight control system and surfaces are given in paragraph 2., o., Section III. Check the angular throw of the rudder and elevator control (See Figure 12) before the tail fillets are installed.

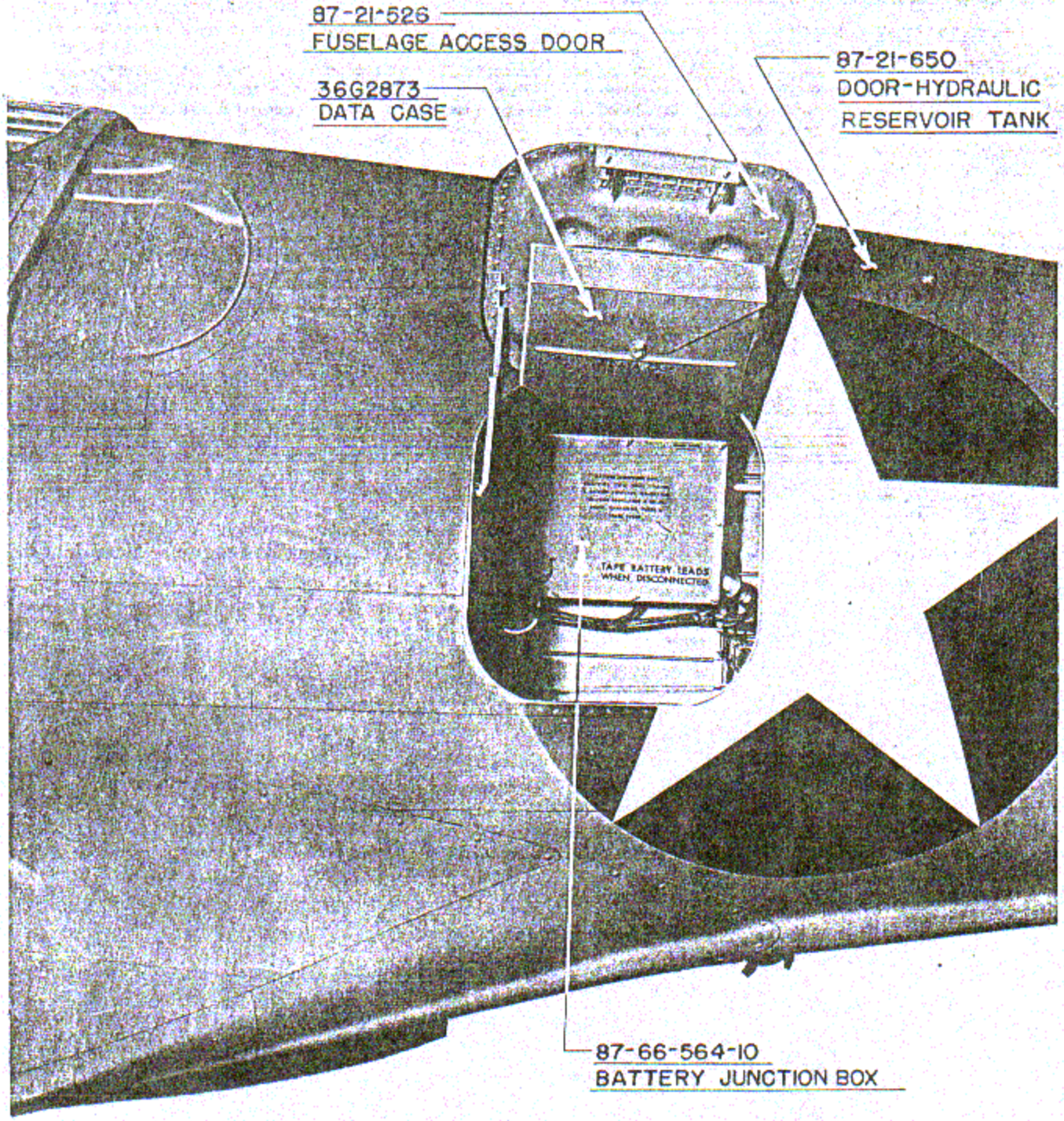


Fig. 31 - Fuselage - left side - access door open.

4. Fuselage and Engine Mount.

a. General. - (Drawing 87-21-901 and 87-21-903)

(1) Fuselage: The fuselage proper is of semi-monocoque type construction with bulb angle stringers, channel-section bulkheads and aluminum alloy 24ST skin. Aluminum alloy (A17ST) flush head rivets are used on all exterior surfaces. The construction of bulkhead #5 just aft of the pilot's seat is of sufficient strength to support the airplane on its back in the event a turnover landing is made. This minimizes the possibility of injury to the pilot and damage to the fuselage. The jack point at the aft end of the fuselage is designed to protect the fuselage in event the airplane is landed with the tail wheel not extended.

b. Engine Mount. - (Drawing 87-22-901) The engine mount is of steel tube trussed type construction, employing both bolted and welded joints. The engine mount is attached by bolts and nuts to the four steel fittings which are riveted and bolted to the fuselage. The engine is secured to the engine mount by two bolts thru each of the four engine feet and the four mounting faces incorporated in the engine mount.

5. Cowling. (Drawing 87-29-901) All the sections of cowling are made of Alcad sheet, formed and fabricated by rivets and spot welds. The cowling is attached with Dzus fasteners and screws. Chafing strips are installed between the cowling and points of contact.

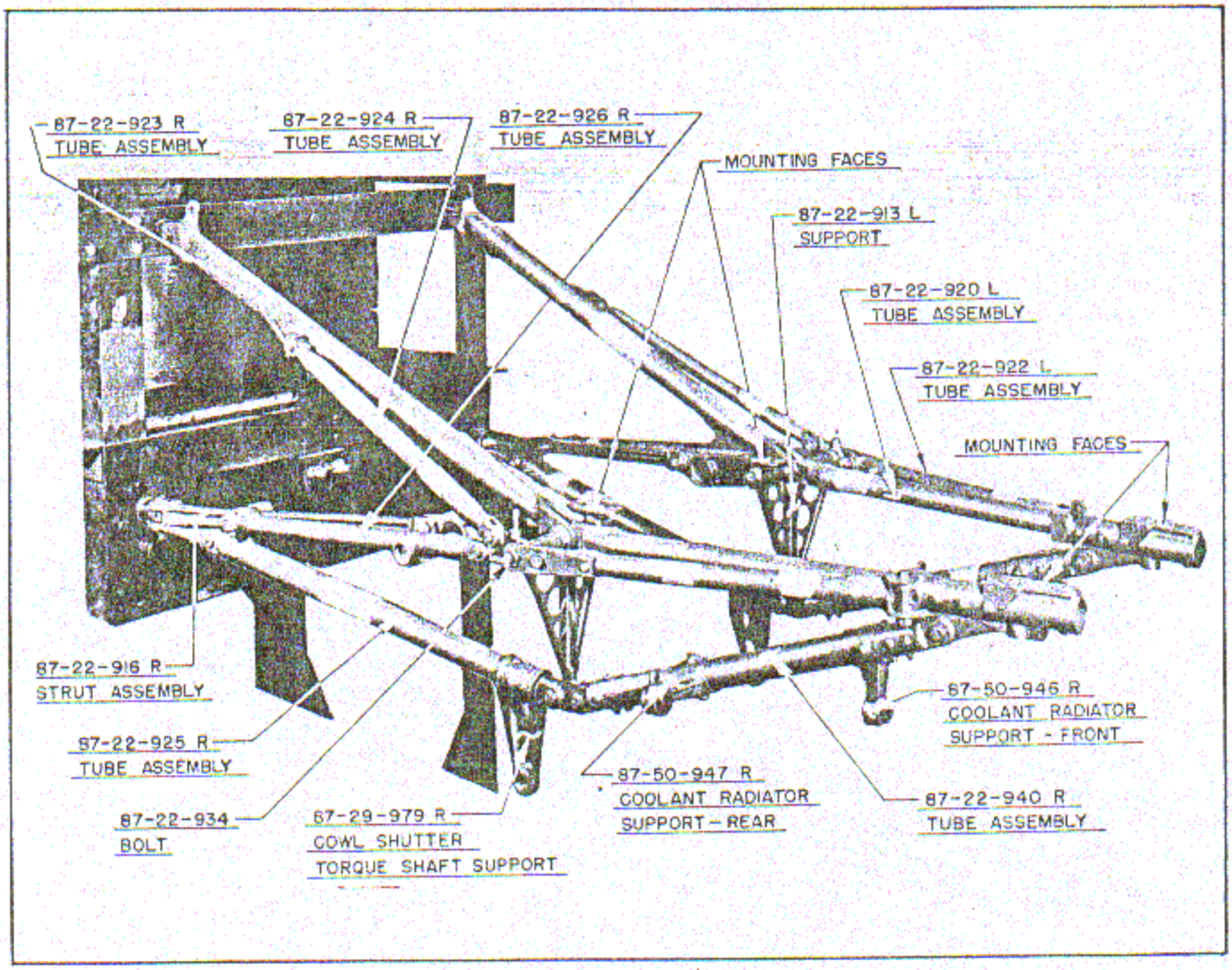


Fig. 32 - Engine mount - 1/4 front view.

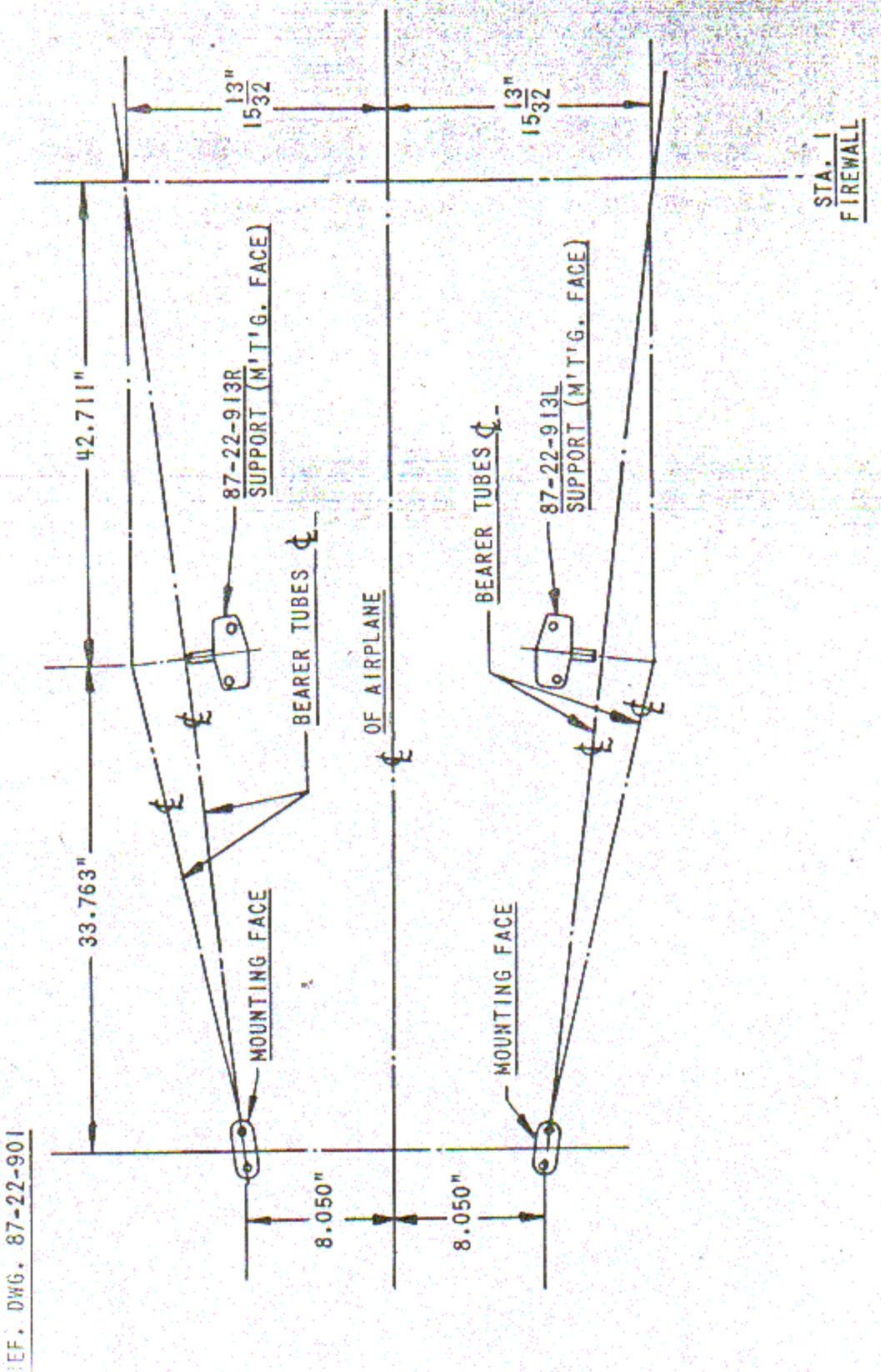


Fig. 33 - Engine mount faces - location - plan view.

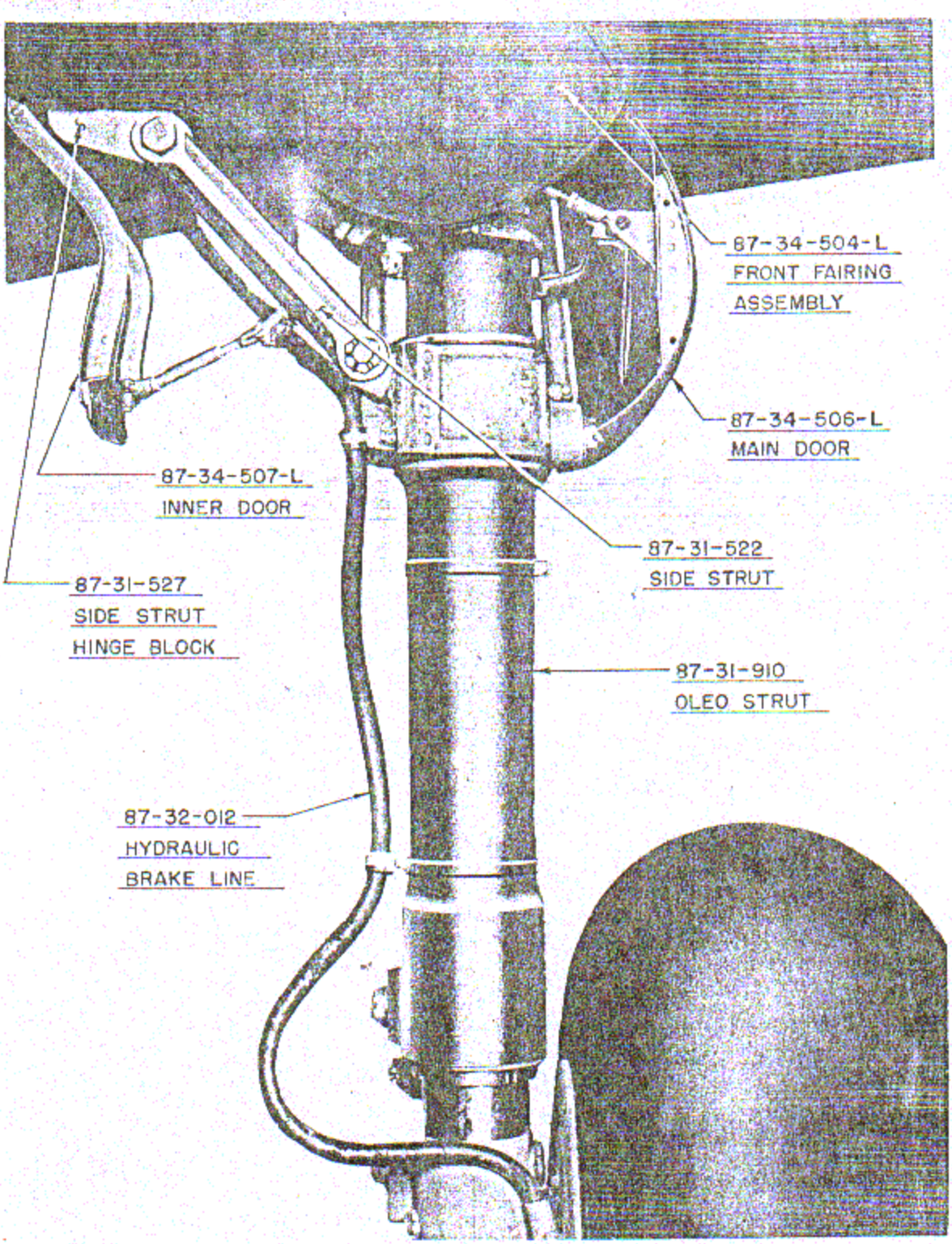


Fig. 34 - Landing gear - looking aft.

6. Landing Gear. (Drawing 87-31-901)

a. General. - (1) Shock Absorber Struts: The landing gear installation comprises, essentially, the oleo strut which absorbs the landing shock and the taxiing shock loads, the main wheel, the landing gear retracting mechanism, the side brace link, the pinion and the bevel gear. The oleo strut is rotated 90° about its longitudinal axis, within the trunnion assemblies as the landing gear is lowered into the landing position, or as it is retracted into the wheel pocket. This rotational movement of the landing gear strut assembly within the trunnions is accomplished by meshing the pinion with the bevel gear, both of which are in fixed position on the oleo strut cylinder and the landing gear hinge fitting, respectively. As the landing gear is lowered or retracted, the pinion simultaneously revolves about the bevel gear, carrying the oleo strut and wheel with it. The pinion and the bevel gear also serve as structural members, and transmit torque loads from the landing gear to the landing gear fittings on the wing. When the landing gear is fully retracted, the wheel lies flush within the wheel pocket.

(2) Retracting Mechanism: The landing gear retracting mechanism consists of two upper retracting links, two retracting arms, two lower retracting links, and a hydraulically operated retracting cylinder in each wing panel. The retracting arms complete the linkage between the upper set of retracting links which are attached to the piston of the retracting cylinder, and the lower set of links which are attached to the lower trunnion of the oleo strut. The retracting arms pivot on a fitting assembly which is attached between the two chassis support bulkheads. These bulkheads are immediately forward of the landing gear wheel pocket and contain the hydraulic retracting cylinder. When the piston of the retracting cylinder is extended, the landing gear is caused to retract into the wheel pocket in the lower surface of the wing.

(3) Warning System: The locks inside the retracting cylinder actuate an electrical switch through a plunger and a bellcrank thereby controlling the operation of a Type E-2 (Spec. 32223-A) warning horn signal immediately aft of Station #5. A lever on the throttle control rod in the cockpit actuates another electrical switch in the landing gear warning system circuit. Position indicator transmitters (8TJ9PXAN), connected to the retracting mechanism in each wing panel are located in the wheel pockets. These transmitters are electrically connected to the landing gear position indicator, (8DJ4PXAB), on the instrument panel. (See paragraph 15, Engine and Aeronautical Instruments, of Section IV.)

b. Installation and Disassembly. -

(1) To Remove Landing Gear Assembly from Wing Panel: (a) Disconnect the clevis end of the inner door rod assembly from the bracket on the side brace link. Disconnect the cable between the main door and the support located below the pinion on the oleo strut. Disconnect the bearing end of the spring loaded rod at the forward end of the main door.

(b) Remove the leading edge section of the wing fillet.

(c) Remove the landing gear fairing assembly.

(d) Install the jackpoint studs (87-03-531) and jack up the airplane.

(e) Remove the bleeder screw at the brake cylinder on the inner wheel fairing and drain the hydraulic fluid from the brake system. Disconnect the hydraulic brake hose at the fitting below the bleeder screw on the inner wheel fairing. Remove the clamps which hold the brake hose to the oleo strut assembly and to the side brace link and let the hose hang free.

(f) Unbutton the Dzus fasteners of the outer wheel fairing and remove the fairing. Remove the axle cap and turn the large nut off the axle. Pull the wheel assembly off the axle.

(g) Working through the wheel pocket:

1. Remove the screws which hold the canvas lining in position in the wheel pocket.

2. Partially retract the landing gear, so that the through bolt, which joins the upper retracting links to the piston end of the retracting cylinder, may be removed.

3. Disconnect the landing gear position indicator cable from the bracket on the inboard retracting arm.

4. Remove the through bolt which joins the upper links to the piston end of the retracting cylinder.

5. Return the piston of the retracting cylinder completely into the cylinder, and disconnect the hydraulic lines.

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

7. Remove the through bolt which attaches the retracting arms to the fitting on the chassis support bulkheads.

(h) Working under the wing panel:

1. Remove the lower retracting links from the lower trunnion on the oleo strut.

2. Remove the bolts which connect the lower links to the retracting arms. (The retracting arms may be lowered through the openings in the lower wing surface to obtain the necessary clearance to remove these bolts.)

3. Disconnect the side brace link from the lower trunnion on the oleo strut, and from the wing fitting.

4. Remove the bolts which hold the hinge fittings of the upper trunnion assembly to the hinge jigging support on the wing nose assembly, and remove the oleo strut assembly.

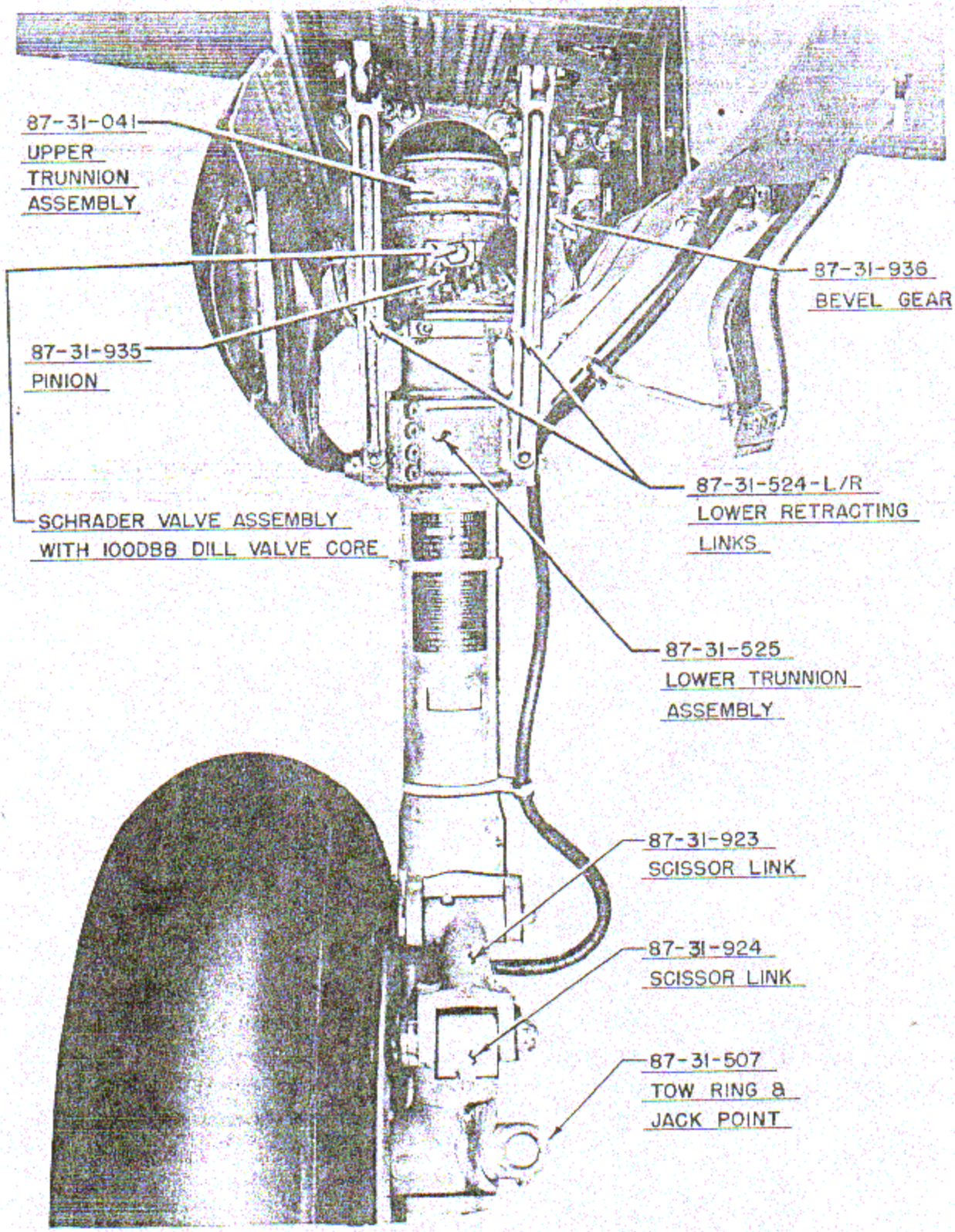


Fig. 35 - Landing gear - looking forward.

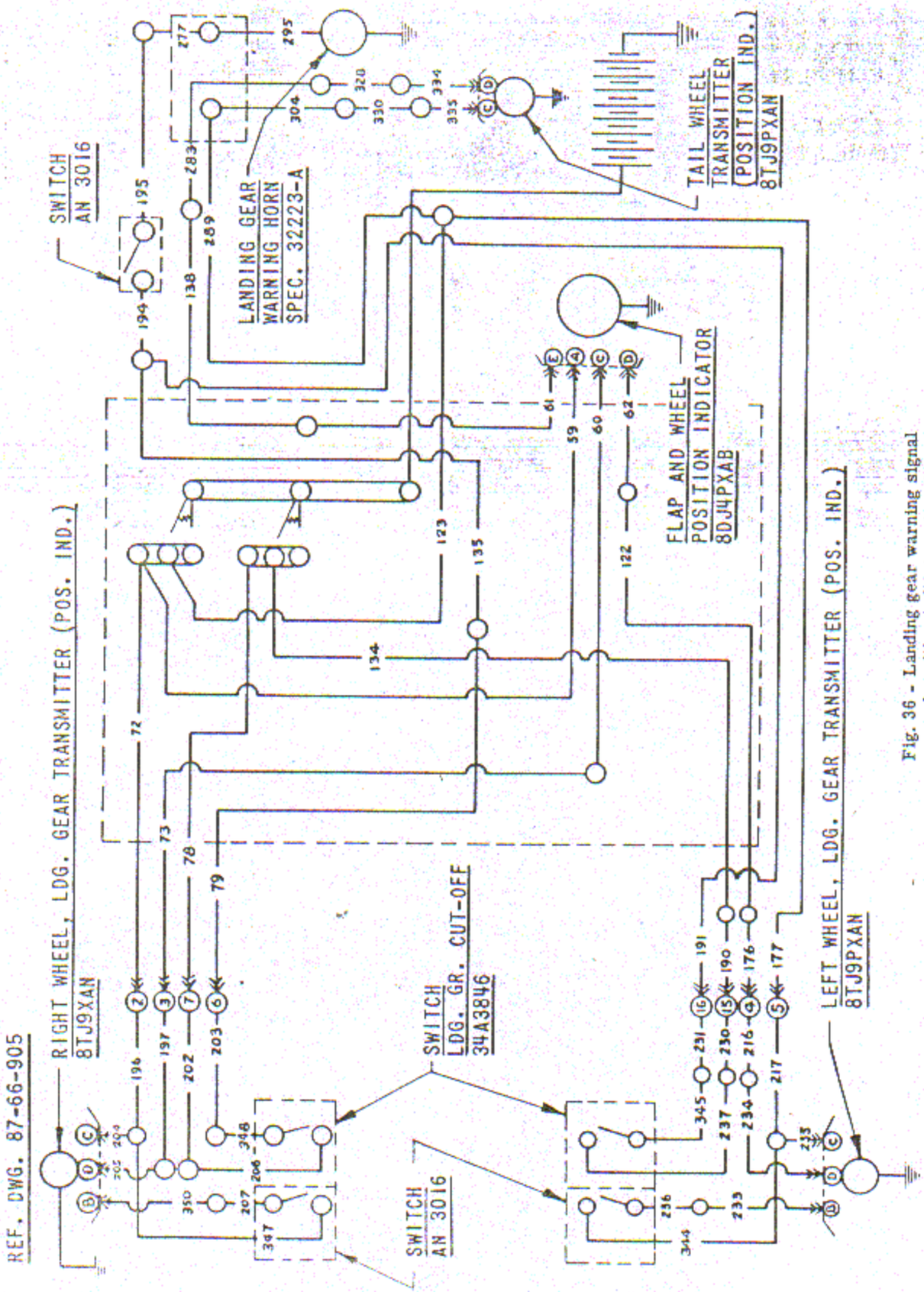


Fig. 36 - Landing gear warning signal and position indicator circuit.

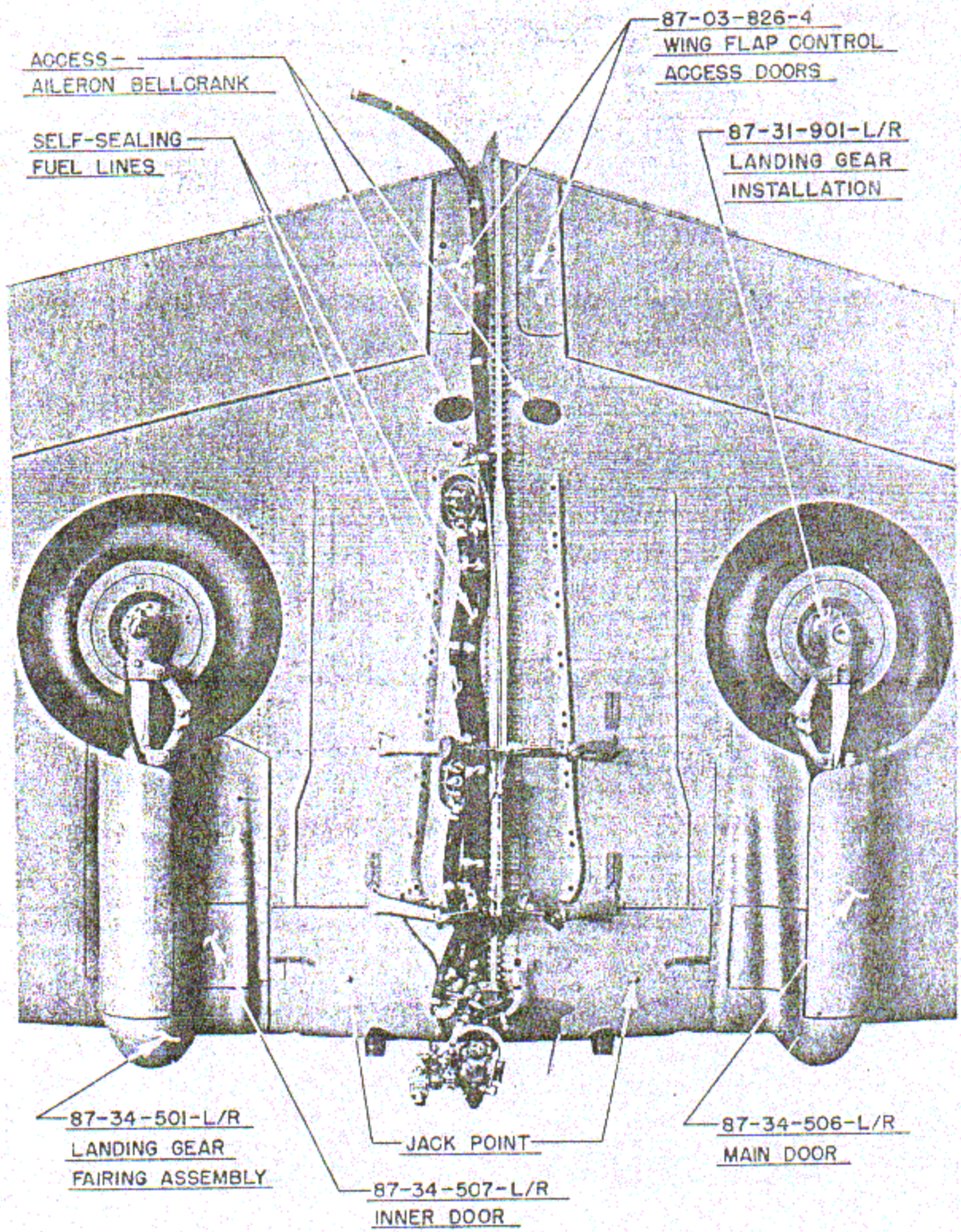


Fig. 37 - Landing gear installation - wheels retracted.

(i) Remove retracting arms and upper links through the lightening hole forward of the wheel pocket.

(j) 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 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 backlash between the bevel gear and the pinion; it is accomplished by removing the shims between the top flange on the cylinder and the pinion, and replacing them between the lower flange on the cylinder and the pinion. This will set the pinion closer to the bevel gear and it will result in less lost motion between the gear teeth.

(3) To Adjust Warning System: (a) Landing Gear Limit 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.

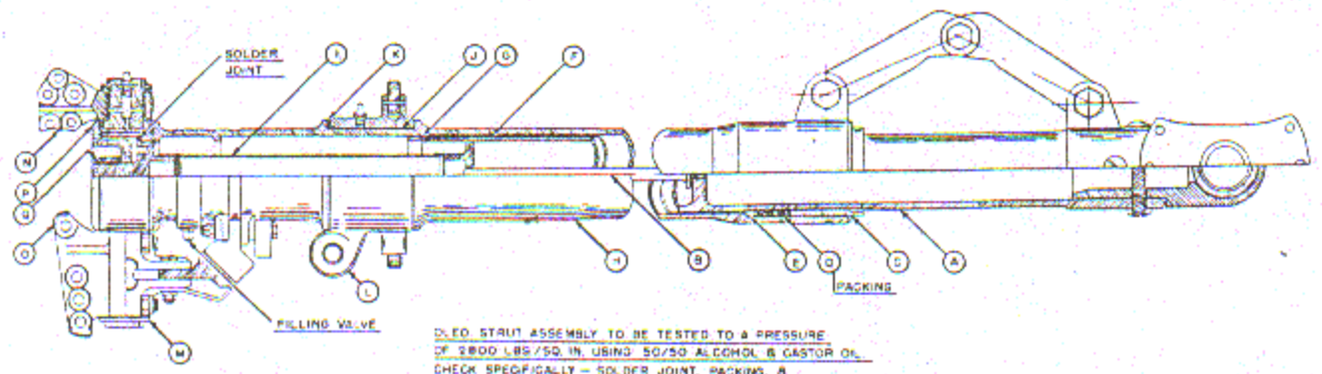
(b) Landing Gear Warning Signal Switch (Throttle Rod): The location of the actuating cam on the throttle rod in the cockpit should be adjusted to actuate the warning signal when the engine is throttled to 1000 R.P.M. and the gear is not locked down.

PISTON ASSEMBLY

LET.	PART NO.	NAME	QUAN.
A	87-31-918	PISTON	1L
B	75-31-050	METERING PIN	1
C	75-31-048	CYLINDER BEARING NUT	1
D	75-31-049	PACKING	1
E	75-31-048	RING	1
F	75-31-045	SLEEVE	1
G	75-31-044	PISTON BEARING	1

CYLINDER ASSEMBLY

LET.	PART NO.	NAME	QUAN.
H	87-31-918	CYLINDER	1L
I	87-31-512	PLUNGER	1
J	87-31-552	BEARING PLATE	1
K	87-31-551	BEARING	2
L	87-31-525	LOWER TRUNNION ASSEMBLY	1L
M	87-31-041	UPPER TRUNNION ASSEMBLY	1L
N	87-31-906-5	FITTING	1L
O	87-31-906-6	FITTING	1L
P	87-31-547	CAP	1
Q	AN310-16	NUT	1



OLEO STRUT ASSEMBLY TO BE TESTED TO A PRESSURE OF 2800 LBS/SQ. IN. USING 50/50 ALCOHOL & CASTOR OIL. CHECK SPECIFICALLY – SOLDER JOINT, PACKING, & METERING PIN ON CYLINDER ASSEMBLY.

Fig. 38 - Landing gear oleo strut.

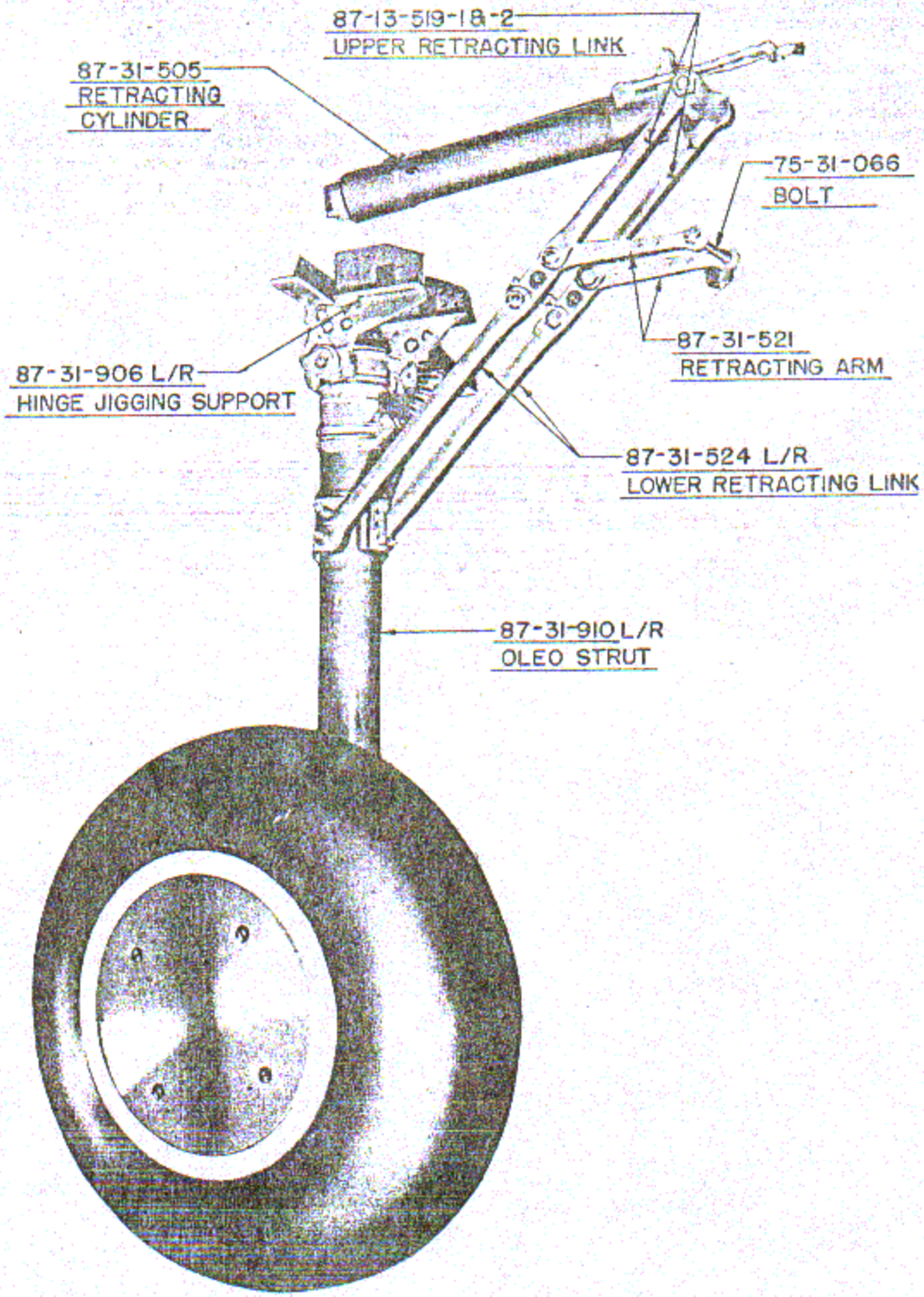


Fig. 39 - Landing gear - extended.

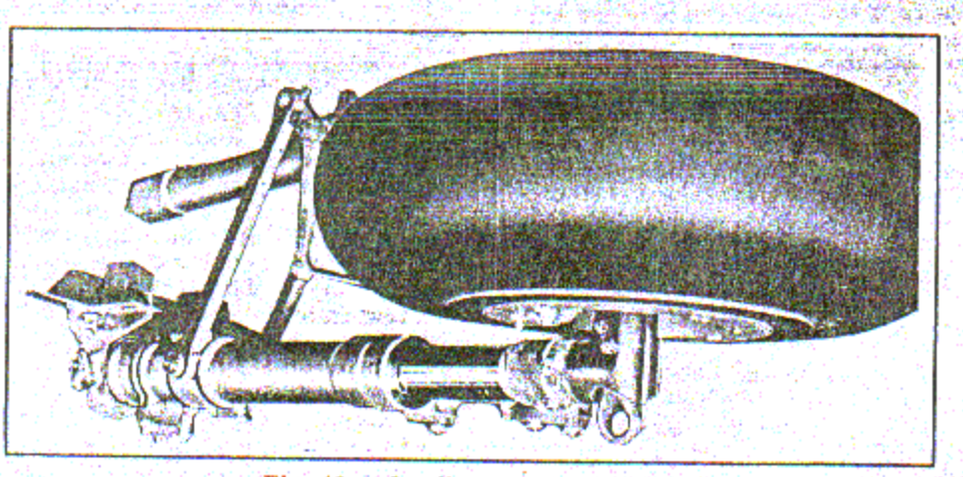


Fig. 40 - Landing gear - retracted.

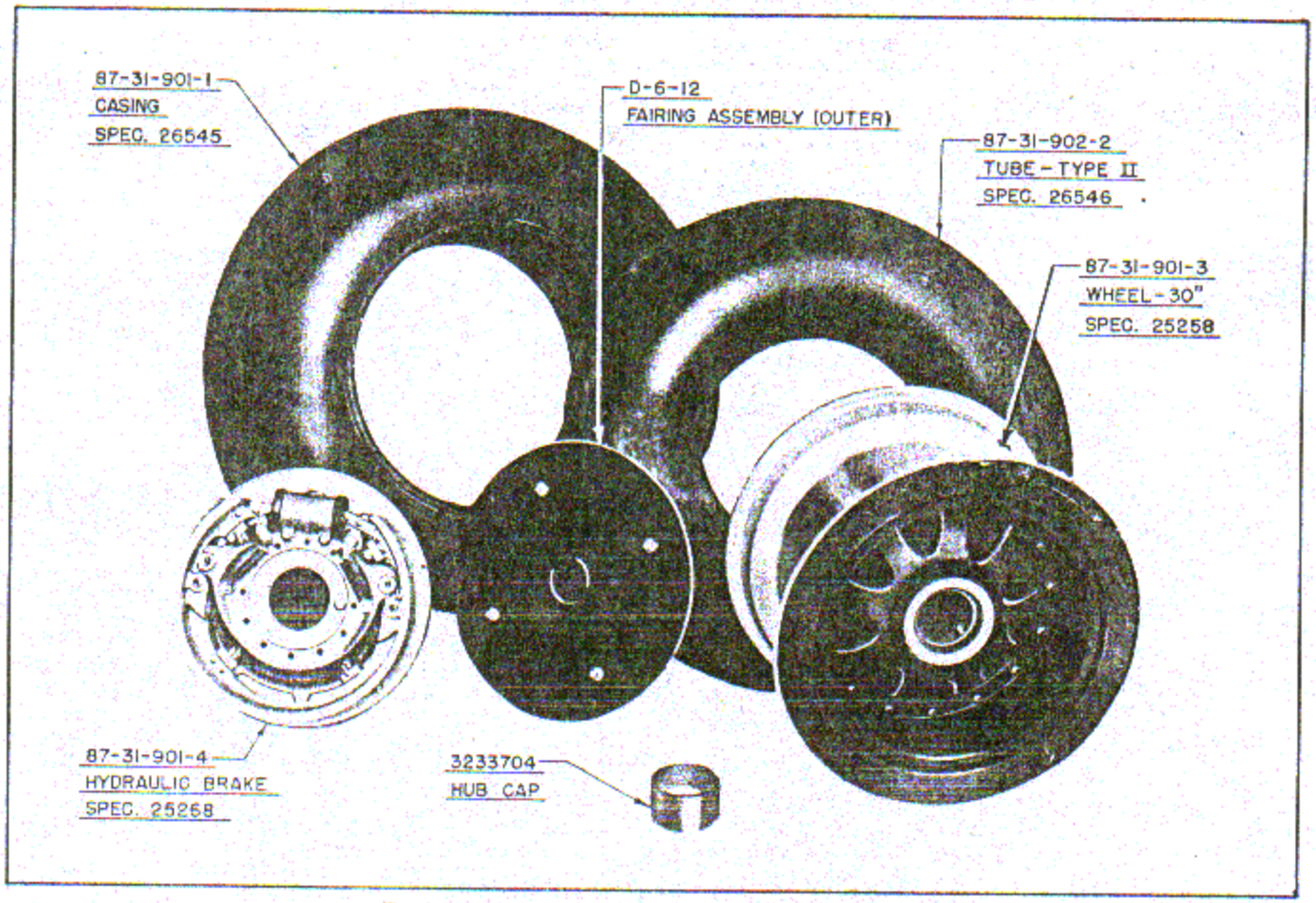


Fig. 41 - Wheel & brake assembly - disassembled.

(4) To Disassemble and Assemble Shock Absorber Strut: (a) To disassemble the shock absorber strut, vent the air pressure in the oleo strut, disconnect the torque scissors and turn the gland nut out of the cylinder, remove brake hose, then pull strut apart.

(b) To assemble the shock absorber strut: Reverse the instructions outlined in (a). In assembling the shock absorber strut care must be taken in screwing the packing gland nut into the cylinder.

(c) A pressure test, of the oleo strut assembly, using 50/50 alcohol and castor oil must show no leaks at 2800 P.S.I. Check specifically the solder joint, and the packing and metering pin on the cylinder assembly.

c. To Adjust Landing Gear Position Indicator Mechanism: See Figures 18 and 45. For additional information see "Adjustment", paragraph 2., Column 37, Section III of this Handbook.

d. Wheels, Brakes and Brake Master Cylinder Units. -

(1) General: The landing gear is equipped with 8 ply 30 inch diameter smooth contour casings, and puncture proof Type II tube. 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 87-32-901.

The brakes are actuated by pedals which are pivoted on the rudder pedal assembly and connected to master cylinder assemblies which are mounted on the back face of the armor plate at Station #2. The brake cylinders and master cylinders are connected by flexible rubber hose and 5/16" O.D. "Everdur" tubing.

(2) Detailed Operation of Brake Master Cylinder Units: The views on Figure 42 show the operation of the master cylinder unit when following the filling procedure recommended by the manufacturer of the unit as given on Figure 43. A description of the different views follows:

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

Second View - Brake in applied position with pressure in system.

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

(3) Filling and Bleeding Hydraulic Brake System: Figure 43 (2 views) gives the method for filling and bleeding the brake system recommended by the master cylinder manufacturer.

(4) To Disassemble Brake Master 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 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 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, which is 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 removed, check the drilled passages for obstruction with compressed air.

(c) Normally it will not be necessary to remove the packing spring from the housing - complete assembly. However, if removal of this spring is desired, proceed

BRAKE OFF

THIS PACKING IS ABOVE THE LIQUID LEVEL AND HAS NOTHING TO DO WITH THE OPERATION OF THE UNIT.

UPPER LEVEL INDICATING SCREW. KEEP LIQUID TO THIS LEVEL.

TRANSFER VALVE ASSEMBLY. SCREWED DOWN TIGHTLY ON GASKET.

THERE MUST BE A VENT HOLE IN FILLER OPENING PLUGS.

LOWER LEVEL INDICATING SCREW. IN CASE OF TROUBLE INSPECT HERE FOR LOWEST PERMISSABLE LEVEL.

THIS SPACER HOLDS THE COMPENSATING VALVE OPEN UNTIL BRAKE IS APPLIED.

OPEN LIQUID PASSAGE BETWEEN MASTER CYL. AND RESERVE CHAMBER INSURES COMPLETELY FILLED SYSTEM UNDER ATMOSPHERIC PRESSURE EVEN DURING THE MOST RAPID TEMP. CHANGES. SLIGHT LIQUID LOSSES IN THE SYSTEM WITH THE BRAKE OFF WILL BE SUPPLIED FROM THE RESERVE CHAMBER.

RETURN SPRING HOLDS UNIT AND BRAKE PEDAL IN RELEASED POSITION.

TO AVOID RATCHET MOVEMENT WHEN APPLYING THE BRAKE, CABLE OR WIRE TO THE INSTRUMENT PANEL FOR SETTING THE PARKING BRAKE MUST HAVE SLACK IN EXCESS OF THE PISTON TRAVEL.

BRAKE APPLIED

LIQUID LEVEL IN THE RESERVE CHAMBER MOVES WITH THE PISTON. THIS MOVEMENT IS MADE POSSIBLE BY THE VENT HOLE IN THE PLUG.

THIS GASKET SEALS PRESSURE IN SYSTEM.

THIS DISC VALVE HAS NOTHING TO DO WITH THE UNIT IN OPERATION AS PRESSURE IS SEALED BY THE GASKET AS INDICATED ABOVE

COMPENSATING VALVE CLOSED BY PRESSURE IN CYLINDER

LIQUID UNDER PRESSURE IS FORCED INTO THE WHEEL CYLINDER APPLYING THE BRAKES.

ROTATED SECTIONAL VIEW THESE LINES INDICATE THE TRANSMISSION OF FORCE THRU ENTIRE UNIT.

PARKING SPRING INEFFECTIVE AS FORCE IS TRANSMITTED THRU THE PARKING SPRING LOCK AS SHOWN.

THE PARKING SPRING LOCK MUST REMAIN IN POSITION SHOWN WHEN THE BRAKE IS NOT TO BE PARKED. THIS WILL BE OBTAINED BY PROPER SLACK IN THE RATCHET CABLE.

TRAVEL OF THE LOWER FITTING EQUALS THE PISTON TRAVEL.

EXTENDING FORCE FROM PRESSURE APPLIED TO THE BRAKE.

BRAKE PARKED

TO PARK BRAKE - PULL ON THE RATCHET CABLE; DEPRESS PEDALS AND KEEP TENSION ON THE RATCHET CABLE: RELEASE PRESSURE ON PEDALS; RELEASE THE RATCHET CABLE.

TO RELEASE PARKED BRAKE - PRESS ON BRAKE PEDALS. THIS CAUSES RATCHET TO RELEASE.

ALTERNATE FILLER AND BLEEDER OPENING MAY BE USED IN LIEU OF THE FILLER PLUGS IN UPPER END FITTING. THERE MUST BE A HOLE IN FILLER OPENING SCREW.

ALTERNATE TRANSFER VALVE DESIGN, WITHOUT GLAND, USING MOLDED PACKING OF ROUND CROSS SECTION.

UNIT LOCKED BY RATCHET IN THE EXTENDED POSITION. FORCE ON RATCHET OVERCOMES THE TENSION OF THE RATCHET RETURN SPRING. THE EXTENSION FORCE APPLIED TO THE RELEASE BRAKE REMOVES THE LOAD FROM THE RATCHET WHICH IS SNAPPED BACK TO THE RELEASED POSITION BY THE RATCHET RETURN SPRING. THE UNIT IS RETURNED TO FULLY RELEASED POSITION BY THE CONTROL UNIT RETURN SPRING WHEN THE LOAD ON THE BRAKE PEDAL IS REMOVED.

EXTENDING FORCE COMPRESSES PARKING SPRING.

PARKING SPRING DEFLECTION. CONTRACTION OF THE LIQUID IN SYSTEM OR SLIGHT LEAK WHILE PARKED IS COMPENSATED BY EXTENSION OF PARKING SPRING WHICH DECREASES THE SPRING DEFLECTION. IF A LEAK IS SUFFICIENT TO CONSUME THE ENTIRE PARKING SPRING DEFLECTION. THE LOAD ON THE RATCHET IS REMOVED AND IT SNAPS BACK TO THE RELEASED POSITION. EXPANSION OF THE LIQUID IS COMPENSATED BY COMPRESSION OF THE SPRING DEFLECTION.

TRAVEL OF LOWER FITTING NOW EQUALS PISTON TRAVEL PLUS PARKING SPRING DEFLECTION

OPERATION OF THE HYDRAULIC PART OF UNIT AS EXPLAINED IN ADJACENT COLUMN.

PULL ON CABLE WHILE PARKING BRAKE AS PER INSTRUCTIONS ABOVE.

RATCHET RETURN SPRING

NO EXTENDING FORCE AFTER SETTING OF RATCHET.

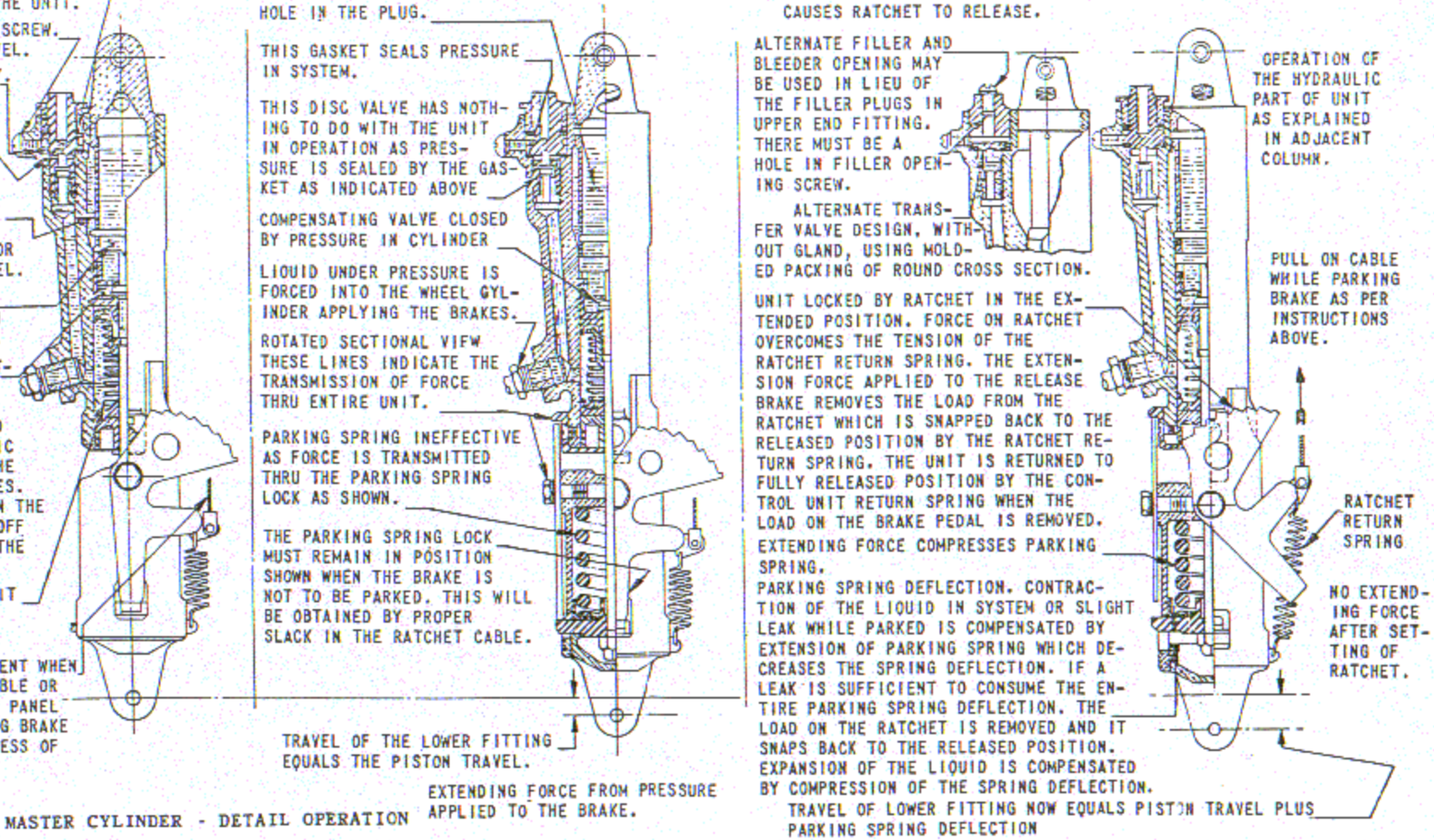


FIG. 42 - BRAKE MASTER CYLINDER - DETAIL OPERATION

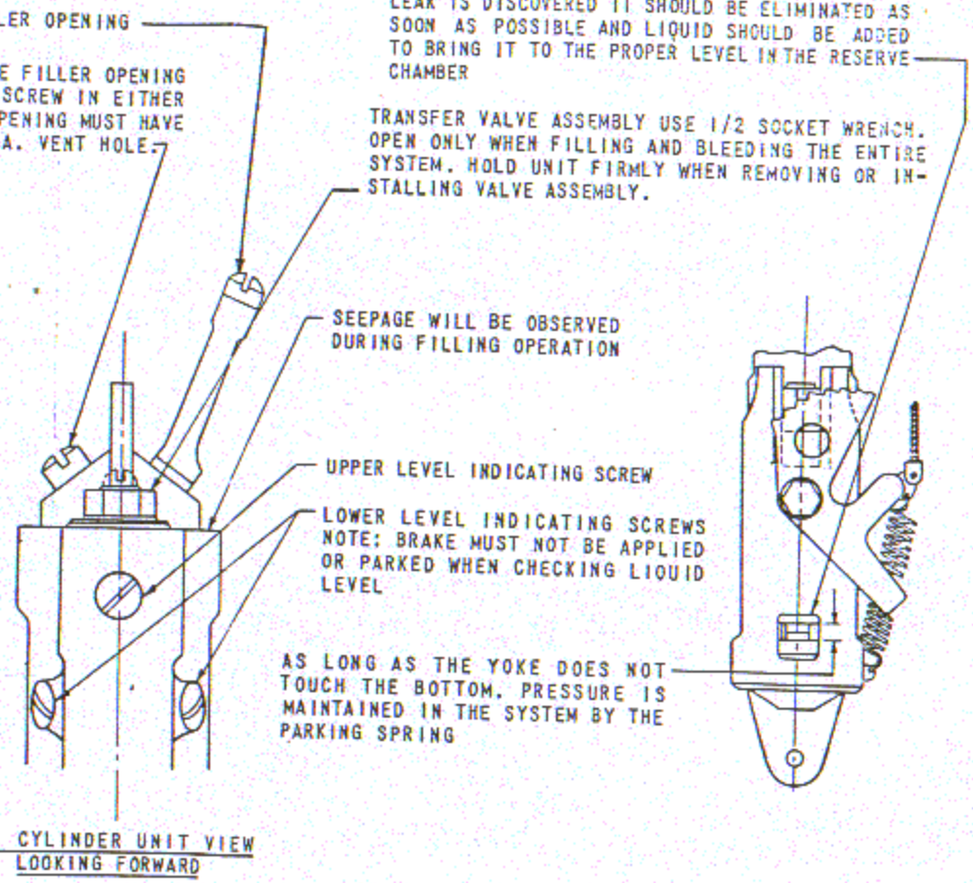
FILLING AND BLEEDING INSTRUCTIONS FOR HYDRAULIC BRAKE CONTROL UNIT

EFORE 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.



R.H. CYLINDER UNIT VIEW
LOOKING FORWARD

FIG. 43 - BRAKE MASTER CYLINDER - SERVICE INSTRUCTIONS

as follows: Remove the ratchet return spring, place a 2" piece of 1-5/8" bar stock on the table of an arbor press and set the housing, with the slotted guides pointing downward, over the bar. By doing so, the load, when applied, will not be taken on the slender guides extending downward. Cut two 3/4" wide by 1" deep slots at one end of an approximately 6" long piece of 1-3/4" 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 guide 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.

(5) To Assemble Brake Master Cylinder Units:

(a) When reassembling, hold the transfer valve assembly upside down, drop in the disc and make sure that it lies flat to avoid damaging the seat 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 is screwed on.

(b) Before assembling, grease the entire inside of the housing with heavy grease of high melting point,

ADJUSTMENT OF BRAKE TREADLE ANGLE

(1) PLACE THE RUDDER PEDALS IN NEUTRAL POSITION, SET THE PEDAL LENGTH ADJUSTMENT IN NEUTRAL (PEDAL ADJUSTMENT LOCKING PIN IN CENTER HOLE (A)), AND PLACE THE BRAKES IN THE OFF POSITION.

(2) LOOSEN LOCK NUT AND ROTATE (B) COUNTER-CLOCKWISE UNTIL IT IS FLUSH WITH THE BOTTOM SURFACE OF LEVER (C).

(3) DISCONNECT AND ADJUST THE CLEVIS ENDS ON RODS (D) AND (E) UNTIL THEY EITHER COVER THEIR INSPECTION HOLES (F) AND (G) BY ONE COMPLETE TURN, OR UNTIL THE TOP OF THE BRAKE TREADLE (H) HAS MOVED FORWARD TO POINT (I). WHEN THE RODS ARE TEMPORARILY RECONNECTED.

(4) BE SURE THAT THE PARKING BRAKE RATCHET IS SEATED FULLY AT POINT (J) AND THAT THE BRAKE CYLINDER (K) IS FULLY COMPRESSED (OFF POSITION) BEFORE CONNECTING THE RODS.

(5) CONNECT RODS AND SAFETY.

(6) ROTATE STOP BOLT (B) CLOCKWISE UNTIL IT TOUCHES POINT (M) AND TIGHTEN THE LOCK NUT.

NOTE: CHECK ADJUSTMENT BY OPERATING THE PARKING BRAKE SEVERAL TIMES. THE PARKING BRAKE RATCHET SHOULD RETURN TO POINT (J) WHEN THE PARKING BRAKE IS OFF. IF IT DOES NOT RETURN TO ITS PROPER POSITION, CHECK THE PARKING BRAKE CONTROL AND CABLE LENGTH.

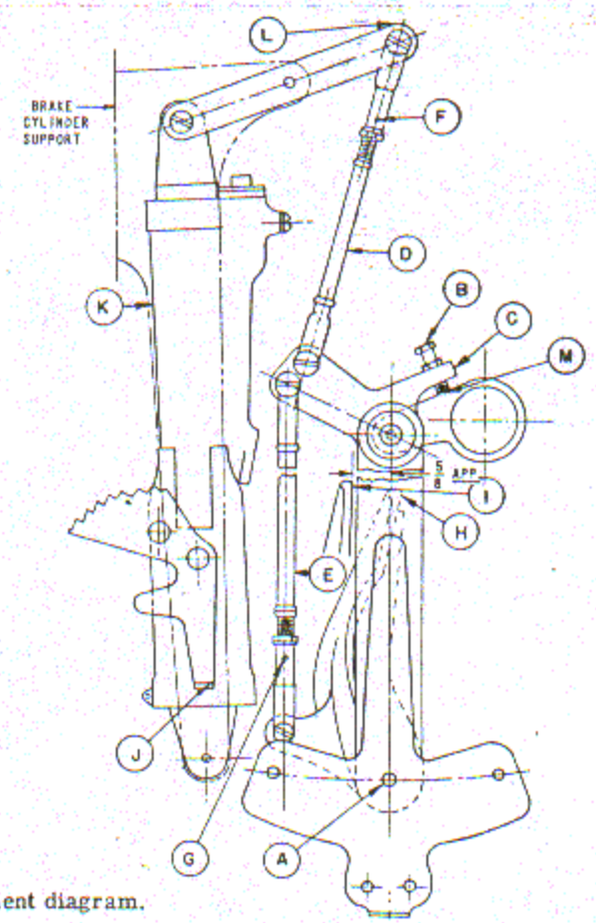


Fig. 44 - Brake treadle adjustment diagram.

preferably rocker arm lubricant, A.C. 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" 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 which causes considerable drag. Use some heavy grease on the threads of the upper end fitting and locating screw, as this will protect threads from corrosion and seal against slight seepage during filling and bleeding operation. If desired, a non-hardening sealing compound such as key paste may be used. Apply sparingly to keep grease or compound away from brake fluid which is in contact with upper end fitting.

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

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

a. General. - (1) Steering Cables: The cables connecting the tail wheel steering horn to the rudder pedals are equipped with springs to reduce taxiing shocks in the rudder pedal control system.

(2) Retracting Mechanism: The tail wheel retracting mechanism consists of an hydraulic retracting cylinder, (87-37-905), mounted on fuselage frames #13 and #14. See Figures 46 & 47. The piston rod extends forward from the cylinder and carries a lug to which the upper end of the oleo shock absorber strut is attached by a bolt. The piston rod extends forward of Sta. #11 and is supported by braces from Sta. #11 and #12. During retraction the piston and rod are forced forward carrying the upper oleo support with it. The oleo strut (87-37-510) is attached by a 3/8" diameter bolt directly to the lug on the retracting piston rod. For general instructions covering air-oil shock absorber struts see T. O. No. 03-25E-1. For information on the operation of the retracting cylinder and the hydraulically operated positive type mechanical

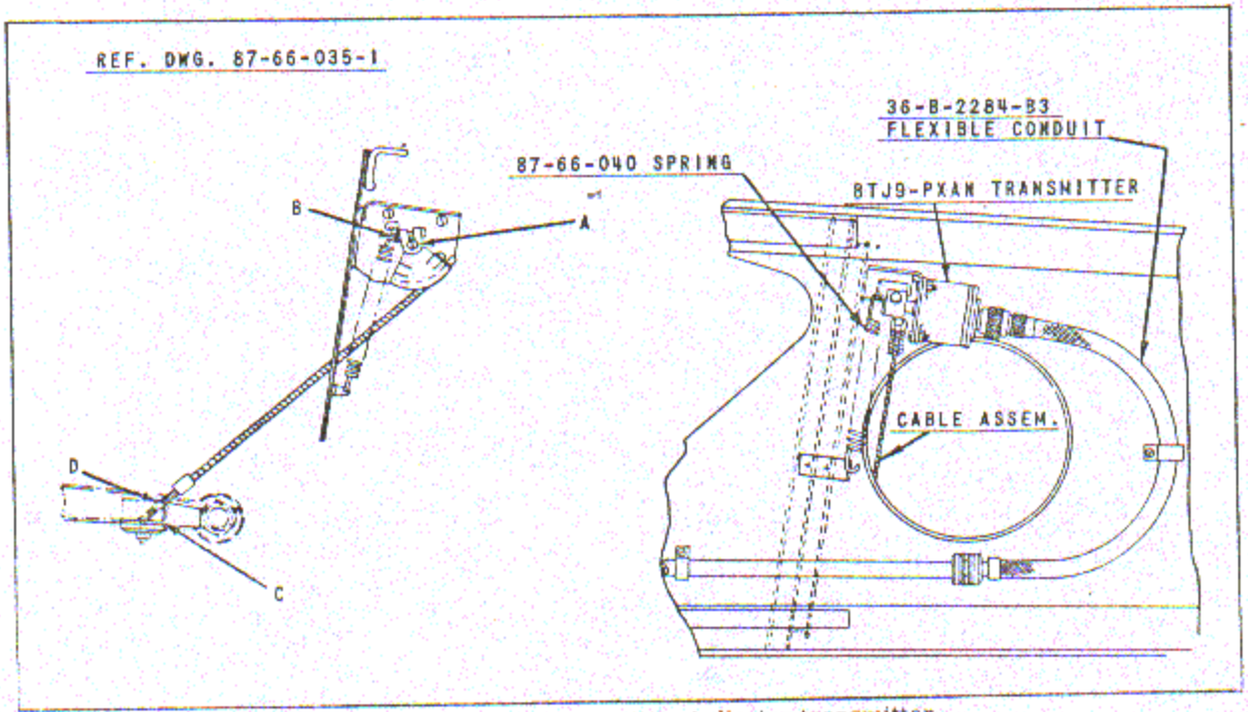


Fig. 45 - Landing gear position indicator transmitter.

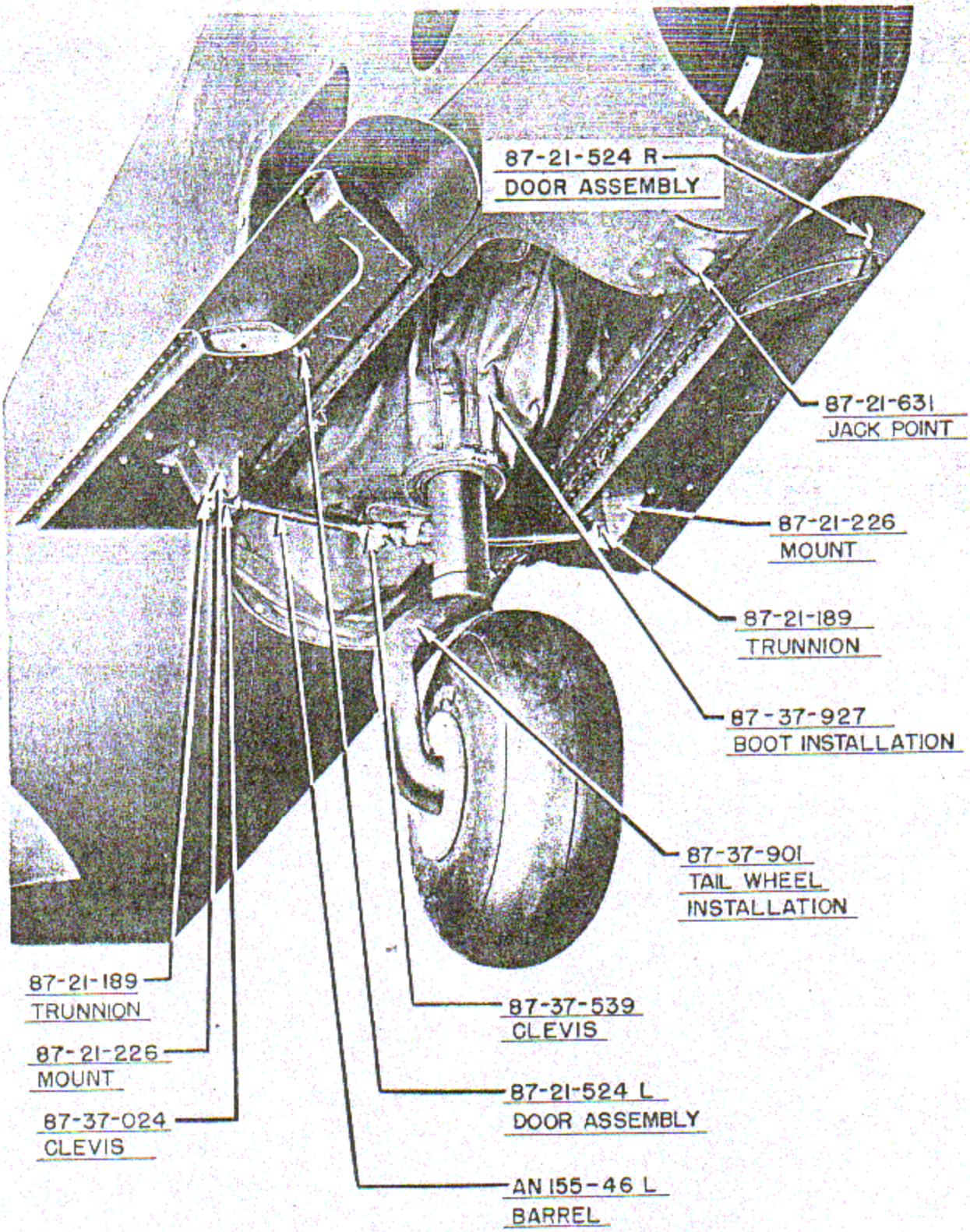


Fig. 46 - Tail wheel installed.

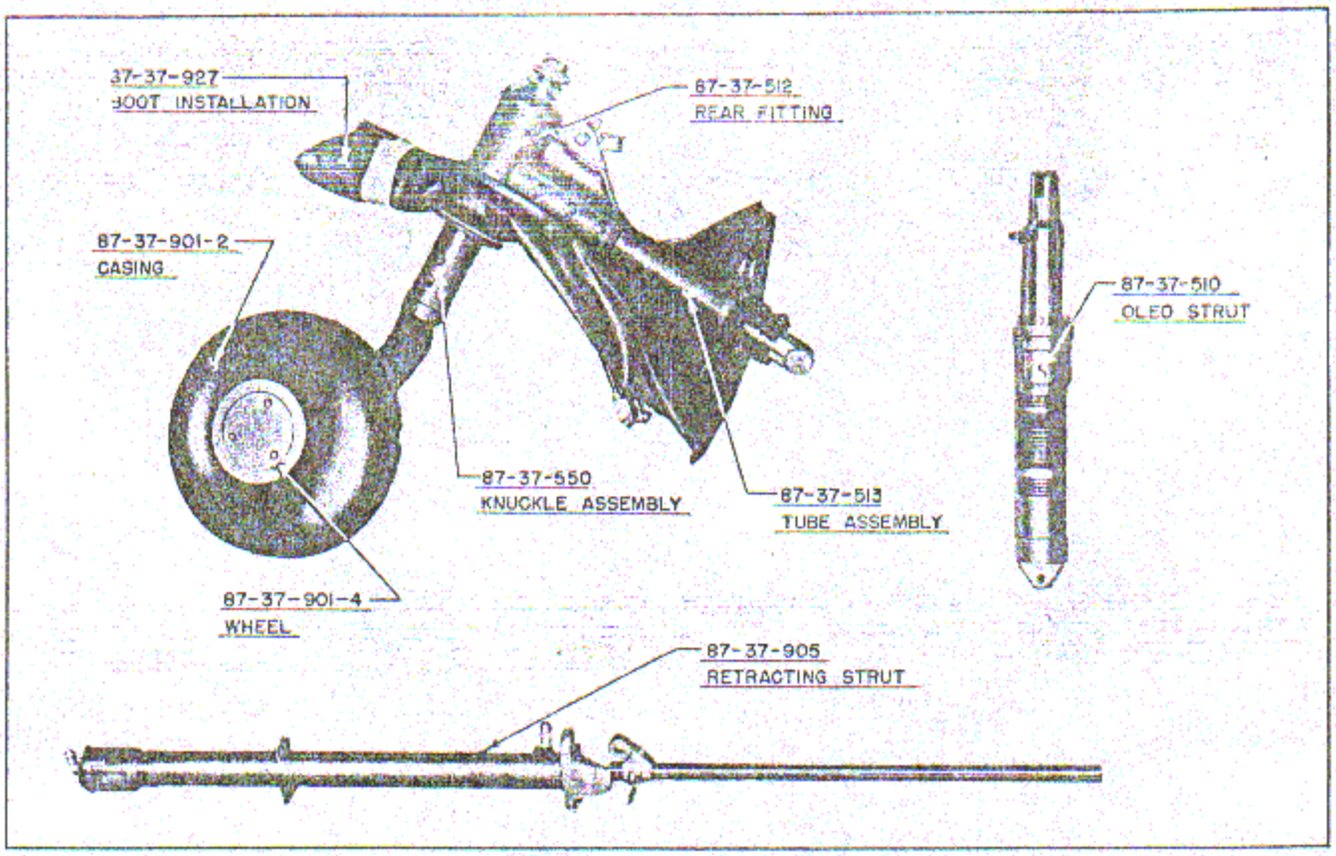


Fig. 47 - Tail wheel details.

lock see paragraph 18., a., 8, of this section. The position indicator transmitter (8TJ9PXAN) is connected electrically to the position indicator instrument on the instrument panel, and is mounted just aft of Sta. #12.

b. Removal and Disassembly. -

(1) To Remove Tail Wheel Assembly: (a) Disconnect the tail wheel door turnbuckles at the doors.

(b) Remove the screws from around the edge of the boot.

(c) Disconnect the tail wheel steering cables.

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

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

(f) Remove the tail wheel and the drag link through the tail wheel opening in the fuselage.

(g) Remove the bolt at the upper end of the oleo strut and remove the strut through the tail wheel opening in the fuselage.

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

(i) Remove the two bolts at the front and two bolts at the middle 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 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 P. S. I. must show no sign of leakage.

c. Adjustment of 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 door and adjust turnbuckle and disconnect at upper end. Repeat for opposite side. Lower tail wheel and attach both turnbuckles.

d. To Adjust Tail Wheel Position Indicator Mechanism.

Hoist the airplane so that the landing gear main wheels and tail wheel can be raised and lowered. Proceed as outlined for adjusting the landing gear position indicator in paragraph 2, Column 37, of Section III. The length of the actuating arm at the transmitter shaft may have to be changed more for a corresponding change in

the tail wheel image travel than for the landing gear mechanism. The tail wheel transmitter is accessible through the hand hole on the right hand side of the fuselage immediately forward of the horizontal stabilizer.

8. Engine and Accessories.

a. Engine. - (1) General: The Rolls Royce Merlin Type V-1650-1, manufactured by the Packard Company, is a twelve cylinder, 60 degree, "VEE" type, liquid cooled engine. The engine incorporates straight toothed gears which drive the propeller at a reduction of 2.095:1 crankshaft speed and a single stage, centrifugal type supercharger, equipped with a two-speed drive mechanism.

The engine is attached to the engine mount by two bolts through each of the four feet which are cast integrally with the crankcase upper section and through the four mounting faces which are integral with the engine mount. Between the engine feet and each of the two front engine mounting faces is a strip of "Ferobestos", .300 of an inch in thickness. A cap is installed under the heads of the bolts which secure the two rear mounting feet of the engine to the engine mount. A strip of rubber .300 of an inch thick is installed between the cap and the top of each engine foot and between the bottom of each rear engine foot and the two rear mounting faces on the engine mount.

(2) Engine Data: As follows:

Bore	5.4 inches
Stroke	6.0 inches
Piston Displacement	1649.0 cubic inches
Compression Ratio	6.0:1
Supercharger Gear Ratio (Low Ratio)	8.15:1 crankshaft speed
Supercharger Gear Ratio (High Ratio)	9.49:1 crankshaft speed
Blower Impeller Diameter	10.25 inches

An automatic overload clutch is used and a dual auxiliary drive for the propeller governor and vacuum pump is provided on the face of the reduction gear housing.

(3) Supercharger: The single stage centrifugal type supercharger is equipped with a two-speed drive mechanism which drives the supercharger impeller at 8.15:1 crankshaft speed (low ratio); or 9.49:1 crankshaft speed (high ratio). The supercharger speed change is accomplished by operating the lever marked "S" on the engine control unit in the cockpit. This lever actuates a valve in the engine scavenge oil system that controls the servo-mechanism which operates the semi-centrifugal drive clutches.

(4) Exhaust System: The exhaust stacks are attached to the cylinder head and project through the engine shroud cowling exhausting directly into the slip stream.

(a) Removal of Exhaust Stacks: Remove the exhaust stacks by removing the four brass nuts from each stack flange.

WARNING: When removing the exhaust stacks, exercise caution to avoid dropping the nuts into the exhaust port where they will enter the cylinder and cause extreme damage to the engine.

(b) Installation of Exhaust Stacks: Always replace the exhaust stack gasket when installing the exhaust stack. Tighten the stack brass nuts evenly to avoid distorting the stack flange.

(5) Carburetor Air Intake System: The carburetor cold air intake duct is located within, but is built independent of the coolant radiator cowl (Dwg. 87-29-920). The carburetor warm air duct (Dwg. 87-29-966) opens into the coolant radiator cowl exit duct aft of the radiator and transmits the warm air to the carburetor air intake elbow. The carburetor air intake elbow is equipped with a dual vane type valve which directs the flow of air to the carburetor. When the lower half of the valve is open admitting cold air, the upper half of the valve is closed restricting the warm air passage; when the valve is turned to admit warm air the cold air passage is restricted. The valve is controlled by a push-pull knob located in the cockpit. The carburetor is equipped with a screen which is located above the air scoop to prevent passage of any foreign matter into the carburetor.

(6) Rubber Seals: The carburetor, oil temperature regulator and coolant radiator air intake systems are of the ramming type, therefore, it is essential that the rubber seals used to close the gaps between the sections of these systems be properly secured and in good condition.

b. Accessories and Accessory Drives. - All power plant accessories may be removed without removing the engine or any part of the airplane structure.

The drive and direction of rotation of each accessory in ratio to the engine crankshaft speed when facing the respective mounting pad on the engine is as follows:

	Gear Ratio in Multiples of Crankshaft Speed.	Direction of Rotation When Facing Each Pad.
Fuel Pump (Elec. Driven) G-6 Generator	1.954:1	Clockwise
Fuel Pump (Eng. Driven) G-9	.60 :1	Counter-clockwise
Vacuum Pump (B-6 or B-11)	.828:1	Counter-clockwise
Magnetos	1.50 :1	Clockwise and Counterclockwise
100008-3 Propeller Governor	.828:1	Counter-clockwise
Tachometer (Type II)	.5 :1	Counter-clockwise
Starter	101.70 :1	Counter-clockwise

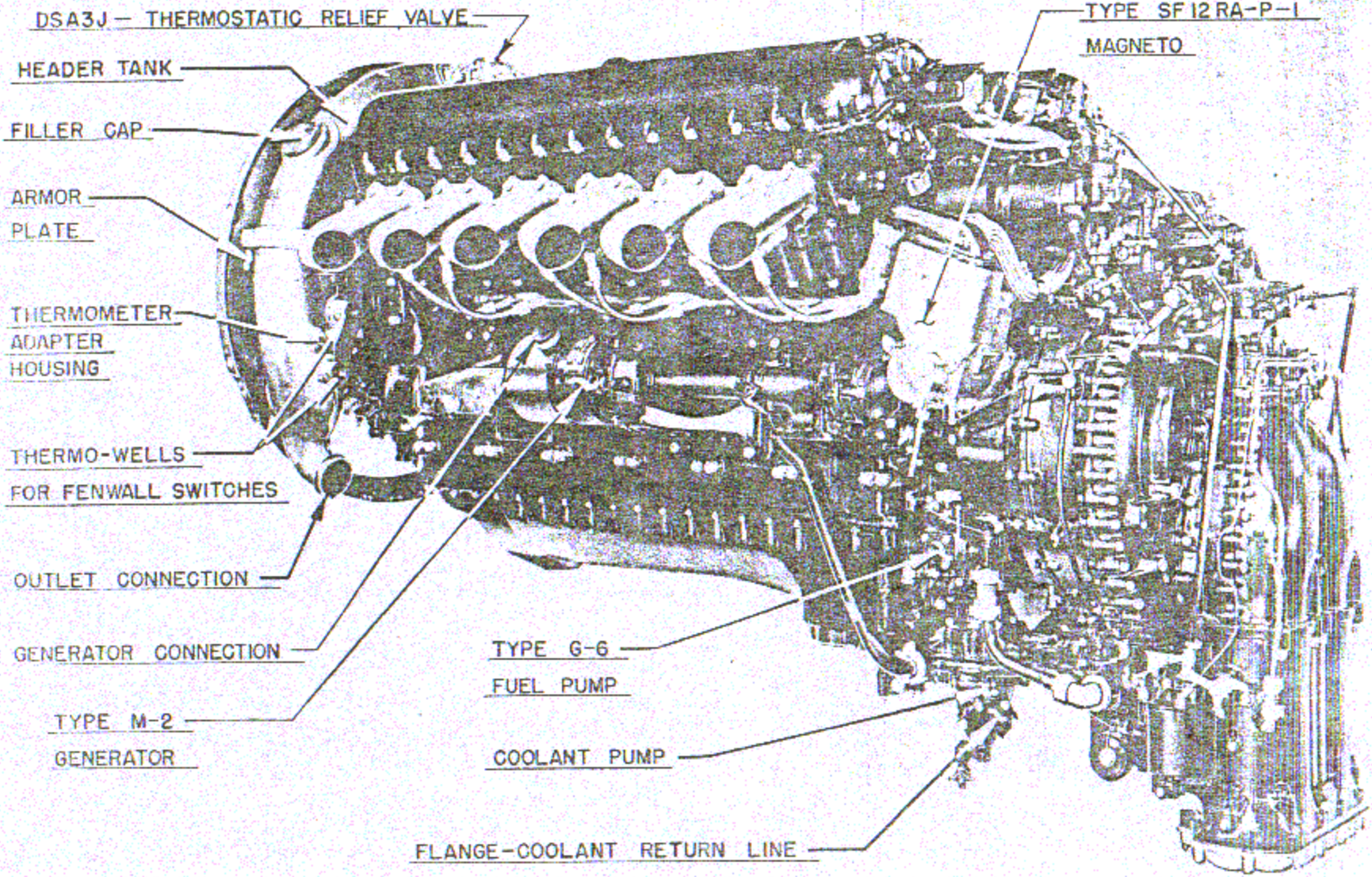


Fig. 48 - Power plant - left side.

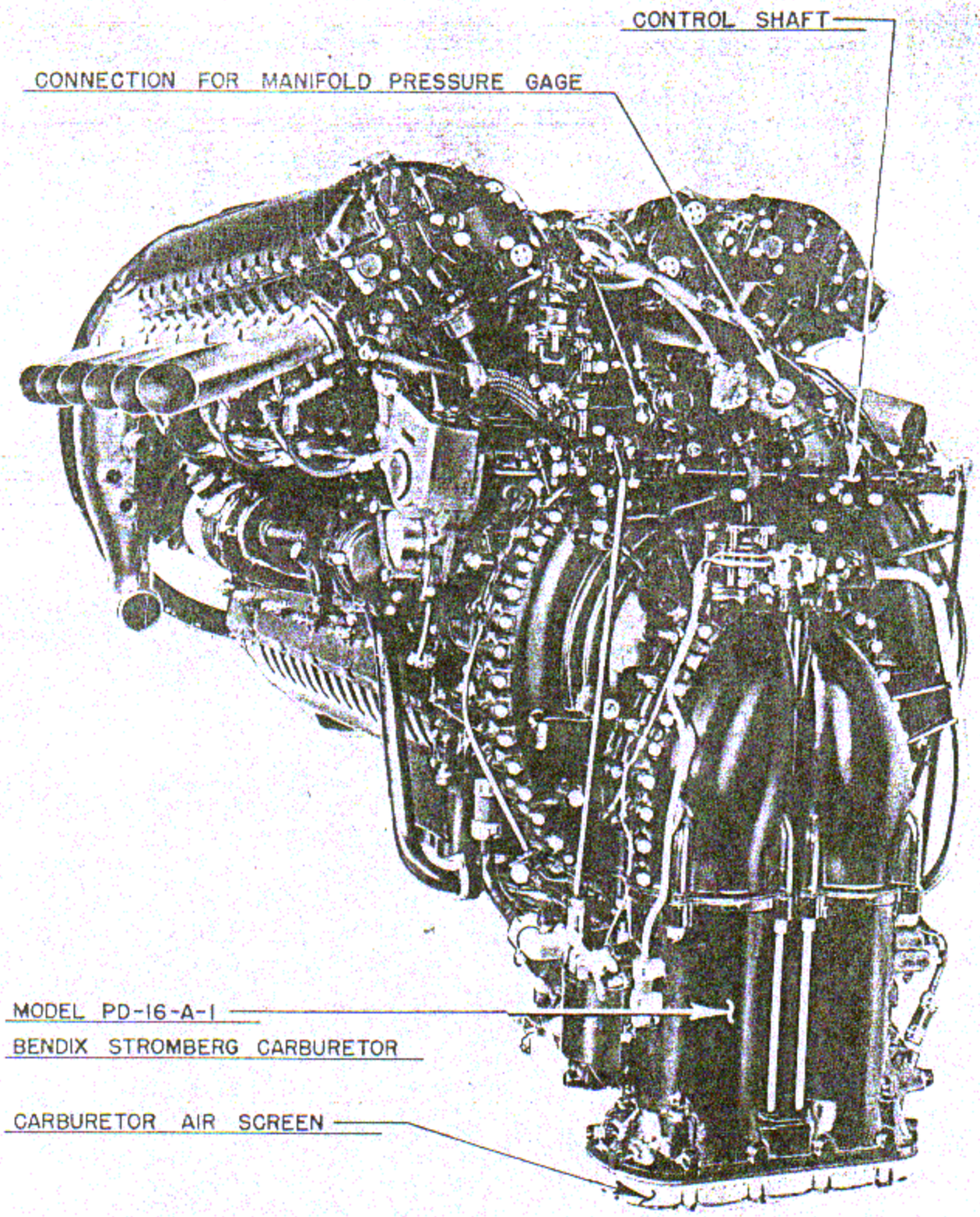


Fig. 49 - Power plant - 3/4 view - left rear.

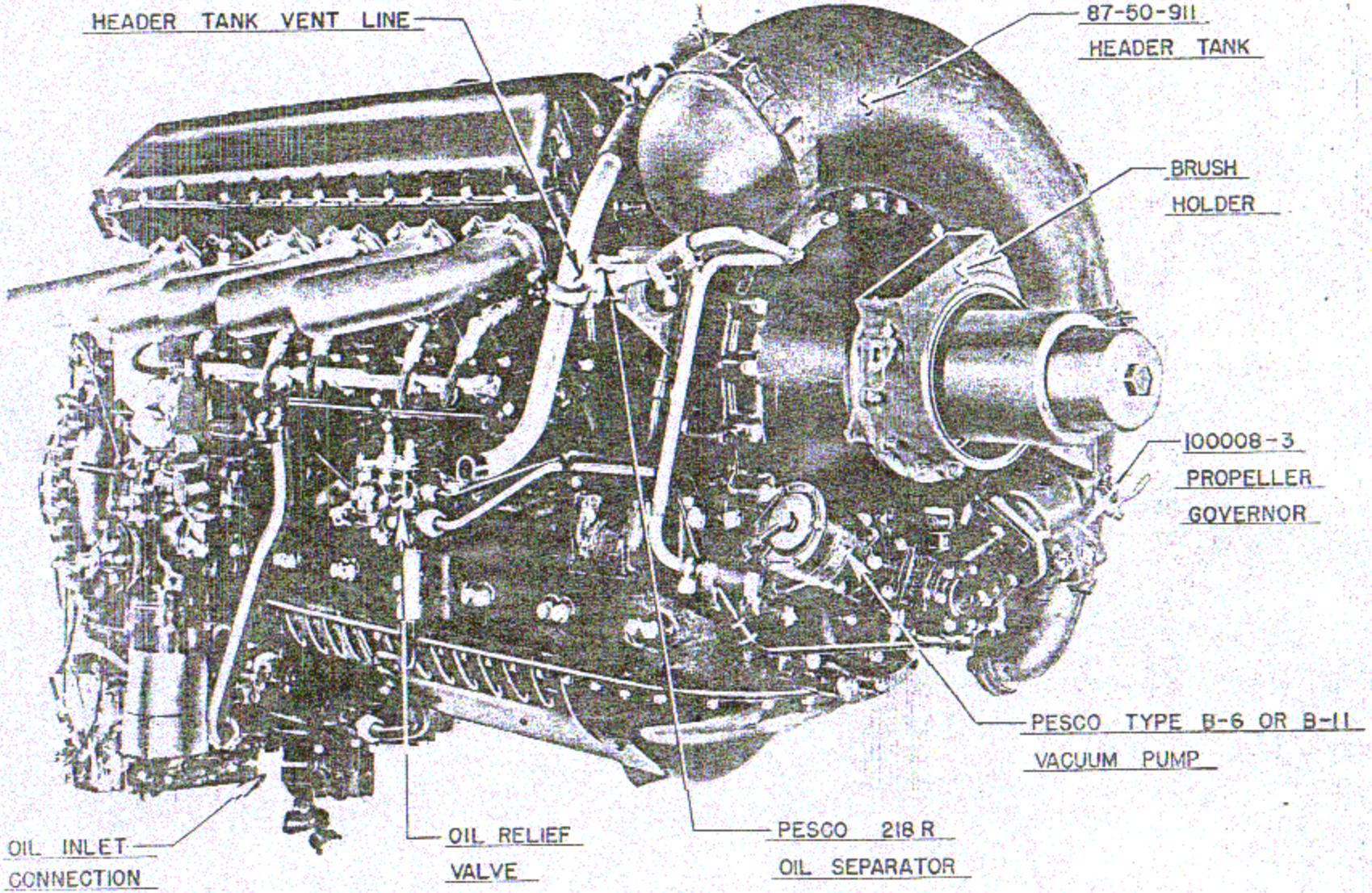


Fig. 50 - Power plant - 1/4 view - right front.

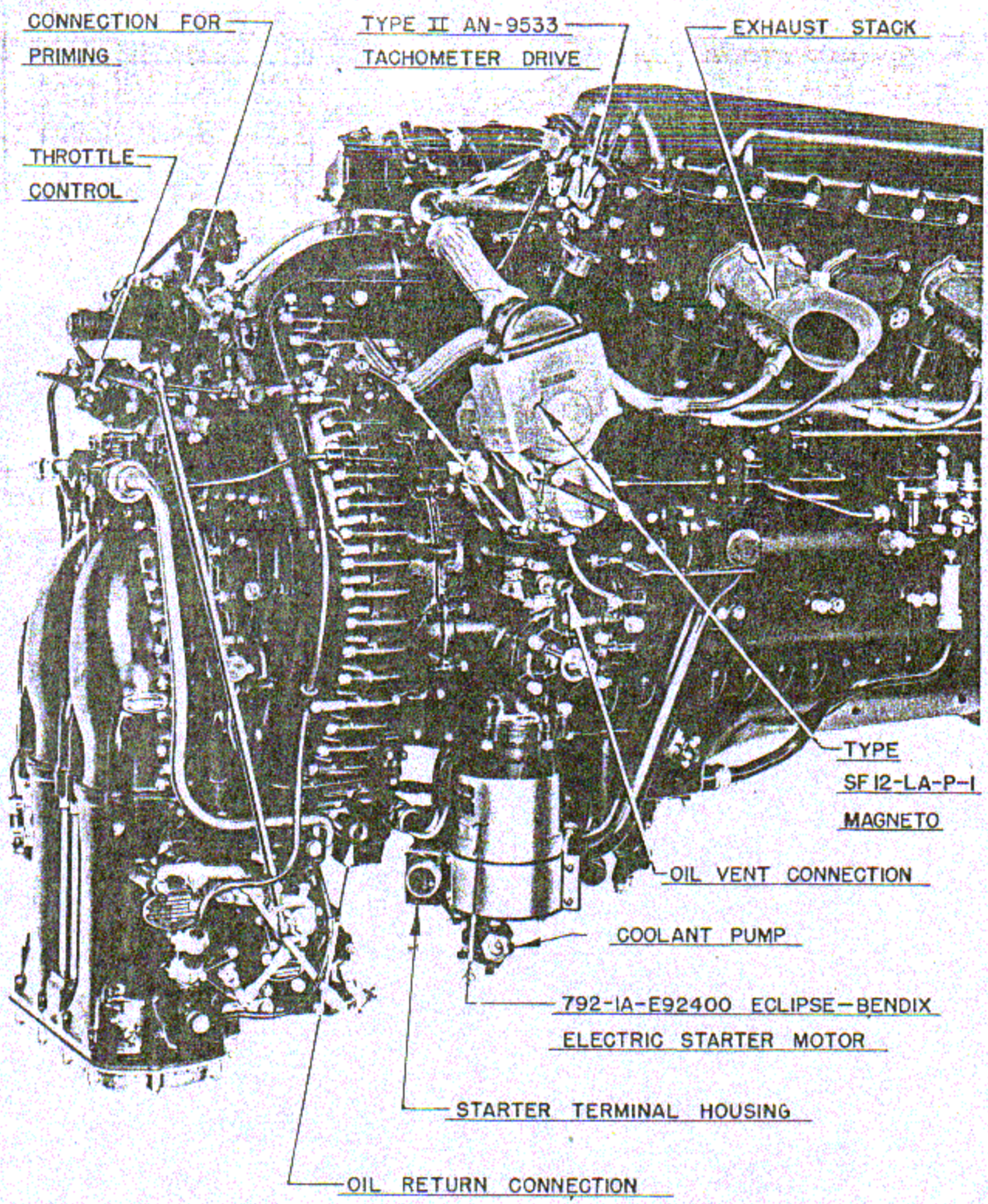
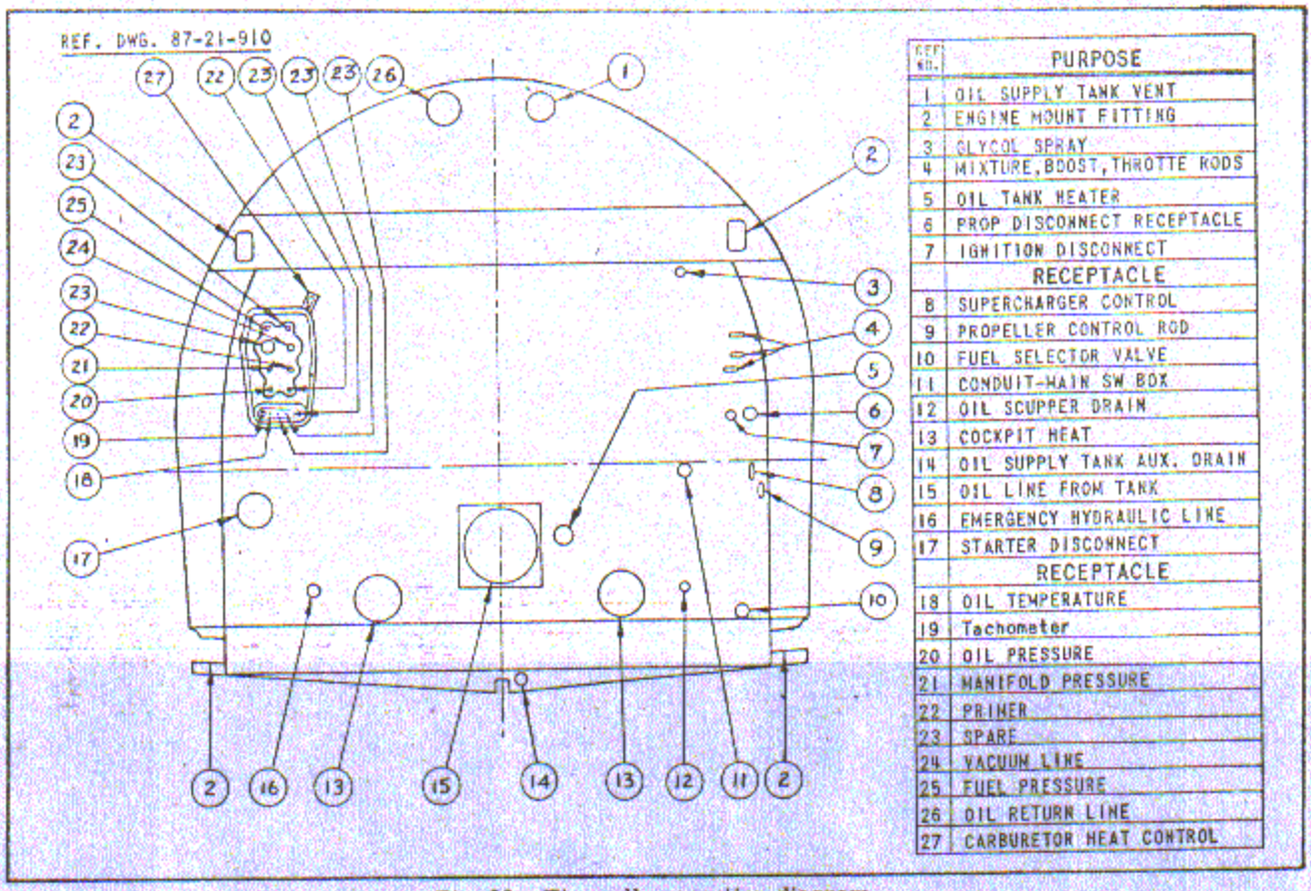


Fig. 51 - Power plant - right rear view.



REF. NO.	PURPOSE
1	OIL SUPPLY TANK VENT
2	ENGINE MOUNT FITTING
3	GLYCOL SPRAY
4	MIXTURE, BOOST, THROTTE RODS
5	OIL TANK HEATER
6	PROP DISCONNECT RECEPTACLE
7	IGNITION DISCONNECT RECEPTACLE
8	SUPERCHARGER CONTROL
9	PROPELLER CONTROL ROD
10	FUEL SELECTOR VALVE
11	CONDUIT-MAIN SW BOX
12	OIL SCUPPER DRAIN
13	COCKPIT HEAT
14	OIL SUPPLY TANK AUX. DRAIN
15	OIL LINE FROM TANK
16	EMERGENCY HYDRAULIC LINE
17	STARTER DISCONNECT RECEPTACLE
18	OIL TEMPERATURE
19	Tachometer
20	OIL PRESSURE
21	MANIFOLD PRESSURE
22	PRIMER
23	SPARE
24	VACUUM LINE
25	FUEL PRESSURE
26	OIL RETURN LINE
27	CARBURETOR HEAT CONTROL

Fig. 52 - Firewall connection diagram.

(1) Carburetor: The engine is equipped with a Bendix-Stromberg PD-16A-1 up draft, two barrel pressure injection type carburetor. The carburetor is mounted on the bottom of the supercharger inlet elbow.

(2) Ignition: Ignition is furnished by two, Delco Magnetos, Finish Type C5-SE12S-2. When viewing the rear end of the engine, the type SF 12LA-P-1 magneto is located at the rear of the right bank of cylinders and fires the spark plugs located on the intake side of each bank of cylinders. The magneto located at the rear of the left bank of cylinders is a type SF 12RA-P-1 and fires the spark plugs which are located on the exhaust side of each bank of cylinders. When viewing the driving end of each magneto, the shaft of the right magneto rotates in a counterclockwise direction, and the shaft of the left magneto rotates in a clockwise direction. The magneto shaft speed is 1.5:1 crankshaft speed. The ignition cables are carried to the respective spark plugs within four separate manifolds which are attached to the engine by cap screws. One tube on each side of the engine carries cold air from the opening of the radiator cowl for cooling the spark plugs on the exhaust side of each bank of cylinders. All parts of the ignition system are shielded against radio interference.

(3) Starting: The Eclipse-Bendix electric starting motor, model 792-1A-E92400 is of the direct drive type and is mounted on the right side at the rear of the engine.

c. Removal of Engine and Accessories. - (1) General: The engine can readily be removed as a unit from the airplane without detaching the magnetos, coolant pump, carburetor, propeller governor, vacuum pump, starter, generator, or any other accessory which is properly a part of the engine unit, with the exception of the engine driven fuel pump. Neither is it necessary to remove any part of the airplane structure nor to remove the engine mount from the fuselage. Proceed with the removal, as follows: drain fuel, oil and coolant system, and remove all sections of the engine and coolant radiator cowlings. It is not necessary to remove the coolant radiator, oil coolers, the self-contained system of coolant radiator shutters or the carburetor air intake scoop or heat control. The propeller and spinner must be removed (See 10., b., this section).

(2) Engine Controls: Push-pull rods and bellcranks which are connected to the engine control unit in the cockpit for actuating the throttle, mixture, boost, supercharger speed change, and propeller governor must be disconnected according to the following procedure:

(a) Mixture Control: Disconnect the rod which is attached to the right end of the engine control torque shaft (on the engine mount) from the bellcrank on the torque shaft (on the engine) that operates the mixture control rod.

REFERENCE DRAWING NO. 87-52-901

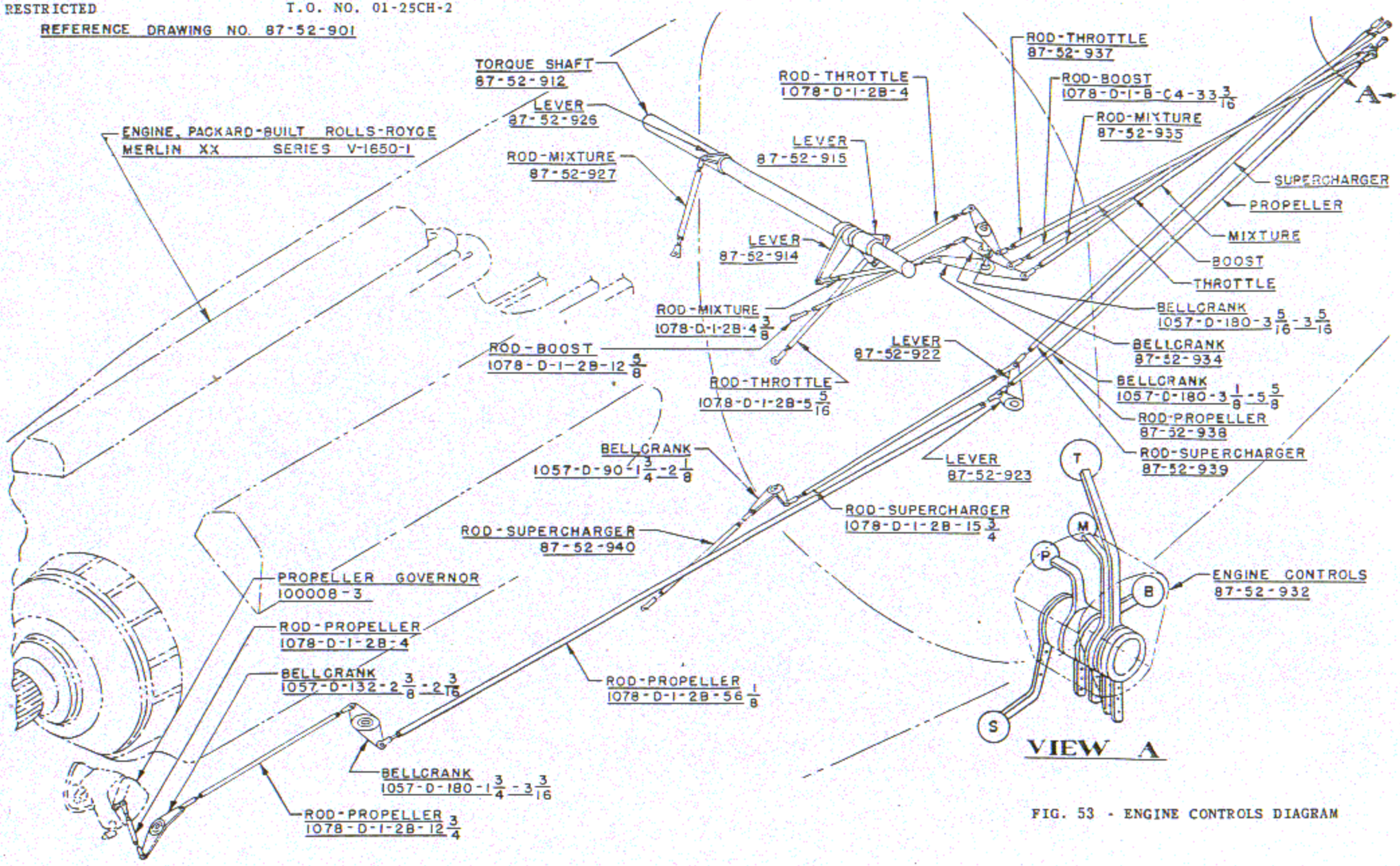


FIG. 53 - ENGINE CONTROLS DIAGRAM

(b) Throttle Control: Disconnect the rod on the left end of the engine control torque shaft (on the engine mount) that is connected to the bellcrank which is attached to the differential housing on the torque shaft mounted on the engine.

(c) Boost Control: Disconnect the rod at the boost control unit on the top left side and at the rear of the engine.

(d) Supercharger Control: Disconnect the rod at the supercharger servo-valve on the lower left side an . at the rear of the engine.

(e) Propeller Governor Control: Disconnect the rod at the propeller governor bellcrank on the left side front end of the engine.

(3) Fuel System: Lines identified by a red band on each side of every connection.

(a) At top, rear end: 1. Loosen hose clamps and hose.

2. Remove 1/4 inch copper line from engine primer, which is connected to supercharger inlet elbow.

(b) Bottom left rear side: 1. Loosen hose clamps and hose.

2. Detach 1/4 inch copper drain line from the engine driven fuel pump and from the drain fitting in the bottom of the fuselage.

3. Remove the line from the airplane.

4. Loosen the hose clamps on each end of the 3/4 inch (inside diameter) self-sealing fuel line between the engine driven and the electrically driven fuel pumps.

5. Remove the line from the airplane.

6. Loosen the hose clamps and hose on the 1/4 inch aluminum alloy vent line at the carburetor and at the top side of the right wing panel.

7. Remove the line from the airplane.

8. Loosen the hose clamps and hose on the 1/4 inch copper fuel pressure line at the carburetor and at the restricted fitting (37A3528) near the fuel pressure warning signal actuator unit.

9. Remove the line from the airplane.

(4) Oil System: The lines are identified by a yellow band on each side of every connection.

(a) Lower right side: 1. Loosen hose clamps and hose at the "Y" drain fitting and at the top of the oil filter.

2. Remove the 1 1/4 inch aluminum alloy tubing.

3. Disconnect supercharger involute drain.

4. Loosen hose clamps and hose at each end of the 1 1/4 inch aluminum alloy tube between the bottom of the oil filter and the engine oil pressure pump.

5. Loosen hose clamps and hose at: a. The 5/8 inch aluminum alloy vent line.

b. Vacuum line "TEE" fitting which is connected to the right side of the engine at the rear.

6. Loosen the hose clamps and hose at the 1/4 inch copper oil pressure line connected to the relief valve on the right side of the engine.

(5) Coolant System: The lines are identified by a white, black, and white band on each side of every connection.

(a) At the right forward side loosen the clamp at the return line to the coolant header tank.

(b) At the left forward side: 1. Loosen the clamps on the line at the base of the coolant header tank.

2. Remove from lower rear side of coolant header tank.

a. Electrical thermo switches (2).

b. Electric thermometer bulb.

(c) At the left rear side: loosen hose clamps and hose of the coolant return at the coolant circulating pump at the bottom near the rear end of the engine.

(6) Vacuum System: The lines are identified by a white, and green band on each side of every connection.

(a) At the front and right side:

1. Loosen hose clamps and hose.

2. Detach 1/2" aluminum alloy vent line at the vacuum relief valve.

3. Loosen hose clamps and hose at the vacuum pump.

4. Remove line.

(7) Electrical Conduits: Disconnect the three flexible conduits at the junction box on the right side of the forward part of the engine, at booster coil box on the left side of the engine and the magneto ground wires.

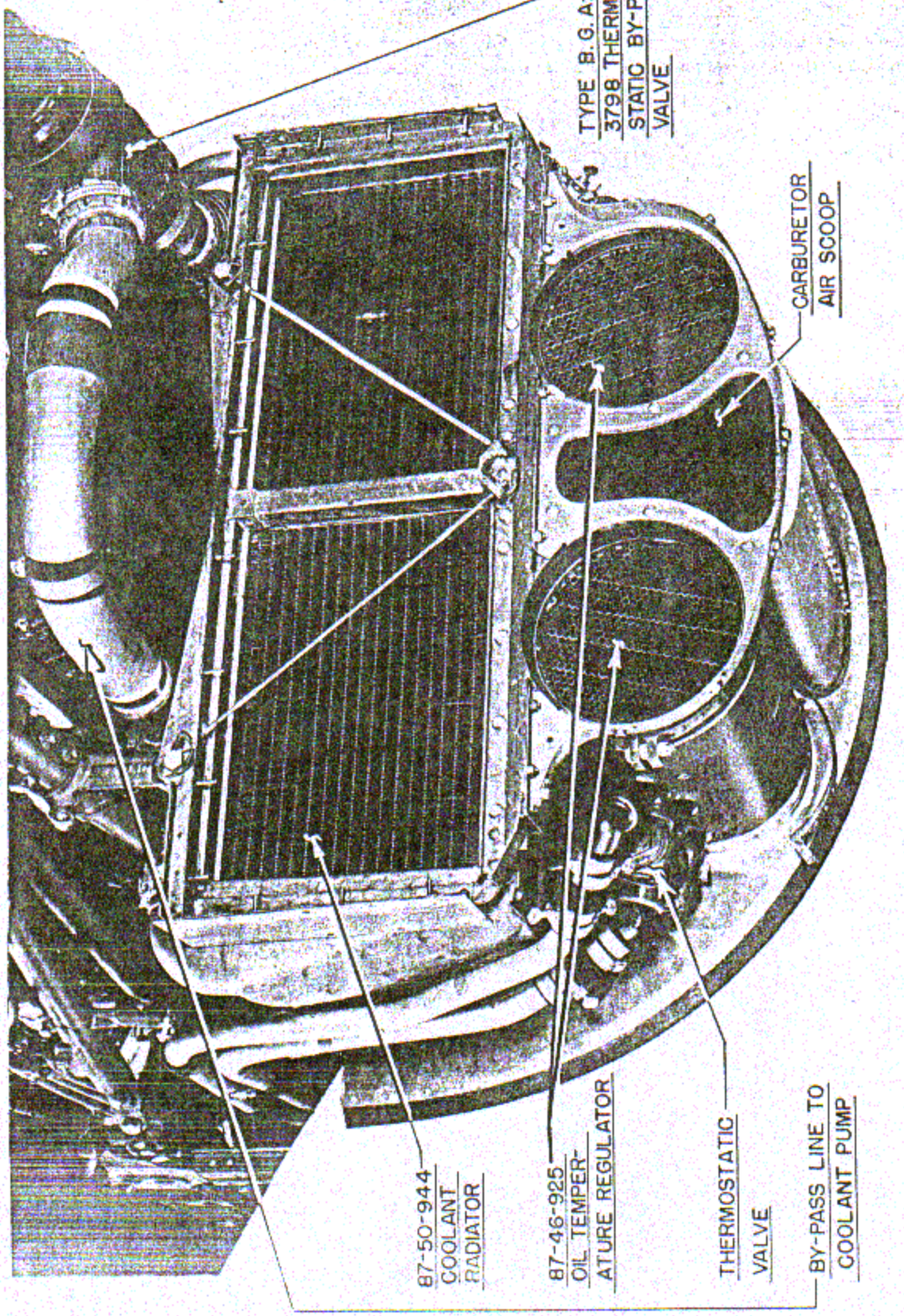


Fig. 54 - Coolant radiator - oil coolers - carburetor air scoop.

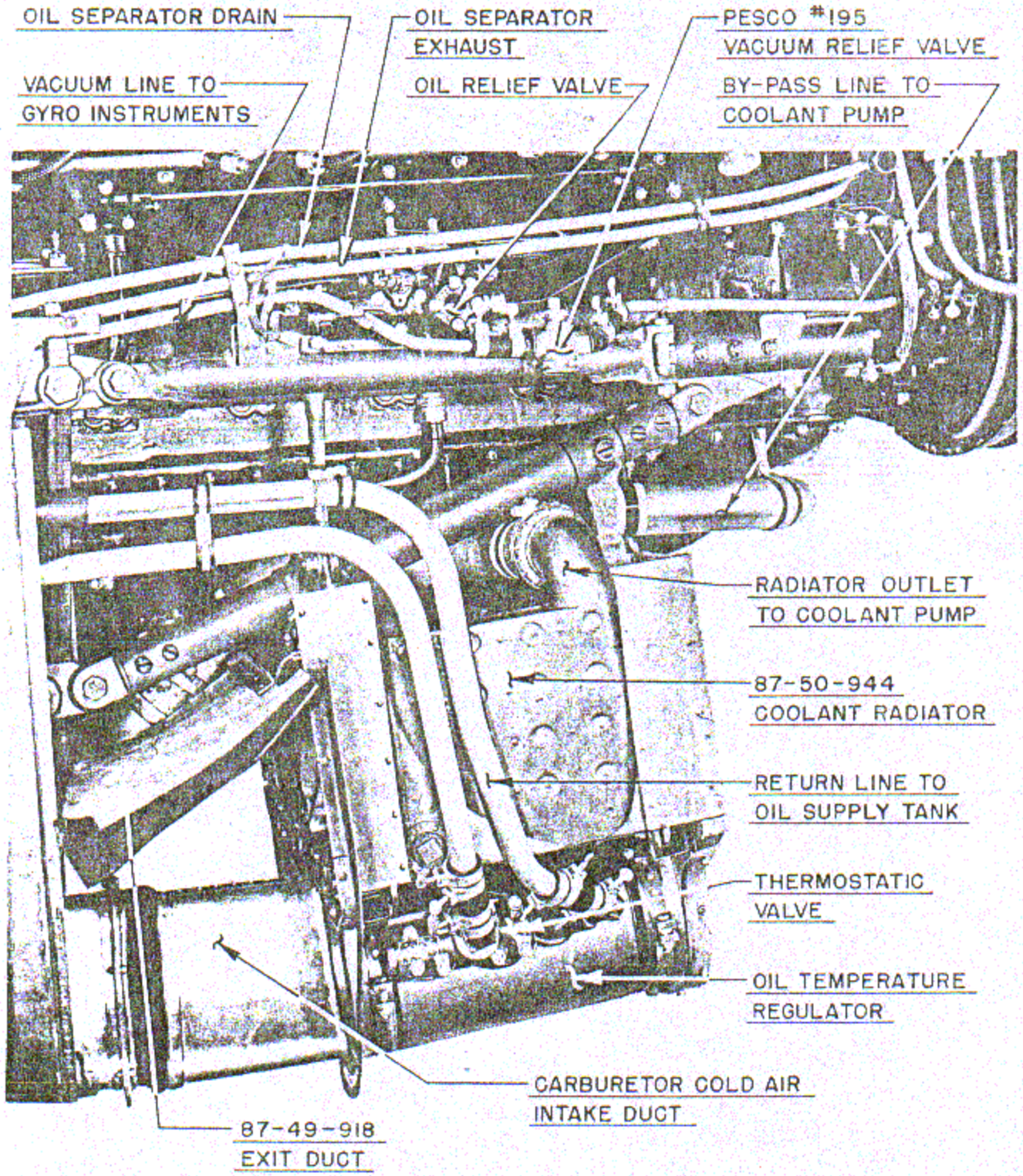


Fig. 55 - Coolant, vacuum and oil system lines - right side.

d. Removal of Engine from Engine Mount. - (1) Disconnection of carburetor air scoop.

(a) Remove the plate from the aft side of the scoop.

(b) Remove the nuts from the studs on the flange of the carburetor on the inside of the carburetor scoop.

(c) Remove the remaining nuts from around the outside of the scoop where the flange is attached to the carburetor.

(2) Attach the engine hoisting sling carefully.

(3) Remove each of the two engine hold-down bolts in each of the four engine feet.

(4) Raise the engine and move it forward and secure it in a suitable engine stand.

e. Special. - Remove the following items remaining attached to the engine which were not removed while the engine was in the airplane.

(1) Coolant header tank.

(2) Forward bulkhead.

(3) Propeller brush cap and holder housing assembly.

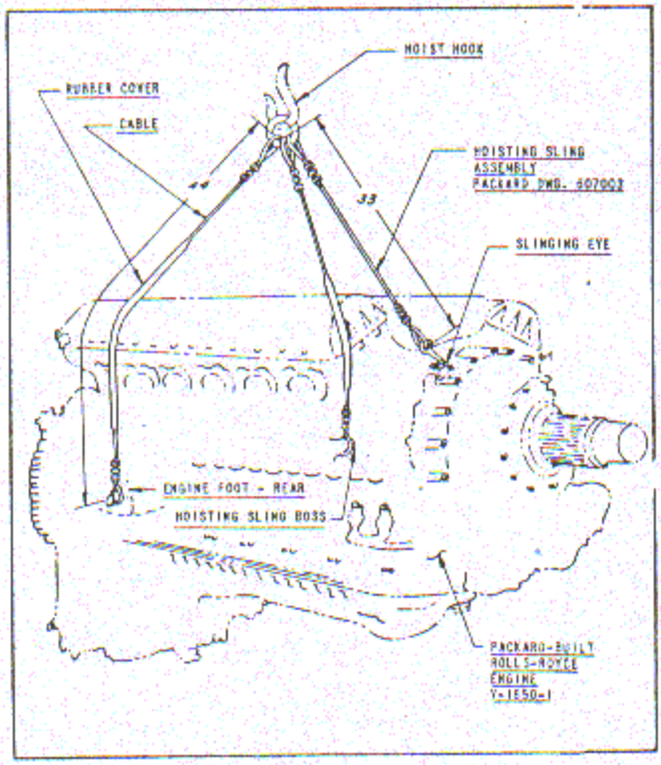


Fig. 56 - Engine hoisting sling.

(4) Propeller governor.

(5) Oil separator.

(6) Vacuum pump.

(7) All the following lines:

(a) Coolant overflow line.

(b) Vacuum lines.

f. Installation of Engine: The engine will be attached to the engine mount then installed in the airplane and all connections made following the procedure in reverse order in the preceding paragraphs.

The engine hold down bolts at the propeller end of the engine should be tightened to 50 to 60 foot pounds torque. The hold down bolts at the rear end of the engine should be tightened to 25 foot pounds torque. Be certain to re-safety all nuts.

9. Engine and Propeller Controls. (Drawing 87-52-901)

Operation and Flight Instructions for the Propeller are contained in T. O. No. 03-20BA-1. Operation and Flight Instructions for the Engine are contained in T. O. No. 02-55AA-1. Service Instructions for the Engine are contained in T. O. No. 02-55AA-2. Operation and Flight Instructions for the P-40F airplane are contained in T. O. No. 01-25CH-1. See Figure 53 in this Handbook for diagram of Engine and Propeller controls.

10. Propeller and Spinner Assembly.

a. General. - (1) Propeller: The propeller assembly drawing number is Curtiss Drawing C 532D-F 50 model C532 Series F, Blade 89301-3.

The propeller is a Curtiss three blade 11 foot diameter, electrically controlled, multi-position and/or constant speed type.

Installation, maintenance and repair instructions for propeller and governor installed in this airplane are contained in T. O. No. 03-20BA-2.

(2) Propeller Spinner Assembly: (Dwg. 87-42-903)

The propeller spinner assembly is comprised of two sections: a nose cone and an aft section. The spinner aft section is secured to the propeller hub by nine nuts and by nine bolts which pass through the spinner aft section aft bulkhead and through the flange on the rear of the propeller hub. It is also attached to the flange of the propeller power unit by three nuts and by three bolts which pass through the forward bulkhead of the spinner aft section. The nose cone is secured to the spinner aft section by three studs and two dowels. The studs and dowels are in the nose cone bulkhead and attach the nose

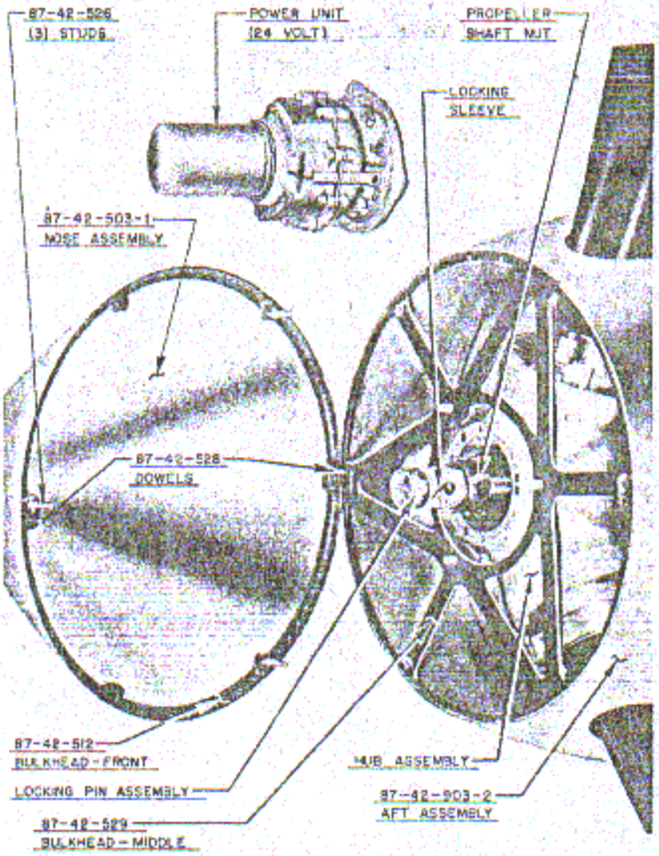


Fig. 57 - Propeller assembly— front view.

cone to the spinner aft section forward bulkhead. These studs are accessible through the lightening holes in the spinner aft section forward and aft bulkheads.

The spinner aft section is comprised of three parts; a detachable sheet metal rear bulkhead, a forged steel forward bulkhead and an aluminum alloy shell which is flush riveted to the forward bulkhead. Screws, inserted in the nut plates on the angle which is riveted to the shell, secure the shell to the spinner aft section aft bulkhead. Also included in the spinner aft section assembly are three covers which extend from the rear edge of the spinner aft section forward to each propeller blade shank, completely enclosing the spinner in the area where the propeller blades protrude through the spinner.

Each individual part of the spinner assembly as well as the complete spinner assembly is statically and dynamically balanced, therefore, in no case shall any individual part of one spinner assembly be interchanged with the same type part of another spinner assembly. However, it is possible to interchange either the nose cone assembly or the complete spinner aft section assembly with the same section of another spinner assembly. It is recommended that both sections of the spinner assembly remain together and be assembled together. A spinner, which may have been damaged so as to destroy this balance, must be replaced by a balanced spinner.

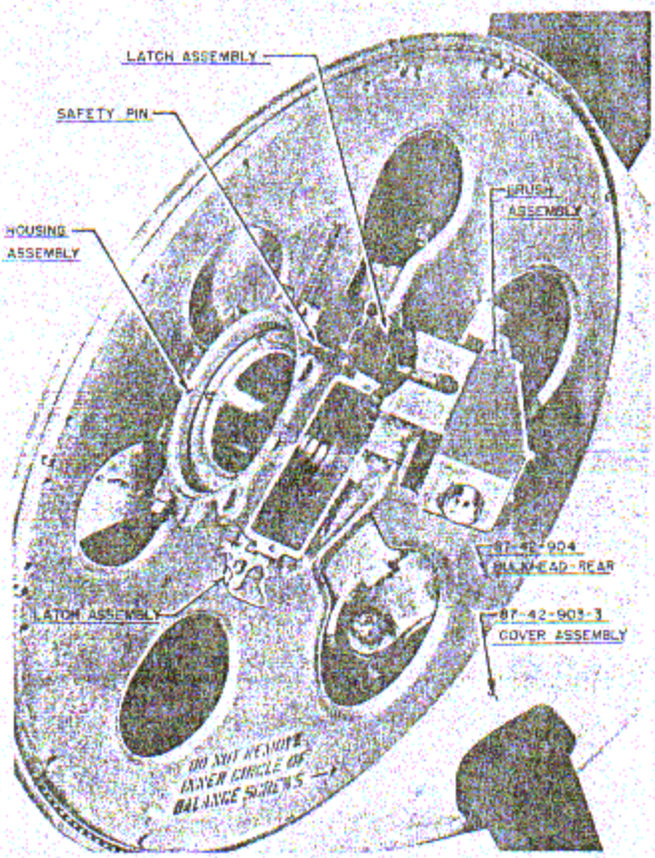


Fig. 58 - Propeller assembly - rear view.

b. Removal of the Propeller and Spinner Assembly from the Airplane.

(1) Operate the propeller to maximum low pitch.

(2) Remove the right section of engine cowling and work through the access hole in the coolant header tank armor plate and the forward bulkhead.

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

(4) Remove the safety pin from each brush holder latch assembly.

(5) Raise the two brush holder latches.

(6) Remove the brush holder cap assembly carefully to avoid damaging the brushes.

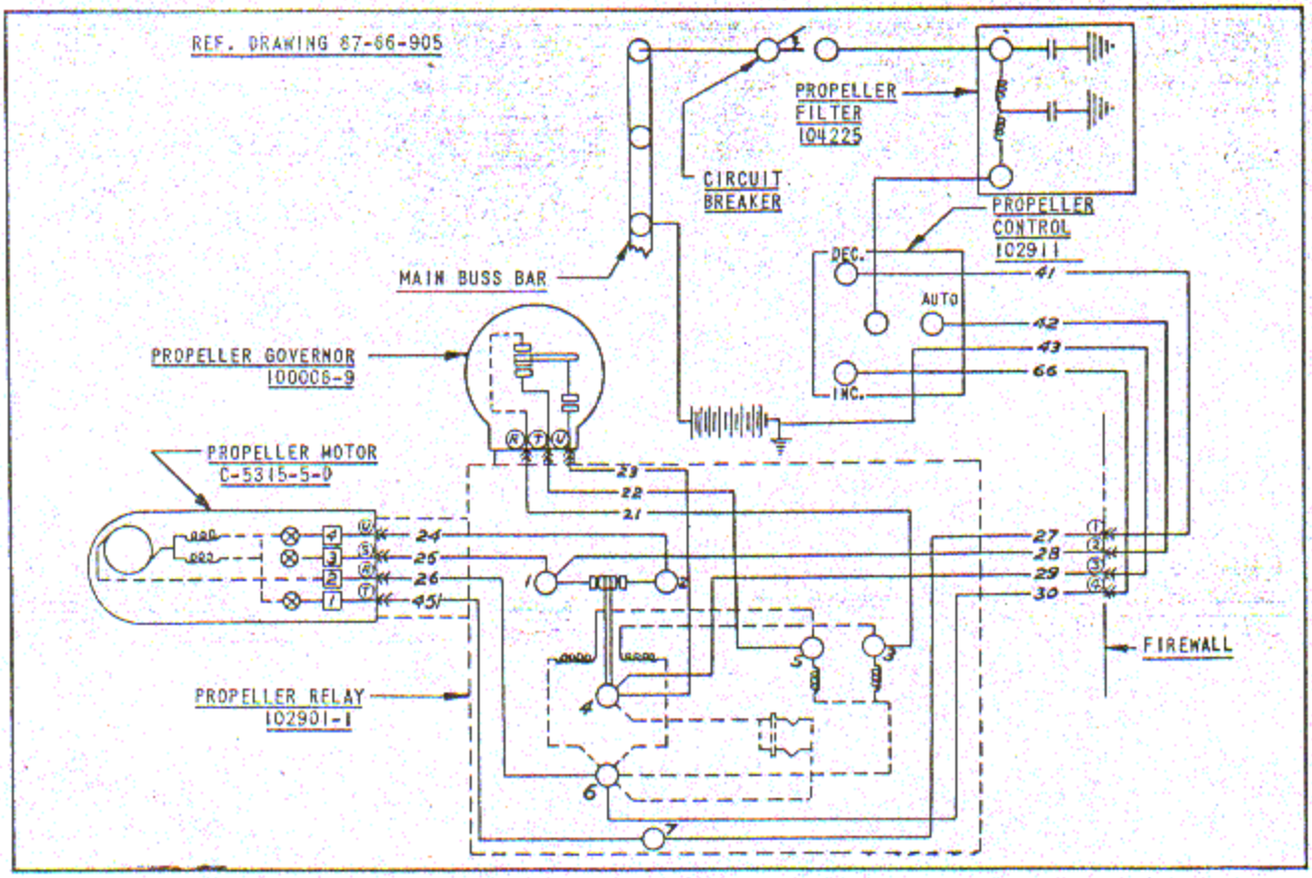


Fig. 59 - Propeller wiring diagram.

(7) Remove the three nuts from the bulkhead of the spinner forward section. Handle the spinner forward section carefully to avoid damage.

(8) Remove the cap screws and the three nuts from the flange of the propeller power unit assembly.

(9) Remove the power unit assembly, the neoprene seal and the grease seal.

(10) Remove the locking pin assembly.

(11) Remove the locking sleeve.

(12) Insert a bar completely through the propeller shaft nut and loosen the nut.

(13) Do not remove the nut, cone snap ring and cone as they will remain in the propeller hub.

(14) The propeller may now be removed from the propeller shaft. Exercise extreme care when removing the propeller to avoid damaging the propeller shaft threads. The propeller weighs approximately 375 pounds, therefore, it is advisable to use a suitable hoist or three men to remove this assembly: - Place the propeller in a suitable buck - never allow the blades to support the weight of the propeller.

c. Removal of Propeller Spinner from Propeller Hub. - (1) Remove the screws from the three cover assemblies on the outer surface of the spinner aft section.

(2) Remove the outer circle of screws from the rear of the aft bulkhead.

NOTE: When disassembling the spinner DO NOT DISTURB THE INNER CIRCLE OF SCREWS IN THE SPINNER AFT SECTION REAR BULKHEAD: THESE SCREWS ARE BALANCE SCREWS.

(3) To remove the aft bulkhead from the propeller hub, remove the nine nuts and bolts from the inner flange of the propeller hub and lift bulkhead from the hub.

d. Assembly and Installation. - Reverse the procedure given in paragraph 10. c. Section IV and perform the following operations: grease the dowel pins on the nose cone with #78 medium grease when installing the nose cone to the spinner aft section.

When re-assembling the spinner aft section outer member to the spinner aft section rear bulkhead, be certain the arrow on the spinner aft section outer member indexes with the arrow on the spinner aft section aft bulkhead.

11. Starting System.

a. General. - (1) The engine is cranked by a direct drive electric starter. A foot treadle on the cockpit floor is pushed forward to operate the type B-11 starter switch which allows a direct flow of current from the battery to the starter motor. The booster coil circuit is also energized by the same movement of the starter switch. The first few impulses of the engine in starting will automatically disengage the starter.

(2) In case of battery failure the engine may be cranked by hand with the crank and extension provided for this purpose. (Crank and extension shaft are stowed in the baggage compartment.)

(3) The starting booster coil is connected into the starting motor circuit, therefore, when starting the engine the starter pedal should be held in the depressed position until the engine is definitely running. The starting booster coil out-put is transferred by a high tension lead to the magneto which fires the spark plugs on the exhaust side of each bank of cylinders.

b. Removal of the Hand Crank Starter Housing: - Refer to Figure 32. (1) Remove all engine cowling except the front Bulkhead Assembly 87-29-935.

(2) Install the engine hoisting sling, and by means of a block and tackle, support the engine sufficiently to relieve the strain from the engine mount.

(3) Remove the two clamps attaching the vacuum line and the fuel signal line to the engine mount side brace 87-22-924R. Remove the bolt joining the side brace 87-22-924R to Tube Assembly 87-22-923R and force the side brace outward and upward in a forward direction. Wire this tube to the engine in this position.

(4) Remove the bolt joining the lower rear side brace 87-22-926R to 87-22-916R strut assembly, and force the side brace outward and downward.

(5) Remove the bolt joining the tube assembly 87-22-923R to the strut assembly 87-22-916R.

(6) Remove the Type C3 fuel pressure warning signal unit from the lower diagonal strut assembly 87-22-925R and secure the lines from this unit to strut 87-22-916R. Remove the bolts attaching the inside collar and the outside control arm to the cowl flap actuating crosstube at the left hand side of the airplane, and move the crosstube assembly to the left to clear the right hand support.

(7) Remove the bolt joining the diagonal strut assembly 87-22-925R to the strut assembly 87-22-916, allowing the diagonal strut to pivot downward sufficiently to clear the lug fitting on strut 87-22-916. Tie strut 87-22-925 in this position.

(8) Disassemble the Adel clip which joins the tachometer shaft to the sight support number 87-41-915. 87-41-914 shaft support is to remain assembled to tube 87-22-923R.

(9) Remove the 87-52-918 engine control torque shaft bearing housings from the left and right hand 87-22-923 tube assemblies, and detach the forward and aft 1078D control rods from the arms mounting from 87-52-911 torque shaft. The torque shaft and housing assembly should then be moved to the left to permit clearance with 87-22-923R tube assembly.

(10) Disconnect the carburetor heater bellcrank assembly number 87-51-921 from support 87-51-912 at tube assembly 87-22-916R.

(11) Detach the propeller control conduit at the firewall connector and remove clamps attaching the propeller rigid conduit to the engine mount structure. This will allow the conduit to be withdrawn from the right hand side of the engine compartment and swing clear, pivoting about the flexible conduit at the junction box near the nose of the engine.

(12) Remove the bolt attaching tube assembly 87-22-923R to the firewall fitting and rotate upward and forward to clear the lug on strut assembly 87-22-916R. Secure this upper diagonal tube assembly to the engine.

(13) This procedure will then permit the strut assembly 87-22-916R to move outboard pivoting about the lower right hand firewall fitting giving free access and sufficient clearance for the removal of the engine hand starter shaft and housing.

c. Installation of the Hand Crank Starter Housing. - The installation of the assembly of the various units mentioned in the preceding paragraph may be accomplished by reversing the procedure outlined in paragraph 11., b.

12. Coolant System. (Drawing 87-50-901)

a. General. - The engine is liquid cooled. For a diagram of the coolant system see Figure 60. For radiator air ducts see Figure 54. The filler cap is in the top of the header tank at the front of the engine and is accessible through a door in the left section of the engine cowling. The system employs a closed circuit with continuous flow from the circulating pump through the engine coolant jackets to a header tank, (Drawing 87-50-911), and then back to the pump through a radiator. The pressure is controlled by the cooling characteristics of the radiator, with a limiting pressure set by a thermostatically controlled relief valve which is located at the highest point of the system at the top of the header tank. The coolant is pumped into the cylinder blocks through pipes bolted to the exhaust side of each block, feeding several points of the block to insure equal distribution

REF. DWG'S. 87-50-901 & 87-29-903

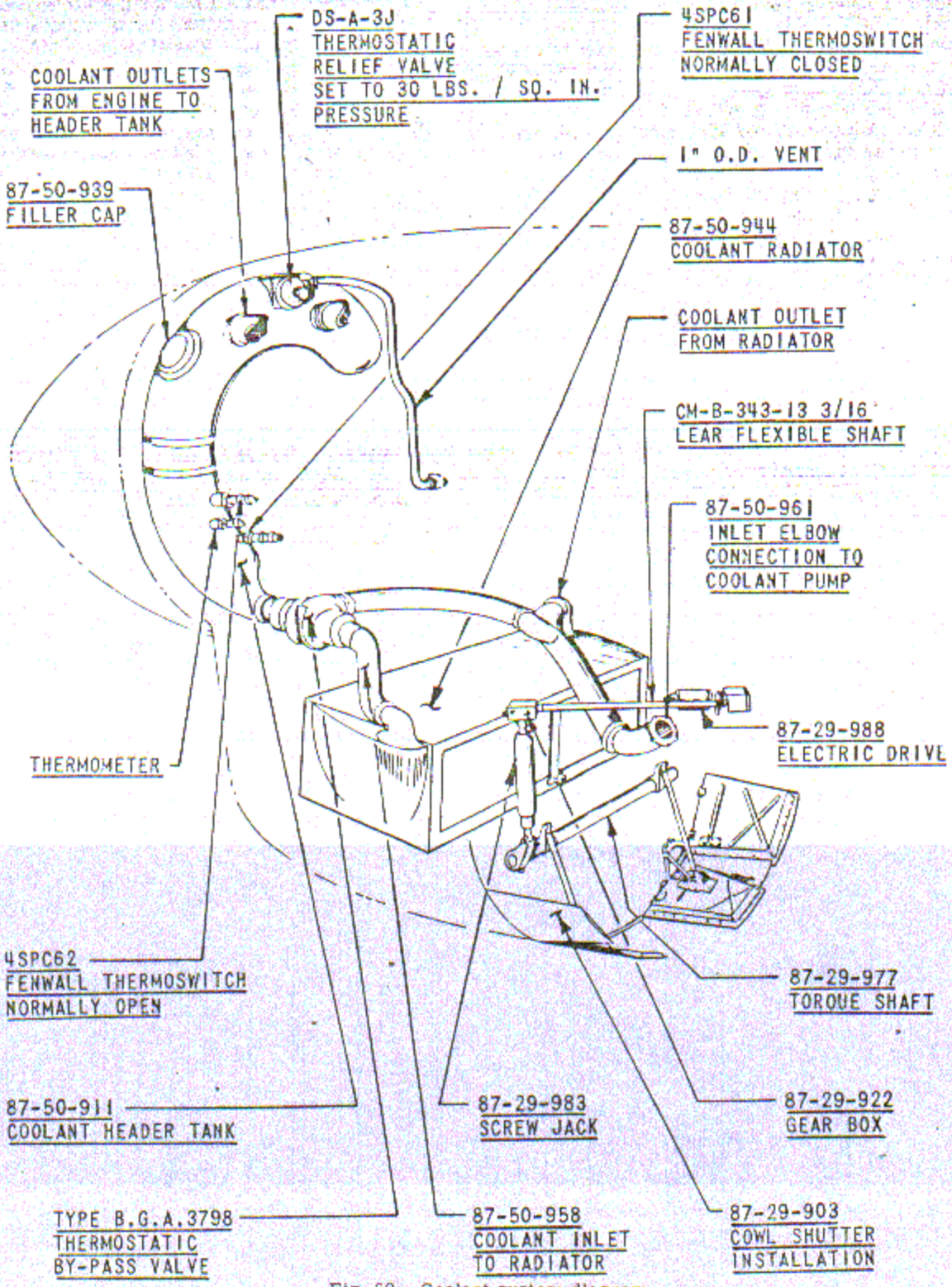


Fig. 60 - Coolant system diagram.

to individual cylinders. Outlet pipes discharge into the header tank. The relief valve at the top of the header tank limits the maximum possible pressure and also provides a controlled escape of air, thus compensating for expansion at different temperatures and insuring that the pressure generated is just sufficient to suppress boiling. The cooling capacity of the radiator is sufficient to prevent the pressure in the tank rising above the set blow-off pressure of 30 P. S. I. However, if for some extraordinary reason this figure should be exceeded, the design of the tank is such that only steam will escape, leaving the liquid as reserve coolant. A thermostat is included in the line from the radiator to the header tank, to control temperature fluctuations, and especially to prevent low temperatures which would otherwise occur on glides. The system is entirely automatic in operation and requires no attention from the pilot. As long as the temperature and pressure are in balance the system is completely closed to the atmosphere.

Coolant for Ground Temperature Above - 16 degrees C. (3 degrees F.)	70% Water 30% Glycol
Coolant for Ground Temperature Below - 16 degrees C. (3 degrees F.)	35% Water 65% Glycol
Coolant Capacity, Engine Only Weight	54 Lbs.
Coolant Outlet Temperatures	
Minimum for take-off 60 degrees C.	(140 degrees F.)
Maximum for all-out level flight or climbing 121 degrees C.	(250 degrees F.)
Normal for cruising 90 degrees C.	(194 degrees F.)
Maximum for cruising 100 degrees C.	(212 degrees F.)

b. Filling the Coolant System. - It is extremely important that the coolant system is filled in the correct manner and to the exact limit.

> CAUTION: Before flight all air pockets in the coolant system must be removed. All coolant should pass through a filter and be of the correct specification number before entering the system.

Ethylene-glycol can and should be used again after draining the system, therefore, care should be taken to avoid waste when filling, and any liquid allowed to run out of the drain tap should be collected in a suitable container.

In this type of closed circuit, there is little danger of faulty filling, however, the following points should be closely observed:

When filling, the drain tap should be left open until a steady flow of coolant issues from the orifices. The tap should then be closed while the coolant is running; all air must be suitably released from the vent plugs in the radiator and coolant top rails on the engine.

Having filled the system to the proper level, the vent plugs should be replaced and the engine run until the coolant temperature is 70 degrees C. (158 degrees F.) to 80 degrees C. (176 degrees F.). Stop the engine and examine coolant level again.

> CAUTION: Use extreme care not to endanger personnel or injure ignition wires by splashing over of hot coolant. The circulation of the coolant should have removed the small air pockets from the system and a small quantity of coolant can be added to correct the level. Since the capacity of the system is known, the amount of coolant can be checked during filling to determine the presence of any air locks in the system as the correct filling level will have been attained before all liquid has been poured in. In some cases these air locks can be displaced by rocking the airplane while filling. Be sure that all pipe joints, clips, etc., are sound and that the header tank is filled to the proper level.

When cruising the coolant temperature must not exceed 110 degrees C. (230 degrees F.) normal at 15 P. S. I. coolant header tank pressure.

> CAUTION: Care must be taken to release the pressure before removing the cap from the coolant header tank when the coolant is at operating temperature.

c. Thermo-Switches. - The high limit and low limit thermo-switches are located in the lower left side of the coolant header tank immediately above the outlet from the header tank leading to the coolant radiator. The contacts of the high limit thermo-switch are normally open. These contacts close at the upper temperature limit, starting the cowl shutter motor to open the cowl shutters at a coolant temperature of 121 degrees C. (250 degrees F.) and light the coolant temperature warning light. The low limit thermo-switch contacts are normally closed; and open when the coolant temperature is below normal, thereby starting the shutter motor to close the cowl shutters at a coolant temperature of 109 degrees C. (229 degrees F.).

(1) Adjustment of the thermo-switch: (a) Remove the cowling from the left side of the engine.

(b) Remove safety wire and unscrew the knurled conduit nut.

(c) Unscrew the aluminum alloy hexagonal conduit adapter nut from the thermo-switch bulb. (Hold the hexagonal part of the thermo-switch bulb during this operation to prevent rotation of the switch bulb in the header tank.)

(2) The adjusting screw is in the center of the bulb and may be turned with a screw driver.

> CAUTION: Take extreme care when adjusting the thermo-switch to prevent possible damage to the insulation on the thermo-switch leads.

Clockwise rotation of the adjusting screw lowers the temperature at which the switch contacts open or close respectively and in a counterclockwise direction to raise

the temperature. (Example: If light functions at 110 degrees C. (230 degrees F.) turn the adjustment screw in a counterclockwise direction until the switch lights the light at 121 degrees C. (250 degrees F.)

(3) 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. The low limit thermo-switch should be adjusted to start the cowl shutter motor moving these shutters to a closed position at a coolant temperature of 109 degrees C. The procedure for adjusting the low limit thermo-switch is the same as described for adjusting the high limit thermo-switch.

(4) Upon completion of adjustment reinstall and tighten both nuts on the assembly. Attach safety wire.

d. Cowl Flaps. - (Dwg. 87-29-903) The coolant radiator cowl shutters are operated by an electric motor drive unit which is mounted on the left side of the engine mount. The energy from the motor is transmitted by a flexible drive-shaft, through an angle-drive, to a jackscrew which rotates a cross-shaft. A system of bellcranks and rods which are attached to the cross-shaft, connect to the shutters.

The shutter electric drive unit includes a friction type safety clutch, a gear reduction drive, a shutter position indicator transmitter unit and two micro-limit switches which are adjusted to switch off the current to the motor when the shutters reach the full "OPEN" or "CLOSED" position.

The motor control switch and the position indicator are located in a box installed on the right side of the cockpit. The shutter control switch box contains a thermal type circuit breaker, a three position selector switch, and a shutter position indicator.

The circuit breaker is used as a line switch and also to protect the shutter control circuit against an overload. When this switch opens due to an overload the toggle moves only half of its normal travel, therefore, to reset the switch and close the circuit, the toggle must be moved to the full "OFF" position and then to the full "ON" position.

The three positions of the toggle type selector switch are: "AUTOMATIC", "OPEN", and "CLOSED". The switch is of the constant type in the "AUTOMATIC" and "OFF" position, and of momentary contact type in the "OPEN" and "CLOSE" position. The selector switch is in the "OFF" position when the toggle is centrally located.

When the three-position selector switch is in "AUTO" position, the shutter motor is controlled by the high limit and low limit thermo-switches, located in the coolant header tank. These thermo-switches operate the motor control electric relays which are located in a junction box on the forward side of the firewall. The low limit thermo-switch, when closed, passes current through the relay thus starting the motor mechanism to move the shutters toward the "CLOSED" position.

The high limit thermo-switch, when closed, passes current through the relay starting the motor mechanism to move the shutters toward the "OPEN" position. The manual operation of the selector switch to either "OPEN" or "CLOSED" position, by-passes both the high limit and the low limit thermo-switches and the relays and may be used as desired to obtain a fixed setting of the shutters as indicated by the shutter position indicator. The switch, when used in this manner, is of momentary contact type and will return to the central "OFF' position when released, thus leaving the shutters in fixed position and the entire shutter control circuit open, including the coolant system warning light circuit. The coolant system warning circuit is closed only when the toggle of the coolant system shutter control selector switch is in the "AUTOMATIC" position. The coolant temperature warning light on the instrument panel, which is connected in series with the high limit thermo-switch, illuminates whenever the high limit thermo-switch closes and is automatically extinguished when the coolant temperature is reduced, allowing the high limit thermo-switch to open. The high limit thermo-switch closes whenever the coolant temperature reaches 121 degrees C. (250 degrees F.) and the low limit thermo-switch closes at a coolant temperature of 109 degrees C. (229 degrees F.) thereby holding the coolant at normal operating temperature between these two limits.

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

f. Repair of Coolant Header Tank. - (1) Repair: Any minor repairs such as small leaks, leaks around rivets leaks around thermometer adapter housings and external reinforcing rings, etc., may be accomplished with a class 3 silver solder. This solder has a low melting point and is used where the application requires high strength and ductility and resistance to shock, vibration and temperature changes. The melting point of class 3 silver solder is 650 degrees C. (1202 degrees F.) and the flow point is 705 degrees C. (1301 degrees F.). Best results will be obtained by using a combination of silver solder and silver brazing flux, showing the least deleterious effect on the material joined.

(2) Testing Coolant Header Tank After Repairs: Before installing the coolant header tank in the airplane after being repaired, test under water to 40 P. S. I. air pressure.

g. Installation of the Thermostatic Relief Valve in the Header Tank. - The DSA3J thermostatic relief valve should be assembled as a complete unit, consisting of the valve assembly, the lockwasher, the special nut, and the valve adapter, before it is installed in the header tank.

(1) To Assemble the complete unit: (a) Hold the valve assembly in a vice by clamping onto the hexagonal nut cast on the valve body.

(b) Place the lock washer over the threaded section of the valve body, so that the three long tabs of the washer fit into the indentations cast in the valve body.

(c) It is recommended that Parker Threadlub No. 6PB (or equivalent) be applied sparingly to the bearing surface of the lockwasher, to prevent the washer from "egg-shaping" when the valve adapter is tightened against it. Apply lubricant, sparingly, to the male threads of the assembly and work the threaded parts to assure even distribution of the lubricant before the final assembly of the unit, and the installation in the header tank.

(d) Place the special nut, with threaded end up, next to the lockwasher, and then screw the valve adapter over the threads of the valve body.

(e) Be sure that the long washer tabs are properly located in the indentations in the valve body, and then tighten the valve adapter against the lockwasher, using a spanner wrench. Do not tighten excessively.

(f) Inspect for position of the short washer tabs over the notches of the valve adapter. If a tab and a notch do not coincide, tighten the adapter until a tab and a notch do coincide. With the aid of a screw driver bend the tab into the notch.

(2) To install the thermostatic relief valve in the header tank: (a) Place the valve unit in the valve seat at the top of the header tank, and screw in the special nut of the valve unit, by hand.

(b) Rotate the valve unit so that the overflow outlet connection on the valve housing is aligned with the overflow pipe on the right hand side of the engine.

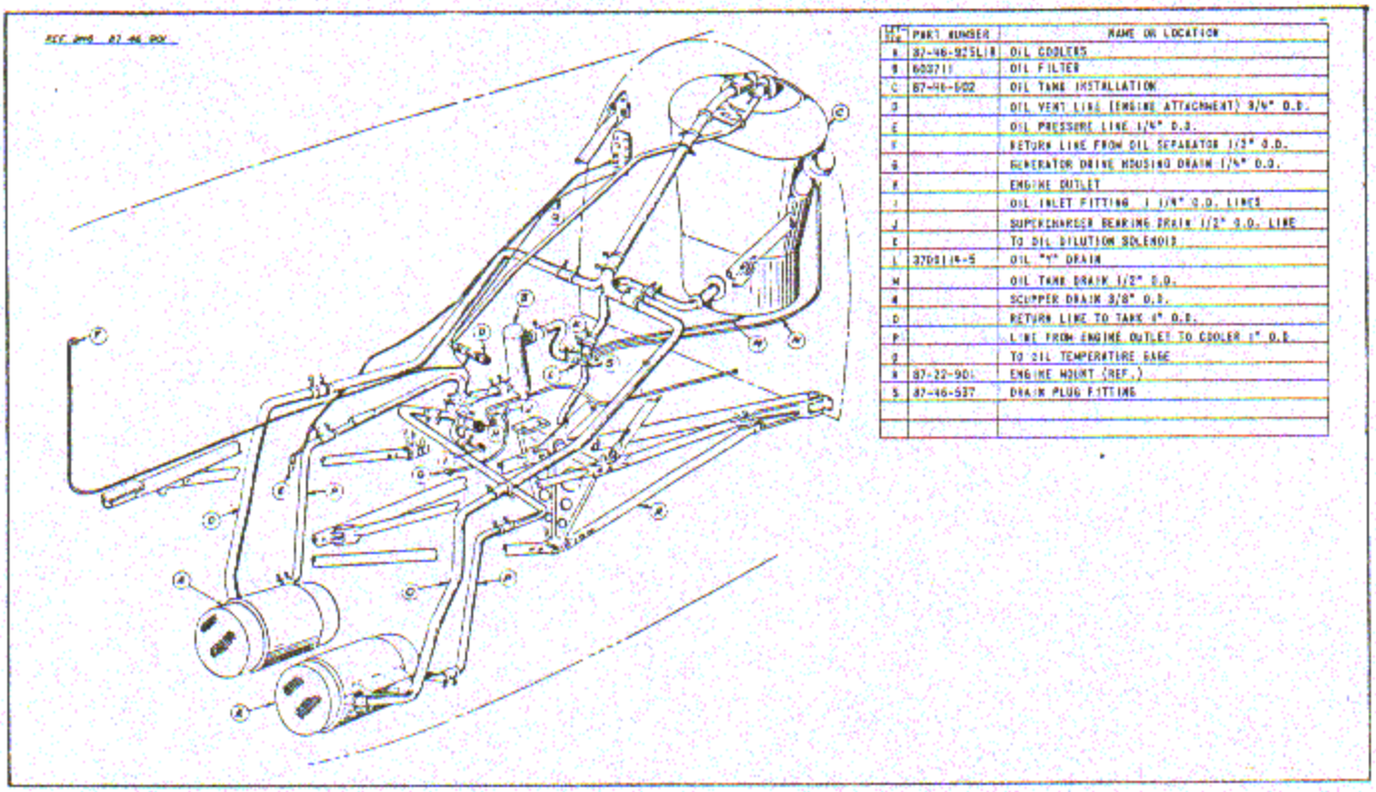
(c) Tighten the special nut against the valve seat using a spanner wrench, and lockwire to the locking plate located just under the valve installation.

NOTE: Do not, under any circumstances, bend a long washer tab into a notch of the special nut.

h. Removal of Thermostatic Relief Valve from the Header Tank. - (1) If it is necessary to replace any part of the valve unit, which has been mentioned, remove and disassemble the unit by reversing the procedure outlined in paragraph 12., g.

(2) Install the part and follow the procedure for assembly and installation as outlined in paragraph 12., g.

(3) For disassembly and assembly of the DSA3J thermostatic relief valve, see T. O. No. 03-1-14.



KEY No.	PART NUMBER	NAME OR LOCATION
A	87-46-925L1R	OIL COOLERS
B	603711	OIL FILTER
C	87-46-502	OIL TANK INSTALLATION
D		OIL VENT LINE (ENGINE ATTACHMENT) 3/4" O.D.
E		OIL PRESSURE LINE 1/4" O.D.
F		RETURN LINE FROM OIL SEPARATOR 1/2" O.D.
G		GENERATOR DRIVE HOUSING DRAIN 1/4" O.D.
H		ENGINE OUTLET
J		OIL INLET FITTING 1 1/8" O.D. LINES
J		SUPERCHARGER BEARING DRAIN 1/2" O.D. LINE
K		TO OIL DILUTION SOLENOID
L	3705114-5	OIL "Y" DRAIN
M		OIL TANK DRAIN 1/2" O.D.
N		SCUPPER DRAIN 3/8" O.D.
O		RETURN LINE TO TANK 4" O.D.
P		LINE FROM ENGINE OUTLET TO COOLER 1" O.D.
Q		TO OIL TEMPERATURE GAGE
R	87-22-901	ENGINE MOUNT (REF.)
S	87-46-537	DRAIN PLUG FITTING

Fig. 61 - Oil system.

13. Oil System. (Drawing 87-46-901)

a. General.

(1) Engine Lubricating System. - The engine lubricating system is of the dry sump type utilizing a gear type pressure pump and two gear type scavenge pumps. Oil is delivered from the pressure pump to a three stage relief valve on the right side of the crankcase. For details of engine lubricating system refer to T. O. No. 02-55AA-1.

The oil is extracted from both ends of the dry sump crankcase via filters by the two scavenging pumps operating in parallel which return the oil to the oil supply tank through the oil cooler via the supercharger change speed gear set servo pump, for which it is the power source. There is also an oil filter installation on the right side of the engine mount between the "Y" drain casting and the oil pressure pump.

(2) Oil Supply Tank. - The oil tank is located aft of the firewall and forward of the armor plate installation at Sta. 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 gallons. The normal tank capacity is 13 gallons and to obtain an overload capacity an additional three gallons may be carried, giving a total oil capacity of 16 gallons. The filler cap is accessible through a door on the left top of the fuselage forward of the windshield. The normal oil level is indicated by the position of a rivet in the filler neck. The tank should always be serviced to this rivet level. A 1/2" O. D. vent tube, from the right side of the engine is connected to the oil supply tank. All discharge lines in the oil system are collected in one drain casting mounted on the leading edge of the right wing panel. Climbs up to 60 degrees and dives up to 90 degrees will be performed only with 1/3 or more of the maximum oil capacity.

(3) Oil Temperature Control. - An oil temperature regulator and oil cooler is installed in the return line from the engine to the tank. Incorporated in the regulator is a viscosity type bypass 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.

(4) Oil Dilution System. - There is also incorporated in the oil system, provision for oil dilution in order to facilitate starting. This system is used before stopping the engine when a cold weather start is anticipated. Dilution is obtained by the controlled addition of engine fuel into the oil inlet line at the "Y" drain cock. The fuel is supplied from a restricted fitting (37A3528) in the fuel pressure gage line. The oil dilution system is controlled by a momentary contact type toggle switch in the cockpit. This switch energizes the circuit that controls the solenoid which operates the oil dilution valve. (For instructions on oil dilution see T. O. No. 02-1-29 and T. O. No. 03-15-3.)

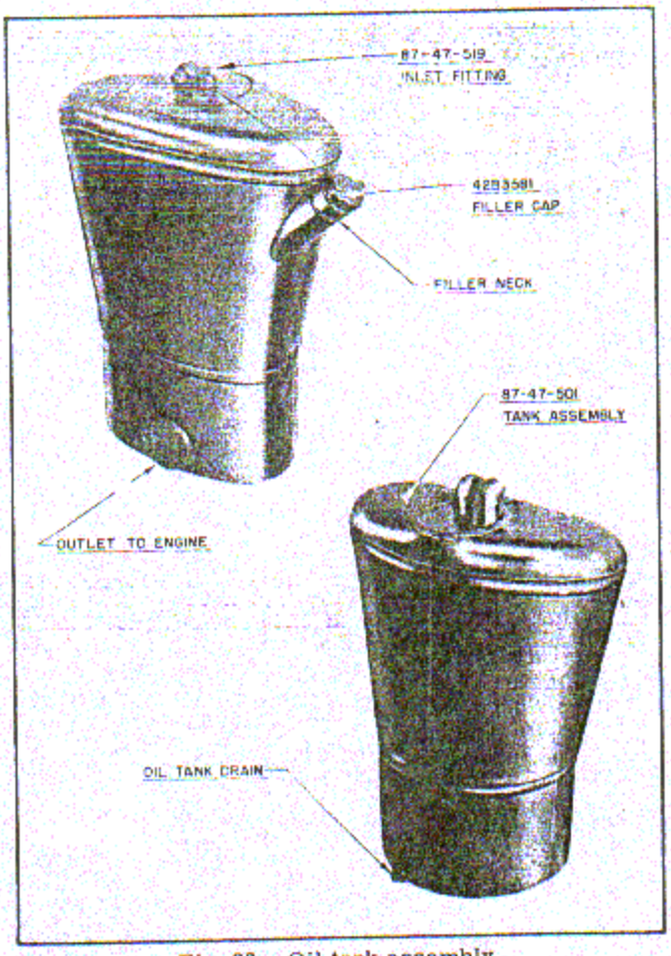


Fig. 62 - Oil tank assembly.

(5) Supercharger Bearing Drain Line: The supercharger vent line on the base of the supercharger housing adjacent to the engine oil outlet line drains through the bottom cowling forward of the "Y" drain casting.

(6) Oil Strainers. - There are two strainers in the dry sump of the engine crankcase and one oil filter in the line from the "Y" drain casting to the pressure pump.

(7) Breather System. - There is a 1" O. D. Crankcase Breather line from the top of the crankcase, forward of the left cylinder block, to a vent in the left section of the engine cowling.

(8) Air-Bleed Cock. - There is a cock on the top of the oil inlet line adjacent to the clamp assembly at the engine oil pump inlet port. The cock is for bleeding air from the oil inlet line.

b. To Remove the Oil Supply Tank. - (1) Drain oil system at "Y" drain cock.

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

(3) Disconnect the line which carries oil to the engine from the bottom of the oil supply tank.

(4) Disconnect the auxiliary oil drain line from the bottom of the oil supply tank.

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

(6) Detach the oil supply tank 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 the tank straight up.

c. To Install the Oil Supply Tank. - Reverse above procedure.

d. To Fill Oil System. - After the oil system has been completely drained the following procedure is recommended. Fill the oil supply tank to the rivet in the filler neck which indicates the correct normal load. Start the engine and run until the oil temperature is approximately 70 degrees C. (158 degrees F.), wait five minutes and then check the oil level, if necessary, add oil to bring the oil level up to the indicating rivet.

14. Fuel System. - (Drawing 87-44-901)

a. General. - (1) Carburetor: The Rolls Royce V-1650-1 engine is equipped with a Bendix-Stromberg up-draft pressure injection type carburetor (Model PD-16-A-1) which incorporates automatic altitude control and a mixture regulator having four main control lever settings: "FULL RICH" "AUTO. RICH", "AUTO . LEAN" and "IDLE CUT-OFF". The mixture can be manually adjusted by movement of the mixture control lever between "AUTO. RICH" and "AUTO. LEAN". Automatic altitude mixture control is also maintained for any fixed position of the control lever between "AUTO. RICH" and "AUTO. LEAN".

(2) Fuel Tanks: There are three fuel tanks equipped with self-sealing fuel cells, and one belly tank, having a total capacity of 200 U.S. gallons. The fuselage and reserve tank located aft of the armor plate installation at Sta. #5, and forward of the fuselage access door, carries a regular and the reserve fuel supply. The two wing tanks (front and rear), located within the wing panel below the cockpit floor, carry the remainder of the regular fuel supply. The belly tank, swung below the wing panel along the center line of the airplane, carries the auxiliary fuel supply. Fuel tank capacities are given on the fuel system diagram, Figure 63.

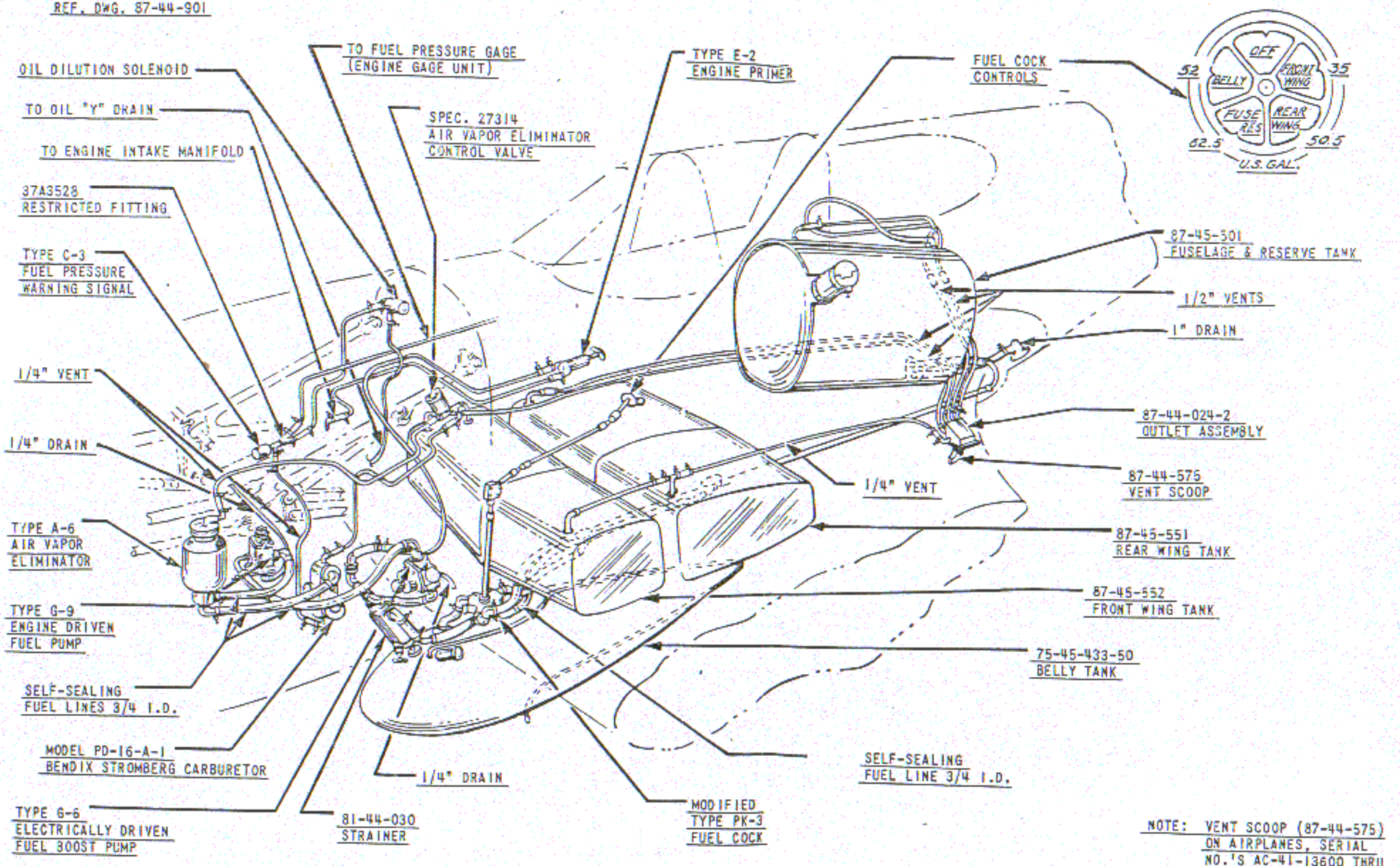
The belly tank is attached to the bomb shackle assembly which is permanently installed under the wing, parallel to the airplane center line. The belly tank is held rigidly by two sway braces (fore and aft) on each side of the tank. The tank may be released from the airplane, while in flight, by pulling up on the belly tank release handle which is located just below the engine control unit in the cockpit. The belly tank is installed only when flights are anticipated requiring more than the normal fuel supply. When the airplane is to be flown without the belly tank, remove the fuel hose between the tank and the fuel cock, and install the neoprene cover cap (87-44-566-stowed in the duffle bag) on the tube connection of the fuel cock. All the fuel tanks are vented to the atmosphere. The wing tanks have main vent lines connected to the right end of each tank, and auxiliary lines connected to the left end of each tank. The fuselage and reserve tank is vented fore and aft. The wing, and fuselage and reserve tank vent lines drain into an outlet assembly in the wing fillet on the left side of the airplane. This drain outlet has a scoop assembly attached to its lower extremity which helps to maintain pressure in the fuel tanks at high altitudes. The Type A-6 air vapor eliminator is vented through a relief valve to the front wing tank. The air vapor eliminator removes air trapped in the fuel before it flows into the carburetor. The carburetor fuel chamber is vented directly into the front wing tank; the vent line allows air to be expelled from the fuel chamber while 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 which serves to trap a supply of fuel for aerobatic maneuvers.

(3) Fuel Lines: The fuel lines are 3/4 inch inside diameter self-sealing hose of either U. S. Rubber 245 Thiokol, Goodyear All-Synthetic 145, B. F. Goodrich All-Synthetic 166 with sealing layer, or B. F. Goodrich 126. The fuel lines will seal completely within two minutes after puncture by gunfire at a temperature of -4 degrees C. to 38 degrees C. (25 degrees F. to 100 degrees F.) and within four minutes after puncture at a temperature of -7 degrees C. (20 degrees F.) or below. All the lines of the fuel system have a "Red" band at each side of every connection.

WARNING: Be sure that all layers of material in the self-sealing fuel hose are firmly sealed together. After installation, be sure that the proper number of layers of material are showing beyond the hose clamp. Any discrepancy here, will require immediate investigation, as a layer of material may have been pushed into the hose when it was installed on the tube connection, thus closing the fuel passage.

(4) Fuel Strainers and Tank Sumps: Attached to the bottom of each fuel tank within the wing is a sump in which is installed a finger type fuel strainer, the fuel line outlet, a drain plug and a drain cock. The fuel tanks are so designed as to allow water or sediment etc., to drain to the tank sump with the airplane in normal position at rest. The drain cock provided in each sump will permit the draining of any sediment or water without draining the fuel. Access is gained to these wing fuel tank sumps through doors in the keel fairing. The fuselage fuel tank is provided with a remote sump which is equipped with a drain plug and drain cock, and is accessible from the under side of the fuselage immediately aft of the wing trailing edge. The belly tank sump is directly under the tank. A fuel strainer type C-3 is located in the fuel line between the fuel selector valve and the electrically driven fuel boost pump. Access to this strainer is gained through the engine cowl section aft of the coolant radiator cowl shutters.

REF. DWG. 87-44-901



NOTE: VENT SCOOP (87-44-575) ON AIRPLANES, SERIAL NO.'S AC-41-13600 THRU & INCLUDING AC-41-13623 ONLY.

FIG 63 - FUEL SYSTEM

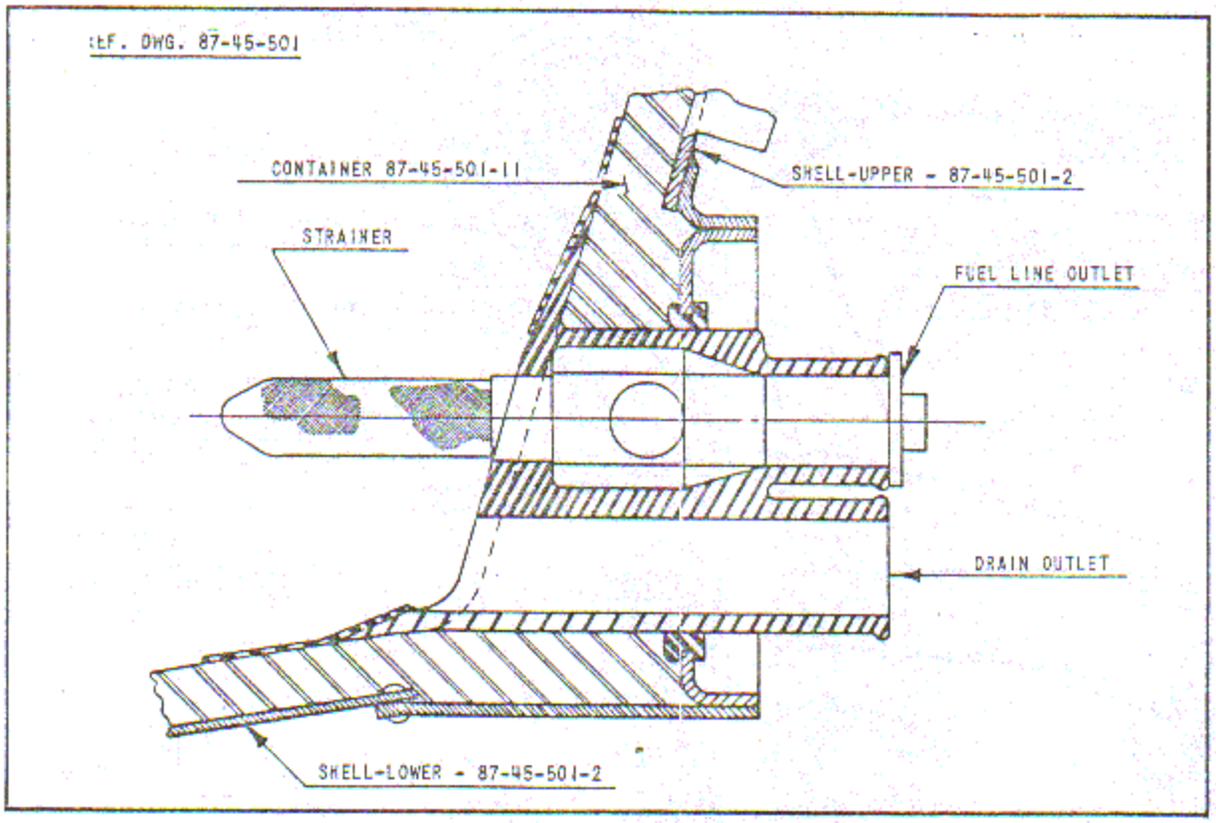


Fig. 64 - Fuselage & reserve tank sump and drain.

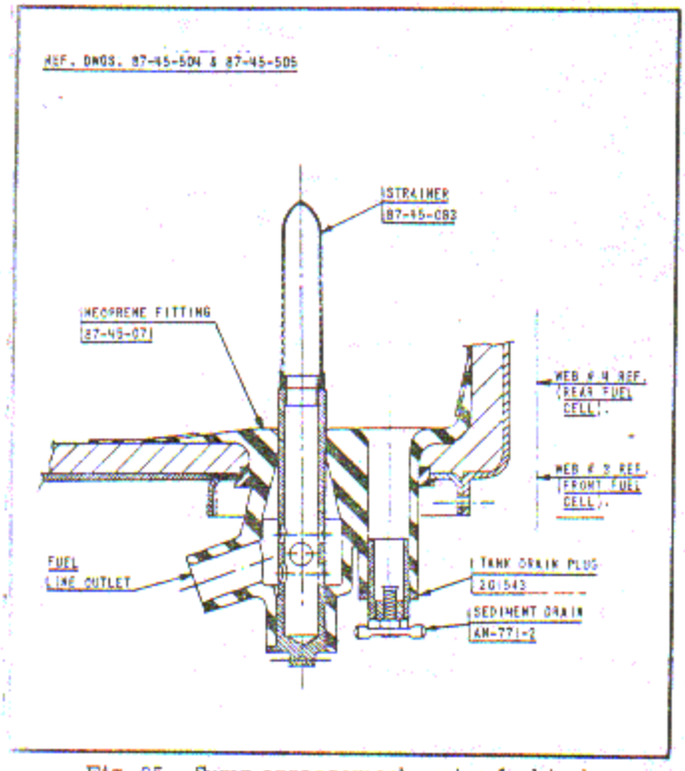


Fig. 65 - Sump arrangement - wing fuel tank.

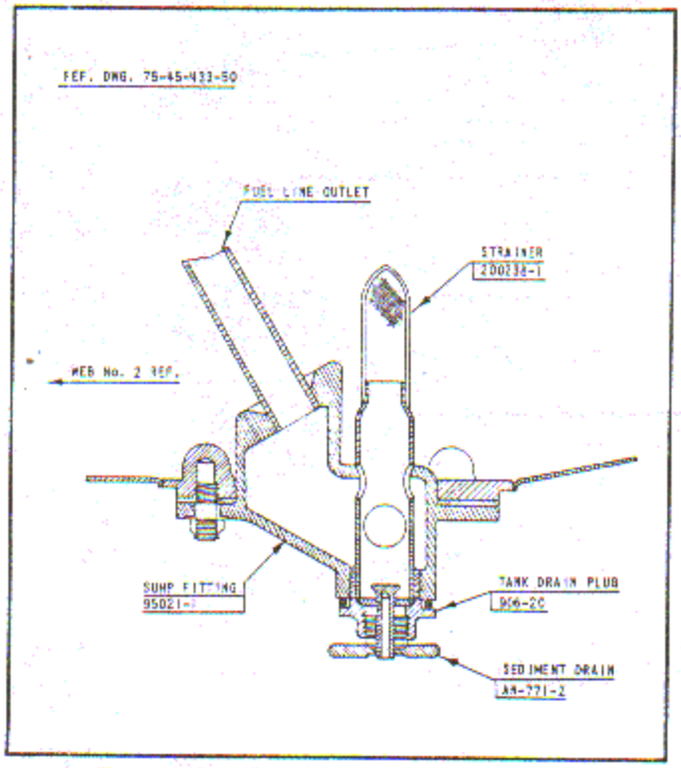


Fig. 66 - Belly tank - sump arrangement.

(5) Fuel Quantity Gages: Each fuel tank in the wing 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. D. Selsyn Type (8TJ13LAH) Gage Transmitter, which is connected electrically to a fuel quantity indicator (8DJ11LAN), on the instrument panel. See paragraph 16, a., (3), (c) of this section.

(6) Fuel Pressure Gage: See Paragraph 16, a., (3), (m), of this section. (The fuel pressure warning light is located on the top left side of the instrument panel.)

(7) Primer: The engine primer system consists of a supply line from the electrically driven boost pump to the Parker Type E-2 Primer, located in the cockpit, and a line from the primer to a fitting on the engine from which lines branch to the intake manifolds.

(8) Scupper Drains: The wing fuel tank scuppers in the left hand wing fillet are provided with drain lines passing downward through the lower wing skin left of the fuel tank door, and near to the wheel pocket.

(9) Fuel Pumps: The engine driven fuel pump AN9519 Type G-9 is serviced according to the procedure in T. O. No. 03-10EA-1. The fuel boost pump, Type G-6 Spec. 28332 is driven by an electric motor, Spec. 32316 and is serviced according to the procedure in T. O. No. 03-10EA-1. The two fuel pumps are interchangeable.

(10) Vapor Eliminator: The Air Vapor Eliminator Control Valve is an AN Spec. 27314 unit and the Air Vapor Eliminator Assembly is Type A-6 Spec. 28429. These units are serviced according to the procedure in T. O. No. 03-10-23.

The air vapor eliminator consists of an inner and an outer chamber thru which the fuel passes before it reaches the carburetor. The fuel is pumped directly into the outer chamber of the air vapor eliminator assembly through an inlet connection in the bottom of the unit. The fuel rises in the outer chamber and overflows into the inner chamber of the unit, and thence through the outlet, at the bottom of the assembly, to the carburetor. The fuel pumps maintain a pressure of about 15#/sq. in. At the top of the air vapor eliminator unit, there is a float operated needle valve which shuts off the air vent line between the top of the unit and the front wing fuel tank, when the proper fuel level is reached. As the fuel rises in the air vapor eliminator unit, the air is forced through the needle valve and into an air vapor eliminator control valve which is installed in the vent line between the air vapor eliminator and the front wing fuel tank. The control valve is set to open at an approximate pressure of 12#/sq. in. When the proper fuel level in the unit is reached, the float operated needle valve closes the air vent line and the fuel pumps maintain a constant pressure of 15#/sq.in. When air is pumped into the air eliminator unit, by reason of an empty tank, the pressure drops to approximately 10#/sq.in. As the fuel level in the unit becomes lower, the needle valve opens, and air passes into the control valve. However, since the control valve will not open until a pressure of 12#/sq.in. is attained, there is a constant pressure exerted on the fuel remaining in the unit, thus insuring a pressure feed to the carburetor. The capacity of the unit is slightly over one gallon which is sufficient to operate the engine for approximately 90 seconds. This is a sufficient quantity of fuel to guard against engine failure when switching from an empty tank to a full one. When fuel is again pumped into the unit at 15#/sq.in. pressure, the air in the unit is forced through the control valve and is vented into the fuel tank. When the proper fuel level is reached, the float operated needle valve is closed.

In the strainer chamber of the carburetor, there is a small float-type needle vent valve which operates to eliminate air vapor in the chamber. As the fuel level becomes lower in the strainer chamber, the float operated needle valve opens, and releases the vapor that is present. As the fuel level becomes normal again, the needle valve is closed. This valve serves to prevent vapor lock and it is helpful in re-establishing a new flow of fuel, quickly, when the fuel lines have run dry because of an empty tank. The air vapor and any delivery of fuel that occurs by the action of this valve is passed through the air vapor vent line between the carburetor and the front wing fuel tank.

b. Removal.

(1) To Remove Belly Fuel Tank: (a) Drain the tank by means of a stop-cock at the bottom of the tank.

(b) Disconnect the fuel line at the belly tank which leads to the fuel selector valve.

(c) Release the tank from the bomb rack mechanism by actuating the control in the cockpit, marked "Belly Tank Release"

(d) Install the Neoprene cap (87-44-566) which is stowed in duffle bag on end of fuel selector line whenever the belly tank is removed.

(2) To Remove Either Fuel Cell From Wing: (a) Remove the landing gear inboard fixed fairing.

(b) Disconnect and remove the belly tank sway braces.

(c) Remove the keel fairing.

(d) Remove the wing fillets.

(e) 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 #3.

(f) Drain the fuel cells.

(g) Disconnect the vents at the top of the fuel cells.

(h) Remove the fuel lines, fuel gages and the filler caps.

(i) Remove the retaining nut on the gage neck with the special wrench provided.

NOTE: Remove all the connections to the fuel cells otherwise the fuel cells will be torn at the fittings.

(j) Remove the bonding.

(k) Remove the tank straps and the lower section of the tank shell (pan assembly).

(l) 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 Fuel Tank: (a) Remove the pilot's seat.

(b) Remove the filler neck.

(c) Remove the tank pipe fittings.

(d) Remove the tank gage.

(e) Remove the pilot's headrest.

(f) Remove the armor plate at Sta. 5.

(g) Push the handle of the auxiliary hydraulic hand pump to the extreme forward position.

(h) Remove the control stick.

(i) Remove the tank through Sta. 5 bulkhead and raise straight up.

(j) Remove the fuselage fuel cell from the shell as follows:

1. Remove the bolts through flanges attaching the top segment of the shell to the bottom section. Remove the segment taking care not to damage the vent line fittings.

2. Remove the bolts attaching the front end of the tank to the shell. Push the gage fitting through the end section and remove.

3. Remove the fuel cell from the remaining section of the shell taking care not to damage any of the fittings.

(4) To Install the Fuel Tanks: (a) Belly Tank: Reverse the procedure outlined in b., (1) preceding.

(b) Wing Tanks: 1. The installation of the wing fuel cells is accomplished by the use of the two locating tools, (87-88-594 and 87-88-595), one for the filler neck and the other for the gage opening. These tools are used to guide the filler and gage necks into their respective holes in the wing surface. The locating tools (see Figure 72) should be worked as follows:

a. Screw the gage opening tool (87-88-595) into the gage opening by hand, then insert the filler opening locating tool (87-88-594) in the opening and tap the tool in lightly using a wooden mallet. This tool is turned from close grained hard wood and should never be driven in by excessive force.

2. Install the fuel cells in the wing and guide the filler and gage necks through their respective openings in the wing. Install the bottom shell and tighten all retaining straps.

3. Remove the locating tools and install the gage and other fittings.

4. Reverse the procedure outlined in b. (2) from (a) to (1) inclusive.

(c) Fuselage Tank: Reverse the procedure outlined in b. (3).

(5) To Remove the Fuselage Fuel Tank Quantity Gage:

NOTE: Never remove the fuel quantity gage from the fuselage fuel tank unless it is absolutely necessary.

To remove the fuel cell section of the fuel quantity gage:

(a) Remove the six flange screws and remove the transmitter. Take care to keep magnetic particles away from transmitter magnet and also away from inside of the cup.

(b) Lift the cup from the socket enough to hold it from turning and unscrew 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 Wing Tank Quantity Gage: See T. O. No. 01-25C-23.

(7) To Install Fuselage Tank Fuel Quantity Gage: Reverse the procedure given in (5). 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. The index mark on the flange of the cup is in the plane of the float circle. Locate the index mark so that for a rising float, the pinion rotates counterclockwise, when viewed from the pinion end of the shaft.

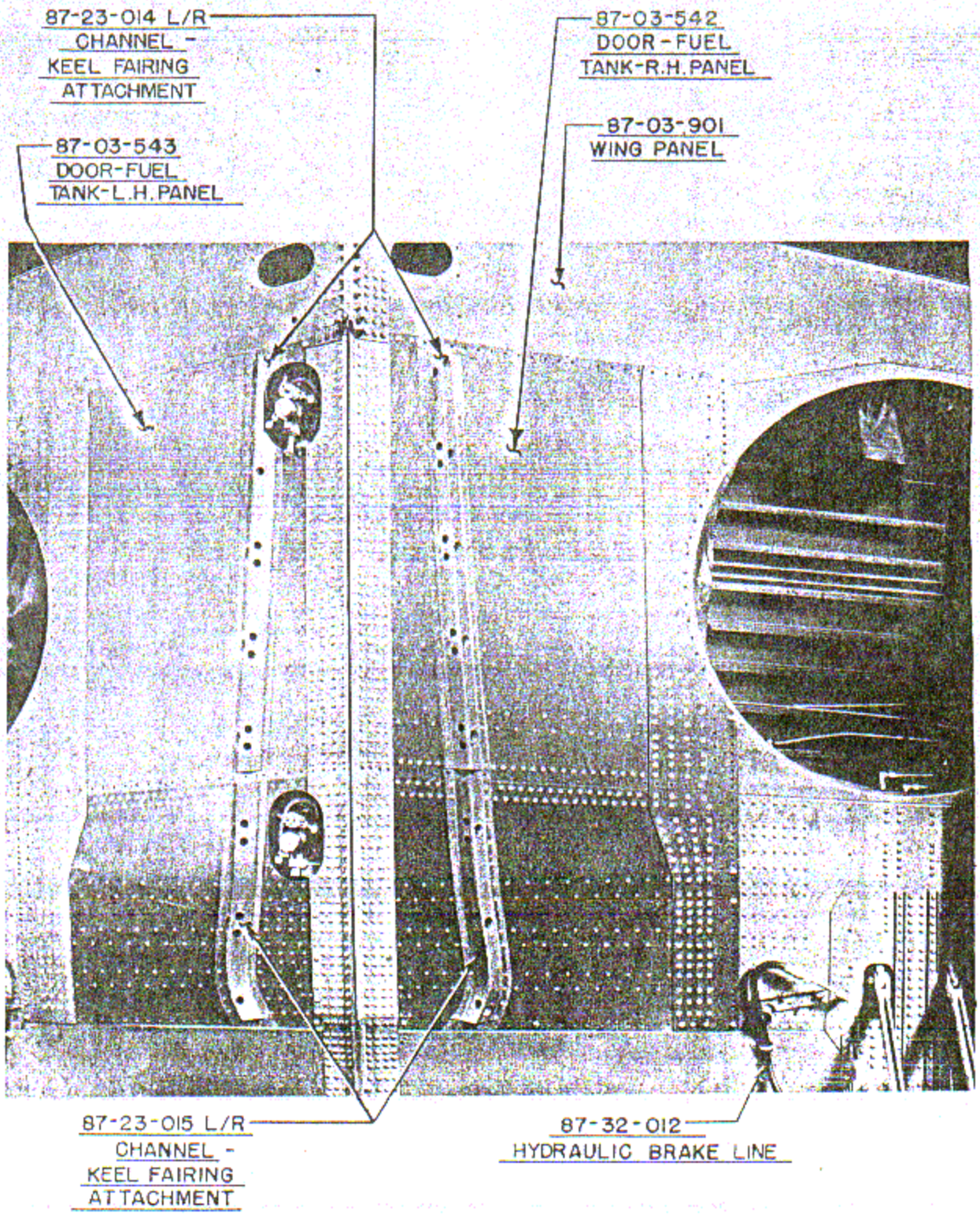


Fig. 67 - Wing fuel tanks - access doors installed.

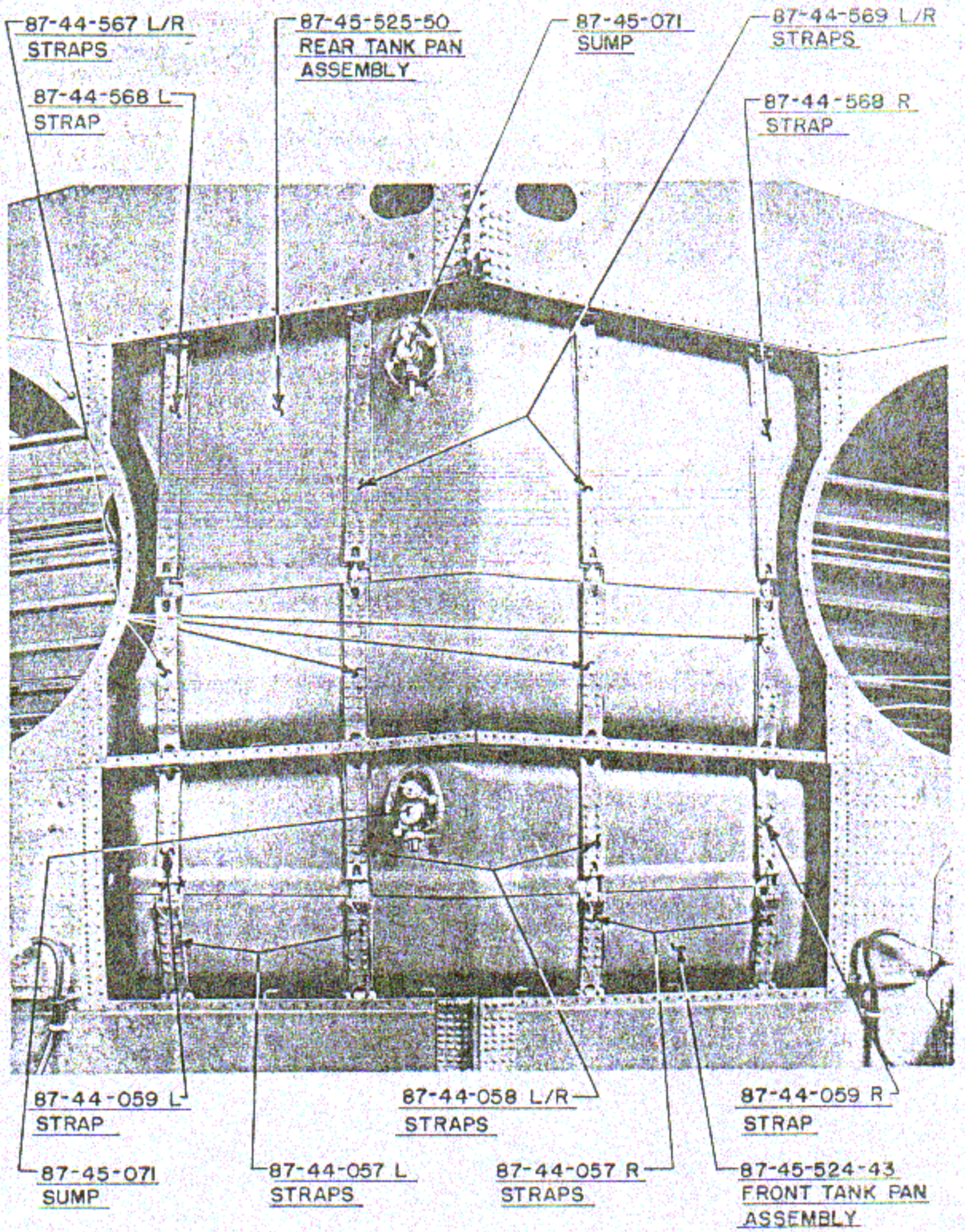


Fig. 68 - Wing fuel tanks - access doors removed.

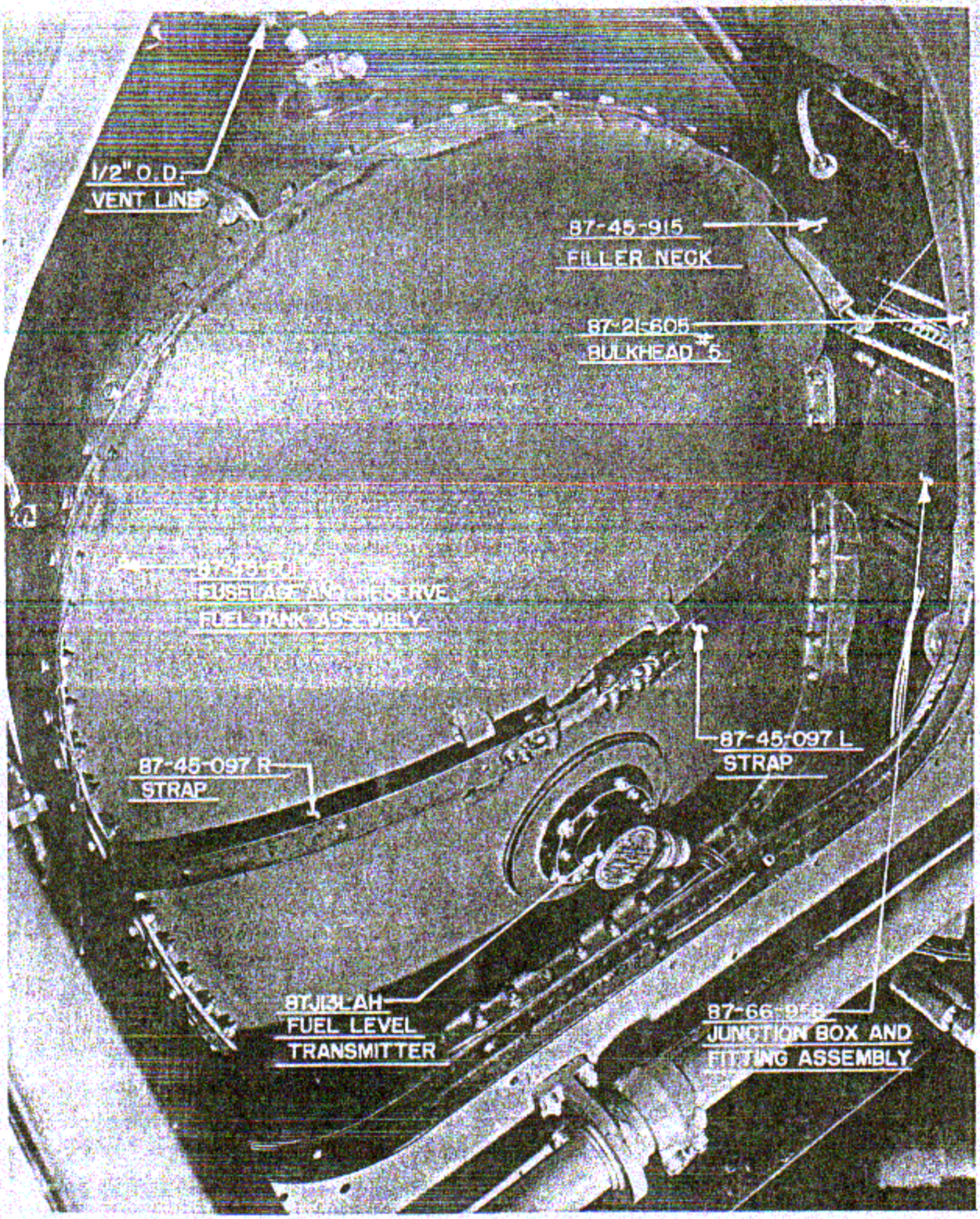


Fig. 69 - Fuselage & reserve fuel tank - installed.

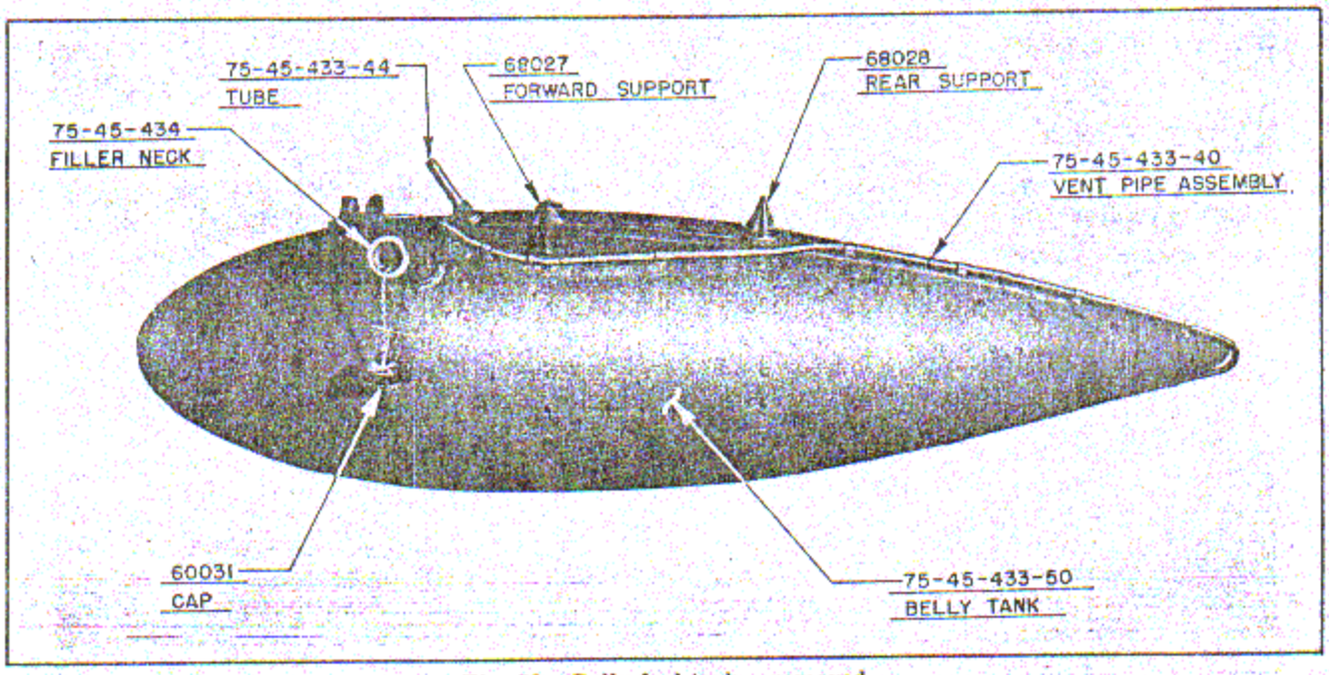


Fig. 70 - Belly fuel tank - removed.

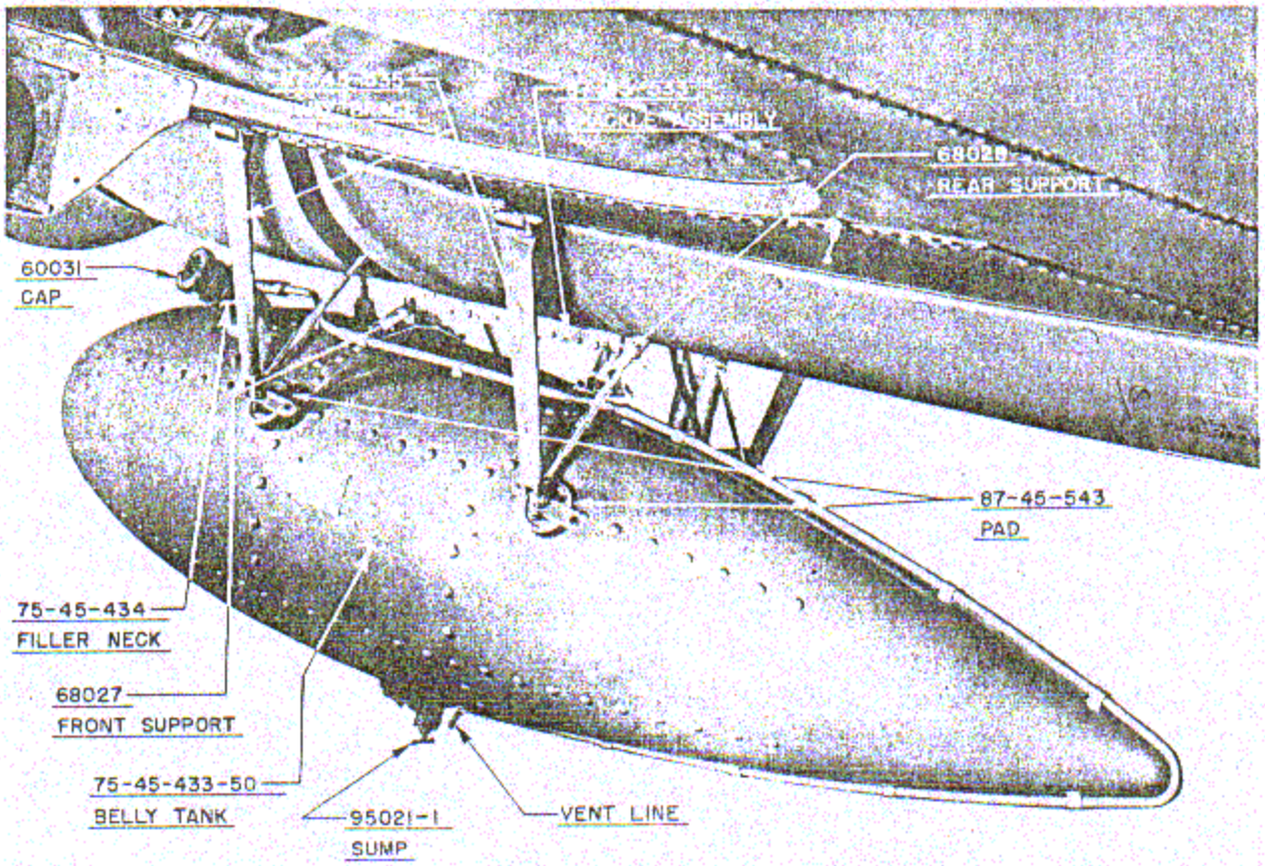


Fig. 71 - Belly fuel tank installed.

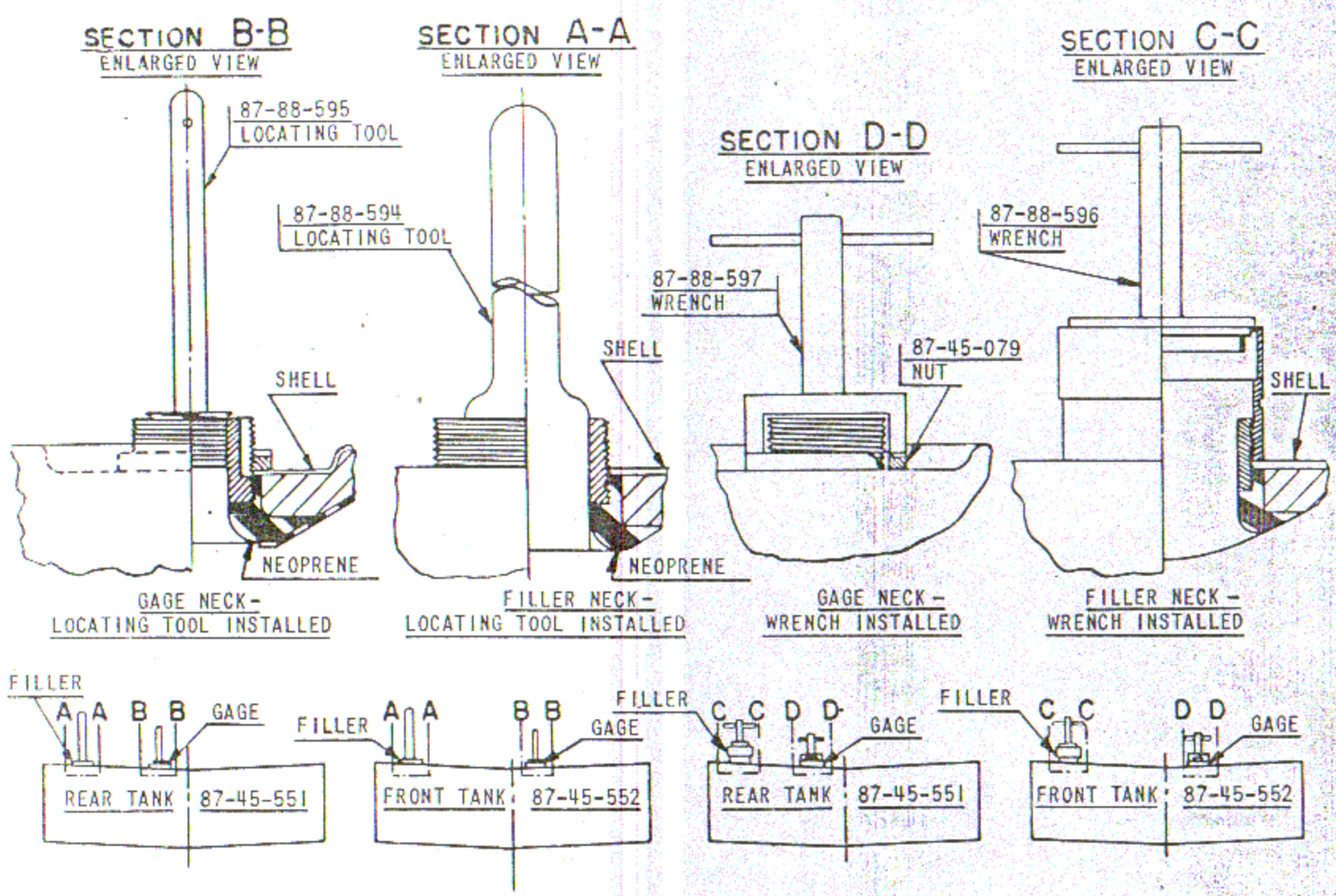
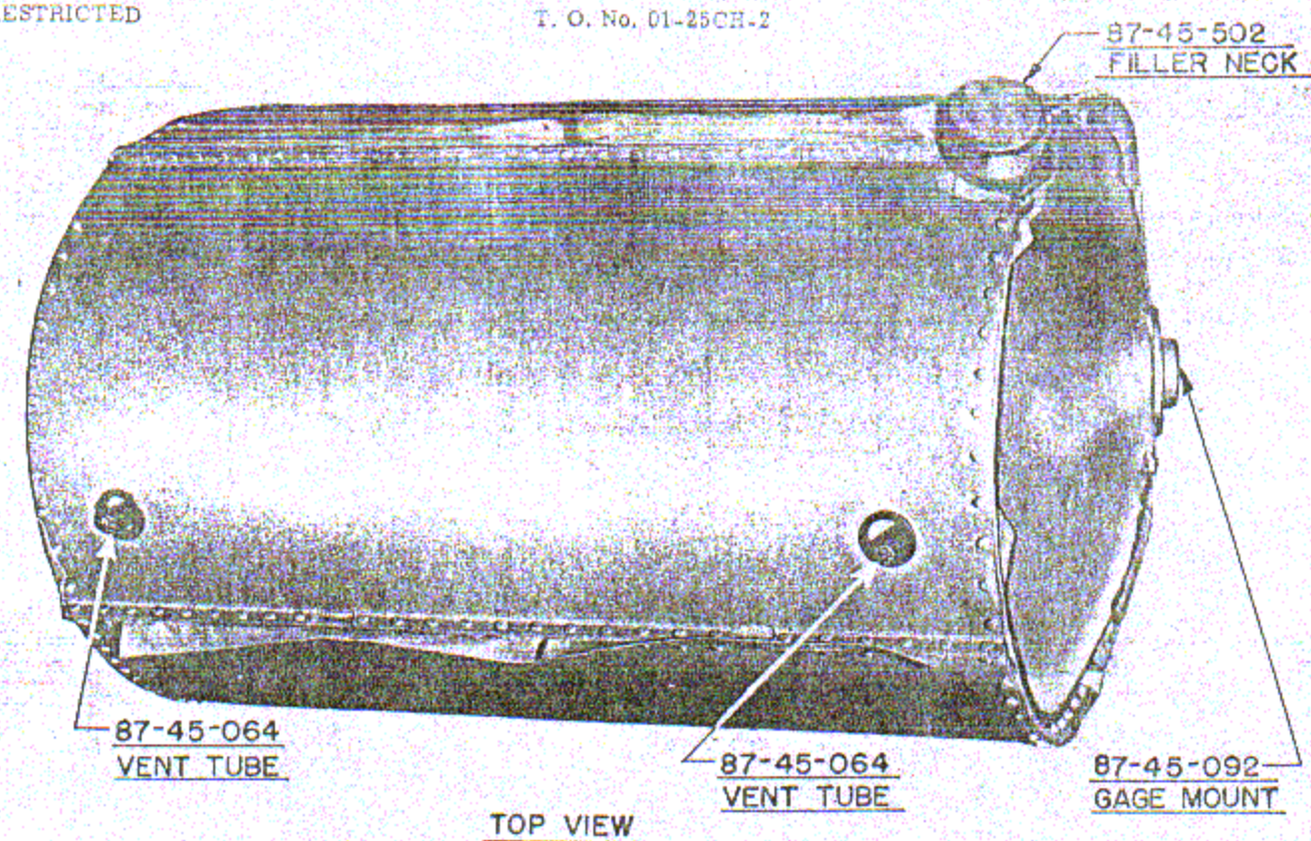


Fig. 72 - Wing tank installation tools.



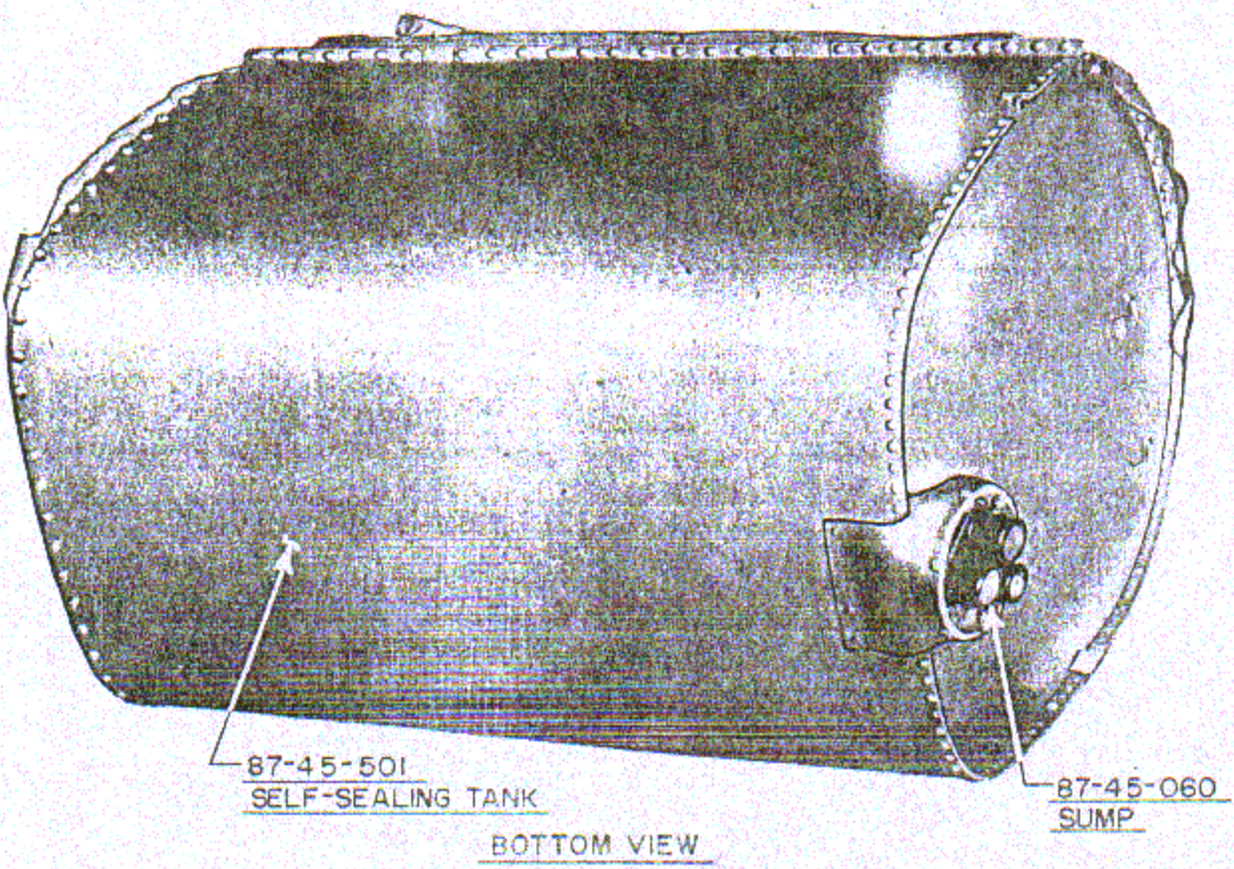


Fig. 73 - Fuselage & reserve fuel tank - removed.

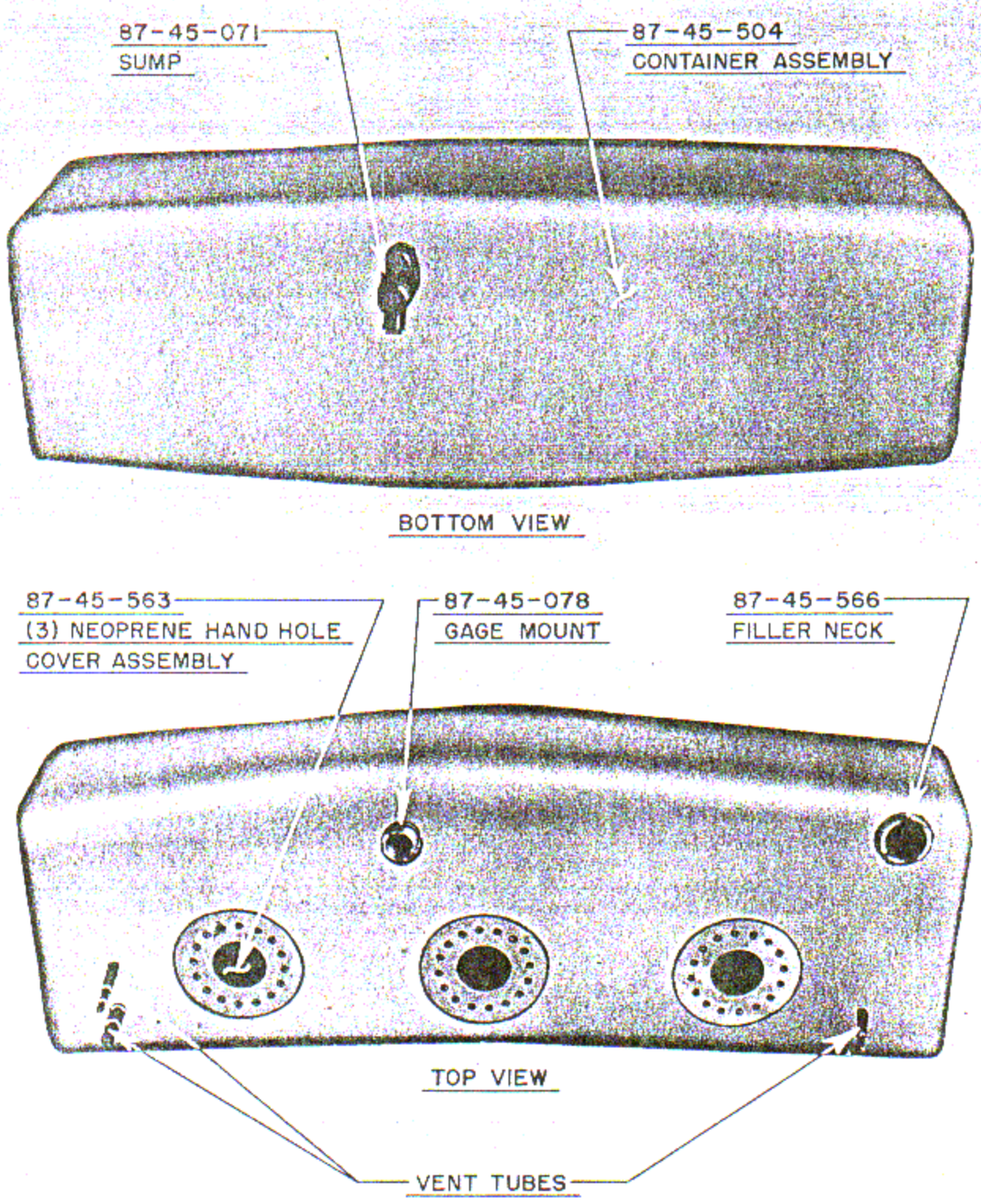


Fig. 74 - Wing fuel tank - front.

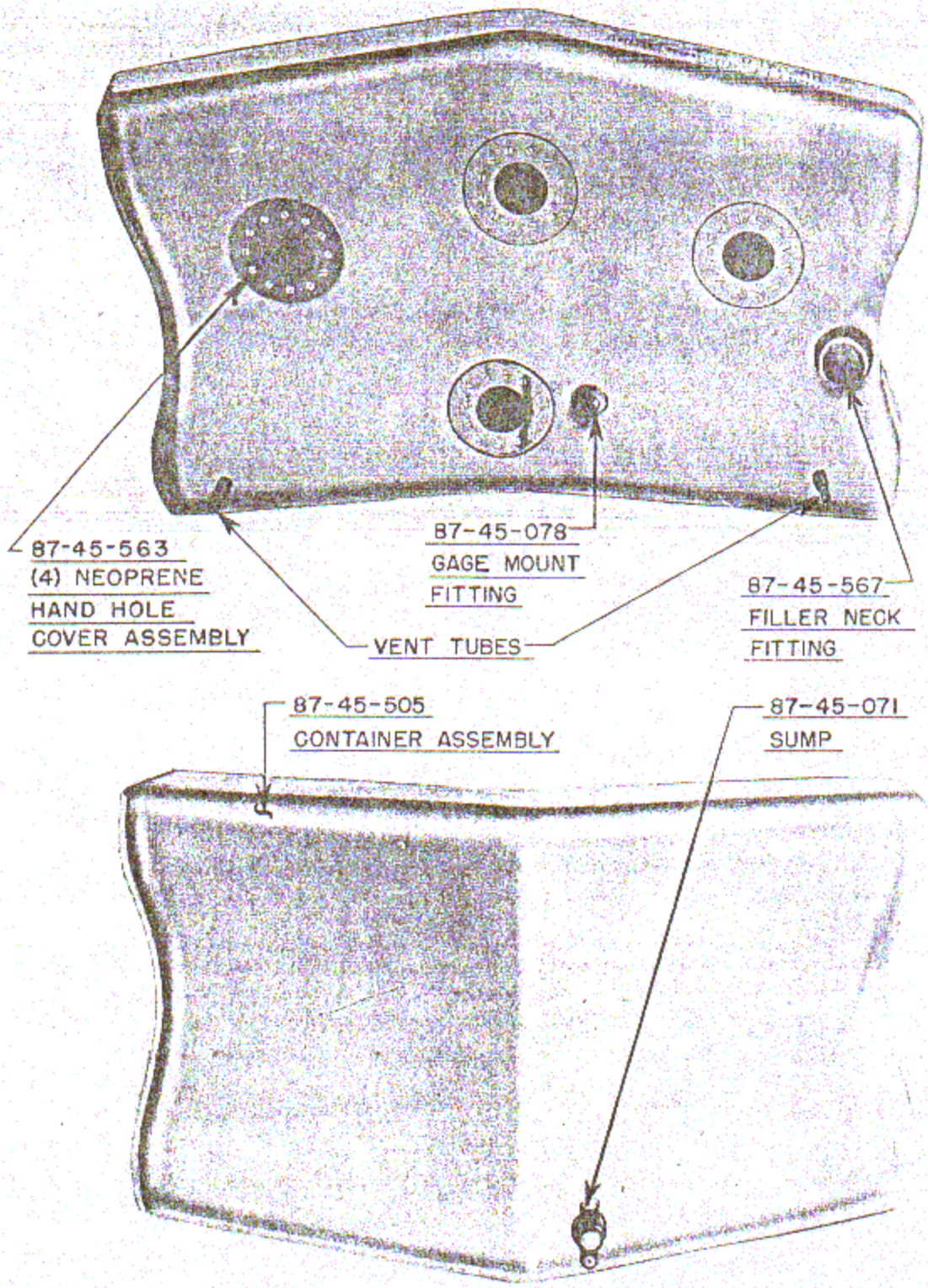


Fig. 75 - Wing fuel tank - rear.

c. To Adjust Fuselage Tank Quantity Gage. - (1) Tank must be empty so that the float will rest on the bottom of the tank.

(2) Loosen the four screws on top of transmitter and rotate large diameter disc to mid position of travel.

(3) Connect the transmitter to the indicator and battery, and replace transmitter in the cup so that the screw holes align and the conduit connector points in the desired direction. Note 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 notches which make indicator read nearest to zero, then release the magnet. This is the approximate zero adjustment.

(4) Replace the transmitter in the cup and secure it in place with the six flange screws. Rotate the large diameter disc until the indicator reads exactly zero and tighten the four screws which hold the indicator 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 instrument 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 though the zero reading has been corrected by adjusting the transmitter at the tank. (The dial cannot be removed without removing pointer.) For additional information on the Service and Maintenance of D. C. Selsyn Transmitters and Indicators see T. O. No. 05-55A-3.

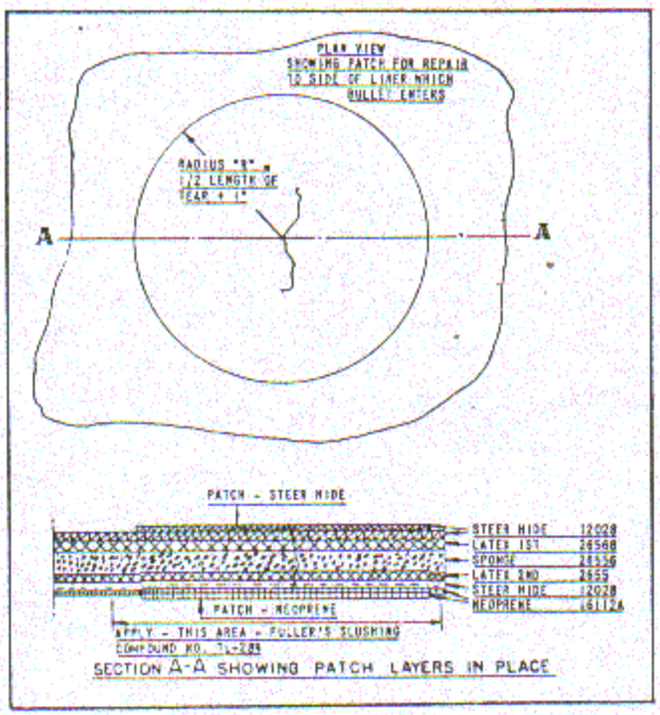


Fig. 76 - Repair of fuel cell on bullet entrance side.

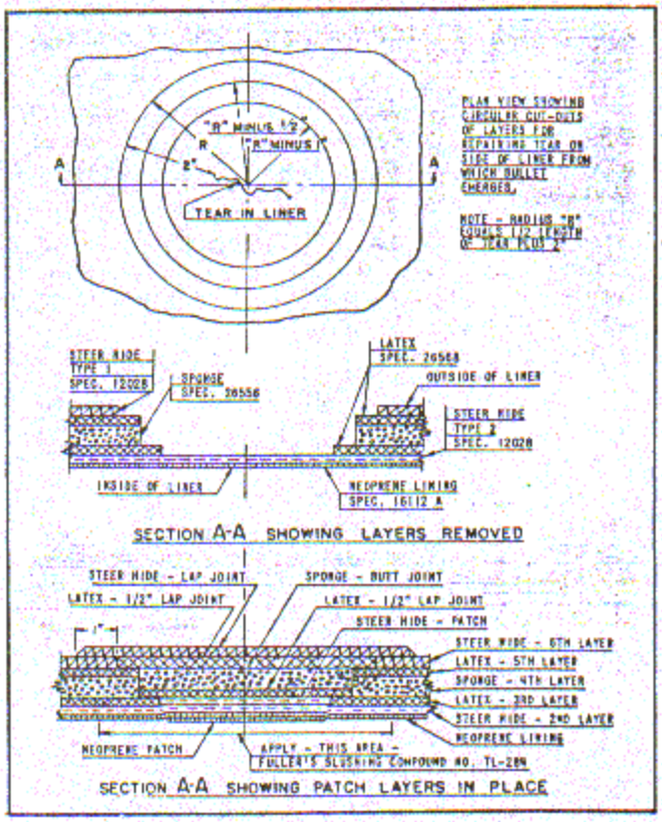


Fig. 77 - Repair of fuel cell on bullet exit side.

d. Repair of Fuel Tanks. - A fuel tank damaged enough to necessitate repairs must be removed and sent to a repair depot.

(1) Repair of Self-Sealing Fuel Cells: After removing the fuel tank cells from the aluminum containers, the procedure as recommended by the manufacturer is as follows:

(a) Remove Inspection Hole Covers which are Nearest to the Damaged Area: The number of Inspection Holes in each fuel tank is as follows:

Fuselage Tank:	1 Inspection Hole
Front Wing Tank:	3 Inspection Holes
Rear Wing Tank:	4 Inspection Holes

(b) Repair of Fuel Cell on Bullet Entrance Side:

1. Clean the neoprene ballon 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.

(c) Repair of Self-Sealing Fuel Cells on the Bullet Exit Side: 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 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, except in the case of the sponge patch where a butt joint should be used instead of a lap joint. (See Figure 77). 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 they are damaged, 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 fitting 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 joining surface must be cleared of a Zinc Chromate Slushing Compound before applying the Bostick M-40 cement. A balloon cloth 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 provided so that the workmen suffer no serious effects while making these repairs.

(2) Repair of Tank Shells: (a) Cleaning procedure: Refer to T. O. No. 01-1E-26.

(b) Air Corps repair and manufacturing practices for aluminum alloys are outlined in T. O. No. 23-15-1.

(c) Failures in fuel tank shells can usually be repaired by removing the fuel tank cells and welding the cracks. The paint coatings should first be removed for a distance of at least 3" all around the crack. This can be done by the application of paint remover which should then be thoroughly washed off with hot water.

(d) Drill a small hole (3/64" or 1/16" diameter), at each end of the crack, to prevent progression of the crack under the welding heat or after the tank is again in service. The welding can then be accomplished using an oxy-hydrogen flame. The flame should be adjusted to a neutral condition with the hydrogen gage set about 5 P. S. I. above the oxygen gage. A filler rod of the same material as the tank can be used although 4% silicon rod, if available, is generally easier to handle and gives better results in complicated welds. United States Aluminum Company Flux #22, or equivalent, should be used. Mix the Flux to a paste condition with water and coat the part to be welded with the Flux and dip the rod in the Flux also. 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 safe practice to follow is to weld from each end of a crack toward the center to prevent the crack from progressing ahead of the flame.

(e) Cracks in the shell around rivets can be repaired in the manner described in the preceding paragraph (d), however, it is more desirable in this case to use silicon rod if available.

15. Engine and Aeronautical Instrument. - (Drawing 87-61-501)

a. General. - (1) Instrument Panel: The instrument panel is mounted on two supports at the bottom and braced by two rods at the top which are attached to the armor plate. The supports and braces are mounted on bushings (of 150 P20 Monel) which 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 be in accordance with the installation, Drawing 87-61-501-50.

(2) Lighting: (a) Instruments: The dial, indicators and controls are painted with fluorescent paint, which become luminous under ultra violet light rays.

(b) Cockpit: The wing fuel tank gages on the cockpit floor are individually lighted.

(c) Fluorescent Spot Lights: The cockpit is illuminated by two self-contained Grimes fluorescent spot lights, Type C-5. A special 4 watt, 24 volt, RP-12 bulb is used, and either visible or ultra violet light is emitted from the lamp by rotating the knurled cap which contains the lens, 90 degrees. By removing the aluminum lens housing from the bakelite base, the bulb may be taken out and replaced. The double contact bulb is designed to fit into the socket in only one position. Each light is controlled by a separate switch, integral with a rheostat, located on the main electrical control switch panel. To start the light, turn the rheostat knob to the right to "START", and hold in that position for a few seconds, until the light illuminates; then turn the knob to the left until the desired intensity of illumination is obtained. A base for mounting the spotlight is provided on each side of the cockpit near Station #4. An auxiliary base is provided on each side of the windshield side panel frame. When the fluorescent spot light is mounted in the base, it may be readily aimed in any direction.

(d) Switches and Rheostats: The switches for the instruments are on the electrical control panel. The compass, gun sight lights and fluorescent spot lights are controlled by rheostats with integral switches.

(3) Instruments: The following instruments are mounted on the instrument panel:

(a) Rate of Climb Indicator, Type C-2, T. O. No. 05-20-26.

(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. 05-20-10.

(h) Suction Gage, Type F-3, T. O. No. 05-20-6.

(i) Clock, Type A-11, T. O. No. 05-1-9.

(j) Manifold Pressure Gage, Type D-10, T. O. No. 05-40-2.

(k) Tachometer, Type C-9, T. O. No. 05-5C.

(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) Wing Flap and Landing Gear Wheel Position Indicator, electrically operated, (Selsyn, Type 8DJ-4PXAB and K-4129934) - T. O. No. 05-55A-2. In operation, the motion of the main wheels, tail wheel and wing flaps is followed by the respective position indicating tabs and pointer on the indicator dial. When the wheels and flaps are in the "UP" position indicating tabs and pointer complete the luminous image representing the outline of an airplane in a plan view on the dial. The tabs and pointer disappear entirely from view, leaving a gap in the luminous outline, when the ignition switch is in the "OFF" position.

(o) Fuel Quantity Indicator: 1. The fuel quantity indicator for the fuselage fuel tank is of the magnetic coupling type. G. E. 8DJ-11LAN (Drawing 87-45-506) T. O. No. 05-55A-3.

2. The fuel quantity indicators for the front and rear wing tanks are of the magnetic float type, manufactured by the Boston Auto Gage Co. (Drawing SK-150-X-1) and are located in the floor of the cockpit. These gages have a luminous dial and pointer and are indirectly lighted in accordance with Spec. #32120. See Drawing 87-44-536 for additional details.

(p) Ammeter - Spec. 94-32191, Type D-2.

(4) Vacuum System: (a) Vacuum Operated Flight Instruments: The gyro instruments are operated by either a #194-D, Type B-6, or a #194-F, Type B-11 engine driven vacuum pump. The pump is driven by a power take-off in front of the propeller reduction gear housing on the engine.

(b) Relief Valves: There are two relief valves in the vacuum system. The Pesco #195 relief valve, which is incorporated in the line between the gyro instruments on the panel and the vacuum pump, is attached to a bracket on the engine mount on the right-hand side of the engine. The Parker #4561-2-1/8D relief valve is installed in the vacuum line to the Turn and Bank Indicator, and it is located directly in back of the instrument. See Figure 78.

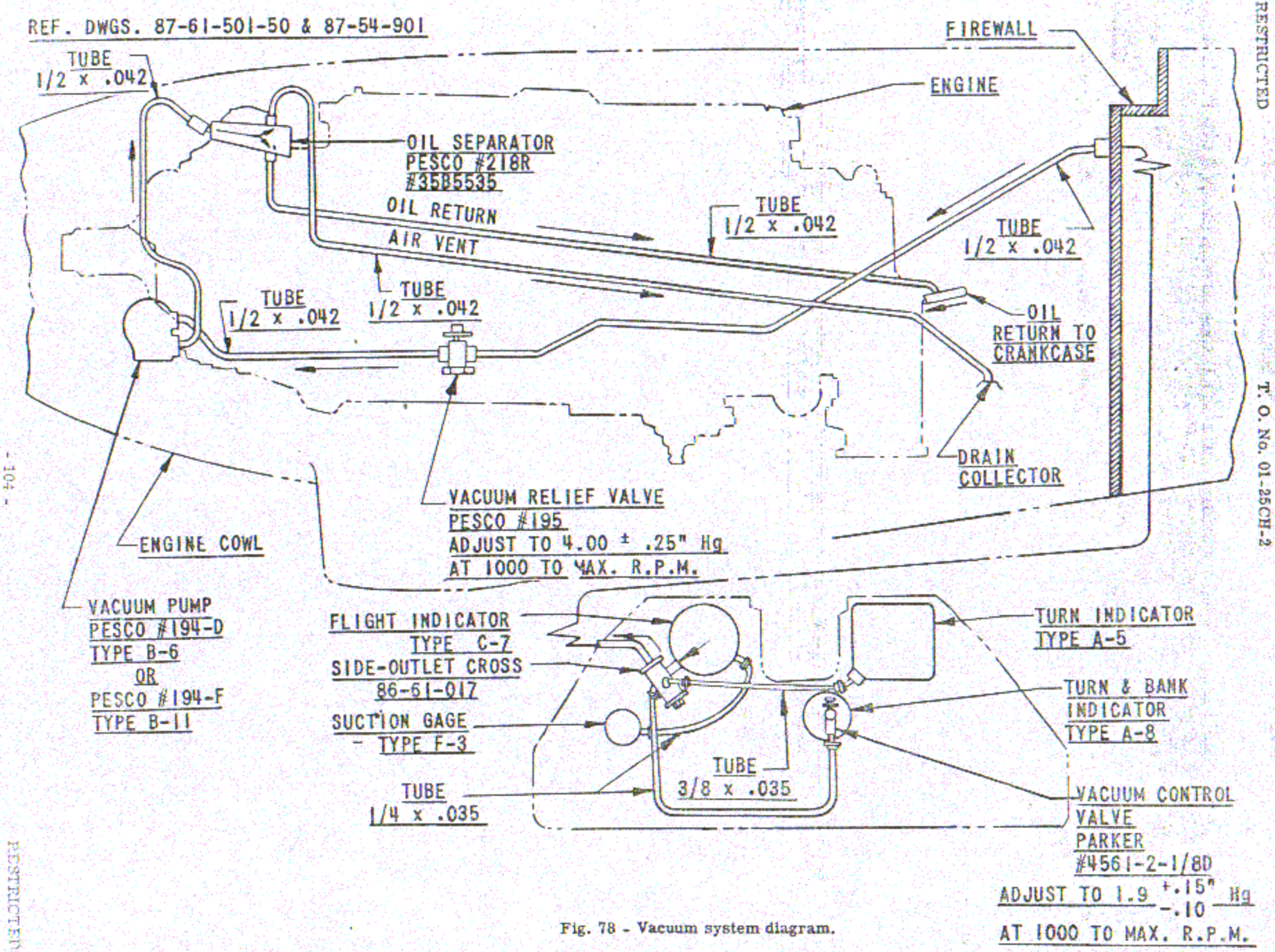


Fig. 78 - Vacuum system diagram.

RESTRICTED

(c) Oil Separator: A Pesco #218R oil separator is mounted on a bracket attached to the right side of the propeller reduction gear housing. The 1/2" O.D. discharge line from the vacuum pump is connected to the small end of the oil separator. The 1/2" O.D. separator exhaust and drain lines are connected to the large end of the oil separator at the top and bottom, respectively. The exhaust line runs to the drain collector which is attached to the leading edge of the wing; the drain line is connected to the crankcase oil vent line near the electric starter motor.

(5) Pitot Static Tube (Electrically Heated): An electrically heated airspeed head, Spec. 27876, Type D-1 (24 Volt) is installed on the left wing. For applicable instructions, see T. O. No. 05-50-1. Airspeed lines are of copper tubing with triple solderless fittings.

(6) Drains: Drain plugs for the airspeed lines are located in the bottom surface of the wing, inside the left-hand landing gear fairing.

16. Surface Controls. (Drawing 87-64-501)

a. General. - 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 bellcrank; cables run aft from the bellcrank and then outboard to a drum which operates the aileron through an eccentric arm.

(1) Aileron Control: The ailerons are controlled by lateral movement of the control stick; for full aileron control, the control stick is operated to a position 20-1/2°, either side of the center line of the airplane. The turnbuckles on the cables are accessible through the inboard trailing edge of the wing when the flaps are lowered.

(a) The adjusting nut on the links, connected to the arm on the control stick torque shaft, is accessible above the wing upper skin.

(b) All cables requiring specified tension are tested for correct loading by a tensionometer.

(c) The following tensions are specified:

Elevator Cables	100#
Rudder Cables	100#
Tail Wheel Cables (Retracted)	0#
Tail Wheel Cables (One Load)	40#
Tail Wheel Cables (Extended)	110#
Aileron Cables	90#

(2) Elevator Control: (a) Neutral position of the control stick is 1-1/2 degrees aft of a vertical line through the line of thrust. Movement of the control stick, forward and aft of neutral poistion, for full elevator travel is 17-1/2 degrees forward (nose down) and 26 degrees aft (nose up).

(b) The control stick is connected to the elevator control by a push-pull tube to a lever on a front jackshaft at Station 5. Bellcranks on the jackshaft at Station 5 are connected by two pairs of cables to bellcranks on a rear jackshaft at Station 16, from which a single short push-pull link connects to the elevator horn. The cables are crossed between bellcranks. The cables are accessible through the rear fuselage inspection doors.

(c) The stop for the elevator system is an adjustable cylinder and piston unit attached to the front of the control stick and leading forward and down to attach to the wing match angle.

(d) The stops for the aileron system are bolts through the arms on the aft end of the torque shaft.

(3) Rudder and Tail Wheel Controls: (a) The rudder control system consists of a cable extending aft from the rudder pedal assembly which passes around a reduction pulley mounted on an arm at Station 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.

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 extends from one pedal forward around two pulleys to the opposite pedal.

(b) Each control cable to the tail wheel passes through a pair of guide pulleys at Station 13. Slack in the cable is avoided by the use of coil type tension springs attached to the lift tube at the center line of the fuselage and to the cable at Station 12. The cable also incorporates a 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. Rudder pedal travel in the full forward position is limited by the adjustable stop screw head.

(4) Wing Flap Controls: The wing flap control system consists of a hydraulic actuating cylinder mounted on the airplane center line within the wing near the trailing edge. The motion is transmitted through bellcranks to spanwise push-pull tubes in the wing. Turnbuckles connect the flaps to the push-pull tubes. For adjustment purposes, the link and turnbuckles may be reached through the trailing edge of the wing when the flap is lowered, or through doors in the bottom of the wing.

(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 chain and sprocket drive to a gear box mounted just forward of the rear elevator jackshaft. From this box three flexible shafts (2 for the elevators and 1 for the rudder) transmit motion

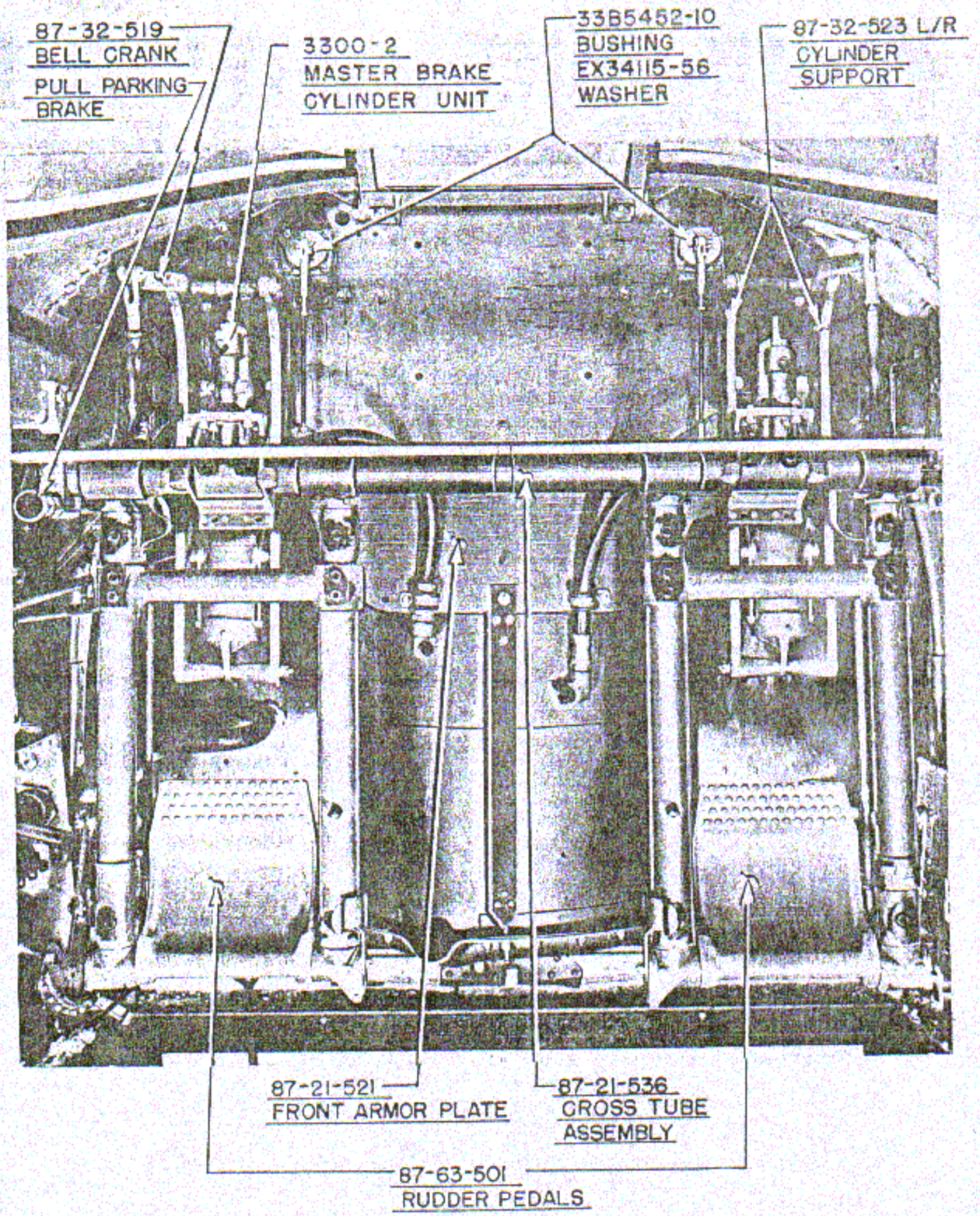


Fig. 79 - Rudder pedals and brake master cylinders.

REF. DWG. 87-64-501

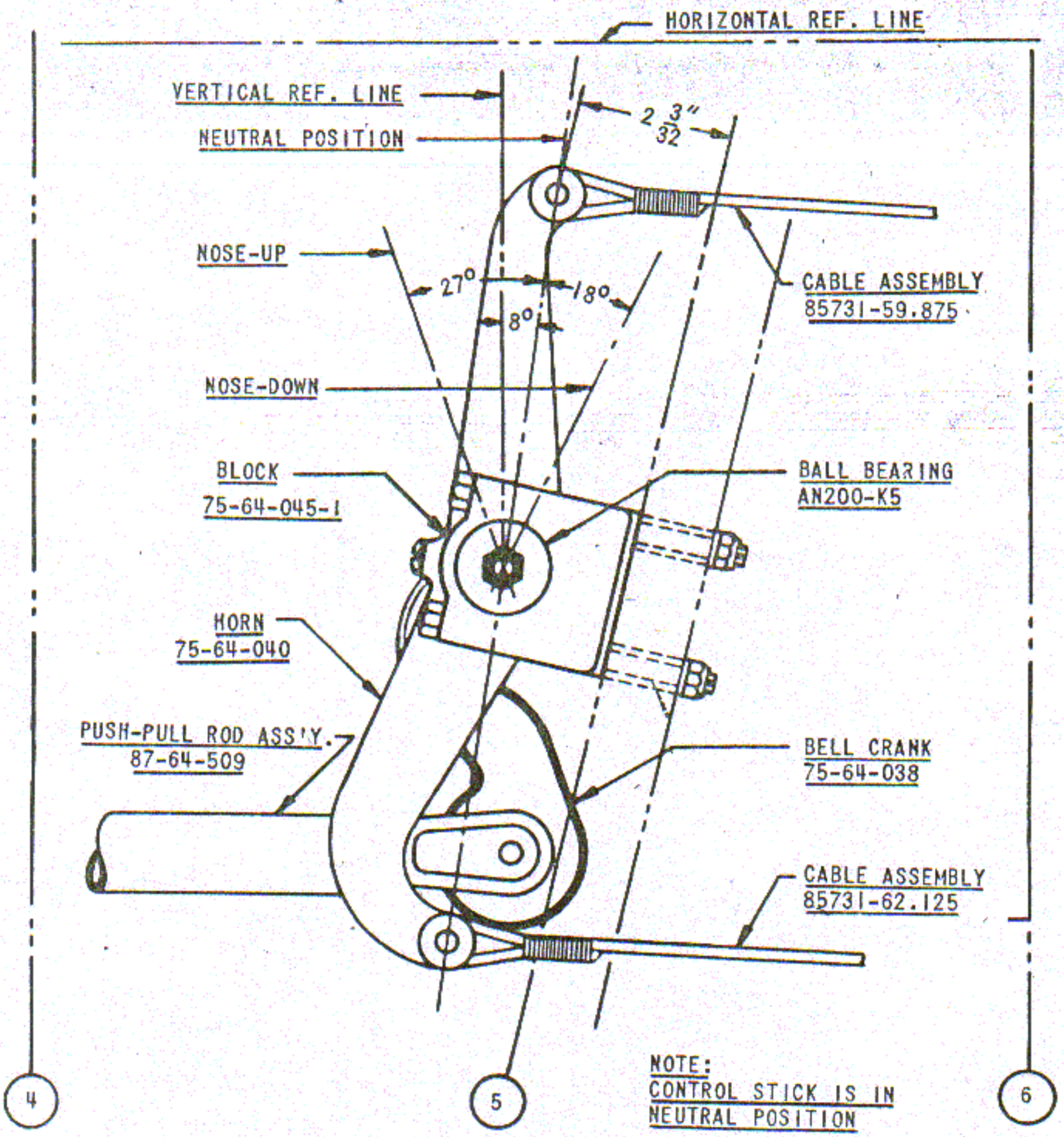


Fig. 80 - Jackshaft setting - flight controls.

REF. NO. 87-33-901

(A) 87-33-504 AUXILIARY HAND PUMP

(B) 87-33-504 EMERGENCY HAND PUMP

(C) 87-64-004 FLAP ACTUATING CYLINDER

(D) 87-33-576 SHUT-OFF VALVE ASSEMBLY (2)

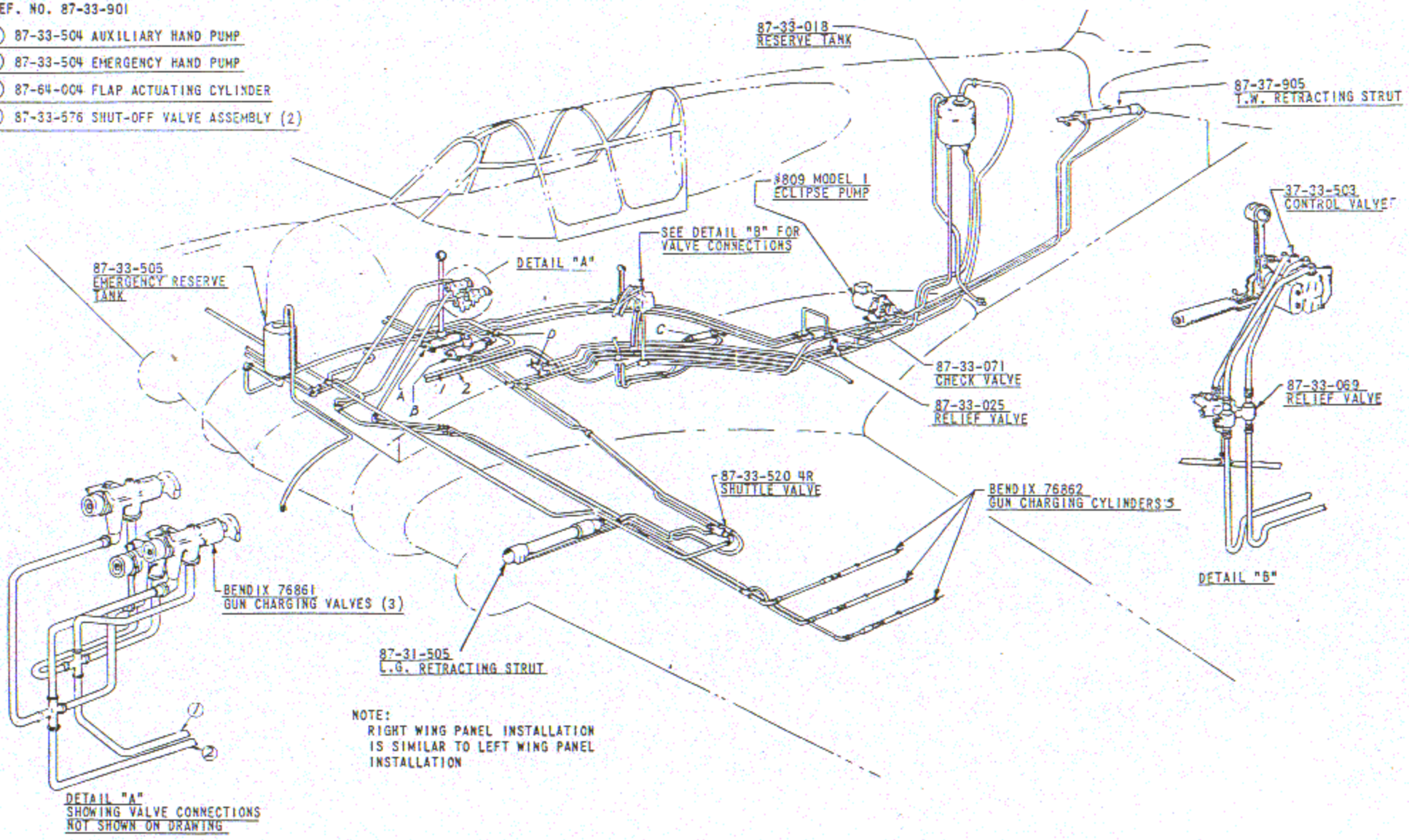


FIG. 81 - HYDRAULIC SYSTEM DIAGRAM

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	P XING	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	2
H	87-33-504-2	#10-32 ALLEN SET SCREW	2
I	VALVE ASSEMBLY -		
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
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

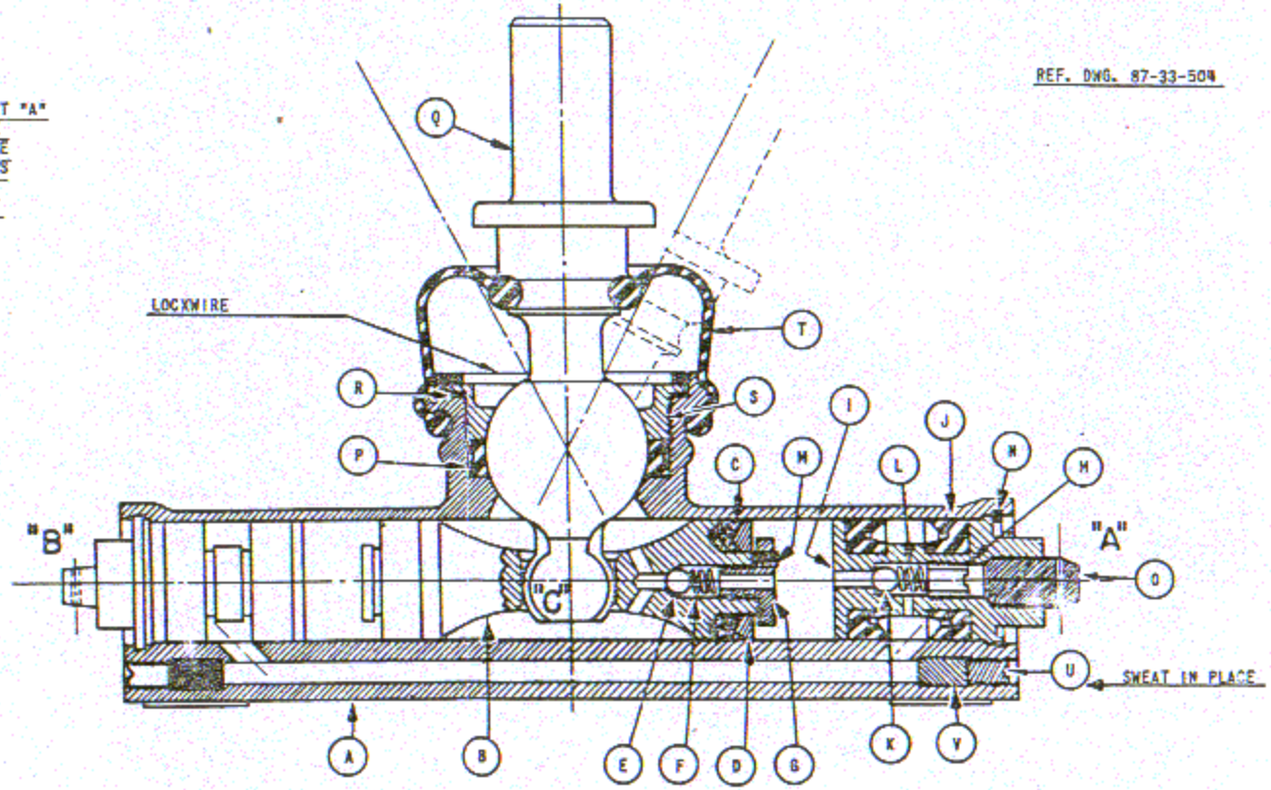
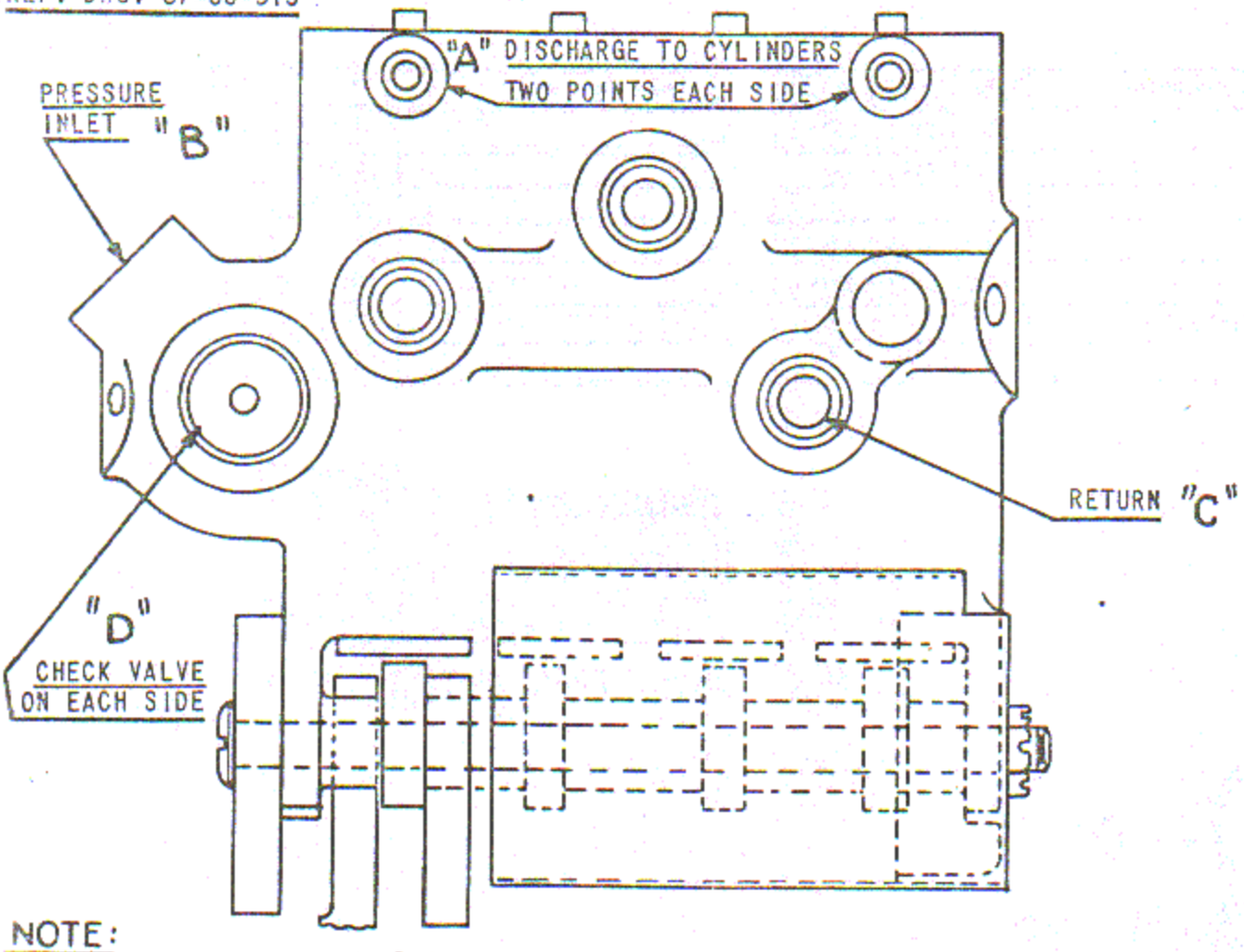


FIG. 82 - HYDRAULIC HAND PUMP

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:

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".

Fig. 83 - Hydraulic control valve - pressure test data.

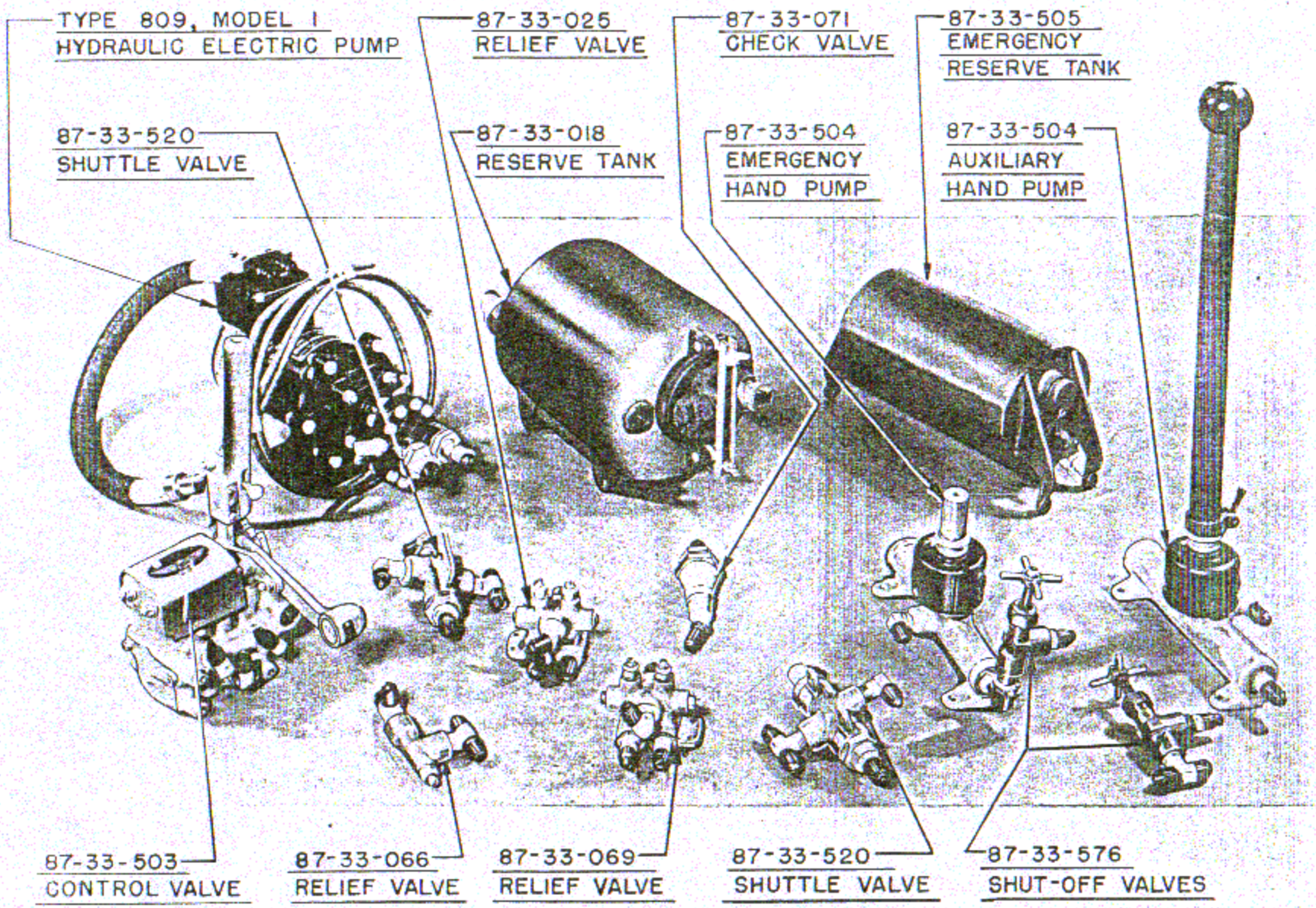
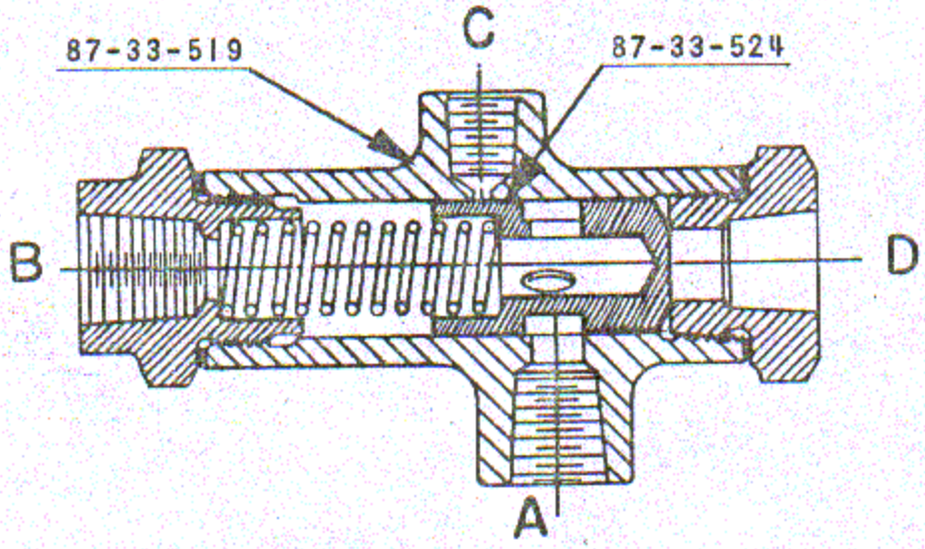


Fig. 84 - Hydraulic system components.

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 81-33-524 & 87-33-519
THROUGHOUT THE ENTIRE STROKE.

#4 - THIS TEST MUST BE RUN WITH ALL HYDRAULIC FITTINGS INSTALLED
AS SHOWN ON 87-33-501

Fig. 85 - Hydraulic system - shuttle valve - test procedure.

1. FOR TEST AND ASSEMBLY USE HYDRAULIC BRAKE FLUID #5. UNDER NO CONDITIONS SHOULD MINERAL OIL BE USED.
2. TO MANIPULATE PAWL "E", - USE 5/32" DIA. DRILL ROD, 16" OR LONGER, END THREADED #8-36 - INSERT ROD THRU 1/4" HOLE IN CAP "G".
3. ELIMINATE OR ADD SHIMS AS REQUIRED TO SHIMS N&O SO THAT LOCKS "D" WILL HAVE CLEARANCE OF .003"-.006" IN LOCKED POSITION.
4. TEST COMPLETE ASSEMBLY TO 2500#/SQ. IN.

	PART NUMBER	PART	NO.
A	87-33-510	CYLINDER	1
B	87-31-027	PISTON	1
C	87-33-515	END	1
D	75-33-027	LOCK	12
E	75-33-021	PAWL	1
F	75-33-029	ROCKER	1
G	75-33-023	CAP	1
H	87-31-034	SHAFT	1
I	75-33-026-1	PIN	1
J	75-33-026-2	PIN	1
K	87-31-028	BEARING	1
L	75-33-025-1	NUT	1
M	75-33-025-2	NUT	1
N	75-33-030-1	SHIM	2
O	75-33-030-2	SHIM	2

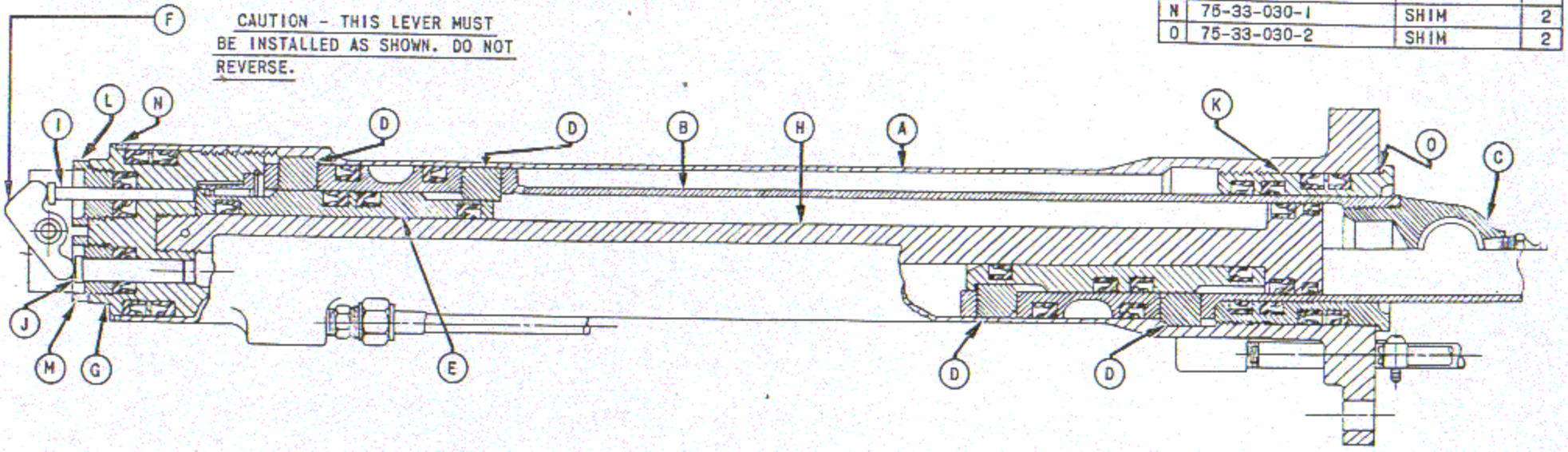


FIG. 86 - LANDING GEAR - RETRACTING STRUT

to the tab control actuator unit. Short tie rods connect these actuators to the individual tabs. Control chain tension is adjustable by turnbuckles accessible through the baggage compartment door. To remove the trim tabs, see Section IV, paragraph 3 of this Handbook.

(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 (37-14-568), 7/8 of an inch with a tolerance of +0 and -1/32 of an inch is allowed between the end of the actuator screwjack, 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 screwjack), to assure proper travel 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 degrees, 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 center line with the rudder center line. The lock nut is tightened against the clevis end, and the clevis end and tube end are jointly drilled and cottered.

(c) The trim tab on the left aileron is controlled by means of an electric motor mounted in the aileron. The momentary contact toggle switch for controlling the trim tab motor is located on the main switch panel. To remove the trim tab from the aileron, see Section V, paragraph 2 of this Handbook.

b. To Remove the Elevator Control Jackshafts:

(1) Remove the pilot's seat, remove the covers which enclose the horns and remove the forward jackshaft by disconnecting the push-pull tube from the arm and the four cables from the horns on each end of the jackshaft. Remove the eight bolts attaching the three bearing supports to the bulkheads and remove the shaft with the bearing supports. The bearing supports may then 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 the bearing supports.

c. To Remove the Wing Flap Control Mechanism: The wing flap actuating cylinder and bellcrank 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 remove the fuselage and separate the wing panels, remove the bolts which attach the turnbuckle fittings to the tube and withdraw the tube inboard while sliding the fittings off the tube.

17. Hydraulics. (Drawing 87-33-901)

a. General.

The hydraulic system can be operated by either the electrically driven hydraulic pump or by the outboard manually operated hydraulic pump. The electrically driven hydraulic pump is used for normal retraction and extension of the landing gear, operating the wing flaps and charging the machine guns. The outboard manually operated "Auxiliary" hydraulic pump is used in event of failure of the electrically driven hydraulic pump. The inboard "Emergency" hydraulic pump is used for lowering the landing gear main wheels only in event of failure to either of the two afore mentioned pumps.

The electrically driven hydraulic pump is controlled by a toggle switch which is installed immediately below the handgrip on the flight control stick. One handle is provided for the two manually operated hydraulic pumps and is equipped with a latch for interchangeability with each pump.

The hydraulic selector control valve assembly is located on the left side of the cockpit. The selector control valve assembly is equipped with two handles; one for controlling the landing gear, and the other for controlling the position of the wing flaps.

The hydraulic system reserve fluid supply tank is located within the fuselage immediately aft of the fuselage access door. The emergency hydraulic system reserve fluid supply tank is attached to the forward side of the firewall.

The lines of the hydraulic system are of "Everdur" or stainless steel tubing (Spec. 57-180-3) throughout, except the vent and drain lines which are 52SO aluminum alloy tubing.

The lines of the hydraulic system which connect to the landing gear retracting cylinders and the lines connecting to the hydraulically operated gun charging mechanism are accessible through the wheel wells in the wing and through the gun bay in the wing. Removable plates on the wing are provided to permit access to the lines in regions within the wing structure.

(1) Electrically Driven Hydraulic Pump: The Eclipse Aviation hydraulic pump, Type 809, comprises the hydraulic pump and an electric motor. The pump is equipped with an integral relief valve which is adjusted to by-pass the hydraulic fluid at 1000 pounds pressure per square inch. For data applicable to this pump refer to T. O. No. 03-30CA-2.

(2) Manually Operated Hydraulic Pumps: Two manually operated hydraulic pumps are attached to the

right side of the cockpit floor. These pumps are of the single cylinder, reciprocating, double action type. The outboard pump is the "Auxiliary" hydraulic pump and is used to keep pressure in the main hydraulic system in event of failure of the electrically driven hydraulic pump. The inboard pump is connected to a separate hydraulic system which will extend the landing gear main wheels only. This pump is used only in "Emergency".

(3) Hydraulic Selector Control Valve: The control valve assembly consists of a housing containing eight, cam operated poppet valve assemblies which control the direction of fluid flow. These poppet valves are controlled by two camshafts which are operated by two levers.

Two shut-off valves are incorporated in the hydraulic system which are operated when the "Emergency" hydraulic system is to be used. These valves are located on the cockpit floor, one adjacent to the "Emergency" hydraulic pump and the other on the left side of the cockpit floor.

(4) Restricted Fittings and Check Valves: (a) A restricted fitting is installed in the boss where the return line from the wing flap actuating cylinder connects to the selector control valve. When the flaps are being raised, due 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 during this operation thus regulating the rate at which the flaps move upward.

(b) A check valve is installed in the pressure line from the electrically driven hydraulic pump in the fuselage; this valve is located on the left side of the airplane and may be reached through the fuselage access door. This valve prevents by-passing the hand pump pressure through the electrically driven hydraulic pump when the hand pump is operated.

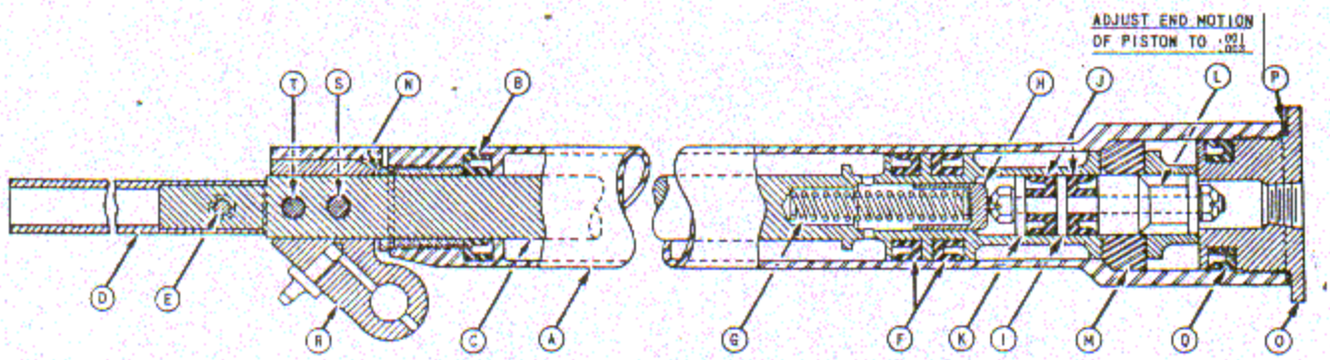
(5) Relief Valves: The single relief valve for the hydraulic hand pump and the twin relief valve for the landing gear control are located in the lower left side of the fuselage forward of the stowage compartment. The twin relief valve for the flap control is located on the lower left side below the hydraulic control selector valve. See paragraph 2., y., column 39, in Section III of this Handbook, for testing information.

(6) Shuttle Valve: A shuttle valve (87-33-520) is installed between the landing gear retracting cylinder 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 85 for testing information.

(7) Landing Gear Retracting Cylinder: (a) The retracting cylinders (Drawing 87-31-505) have a stroke of 11-1/6 inches and are equipped with two sets of hydraulically operated locks, which are operated by the over travel of an internal sliding actuator. The locks consists 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.

REF. DWG. 87-37-905

LET.	PART NO.	NAME	QUAN.	LET.	PART NO.	NAME	QUAN.
A	87-37-020	CYLINDER	1	K	75-37-026	WASHER	1
B	75-37-032	CUP PACKING	1	L	75-37-024	ACTUATOR	1
C	87-37-919	PISTON	1	M	75-37-023	LOCK	2
D	87-37-018	GUIDE	1	N	75-37-020	BUSHING	1
E	87-37-905-5	RIVET	1	O	75-37-019	CAP	1
F	75-37-030	CUP PACKING	2	P	75-37-028	SHIM	2
G	75-37-079	SPRING	1	Q	75-37-029	CUP PACKING	1
H	75-37-080	FOLLOWER	1	R	81-37-013	LUG	1
I	75-37-025	STUD	1	S	AN24-20	BOLT	1
J	75-37-031	CUP PACKING	2	T	AN24-25	BOLT	1



STRUT MUST BE FREE OF CHIPS.
STRUT MUST NOT LEAK AT 2500 LBS./SQ. IN. PRESSURE
USE ONLY LOCKHEED #5 HYDRAULIC FLUID.
LEAK TEST MUST BE MADE WITH PISTON IN MID - STROKE POSITION.

Fig. 87 - Tail gear - retracting strut.

(b) Figure 86 shows a section through the upper half of the retracting cylinder 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).

(8) Tail Gear Retracting Cylinder: (Figure 87) The principle of operation of the tail wheel retracting cylinder is the same as the landing gear retracting cylinder 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 warning system which operates the electrical horn.

(9) Wing Flap Actuating Cylinder: This cylinder consists of a hydraulic cylinder and piston located as described in this section, paragraph 16., a., (4).

(10) Lines: All hydraulic system tube fittings stamped 150 are heat treated, to 150,000 pounds per square inch. See nameplate in cockpit. All hydraulic lines are identified by a white and blue band on each side of every connection.

b. Filling and Bleeding Hydraulic System: See paragraph 2., v., column 39, in Section III.

(1) Drain the hydraulic system by opening the valve on the left side of the cockpit floor and operate the auxiliary hydraulic hand pump. Place a vessel beneath the drain to collect the hydraulic fluid.

c. Removal and Disassembly. - (1) To Remove the Electrically Driven Hydraulic Pump: The pump is accessible through the fuselage door, and may be removed as a unit by disconnecting the hydraulic lines and electric conduit and removing the mounting bolts.

(2) To Remove The Manually Operated Hydraulic Pumps: The manually operated hydraulic pumps are removed from the floor of the cockpit by disconnecting the hydraulic lines and removing the eight hold-down screws.

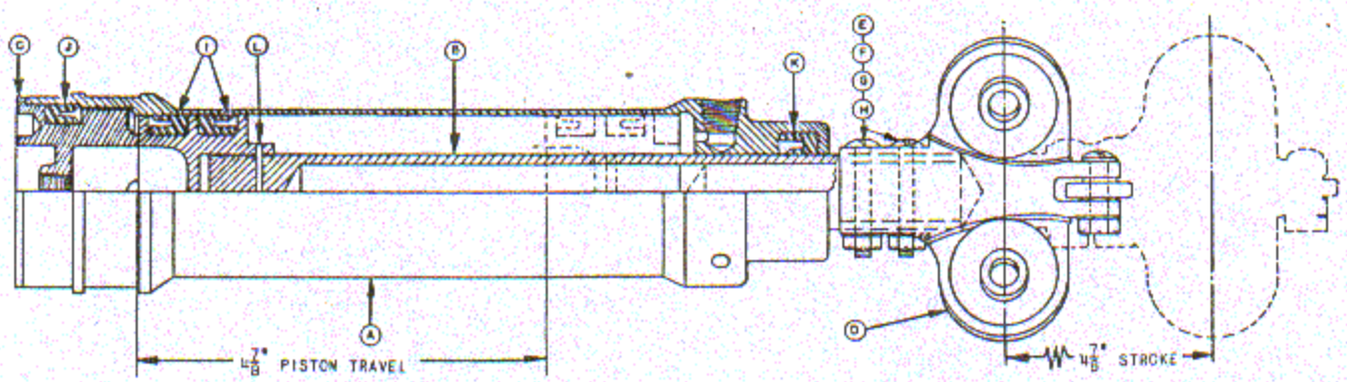
(3) To Remove the Hydraulic Selector Valve Unit:

(a) Disconnect the two hydraulic lines at the bottom of the unit and one additional line on the inboard side and three more at the top.

(b) Remove the four bolts holding the selector valve on to the mounting casting and remove the valve.

(4) To Disassemble the Hydraulic Selector Valve: To disassemble the valve proper: first, withdraw the two through bolts which act as 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 a 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.

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	H	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



PRESSURE TEST ASSEMBLY TO 2500 #/S. IN.
SEE FOLLOWING PAGE FOR ASSEMBLY & DISASSEMBLY INSTRUCTIONS

REF. DWG. 87-64-00N

Fig. 88 - Wing flap - actuating cylinder.

NOTE: Each poppet valve should be taped to indicate its location in the valve body, as the poppet valves are lapped into their respective seats.

(5) To Assemble the Hydraulic Selector Valve: When assembling the selector control valve, care should be taken to insert the poppet valves in the proper location, otherwise it will be necessary to lap each valve into the respective seat. When assembling the rubber packings, care must be taken not to damage the feather edges of the packings, as a small cut will cause leaks. Best results for installing packings will be obtained by thoroughly wetting the packings and mating parts with hydraulic 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 clearance between the cams and the cam 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 cam followers. Before installing the valve in the airplane, test in accordance with instructions given in Figure 83.

(6) To Disassemble and Assemble the Landing Gear Retracting Cylinder: (a) To disassemble the landing gear retracting cylinder, see Figure 86 remove the piston end. Then remove warning switch actuating rocker "F" so that a bar may be inserted in the slot to unscrew the cylinder cap "G". Cylinder cap, piston and all internal parts should then be removed together. Care must be taken in pulling out shaft "H" from the inside of piston so that the packings are not fouled in the square broached holes.

(b) At assembly the retracting cylinder should be adjusted for between .001 and .003 backlash at both ends. This can best be done by inserting a #8-36 threaded rod in the 1/4" hole in the cylinder cap "G" to actuate the pawl.

(c) A pressure test at 2500#/sq.in. must show no signs of leakage. Use hydraulic brake fluid #5, under no condition should mineral oil be used.

(7) To Disassemble and Assemble the Tail Wheel Retracting Cylinder: (a) To disassemble the cylinder, see Figure 87 remove lug "R". Remove the two attaching shear bolts connecting the lug to the piston and unscrew cylinder cap. Thus the piston and actuator will be free for removal.

(b) Upon assembly of the cylinder, adjust the piston backlash from .001 tight to .003 loose.

(c) A pressure test at 2500#/sq.in. must show no signs of leakage.

(8) To Remove the Wing Flap Actuating Cylinder: See paragraph 17., c., (Surface Controls), this section.

18. Ignition and Electrical System. (Drawing 87-66-901)

a. General. - The electrical system is a single-wire grounded negative installation including the wiring and equipment for ignition, generator, starter, electrical instruments, running lights, instrument and cockpit lights, gunnery equipment, landing gear, position and warning systems, and the electrically controlled propeller. For data pertaining to the instrument panel lights, see paragraph 16., a., (2), of this section. All electrical cables are carried in rigid aluminum or flexible conduits. Junction boxes or disconnect plugs are provided at all points of juncture of the electrical wiring to facilitate connection and replacement of the wiring.

(1) Ignition System: The Type A-9 ignition switch is mounted on the left side of the instrument panel.

(2) Generator System: Power is supplied to the electrical system by a Type M-2, generator which is mounted on the left side of the engine. The generator voltage regulator is accessible through the fuselage access door. The generator circuit is controlled by a switching relay and B-5A switch on the main switch panel.

(3) Electrically Driven Hydraulic Pump Motor: The electrically driven hydraulic pump is driven by an Eclipse 24-volt motor. For additional data on this motor see paragraph 18., a., (1), of this section.

(4) Switches and Rheostats: See Figure 88. For battery and generator switches see T.O. No. 01-25CH-1. The propeller switch circuit breaker (100602-1) and the three way switch (102911) are located on the lower left side of the main electrical control switch panel. The gun switch Type B-5A is on the left side of the main switch panel, and the gun trigger switch Type B-4 is located in the handgrip of the control stick. The electrically driven hydraulic pump switch Type B-6B is located beneath the handgrip on the control stick. The landing gear warning signal switch, Type AN3016 (B-6B) is actuated by a lever attached to the throttle rod. The following switches, rheostats and instruments are installed on the main switch panel below the instrument panel.

(a) Bomb Safety Switch AN3015 (B-5A)
(b) Camera Switch AN3015 (B-5A)
(c) Ignition Switch 32226 (A-9)
(d) L. H. Aileron Electric Trim Tab Control Switch AN3019 (B-11)
(e) Running and Signal Light Switch AN3017 (B-7A)
(f) Fluorescent Spot Lights Rheostats
(g) Wing Fuel Gage Lights AN3017 (B-7A)
(h) Landing Light Switch AN3018 (B-9A)
(i) Oil Dilution Switch AN3016 (B-6B)
(j) Pitot Heater Switch AN3015 (B-5A)
(k) Coolant Temperature Warning Light and Fuel

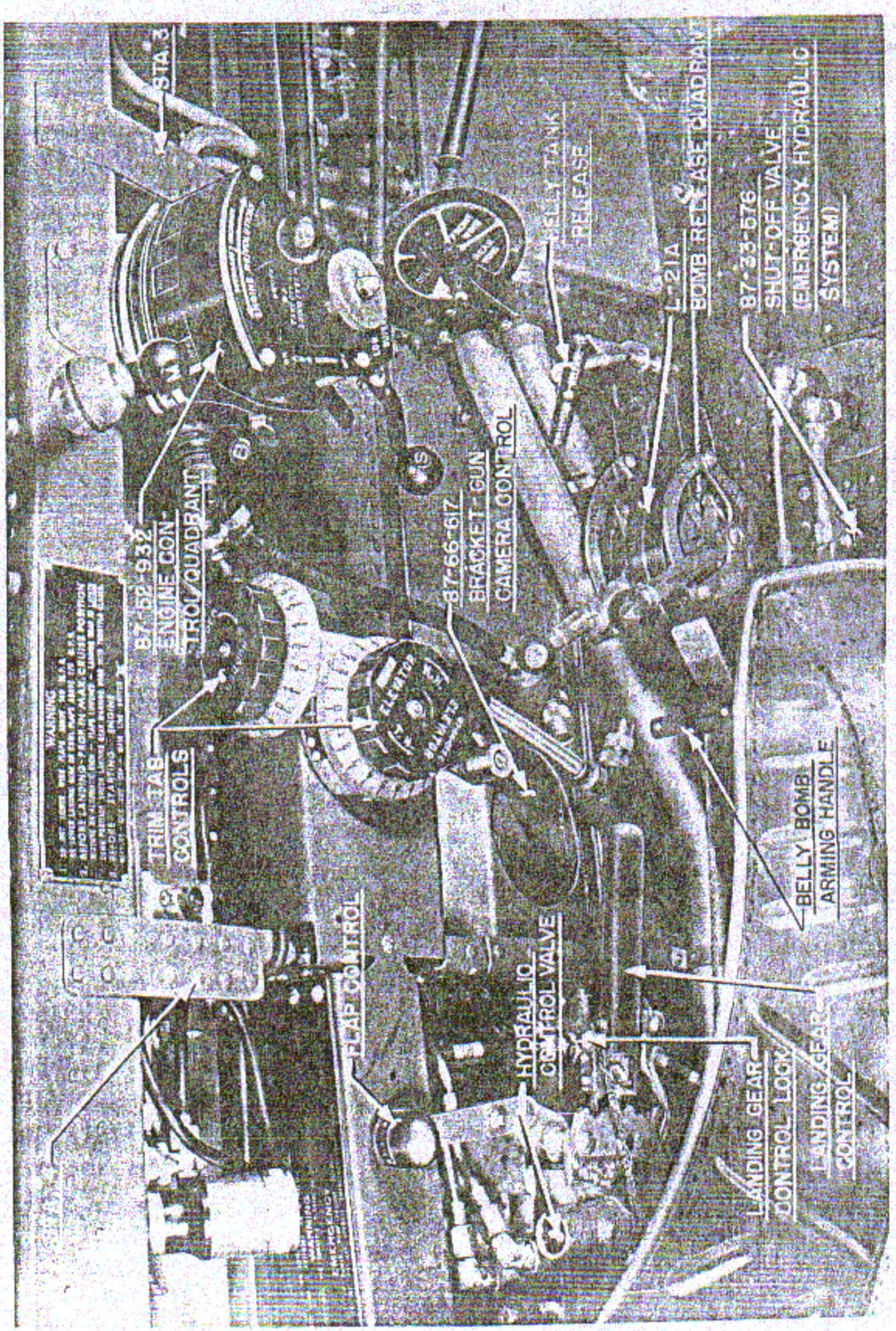


Fig. 89 - Cockpit - left side.

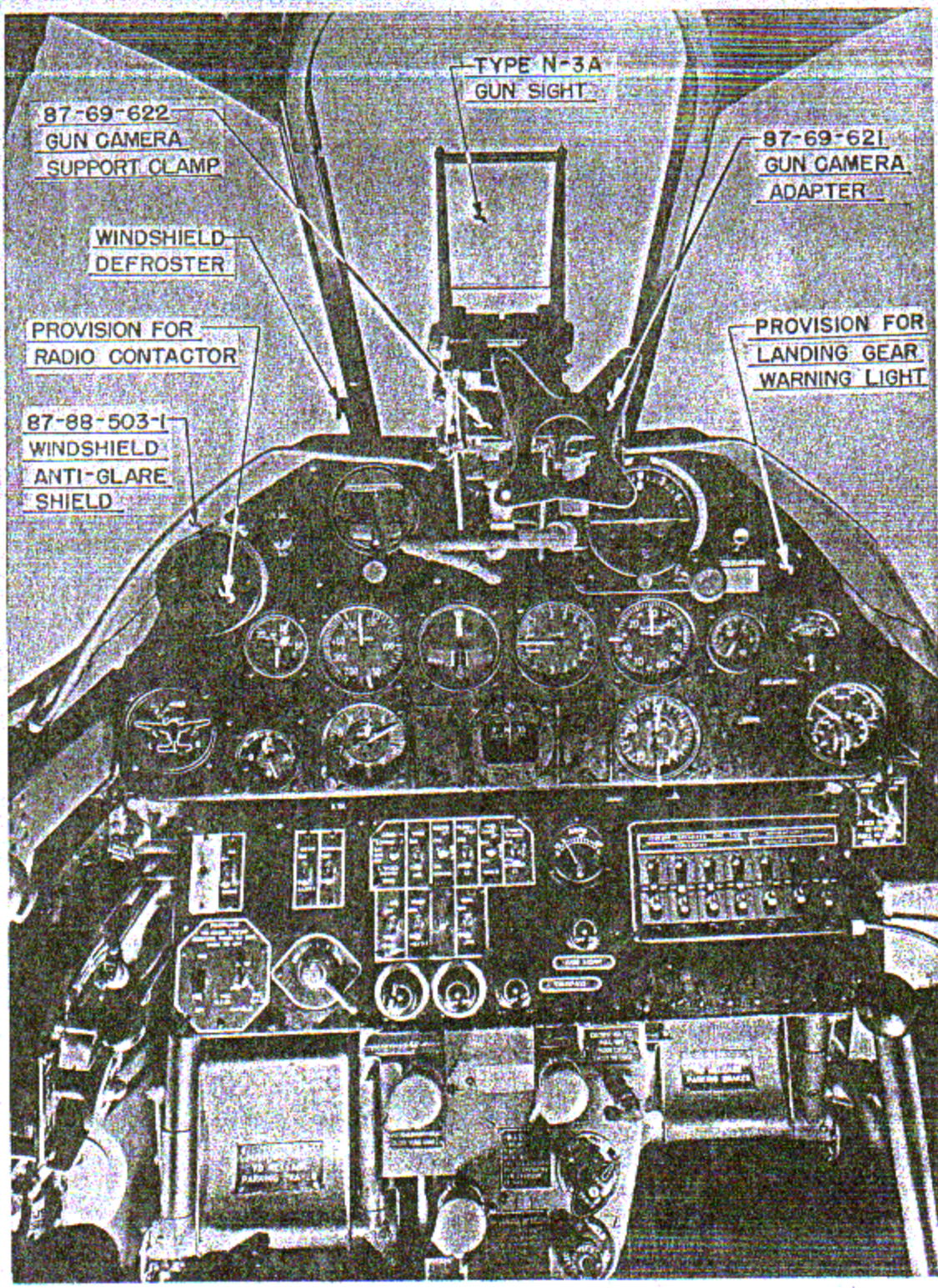


Fig. 90 - Cockpit - forward.

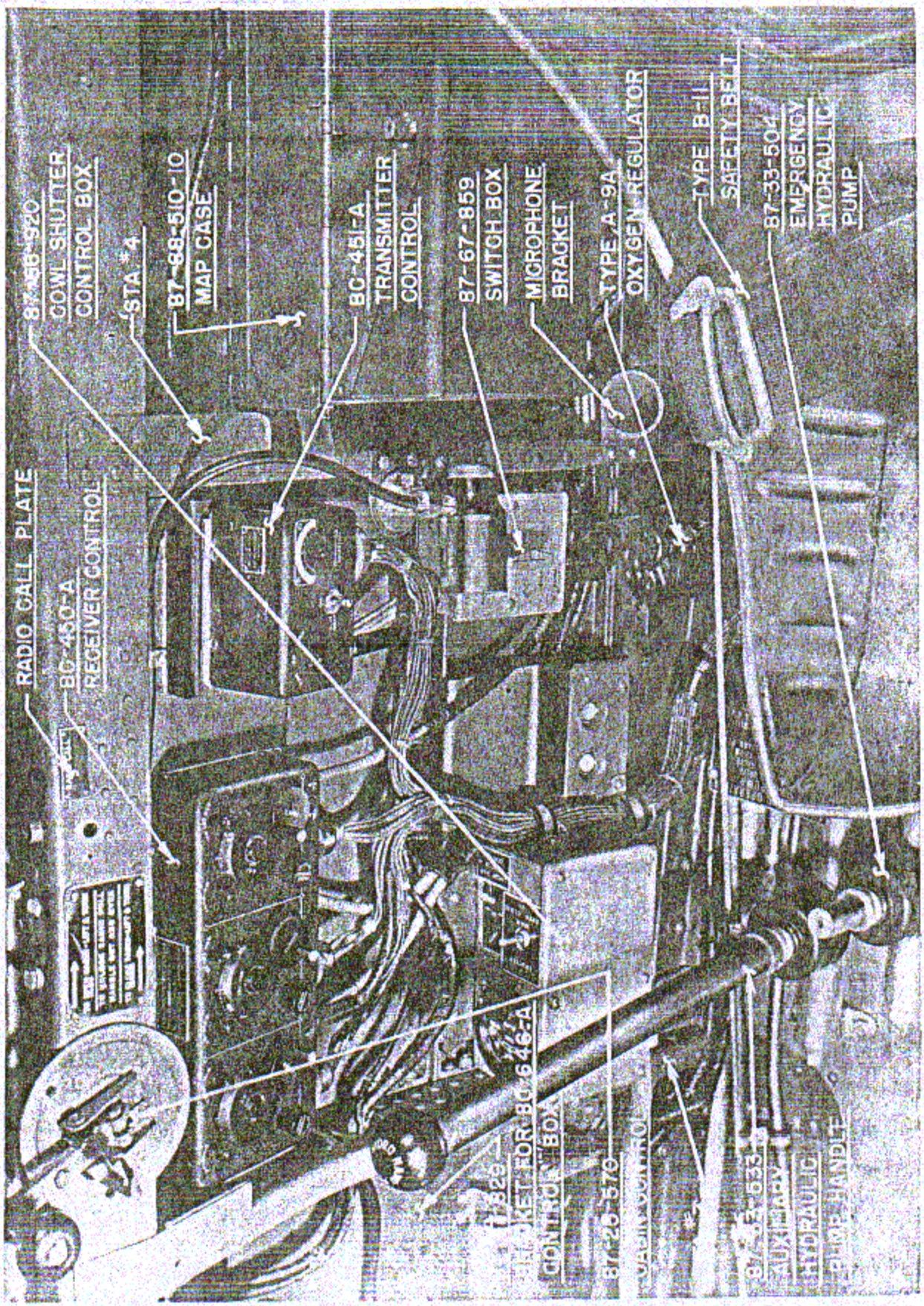


Fig. 91 - Cockpit - right side.

Pressure Warning Light Test Switch AN3019 (B-11)

(l) Generator Line Switch AN3015 (B-5A)

(m) Gun Sight Rheostat (75-66-666-45) Spec. 94-32229

(n) Compass Light Rheostat (75-66-666-25) Spec. 32009

(o) Ammeter Spec. 32191

(5) Circuit Breakers: The circuit breaker panel includes seven circuit breakers, protecting the following circuits:

Location (From Left to Right)	Circuit	Capacity
1	Inboard Guns	30 amp.
2	Outboard Guns	35 amp.
3	Bombs	30 amp.
4	Gun sight	15 amp.
5	Landing Light Limit Switch	20 amp.
	Landing Gear Warning Signal Cut-Off Switch	20 amp.
	Electric Fuel Boost Pump	20 amp.
	Oil Dilution System	20 amp.
	Starter Switch	20 amp.
	Pitot Tube Heater	20 amp.
6	Trim Tab Control (L.H. Aileron only)	15 amp.
	Running Lights	15 amp.
7	Coolant Temperature Warning Light	2 amp.
	Fuel Pressure Warning Light	2 amp.
	Landing Gear Limit Switches	2 amp.
	Fuel Quantity Gage Lights	2 amp.
	Landing Gear Position Transmitter and Indicator	2 amp.
	Flap Position Transmitter and Indicator	2 amp.
	Fluorescent Spot Lights	2 amp.

(6) Wiring Diagram: (Drawing 87-66-905) The electrical wiring diagram is carried in the aircraft data case.

(7) Electrical Bonding: All parts are bonded according to Air Corps Specification, and replacement should be made with clamps, bolts, metal strips, pig tails, etc., similar to those provided in the original installation.

(8) Battery: A Type G-1 battery, capacity 24 volt, 34 ampere hour, Spec. 32234, supplies the electrical power. The battery is accessible through the fuselage access door. (Refer to Drawing 87-66-510).

(9) Circuits Passing Through the Ignition Switch: The ignition battery switch, which actuates the battery solenoid, has to be closed before power can flow through any of the electrical circuits.

19. Fuselage Equipment.

a. General. - (1) Safety Belts: A Type B-11 Pilot's adjustable safety belt (Dwg. 34G1646) is attached to the bracket on each lower rear side of the pilot's seat. The safety belt shoulder strap (Drawing 41G8725) is attached to the bungee assembly located on the back of the pilot's seat.

(2) Stowage Compartment: The stowage compartment is located between Station #9, and #10 and is accessible thru the fuselage access door. See paragraph 19., b., of this section for tools and equipment stowed in this compartment.

(3) Windshield: The windshield center section is comprised of two panes of laminated plate glass. The front pane is three ply plate glass having a total thickness of 5/16 of an inch. The rear pane is five ply plate glass having a total thickness of 1-1/2 inches. A 5/32 inch space is provided between the panes to permit the circulation of warm air from the duct aft of the coolant radiator to defrost the windshield. The two side sections of the windshield are curved, non-shatterable, three ply plate glass having a total thickness of 3/8 of an inch. A rear vision mirror is mounted on the forward top left side of the windshield. The defroster air is controllable from the cockpit. The tube for the glycol spray is mounted at the bottom of the windshield and the glycol spray pump is located within the cockpit.

The windshield is mounted in an aluminum alloy frame and sealed with "Everseal" stripping. The frame is assembled to the fuselage by flush head screws in fibre nuts and may be attached or removed as one unit.

(4) 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 hand-crank located on the forward right hand side of the cockpit (See Detail "B", Figure 93). This crank may be disengaged, in case of an 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 lockwires as shown in Detail "A". It is imperative that these lockwires are installed and the canopy release mechanism should be inspected before each flight to insure the safe operation of the canopy. If the lockwires 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.

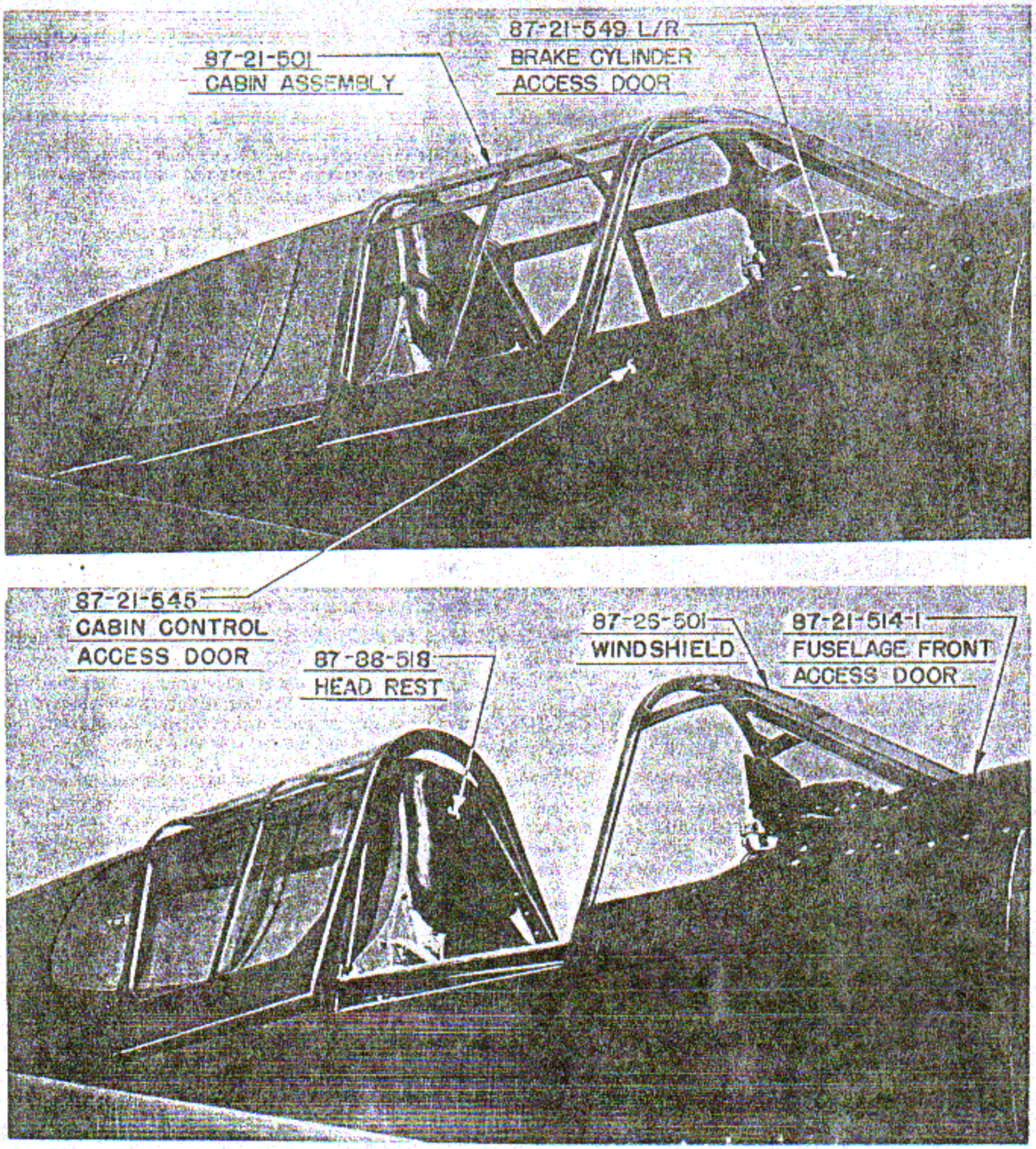


Fig. 82 - Cabin enclosure - open and closed.

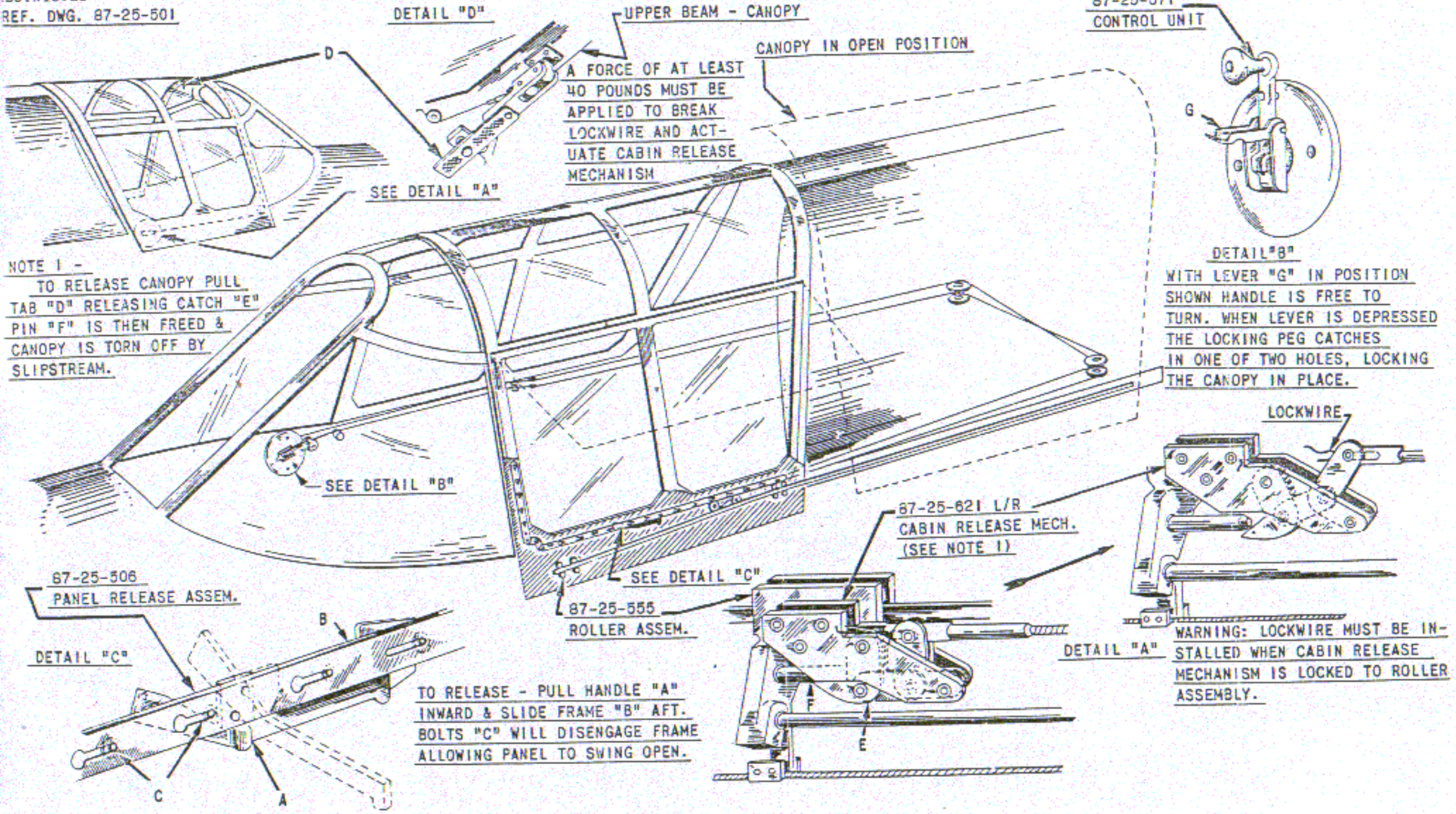


FIG. 93 - DETAIL OPERATION OF CABIN CONTROLS

b. Miscellaneous Equipment. - (1) Aircraft Data Case: A data case for carrying handbooks, drawings, etc. is located on the inboard side of the fuselage access door.

(2) Map Case: A map case is installed on the right side of the cockpit adjacent to the pilot's seat.

(3) First Aid Kit: The first aid kit (X42D7411) is attached to the map case.

(4) Relief Tube: A pilot's relief tube (87-88-516) is located on the under surface of the pilot's seat.

(5) Headrest: The pilot's headrest is mounted on the armor plate at Station #5.

(6) 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.

(7) Duffle Bag: The duffle bag (87-88-556) is located in the stowage compartment.

(8) Special Tools and Equipment: These are carried in a special tool pocket attached to the duffle bag.

(9) Mooring Kit: The mooring kit is carried in two special pockets attached to the duffle bag.

(10) Starter Crank and Crank Extension: The starter crank and the crank extension are located in the stowage compartment on the right hand side of the fuselage above the duffle bag.

(11) Rear Vision Mirror: A rear vision mirror (87-88-609) is mounted in an aluminum alloy fairing bolted to the top of the windshield at the left of the center line.

(12) Armor Plate: The fuselage armor plate installation comprises a 3/8 inch non-magnetic plate mounted forward of the instrument panel at Station #2, a 5/16 inch plate mounted forward of, and completely covering the bulkhead at Station #5, and a 5/16 inch plate having the same contour as, and attached to the forward upper half of the main armor plate at Station #5.

(13) Static Ground: (Drawing 87-88-046-10) A static ground assembly is fastened to the bottom of the fuselage, on the airplane's center line, 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 3.)

c. Removal and Disassembly of Windshield and Cockpit Enclosure. - (1) Windshield Glass: The windshield 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 fiber locks.

(2) Cockpit Enclosure: The cockpit enclosure may be removed by pulling the emergency release and lifting the canopy from the airplane, 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 the forward edge of the frame. Slide the Plexiglas sheet forward and out of the frame. Care must be taken in the removal of Plexiglas to prevent marring its soft surface.

d. Assembly and Installation. - (1) To install the Windshield glass, reverse the procedure outlined above in preceding paragraph 19., c., (1). When the glass is reinstalled, seal the joints on assembly with a good grade of automobile top sealer.

e. Care of Transparent Sheets. (See T. O. No. 01-1-1 for Air Corps cleaner and polisher). - (1) Slight surface scratches are easily removed by rubbing the transparent sheet by hand with a soft cloth moistened with 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 transparent sheet is soluble in ketones, lower esters, aromatic hydrocarbons, phenols, arylhalides, aliphatic acids, chlorohydrins, acetals, chloroform, ethylene dichloride, propylene dichloride and tetrachloroethylene.

20. Heating and Ventilating System.

a. General. - (Drawing 87-81-901) The cockpit is heated and ventilated by warm air which is conveyed by a duct from the coolant radiator exit duct. This duct is joined by a duct which conveys cold air from an opening in the leading edge of the right wing panel near the fuselage. A vane type valve at the junction of the warm and cold intake ducts governs the mixture of hot and cold air entering the cockpit. The valve is operated by a push-pull control located in the cockpit. The heat and ventilating air enters the cockpit through the openings in the firewall at the floor line.

b. Cockpit Heater. - The hot air for heating the cockpit is obtained from the radiator and oil cooler air duct.

The cold air for cooling the cockpit is obtained through an opening in the leading edge of the right wing panel.

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.

See the nameplates in the cockpit adjacent to the control.

c. Wing Gun Heater. - The wing guns are heated by ducts inserted in the radiator and oil cooler air exit ducts. A flexible hose conveys the hot air to the gun compartment in each wing panel.

21. Oxygen Equipment. (87-83-502)

a. General. - The oxygen installation is a low pressure system operating at approximately 350 lbs. per sq. inch. 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 in. O.D. copper tube or 52SO 1/2 hard, a Type A-9 regulator (Spec. 40319), a relief valve, and a one-way filler valve.

(1) Oxygen Cylinder: The oxygen cylinder has a capacity of 1,000 cu. inch and will withstand pressure of approximately 750 lbs. per sq. inch. The cylinder rests on rubber padding in a cradle installation mounted on the center line of bulkheads eleven and twelve at the bottom of the fuselage. A rubber lined strap, joined at the top by a turnbuckle holds the cylinder securely in the cradle. The cylinder may be removed thru the fuselage access door by disconnecting the oxygen and filler lines at the cross forward of the tank and releasing the retaining strap by means of the turnbuckle.

(2) Cross: The cross connection has a relief valve which will open at a pressure of 450 to 500 lbs. per sq. in. One line goes to the oxygen regulator and the other to the filler valve.

(3) Oxygen Regulator: The oxygen regulator is located near the floor of the cockpit on the right side of the airplane, near the pilot's seat.

b. Filling of Oxygen Cylinder. - Attach the line from the oxygen storage tank to the filler line connection located inside and to the lower right of the fuselage access door. The filler line connection contains a one-way valve which permits flow thru the filler line only in the direction of the cylinder. Fill the oxygen cylinder to a pressure not in excess of 450 lbs. per sq. inch.

22. Communications Equipment.

a. General. - The two way radio communication equipment installed in these airplanes is the Type SCR 274-N command set and SCR 515-A set.

(1) SCR 274-N Command Set: (a) Transmitter control, receiver control and receiver tuning control are located on the right side of the cockpit between the fuselage frames 3 and 4.

(b) The receiver remote control unit is located on the right side of the cockpit between fuselage frames 3 and 4.

(c) Three receivers are mounted on a shelf above the center line of the fuselage between fuselage frames 8 and 9, with two transmitters mounted above these.

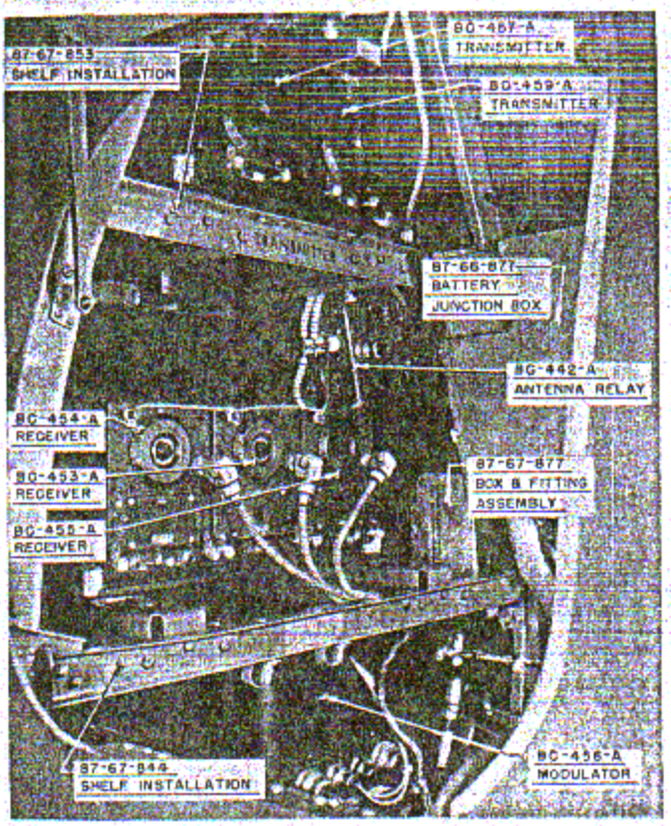


Fig. 94 - Radio installation

(2) SCR 515-A Set: (a) The SCR 515-A set remote control is mounted on the right side of the cockpit between fuselage frames 2 and 3.

(b) The receiver and transmitter unit is mounted on a shelf above the center line of the fuselage between the fuselage frames 10 and 11.

(c) The SCR 515-A dynamotor unit is installed below the fuselage center line between fuselage frames 8 and 9.

(3) SCR 522, TR 1143 and R 3003 Sets: Provision is made for the installation of alternate radio equipment types SCR 522, TR1143 and R 3003.

23. Gun Camera. (Drawing 87-69-590-2)

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. Detail instructions concerning the maintenance and operation of the camera may be found in T. O. No. 10-10-7.

Provision is made for mounting a British type gun camera immediately outboard of the landing gear on the bottom surface of the right wing panel.

(1) Gun Camera Removal: To take out gun camera, remove two bolts attaching it to the gun sight.

(2) Gun Camera Installation: Reverse the above process.

(3) Adjustment: The camera may be adjusted by loosening two bolts which tightened the collar assembly on the adapter ball.

b. Overrun Control, Gun Camera. - Mounted on the left side of the cockpit between fuselage frames #3 and #4.

24. Gunnery Equipment. (See T. O. No. 11-1-6 and T. O. No. 11-35-5)

a. General. - (1) The gunnery equipment consists of a modified N-3A gun sight and three .50 caliber Browning machine guns mounted within each wing panel.

(2) The normal ammunition load for the wing guns is 1410 rounds (235 rounds per gun) with provision for additional rounds as alternate load giving a total of 1686 rounds.

b. Gun Sight. - (Drawing 87-69-590-1) The gun sight, a modified Type N-3A (Drawing 87-69-589), is supported by a casting mounted on the forward armor plate. The sight is above the instrument panel on the center line of the airplane. It may be removed without disturbing the setting by removing the nut from the bolt attaching the yoke assembly to the base assembly.

(1) Sight Adjustment: The gun 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 the 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, the horizontal adjustment.

(2) Lens Adjustment: The lens adjustment is set by the manufacturer and further adjustment should not be necessary unless the set screw in the adjustment knob has become loose, thereby allowing the knob to turn. The lens may be adjusted by turning the adjustment knob to the left side of the sight assembly. 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 distance, does not change in relation to the target as the head is moved over the field of vision.

c. Wing Guns. - The Gun installation (Drawing 87-69-701) consists of three .50 caliber Model M-2 machine guns mounted within each panel. The unsynchronized guns fire outside of the plane of propeller rotation at the full automatic rate of the weapon.

d. Ammunition Boxes. - See Figure 97, 98, 99, and 100. There are two single and two double stainless steel ammunition boxes located outboard of the gun compartment in each wing panel. Each of the double boxes is divided lengthwise, into two equal compartments. Each compartment in the double boxes is partitioned in the middle: these partitions serve to minimize the force required to pull the ammunition belts from the boxes to the guns. The two single ammunition boxes are similarly constructed, but each have just one compartment; the inboard box #1 is not partitioned. All the boxes contain roller assemblies over which the ammunition belts are passed from one compartment into another, and into the feed chutes. The ammunition boxes are accessible through doors in the top surface of the wing. Directions for loading the boxes are given on an instruction plate mounted on top of each box. The cartridge belts must be joined together between the two boxes which serve a gun. Be certain that the first cartridge and link are properly engaged by the belt holding pawl of the gun.

e. Chutes. - See Figures 97, 98, and 101. The ammunition is guided thru feed chutes from the ammunition boxes to the belt holding pawl of the guns. There are two long removable feed chutes located in the ammunition box compartment of the wing which guide the ammunition from the front and rear compartments of boxes #3 and #4, to the feed chutes within the gun compartment. The two removable chutes are pinned to box #3, after the ammunition is started in the chutes. There are four feed chutes (the feed way to the inboard gun is comprised of two separate chutes pinned together by a pin lock hinge) in the gun compartment which guide the ammunition belts to the pawl of the guns. As the ammunition is fired, the empty cases are ejected from the bottom of the gun and are guided thru the lower surface of the wing by case chutes. The links are ejected from the side of the gun and are guided thru the bottom of the wing by link chutes. One case chute and one link chute is provided for each gun. All feed chutes and link and case ejection chutes are made of stainless steel.

f. Gun Mount. - The guns are mounted in the wing by front and rear mount adapters. The front adapter is hung in a yoke assembly which is attached to a support on web #3. One front mount bolt is used to secure the adapter in the yoke assembly. The rear adapter is held between two sets of serrated plates which are attached to a fitting on web #5. A special flat-sided bolt, which is hinged in the middle to facilitate installation in a restricted space, is used to fix the rear adapter between the serrated plates.

g. Gun Adjustment. - Horizontal and vertical gun adjustments are made at the rear gun mount. Vertical adjustments are made by loosening the two locking bolts which clamp the serrated locking plates in position. Move the gun up or down to desired setting and tighten bolts to clamp serrated plates in position. Horizontal adjustments are made by loosening the two set screws holding the rear gun mount adapter in place on the lateral adjusting sleeve and by turning the rear mount bolt until the required setting is obtained. Hold in position by tightening the set screws. The guns may be adjusted vertically from parallel to the line of flight of the airplane at high speed at best performing altitude with full load less 1/2 of the fuel load to parallel to the line of flight at 11.5% below the high speed under the same conditions, all settings being corrected in accordance with H39G3939. The vertical gun settings, angles with respect to the gun leveling lugs are 100% high speed muzzle down 0°07' and 88.5% high speed muzzle down 1°14'. The guns may be adjusted laterally from parallel to center line of fuselage to the convergence of fire at 200 yards (equals 0°37' inboard to a line parallel to the center line of the airplane). The adjustments for various flying conditions are given on the gun sighting chart, Figure 102.

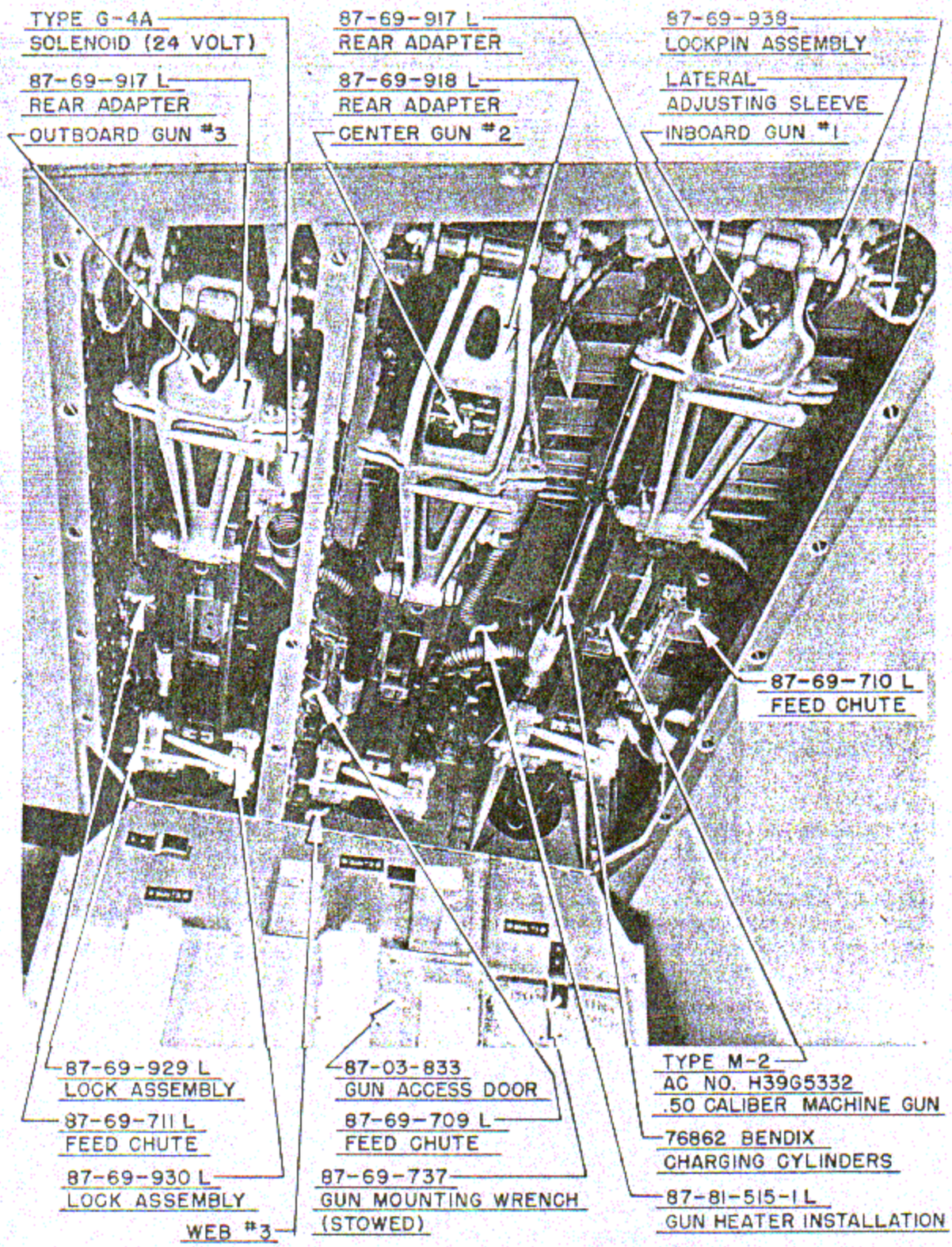


Fig. 95 - Wing guns - bottom view - gun access door open.

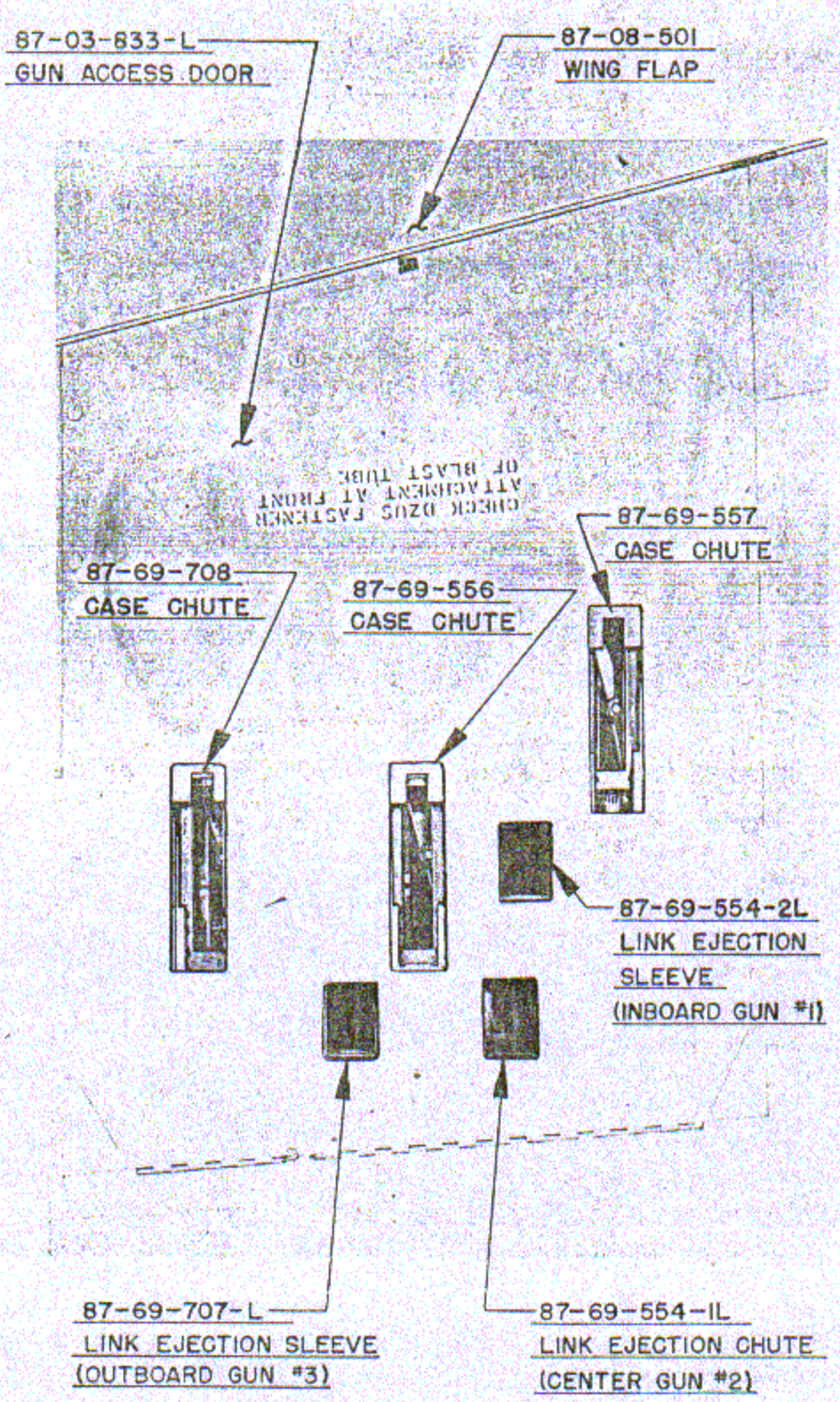


Fig. 96 - Wing guns - bottom view - gun access door closed.

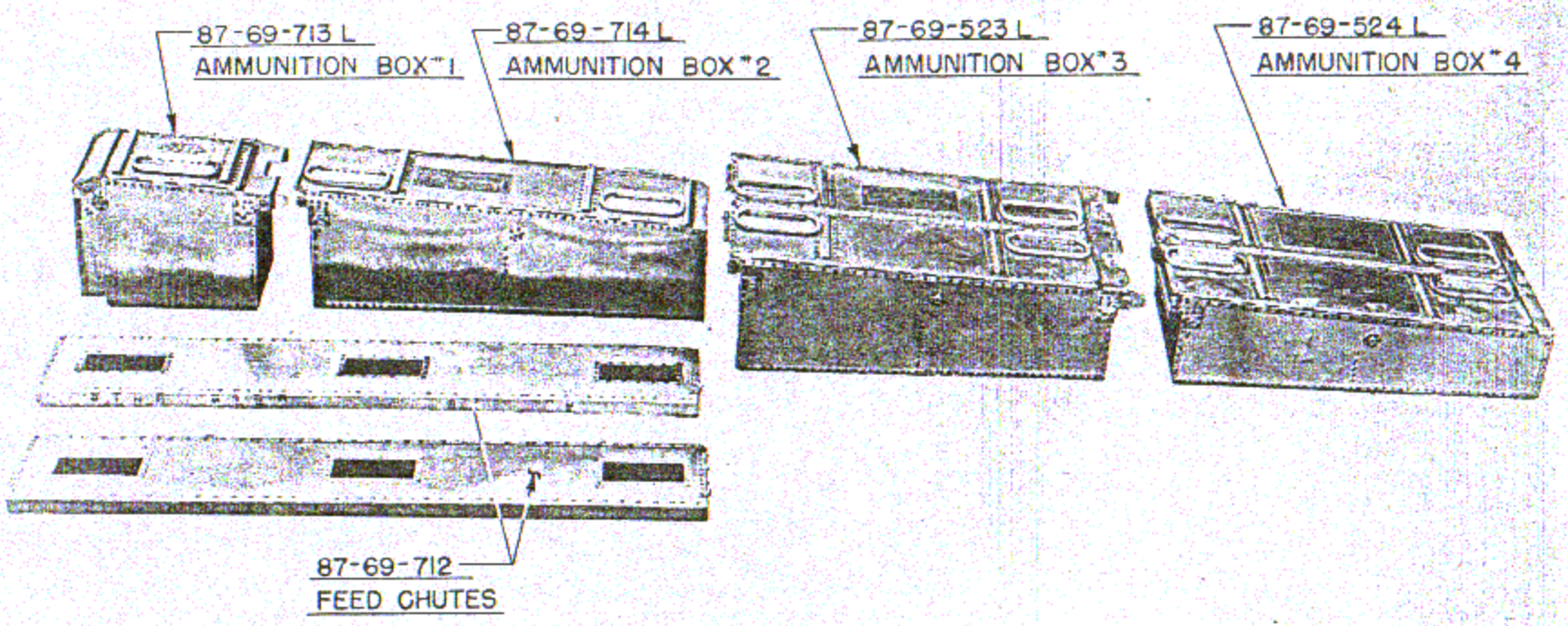


Fig. 97 - Ammunition boxes and chutes.

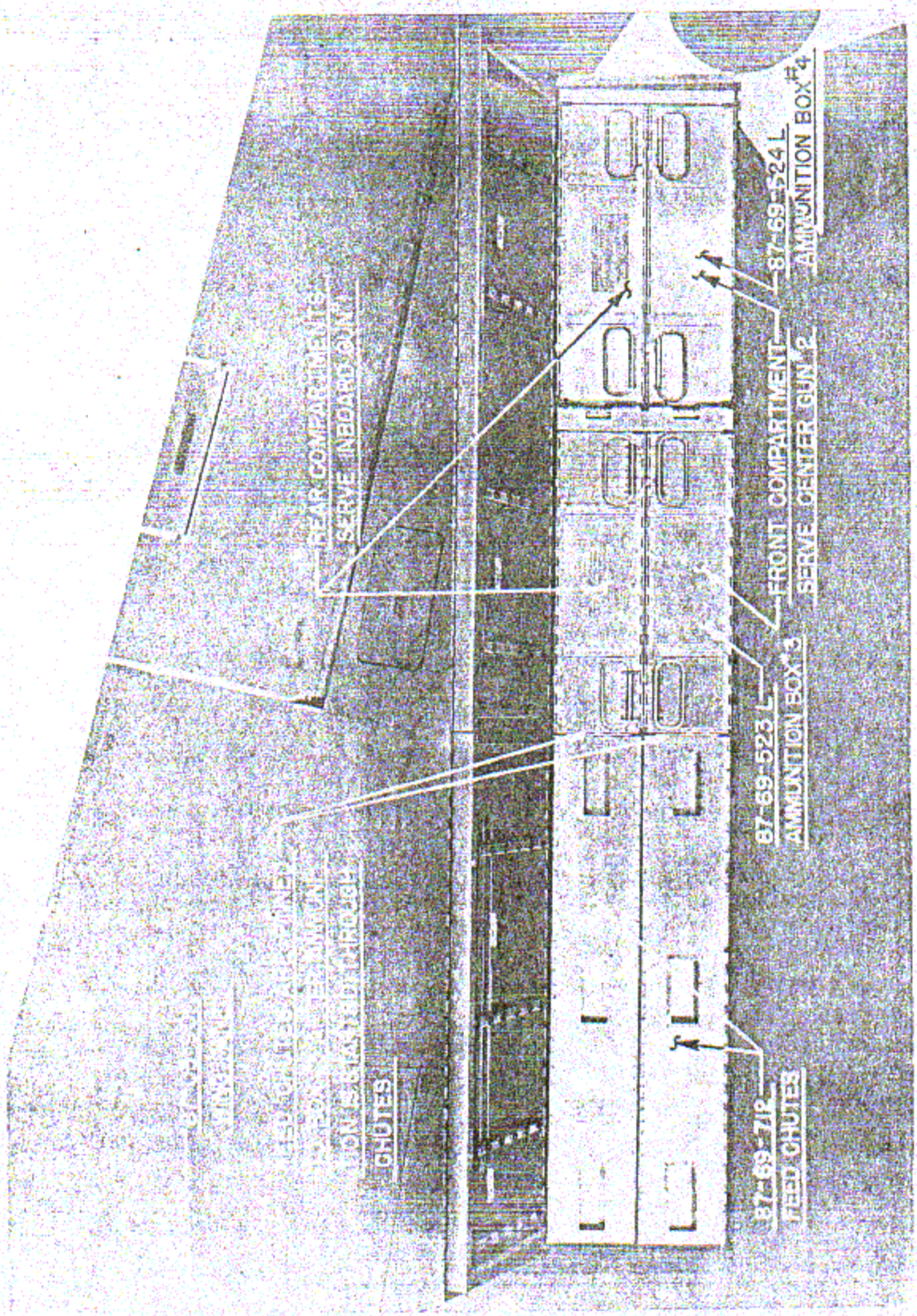


Fig. 98 - Ammunition compartment access doors open - boxes and feed chutes installed.

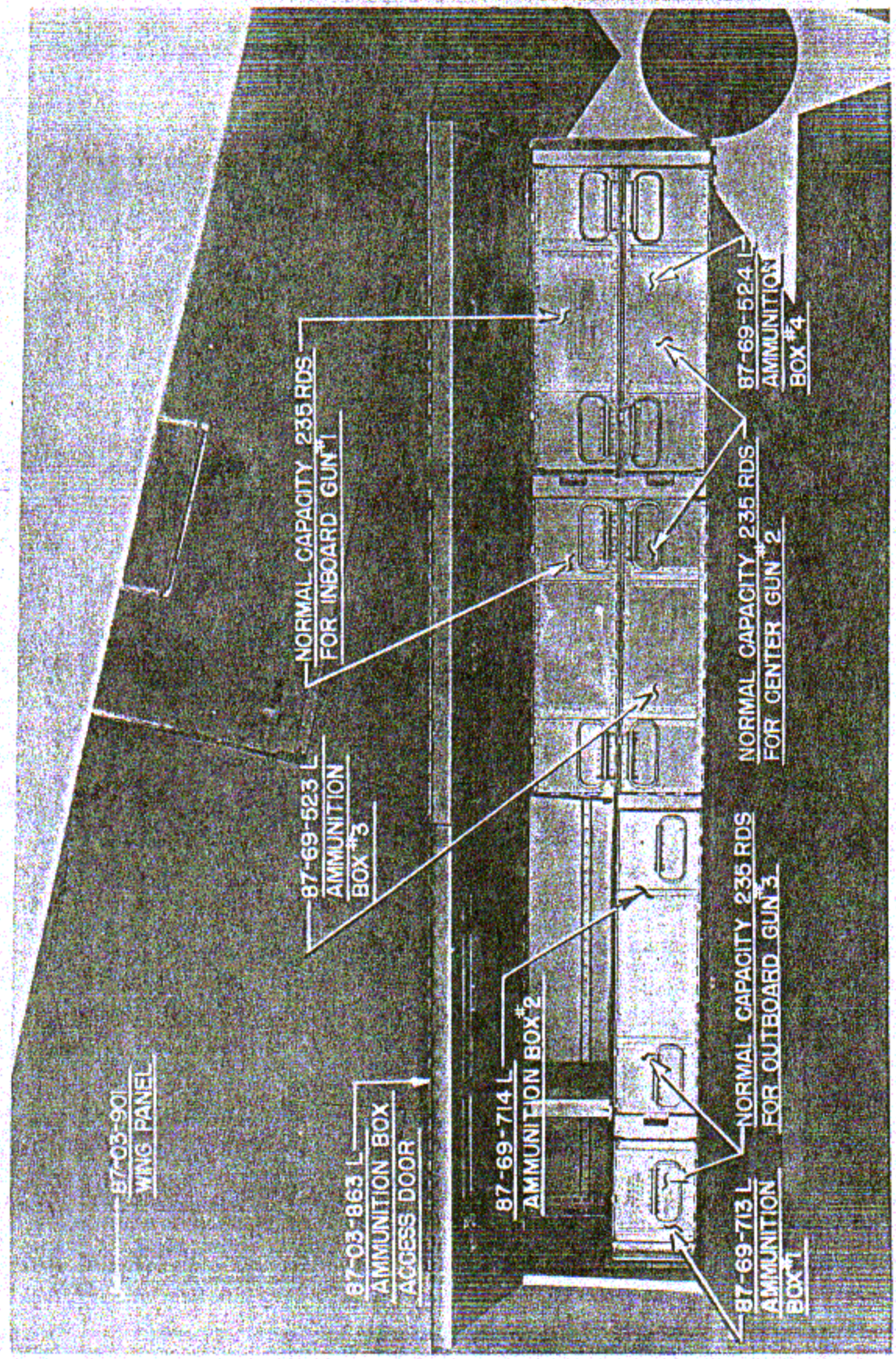


Fig. 99 - Ammunition boxes installed - feed chutes removed.

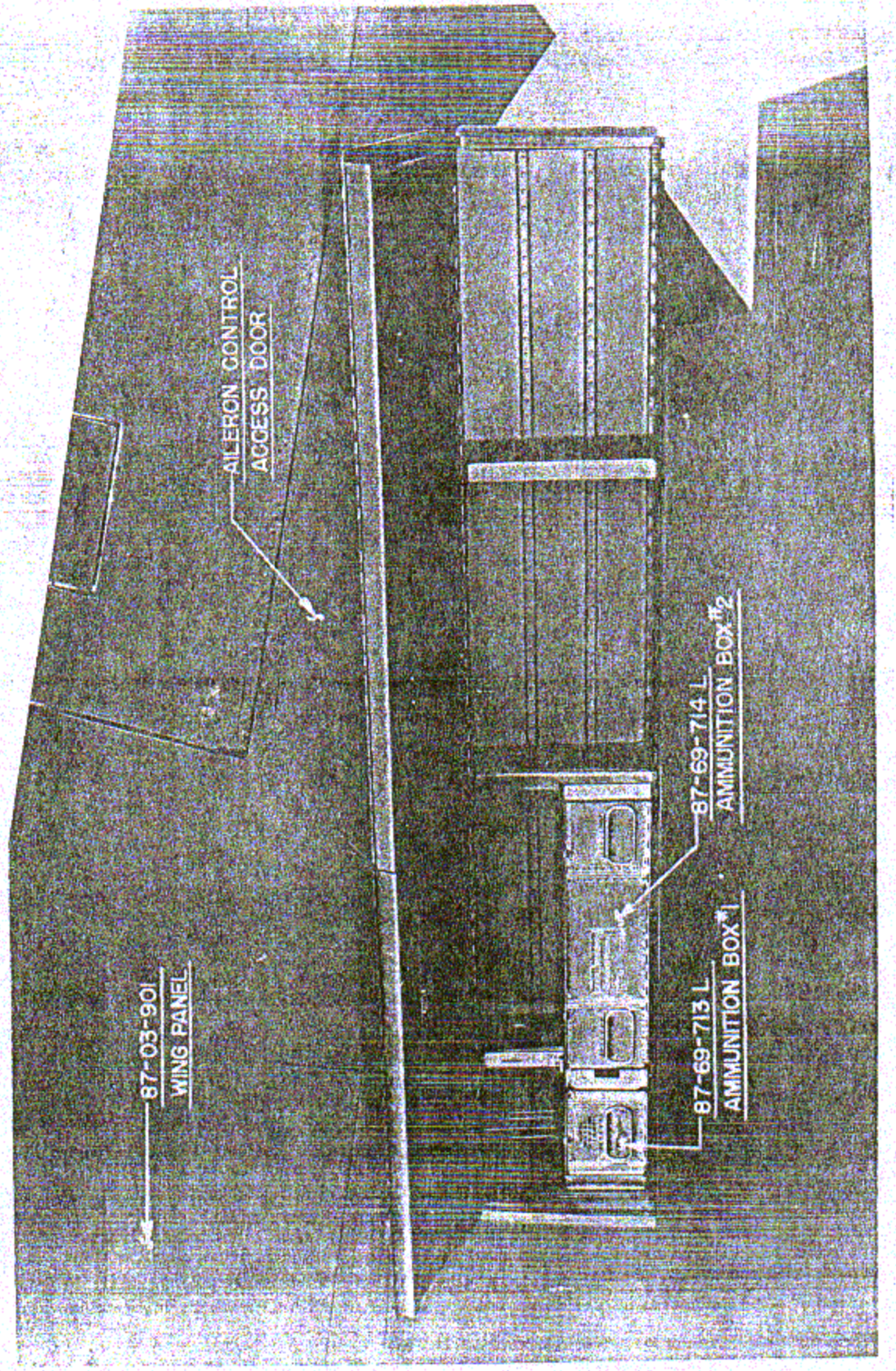


Fig. 100 - Two inboard ammunition boxes installed - chutes and outboard boxes removed.

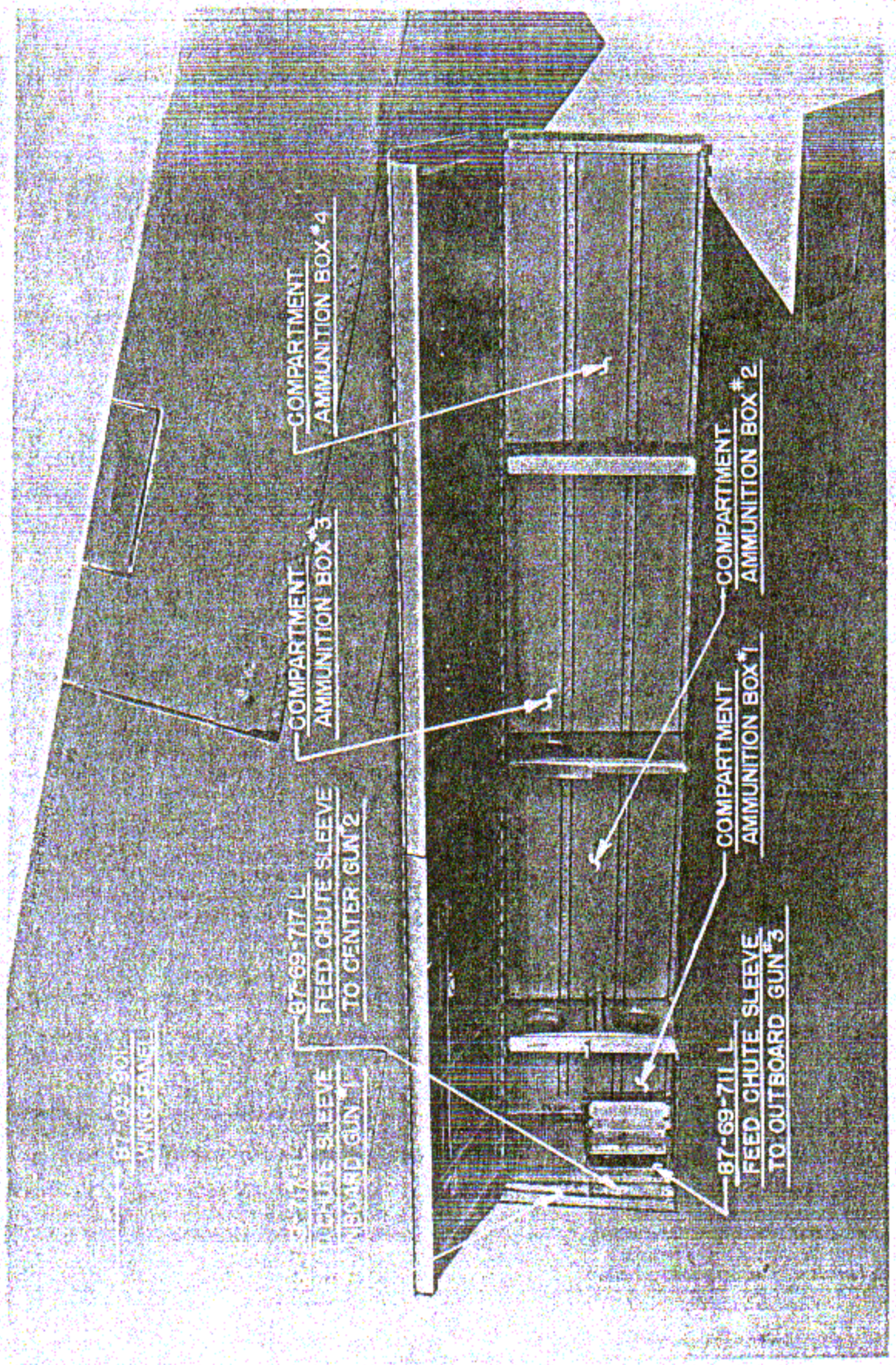


Fig.101 - Ammunition boxes and feed chutes removed.

h. Gun 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 instrument panel at the center of the cockpit adjacent to the engine primer. The gun-charging valve knob on the left side of the panel controls the charged and safety condition of the two inboard guns in the wing panel. The valve knob on the right, controls the charged and safety condition of the two inboard guns in the right wing panel and the lower valve knob controls the outboard gun in each wing panel.

(2) The guns are electrically fired by a B-4 trigger switch located in the handgrip on the control stick which actuates a G-4A solenoid attached to the inboard side of the gun and controlled through the safety switch mounted on the left side of the main switch panel. The safety switch has two positions, either "ON" or "OFF", which controls the condition of all guns.

(3) To fire the guns, charge the guns with the charger valves as follows: Turn the valve handles clockwise 140° away from the red markers on the panel. Actuate one charger valve at a time. Push the charger valve handle all the way in and actuate the hydraulic motor switch on the control stick until the handle pops out. Repeat this procedure for the remaining valves and the guns are charged. Trip the gun circuit breakers and the gun switch to the "ON" position and depress the trigger switch on the control stick hand grip for the desired burst of gun fire.

(4) To lock all guns, match the red point on the charger valve handle with the red marker on the panel and push handle all the way in. Actuate the hydraulic electric motor switch until the handle pops out. The gun is now locked rearward. To lock guns actuate one charger valve at a time. To charge guns again after they are locked, turn the charger handle 140° clockwise from the red marker and the guns are charged.

i. Doors and Covers. - The long, hinged double door aft of web #3 in the top surface of the wing panel is provided for access to the ammunition boxes. The door in the lower surface of the wing aft of web #3 provides access to the gun installation and is installed with a hinge on the leading edge and Dzus fasteners around the remaining edges. The door may be removed from the wing panel for extensive gun adjustments by removing the hingepins.

j. Wing Gun Installation. - (See Curtiss Armament Handbook) Install the rear adapters and the blast tube adapters on the guns. Slide the blast tube adapter over the muzzle of the gun to its proper location on the gun barrel. The proper location of each adapter is as follows: (Measure from the muzzle to the aft end of the adapter).

Inboard guns - 10-3/16 inches
Center guns - 15-1/2 inches
Outboard guns - 15-9/16 inches

These measurements are approximate, as the round louvers, which will definitely determine the location of the adapters may alter the measurements to a plus or minus. If the gun barrel has the long louvers, the adapter will be secured with 3 studs. If the gun barrel has the round louvers, the adapter will be secured with 2 studs. When the adapters are installed, the studs should be lockwired in position. Remove the solenoids and the hydraulic gun chargers from the gun compartment, and let hang below the wing. Install the yoke with the front adapter attached to the yoke mount in the forward end of the gun compartment. Turn up the yoke nut bolt so that the adapter can be properly aligned with the gun. This operation will only be necessary on the initial installation, or on service installations when it has been necessary to remove the yoke from its mounting. The gun charger cylinders must be set in the proper rotational position so that when the cylinders are installed they will line up with their respective brackets on the guns. If an adjustment is necessary, loosen the hose fitting aft of the wing web and rotate the charger cylinder to its proper position. Tighten all hose fittings after the adjustment is completed. The charger cylinder adjustment cannot be made after the guns are installed in the wing.

Set the rear serrated plates approximately 1/2 inch from their lowest position and tighten locking bolts so that the serrated plates are positively engaged, but not so tight that fore and aft movement of the plates is stopped. Insert the locking pin assemblies in the front adapters in readiness for the installation of the gun. Be sure all the toggles are installed on the inboard side of the adapters. Place the gun charger hose over the front adapters so it will not be pinched between the guns and the wing bulkheads. The guns may be installed by guiding the muzzles through the round cutouts in webs #3, #2, and #1. Engage the front adapter and temporarily support the rear of the gun by inserting the drift pin (87-69-738) through the rear mount adapter. Now raise the forward end of the gun until the holes align with the pins of the locking pin assemblies. Push the locking pins into the mount holes in the gun, swing the eye bolt up to engage the outboard locking pin assembly and throw the toggle up to lock the gun in the adapter. Remove the drift pin and allow the rear of the gun to hang free. Install the solenoid and the gun charging cylinder on the gun. Swing the rear mount adapter upward and engage the saddle tie rod and tighten the saddle by locking the toggle on the underside of the adapter. Raise the aft end of the gun and install the rear mounting bolt and locking pin. Secure the feed chutes to the inboard and center guns. The feed chutes on the outboard guns are not attached until the guns are boresighted. Next, install the blast tubes over the muzzle of the gun and screw onto the adapter on the barrel as far as it will go. Then back off the blast tube until the two lugs on the front of the tube are in a vertical position. Slip the leading edge cover plates over the blast tubes and button them to the leading edge of the wing.

k. Removal of the Wing Guns. - Reverse the preceding instructions in paragraph j. If care is taken, the guns can be removed without disturbing the adjustments.

l. Removal of Gun Action from the Installed Gun. -

(1) Remove the leading edge cover plate and unscrew the blast tube from the adapter on the muzzle of the gun. Remove the blast tube.

(2) Unfasten the gun access door.

(3) Detach the feed chutes from #1 and #2 guns and the link chute from #3 gun.

(4) Unscrew the yoke nut, which is accessible through the nut port in the top of the wing, to lower the front of the gun as much as possible.

(5) Loosen the front mounting bolt sufficiently, to allow the front adapter to pivot on the yoke.

(6) Remove the rear mounting bolt without disturbing the adjustment.

(7) Release the toggle on the rear mount adapter and free the saddle over the gun. Swing the adapter downward.

(8) Remove the charger cylinder from the gun and remove the special charger cylinder bolt studs.

(9) Pull out the safety catch on the back plate, push up on the latch and slide the back plate up until it is free of the gun.

(10) Remove the bolt and driving pin through the back plate opening.

(11) Release the gun barrel lock spring with the flat end of the drift pin to depress the spring.

(12) Remove the gun barrel with the barrel extension and lock frame.

25. Wing Bomb Installation. (Drawing 87-70-500)

a. General. - The wing bomb installation consists of a Type L-21A manually operated bomb control assembly mounted on the cockpit floor at the left of the pilot's seat, and a Type Q-2 bomb rack installed aft of web #2 and between stations #100 and #122, in each wing panel. The bomb rack will carry three 20 pound Type M42, or three 30 pound Type M5 fragmentation bombs, or three 20 pound Type M45 practice bombs. When the bomb control is in the "SELECTIVE" position, and the bomb switch on the left hand side of the switch panel is in the "ON" position, two bombs at a time (one bomb from each rack) will be released, by depressing the bomb switch on top of the handgrip of the control stick. The bombs are successively, released, beginning with the outboard bomb on the rack. The wing bomb load may be released in salvo, without depressing the bomb switch, by moving the selector handle of the control quadrant, to the "SALVO" position. The bombs may be released in the armed or unarmed condition by moving the bomb arming handle of the control in the "ARM" or "SAFE" position, respectively.

Complete instructions for the installation and operation of the wing bombs are given in the Curtiss Armament Handbook.

26. Belly Bomb Installation. (Drawing 87-45-508)

a. General. - The belly bomb is carried on a Type B-7 bomb shackle mounted along the centerline of the airplane, below the keel fairing. The Type A-3 release control handle is mounted on the aft side of Station #3 bulkhead at the left side of the cockpit. The arming control handle is mounted on a tripod located at the left of the pilot's seat. Four sway braces with adjustable turnbuckles hold the bomb in a rigid attitude while in flight. The sway braces can be adjusted to accommodate any one of twelve different types of bombs ranging in size from 100 pounds to 600 pounds.

Complete instructions for the servicing and loading of the belly bomb are given in the Curtiss Armament Handbook.

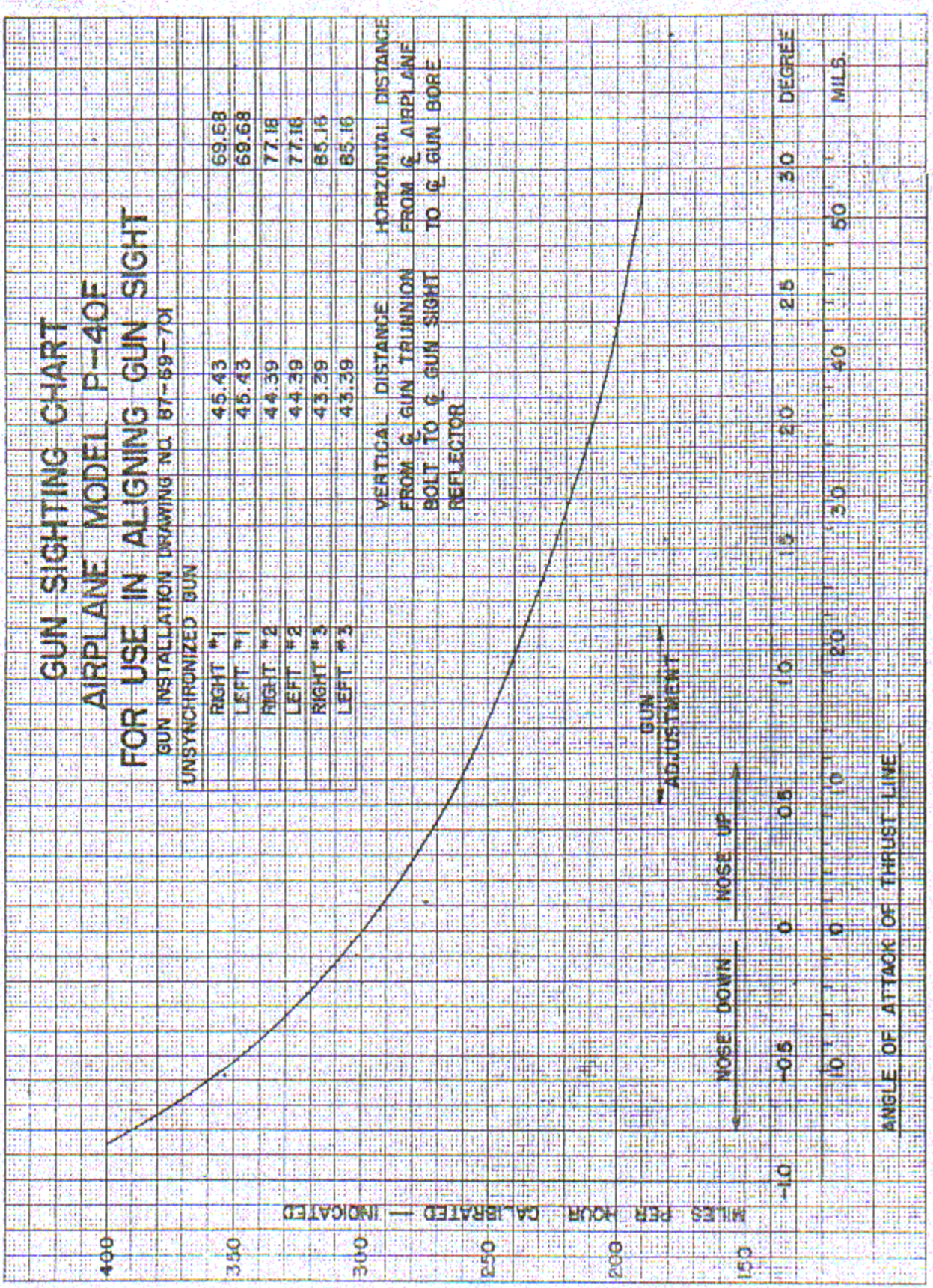
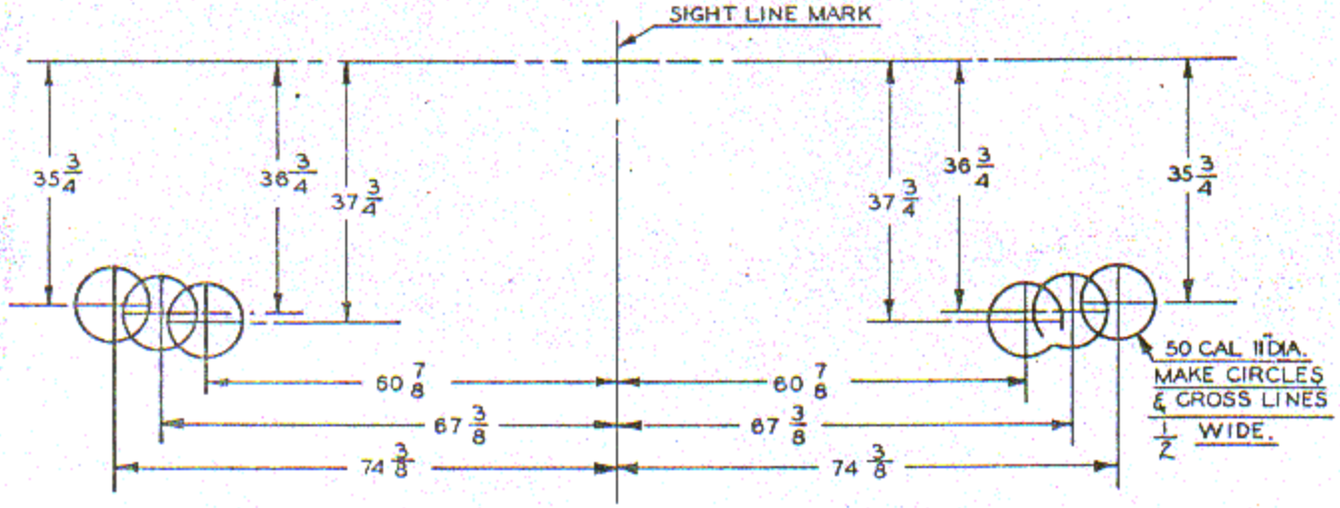


Fig. 102 - Gun Sighting Chart

P-40F TARGET 1000 INCH RANGE GUNS CONVERGE AT 250 YARDS.

1- SET AIRPLANE IN FLYING POSITION.
FOR 278 M.P.H. SET GUN LEVEL LUGS LEVEL — 240 M.P.H. SET GUN LEVEL LUG 14 MILES (0°47.8) NOSE UP
2- SET SIGHT MARK OF TARGET USING SIGHT LINE LEVEL INDICATOR AND PLUMB BOBS
3- ADJUST SIGHT AND GUNS TO THEIR RESPECTIVE TARGETS



P-40F TARGET.-1000 INCH RANGE GUNS CONVERGE AT 350 YARDS.

1- SET AIRPLANE IN FLYING POSITION.
FOR 278 M.P.H. SET GUN LEVEL LUGS LEVEL - 240 M.P.H. SET GUN LEVEL LUGS 14 MILES (0°47.8) NOSE UP
2- SET SIGHT MARK OF TARGET USING SIGHT LINE LEVEL INDICATOR AND PLUMB BOBS
3- ADJUST SIGHT AND GUNS TO THEIR RESPECTIVE TARGETS.

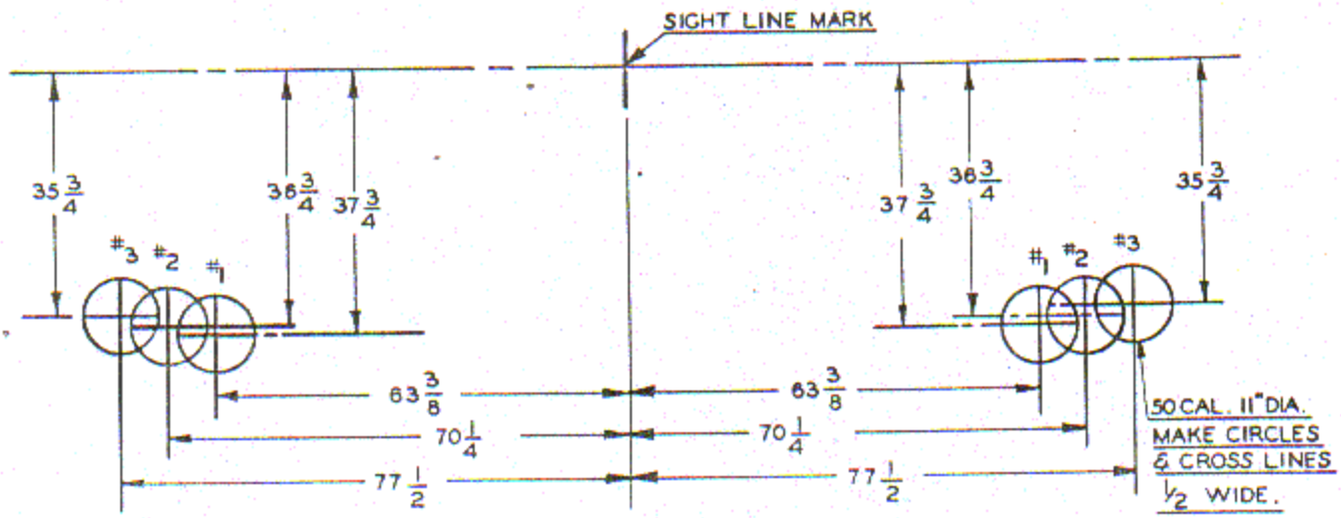


FIG. 103 — GUN ADJUSTMENT CHARTS