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ERECTION AND MAINTENANCE INSTRUCTIONS

FOR

ARMY MODEL PT-13D NAVY MODEL N2S-5 AIRPLANES

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

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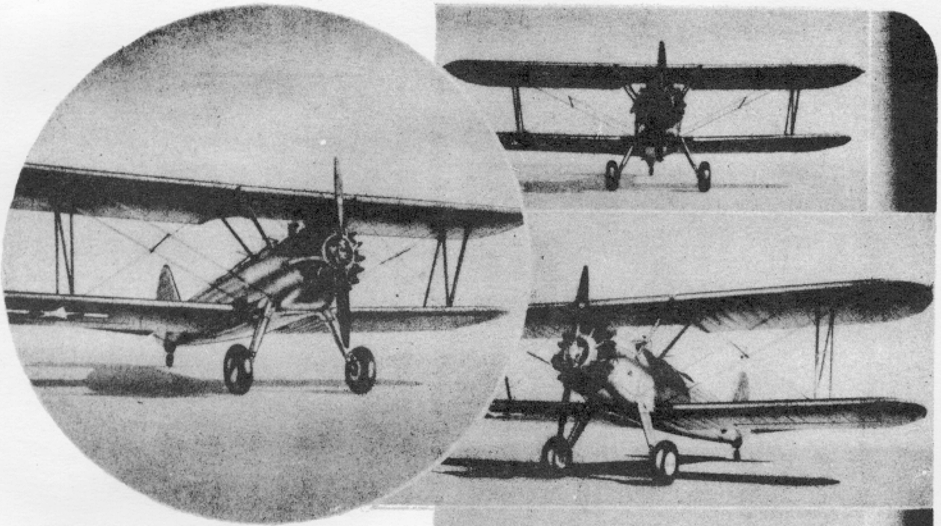

Figure 1
PT-13D/N2S-5 (Standardized)
Primary Trainer Airplane

INTRODUCTION

This manual contains the recommended erection and maintenance instructions for the PT-13D/N2S-5 (Standardized) Primary Trainer airplane.

In analyzing the problems encountered in maintaining this airplane and in recommending solutions of these problems, this handbook summarizes the experience of the manufacturer in building airplanes of this design and reports from pilots and maintenance personnel who have been associated with these airplanes.

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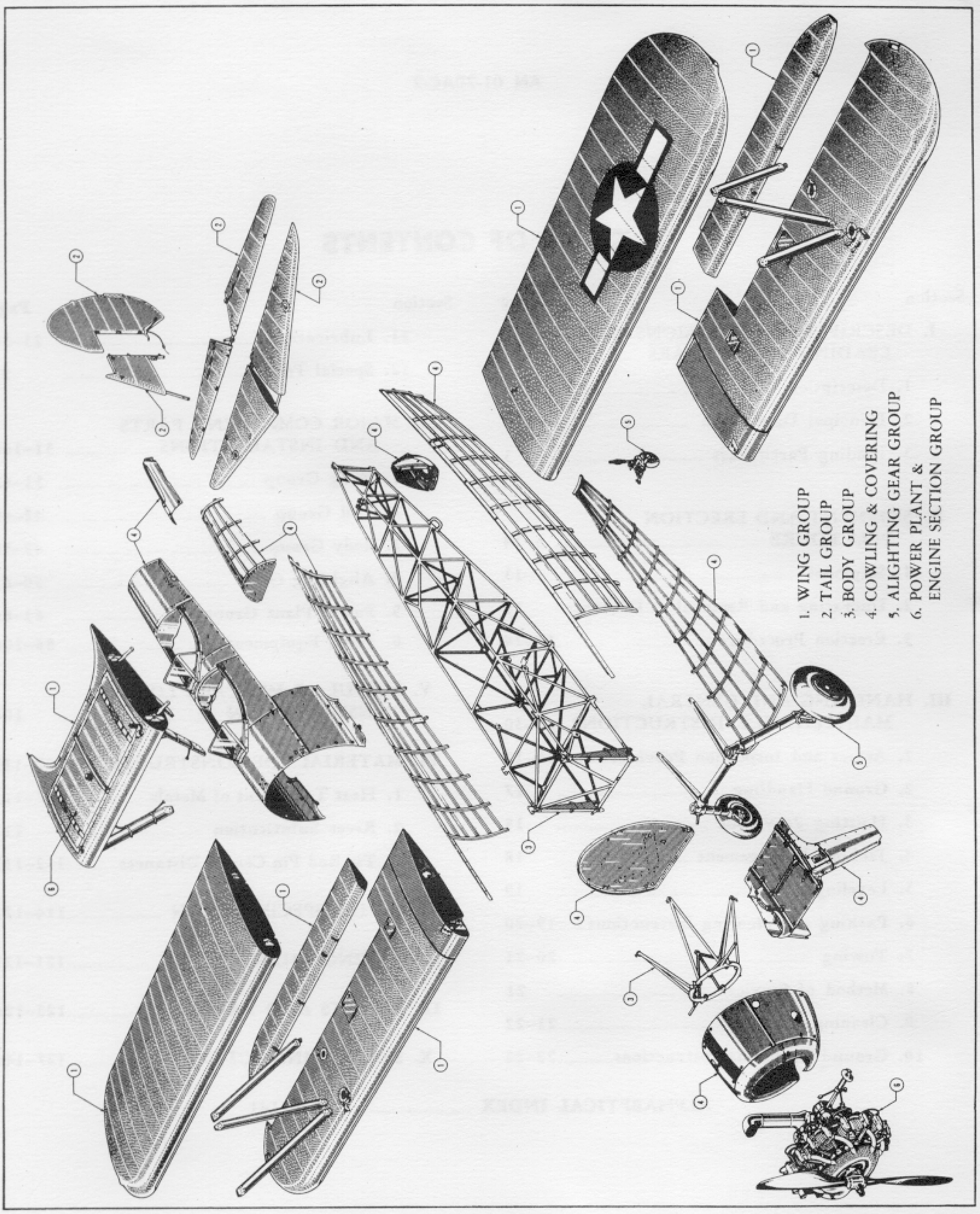
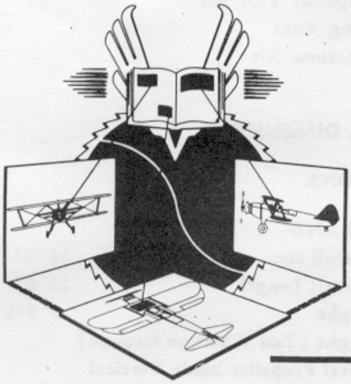


Figure 2—Breakdown of Major Component Assemblies



SECTION I

DESCRIPTION, DIMENSIONS AND LEADING PARTICULARS

1. DESCRIPTION.

PT-13D/N2S-5 (Standardized) is the model designation of the Boeing-built Army-Navy primary trainer airplane. It is a single engine, two place open cockpit biplane.

a. WINGS.—The upper wing is composed of two outer panels and a center section. The lower wing is composed of two panels, each attached to the fuselage structure. Each wing panel is of wooden spar and rib construction with aluminum alloy drag struts and tie-rod type bracing. Ailerons constructed of aluminum alloy are fitted into the trailing edge of each lower wing panel. All wing panels and ailerons are fabric covered.

b. EMPENNAGE.—Tail surfaces are fabricated of welded chrome-moybdenum steel tubing and have leading edges faired with aluminum alloy sheet. All surfaces are fabric covered. Controllable wooden trim tabs are fitted into the inboard trailing edge of each elevator.

c. FUSELAGE.—The fuselage structure is of welded chrome-moybdenum steel tubing. Aluminum alloy stringers and arches are riveted together and bolted to clamps attached to the fuselage structure to form the fuselage fairing over which fabric covering is applied. All cowling is fabricated from aluminum alloy sheet.

d. ALIGHTING GEAR.

(1) The main landing gear is of the wheel type full cantilever unit equipped with spring-oil shock absorber struts, 24-inch streamline wheels, 27.50″ x 8.90″ – 12.50″ four-ply rayon casings and 10 x 1½-inch hydraulic brakes.

(2) A full swiveling steerable tail wheel mounting a 10-inch smooth contour four-ply or six-ply tire and incorporating an air-oil type shock absorber is provided. The rudder pedals give positive control through five degrees more than rudder travel range each way, and after that the tail wheel disengages to become free-swiveling for the remainder of the 360 degrees rotation.

e. POWER PLANT.—A Lycoming Model R-680-17 direct drive, nine-cylinder, air-cooled radial engine powers this trainer. The engine drives an 8 ft., 6 in. ground adjustable steel propeller or an 8 ft., 2 in. fixed pitch wooden propeller and is rated at 220 bhp at 2100 rpm at sea level.

(1) OIL SYSTEM.

(a) The oil system consists of an oil tank, "Y" drain, oil temperature wells, and incorporates an oil dilution system. The oil tank is fabricated of aluminum alloy and has an oil capacity of 4.76 U.S. gallons (3.96 Imperial) with an additional 1.60 U.S. gallons (1.34 Imperial) expansion space. A stand pipe sump in the bottom of the tank prevents sediment in the oil tank from flowing into the engine. A hopper installed within the tank in conjunction with the oil dilution system aids in starting and warm-up of the engine.

(b) The oil dilution system consists of an oil dilution solenoid valve with a fuel line extending to the "Y" drain in the oil-in line of the oil system. The oil dilution valves are controlled by a toggle switch mounted on the left side of the instrument panel in the front cockpit.

(2) FUEL SYSTEM.

(*a*) The PT-13D/N2S-5 has a gravity feed type fuel system including an aluminum alloy tank, fuel strainer, fuel valve, and aluminum alloy fuel lines. The fuel tank mounted in the upper wing center section has a 46 U.S. gallon (38.3 Imperial) capacity with a 1.38 U.S. gallon (1.15 Imperial) expansion space. Supply lines are attached to each corner of the fuel tank to insure continuous fuel flow in all permitted flight attitudes. Sumps are provided at the two aft corners incorporating cocks to drain accumulated sediment and water.

(*b*) The sight-type fuel gage extending from the underside of the tank incorporates a drain for drawing off collected sediment. The fuel strainer is located at the lowest point in the fuel system just ahead of the firewall and is easily accessible for servicing. A fuel valve, operated by a control unit in either cockpit, is installed in the fuel line at the firewall.

f. FIXED EQUIPMENT.

(1) FLIGHT CONTROLS.

(*a*) Elevator Control
(*b*) Aileron Control
(*c*) Hydraulic Brake Control
(*d*) Rudder and Brake Control
(*e*) Elevator Tab Control

(2) FURNISHINGS.

(*a*) Two Wooden Adjustable Type Seats
(*b*) Two Shoulder Harnesses
(*c*) Two Lap-Type Safety Belts
(*d*) Hand-type 2TA or 2TB Carbon Dioxide Fire Extinguisher (2 lb. capacity)
(*e*) Baggage Compartment
(*f*) Two-place RC-73 Interphone System.
(*g*) Data Case
(*h*) Flight Report Holder
(*i*) Engine and Cockpit Covers
(*j*) Rear Vision Mirror
(*k*) Static Ground

(3) INSTRUMENTS.

(4) ELECTRICAL SYSTEM.

(*a*) Battery
(*b*) Navigation Lights
(*c*) Instrument and Instrument Panel Lights
(*d*) Front and Rear Cockpit Switch Boxes
(*e*) Battery Junction Box
(*f*) Tachometer Junction Box

g. MISCELLANEOUS EQUIPMENT.

(1) One Special Tool Kit
(2) Mooring Case
(3) Publications Kit

2. PRINCIPAL DIMENSIONS.

a. DIMENSIONS.

(1) AIRPLANE—GENERAL.

(*a*) Overall Span	32′ 2″
(*b*) Overall Length	25′ 0″
(*c*) Height	9′ 3⅝″
(*d*) Height (Tail Wheel on Ground)	
1. Metal Propeller Blade Vertical at Top	10′ 5⅛″
2. Wood Propeller Blade Vertical at Top	10′ 3⅛″

(2) WINGS.

(*a*) Airfoil Section	NACA 2213
(*b*) Chord at Root	5′ 0″
(*c*) Chord at Construction Tip Section	5′ 0″
(*d*) Incidence	
1. Upper Wing	4°
2. Lower Wing	3°
(*e*) Dihedral	
1. Upper Wing	½°
2. Lower Wing	1½°
(*f*) Sweepback	0°

(3) STABILIZER.

(*a*) Span	12′ 6″
(*b*) Maximum Chord (Including Elevator)	4′ 7-15/16″
(*c*) Incidence	+3°
(*d*) Dihedral	0°

(4) FUSELAGE.

(*a*) Width (Maximum)	3′ 4⅝″
(*b*) Height (Maximum)	3′ 10¼″
(*c*) Length (Without Engine Mount)	18′ 1⅜″
(*d*) Length (With Engine Mount)	19′ 9½″

b. AREAS.

(1) Wings (Total Less Ailerons)	273.82 sq ft
(*a*) Upper (Including Center Section)	147.4 sq ft
(*b*) Lower (Less Ailerons and Including 13.8 sq ft of fuselage)	126.42 sq ft

(2) Ailerons (Total)	30.06 sq ft
(3) Stabilizer (Including Elevators and 2.6 sq ft of Fuselage)	37.90 sq ft
(4) Elevators (Two, including Trim Tabs)	14.14 sq ft
(5) Elevator Trim Tabs (Total)	1.30 sq ft
(6) Fin	3.14 sq ft
(7) Rudder (Including Balance and Tab)	11.93 sq ft
(8) Rudder Trim Tab	0.10 sq ft

3. LEADING PARTICULARS.

a. SETTINGS AND RANGES OF MOVEMENT OF CONTROL SURFACES

(1) AILERONS—LOWER WING.

Up (From Neutral)	23° (6⅛″)
Down (From Neutral)	18° (4⅞″)

(2) ELEVATORS.

Up (From Neutral)	28° (9-21/32″)
Down (From Neutral)	22° (7⅝″)

(3) ELEVATOR TRIM TABS.

Up (From Neutral)	15° (1⅛″)
Down (From Neutral)	15° (1⅛″)

(4) RUDDER.

Left (From Neutral)	30° (17″)
Right (From Neutral)	30° (17″)

b. ALIGHTING GEAR.

(1) MAIN LANDING GEAR.

(a) Type—Conventional, two main wheels located ahead of the center of gravity.

(b) Tread (Taxiing)—6′ 5-7/16″.

(c) Shock Struts.

1. Type—Spring-Oil.

2. Make and part number — Halliburton Oil Well Cementing Co.; Boeing Wichita Part Number E75N1-2643.

3. Fluid required — AN Specification No. AN-VV-O-366 (red).

(d) Wheels.

1. Type — Bendix Products Division, 24″ streamline No. 56372.

2. Tire — AN Specification No. AN-C-55 27.50″ x 8.90″ – 12.50″ smooth contour four-ply rayon.

3. Tire Pressure — 16 PSI.

(e) Brakes. — Type — Hydraulic — Bendix Products Div.—Part No. 57863L and 57864R.

(2) TAIL GEAR.

(a) Type — Wheel, full swiveling, steerable.

(b) Shock Strut.

1. Type — Air-oil combination.

2. Make and Part Number — Bendix Products Division; Boeing Wichita Part Number 75-2702.

3. Fluid required — AN Specification No. AN-VV-O-366 (red).

4. Air Pressure — 400 PSI.

(c) Wheel.

1. Type — 10″ Smooth Contour U.S. Army Specification No. 98-25272.

2. Tire — AN Specification No. AN-C-55 10″ smooth contour four-ply or six-ply rayon.

3. Tire Pressure — 30 PSI.

c. ENGINE.

(1) Number — One.

(2) Designation — Lycoming Model R-680-17.

(3) Gear Ratio—Direct Drive.

(4) Fuel — AN Specification No. AN-F-23.

(5) Oil—AN Specification No. AN-VV-O-446.

d. PROPELLER — METAL.

(1) Manufacturer — McCauley Steel Propeller Co.

(2) Type (2 blades) — Solid steel ground adjustable.

(3) Hub — Number AC 41D5926.

(4) Blade — Number SS-135-6.

(5) Diameter — 8′ 6″.

(6) Setting of blade angle at 42-inch station—11.7°.

e. PROPELLER — WOOD.

(1) Manufacturer — Sensenich Brothers.

(2) Type (2 blades) — Wooden blade, fixed pitch.

(3) Hub — Number AC 41G2325-9.

(4) Blade — Number AC 44K9705 or Sensenich No. 98AA66.

(5) Diameter — 8′ 2″.

f. TANK CAPACITIES.

	Gallons
(1) Fuel	
(a) Tank	46 U.S. (38.3 Imperial)
(b) Expansion	1.38 U.S. (1.15 Imperial)
(2) Oil	
(a) Tank	4.76 U.S. (3.96 Imperial)
(b) Expansion	1.60 U.S. (1.34 Imperial)

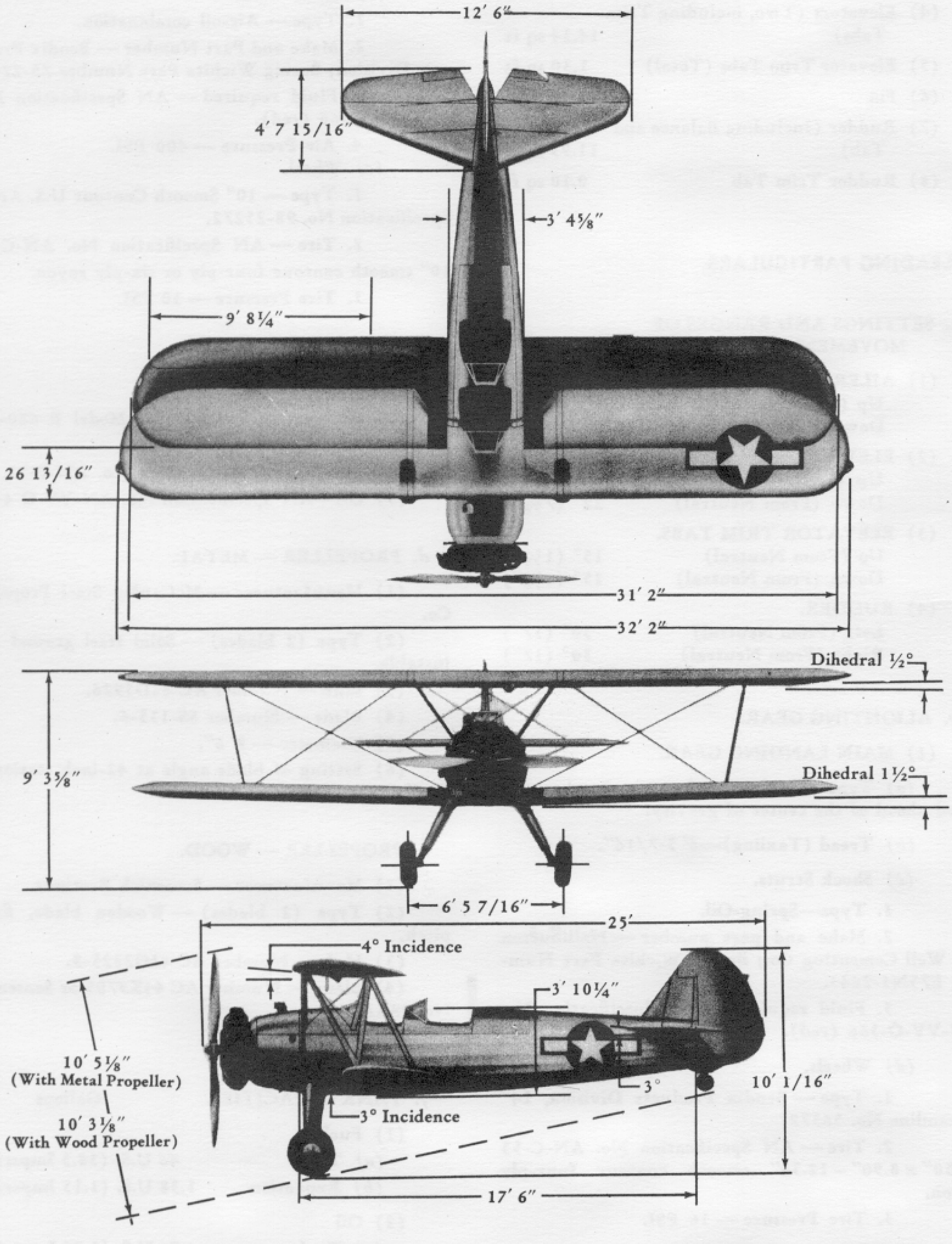


Figure 3—PT-13D/N2S-5 General Dimensions Diagram

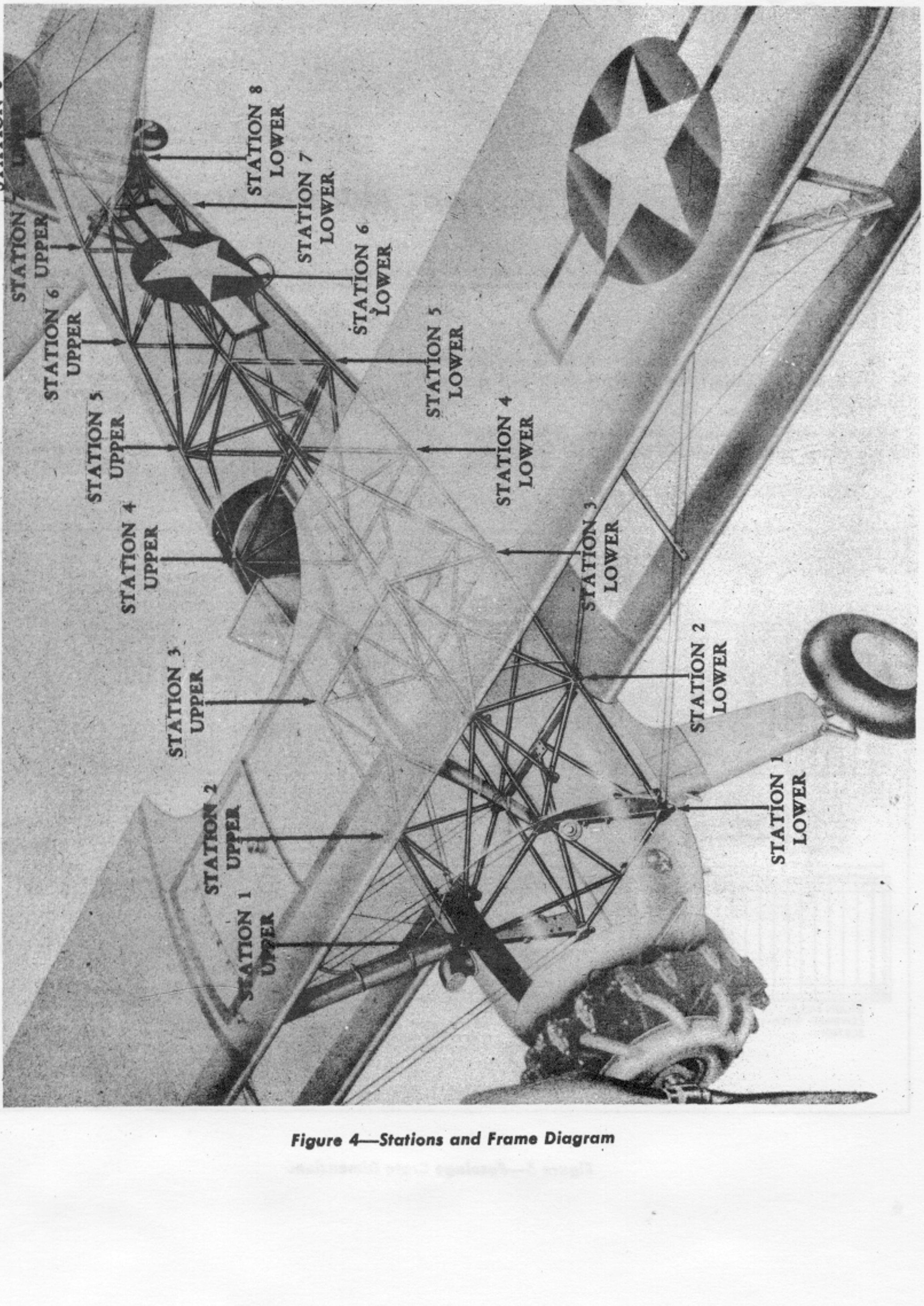
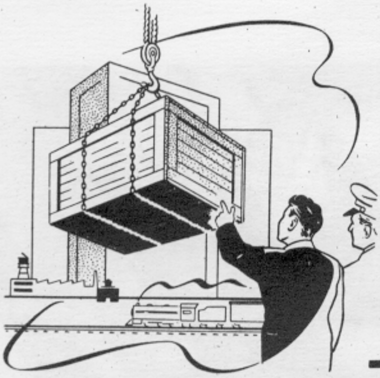


Figure 4—Stations and Frame Diagram



SECTION II

SHIPMENT AND ERECTION PROCEDURE

1. SHIPMENT.

The complete PT-13D/N2S-5 airplane is shipped in two crates, referred to as the wing crate and the fuselage crate.

These crates are wooden knock-down type properly assembled with reinforcing angles and lag screws.

a. FUSELAGE CRATE. *(See figure 6.)*

(1) DIMENSIONS. *(See figure 5.)*

(a) Skids are made of fir, 4x4 inch stock.

(b) All bracing, cross bracing, framing and reinforcing should be fir or yellow pine, 2x4 inch stock.

(c) Reinforcing angles are fabricated from mild steel and should be approximately 4x4x$\frac{1}{4}$x3$\frac{1}{2}$ inches.

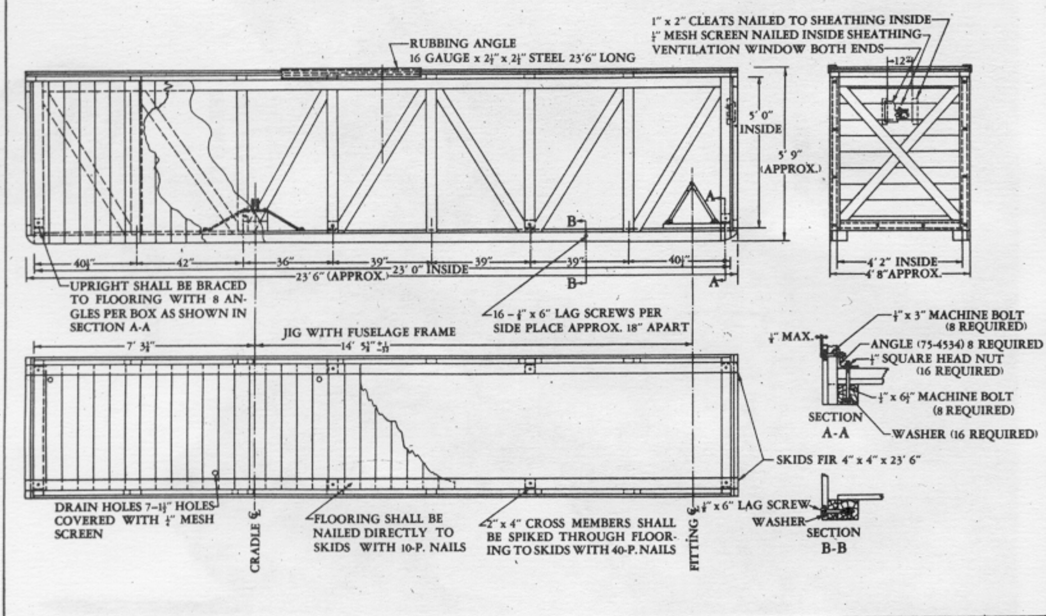
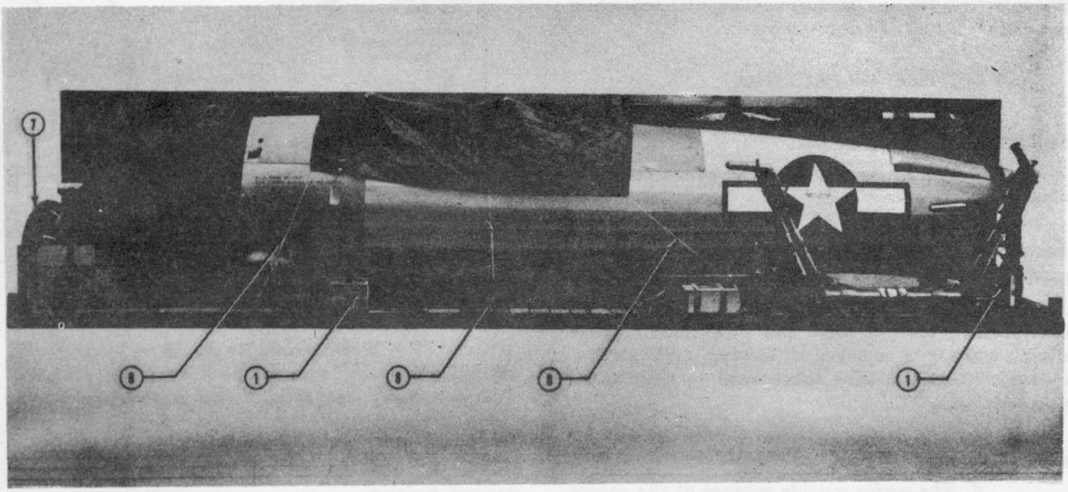


Figure 5—Fuselage Crate Dimensions



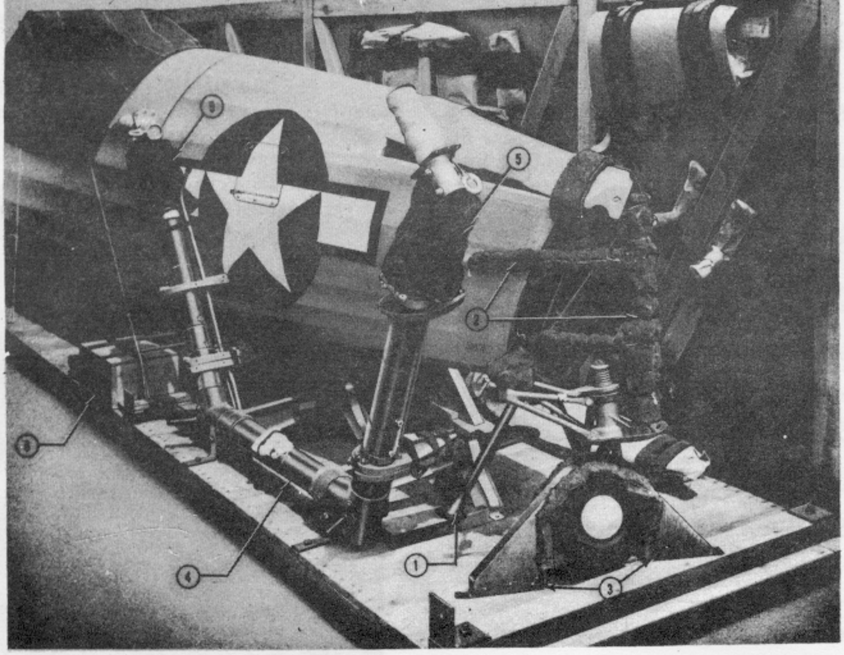


Figure 6—Fuselage Crating Arrangement

(2) CONTENTS.—The following items are packed within the fuselage crate; fuselage with engine installed, landing gear, propeller, and tail wheel assembly.

(3) METHOD OF PACKING.

(a) The oil tank must be drained by opening the "Y" drain.

(b) The engine should be prepared for shipment in this manner:

1. All rocker arm valve covers should be removed and each valve sprayed with corrosion-preventive compound, AN Specification AN-VV-C-576.

2. Each spark plug should be removed and each opening sprayed with the spray noted above in such manner as to cover all interior surfaces. Dehydrator plugs are then substituted in each spark plug opening.

3. The engine openings should be covered with suitable moisture-impervious plugs or covers.

4. The entire outside surface of the engine should be sprayed with corrosion-preventive compound, AN Specification AN-VV-C-576.

5. The entire engine should be wrapped in heavy paper and the regular engine cover installed.

(c) The fuselage must be placed on supports extending from the floor of the crate, and secured in place with bolts through the main landing gear fittings and the tail wheel trunnion fittings. For location, *see (1), figure 6.*

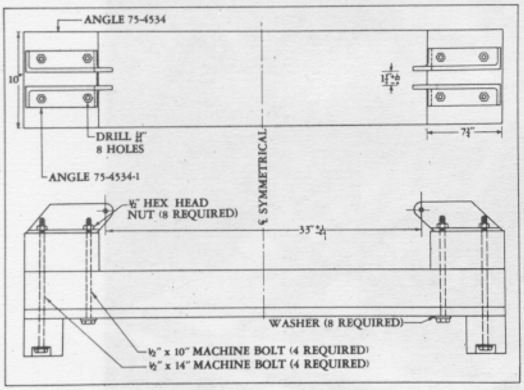


Figure 7—Front Fuselage Shipping Support

(d) Exposed parts of the tail wheel strut should be covered with heavy grease and wrapped with ½-inch felt secured with heavy cord. The upper empennage cowl and control cables should be wrapped in heavy paper and secured with heavy cord. *(Reference (2), figure 6.)*

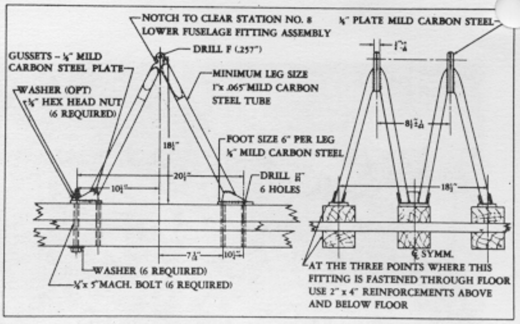


Figure 8—Rear Fuselage Shipping Support

(e) A block should be placed on each side of the tail wheel, the tail wheel packed with ½-inch felt and secured by steel strap nailed at each end to the floor. *(See (3), figure 6.)*

(f) The control sticks should be tied in a neutral position.

(g) If the shoulder harnesses and safety belts are secured, the possibility of cockpit damage will be minimized.

(h) The landing gear must be bound in position, *(see (4), figure 6)*, after the right axle knuckle assembly has been revolved 180 degrees inboard.

(i) Blocks should be placed under each landing gear sponson arm and the arms secured with steel straps. *(See figure 9.)*

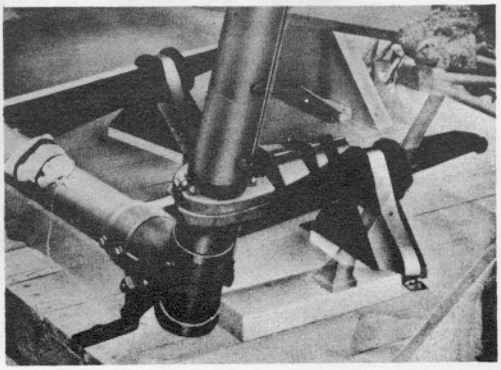


Figure 9—Landing Gear Crating Arrangement

(j) Both exposed landing gear struts should be coated with heavy grease, wrapped with ½-inch

felt, and the felt attached with heavy cord. *(See (5), figure 6.)*

(k) The open ends of both hydraulic lines should be taped to prevent accumulation of dust or foreign matter.

(l) The following items should be packed on the right side of fuselage crate: main strut fairing, lower right and lower left; front fairing assembly, left and right; inspection doors, left and right; rear fairing assembly, left and right; fuselage bottom cowl support assembly, left and right; fillets, left and right; wing root inspection doors, left and right.

Note

Each item should be wrapped in heavy paper and supported with steel straps. *(See figure 10.)*

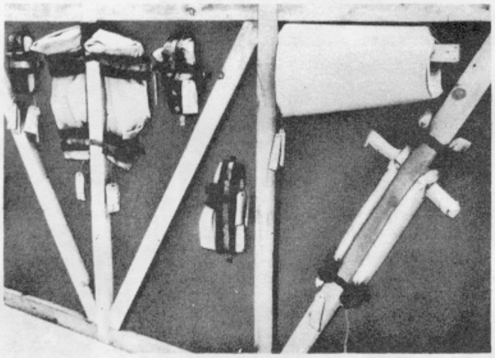


Figure 10—Packing Arrangement on Rear Side Fuselage Crate

(m) The brake box should be held in place with a steel strap as shown in *(6), figure 6.* This brake box is approximately 12x12 inches and contains all of the brake assemblies and rods.

(n) Engine kits should be attached with steel straps immediately forward of the brake box.

(o) The brake fluid bottle should be placed in a wooden box and secured with steel straps directly to the right of the brake box.

Note

All supporting steel straps should be nailed to the floor or sides as location may require.

(p) The entire surface of each propeller blade should be cleaned with light engine oil. The inside of the propeller hub should be packed with a heavy grease and the entire assembly wrapped in heavy paper.

(q) The propeller should be placed on specially constructed blocks on the crate floor opposite the landing gear. Each tip must be wrapped with ½-inch felt and secured with steel straps as shown in *figure 11.*

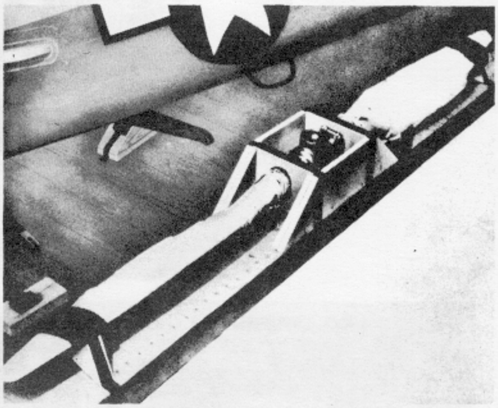


Figure 11—Arrangement of Propeller in Crate

(r) Tires should be wrapped with felt, felt placed between the wheels, and both wheel assemblies placed in a box in front of the engine and secured with steel straps as shown by *(7), figure 6.*

(s) The regular cockpit cover must be installed and secured to the floor in six places. *(See (8), figure 6.)*

(4) FUSELAGE CRATE ASSEMBLY.—The order of assembly of the fuselage crate will be to attach the sides to the crate bottom followed by the ends and the top.

b. WING CRATE. *(See figure 12.)*

(1) Dimensions are as shown in figure 13.

(2) CONTENTS.—The following items must be shipped in the wing crate: two upper wing panels, two lower wing panels, center section with fuel tank installed, interplane struts, center section struts, tie rods, fin and rudder, and stabilizer with elevators attached.

(3) METHOD OF PACKING.

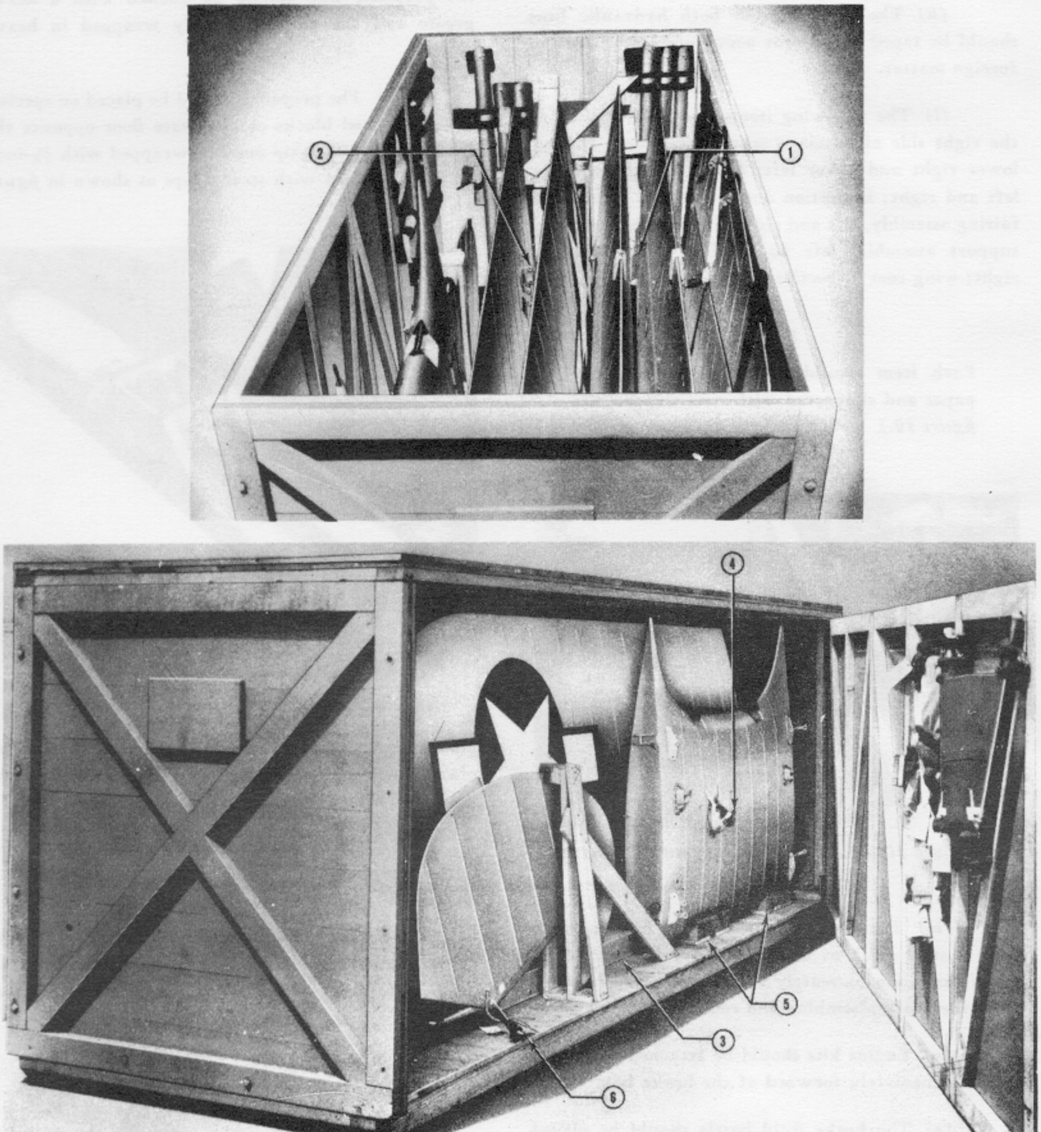


Figure 12—Wing Crating Arrangement

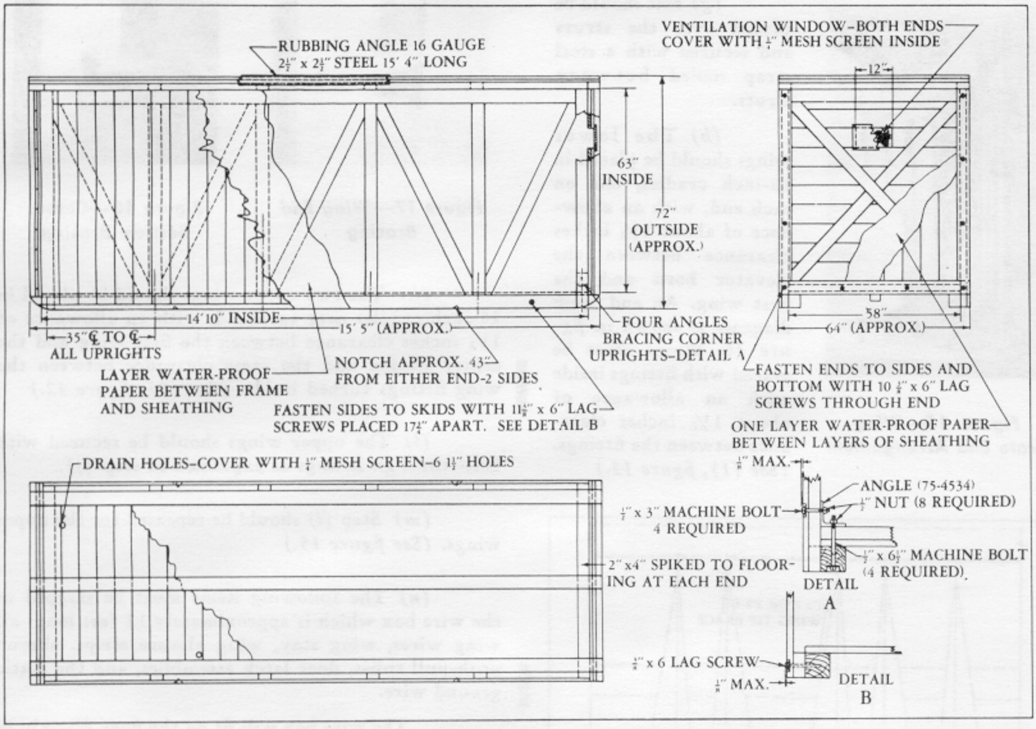


Figure 13—Wing Crate Dimensions

Note

All exterior surfaces should be thoroughly cleaned before packing.

(a) **The wing crate should be assembled with the front side and the top removed.**

(b) **The stabilizer and elevator should be bolted against the back side with approximately 5/8-inch bolts through each of four stabilizer fittings and the crate side.**

Note

A bracing block should be placed between the stabilizer fittings and the back side. ***(See figure 14.)***

(c) **The location of felt and steel straps over the stabilizer assembly directly above the two bracing strips is shown in *figure 14*.**

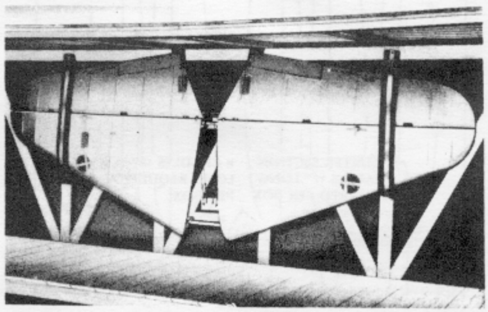


Figure 14—Stabilizer in Crate

(d) **With a suitable block as a support, the four control cables are then drawn taut and secured.**

(e) **The inspection windows and brace wire fittings should be taped.**

(f) **The struts are arranged and secured in end of crate as shown in *figure 15*.**

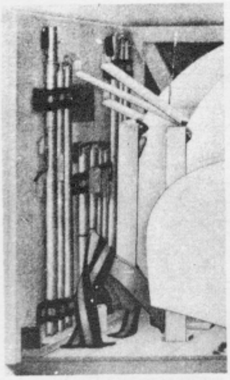


Figure 15—Wing Crate End Arrangement

(g) Felt should be placed over the struts and secured with a steel strap nailed between struts.

(h) The lower wings should be placed in 18-inch cradles, one on each end, with an allowance of about 1½ inches clearance between the elevator horn and the first wing. An end view diagram is shown in *figure 16*. Wings must be placed with fittings inside with an allowance of about 1½ inches clearance between the fittings. *(See (1), figure 12.)*

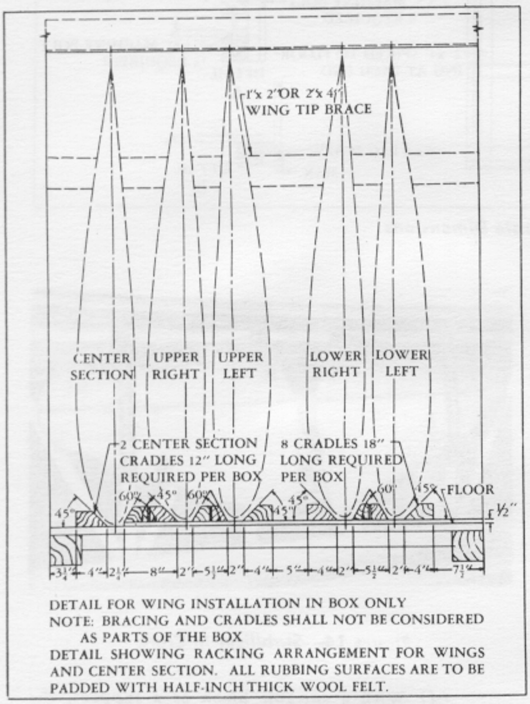


Figure 16—Wing Crate End Diagram

(i) The lower wings should be braced at each tip with supports from the end of crate against notched and padded boards. *(See figure 15.)*

(j) Bolts are installed through the wing fittings and through the end of the crate.

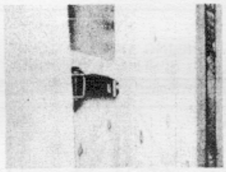


Figure 17—Wing End Bracing

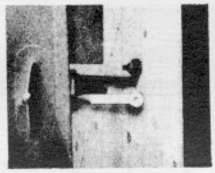


Figure 18—Center Section Bracing

(k) The two upper wings should be placed in 18-inch cradles near each end, with an allowance of 1½ inches clearance between the first wing and the center section and the same clearance between the wing fittings turned inside. *(See (2), figure 12.)*

(l) The upper wings should be secured with bolts through fittings as explained in step *(j)*.

(m) Step *(i)* should be repeated for the upper wings. *(See figure 15.)*

(n) The following items must be shipped in the wire box which is approximately 12 feet long: all wing wires, wing stay, wing closure strips, aileron push-pull tubes, door latch assemblies, and the static ground wire.

The wire box will fit on the floor directly in front of the wings and is secured with steel straps in three places. One end should be placed against the floor brace and the other end secured with a small block nailed to the floor. *(See (3), figure 12.)*

(o) Before placing the center section in the shipping crate, the following details should be accomplished:

1. Fuel tank "slushed out" with an anti-rust solution.

2. Felt secured over the rear view mirror with tape. *(See (4), figure 12.)*

3. All fuel tank openings and all line openings plugged or taped.

4. Wing attaching bolts placed in a small sack and taped on upper center section fittings.

(p) The center section must be placed on two 12-inch cradles directly in front of the wire box. *(See (5), figure 12.)*

(q) The center section is then secured with a bolt through each fitting and through the crate end. *(See figure 18.)*

CAUTION

Excessive tightening of these bolts will bend the wing fittings.

(r) The tail wheel cowl and boot can be placed on the floor between the upper wings and struts and then wrapped with felt and secured with steel strap as shown in figure 15.

(s) The rudder is placed on the floor between the center section and the struts in front of the wire box and a piece of felt placed between the rudder tip and the floor. *(See (6), figure 12.)*

(t) Felt and a securing steel strap should be placed over each rudder horn.

(u) The following items should be wrapped with felt and secured to the remaining side of the crate: fin; tail wheel cowl assembly, left and right; fuel lines; and fuel gage.

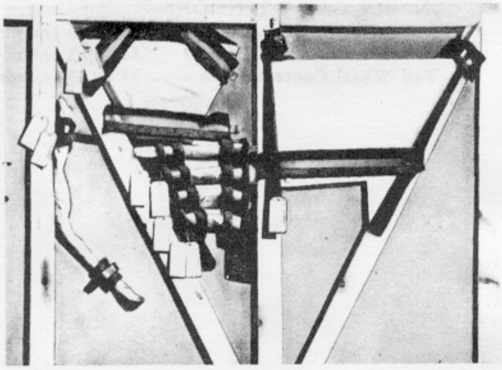


Figure 19—Packing Arrangement on Front Side Wing Crate

(4) WING CRATE ASSEMBLY.—The side to which the elevator and stabilizer assembly has been attached should be bolted onto the base of the crate followed by the ends and top. The opposite side should be attached last and should be marked "OPEN THIS SIDE ONLY."

2. UNCRATING AND REMOVAL OF CONTENTS.

a. FUSELAGE CRATE.

(1) The top should be removed from the fuselage crate first, with the ends removed next and the sides last.

(2) All parts, exclusive of the fuselage, which have been attached to the crate sides for shipment should be removed and prepared for assembly.

Note

Care should be exercised in removing steel straps and packing felt in order not to damage the parts.

(3) The bolts securing the fuselage to the crate should be removed but the fuselage should remain on the crate base until erection procedure begins.

b. WING CRATE.

(1) The side of the wing crate labeled "OPEN THIS SIDE ONLY" should be removed from the crate and the contents may be easily removed without further disassembly of the crate.

(2) The wing and empennage sections should be removed in the order of their packing and the parts which are attached to the crate sides disattached and prepared for assembly.

Note

Special care should be exercised not to damage the fabric covering of the wing and empennage sections when removing them from the crate.

3. ERECTION PROCEDURE.

a. LANDING GEAR, WINGS AND EMPENNAGE.

(1) With the rear of the fuselage frame placed on a jack, the tail wheel trunnion should be bolted to the fuselage fittings and the tail wheel control cables attached to the tail wheel post. The jack may then be removed to allow the tail wheel to rest on the base of the crate.

(2) In reassembling a crated airplane, it is necessary that the upper wing center section be assembled onto the fuselage while the fuselage is still on the crate base. This will allow the hoisting eyes provided on the center section to be used to raise the body sufficiently to allow installation of the main landing gear.

(a) The cabane struts should be bolted to the fuselage frame fittings, the center section placed in the correct position and the strut attachment bolts installed. The drag, anti-drag and roll wires should be connected with both anti-drag wires set for a pin-center distance of 38 inches.

(*b*) The right axle knuckle of the main landing gear which has been revolved 180 degrees inboard for packing should be returned to its original position and secured with the bolts supplied. The brakes, wheels and tires are then installed to form a complete assembly.

(*c*) With the fuselage hoisted sufficiently, the landing gear is attached to the fuselage frame at stations 1 and 2 with the bolts supplied.

(3) The wing sections, empennage, empennage cowling, main landing gear fairing and the propeller are then installed and the airplane prepared for flight according to the procedures set forth in the assembly and installation instructions of section IV.

b. RIGGING DATA.—Complete rigging instructions will be found in Section IV. The following data is supplied as supplemental to the erection procedure.

DIHEDRAL—Upper Wing—½°
Lower Wing—1½°

Note

It is recommended that the dihedral angle be set by the use of a dihedral board described in *figure* 51 and not by the use of inch measurement.

INCIDENCE—Upper Wing—4°
Lower Wing—3°

TENSIONS OF EXTERNAL BRACE WIRES. *(See figure 53.)*

ELEVATOR MOVEMENT—Up 28° — Down 22°.

STABILIZER INCIDENCE—3°.

RUDDER MOVEMENT—Right 30° — Left 30°

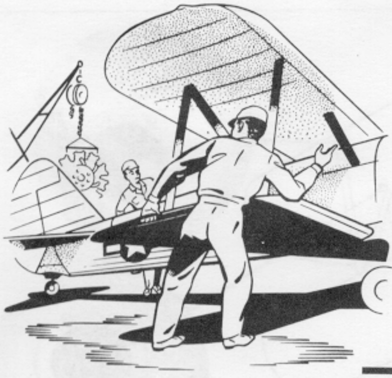
AILERON MOVEMENT—Up 23° — Down 18°

ELEVATOR TRIM TAB MOVEMENT—
Up 15° — Down 15°

STAGGER AT STRUT POINT—26-13/16 inches

CONTROL CABLE TENSIONS—

Rudder Control Cable —	60 to 80 pounds
Trim Tab Control Cable—	10 to 15 pounds
Tail Wheel Control Cable —	35 to 45 pounds



SECTION III

HANDLING AND GENERAL MAINTENANCE INSTRUCTIONS

1. ACCESS AND INSPECTION PROVISIONS.

a. Inspection windows and access doors are incorporated on the Model PT-13D/N2S-5 to facilitate periodic inspections which occur at established intervals.

b. Inspection windows are provided in the following places: on the top side of the lower wings at the strut points, on the bottom side of the upper wings at the strut points, on the bottom side of the lower wings at the aileron idlers, and at each stabilizer brace wire lug.

c. Access doors are provided in the following places: at the front and rear lower wing installation bolts, at each aileron idler, at each aileron bellcrank, at each hydraulic line fitting connecting flexible hose and hydraulic tube, and at the tab control pulley immediately forward of the empennage.

d. A fuselage clean-out door is located immediately forward of the rear jack point.

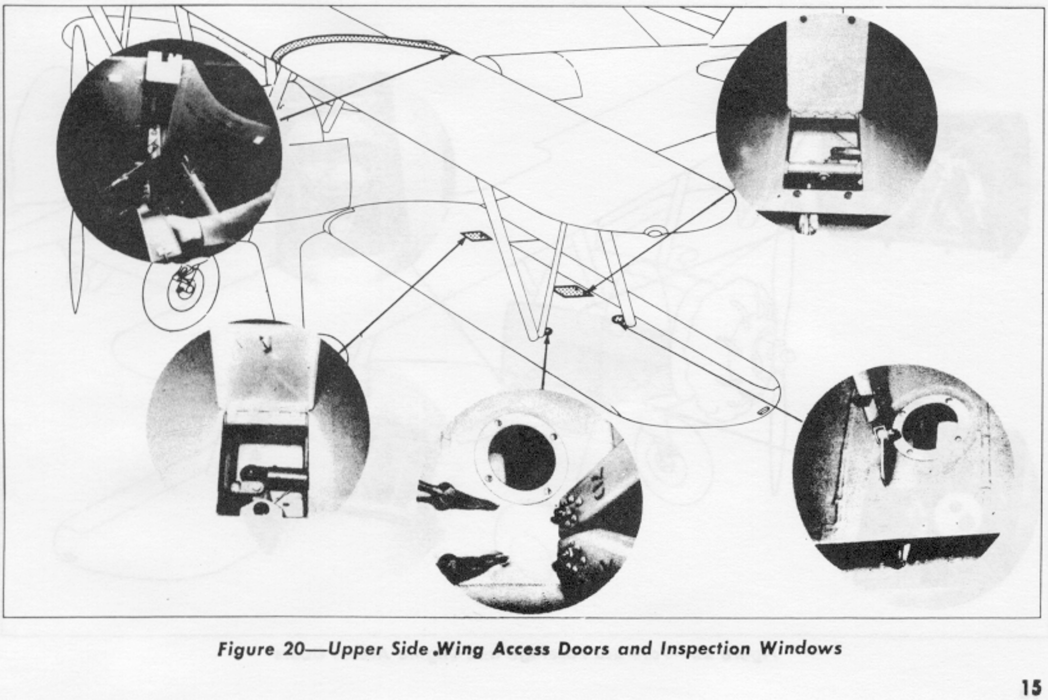


Figure 20—Upper Side Wing Access Doors and Inspection Windows

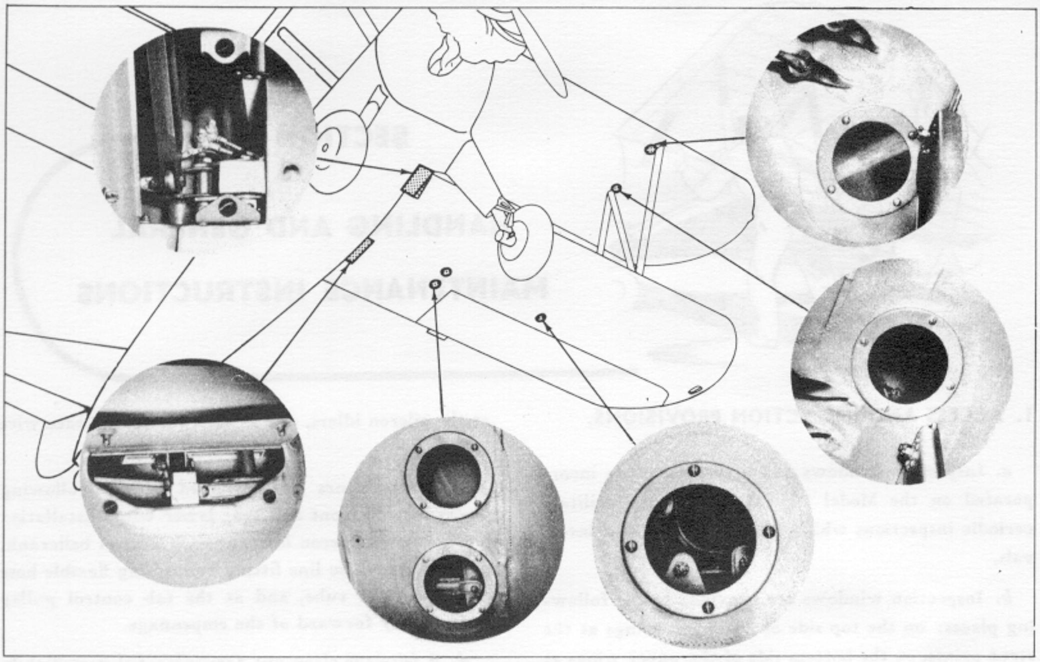


Figure 21—Under Side Wing Access Doors and Inspection Windows

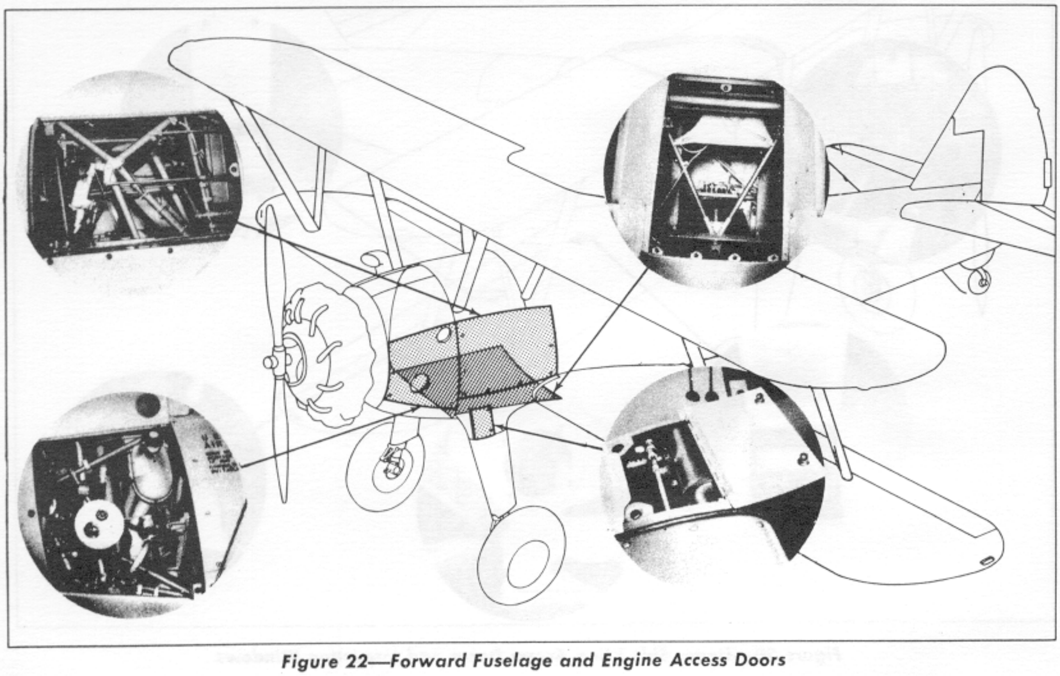


Figure 22—Forward Fuselage and Engine Access Doors

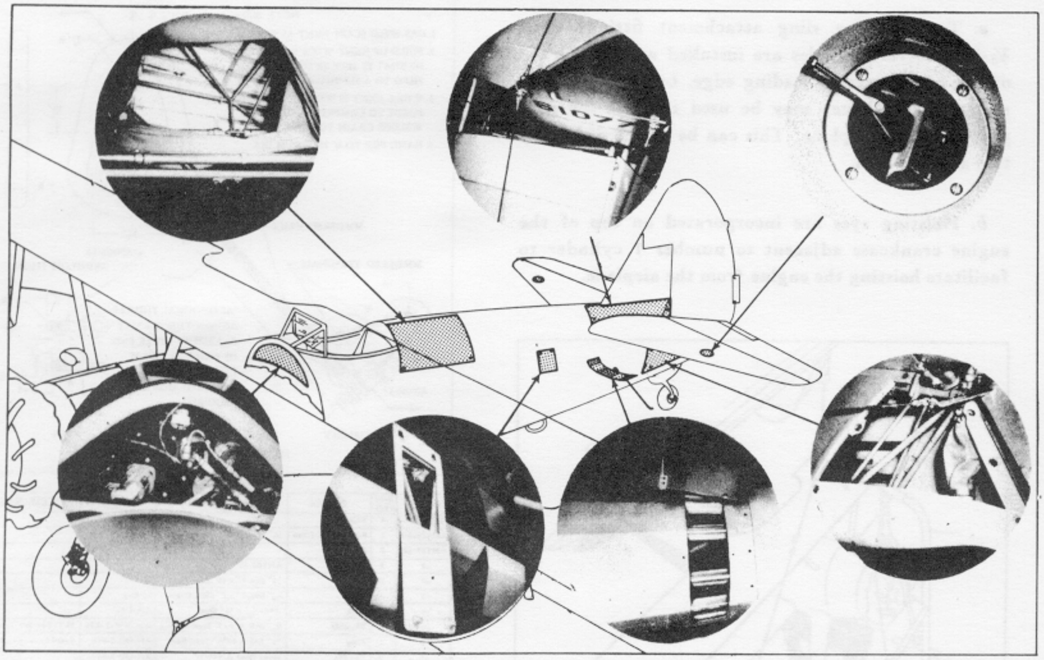


Figure 23—Rear Fuselage and Empennage Access Doors

e. All inspection windows and access doors are properly reinforced with surrounding patches.

f. Inspection windows are round plastacel mounted in alumiuum alloy frames and installed with screws. Access doors are made from aluminum alloy and are latched with Dzus fasteners.

2. GROUND HANDLING.

a. Hand holes are provided in each lower wing tip to facilitate ground handling.

b. Lift handles extend from each side of the fuselage aft of the baggage compartment. These handles are welded to and are an integral part of the fuselage tube structure.

c. Steps are welded to the engine ring mount to provide easy access for refilling the fuel tank.

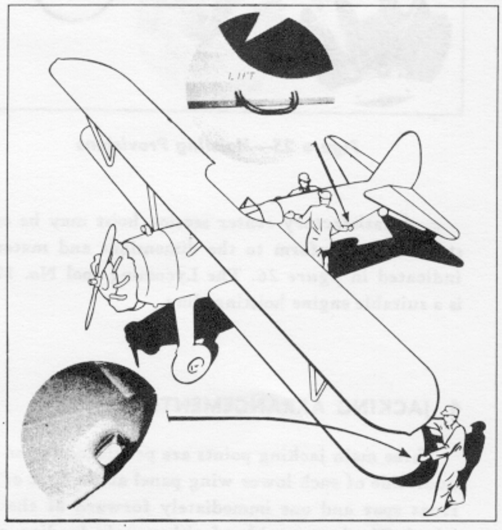


Figure 24—Ground Handling Points

3. HOISTING PROVISIONS.

a. Two hoisting sling attachment fittings with 3/8-inch clevis pin holes are installed at each corner of the center section leading edge. Lift handles (see paragraph 2 above) may be used to hoist the rear portion of the airplane. This can be accomplished by two average men.

b. Hoisting eyes are incorporated on top of the engine crankcase adjacent to number 1 cylinder to facilitate hoisting the engine from the airplane.

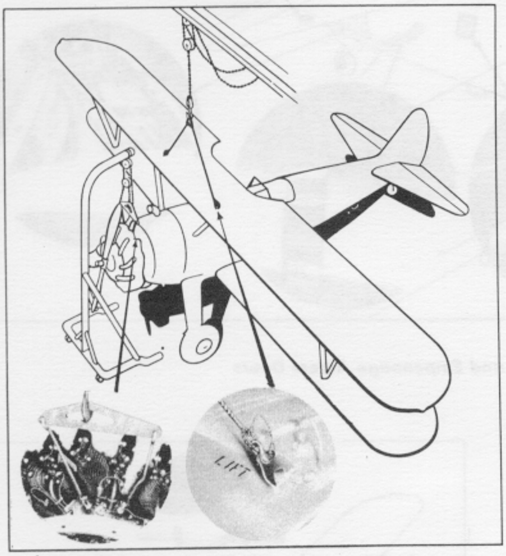
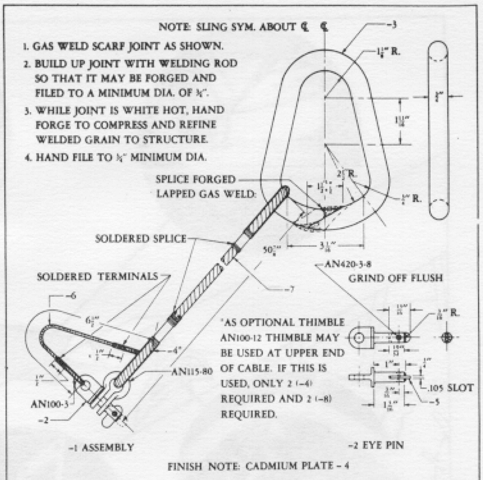


Figure 25—Hoisting Provisions

c. A satisfactory center section hoist may be constructed to conform to the dimensions and material indicated in *figure 26.* The Lycoming tool No. 1240 is a suitable engine hoisting sling.



PARTS LIST

PART	NO. REQ.	NAME	MATERIAL	SPEC.	REMARKS
AN100-3	4	Thimble			
AN420-3-8	1	Rivet, C'S'K Head	3/32" Diameter		
AN115-80	2	Shackle			
-8	2	Thimble	AN100-12		
-7	2	Cable	3/8" Dia. 7"×19" Flex. Cable	22-C-2	
-6	2	Cable	5/16" Dia. 7"×7" Flex. Cable	22-C-2	
-5	2	Lock	.100/3/16"×3/8" Steel	AN-S-11	
-4*	4	Thimble	7/16" O.D.×.035" Steel Tubing	AN-WW-T-850	H.T. 200,000#/In.²
-3	1	Ring	3/4" Dia.×20¾" Steel Rod	AN-QQ-S-646	Proof Load to 10,000#
-2	2	Eye Pin	Make from AN46-17	AN-QQ-S-689	
-1	1	Assembly			

Figure 26—Center Section Hoist Sling

4. JACKING ARRANGEMENT.

Three main jacking points are provided, one on the underside of each lower wing panel at the root of the front spar and one immediately forward of the tail wheel. The bottom side of either main landing gear knuckle can be used as a jacking point.

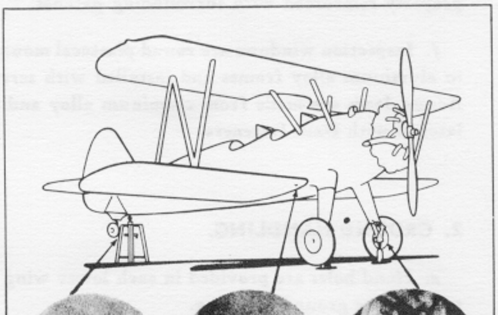


Figure 27—Jack Points

5. LEVELING.

a. LEVELING AIRPLANE WITH THE LANDING GEAR INSTALLED.

(1) With an adjustable jack under the rear jack point, a spirit level should be placed on the horizontal leveling lugs on the fuselage cross tube at station number 1 lower. The adjustable jack should be moved up or down until the spirit level shows the correct reading.

(2) Adjustable jacks should be placed under each main landing gear axle knuckle. A spirit level should be placed on the lateral leveling lugs and the proper jack adjusted until the correct level reading is obtained.

Note

After the airplane has been leveled laterally, the horizontal level should be rechecked.

b. Correct procedure for leveling the airplane after the landing gear has been removed will be found in paragraph 1, *e*, section IV of this manual.

6. PARKING AND MOORING INSTRUCTIONS.

a. PARKING.—After chocks have been placed in front of each main landing gear wheel, the parking brake handle should be pulled out and toe pressure simultaneously applied to each rudder pedal. This will "set" the parking brakes. The parking brakes may be released by applying additional toe pressure to each rudder pedal. It is not necessary to touch the parking brake handle while releasing the brakes. All flight control surfaces should be locked with the red handle located on the left side of each cockpit. Flight controls should be locked in the following manner:

(1) Aileron controls should be neutralized and the control stick placed in its forward position.

(2) Right rudder should be applied.

(3) The red handle should be pushed forward and down by hand to its locked position.

(4) Left rudder should be applied until the locking pin snaps into place.

b. MOORING.

(1) The parking brakes must be set and all flight controls locked before mooring the PT-13D/N2S-5.

(2) Mooring eyes are provided on the underside of each lower wing panel at the rear interplane strut points. The tail wheel should be secured with a double hitch thrown over the wheel around the tail wheel post to fit snugly against the boot attaching bracket.

(3) The airplane should be moored with a ½-inch rope or a 3/16-inch cable. When apron mooring rings are not available, the mooring kit should be used. This mooring kit consists of one anchor driving rod, eighteen mooring anchor arrows, six anchor rods, three anchor rod eyes, three mooring ropes and one ground breaking pin.

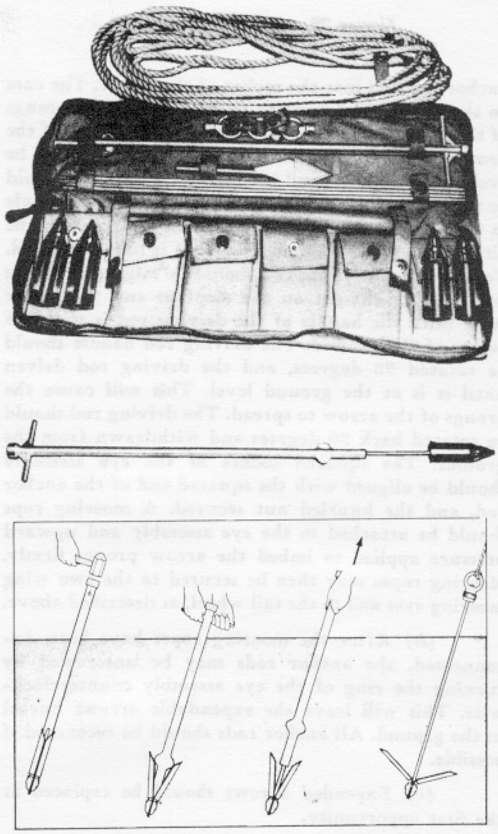


Figure 28—Mooring Kit and Use

(4) Using the equipment furnished in the mooring kit, an airplane may be moored in this manner:

(a) An anchor rod should be screwed into the arrow point and the driving rod slipped over the

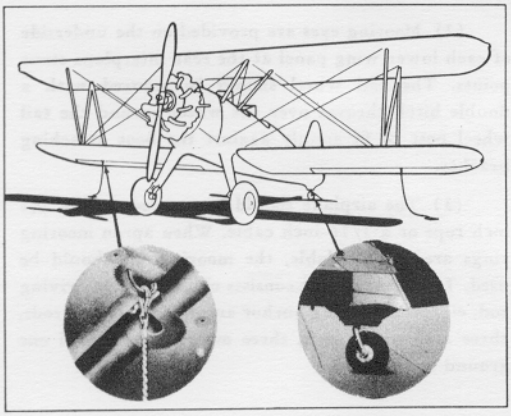


Figure 29—Mooring Diagram

anchor rod and into the socket of the arrow. The cam on the driving rod must be turned so that the prongs of the arrow will not spread while being driven. If the ground is hard, the hardened surface may first be broken with the ground breaking pin. Caution should be taken to drive each anchor rod at the proper angle so that each rod will be in line with the point on the airplane to which the mooring rope is to be attached. To drive properly, the rod should be aligned with the point of attachment on the airplane and the arrow sunk until the handle of the driving rod is within 3 inches of the ground. The driving rod handle should be rotated 90 degrees, and the driving rod driven until it is at the ground level. This will cause the prongs of the arrow to spread. The driving rod should be rotated back 90 degrees and withdrawn from the ground. The squared socket of the eye assembly should be aligned with the squared end of the anchor rod, and the knurled nut secured. A mooring rope should be attached to the eye assembly and upward pressure applied to imbed the arrow prongs firmly. Mooring ropes may then be secured to the two wing mooring eyes and to the tail wheel, as described above.

(b) After the mooring ropes have been disconnected, the anchor rods may be unscrewed by turning the ring of the eye assembly counterclockwise. This will leave the expendable arrows buried in the ground. All anchor rods should be recovered if possible.

(c) Expended arrows should be replaced at the first opportunity.

(d) If the ground is frozen too hard to allow sinking of the mooring arrows, this procedure may be followed: using the ground breaker, a hole approximately eight inches square and eight inches deep should be dug. A cross bar, to which a mooring rope has been tied, should be inserted in the hole and the hole filled with water which, when frozen, will secure the mooring bar.

CAUTION

In no instance should the load on a mooring cable or rope be such as to cause the cable to assume a position vertical to the ground.

c. MOORING IN HIGH WIND.—For emergencies, when warning of storms or high winds are received, the following additional precautions should be taken:

(1) A spoiler should be clamped on the wings in a manner to avoid damage to the fabric covering of the wing or the controls. The spoiler may consist of a wooden two-by-four, with a length equal to approximately 75 per cent of the wing span. It should be located 6 to 9 inches aft of and parallel to the leading edge of the wing with the four-inch dimension perpendicular to the wing surface and in such a manner that little or no space exists between the bottom of the spoiler and the wing surface.

(2) Felt-padded wooden clamps should be installed to lock all movable control surfaces securely. The clamps may be fabricated locally and used even though internal surface control locks have been properly set.

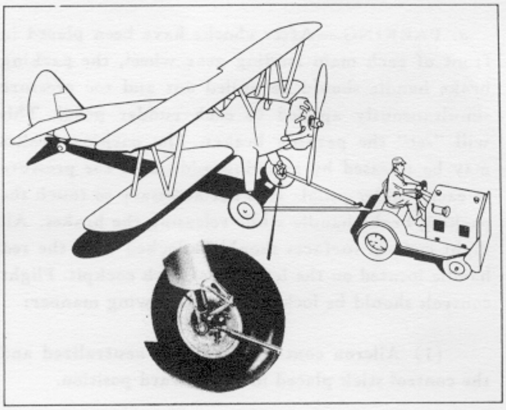


Figure 30—Towing Arrangement

7. TOWING.

Towing eyes are provided on each main landing gear axle knuckle. By using a conventional towing bar, triangular and solid, the plane can be moved forward or backward with little or no difficulty.

CAUTION

Before towing a plane, the parking brakes must be released.

8. METHOD OF SERVICE.

a. FUEL.

(1) When refueling the PT-13D/N2S-5, the fuel supply hose nozzle should be grounded against some part of the fuel tank, either the stiffener, hoisting eye or some similar accessible metal. For filler cap location refer to *figure 131.*

(2) With this plane in a three-point position, the fuel tank is so located that it may be completely filled and the allowable 1.38 gallons expansion space will automatically remain.

(3) Service this airplane with 73 octane fuel conforming to AN Specification No. AN-F-23. In case of an emergency and 73 octane fuel is not available, refer to T. O. No. 06-5-1.

WARNING

After each refueling, make certain that the filler neck cap has been replaced and is secure.

b. OIL.

(1) The oil tank filler neck is located in such a position that the tank may be filled and 1.76 gallons expansion space will automatically remain intact.

(2) This plane should be serviced with oil conforming to AN Specification No. AN-VV-O-446, Grade 1120 in temperatures of 4° C (39° F) and above, Grade 1100 in temperatures of —7° to +27° C (20° to 80° F) and Grade 1080 in temperatures of 10° C (50° F) and below.

c. HYDRAULICS.—Instructions for servicing the landing gear struts and the hydraulic brake system may be found in section IV.

9. CLEANING

a. EXTERIOR.

(1) The entire exterior surface of the airplane should be washed at regular intervals determined by the conditions of the operating locale. Attention should be given to the preservation of the fabric in lieu of the appearance of the airplane.

(2) A soft soap conforming to U.S. Army Specification No. 18001 should be used at the rate of three pounds per 100 gallons of water. When using this solution with a steam pressure unit, the nozzle should be held at least one foot from the fabric at all times. If a steam pressure unit is not available a soft cloth can be used.

Note

A careful check should be made at regular intervals to see that the drain holes in the wings and empennage are kept open.

(3) Heavy deposits of dirt, grease or oil may be removed with a solution of one part compound conforming to AAF Specification No. 20015 and four parts kerosene, Federal Specification No. VV-K-211. This solution should be sprayed or mopped on the incrustations and allowed to soak from 10 to 15 minutes. After the difficult spots have been removed the immediate area should be washed with soap and water.

(4) After completing the washing operation with the soft soap solution, the entire plane should be washed down with clear water and allowed to dry in a shaded area.

CAUTION

Since the walkways on the upper inboard surfaces of the lower wing are made of a rubberized material, grease solvents or gasoline will cause this material to deteriorate rapidly. Care should be taken to protect these walkways when any such solvents are being used in cleaning.

b. INTERIOR.

(1) The interior of this airplane can be cleaned with a steam pressure unit and a soft soap solution in the same manner as the exterior surfaces are cleaned.

CAUTION

Steam pressure should not be introduced against any grease packed bearing, rod end or bellcrank.

(2) Small gravel and dust accumulating in the fuselage may be blown out the clean-out door located immediately forward of the tail wheel on the under

side of the fuselage. This can be accomplished with an air hose of average air pressure.

c. ENGINE.

(1) The engine should be cleaned with a dry cleaning solvent conforming to Federal Specification No. P-S-661 or with kerosene, Federal Specification No. VV-K-211. These solvents may be used in a hand spray.

(2) Removal of the solution may be accomplished by "hosing down" with water or blowing with compressed air, followed by wiping with a clean rag.

(3) Engines should be cleaned in an open place or in properly ventilated booths. All electrical devices must be vapor proofed and equipment grounded to prevent static discharges.

10. GROUND OPERATING INSTRUCTIONS.

a. REGULAR STARTING AND WARMING UP PROCEDURE.

(1) Ignition Switch—"OFF".

(2) Fuel Supply—"ON".

(3) Engine should be pulled through several revolutions with the throttle closed in order to suck the fuel mixture into the cylinders and to insure that cylinders are not partially filled with oil or liquid fuel.

(4) Throttle—"1/3 OPEN". Retard to three-quarters inch open as soon as the engine starts.

(5) Mixture Control—"FULL RICH".

(6) Carburetor Air Control—"COLD".

(7) Primer—Normally two strokes in fairly warm weather and four strokes in cold weather.

CAUTION

Avoid excessive priming as this has a tendency to wash the oil off the cylinder walls causing scoring of the barrels or seizing of the pistons. Do not prime or pump throttle for a warm engine.

(8) Energize starter.

(9) Ignition Switch—"ON".

(10) Engage engine starter clutch.

(11) Set throttle to attain an indicated engine speed of from 800 to 1000 rpm for warm-up.

CAUTION

If the oil pressure gage does not register within 30 seconds, stop engine.

(12) Begin taxiing when oil temperature is at least 10° C (50° F) with an oil pressure of 50 pounds per square inch and engine does not misfire when accelerated rapidly.

Note

Oil pressure during warm-up should not exceed 100 pounds per square inch maximum.

CAUTION

Excessive ground operation should be avoided as engine will become too hot to take off.

b. FAILURE OF ENGINE TO START.

(1) Excessive priming is probably the most general cause of difficulty in starting and often results in damage to the engine. Should the engine be overprimed, the throttle should be opened and the engine pulled backwards through several revolutions with the ignition switch "OFF" to clear the cylinders of excess fuel.

(2) If the engine does not start with the first attempt, another attempt should be made without additional priming.

c. ENGINE AND ACCESSORY GROUND OPERATION TEST.

(1) After warm-up, as indicated by oil temperature of 10° to 70° C (50° to 158° F), the throttle should be advanced to full open position and rpm should not be less than 1650.

(2) The ignition should be tested by switching from "BOTH" to "LEFT" magneto and then to "RIGHT" magneto and back to "BOTH", allowing the engine to pick up loss in rpm. Engine drop-off should not exceed 75 rpm.

WARNING

Never exceed 10 seconds on either magneto when testing.

(3) Oil pressure should be checked for 50 to 80 pounds per square inch.

(4) Oil temperature should be checked for 10° to 70° C (50° to 158° F).

11. LUBRICATION.

A periodic check chart, *figure 31* and diagrams locating points of lubrication, *figures 32, 33, 34, 35, 36, and 37* are provided to facilitate proper lubrication of the PT-13D/N2S-5 airplane. Color coding and lubricant key numbers have been incorporated to denote period of service and the lubricant to be used.

a. SUBSTITUTE BEARINGS.

(1) All substitute bearings must be disassembled to perform proper lubrication. Rigid bearings are disassembled by removing the bolt which passes through the cone; the cone, in two pieces, is then easily removed. Self-aligning bearings are disassembled by removing the bolt extending through the cone, rotating the cone 90 degrees, and removing the cone through the slots provided in the race.

(2) Bearing surfaces should be wiped clean or washed in gasoline prior to the application of new lubricant. It is recommended that a cloth saturated with gasoline be used to clean the bearing races, care being taken to prevent excessive gasoline from contacting fabric covering.

Note

At each lubrication period, bearing surfaces should be examined for excessive pits or burrs and the bearing replaced if necessary.

(3) When reassembling the bearings, the grease retaining grooves should be filled with the grease specified in the lubrication charts and a thin film applied to all bearing surfaces.

(4) A complete list and illustrations of all substitute bearings is included in Section IX of this manual.

b. The rudder pedal assembly, *figure 33*, detail A, tab control gear box, *figure 33*, detail D, tail wheel post assembly, *figure 34*, detail A, tail wheel, *figure 34*, detail D, main landing gear wheels, *figure 34*, detail G, must be disassembled to be properly grease packed.

CAUTION

Care must be taken to prevent grease from coming in contact with the rubber bushings at the elevator horn. *(See figure 32*, detail C.)

Note

Excessive amounts of grease are not required to lubricate the rudder pedal channels properly, *figure 33*, detail A, and the seat support tubes, *figure 37*, detail D. Oil lubricants should be used sparingly to prevent excessive oil from dripping on the fabric covering.

12. SPECIAL TOOLS.

A Boeing special tool kit, E75-4513, including a spanner wrench and a wing compression strut wrench, is included in the baggage compartment of each airplane. No other special tools are required for the PT-13D/N2S-5 airplane.

ARMY 25 HOURS (Navy 30 Hours)

	Fig. No.	Detail	Lubricant
1. Idler—Rudder Control Cable	33	C	AN-O-6A
2. Key—Rudder Pedal Adjuster	33	A	AN-O-6A
3. Brake Cylinder Attaching Bolts	33	F	AN-O-6A
4. Bellcrank—Rudder and Brake Control	33	F	AN-O-6A
5. Connecting Rod—Brake Pedal to Bellcrank	33	F	AN-O-6A
6. Bearings—Tab Control Handles	33	E-B	AN-O-6A
7. Tab Control Cable-Gear Linkage Joints	33	D	AN-O-6A
8. Rudder Hinges	34	B	AN-O-6A
9. Tab Hinges and Horns	34	C	AN-O-6A
10. Elevator Hinges	34	E	AN-O-6A
11. Aileron Hinges	34	F	AN-O-6A
12. Torque Arms—Main Landing Gear	34	H	AN-G-3
13. Carburetor Air Control Unit	35	C	AN-O-6A
14. Engine Control Unit and Connecting Rods	35	D	AN-O-6A
15. Carburetor Air Control Rods	35	G	AN-O-6A
16. Ignition Switch Connecting Rods	36	A	AN-O-6A
17. Fuel Cock Control Rods—Rear Cockpit	36	B	AN-O-6A
18. Fuel Cock Control Rods—Front Cockpit	36	C	AN-O-6A
19. Universal Joint—Flight Control Parking Lock	37	A	AN-O-6A
20. Bearings—Flight Control Parking Lock	37	B-C	AN-O-6A
21. Bearing—Elevator Lock Yoke Shaft	37	F	AN-O-6A
22. Seat Adjustment Mechanism	37	E	AN-O-6A

ARMY 100 HOURS (Navy 120 Hours)

	Fig. No.	Detail	Lubricant
1. Bearings—Aileron Push-Pull Tubes	32	A	AN-G-3
2. Idler—Elevator Control	32	B	AN-G-3
3. Bearing—Elevator Control Push-Pull Tube	32	B	AN-G-3
4. Elevator Horn	32	C	AN-G-3
5. Aileron Control Bellcrank and Arm	32	D	AN-G-3
6. Aileron Idler	32	E	AN-G-3
7. Control Stick Forks and Torque Tube Bearings	32	F	AN-G-3
8. Rudder Pedal Support Bearing	33	A	AN-G-3
9. Rudder Pedal Adjusting Channel	33	A	AN-G-3
10. Trim Tab Gear Box	33	D	AN-G-10
11. Trim Tab Gear Mechanism Bearings	33	D	AN-G-3
12. Rudder Control Idler Bearing	33	C	AN-G-3
13. Tail Wheel Post Assembly	34	A	AN-G-3
14. Main Landing Gear Wheel Bearings	34	G	AN-G-15
15. Tail Wheel Bearings	34	D	AN-G-15
16. Carburetor Air Control Rods and Bellcranks	35	A	AN-G-3
17. Throttle and Mixture Control Rods and Bellcranks	35	B-E-F-G	AN-G-3
18. Carburetor Air Control Rod Bearing	35	G	AN-G-3
19. Pilot's Seat Support Tubes	37	D	AN-G-3
20. Flight Control Lock Connecting Rod	37	F	AN-G-3

ARMY 500 HOURS (Navy 500 Hours)

	Fig. No.	Detail	Lubricant
1. Rudder Pedal Shaft	33	A	AN-G-3

Figure 31—Lubrication Periodic Check List

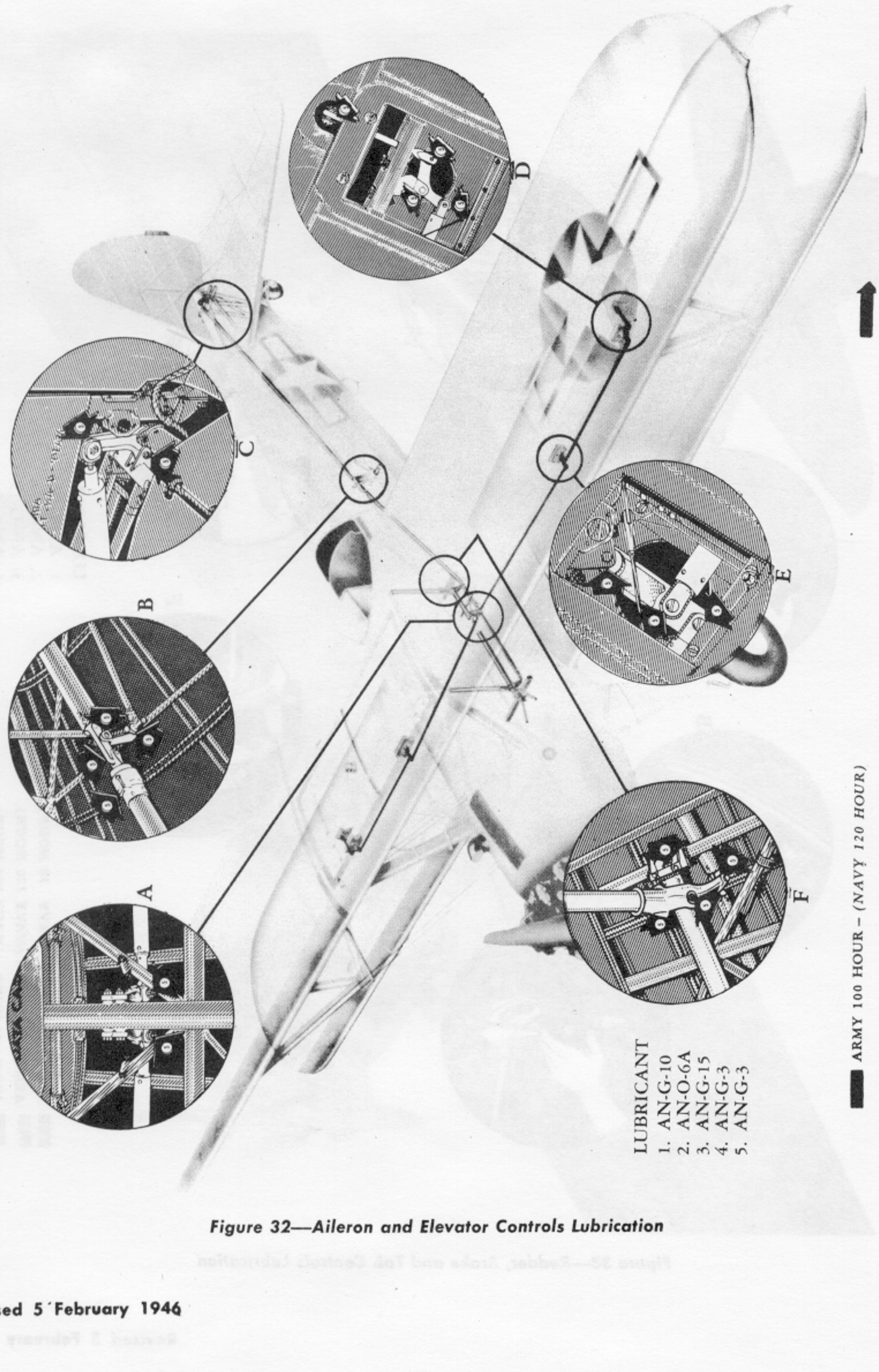


Figure 32—Aileron and Elevator Controls Lubrication

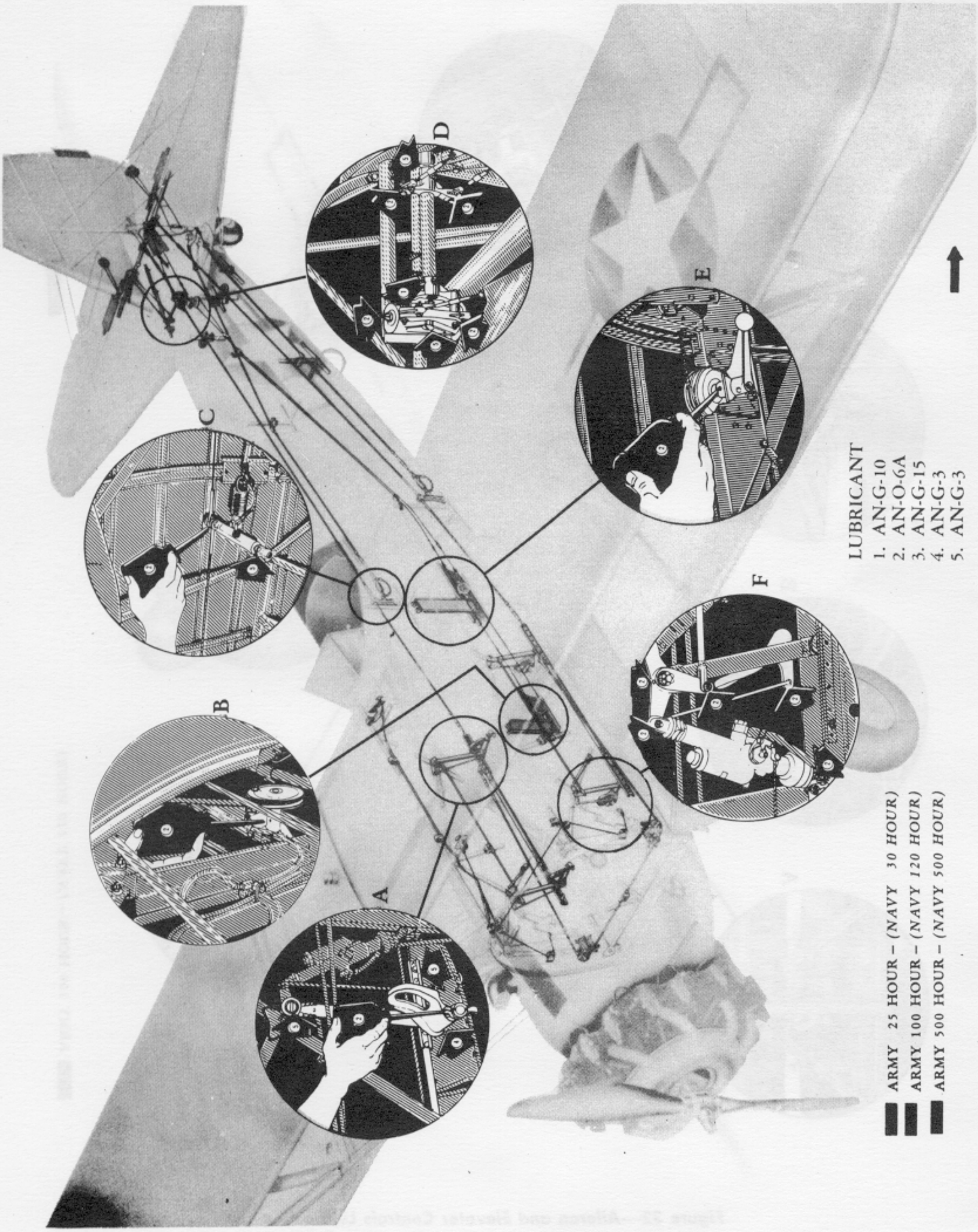


Figure 33—Rudder, Brake and Tab Controls Lubrication

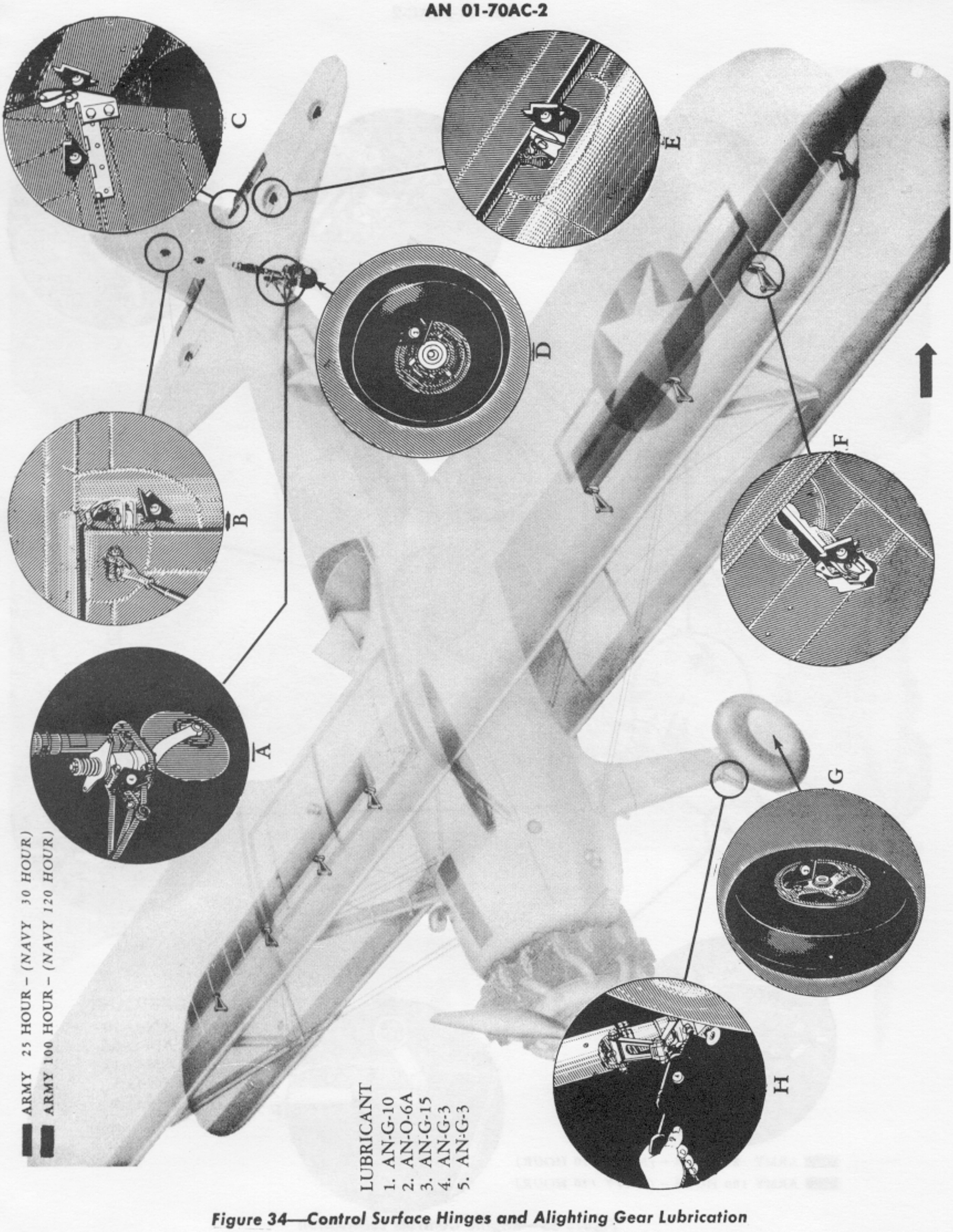


Figure 34—Control Surface Hinges and Alighting Gear Lubrication

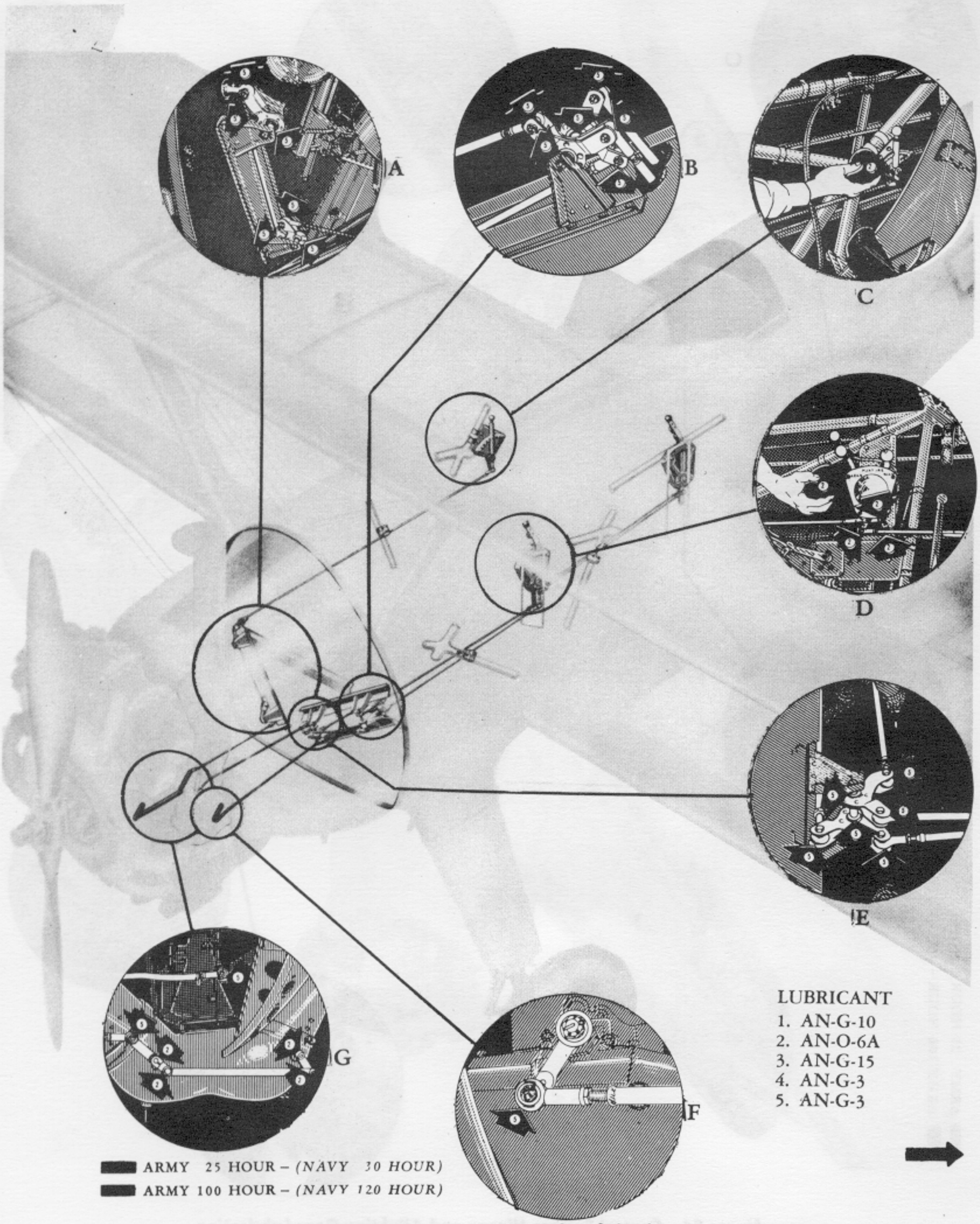


Figure 35—Engine Controls Lubrication

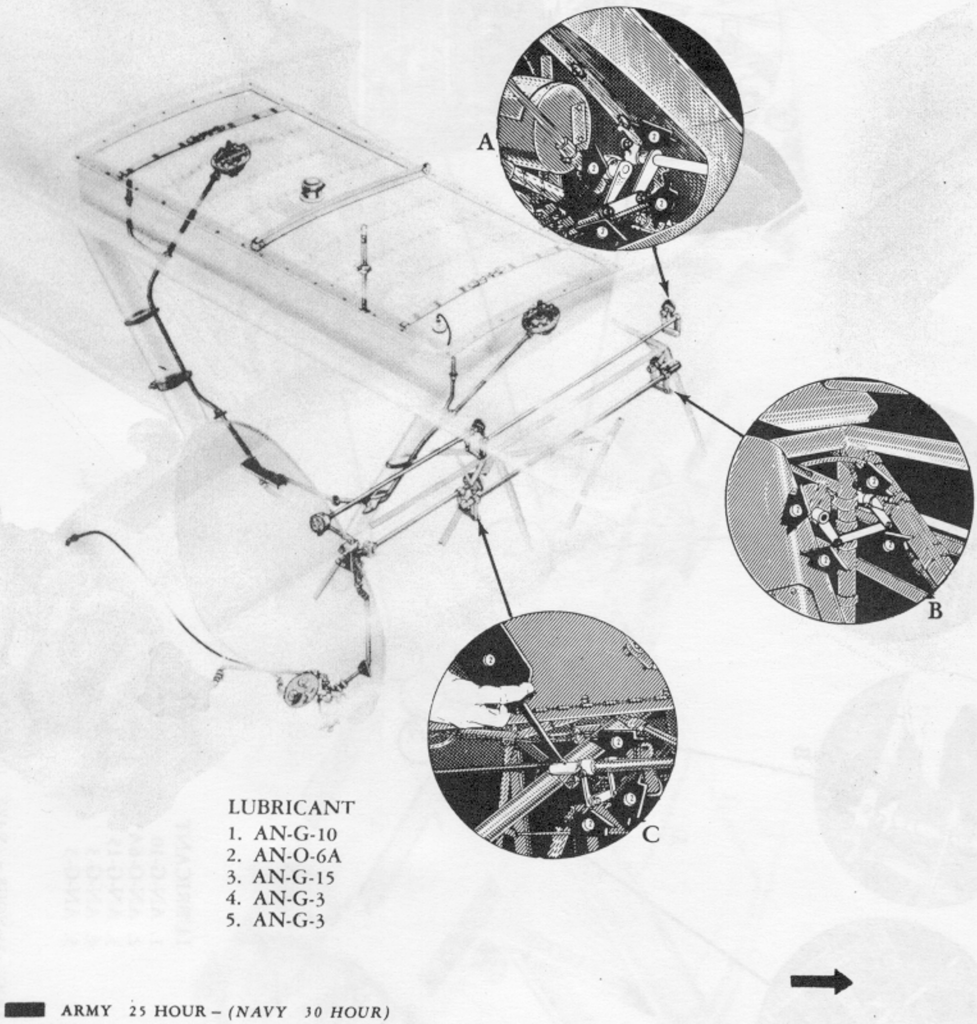


Figure 36—Fuel System and Magneto Control Lubrication

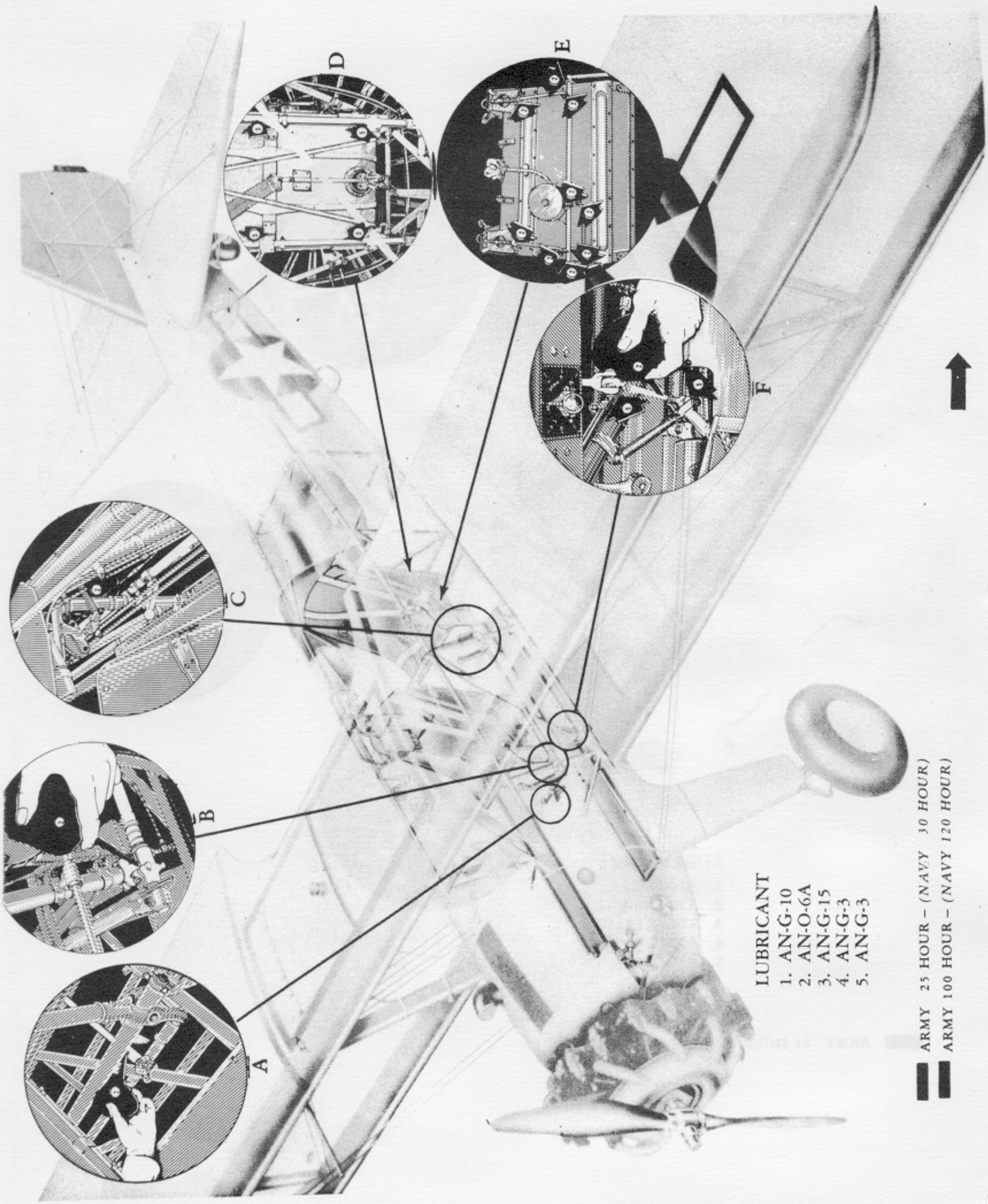
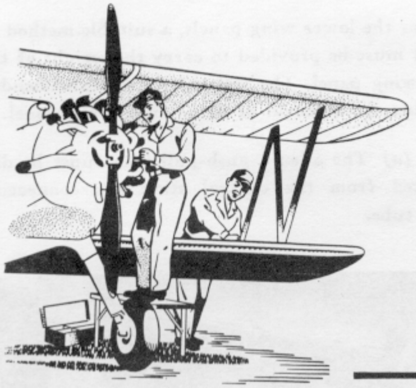


Figure 37—Furnishings Lubrication



SECTION IV
MAJOR COMPONENT PARTS AND INSTALLATIONS

1. WING GROUP.

a. DESCRIPTION.

(1) The wing group consists of two upper outer panels, a center section, two lower panels, two ailerons, and the necessary struts and wires for rigging the wings. The ailerons are incorporated in the trailing edge of the lower wing.

(2) The wings and center section are of conventional wood fabric construction, using solid or laminated, routed or unrouted spars of rectangular cross section. These spars may be made of any of the following species of wood; however, all material in any one spar will be of the same species: Spruce, Noble Fir, Western Hemlock, Port Orford White Cedar, Yellow Poplar or Douglas Fir. Only spars fabricated of Douglas Fir are routed. At points of high stress these spars are reinforced by the addition of mahogany plywood shims.

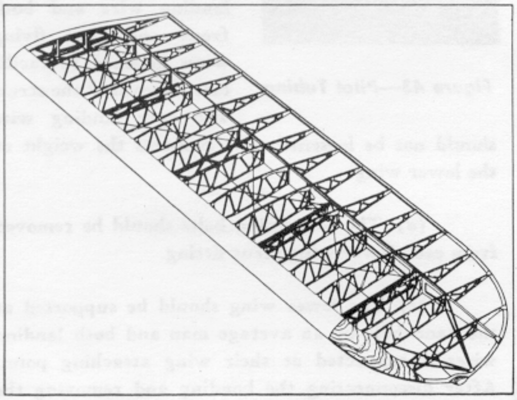


Figure 38—Upper Wing Structure

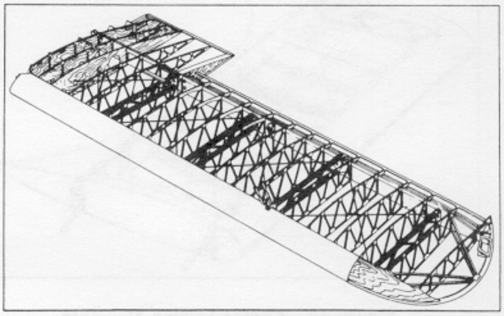


Figure 39—Lower Wing Structure

(3) The ribs are of the truss type, constructed of 5/16-inch square spruce sections joined together at the joints by glued and nailed plywood gussets. Suitable walkways covered with rubberized canvas are provided at the lower wing roots.

(4) The compression struts, which are bolted between the spars, are fabricated of formed aluminum alloy sections, riveted together and provided with extruded section end fittings. The single drag bracing system incorporates AN standard type, carbon steel square section rods and clevises.

(5) The interplane struts are made of drawn streamline 17ST aluminum alloy tubing. The end fittings are 24ST aluminum alloy reinforcement plates riveted to the inside of the tubes. The lower end fittings on the rear of the outer bay struts are adjustable through a chrome-molybdenum steel clevis, which permits adjustment without removing the attaching wing bolts. Interplane struts are attached to the wing by 14S aluminum alloy forgings bolted to the spars.

(6) All other fittings, with the exception of the chrome-molybdenum flying and landing wire lugs, are 24ST plates.

(7) Construction of the center section is essentially the same as that of the wings, with two exceptions. The leading edges are covered with 1/16-inch mahogany plywood and the compression struts are modified to permit the installation of the gasoline tank. The center section or cabane struts are made of drawn streamline 17ST aluminum alloy tubing with end fittings of 24ST aluminum alloy reinforcement plates riveted to the inside of the tubes.

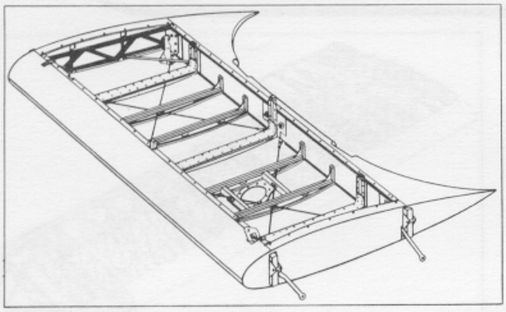


Figure 40—Center Section Structure

(8) The ailerons are aluminum alloy riveted structures and are attached to the wing by forged aileron hinge brackets. A small metal trim tab is bolted to the left aileron trailing edge.

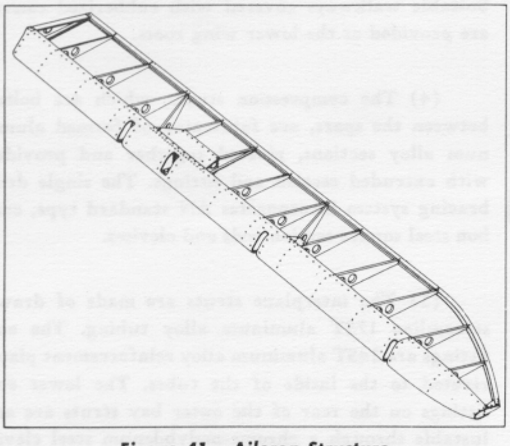


Figure 41—Aileron Structure

b. REMOVAL AND DISASSEMBLY.

(1) LOWER WING.—Prior to attempting removal of the lower wing panels, a suitable method of support must be provided to carry the weight of the upper wing panel. The following is a recommended procedure for removal of each lower wing panel.

(a) The aileron push-pull tube must be disconnected from the control stick interconnecting torque tube.

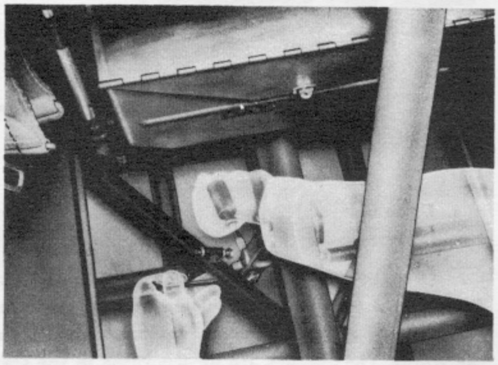


Figure 42—Aileron Push-Pull Tube Disconnect

(b) When removing the left lower wing panel the pitot tubing must be disconnected at the lower wing strut and at the forward wing attachment fitting.

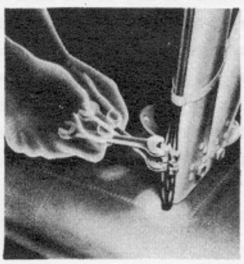


Figure 43—Pitot Tubing

(c) The wing wire stay should be removed and the front landing wire and both front and rear flying wires loosened to facilitate removal of the strut. The rear landing wire should not be loosened as it supports the weight of the lower wing.

(d) The connecting bolts should be removed from each lower wing strut fitting.

(e) The lower wing should be supported at the hand hole by an average man and both landing wires disconnected at their wing attaching point. After disconnecting the bonding and removing the nuts from the wing attaching bolts, accessible through

access doors on the underside of the wing, the wing should be moved slightly to facilitate removal of the bolts.

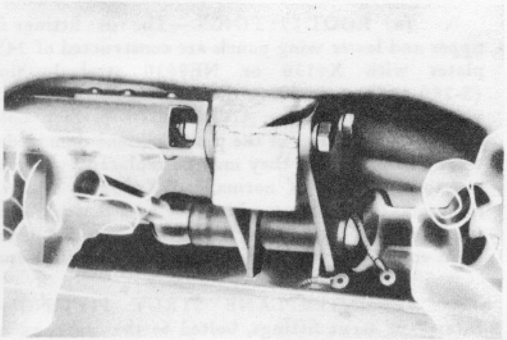


Figure 44—Rear Wing Root Connecting Bolt Removal

(2) UPPER WING.—The following is a recommended procedure for removal of each upper wing panel:

(a) The wing closure strip must be removed and all interwing wiring disconnected by sliding the transparent tubing off the quick disconnect and pulling the wires apart.

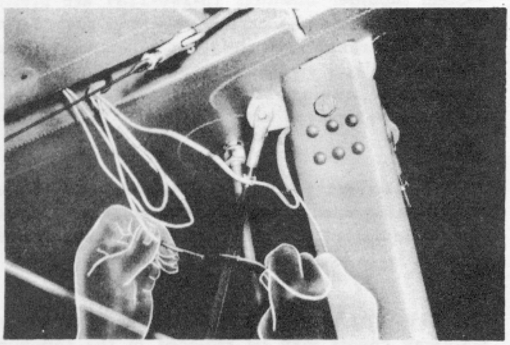


Figure 45—Disconnecting Interwing Wiring

(b) All bonding between the upper wing and the center section should be disconnected.

(c) Flying wires should be disconnected at the wing fittings.

(d) With two men supporting the wing panel, the strut attachment bolts and nuts from the wing attachment bolts may be removed. Slight movement of the wing facilitates removal of the wing attachment bolts.

Note

It is suggested that the struts be completely removed to avoid the possibility of damaging the strut fittings on the lower wing.

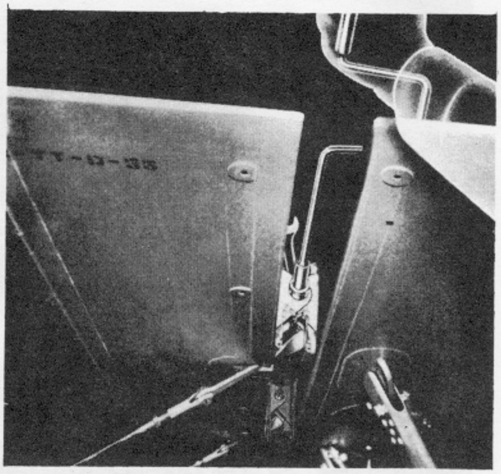


Figure 46—Removal of Upper Wing Connecting Bolts

(3) AILERON.

(a) All bonding between the aileron and lower wing panel should be disconnected and the aileron link bolt removed.

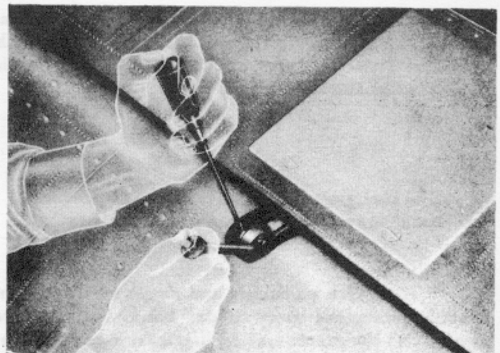


Figure 47—Aileron Link Bolt

(b) The aileron may be removed by detach-

ing the four aileron clevis nuts located on the underside of the aileron.

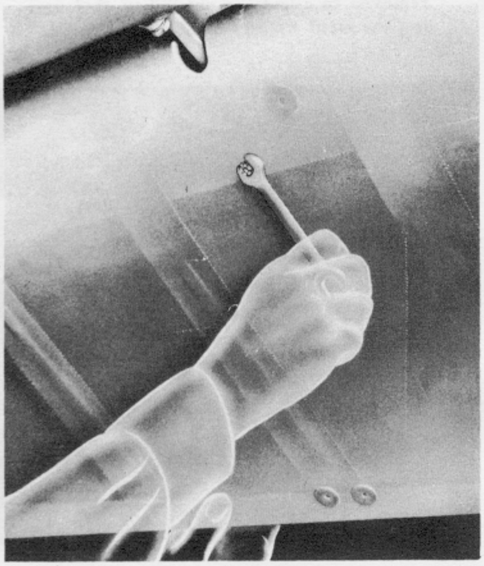


Figure 48—Aileron Clevis Nuts

(4) CENTER SECTION. — The outer wing panels of the upper wing should be removed prior to attempting removal of the center section. The following instructions are recommended procedure concerning removal of the center section.

(a) The fuel tank should be drained and all fuel lines disconnected from the underside of the center section. The pressure line should also be disconnected at the back of the venturi tube.

Note

The fuel gage should be removed to prevent breakage while removing the center section.

(b) With all tubing and rigging wires disconnected, interplane strut upper bolts should be removed and the center section lifted from the airplane.

Note

With the center section removed, the cabane struts should be removed to eliminate the possibility of damaging the strut fittings.

c. MAINTENANCE REPAIRS.

(1) FITTINGS.

(a) ROOT FITTINGS.—The root fittings for upper and lower wing panels are constructed of 24ST plates with X4130 or NE8630 steel bushings (S-280-12S) pressed into them. This type fitting provides pin joints using AN standard ½-inch bolts. Should the bushings in the plates become damaged or worn out-of-round, they may be replaced by slightly oversize bushings of normalized X4130 or NE8630 material. The bolts attaching the root fittings to the spars should be kept snug at all times but not drawn tight enough to fracture the wood fibers of the spar.

(b) INTERPLANE STRUT FITTINGS.—Interplane strut fittings, bolted to the spars, extend through the upper surface of the lower wing and the lower surface of the upper wing. These fittings are machined from 14S aluminum alloy forgings. If damaged in a crash, they may be straightened cold and should be closely inspected for cracks after straightening. Steel bushings (S-280-12S) are pressed into these fittings where the interplane strut bolts pass through them. If these bushings become worn or out-of-round, they may be replaced with X4130 or NE8630 steel bushings 1/32-inch oversize.

(2) STRUTS (CABANE AND INTERPLANE).—Steel shoulder bushings (S-280-12S) are pressed into the cabane and inerplane struts in such a way as to pass through both the strut tube and the reinforcement plates riveted to the inside of the tube. Should these bushings become worn or out-of-round, they may be replaced with bushings 1/32-inch oversize.

Attachment bolts for wing or strut fitting should be replaced with new bolts when any sign of wear is indicated. All nuts should be tightened only sufficiently to assure secureness.

(3) WALKWAY COVERS.—Excessively worn walkway covers may be replaced in the following manner:

(a) The binder strip on the outboard edge of the walkway must be removed and the old walkway cover taken off.

(b) Entire walkway surfaces should be thoroughly cleaned with gasoline.

Note

Any cement which cannot be removed with gasoline must be sanded until removed.

(*c*) Rubber cement conforming to AN Specification No. AN-C-54 is applied to the walkway surface and to the back side of the walkway cover.

(*d*) Both surfaces should be allowed to partially dry before placing the cover in its correct position.

(*e*) With cover in its proper position, the binder strip is reinstalled.

Note

The walkway should not be used until the cement has been allowed to dry over night.

(4) INTERPLANE WIRES.—Interplane wires showing signs of permanent set or wrench marks should be replaced by new wires.

d. INSTALLATION.—Installation of the wing panels to the airplane requires the use of no special tools or equipment; however, the wing panels must be installed in the following sequence, center section first, lower wing panels second and upper wing panels last.

The following procedure should be followed to facilitate installation of the individual wing panels:

(1) CENTER SECTION.

(*a*) With cabane struts connected, the center section should be lifted or hoisted into its correct position and strut attachment bolts installed.

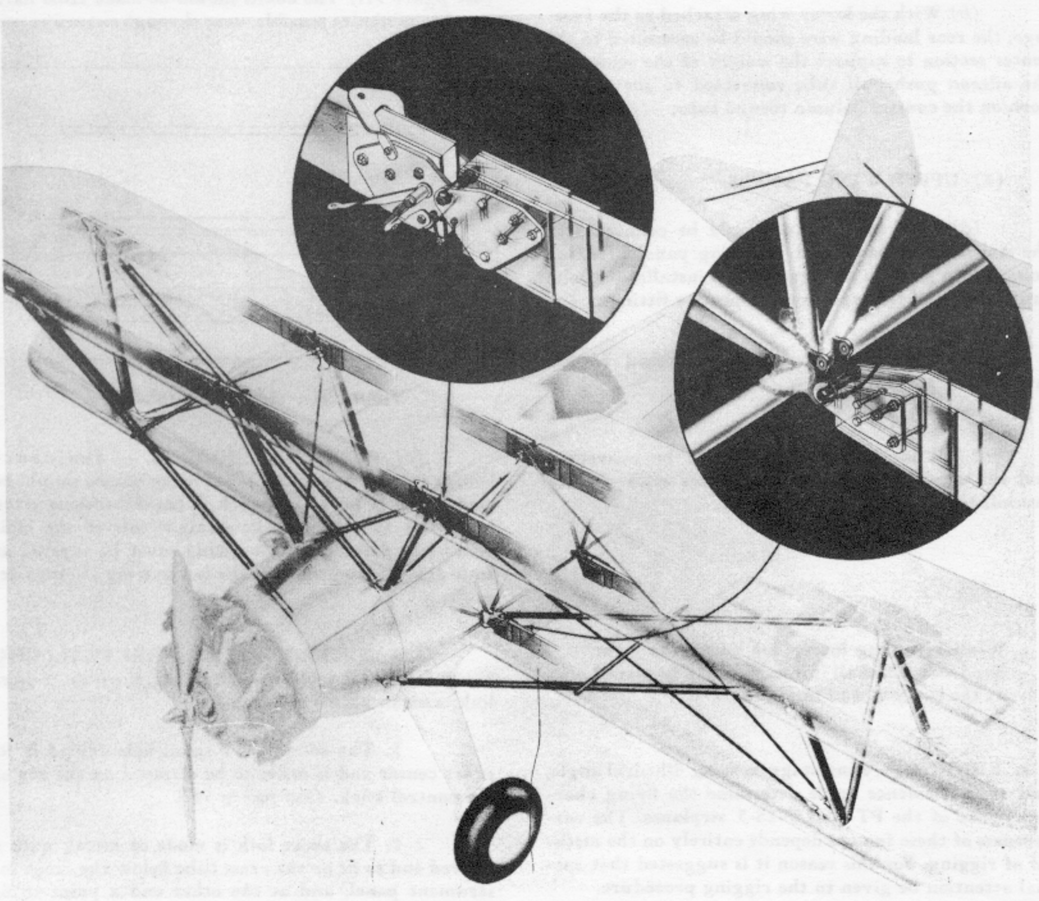


Figure 49—Wing Installation

(*b*) The drag, anti-drag and roll wires should be connected. Both anti-drag wires should be set for a pin-center distance of 38 inches. This will place the center section in an approximately correct position.

(2) LOWER WING PANELS.—In the event a new lower wing panel is being installed, the inboard aileron push-pull tube must be installed prior to installation of the wing panel to the fuselage. The push-pull tube attaches to an idler in the wing, accessible through an inspection door.

(*a*) The landing wires should be connected to the lower wing and the lower wing placed in position so that the two lower wing attachment bolts can be inserted.

(*b*) With the lower wing attached to the fuselage, the rear landing wire should be connected to the center section to support the weight of the wing and the aileron push-pull tube connected to the control horn on the control column torque tube.

(3) UPPER WING PANELS.

(*a*) The wing struts should be connected to the upper wing panel and the wing panel lifted or hoisted into position so that the two installation bolts can be inserted through their respective fittings.

(*b*) The struts should be attached to the lower wing strut fittings.

(4) All interplane wires should be connected and the airplane rigged in accordance with rigging procedure.

Note

When installing interplane wires, the right hand threads in all instances are to be placed at the lower end of the wire.

e. RIGGING.—Wing stagger, wing dihedral angle, and wing incidence angle determine the flying characteristics of the PT-13D/N2S-5 airplanes. The correctness of these factors depends entirely on the method of rigging. For this reason it is suggested that special attention be given to the rigging procedure.

(1) SPECIAL RIGGING TOOLS.—The following equipment should be used to rig the airplane.

(*a*) WIRE WRENCH.—To eliminate the possibility of scratching or nicking the steel brace wires, a wire wrench similar to the one shown in *figure* 50 should be used. Such a wrench can be fabricated by wedging a piece of wood approximately six inches long inside a piece of 1-inch pipe of equal length. A slot twice the thickness of the rear flying wire should be cut in each end of the pipe.

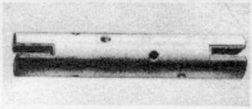
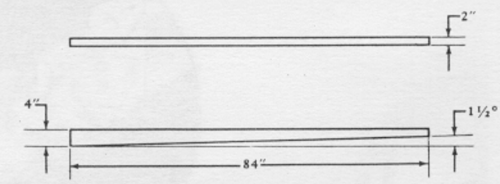


Figure 50—Wire Wrench

(*b*) DIHEDRAL BOARD.—A dihedral board can be fabricated of 2- by 4-inch stock seven feet long, with one edge tapered at a 1½ degree angle. *(See figure 51.)* The board should be made from hard wood to minimize possible wear through extensive use.



NAME OF PART	MATERIAL	STOCK
BOARD-DIHEDRAL	WOOD — HARD	2 x 4 x 84

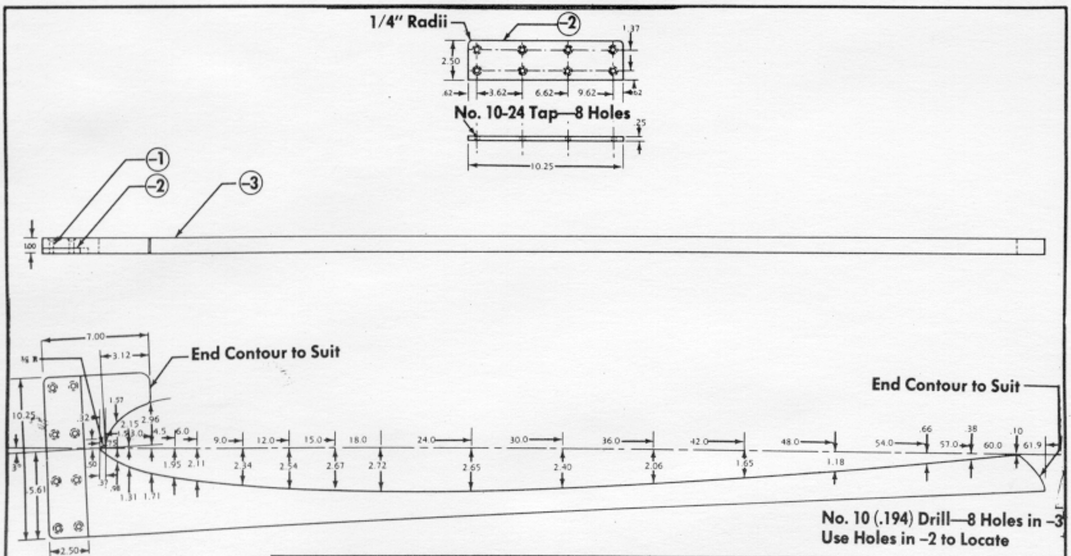
Figure 51—Wing Dihedral Board

(*c*) INCIDENCE BOARDS. — Incidence boards for the upper and lower wing panels should be made from 2- by 4-inch stock to the dimensions given in *figures 52 and 53*. The straight side of the incidence board for the upper wing must be tapered at four degrees, and that for the lower wing at three degrees.

(*d*) CONTROL STICK NEUTRALIZING TOOLS.—These tools comprise a metal collar, a short link, and an adjustable link.

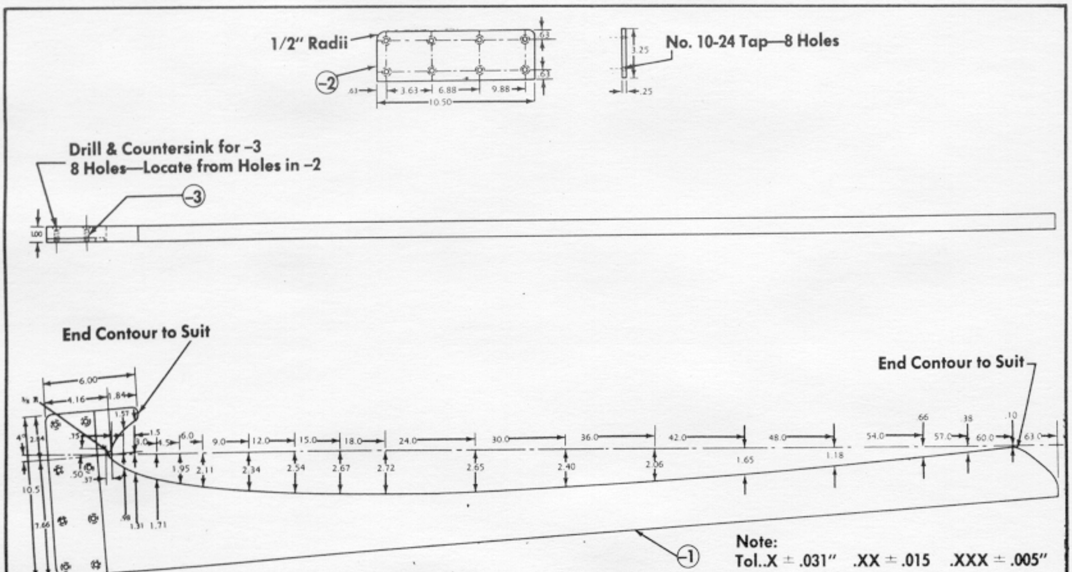
1. The collar has a small hole drilled in its exact center and is made to be clamped on the top of the control stick. *(See figure 55.)*

2. The short link is made of metal, with a curved end to fit on the cross tube below the front instrument panel, and at the other end a point to fit into the hole in the collar on the control stick. The short link is used in aligning the elevators with the stabilizer. *(See figure 55.)*



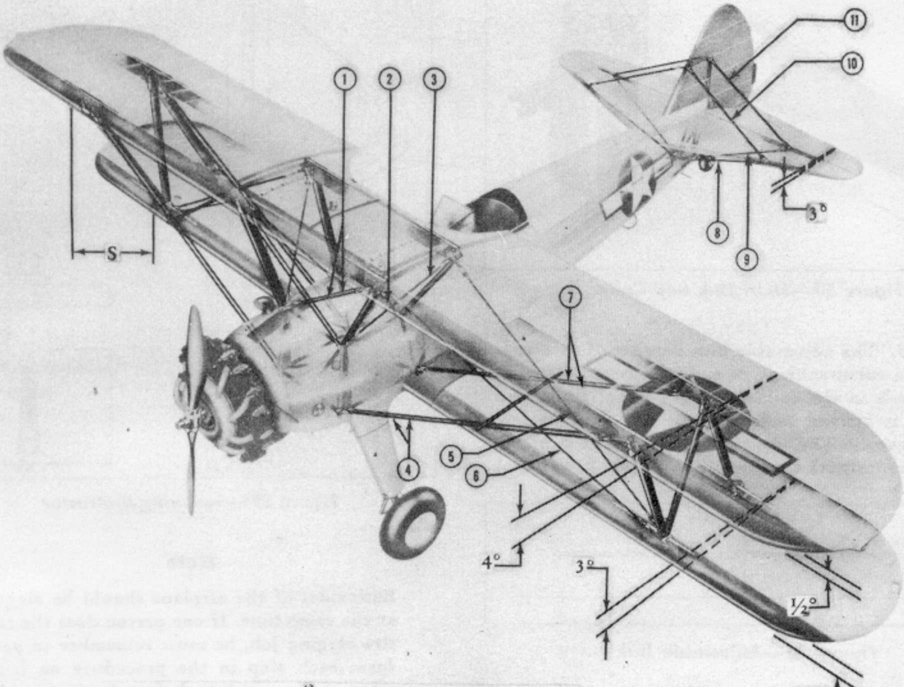
DASH NO.	NO. REQ'D	NAME OF PART	MATERIAL	STOCK
−3	1	Gauge	Maple	1"x10¼"x66"
−2	1	Plate	C. R. Steel	¼"x2½"x10¼"
−1	8	Flat Head Machine Screw	Stock	No. 10-24x1"

Figure 52—Lower Wing Incidence Board



DASH NO.	NO. REQ'D	NAME OF PART	MATERIAL	STOCK
−3	8	Flat Head Machine Screw	Stock	No. 10-24x1"
−2	1	Support	Alum.	¼"x10½"x3¼"
−1	1	Base Plate	Maple	1"x10½"x67"

Figure 53—Upper Wing Incidence Board



S-(STAGGER) = $26\frac{13}{16}'' \pm \frac{1}{8}''$ AT STRUT POINT

INDEX NO.	TIE ROD NO.	NOMENCLATURE	SIZE	TENSIOMETER READING		
				MINIMUM	NOMINAL	MAXIMUM
1	75-1001-1	Tie Rod—Center Section Roll	5/16-24-6100	1100	1250	1400
2	AN676AC-3575	Tie Rod—Anti-drag Cabane	3/8-24-8000	No Reqd. Load	No Reqd. Load	No Reqd. Load
3	AN675AC-3925	Tie Rod—Drag Cabane	5/16-24-6100	1200	1650	2100
4	AN675AC-12025	Tie Rod—Front Flying Wire	5/16-24-6100	750	850	950
5	AN675AC-8900	Tie Rod—Rear Landing Wire	5/16-24-6100	1500	1850	2200
6	AN675AC-9300	Tie Rod—Front Landing Wire	5/16-24-6100	1500	1750	2000
7	AN676AC-11925	Tie Rod—Rear Flying Wire	3/8-24-8000	1000	1200	1400
8	AN674A-3900	Tie Rod—Lower Front	1/4-28-3400	215	315	415
9	AN674A-3850	Tie Rod—Lower Rear	1/4-28-3400	235	335	435
10	AN673A-4425	Tie Rod—Upper Front	10-32-2100	200	300	400
11	AN673A-4675	Tie Rod—Upper Rear	10-32-2100	200	300	400

Figure 54—Rigging Diagram

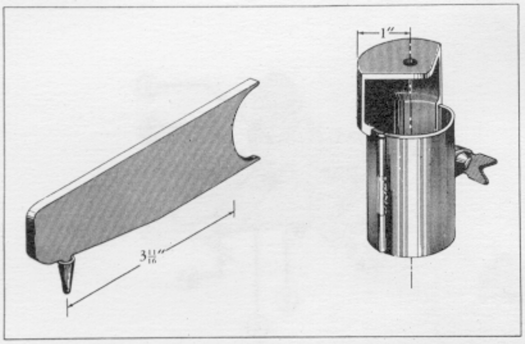


Figure 55—Short Link and Collar

3. The adjustable link consists of two rods joined by a turnbuckle. One end is constructed to fit into the hole in the collar on the control stick, and the other is curved to hook over the right or left upper longerons. The adjustable link is used in aligning the ailerons with the lower wings. *(See figure 56.)*

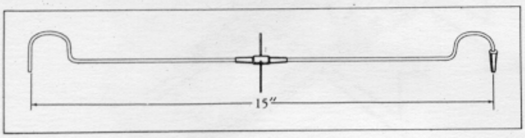


Figure 56—Adjustable Link

(e) TENSIOMETER.—A tensiometer conforming to AAF drawing No. 32A2148 should be used to check tensions on the wing and interplane wires.

Note

A tensiometer *must* be used to rig the airplane properly.

(f) LEVEL BAR.—A level bar should be made from metal suitable to maintain a squareness within close tolerance. This bar should be notched in four places to allow clearance of the floorboard edges and the storage battery bracket rods, when used on the lateral leveling lugs. *(See figure 58.)*

(g) SWINGING PROTRACTOR.—A swinging protractor similar to the one shown in *figure 57* should be used to check the aileron and elevator travel.

(h) MISCELLANEOUS EQUIPMENT.—Adjustable jacks, plumb bob lines, a 25-foot steel tape, a 36-inch scale, a level protractor, and a conventional spirit level are the additional necessary equipment required to rig the wing bays on this airplane properly.

(2) RIGGING PROCEDURE.—With wing panels and center section installed, the following rigging instructions should be adhered to.

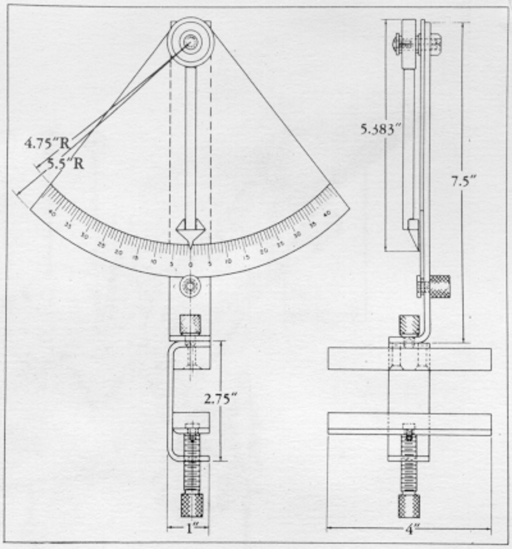


Figure 57—Swinging Protractor

Note

Both sides of the airplane should be rigged at the same time. If one person does the entire rigging job, he must remember to perform each step in the procedure on both sides of the airplane before beginning the next step.

(a) LEVELING.

1. A close fitting wooden block should be placed between the torque links of the main gear shock struts.

2. An adjustable jack should be placed beneath each main landing gear axle jack point.

Note

If the landing gear is removed, jacks are placed under the wing jack points, or under a suitable substitute support.

3. An adjustable jack should be placed beneath the rear jack point located immediately forward of the tail wheel.

4. The storage battery, if installed, must be removed to provide access to the leveling lugs.

5. The leveling bar should be placed on the leveling lugs provided on the lower longerons immediately aft of station number 1. *(See figure 58.)* A spirit level should be placed on top of the leveling bar and the airplane leveled transversely by adjusting the jacks under the main landing gear or wings, or under the substitute support.

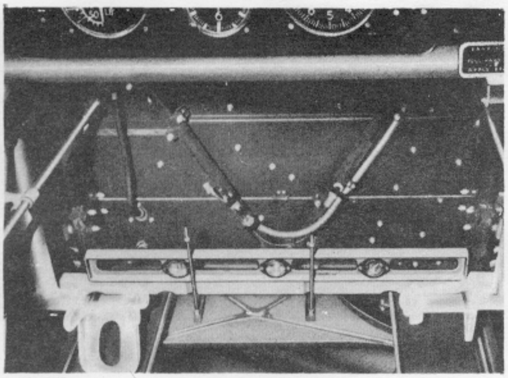


Figure 58—Transverse Leveling

6. The spirit level should be placed on the leveling lugs provided on the lower fuselage cross tubes at stations 1 and 2 and the airplane leveled longitudinally by adjusting the jack beneath the rear jack point. *(See figure 59.)*

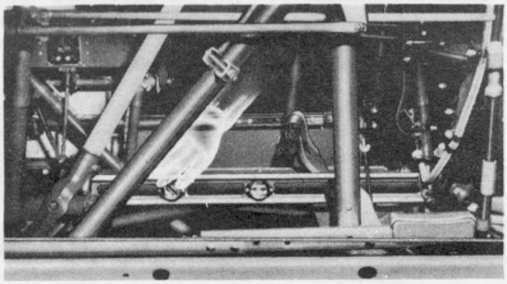


Figure 59—Longitudinal Leveling

(b) CENTERING.—The center section should be centered by hanging a plumb bob over the outboard side of each front upper wing attachment bolt bushing and the distance measured from the fuselage box tube to the plumb bob line. This distance, 23 inches (± 1/32), must be equal (± 1/16) on each side of the fuselage. Location of the center section is controlled with two sets of roll wires having two wires each, both of which must have equal tensions (± 150 pounds). Correct roll wire tensions are 1100 minimum, 1250 nominal, and 1400 pounds maximum. *(See figure 60.)*

CAUTION

Wire wrenches only *(figure 50)* are to be used to tighten or loosen rigging wires. The use of pliers or other conventional wrenches will cause damage which may lead to failure of the wires.

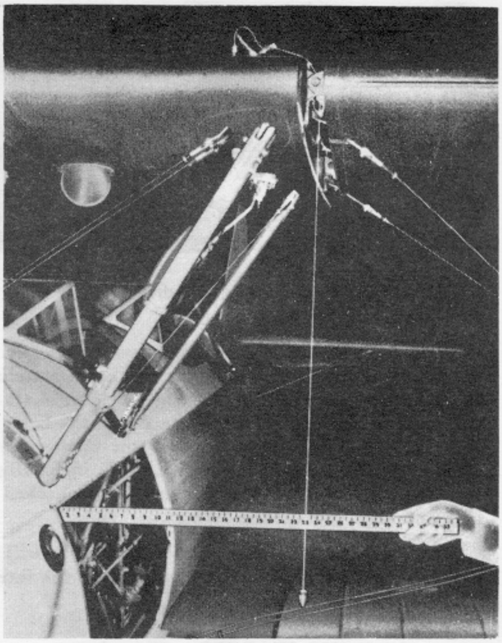


Figure 60—Center Section Centering

Note

To obtain equal roll wire tensions within the specified tolerances, it is often necessary to quarter a roll wire by removing the clevis pin from an attaching clevis and running the clevis up ½ turn.

(c) DIHEDRAL SETTING.—The correct dihedral angle is set by placing the dihedral board on top of the lower wing with the small end of the board toward the wing tip. A spirit level should be placed on top of this board and the rear landing wire adjusted until level reading is obtained. *(See figure 61.)*

Note

The rear landing wire at this point will be supporting the weight of the lower wing and all other wing wires should be completely slack.

Adjustment of the lower wing to the correct dihedral angle will automatically set the upper wing at the correct angle.

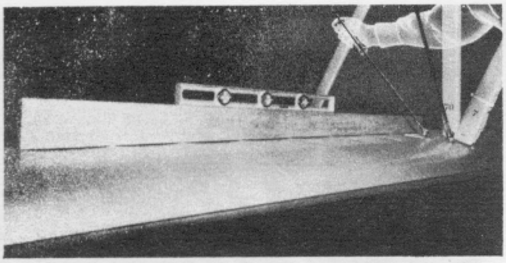


Figure 61—Wing Dihedral Check

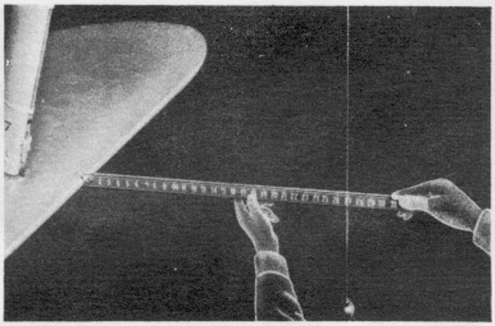


Figure 62—Wing Tip Stagger Check

(d) SQUARENESS CHECK.—Squareness of the lower wing panels should be checked by scaling the distance from the center of the propeller shaft at the front of the engine to the centers of the bolts at the right- and left-hand lower front strut points. These distances should be equal within 3/8 inch. Alignment of the lower wing panels should be checked if this tolerance is exceeded.

If a wing panel is "out-of-square" it will be necessary to re-rig the panel by adjusting the internal brace wires.

(e) WING STAGGER.—The wing stagger is determined by hanging a plumb bob over the leading edge of the upper wing directly in line with the strut point and measuring the distance from the leading edge of the lower wing to the plumb bob line. This distance must be 26-13/16 (± 1/8) inches. *(See figure 62.)*

Note

Stagger should be 26-9/16 (± 1/8) inches with upper spoiler strip removed.

If the wing stagger is too great, the anti-drag wire should be tightened and the drag wire loosened the same number of turns until the measurement is within the specified tolerance. If the wing stagger is too small, the procedure should be reversed; that is, tighten the drag wire and loosen the anti-drag wire. After the strut point stagger has been set, the drag wires should be checked for 1200 minimum, 1650 nominal, and 2100 maximum pounds tension. No tensiometer reading is required for the cabane anti-drag wires.

CAUTION

After the correct tension for the drag wires has been obtained, the drag and anti-drag wires must not be moved during the remainder of the rigging procedure.

(f) LANDING AND FLYING WIRE ADJUSTMENT.—The rear landing wire and the rear flying wires form the rear bay and pull against each other. If either the landing wire or the flying wires are tightened in either the front or the rear bay, the remaining wire or wires will increase in tension. The strut arrangement between the upper and lower wings is stationary, and any movement of either wing by necessity moves the other wing. With these basic ideas in mind, the procedure is as follows:

1. The rear landing wire should be tightened six or seven half turns. This will pull the lower wing up, making the dihedral angle too great. This is counteracted by tightening the rear flying wires to their correct tension of 1000 pounds minimum, 1200 nominal, 1400 maximum. Since the flying wires are attached to the fuselage, this pulls the upper wing tip down and corrects the dihedral of both wings, as well as giving the rear landing wires their proper tension of 1500 pounds minimum, 1850 nominal, 2200 maximum.

2. All wires in the front bay should be tightened "hand-snug" and then the front flying wires rigged to a tension of 750 pounds minimum, 850 nominal, 950 maximum.

3. Step 2 should automatically set the front landing wire to within its tolerance of 1500 pounds minimum, 1750 nominal, 2000 maximum. If these tolerances are exceeded, the front flying and landing wires must be adjusted until all front bay wires are within tension tolerance.

4. The strut point stagger should be rechecked as outlined in paragraph *(e)*. If the stagger is not within the specified tolerance, it should be corrected by adjusting the front flying wires and front landing wire. The upper wing may be moved forward by tightening the front flying wires and may be pulled aft by tightening the front landing wire. In either case, the corresponding wire or wires should be loosened the same number of half turns to maintain the proper tension on all wires in the front bay.

CAUTION

When only one wing has been replaced and that side of the airplane has been rigged, it is necessary to check tension on all wing wires on the oposite side of the airplane. If tensions are not within specified tolerances, the wing should be re-rigged.

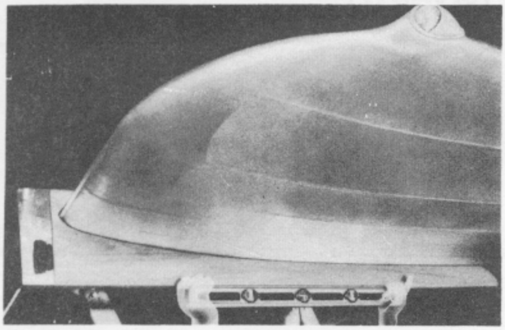


Figure 63—Upper Wing Incidence Check

(*g*) INCIDENCE SETTING.

1. The upper wing incidence angle should be checked by placing the upper incidence board, with a spirit level on its under side, directly under the first rib outboard of the strut fitting. *(See figure 63.)* If the incidence angle is too great, the rear flying wires must be loosened; if the angle is too small, the rear flying wires must be tightened. The incidence is correct when a level reading is obtained.

CAUTION

When it is necessary to correct the incidence angle, the tension of the rear landing wire must be rechecked after adjusting the front flying wires.

2. The lower wing incidence angle should be checked by placing the lower incidence board, with a spirit level on its under side, directly under the first rib outboard of the strut fitting. This angle should be corrected by adjusting the rear strut length at its lower fitting. *(See figure 64.)*

Note

After the wing incidence angle is set, the lock nut must be secured.

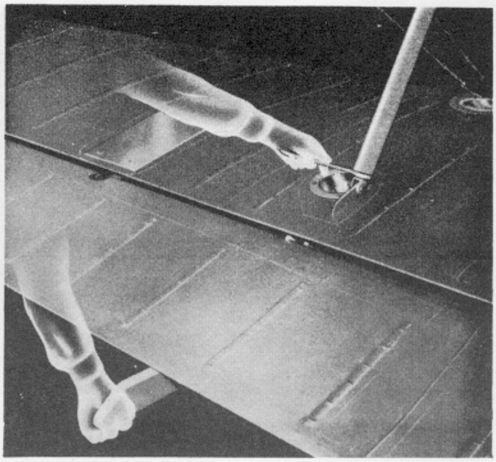


Figure 64—Lower Wing Incidence Check

(*h*) AILERON ADJUSTMENT.

1. The control sticks should be placed in an absolutely neutral lateral position. This is accomplished with the use of the control stick collar *(figure 55)*, the adjustable link *(figure 56)*, and a small level protractor. See *figure 65* for correct application of these tools.

Note

Since the wooden control stick is turned with a slight taper, it will be necessary to set the level protractor at ½ degree to compensate for the taper of the stick.

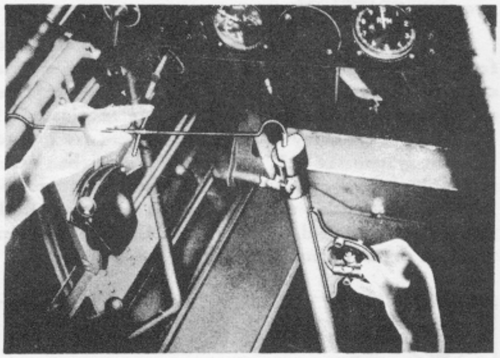


Figure 65—Neutralizing Stick for Aileron Adjustment

2. With the control stick clamped in a neutral position, the eyebolt on the inboard end of the aileron push-pull tubes should be adjusted until the ailerons are in a neutral position. *(See figure 66.)* The lock nut should then be tightened.

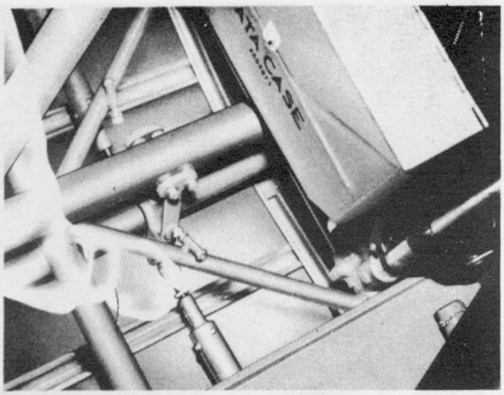


Figure 66—Trimming Aileron With Wing

3. The swinging protractor *(figure 57)* should be attached to one of the ailerons, and the stop bolts which limit the movement of the horn on the interstick torque tube should be adjusted to give twenty-three degrees of upward aileron travel. The adjustment is correct when the maximum upward travel is 6⅛ inches, measured from the trailing edge of the wing to the trailing edge of the inboard end of the aileron. Setting the upward travel automatically adjusts the downward travel. The lock nuts on the stop bolts must be tightened *(figure 66)* and the clamps removed from the control sticks.

2. TAIL GROUP.

a. DESCRIPTION.

(1) All units of the empennage are constructed from chrome-molybdenum steel tubing with fabric covering. Leading edges, trailing edges, and root ribs of the elevators, stabilizer, and fin are fabricated of 24ST aluminum alloy sheet. Tail surfaces are braced by two systems of AN standard type carbon steel streamline wires, one in the plane of the front stabilizer spar and one in the plane of the rear spar. Both systems are attached to the fin, stabilizer, and lower fuselage truss through concentric welded lugs.

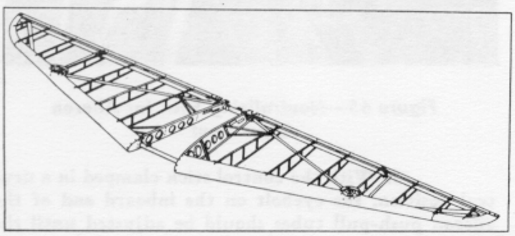


Figure 67—Stabilizer Structure

(2) The stabilizer is constructed as a unit and attached to the fuselage with four AN standard bolts passing through four forged chrome-molybdenum steel lugs. The stabilizer is of an unsymmetrical section with maximum camber on top. *(See figure 67.)*

(3) The elevators are symmetrical right- and left-hand units hinged to the trailing edge of the stabilizer. They are bolted together at the plane of symmetry, with a forged aluminum alloy control horn installed at their joining point. *(See figure 68.)*

(4) Wooden trim tabs, controllable in flight, are inset in the inboard trailing edges of the elevators. *(See figure 68.)*

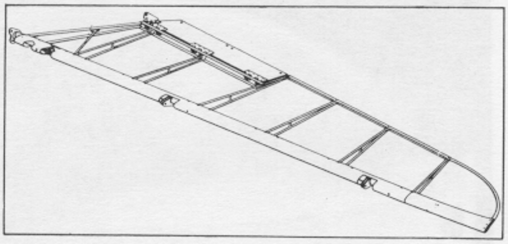
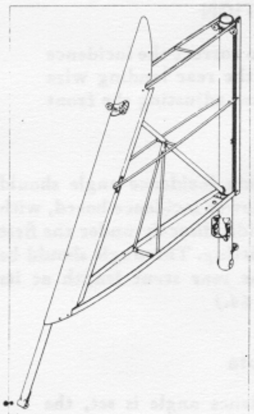


Figure 68—Elevator Structure

(5) The fin is similar in construction to the stabilizer, and is bolted to the upper fuselage truss and supported by brace wires. *(See figure 70.)*

(6) The rudder frame and mast are welded into an integral unit, with a small metal trim tab attached to the trailing edge of the rudder to afford ground adjustment to overcome "yaw." *(See figure 69.)*

Figure 69— Rudder Structure →



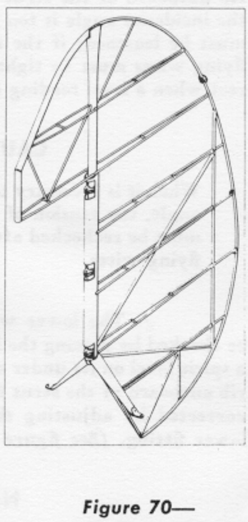


Figure 70— Fin Structure ←

b. REMOVAL AND DISASSEMBLY.

(1) RUDDER.

(a) The tail wheel side cowling and the stabilizer cowling must be removed to provide access to the disconnect in the rudder light cable assembly.

(b) The rudder light cable may be disconnected by sliding the transflex tubing back and pulling the connection apart.

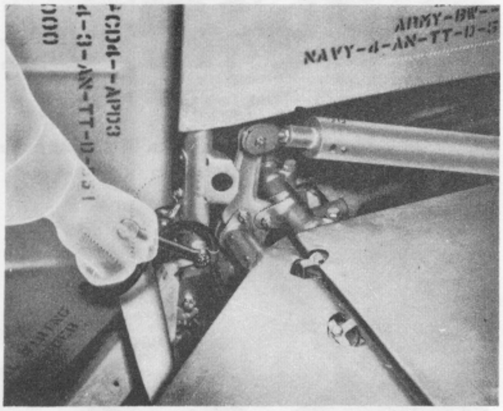


Figure 71—Cable Clamp Nut

(c) The ferrule nut, which attaches the rudder conduit assembly to the bracket provided on the fuselage structure, and the cable clamp on the fin post must be removed before attempting removal of the rudder. *(See figure 71.)*

Figure 72—Fin and Rudder Connecting Bolts

(d) Tension of the rudder control cables should be released and the cables disconnected from the rudder horn.

(e) Bonding should be disconnected between the fin and rudder and the rudder installation bolts removed. *(See figure 72.)*

(2) FIN.—The rudder should be removed prior to removal of the fin; however, the fin and rudder may be removed as a unit. Removal of the fin and rudder as a unit requires the disconnection of control cables, electrical wiring, and bonding as set forth in rudder removal, in addition to the following removal procedure for the fin assembly.

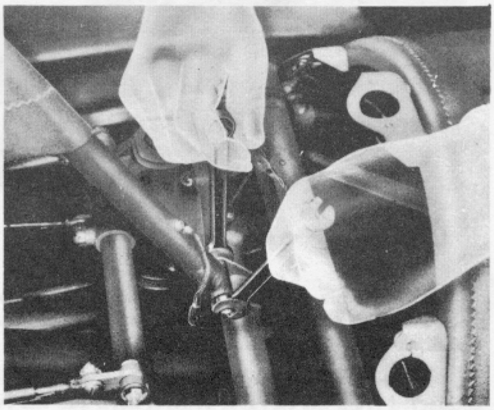


Figure 73—Front Fin Bolt Removal

The fin assembly is removed in the following manner:

(a) Brace wires are disconnected from the fin and the three-way bonding connection disconnected immediately forward of the front fin bolt.

(b) The front and rear fin bolts are now removed. The rear fin bolt also attaches the rudder light cable clamp referred to in rudder removal. *(See figure 73.)*

(3) STABILIZER AND ELEVATOR.—The stabilizer and elevators are usually removed as a unit; however, they may be removed separately. The fin assembly must be removed to permit removal of the stabilizer assembly.

The following procedure is for the removal of elevator and stabilizer as a unit:

(a) The lower stabilizer brace wires should be disconnected and tension relieved in the trim tab control cables by loosening the turnbuckles.

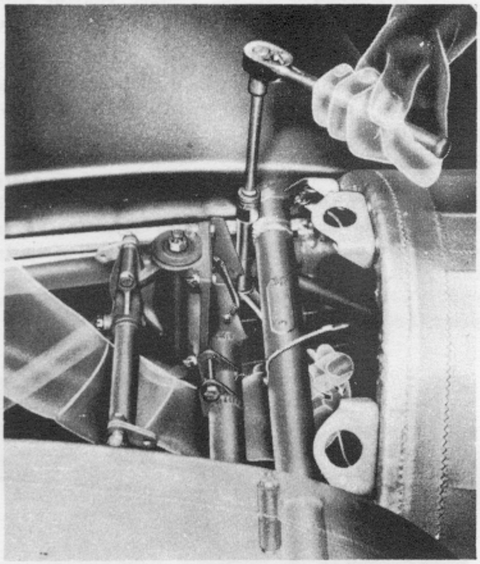


Figure 74—Removal of Front Stabilizer Bolts

(*b*) Trim tab control cables should be disconnected at the tab control mechanism and the front stabilizer installation bolts removed. (*Figure 74.*)

(*c*) The elevator push-pull tube must be disconnected from the elevator control horn and the two rear stabilizer attachment bolts removed. (*See figure 75.*)

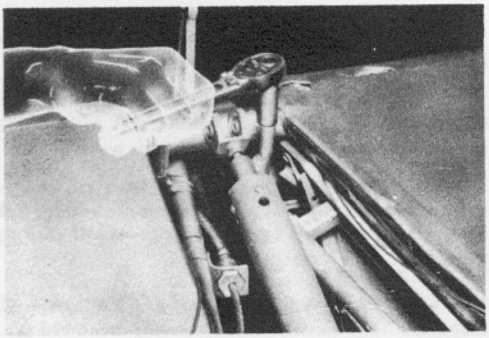


Figure 75—Rear Stabilizer Bolt Removal

(4) ELEVATORS.—Each elevator may be removed as a separate unit in the following manner:

(*a*) With cable tension released, the trim tab control cables should be disconnected and the trim tab cable pulley, located on the underside of the stabilizer, removed. (*See figure 76.*)

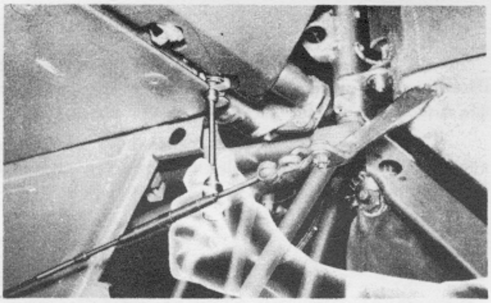


Figure 76—Trim Tab Cable Pulley

(*b*) The elevator upper horn bolt must be removed. (*See figure 77.*)

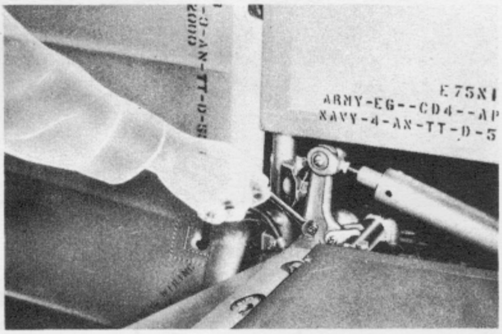


Figure 77—Upper Elevator Horn Bolt Removal

(*c*) The elevator lower horn bolt must be removed. (*See figure 78.*)

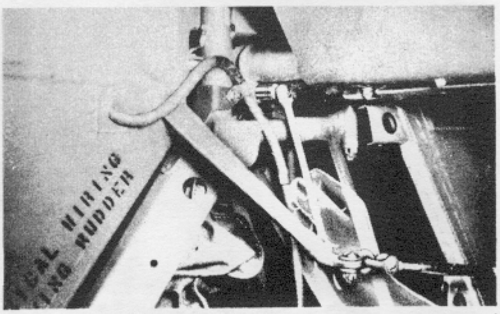


Figure 78—Lower Elevator Horn Bolt Removal

(*d*) All bonding should be disconnected and the three bolts connecting the elevator and stabilizer removed. (*See figure 79.*)

(*e*) The elevator may then be removed. Care should be taken when removing the elevator from the stabilizer to see that the trim tab control cable

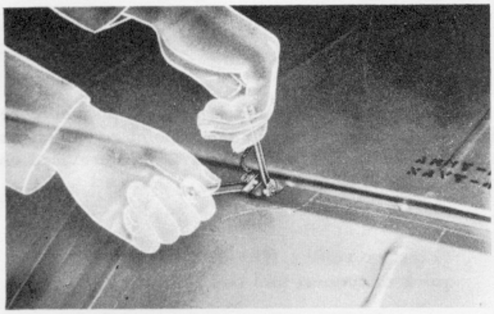


Figure 79—Elevator Hinge Bolts

does not tear the fabric as it is pulled from the stabilizer. Since the elevators are two separate symmetrical units, the removal procedure is identical for both sides.

(5) TRIM TABS.—The following procedure outlines the steps necessary in removing the trim tabs while the elevator is installed on the airplane.

(a) The elevator trim tab control cable turnbuckle should be loosened to relieve cable tension, and the cable then removed from the trim tab at the tab fitting.

(b) The trim tab hinge pin is removed allowing removal of the tab. *(See figure 80.)*

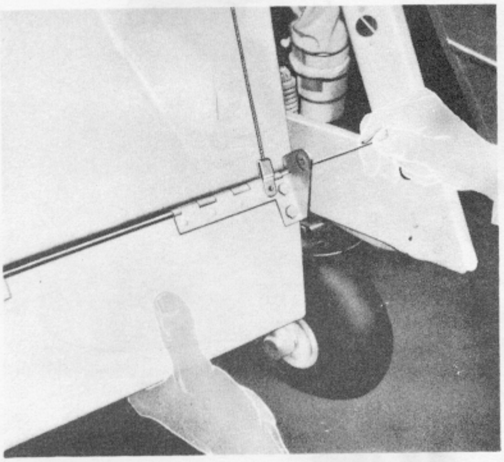


Figure 80—Trim Tab Hinge Pin

c. INSTALLATION.

(1) STABILIZER AND ELEVATOR. — The stabilizer and elevators are most commonly removed and installed as a single unit in the manner listed below.

(a) Before setting the unit in place on the fuselage, the upper and lower brace wires should be attached to their respective stabilizer fittings.

(b) With the stabilizer unit in place, two 1/16-inch steel washers (AN960-616) are placed between the stabilizer attachment fittings and the fittings on the fuselage frame, and the attachment bolts are installed. To facilitate installation and inspection, the front stabilizer bolts should be installed with the nuts up and the rear bolts installed with the nuts down.

(c) The bonding jumpers should then be attached and the lower brace wires secured.

(d) The elevator push-pull tube is attached to the elevator control horn and adjusted in accordance with the empennage rigging procedure, paragraph *d*, following.

(e) Trim tab control cables should then be connected at the trim tab control mechanism.

(2) ELEVATOR.—Individual elevators may be joined to the stabilizer and opposite elevator in the following manner:

(a) Elevator hinge bolts are installed and the bonding at the hinge point connected.

(b) The control cable pulley should be reinstalled on the stabilizer. The trim tab control cables should be inserted through the openings in the root ribs, passed over the pulleys, and threaded through the elevator fabric.

Note

To facilitate the above operation, wires may be attached to the ends of the cables to aid in directing the cables through the holes provided.

(c) Bolts attaching the elevator to the control horn should be installed.

(d) Trim tab control cables are attached and rigged in accordance with empennage rigging procedure described in paragraph *d*, following.

(3) FIN.—The fin assembly may be installed in the following manner:

(a) With the fin in position, the forward and aft attaching bolts should be installed and the brace wires connected.

Note

The rear fin attaching bolt also holds the tail wheel cowl in place. It is therefore necessary to install this cowl before the bolt is set and safetied.

(*b*) The bonding at the front attachment fitting should be connected and the fin brace wires rigged to proper tension as described in the rigging procedure set forth in paragraph *d*, following.

(4) RUDDER.—With the fin in place and properly rigged, the rudder is installed in the following manner:

(*a*) The three rudder attachment bolts are installed and the bonding at each hinge point attached.

Note

The bearing in the rudder hinge fitting on the fin assembly should be inspected and, if found to be worn or excessively pitted, it should be removed and a new bearing pressed in place.

(*b*) The rudder tail light conduit should be clamped at the aft fin attachment point and the light cable connected at the bracket assembly provided on the fuselage frame.

Note

Transflex tubing should be slid over the quick disconnect and tied in place.

(*c*) Cables should now be attached to the rudder horns and rigged to the proper cable tensions described below.

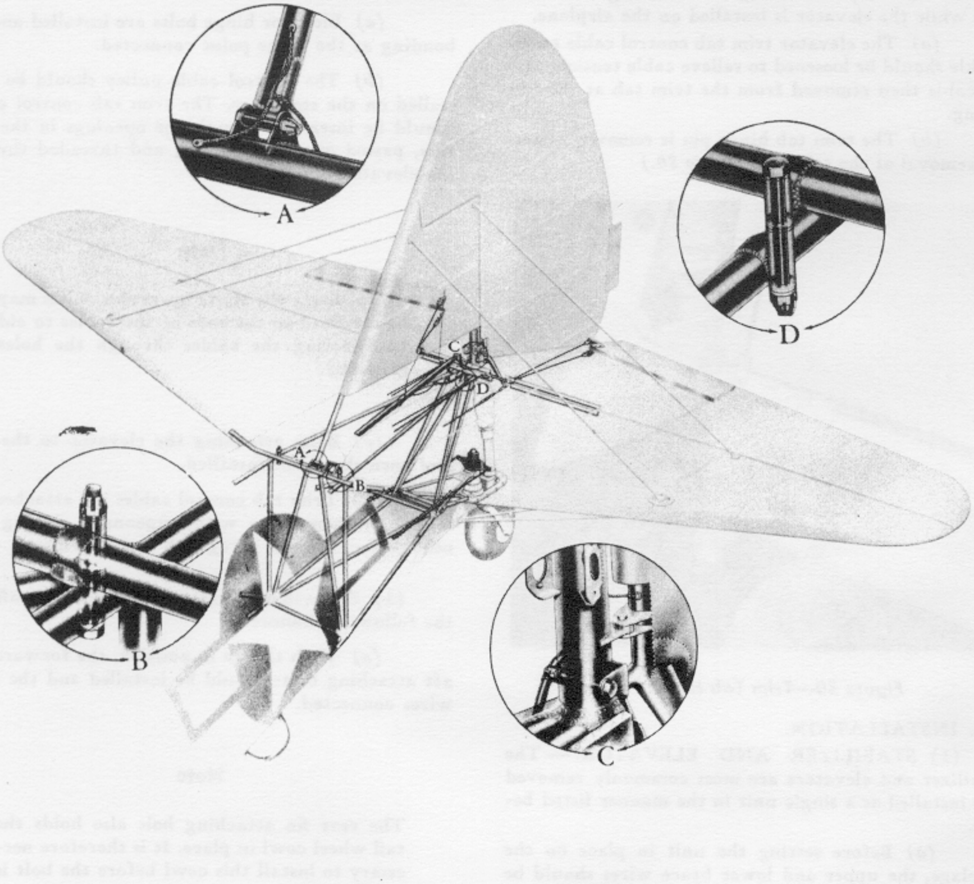


Figure 81—Empennage Installation

d. RIGGING.—Before attempting the empennage rigging, the airplane must be leveled according to the procedure found under wing rigging, section IV, paragraph 1,*e.*(2).

(1) The upper and lower brace wires should be tightened snug with the hands only.

(2) The stabilizer should be leveled with a conventional spirit level placed on the two elevator bearing fittings. *(See figure 82.)* Both sides of the stabilizer should be checked. Leveling is accomplished by adjusting the upper and lower rear brace wires.

CAUTION

Wire wrenches only *(see figure 50)* are to be used to tighten or loosen rigging wires. The use of pliers or other conventional wrenches will cause damage which may lead to failure of the wires.

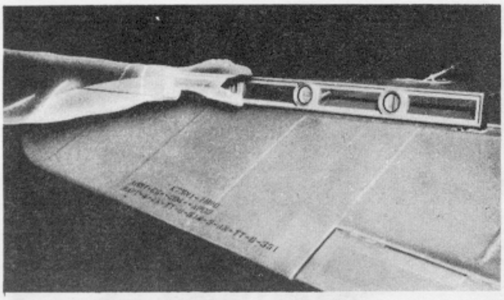


Figure 82—Stabilizer Leveling

(3) The fin should be leveled vertically. *(See figure 83.)* This adjustment is made with the upper rear brace wires.

(4) The fin and rudder should be clamped together and visually aligned with the center section spar stiffener by adjusting the upper front brace wires. The clamp is then removed.

(5) The upper front brace wires should be adjusted to a pin center length of 45¾ inches. The lower front wires should be adjusted to a length of 40⅞ inches.

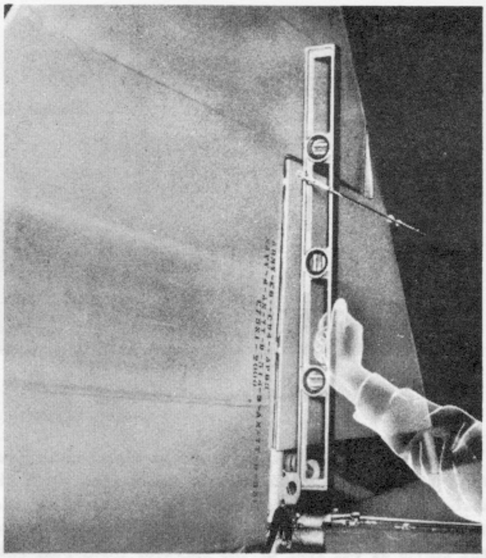


Figure 83—Fin Leveling

(6) The tension of the empennage brace wires should be checked with a tensiometer. The upper wires should have a tension of 200 to 400 pounds; the lower front wires, 215 to 415 pounds; the lower rear wires, 235 to 435 pounds.

(7) ELEVATOR ADJUSTMENT.

(a) The control sticks should be neutralized longitudinally by the use of the collar and short link, as shown in *figure 84.*

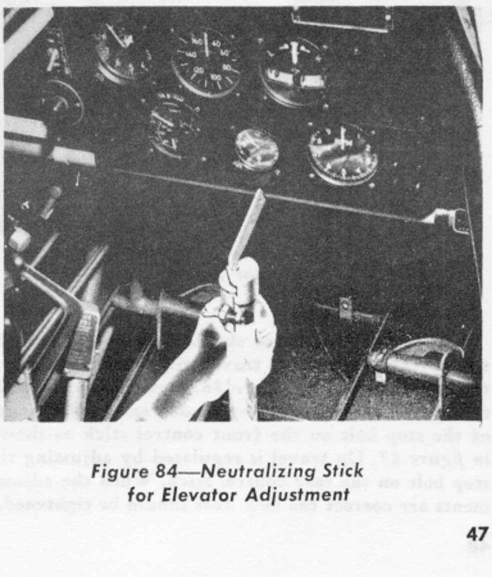


Figure 84—Neutralizing Stick for Elevator Adjustment

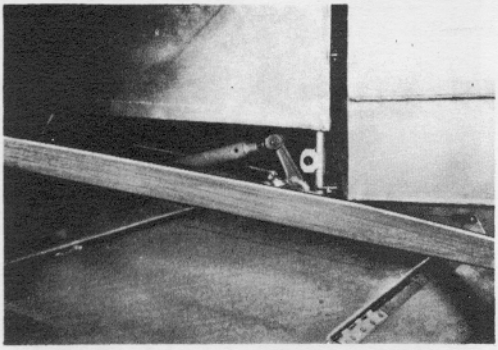
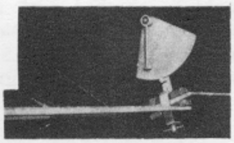


Figure 85—Elevator Trimming

(b) With the control sticks clamped in neutral position, the elevator is to be aligned with the stabilizer by placing a straightedge on top of the elevator and stabilizer parallel to the fin and adjusting the clevis at the rear of the elevator push-pull tube until the straightedge indicates alignment of the surfaces. *(See figure 85.)* The lock nut should then be tightened.

Figure 86— Elevator Travel Check



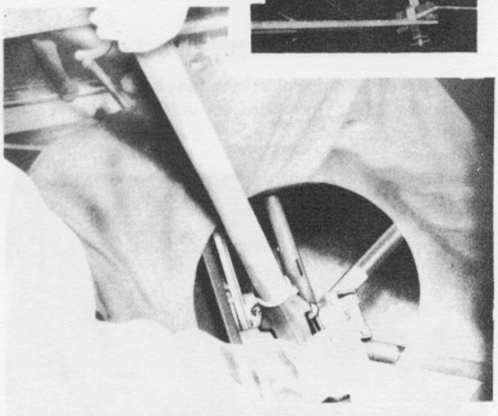


Figure 87—Elevator Travel Adjustment

(c) The elevator should be checked for 28° up travel and 22° down travel with the swinging protractor as shown in *figure 86*. Down travel adjustment is made by increasing or decreasing the length of the stop bolt on the front control stick as shown in *figure 87*. Up travel is regulated by adjusting the stop bolt on the rear control stick. When the adjustments are correct the lock nuts should be tightened.

(8) RUDDER ADJUSTMENT.

(a) A wooden block 3-11/16 inches in length should be placed between the front of each rudder pedal rack and the phenolic stop block located on the buss cable pulley brackets. The rudder buss cable should be tightened to hold the pedal racks against the wood blocks.

Note

After rigging, all cables in the system should have not more than three threads out or twelve threads in at either end of the turnbuckle barrels.

(b) The turnbuckles at the rudder control horns should be adjusted to obtain visual alignment of the rudder with the fin and with the center section stiffener over the fuel tank. *(See figure 88.)* The wooden stop blocks should then be removed.

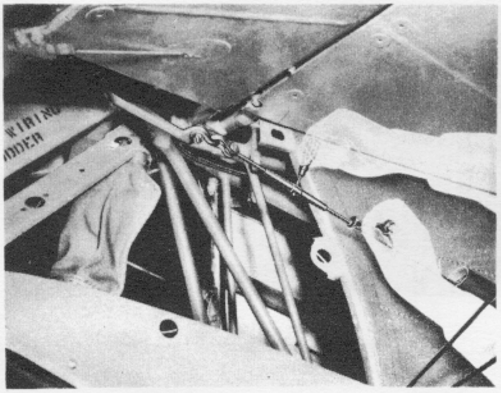


Figure 88—Rudder Adjustment

(c) Rudder travel should be checked for 30 degrees, or 17 inches at the trailing edge, on each side of the neutral position.

(d) The rudder control cables should be checked for a tensiometer reading of 60 to 80 pounds.

(e) The tail wheel control cables should be tightened and checked for a tensiometer reading of 35 to 45 pounds.

(9) TRIM TAB ADJUSTMENT.

(a) Both cockpit trim tab control handles should be set at zero, and the turnbuckles located aft of the tab control non-reversing mechanism adjusted to obtain visual alignment of the trailing edges of the tabs and elevators.

(b) Correct trim tab travel of 15 degrees, or 1⅛ inches, in each direction may be obtained by filing the tab control horns as necessary.

(c) The trim tab control cables should be checked for a tensiometer reading of 10 to 15 pounds.

e. MAINTENANCE REPAIRS.—Only minor maintenance repairs may be accomplished on the empennage without affecting structural members; therefore, maintenance personnel should refer to the structural repair manual for this airplane before repairing any internal damaged members of the empennage.

Minor repairs consist of replacing damaged or broken brace wires and keeping all drain holes free from obstruction.

3. BODY GROUP.

a. DESCRIPTION.

(1) The body group consists of the fuselage frame structure with all cowling and fairing.

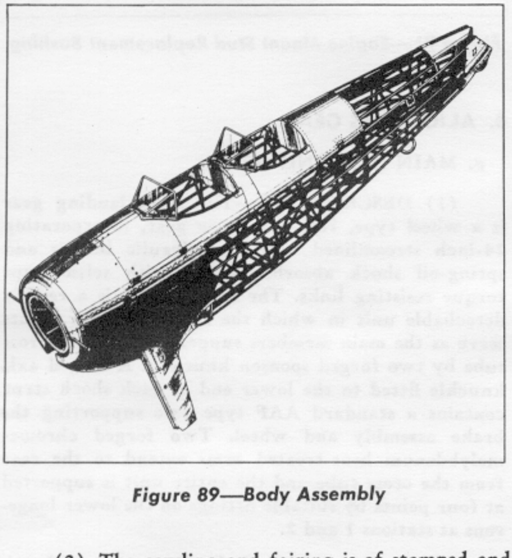


Figure 89—Body Assembly

(2) The cowling and fairing is of stamped and drawn aluminum alloy sheet. Cowling is suitably reinforced and provided with Dzus fasteners or screws for attachment. Aluminum alloy stringers and arches are riveted together and bolted to clamps

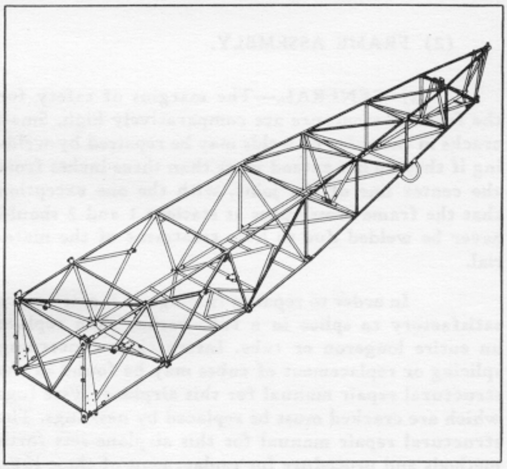


Figure 90—Fuselage Frame Assembly

attached to the fuselage structure to form fuselage fairings over which fabric covering is applied.

(3) The fuselage structure is of welded chrome-molybdenum steel tubing with fittings for attachment of the landing gear, lower wing, cabane struts, and flying wires provided as an integral part of the fuselage structure.

b. MAINTENANCE REPAIRS.

(1) COWLING AND FAIRING. — Should cracks develop in the cowling or fairing, it is recommended that the crack be stopped by drilling a small hole approximately 1/16-inch in diameter through the cowling at the end of the crack. Care must be exercised to make sure that the hole clears out the end of the break and that it is round and smooth. To reinforce the area around the crack, a patch of suitabe size may be riveted or spot welded in place over the crack. Repair of this type must be used only on non-structural members.

Note

Due to heat treatment of cowling, torch welding should not be attempted.

Careful check should be made at various inspection periods to ascertain that fairing around lift handles maintains the proper contour. Should this fairing become excessively bent in, the rudder cables might be fouled. The fairing may be straightened by cutting a hole in the fabric and patching the fabric after the fairing has been straightened.

(2) FRAME ASSEMBLY.

(a) GENERAL.—The margins of safety for the fuselage structure are comparatively high. Small cracks in the tubes or welds may be repaired by welding if they do not extend more than three inches from the center line of the joint, with the one exception that the frame cross-tubes at stations 1 and 2 should never be welded due to heat treatment of the material.

In order to repair a fuselage, it is often more satisfactory to splice in a tube rather than replace an entire longeron or tube. Instructions concerning splicing or replacement of tubes may be found in the structural repair manual for this airplane. Wire lugs which are cracked must be replaced by new lugs. The structural repair manual for this airplane sets forth methods and procedure for replacement of these lugs.

(b) FITTINGS.—The following fuselage attachment fittings are formed of chrome-moybdenum steel: front cabane strut fittings, rear cabane strut fittings, lower front spar fittings, lower rear spar fittings, main landing gear sponson knuckle fittings, landing gear torque arm fittings, and rear stabilizer fittings. These fittings are so designed that when required, they may be drilled 1/16-inch oversize and chrome-molybdenum steel bushings pressed in place, thus enabling the use of standard size attachment bolts. This applies only to the fittings listed above and not to the wire pull fittings which correspond to standard wire lug dimensions and must not be drilled oversize.

(c) ENGINE MOUNT STUDS.

1. Studs are used to attach the engine mount to the fuselage in order that the mount can be removed without disturbing the threads in the fuselage fittings. It is not intended that these studs be removed. When removing the engine mount, the castellated nuts must be removed rather than the studs.

2. Should the threads on the outer end of the studs become damaged, care should be taken in the replacement of the stud. The threads on both the stud and in the fuselage fittings are of highest quality commercial type, and due to their importance, demand that care be exercised at all times while working with them.

3. Should the threads on the engine mount attachment fitting become damaged, the strength of the fitting is sufficient to permit two oversize stud replacements. The studs are made from 7/16 AN bolts, and may be replaced by ½-inch or 9/16-inch studs. The fuselage fitting must be tapped out to the size of stud being used, and the engine mount end of the stud turned down to 7/16-inch diameter and threaded to 7/16-20.

When the maximum of two oversize studs has been used, the fuselage fitting may be repaired by inserting a replacement bushing, SK-326-1, as shown in *figure 91*. With the replacement bushing the regular stud, part No. 73-2131-1, may be used.

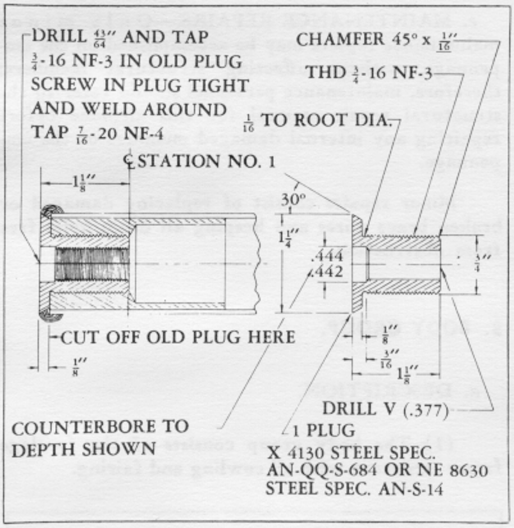


Figure 91—Engine Mount Stud Replacement Bushing

4. ALIGHTING GEAR.

a. MAIN LANDING GEAR.

(1) DESCRIPTION.—The main landing gear is a wheel type, full cantilever gear, incorporating 24-inch streamlined wheels, hydraulic brakes and spring-oil shock absorber struts with scissor-type torque resisting links. The main chassis is a readily detachable unit in which the shock absorber struts serve as the main members supported from the cross tube by two forged sponson knuckles. A forged axle knuckle fitted to the lower end of each shock strut contains a standard AAF type axle supporting the brake assembly and wheel. Two forged chrome-molybdenum heat-treated arms extend to the rear from the cross tube and the entire unit is supported at four points by suitable fittings on the lower longerons at stations 1 and 2.

All parts of the main landing gear are shrink or press fit, and bolted.

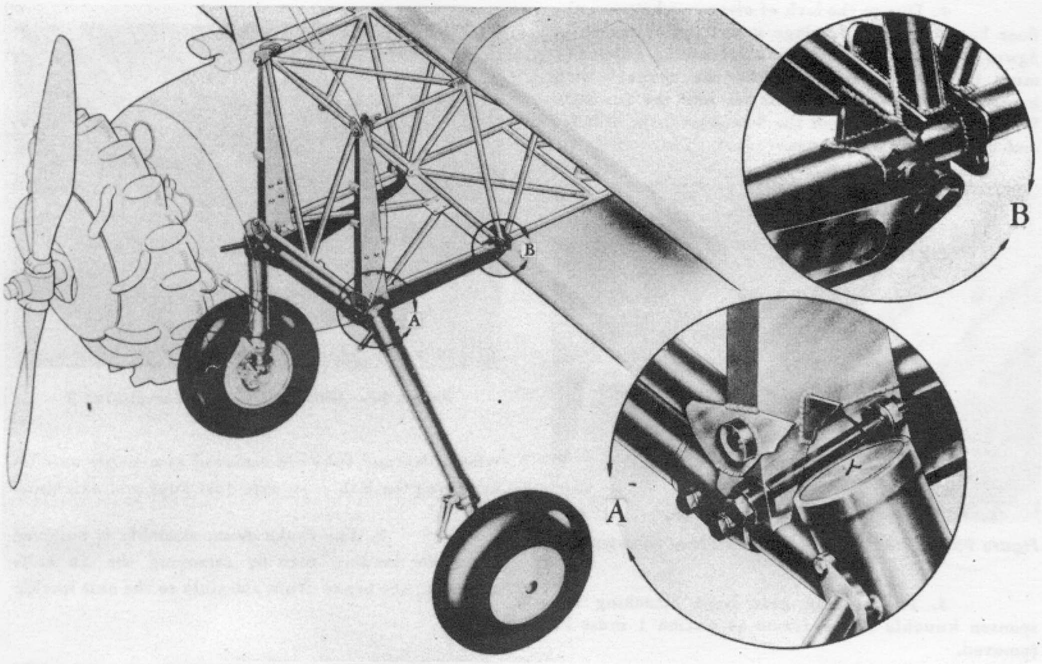


Figure 92—Main Landing Gear

(2) REMOVAL AND DISASSEMBLY.

(a) REMOVAL.—The airplane must be properly supported by a hoist or on jacks to enable removal of the main landing gear. Correct hoisting and jacking procedures are found in section III, paragraphs 3 and 4, of this manual.

The landing gear is removed in the following manner:

1. Removal of the main landing gear necessitates the removal of the belly cowling and four pieces of landing gear cowling on each strut.

2. The complete hydraulic system should be bled and the main hydraulic lines disconnected at the top of each strut.

3. Two bolts should be removed from the front and rear of each channel assembly supporting the belly cowling. The two channel brackets must be disconnected and the channel removed.

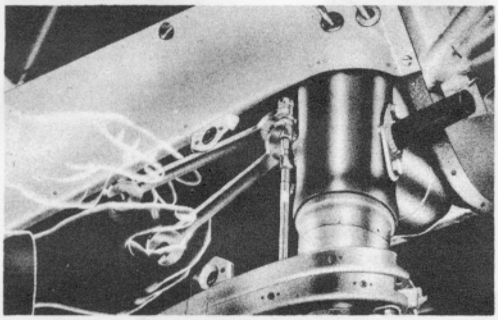


Figure 93—Hydraulic Line Disconnect

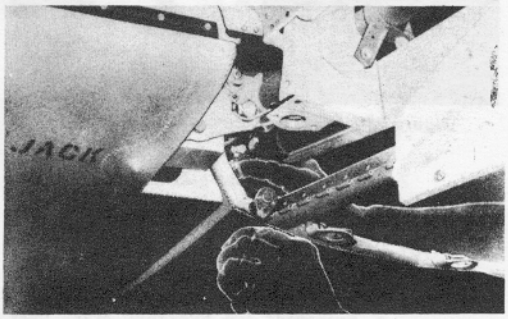


Figure 94—Belly Cowl Channel Rear Bolt

4. Due to the lack of clearance between the floor board and the fuselage structure, as shown in *figure 95*, the battery support attaching bolts (1) must be disconnected to allow the channel with bracket attached (2) to slide aft into the fuselage. With the bracket clear of the floor board, the bracket and channel are easily removed.

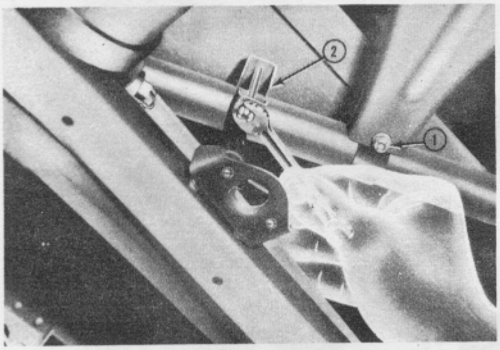


Figure 95—Channel Bracket and Battery Support Bolt

5. The landing gear bolts attaching the sponson knuckle to the frame at station 1 must be removed.

6. The landing gear bolts attaching the sponson arm to the frame at station 2 must be removed.

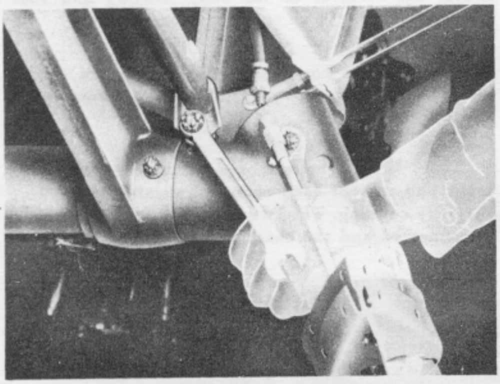


Figure 96—Landing Gear Bolts at Station 1

7. The main landing gear may then be removed from the airplane.

(b) DISASSEMBLY.

1. MAIN LANDING GEAR ASSEMBLY.

a. Bulkheads and hydraulic brake lines are easily removed from both landing gear struts. The

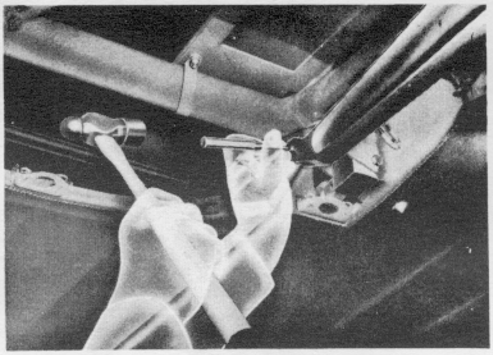


Figure 97—Landing Gear Bolts at Station 2

wheel, tire and tube are removed as a single unit by removing the hub caps, axle dust cups and axle nuts.

b. The brake drum assembly is removed from the landing gear by removing the six bolts attaching the brake drum assembly to the axle knckle flange.

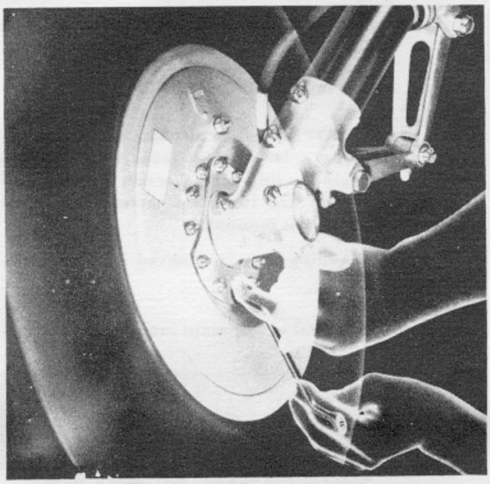


Figure 98—Brake Attaching Bolts

Note

The following instructions are for the disassembly of the main landing gear unit which is a press fit and bolted assembly. Further disassembly of the average landing gear unit requires the use of a hydraulic press or jack arrangement capable of exerting 10-ton pressures. Damaged or exceptional units may require a press capable of 15 tons pressure. All photographs referred to in this disassembly procedure show a suggested set-up for each operation when using a vertical press. In the event a vertical type press is not being used, the set-ups must be modified accordingly.

c. The two bolts securing the axle to the axle knuckle must be removed.

d. The axle should be placed in a power press. *Figure 99* shows a typical set-up consisting of the axle and knuckle assembly (1), press plate (2), the press table (3), and a punch (4) against which downward pressure is applied to push the axle out of the knuckle.

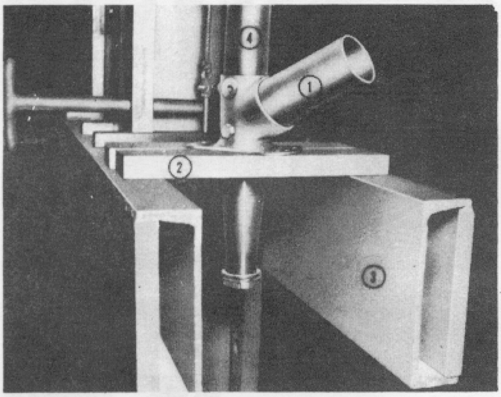


Figure 99—Axle Removal

e. The two bolts connecting the axle knuckle and the shock absorber strut should be removed and the axle knuckle pressed from the strut. *Figure 100* shows a typical set-up required to press the axle knuckle off the shock strut. This set-up consists of (1) the axle knuckle, (2) upper and lower press plates, (3) jig for securing the assembly in place, (4) two metal bars and a cross bar against which downward pressure is applied to press the axle knuckle off the shock strut.

f. The bolts connecting the sponson knuckle and the shock strut must be removed and the strut pressed from the sponson knuckle. *Figure 101* shows a typical set-up, consisting of (1) sponson assembly, (2) jig for securing knuckle and (3) punch against which downward pressure is applied to press the shock strut out of the sponson knuckle.

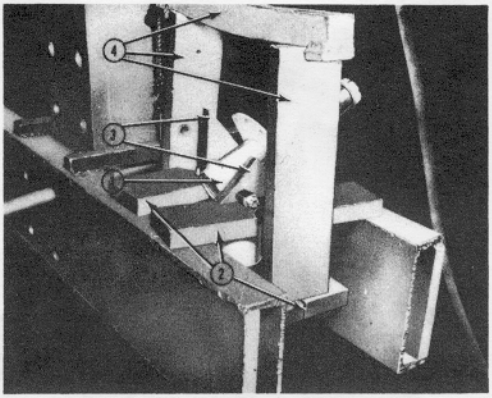


Figure 100—Axle Knuckle Removal

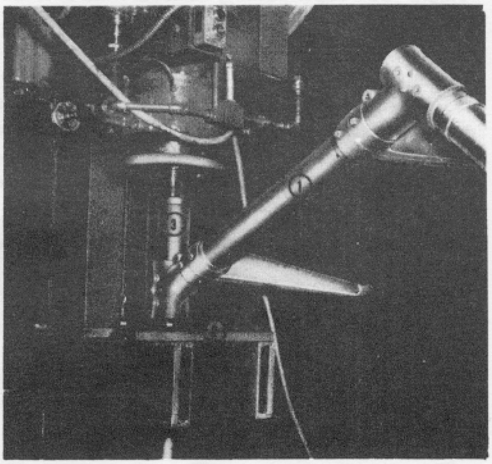


Figure 101—Shock Absorber Strut Removal

g. The two bolts connecting the sponson knuckle and the sponson arm must be removed. As shown in *figure 102*, one of these bolts (1) should be bent and used to punch out the back taper bushings. This same bolt or a conventional punch (2) of the necessary length can be used to remove the front taper bushings.

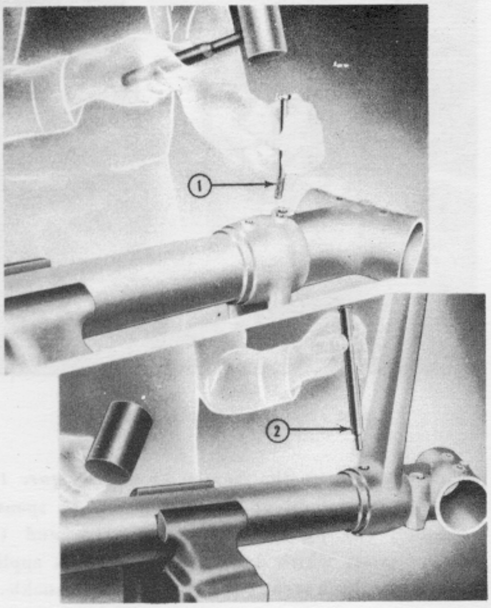


Figure 102—Taper Bushing Removal from Sponson

h. A suitable method of removing the sponson arm from over the knuckle is shown in *figure 103*. The assembly is placed in a vise and the arm driven off, using a drift plug, preferably aluminum, and a sledge hammer. Further disassembly will be facilitated if this sponson arm is driven against the remaining sponson arm as it appears in *figure 104*.

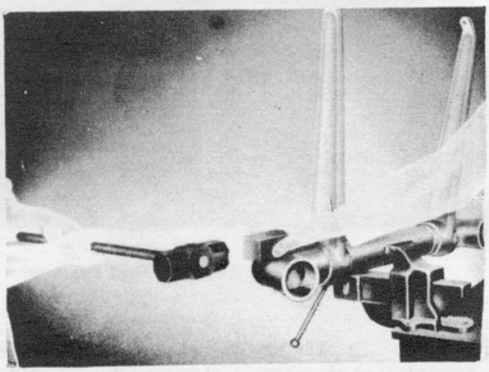


Figure 103—Sponson Arm Removal

i. *Figure 104* shows a typical set-up for removing the sponson knuckle. This set-up consists of (1) the sponson tube assembly, (2) the upper and lower securing jigs and (3) two shafts of metal against which direct downward pressure is applied to press the knuckle off the sponson tube.

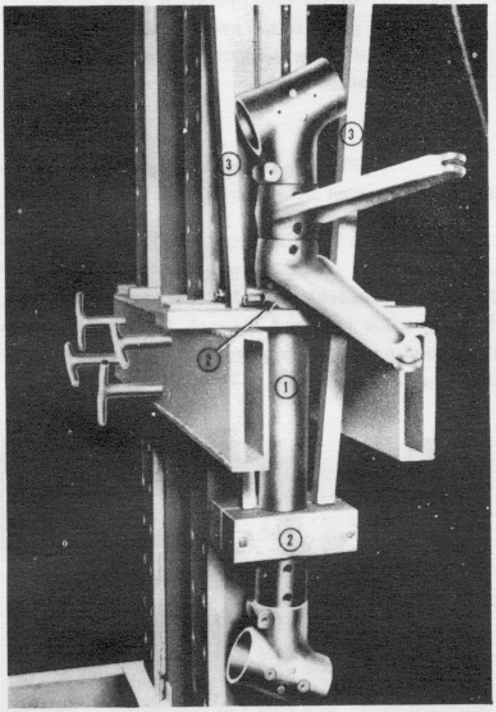


Figure 104—Sponson Knuckle Removal

j. *Figure 105* shows a satisfactory jig which can be used after one knuckle has been removed and it is then necessary to remove the other sponson knuckle.

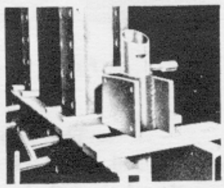


Figure 105—Knuckle Removal Jig

2. SHOCK ABSORBER STRUT. — The shock absorber strut is fabricated of four major assemblies shown in the cutaway illustration, *figure 106;* they are: upper cylinder assembly (1), lower cylinder assembly (2), the outer piston tube assembly (3), and the inner piston tube assembly (4).

The strut assembly may be disassembled in the following manner:

a. The outer piston assembly (3) is removed from the strut by unscrewing the packing gland nut (5), disconnecting the torque links (6), and pulling the piston (3) from the cylinder.

Note

All hydraulic fluid is released from the strut when the piston is removed and should be drained into a suitable container.

b. The spring seat washer (7) and the compression spring (8), can be slipped from around the metering pin (9), and the metering pin removed from the piston by removing the nut (10) accessible from the bottom of the piston.

c. The piston tube upper bearing (11) can be easily removed by melting the solder around the two flat head pins (12) and removing the pins.

d. With the upper bearing (11) removed, the piston tube stop (13), lower bearing (14), packing rings and adapter (15), wiper assembly (16), and packing gland nut (5) are easily slipped from the outer piston tube (3).

e. With the outer piston assembly removed from the strut, the inner piston assembly (4) may be removed by inserting a suitable wrench through the top of the cylinder to remove the nut (17). The bolt (18) attaching the upper cylinder (1), must be removed to provide access to this nut. The washer (19) and pin (20) must also be removed.

1. Upper Cylinder Assembly.
2. Lower Cylinder Assembly.
3. Outer Piston Tube Assembly.
4. Inner Piston Tube Assembly.
5. Packing Gland Nut.
6. Landing Gear Torque Links.
7. Spring Seat Washer.
8. Shock Strut Compression Spring.
9. Metering Pin.
10. Metering Pin Attaching Nut.
11. Piston Tube Upper Bearing.
12. Flat Head Pin.
13. Piston Tube Stop.
14. Lower Cylinder Bearing.
15. Packing Rings and Adapter.
16. Packing Gland Ring Wiper.
17. Inner Piston Retaining Nut.
18. Upper Cylinder Attaching Bolt.
19. Washer.
20. Flat Head Pin.
21. Set Screw.
22. Inner Piston Bearing.
23. Piston Insert.
24. Lock Ring.
25. Zerk Fittings.
26. Torque Link Bolt.
27. Shock Strut Filler Plug.

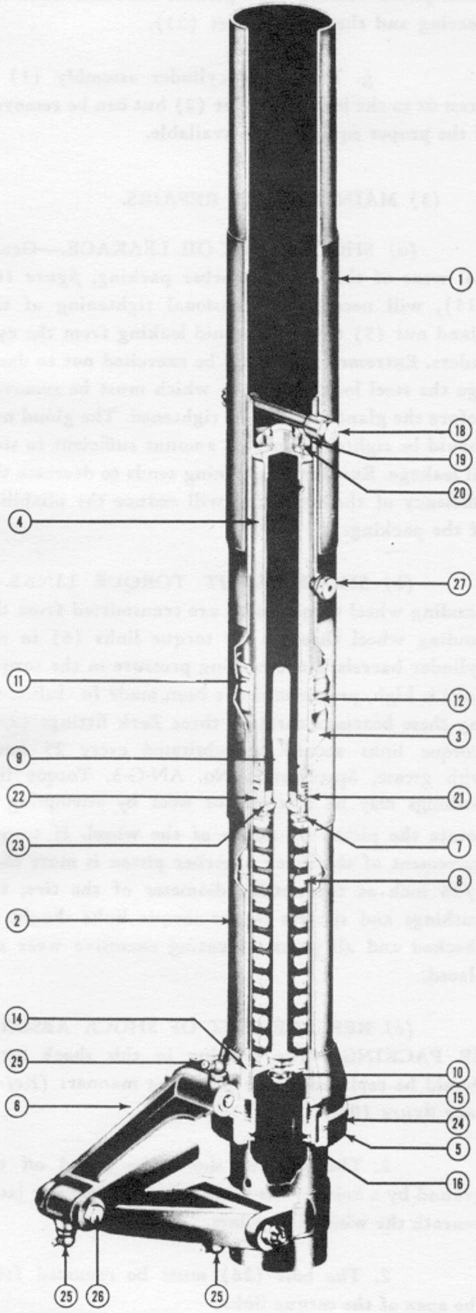


Figure 106—Main Landing Gear Shock Strut

f. Removal of the set screw (21) in the inner piston bearing (22) permits the removal of the bearing and the piston insert (23).

g. The upper cylinder assembly (1) is press fit to the lower cylinder (2) but can be removed if the proper equipment is available.

(3) MAINTENANCE REPAIRS.

(a) SHOCK STRUT OIL LEAKAGE.—Gradual wear of the shock absorber packing, *figure 106* (15), will necessitate occasional tightening of the gland nut (5) to prevent fluid leaking from the cylinders. Extreme care should be exercised not to damage the steel lock ring (24) which must be removed before the gland nut can be tightened. The gland nut should be tightened only an amount sufficient to stop oil leakage. Excessive tightening tends to decrease the efficiency of the strut and will reduce the pliability of the packing.

(b) SHOCK STRUT TORQUE LINKS.—Landing wheel torque loads are transmitted from the landing wheel through the torque links (6) to the cylinder barrels. Since bearing pressure in the torque links is high, provisions have been made fo lubricating these bearings through three Zerk fittings (25). Torque links should be lubricated every 25 hours with grease, Specification No. AN-G-3. Torque link bushings may be checked for wear by attempting to rotate the piston by means of the wheel. If torque movement of the shock absorber piston is more than 1/16 inch at the outside diameter of the tire, the bushings and spacers in the torque links should be checked and all parts indicating excessive wear replaced.

(c) REPLACEMENT OF SHOCK ABSORBER PACKING.—The packing in this shock strut should be replaced in the following manner: *(Reference figure 106.)*

1. The airplane should be raised off the ground by a hoist at the wing hoisting fitting or jacks beneath the wing jack points.

2. The bolt (26) must be removed from the apex of the torque links.

3. The lock ring (24) which safeties the packing gland nut (5) should be removed.

4. The packing gland nut must be unscrewed and the outer piston tube (3) pulled completely out of the cylinder. Removal of the piston tube will release all hydraulic fluid within the strut. This fluid should be drained into a container.

5. All parts in the strut and especially the bearing surfaces should be examined for excessive wear or undue roughness.

6. With a torch, the solder should be softened around the two flat head pins (12) holding the piston tube bearing (11) and the bearing removed from the piston tube. Removal of this threaded bearing is facilitated by placing a steel bar into its notched upper surface.

7. The piston stop (13) should be slipped off the piston tube (3) followed by removal of the lower cylinder bearing (14).

8. The worn packing rings and male adapter should be removed and the new packing rings slipped over the piston tube into their approximate correct position.

9. The male adapter ring and lower cylinder bearing should be slipped over the piston tube and against the packing rings.

10. The piston stop (13) and piston tube bearing (11) should be reassembled and the outer piston tube inserted into the cylinder.

Note

The two flathead pins securing the piston tube bearing should be "sweat to lock." The piston tube bearing should be screwed down tight before installing pins.

11. The packing gland nut (5) should be reinstalled.

12. Packing gland nut lock ring (24) and the bolt (26) at scissors link apex must be reinstalled.

13. The shock absorber should be filled with new fluid.

(d) REPLENISHING OF FLUID. — The shock strut filler plug (27), accessible through the landing gear cowling, should be removed at every 25-hour inspection period to check fluid level. Fluid

should be maintained at filler opening level. Fluid, AN Specification No. AN-VV-O-366, should be used to replenish this strut.

Note

A new copper filler plug gasket should be used each time the shock strut is filled or checked.

(e) WHEELS.—The wheels are of cast aluminum alloy construction with integral drop center rims. Tapered roller bearings and a standard stub axle are used with these wheels. When the wheel casting becomes damaged to the point where excessive distortion is noted, or cracks appear in the casting, no attempt should be made to repair. Other than replacement of the drum and bearing cups, very little repair can be made to the wheel itself.

(f) TIRES.—Main landing wheel tires should be inflated until the deflection markers just touch the ground. This will require an inflation pressure of approximately 16 pounds per square inch.

(4) ASSEMBLY AND INSTALLATION.

(a) ASSEMBLY.

1. MAIN LANDING GEAR ASSEMBLY.

a. The sponson tube, sponson arm and two knuckles constitute the upper portion of the main landing gear. The sponson tube and sponson knuckles are assembled after the knuckles have been placed in boiling oil and the ends of the sponson tube placed in granulated dry ice. Assembly of the two parts when in their respective expanded and contracted condition assures a tight friction fit after the metal has returned to normal temperature. Bolt holes must be aligned before the metal begins to return to normal temperature. The sponson arms must be slipped on the sponson tube before the last knuckle is assembled. With both knuckles assembled to the sponson tube, an arm is press fit onto each knuckle and the taper bushings and bolts are installed.

b. The lower portion of the landing gear is comprised of two shock absorber struts, two forged side knuckles and two standard AAF type axles. The axles are press fit and bolted into the flanged knuckles. The flanged knuckle with axle installed is then press fit and bolted to the lower ends of the shock absorbers. The upper ends of the shock absorbers are press fit and bolted into the lower end of the respective sponson knuckles.

c. Heat treatment requirements for all landing gear parts may be found in section VI of this manual.

2. SHOCK ABSORBER STRUT.—The shock strut is assembled by reversing the disassembly procedure described in paragraph 4.*a.*(2). The two flathead pins securing the piston tube bearing should be "sweat to lock". The packing gland nut should be tightened only sufficiently to prevent oil leakage.

(b). INSTALLATION.—The main landing gear may be reinstalled on the airplane by reversing the removal procedure, paragraph 4.*a.*(2) of this section.

b. AUXILIARY LANDING GEAR.

(1) DESCRIPTION.

(a) The PT-13D/N2S-5 installs a free swiveling, steerable tail wheel, incorporating an air-oil type shock strut and mounting a 10-inch smooth contour tire.

(b) The tail wheel assembly consists of a cantilever tail wheel fork and post assembly, and a welded steel tube trunnion assembly.

(c) The tail wheel is steerable through 5 degrees more than rudder travel range each way and after that disengages to become free swiveling for the remainder of a 360 degree rotation.

(2) REMOVAL AND DISASSEMBLY.

(a) REMOVAL.—The following is a suggested procedure for removal of the tail wheel assembly.

1. The tail of the airplane should be raised. Correct jacking procedure is found in section III, paragraphs 3 and 4 of this manual.

2. All tail wheel cowling and covering should be removed.

3. All tension in the tail wheel control cables should be released at the turnbuckles accessible through the baggage compartment.

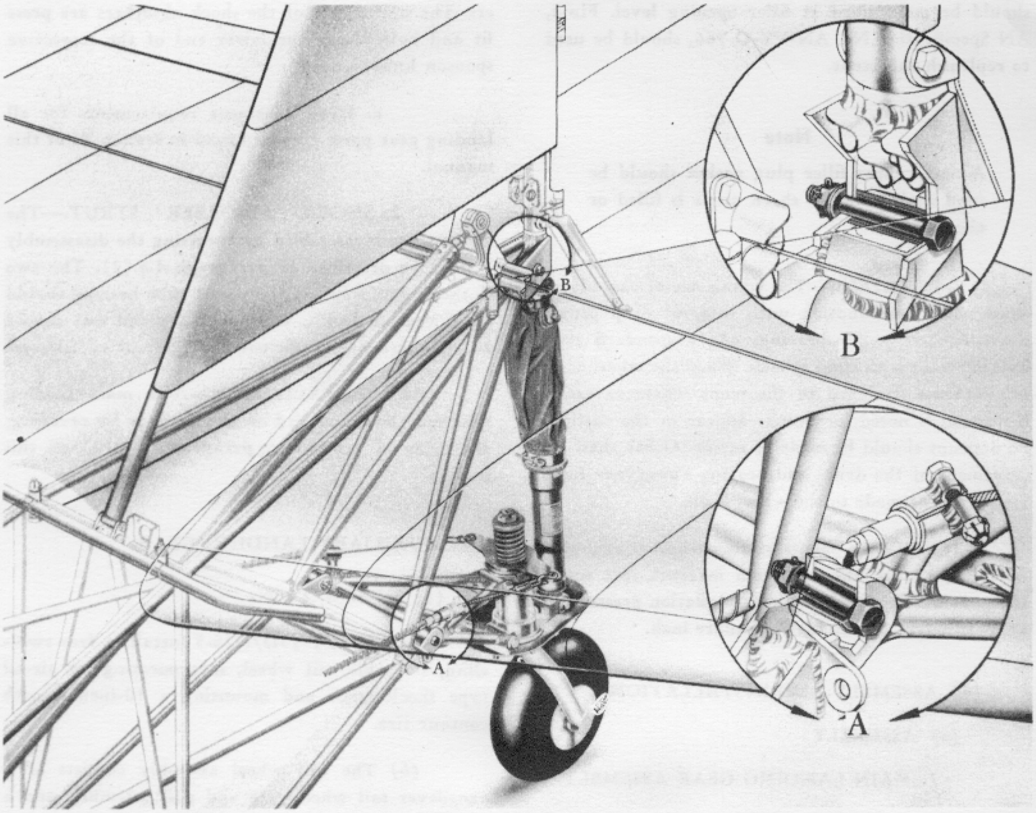


Figure 107—Tail Wheel Installation

4. With cable tensions released, the cables are disconnected at the tail wheel, *figure 108* (1), and the cable fairleads (2) are removed, thus allowing the cable to slip through the fairlead bracket.

5. The tail wheel assembly is then removed by disconnecting the tail wheel trunnion, *figure 108* (3), and the top of the shock absorber strut, *figure 109*, from the fuselage frame.

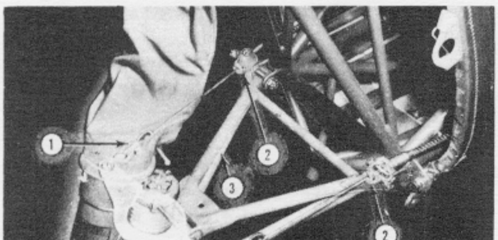


Figure 108—Disconnecting Tail Wheel Trunnion

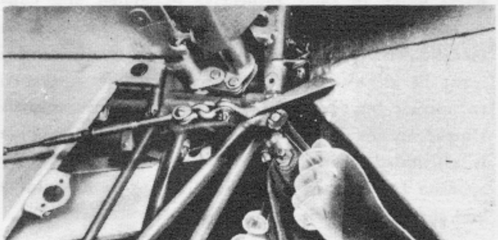


Figure 109—Tail Wheel Strut Attaching Bolt

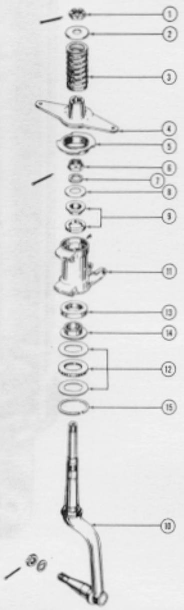
(b) DISASSEMBLY.

1. Shock strut assembly and trunnion assembly are easily disassembled from the tail wheel post assembly by removing the attaching bolts.

2. The wheel, tire, and tube are removed as a single unit by removing the hub cap, axle dust cup, and axle nut.

3. The tail wheel post assembly, *figure 110*, is disassembled by removing the tail wheel post locknut (1), spring retainer (2), spring (3), and mast assembly (4). The sleeve cap (5) may then be slipped off and the bearing locknut (6) removed. This permits the removal of the keyed washer (7), grease retaining cup (8), and the upper bearing assembly (9), and also releases the knuckles and axle assembly (10) from the housing (11). The three felt grease retaining washers (12), thrust plate (14), and lower bearing (13) may be released by removing the snap ring (15) from the lower side of the housing (11).

4. The shock absorber strut assembly, *figure 111*, is disassembled by unscrewing the bearing nut (1) and pulling the piston assembly (2) from the cylinder (3). Removal of the piston head (4) from the end of the piston assembly permits the recoil valve (5), packing rings, adapters and packing (6) to be slid from the piston. The metering pin (7) is threaded into the bottom of the piston and is easily removed with piston assembly pulled from the cylinder.



1. Tail Wheel Post Locknut.
2. Spring Retainer Washer.
3. Tail Wheel Post Spring.
4. Mast Assembly.
5. Post Support Sleeve Cap.
6. Bearing Locknut.
7. Wheel Bearing Retainer Washer.
8. Grease Retainer Cup.
9. Upper Bearing Assembly.
10. Knuckle and Axle Assembly.
11. Tail Wheel Knuckle Housing.
12. Grease Retaining Washer.
13. Lower Spindle Bearing.
14. Bearing Thrust Plate.
15. Snap Ring.

Figure 110—Tail Wheel Post Assembly

(3) MAINTENANCE.

(a) TRUNNION ASSEMBLY AND TAIL WHEEL POST ASSEMBLY.

1. Tail wheel attachment bearings in the trunnion fuselage fittings and at each end of the oleo strut are of special oilite material and require no lubrication.

2. The tail wheel knuckle assembly, *figure 110* (10), is supported at the upper end and lower end of the housing by friction bearings. The purpose of the friction bearings is to create a snubbing action to prevent tail wheel shimmy. Should a condition of shimmy develop in the tail wheel or if inspection discloses more than .005-inch clearance between the bearing and the thrust plate, it is recommended that the bearing and/or the thrust plate be replaced. With the tail wheel post assembly disassembled, all parts indicating wear can be easily replaced.

(b) SHOCK ABSORBER STRUT OIL AND AIR LEAKAGE.

1. In the tail wheel shock absorber strut both air and hydraulic fluid are used to produce controlled resistance to taxiing, take-off, and landing loads. The static weight of the airplane is carried by the air in the upper chamber and when compressed, serves to extend the strut to its original position to receive the next impact load. Upon impact the hydraulic fluid in the lower cylinder is forced through an orifice into the upper cylinder. The flow of hydraulic fluid through the orifice is controlled by a metering pin, *figure 111 (7)*, mounted on the base of the lower cylinder, thereby giving a cushioning effect when a sudden load is applied.

2. Hydraulic fluid is forced through the holes in the piston head, *figure 111* (4), on the down stroke of the piston. This oil between the piston and the cylinder produces a snubbing effect on the expansion stroke of the strut. Such snubbing effect is necessary to prevent quick rebound of the upper cylinder when loads, such as encountered in landing, are suddenly relieved from the strut. It is therefore imperative that correct proportions of fluid and air be maintained to prolong the life of the strut and to obtain satisfactory service.

3. Gradual wear of the shock absorber packing and valve core assembly will necessitate occasional tightening of the bearing nut and/or replacement of the air valve assembly to prevent fluid and air from leaking from the cylinder. While tightening the bearing nut, the piston should be moved up and down to assure that feather edges of the packing rings mate to the walls of the piston tube. The bearing nut is considered sufficiently tightened when the piston works freely without loss of air or oil. The valve assembly, *figure 111 (8)*, is replaced by releasing all air from the strut and installing a new valve assembly.

Note

Prior to depressing the valve core, a rag should be wrapped over the valve assembly to prevent hydraulic fluid from spraying.

(c) REPLACEMENT OF SHOCK ABSORBER PACKING.—When the "V" packing rings become worn so that they are no longer serviceable, the rings and adapters should be replaced by installing the "O" packing ring assembly which is contained in the packing replacement kit, Boeing part No. E75-2702S. The packing may be replaced in the following manner:

1. Prior to attempting disassembly of the tail wheel shock absorber strut, the airplane should be jacked up and all air released from the strut assembly.

2. The lock ring must be removed from the top of the outer cylinder.

3. The bearing nut should be unscrewed and the piston pulled from the strut assembly.

4. With the strut disassembled, all oil should be drained from the strut and the entire strut cleaned with gasoline.

1. Bearing Nut.
2. Piston Tube Assembly.
3. Cylinder Assembly.
4. Piston Head.
5. Recoil Valve.
6. Packing Rings and Adapters.
7. Metering Pin.
8. Air Valve Assembly.

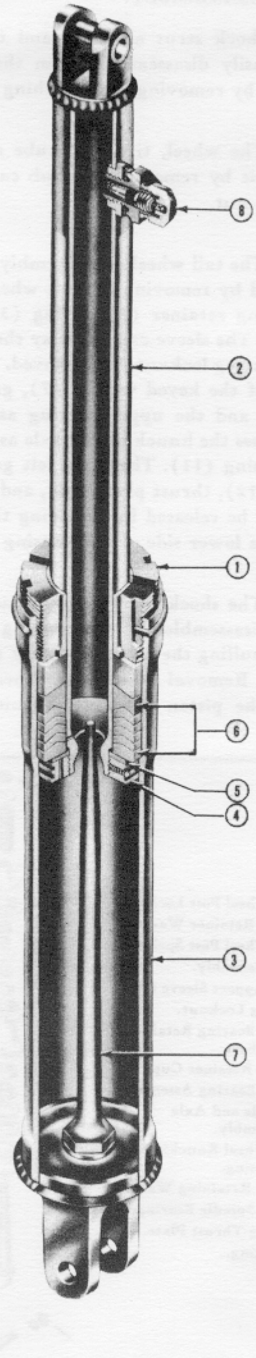


Figure 111—Tail Wheel Shock Absorber Strut

TROUBLE	PROBABLE CAUSE	REMEDY
	(Index Numbers in Parenthesis Refer to Figure 111)	
I. Air leaks.	1. Undue wear of valve core seat.	1. The valve core, AN809-1, should be depressed several times. If this fails to stop leak, valve core should be replaced.
	2. Scratches or nicks in copper gasket.	2. Copper gasket, AN901-5C, should be replaced.
	3. Improper assembly of valve core or filler plug.	3. Valve core or body should be tightened down.
	4. Leak in wall of air chamber.	4. Piston tube assembly (75-2732, *figure 111*, (2)) should be replaced.
II. Fluid leaks.	1. Improper packing adjustment.	1. Bearing nut (1) should be tightened down just enough to stop leakage.
	2. Deterioration of packing.	2. Packing (6) should be replaced.
	3. Improper packing installation.	3. Be sure packing is in place according to drawing Nos. 75-2702 and E75-2702S. Do not use old style "V" ring packing. The "O" ring Packing Kit is to be used.
	4. Scored piston or cylinder.	4. Damaged piston, part No. 75-2732, or cylinder, part No. 75-2733, should be replaced with spare part and sent to overhaul depot for major repair.
	5. Bent piston tube.	5. Same as 4.
	6. Leaks in oil chamber due to sweated joints.	6. Replace leaking assembly with spare parts. Send leaking parts to overhaul depot for resoldering.
III. Improper taxiing characteristics.	1. Improper air inflation or fluid level too high.	1. See *(e)* "Replenishing," following, for filling and inflating instructions.
	2. Improper packing adjustment.	2. Back off bearing nut (1) to allow freedom of piston movement, but not enough to permit fluid leakage.
	3. Improper inflation of tire.	3. Fill tire until deflection mark on side of tire just touches the ground when the plane is in gross load condition.
	4. Structural and/or mechanical failure.	4. Replace defective parts.
IV. Rigid landing characteristics.	1. Over-inflation.	1. Inflate according to nameplate instructions.
	2. Tight packing.	2. Back off bearing nut (1) to allow freedom of piston movement, but not enough to permit fluid leakage.
	3. Fluid level too high.	3. Fill according to instructions in *(e)* "Replenishing," following.
V. Hard landings due to non-functioning of shock absorber unit.	1. Under-inflation.	1. Inflate according to nameplate instructions.
	2. Fluid level too high.	2. Fill according to instructions in *(e)* "Replenishing," following.
	3. Mechanical failure or improper assembly.	3. Check strut with assembly drawing No. 75-2702 to insure that all parts are properly installed.

Figure 112—Tail Wheel Shock Strut Trouble Shooting Chart

5. With the piston out of the lower cylinder, the packing rings are replaced by removing the set screws in the piston head, unscrewing the head, and sliding the recoil valve, the male adapter ring and the packing from the piston.

6. The packing rings should be placed on the adapter, and the adapter and packing washer, the recoil valve, and the piston head reinstalled on the piston.

7. The piston assembly is slipped into the outer cylinder and the bearing nut reinstalled. While tightening the bearing nut, the piston should be moved up and down a number of times to insure that the packing rings are correctly aligned and properly seated.

Note

Synthetic rubber packing rings develop high frictional forces. It is recommended that "oil drag" (graphite in oil) be used on the packing rings when reassembling the strut. This tends to reduce friction and prevents seizing.

8. The strut should be filled with new fluid and reinflated.

9. A close check should be made to ascertain that no oil or air leaks are present on the strut. In the event oil is leaking around the piston, the bearing nut should be tightened only sufficiently to stop the leak without hindering piston movement.

10. All other parts of the shock absorber strut assembly may be easily replaced with the shock strut disassembled.

(d) DIAGNOSIS OF IMPROPER STRUT OPERATION.—*Figure 112* is a trouble shooting list to be used in diagnosing improper operation of the strut. Index numbers in parenthesis, (1), (2), etc., refer to *figure 111*.

(e) REPLENISHING.

1. The fluid level in the tail wheel shock absorber strut should be checked and refilled if necessary every 25 hours. In all cases this strut should be refilled with red fluid, AN Specification No. AN-VV-O-366. Under no circumstances should fluid having a castor oil base be used in this strut without replacing all neoprene parts with natural rubber parts. Hydraulic fluid having a castor oil base, when used with synthetic rubber packing, causes deterioration of the packing within approximately 30 days with the result that the strut fails to function properly.

2. The shock absorber strut fluid may be replenished in the following manner:

a. All air must be expelled from the strut by depressing the valve core until the strut is completely deflated.

b. The filler plug and copper gasket must be removed and the old gasket discarded.

c. The strut should be filled with proper hydraulic fluid to the filler plug level.

d. The filler plug should then be inserted and the strut extended and compressed two or three times. This eliminates air trapped in the hydraulic fluid.

e. The filling procedure should be repeated until proper fluid level is obtained.

Note

Since the amount of oil and air contained within the strut is small, proper function of the strut is highly dependent upon the correct maintenance of proper fluid level.

f. The filler plug and a new copper gasket should be installed in the strut. Care should be taken in replacing the gasket and the plug to see that both are free from dirt and scratches and that the filler plug fits snugly.

g. The strut should be reinflated with compressed air, bottle air, pump, or other suitable means. The airplane should be rocked occasionally while inflating the strut to overcome packing friction, thus preventing over-inflation.

CAUTION

Bottle gases such as hydrogen, oxygen, acetylene, etc., should never be used.

h. Proper inflation of the strut is checked by measuring from the center of the air valve to the face of the packing gland nut. The proper distance is 3⅝ inches ± ¼ inch, measured with tail wheel resting on ground.

i. With valve cap replaced, close check should be made of the air valve, filler plug base and at the bearing nut for air leaks.

(f) TAIL WHEEL TIRE.—The tail wheel tire should be inflated until the deflection marker just touches the ground. This will require a pressure of approximately 30 pounds per square inch.

(4) ASSEMBLY AND INSTALLATION.

(a) ASSEMBLY.—Assembly of the tail wheel post assembly and shock strut assembly may be accomplished by reversing the disassembly procedure, paragraph 4.*b*.(2) *(b)*.

(b) INSTALLATION.—The tail wheel assembly is installed by reversing the removal procedure, paragraph 4.*b*.(2) *(a)*.

5. POWER PLANT GROUP.

The power plant group includes the engine and accessories, engine controls, propeller, oil system, and fuel system which includes the fuel tank in the upper wing center section.

a. ENGINE.

(1) DESCRIPTION.

(a) A Lycoming Model R-680-17 direct drive, nine cylinder, air-cooled radial engine powers the PT-13D/N2S-5 airplane. It is rated at 220 bhp, 2100 rpm at sea level. The engine is operated from the cockpits through a series of rods and bellcranks.

(b) Starting equipment for the engine consists of a hand operated inertia starter, a starter clutch control and a primer valve mounted on a panel in the left side of the engine cowling.

(c) The exhaust is directed to the slip stream on the right side of the airplane through an exhaust collector ring mounted on the front of the engine.

(2) REMOVAL AND DISASSEMBLY.—The PT-13D/N2S-5 is designed to facilitate quick engine exchange by removing the entire power plant section forward of the engine firewall.

Note

Due to the fact that the engine cannot be removed from the engine mount without first removing all engine accessories, it is recommended that the engine section be removed from the fuselage before attempting removal of the engine.

(a) REMOVAL OF THE ENGINE SECTION.

1. Prior to beginning actual disconnections necessary for removal of the engine section, the propeller and all engine cowling should be removed. The fuel valve must be in the closed position and all oil drained from the oil tank at the "Y" drain in the oil "IN" line.

2. The fuel line running from the fuel cock on the firewall to the fuel strainer must be disconnected at the hose fitting, *figure 114* (1), provided at the fuel strainer.

3. The two oil temperature thermo couplings (2) must be disconnected from the thermo wells provided in the oil "IN" line.

4. The oil pressure line should be disconnected at the coupling (3) provided in the line just below the oil tank.

5. Oil dilution line must be disconnected at the hose fitting (4) provided at the "Y" drain.

6. The ignition switch (5) must be disconnected at the firewall. Since this connection is not readily accessible and may be easily overlooked, it is suggested that a special check be made to ascertain that this step is accomplished prior to attempting removal of the engine.

7. Mixture control, throttle control and carburetor air control rods must be disconnected.

8. The tachometer generator cable (6) must be disconnected at the generator. A bracket which attaches this cable to the engine mount must be removed.

9. With engine hoisting sling attached to the lifting eyes on top of the engine (see section III, paragraph 3), the four nuts on the engine mount studs attaching the engine mount to the fuselage *(see figure 123*, Detail B) must be removed and the power plant section pulled slowly forward until free of the airplane. Careful check should be made when pulling the power plant section from the airplane to see that all disconnections have been accomplished.

(b) DISASSEMBLY OF POWER PLANT SECTION.—With the power plant section removed, the engine, oil tank and all other items attached to the engine mount may be easily removed. With reference to *figure 114*, removal of the engine from the engine mount is accomplished in the following manner.

1. Oil "IN" (7) and oil "OUT" (8) lines from the oil tank to the engine should be disconnected at the engine.

Note

All engine openings and open ends of oil lines should be taped or capped to prevent accumulation of foreign particles.

2. The oil tank vent line (9) from the oil tank to the engine housing should be disconnected at the hose fitting (10) provided at the engine.

3. The fuel line (11) from the fuel strainer to the carburetor should be disconnected at the carburetor.

4. The magneto (12) must be removed to provide proper clearance necessary to remove the engine from the engine mount. The magneto is removed by disconnecting the five ignition wires into the back of the magneto and removing bolts which attach the magneto to the engine housing.

5. The main pressure line (13) to the primer distributor and the engine breather line (14) must be disconnected at the engine.

6. The starter crank extension (15) and starter clutch rod (16) must be disconnected at the starter.

7. To provide clearance necessary for removal of the engine from the engine mount, the carburetor must be removed. Carburetor removal is accomplished by disconnecting air induction box (17) from the underside of the carburetor and removing the bolts which attach the carburetor to the engine.

8. Motor vent line (18) must be removed by disconnecting the hose fitting provided at the engine.

9. Tachometer generator (19) on the right side of the engine must be removed to provide clearance of the engine from the engine mount and can be detached by removing the bolts attaching it to the engine.

10. With the engine properly supported by a hoist, the eight engine bolts *(see figure 123,* Detail A) connecting the engine to the engine mount should be removed and engine and engine mount pulled apart.

CAUTION

Great care must be exercised when pulling the engine and engine mount apart to avoid damaging the distributors.

11. To remove the exhaust collector ring from the engine, the tail pipe, *figure 113* (1), must be

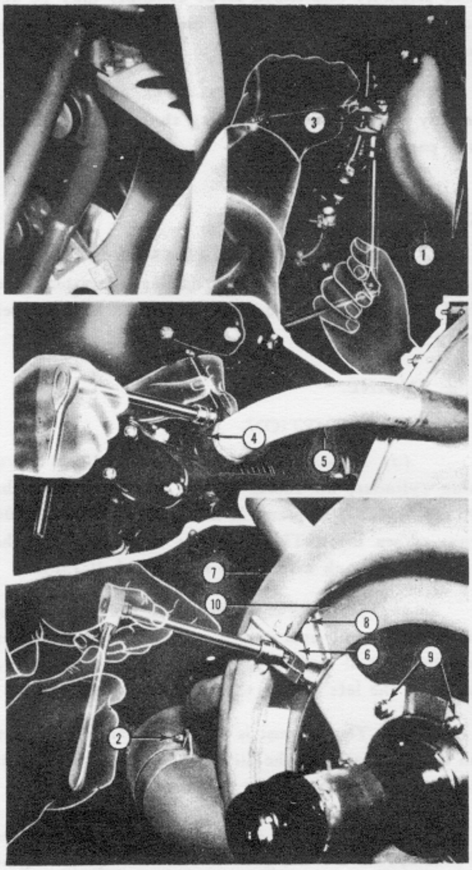
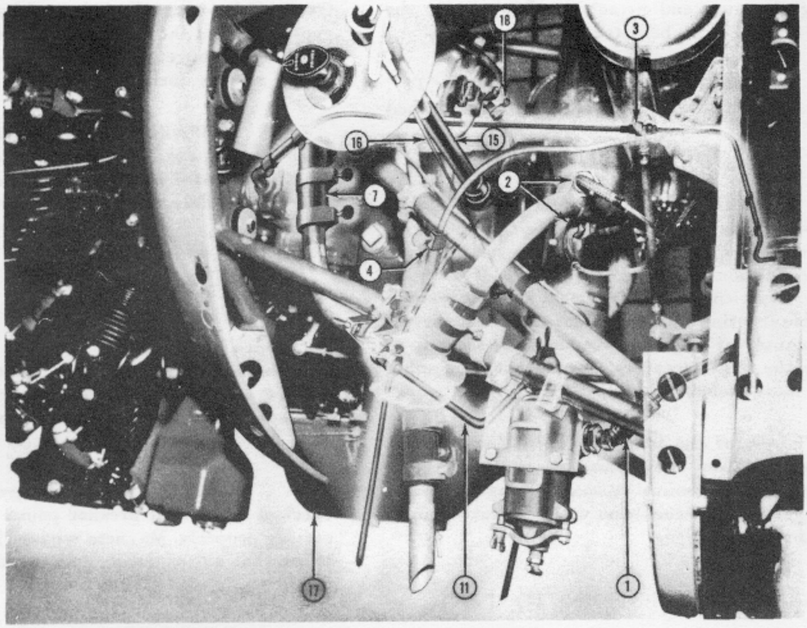


Figure 113—Removal of Exhaust Collector and Ring Cowl



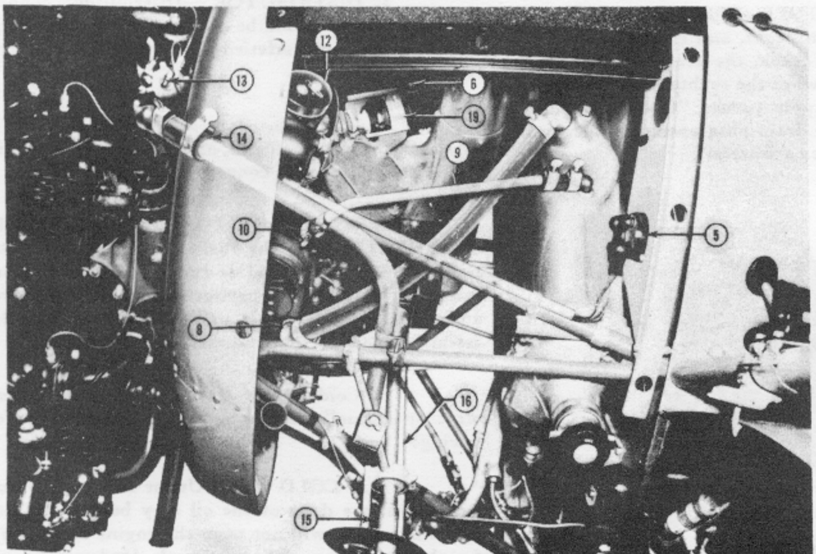


Figure 114—Removal and Disassembly of Engine Section

detached at (2) and the attaching bolt (3) removed. The clamps (4) connecting the exhaust pipes (5) should then be loosened and the pipes removed. By removing the nuts and attaching clamps (6), the collector ring (7) can be lifted from the engine.

12. By removing the nuts (9), *figure 113,* and the bolts (8), the ring cowl (10) is detached from the engine.

(3) ENGINE TROUBLE AND SERVICE REPAIRS.—Improper engine functioning can be attributed to numerous possible sources, thus complicating the determination of the actual source of trouble. However, experience has proved that the best method of "trouble shooting" is first, to decide on the various possible causes of a given trouble and, second, to eliminate the possible causes, one by one, beginning with the most probable.

The use of the following outline of common engine troubles and their possible causes is recommended to assist personnel in maintaining Lycoming engines in serviceable condition with the least amount of wasted time involved.

(a) FAILURE OF ENGINE TO START.

1. LACK OF FUEL.—Fuel tank, fuel lines and connections, shut-off cocks, and strainers should be examined. As a final check, the drain plug should be removed from the bowl of the carburetor. *(See figure 115.)* With fuel supply turned "ON," a steady stream of fuel from the drain plug opening indicates that fuel is reaching the carburetor.

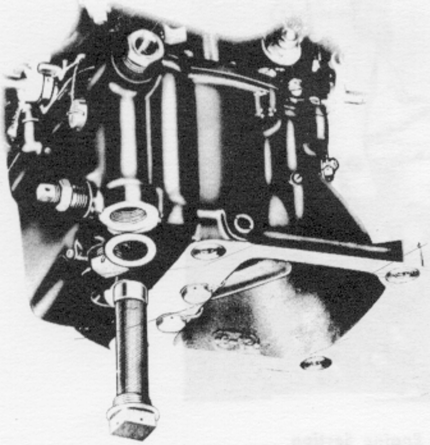


Figure 115—Carburetor Fuel Strainer

2. OVERPRIMING OR UNDERPRIMING.—Insufficient priming is usually indicated by a tendency of the engine to "kick back" when starting. Overpriming is usually indicated by a muffled, hollow explosion from the exhaust or by excess fuel dripping from the carburetor drain or coming out of the exhaust in vapor form.

3. SPARK PLUGS.—Spark plugs should be removed and examined to see whether or not they have been fouled by oil or condensed moisture. Wash plugs with clear gasoline and dry with compressed air.

Note

When airplanes are removed from heated hangers in cold weather, the engine should be started immediately in order to avoid condensation of moisture on spark plugs.

4. MAGNETO.—Magneto should be checked to see that breaker points are clean and operating properly. Magneto wiring should be examined to see that all insulation and connections are in good condition.

5. DISTRIBUTOR.—Distributor connections and wiring should be checked. Distributor rotor should be properly safetied and the distributor free from oil or moisture.

6. WIRING.—Ignition wiring should be checked for burned, chafed, or cracked insulation and for secure and correct connections.

7. WATER OR FOREIGN MATTER IN CARBURETOR.—If the fuel is reaching carburetor and engine fails to run after fuel supplied by priming system is exhausted, the carburetor should be removed and either replaced with another carburetor or disassembled and all fuel and air passages cleaned.

8. Cold engine starting difficulty in cold weather is usually caused by either or both of the following:

a. COLD OIL.—Under low temperature conditions, the drag of the oil may become so great that the starter will not turn the engine fast enough for the magneto to deliver a spark. Under these conditions, it is necessary to either perform oil dilution or pre-heat the oil.

b. INSUFFICIENT VAPORIZATION OF FUEL.—At low temepratures, gasoline may not be sufficiently vaporized to start. If such extreme low temperatures are encountered, starting may sometimes be accomplished by priming with approved highly volatile fuels.

(*b*) UNEVEN RUNNING AND LOW POWER.

1. SPARK PLUGS.—Spark plugs should be removed and checked for cleanness and correct gap setting of .015. Spark plugs should be pressure tested with spark plug tester.

2. WIRING.—Ignition wiring should be checked for damaged insulation and, if possible, the entire harness checked for open circuits and insulation leaks with a high tension ignition harness test set.

3. MIXTURE.—A rich mixture is usually indicated by black smoke from the engine exhaust, sluggish operation of the engine and in extreme cases, engine roughness. A reddish-yellow flame from the exhaust indicates either too rich a mixture or excessive oil consumption.

a. Too lean a mixture is indicated by uneven running, overheating and, in extreme cases, backfiring through the carburetor. Too lean a mixture will give an intermittent blue-white flame at night. Correct mixture is indicated by a steady light blue flame from the exhaust.

b. Mixture trouble can usually be remedied by replacing the carburetor; however, leaks in the induction system may result in too lean a mixture and can often be detected by a whistle in the engine at idling speed.

c. A leaky primer-shut-off valve can cause too rich a mixture. If this condition is suspected, a primer and shut-off valve that is known to shut off properly should be installed.

4. MAGNETO.—Magneto breaker points should be checked for cleanness and proper adjustment. Breaker housing must be clean and free from excess oil. If engine parts that affect timing have been removed, the magneto timing should be checked. Unless some work has been done on the engine to change the timing, it is practically impossible for the timing to change during normal operation of the engine.

5. DISTRIBUTOR.—Distributor caps should be removed and inspected for oil or condensed moisture. Distributor timing should be checked if parts affecting distributor timing have been removed or disturbed. It is practically impossible for the distributor to get out of time unless some part of the engine which affects the timing has been disassembled.

Note

Be sure that two fillister head cap screws that retain distributor rotor assembly are properly safetied. Improper safety of these screws may allow a spark to jump to the safety wire and interfere with the distributor operation.

6. FUEL.—It should be made certain that proper grade of fuel is in airplane fuel tank. Lead deposits on spark plugs and valves may result in rough operation if engine is operated on highly leaded fuels.

7. LOSS OF COMPRESSION.—Loss of compression caused by leaky valves or piston rings may result in rough and sluggish operation. Operation of engine from dirty, dusty or sandy fields may result in abnormal wear of cylinders and rings, particularly if the air cleaner is not properly serviced.

8. VALVE GEAR.—Valve clearance of all cylinders should be checked. Clearance between the valve stem and the valve rocker roller should be .015 inch when the engine is cool and the valve completely closed. If compression loss on one or more cylinders indicates leaky valves, valves should be checked for sticking.

(*c*) ROUGH RUNNING.—If engine produces excessive vibration but seems to be firing evenly, the following items should be checked:

1. PROPELLER.—Rough operation as well as poor performance can often be traced to a damaged propeller, to a propeller of the wrong design, or to a propeller that is out of balance, pitch or track. If the propeller is suspected to be the cause of roughness, another propeller known to give normal performance and smooth operation on another engine of the same model should be tried. Roughness may also be caused by galled or worn propeller cones or by improper tightening of the propeller retaining nut. Correct propeller balance and track should be checked according to paragraph 5.*c.* of this section.

2. ENGINE MOUNT.—Engine mount should be checked for looseness and cracked or broken members. Particular attention should be given to the rubber engine mounting bushings. Engine mount nuts should be tightened snug but not so tight as to compress the rubber bushing to a point where flexibility is lost.

3. CRANKSHAFT.—Crankshaft should be inspected for run-out at front and rear cone locations. *(See figure 117.)*

4. All items enumerated in paragraph *(b)* above should be checked even though the engine seems to be firing evenly.

(d) HIGH OIL TEMPERATURE.

1. INSUFFICIENT OIL.—Under no circumstances should the engine be operated with less than 2½ gallons of oil in the system.

2. INFERIOR OIL OR IMPROPER GRADE OF OIL.—See section III, paragraph 8.*b.* for correct oil recommendations.

3. EXCESSIVE "BLOW-BY".—"Blow-by" caused by worn or stuck piston rings will raise the oil temperature and, in most cases, cause oil to be discharged from the crankcase breather. Excessive ring wear is usually caused by dirt or dust. Stuck rings are, in the majority of cases, caused by excessive cylinder head temperature which is almost always caused by excessive ground operation of the engine.

4. DEFECTIVE TEMPERATURE GAGE. —Maintenance personnel should ascertain that the temperature gage calibration is accurate before disassembling major parts of the engine in locating the cause of high oil temperatures.

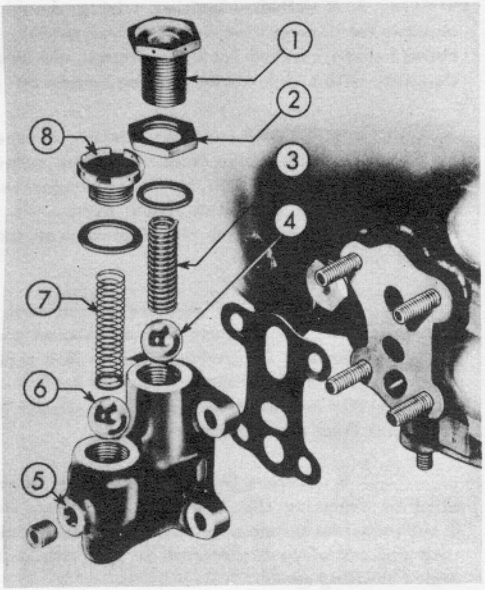
5. EXCESSIVE BEARING CLEARANCE. —Excessive bearing clearance, particularly in the master rod bearing, can cause high oil temperatures. However, unless some abnormal condition causes sudden failure, it will generally be found that excessive rod clearance will gradually raise the oil temperature for a long period of time. This increase in temperature is usually, but not always, accompanied by a drop in oil pressure.

(e) LOW OIL PRESSURE.

1. INSUFFICIENT OIL IN TANK.—If engine has had an oil change since the last flight, the oil level should be checked immediately before starting the engine. Extremely low oil level is sometimes indicated by fluctuation of the oil pressure gage.

2. LEAK IN PRESSURE PASSAGE OR OIL PUMP INTAKE PASSAGE OR LINE.—A leak in oil pressure passage will usually be indicated by excessive oil flow from the return line from the engine to the oil tank. Leaks on the intake side of the pump will rarely cause oil pressure trouble if the oil tank is high enough to assure gravity feed of oil to the pump.

3. OIL PRESSURE RELIEF VALVE.—Oil pressure relief valve nut *(figure 116)* should be removed and a check made to see that foreign matter is not interfering with proper seating of the relief valve ball. It should be made certain that check valve spring and relief valve spring are not reversed.



1. Oil Pressure Adjusting Screw.
2. Locknut.
3. Relief Valve Spring.
4. Relief Valve Ball.
5. Oil Pressure Gage Connection.
6. Check Valve Ball.
7. Check Valve Spring.
8. Check Valve Nut.

Figure 116—Exploded View of Oil Pressure Relief Valve Assembly

4. WORN BEARINGS.—Excessive bearing clearance will cause low oil pressure and high oil temperature.

5. DEFECTIVE PRESSURE GAGE.—It should be made certain that pressure gage is accurately calibrated before replacing or removing major parts of the engine in locating the cause of low oil pressure.

6. WORN OR DAMAGED OIL PUMP.—A worn oil pump may cause a gradual drop in oil pressure over a number of hours of operation. A sudden drop in oil pressure or complete loss of oil pressure may be caused by a foreign object being drawn through the pump.

7. EXCESSIVE OIL LEAKS.—Excessive oil leaks are usually caused by excessive crankcase pressure or by improper sealing of gasketed joints. Excessive crankcase pressure can, in most cases, be traced to sticking of the main crankcase breather valve. If this trouble is suspected, the crankcase breather assembly should be removed and the valve stem cleaned and, if necessary, dressed down with emery cloth and polished with crocus cloth to assure that the valve moves freely on the shaft. Excessive crankcase pressure may also be the result of worn or stuck piston rings.

Leakage from gasketed joints is usually caused by broken or improperly seated gaskets, improperly tightened or unevenly tightened attaching nuts, or warped mating surfaces.

(f) CHECKING CRANKSHAFT RUN-OUT AFTER A SUDDEN STOPPAGE OF PROPELLER.—After any accident which involves sudden stoppage of the propeller, the propeller should be removed and the crankshaft run-out checked at the front and rear cone locations. This operation may be accomplished by clamping a dial indicator so that the plunger bears on the above mentioned locations as shown in *figure 117*. If indicator support is clamped directly to thrust bearing housing studs, be sure to pad studs to avoid damage to threads. The run-out is the total indicator travel. If the run-out at the front cone location exceeds .007 inch or if the run-out at the rear cone location exceeds .003 inch, the engine should be removed and disassembled regardless of the plane in which the run-out exists. Continued operation of engines with crankshaft run-out greater than the above limits is likely to result in rough operation loosening of the thrust bearing housing and eventual failure of the crankshaft at the thrust nut.

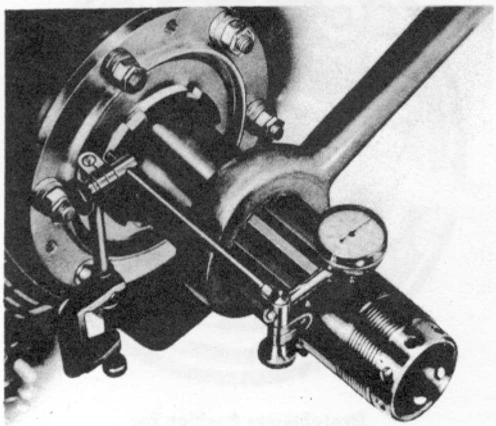


Figure 117—Checking Crankshaft Run-out at Front Cone Location

(4) ENGINE ADJUSTMENTS.

(a) MAGNETO TIMING.

1. ADJUSTMENT OF BREAKER POINTS.

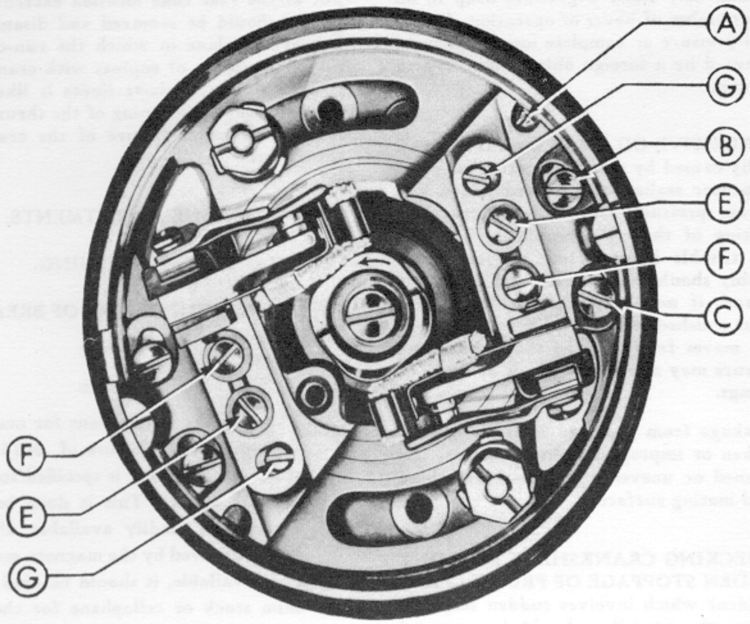
Note

Through the instructions for magneto timing operations, the use of .0015-inch shim stock or cellophane is specified for checking breaker timing. This is done because this material is readily available. If a timing light approved by the magneto manufacturer is available, it should be used instead of shim stock or cellophane for checking the breaker point timing.

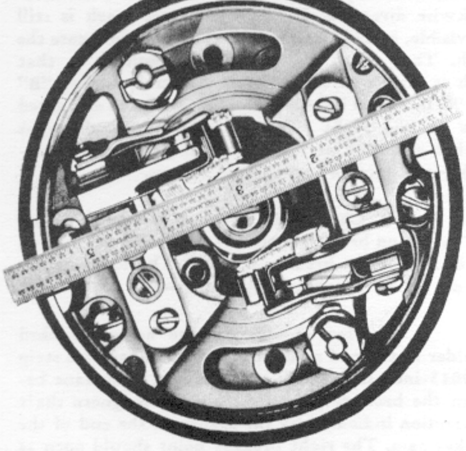
a. Remove breaker cover. Referring to *figure 118*, see that 4½-degree mark is visible through hole "A". If 4½-degree mark cannot be seen through hole, loosen screws "B" and "C" and push the right breaker assembly as far as it will go in a counter-clockwise direction. If the 4½-degree mark is still not visible, remove screws "B" and "C" and locate the mark. Then place the breaker in position so that mark is visible through notch. Assemble screws "B" and "C" into the holes which align with the elongated holes in the right breaker assembly. Push right breaker assembly as far as it will go in a counter-clockwise direction and tighten screws.

b. Check left breaker assembly to see that marks on breaker assembly boss align with mark on the rim of the breaker housing. The breakers are now set for 4½-degree staggered sparks.

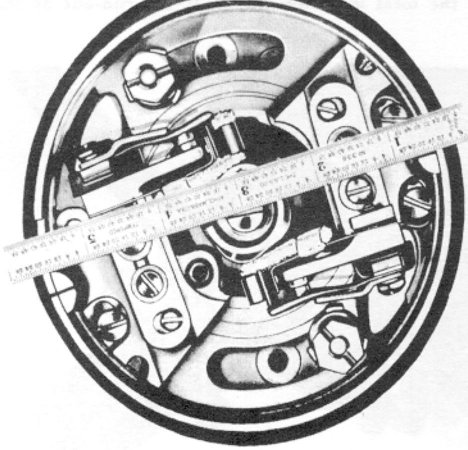
c. Place a straightedge across notched shoulder at the end of the breaker cam. Insert a strip of .0015-inch shim stock or a piece of cellophane between the breaker points. Rotate the magneto shaft in direction indicated by the arrow on the end of the breaker cam. The right breaker point should open as the straightedge lines up with the mark on the boss of the right breaker mounting and the left breaker should open as the straightedge lines up with the mark on the left breaker mounting. If the breakers



Breaker Assembly Viewed from Rear of Engine



Straightedge Position for Left Breaker Point Opening



Straightedge Position for Right Breaker Point Opening

Figure 118—Magneto Breaker Assembly

open too early or too late, they should be adjusted by loosing screws "E" and "F" and moving the breaker in or out by means of eccentric screw "G". Turning the screw "G" clockwise will cause that particular breaker to open earlier. Turning the same screw counter-clockwise will cause that particular breaker to open late. When the correct adjustment is obtained, tighten screws "E" and "F" and recheck to see that adjustment is still correct.

CAUTION

It must be remembered that the breaker points must be set to open at the proper time with relation to the marks on the breaker mounting bosses and that there is no specific gap setting of the breaker points.

2. TIMING MAGNETO TO ENGINE. *(See figures 119 and 120.)*

a. Place No. 1 cylinder on compression stroke. Compression stroke may be located by removing the front spark plug and placing the thumb over the spark plug hole. With the thumb in place, rotate the engine in the direction of normal rotation. The compression stroke will be indicated by definite positive pressure, tending to force the thumb off of the spark plug hole. Assemble top center indicator, Lycoming tool No. 1209-B, in spark plug hole so that arm projecting inside of cylinder is turned down toward the piston. Assemble pointer, Lycoming tool No. 40083, over studs on thrust bearing cap and assemble timing disc, Lycoming tool No. 1225, on crankshaft spline. Turn the engine in direction of normal rotation until pointer on top center indicator begins to move. Stop turning and mark this point on the top dead center indicator scale. Also mark or record the reading of the pointer on the timing disc.

b. Rotate the engine past top center approximately 45 degrees, then rotate the engine in the direction opposite normal rotation until the top center indicator pointer is in the exact location where it was previously marked. Mark or record the reading of the timing disc.

c. Find the exact mid-point between the two marks or readings of the timing disc. This point will be top dead center. Without moving the pointer. rotate the crankshaft until this mid-point is exactly aligned with the pointer. Then without moving the crankshaft, adjust the pointer by means of the knurled adjusting screw until the pointer aligns with the "0" on the timing disc. The timing disc is now set so that readings on the timing disc will correspond with degrees before and after top center for No. 1 piston.

d. Rotate the crankshaft in direction opposite normal rotation to a point approximately 45 degrees before top center of No. 1 cylinder; then turn the crankshaft in direction of normal rotation up to a point of 30 degrees before top center. (This procedure should be followed in order to take up back-lash.) Assemble a gasket on the magneto mounting and then rotate the magneto shaft in direction indicated by arrow on end of cam until the left breaker point is just beginning to open. Holding the magneto shaft in this position, assemble the magneto on the engine and assemble retaining nuts and washers. Tighten the nuts only finger tight.

e. Check the timing disc to see that the crankshaft is still at 30 degrees before top center, then insert a strip of .0015 shim stock or cellophane between the left breaker point. Rotate the magneto in the mounting slots until the point is found where the left breaker point is just beginning to open. Lock the magneto in this position by tightening the mounting nuts.

f. To check the timing, rotate the crankshaft in the direction opposite normal rotation about

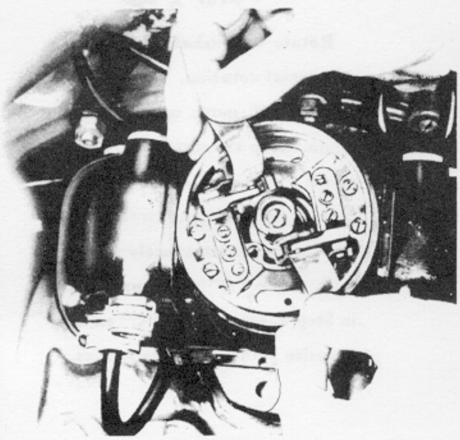
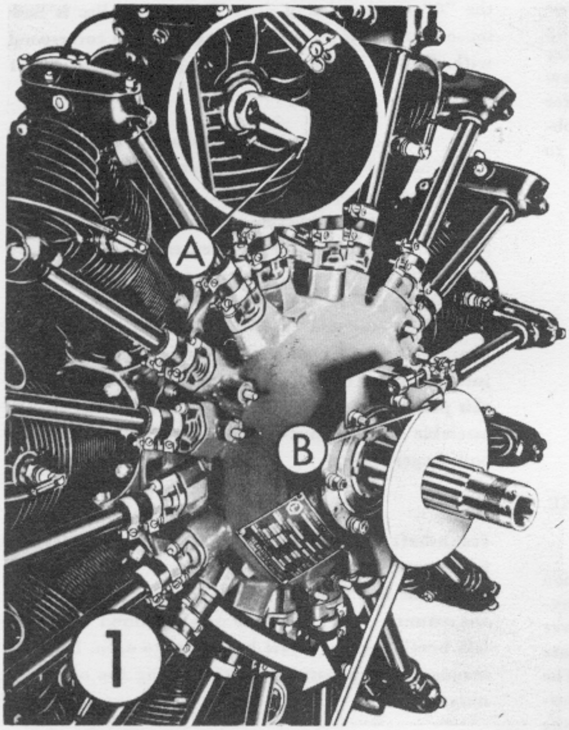


Figure 119—Checking Magneto Breaker Timing (This method to be used only if timing light is not available)



← STEP 1

Rotate crankshaft in direction of normal rotation until piston begins to move pointer of top dead center indicator. Stop here and mark "A" the position of the pointer on the indicator face and "B" the position of the pointer on the timing disc.

STEP 2 →

Rotate crankshaft in direction of normal rotation. The indicator pointer will move up, then down again. Keep turning until pointer comes down past mark "A" then turn crankshaft backwards until indicator pointer exactly lines up with mark "A" previously made in Step 1. Make Mark "C" exactly opposite pointer on timing dics.

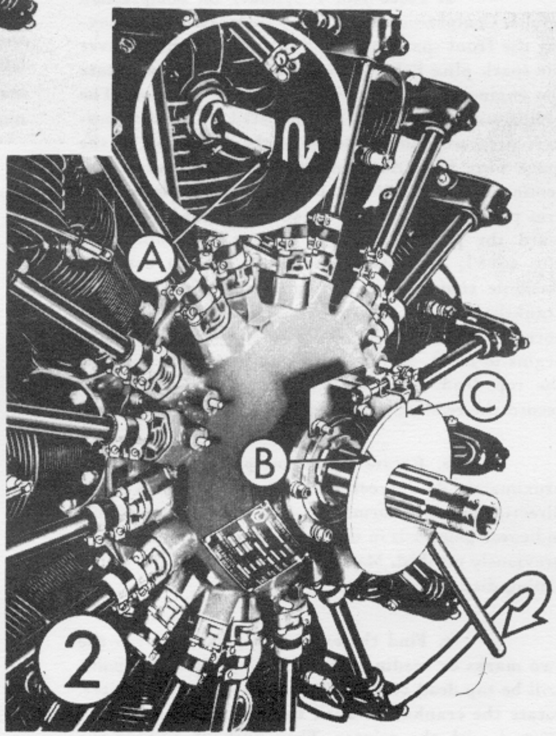
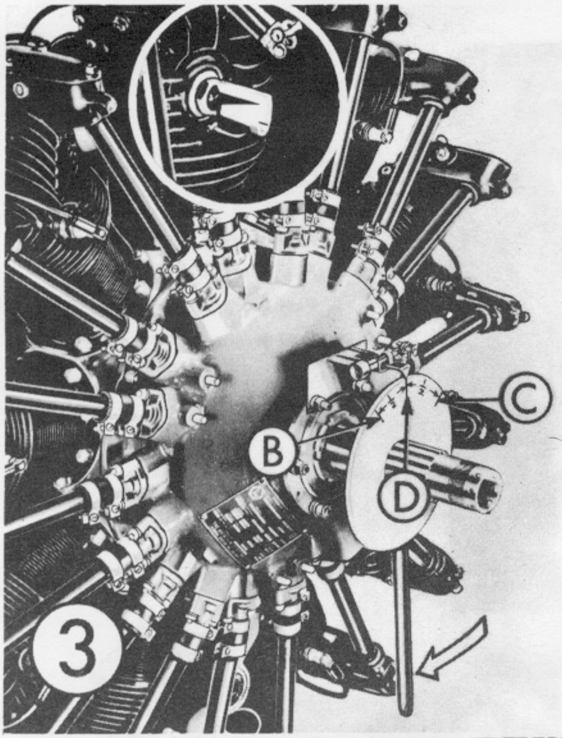


Figure 120—Finding Top Dead Center (Sheet 1 of 2 Sheets)



← STEP 3

Find the exact mid-point between marks "B" and "C". Make a mark "D" here and align this mark with the pointer.

STEP 4 →

Without moving the crankshaft from the position found in Step 3, adjust the pointer to read "0" by turning the knurled knob on the pointer support. Degrees before and after top dead center can now be read directly from the timing disc.

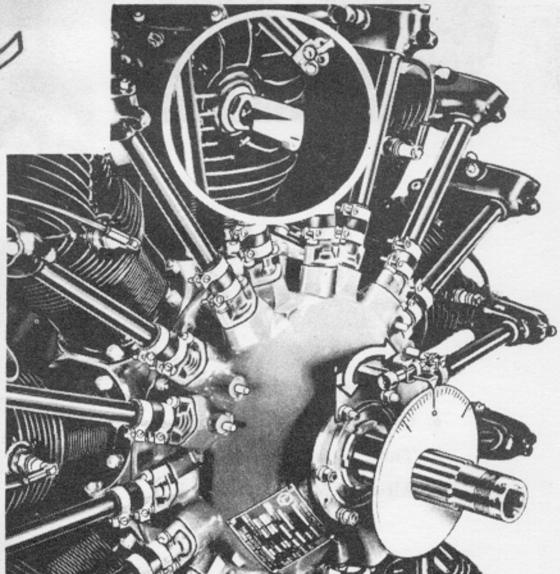
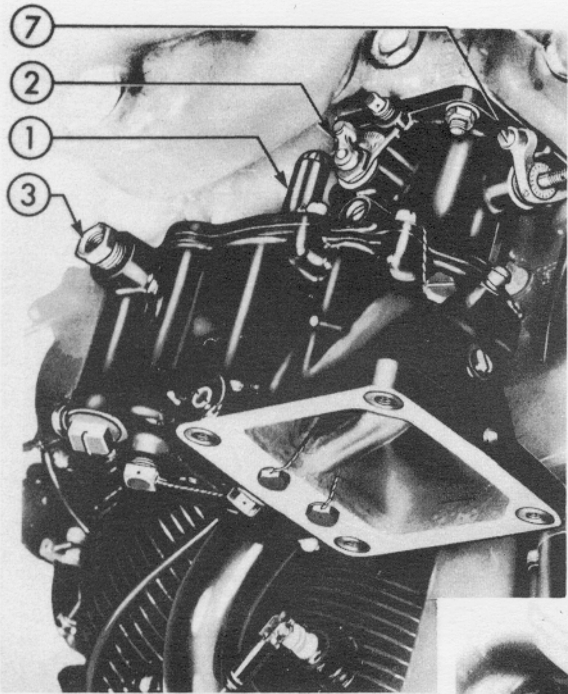
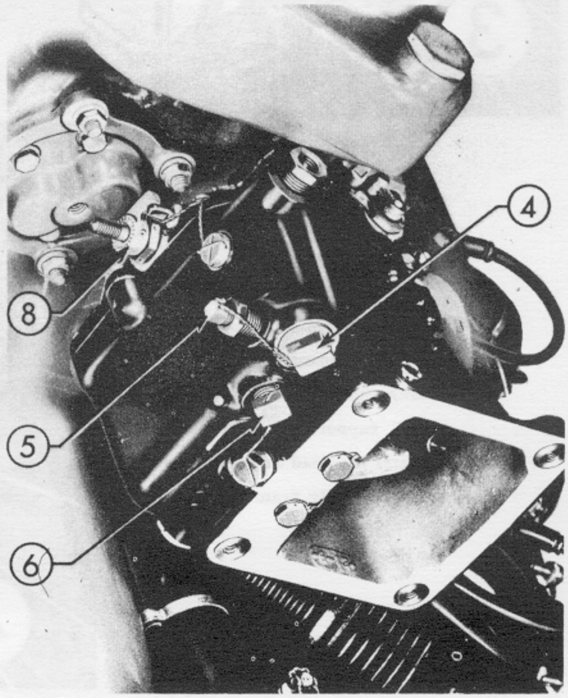


Figure 120—Finding Top Dead Center (Sheet 2 of 2 Sheets)



1. Accelerating Pump
2. Idle Mixture Adjustment
3. Fuel Inlet Connection
4. Fuel Strainer



5. Fuel Pressure Connection
6. Carburetor Bowl Drain Plug
7. Throttle Stop Screw
8. Altitude Mixture Control

Figure 121—Carburetor—Model NAR7B

20 degrees. Insert a strip of .0015 shim stock or cellophane between each pair of breaker points. Rotate or "bump" the crankshaft slowly in direction of normal rotation. The right breaker points should open when the timing disc reads 34 degrees before top center and the left breaker points should open when the timing disc reads 30 degrees before top center. If the breakers do not open at 30 and 34 degrees, the magneto mounting nuts may be loosened and the magneto turned slightly in order to obtain the correct adjustment. Turning the magneto clockwise will cause the breaker points to open earlier, or turning the magneto counter-clockwise will cause the breaker points to open later. When final adjustment is complete, assemble lock nuts on magneto mounting studs.

g. After all timing operations are completed, clean breaker points to remove any trace of cellophane or oil and replace breaker cover. Do not remove timing disc until distributor timing has been checked if this is necessary.

(b) DISTRIBUTOR TIMING.

1. TIMING THE LEFT DISTRIBUTOR.—Set the crankshaft 30 degrees before top center of No. 1 piston as directed in "Magneto Timing," paragraph *(a)*2. above. Assemble gasket, enameled oil seal, and distributor insulating plate in distributor so that hole in plate and seal fit over dowel in such a way that the three tapped holes will be clear to receive the distributor cap attaching screws. Temporarily assemble distributor rotor on distributor coupling so that dowel and coupling fits hole in rotor. Place coupling over spline on distributor shaft so that large electrode on rotor aligns with center of square on distributor insulating plate. Remove rotor, leaving coupling in place on distributor shaft. Secure coupling with washer, nut, and cotter pin. Rotor may now be assembled in place over coupling and secured with two cap screws. Lockwire the two cap screws together. Make sure to carry the lockwire under the rotor, otherwise sparks may jump to the lockwire and cause irregular engine operation. Place distributor cap in position and rotate cap slightly to be sure that aligning dowel fits to hole on cap. Secure cap in place using three cap screws. Lockwire the cap screws together.

2. TIMING THE RIGHT DISTRIBUTOR.—Assemble the right distributor in the same manner as the left, except that no enamel oil seal plate is used in the right distributor.

Note

One of the right distributor cap screws is shorter than the other two. This short screw must be assembled in the rearmost hole in the right distributor, that is, the hole nearest the tachometer drive.

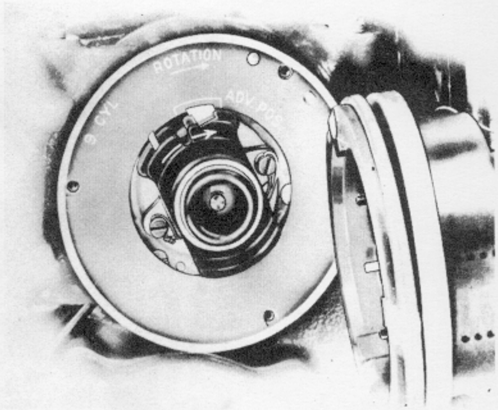


Figure 122—Position of Distributor Finger for Firing No. 1 Cylinder

(c) CARBURETOR ADJUSTMENT.—Start and warm up engine. If necessary, make rough preliminary adjustment of carburetor in order to keep engine running. When engine is warm, adjust idle speed to 500 rpm by means of throttle stop screw. *(See figure 121.)* After getting correct idle speed, adjust the mixture by means of the idle mixture adjustment. *(See figure 121.)* The best idling mixture may be obtained by first leaning the adjustment by turning towards the letter "L" until engine begins to speed up or run rough, then richen the mixture by turning towards the letter "R" until engine begins to "roll". This will give an idea of the extreme ends of the mixture range. Move adjustment towards the lean position just enough to secure smooth operation of the engine. This is the best point for the idle adjustment. It is desirable to use the richest mixture that will give smooth idling even though faster idling speeds will be found at somewhat leaner mixtures. After adjusting the idle mixture, check the idling speed, and, if it is incorrect, readjust the throttle stop screw to give idling speed of 500 rpm.

(5) ASSEMBLY AND INSTALLATION.

(a) ASSEMBLY.—The reassembly procedure of the engine and accessories to the engine mount will

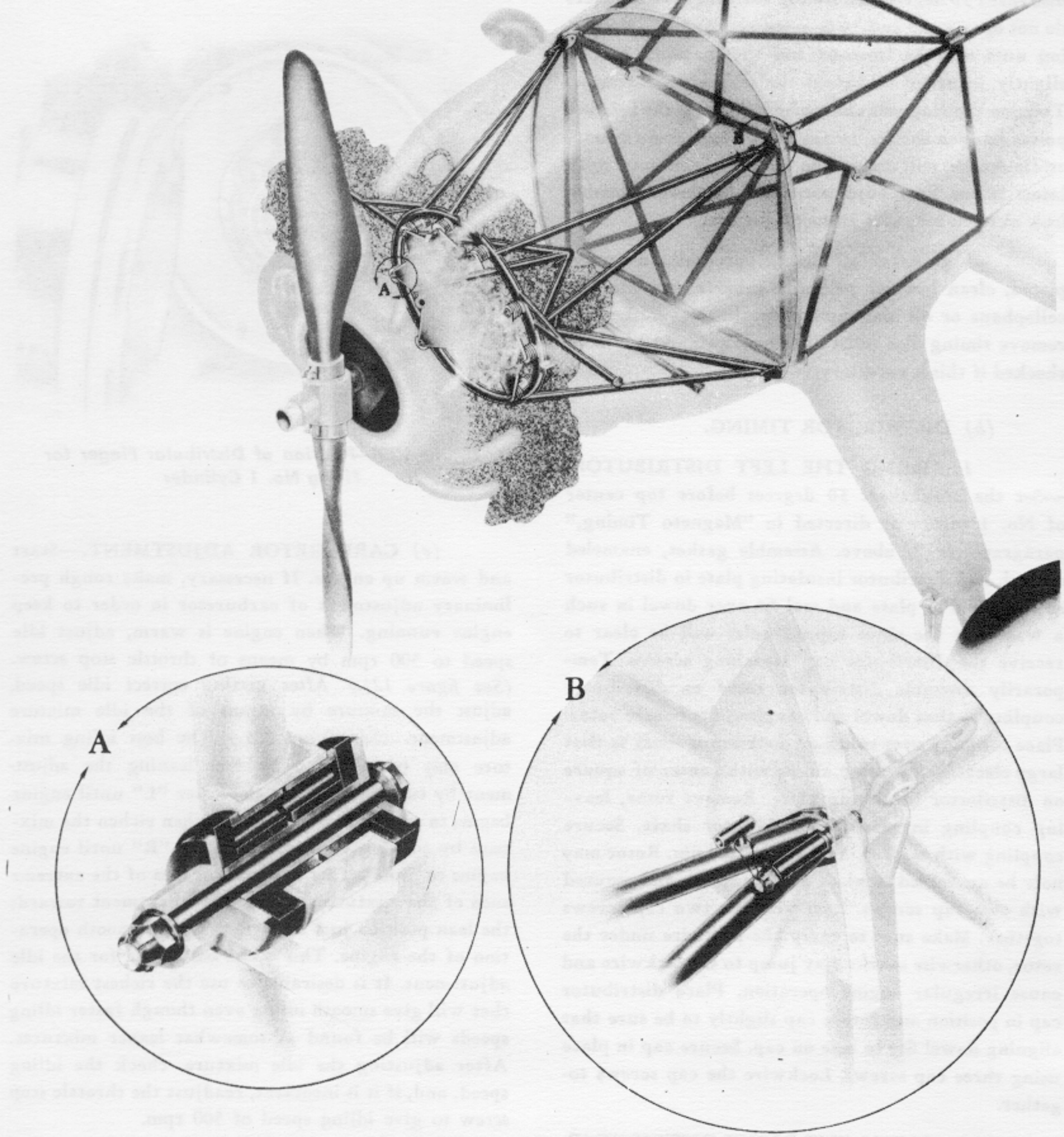


Figure 123—Engine Section Installation

be the exact reverse of the disassembly procedure outlined in paragraph 5.*a.*(2) above.

Note

The rubber engine mount vibration absorbers, *figure 123*, Detail A, should be replaced at each engine change.

(*b*) INSTALLATION.—Procedure for installing the engine unit will be the reverse of the removal instructions as outlined in paragraph 5.*a.*(2) above.

CAUTION

Care should be exercised when fitting the engine mount to the fuselage that the attaching studs, *figure 123*, detail B, are not damaged.

b. ENGINE CONTROLS.

(1) DESCRIPTION.

(*a*) The engine control system consists of a standard B-13 control unit modified to install a microphone switch, *figure 124*, mounted on the left side of each cockpit and a carburetor air control lever, *figure 125*, mounted in an easily accessible position between the front and rear cockpits on the right side. These units are connected to the engine through a series of rods and bellcranks.

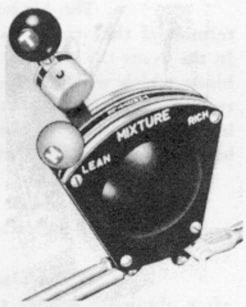


Figure 124—
Engine Control Unit

(*b*) Fore movement of the throttle lever on the control unit increases the engine rpm; aft movement decreases the engine rpm. The fuel mixture is enriched by forward movement of the carburetor mixture control lever and aft movement leans the mixture.

(*c*) The butterfly valves in the carburetor air intake housing regulate the volume of heated air into the carburetor and are controlled by the carburetor air control lever. Cold air only is admitted when the control handle is in its full forward position and progressive aft movement of the handle proportionally increases the volume of hot air and decreases the volume of cold air.

(*d*) Fuel flow from the fuel tank to the engine is controlled by a fuel shut-off valve. This valve is operated by a control handle mounted on the left side of each cockpit, directly below the instrument panel. *(Figure 126.)*

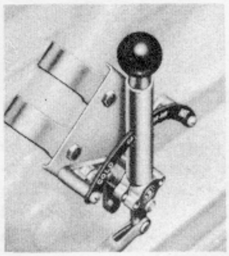


Figure 125—
Carburetor Air Control Lever

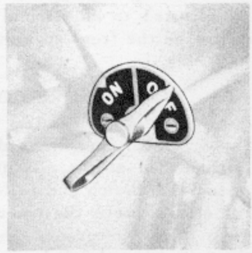


Figure 126—
Fuel Valve Shut-off Lever

(2) REMOVAL AND DISASSEMBLY.—The system of rods, bellcranks and supports connecting the control units with the engine are joined by standard bolts and clevis pins and no special procedure is recommended for removal.

(3) MAINTENANCE REPAIRS.

(*a*) ADJUSTMENT OF CONTROLS.—should it become necessary to adjust the mixture and throttle controls, the following procedure is recommended.

1. THROTTLE CONTROL.

a. The front push-pull rod should be disconnected from carburetor throttle lever.

b. Throttle idle adjustment should be backed off until throttle valve can be felt to be completely closed.

c. Throttle idle adjustment should now be turned clockwise five notches.

d. Throttle valve stop screw is to be adjusted until throttle valve is wide open.

e. Throttle intercockpit push-pull rod should be disconnected from the throttle lever in the rear cockpit making the rear throttle control inoperative while adjustments are being made.

f. The front push-pull rod is now reconnected and should be adjusted in length by turning the clevises on the ends of the rod until the throttle control lever in the front is within ⅛ inch of full travel, both fore and aft. When this rod is fully adjusted, a cushioning effect will be noticed with the control lever in the wide open or idle position.

g. The control in the rear cockpit should be adjusted to correspond with the travel of the control in the front cockpit.

2. MIXTURE CONTROL.

a. The forward push-pull rod should be disconnected at the mixture control lever and adjusted to full-rich and full-lean positions by turning the clevises until the travel of the mixture control gives ⅛-inch clearance when the control lever is in the full-rich and full-lean position.

Note

Control rod should be attached to the upper hole in the control lever.

b. The control in the rear cockpit should be adjusted to correspond with the travel of the control in the front cockpit.

c. After all adjustments are made, it should be made certain that all rods and clevises are properly safetied.

3. CARBURETOR AIR CONTROL.

a. The forward end of the carburetor air control push-pull rod should be disconnected from the carburetor air valve.

b. Cockpit control lever should be placed in the last notch of the "FULL-COLD" position.

c. The carburetor air valve should be turned to the "FULL-COLD" position and the length of the push-pull rod adjusted until the rod will mate properly with the lever on the air valve. The rod and lever should be connected in this position.

d. With valve and control lever properly adjusted in the "FULL-COLD" position, settings will be correct with control lever in "FULL-HOT" or any intermediate position.

(4) ASSEMBLY AND INSTALLATION.—No express procedure is recommended for assembling and installing the engine controls except that the adjustment instructions outlined above must be used in setting travel for the control rods.

c. PROPELLER.

(1) DESCRIPTION.—The PT-13D/N2S-5 airplane is equipped with either a McCauley 8 ft. 6 in. fixed pitch, ground-adjustable steel propeller or a Sensenich 8 ft. 2 in. fixed pitch, non-adjustable wooden propeller.

(2) METAL PROPELLER.

(a) REMOVAL.—To remove the propeller from the engine shaft, the clevis pin securing the hub retaining nut must first be removed. The hub nut is then unscrewed, drawing the propeller off the shaft. The front cone and nut may be removed from the hub by removing the snap ring.

(b) MAINTENANCE REPAIRS.

1. EXCESSIVE ENGINE VIBRATION.—Should excessive engine vibration develop, the ignition system and carburetor should first be checked for proper functioning. If this does not eliminate the vibration, the following is recommended.

a. The blades should be checked to determine if they track within ⅛ inch of each other. In the event the track is greater than ⅛ inch, a new blade which will match properly to obtain the correct track alignment should be installed. While making this check, it is also necessary to check blade lengths which must be within ⅛ inch of each other.

b. The blade pitch should be set at 11.7 degrees at the 42-inch station.

c. If the blades are out of track or if, after obtaining proper track, the propeller continues to vibrate, it must be removed from the engine shaft and checked for balance. This may be done by removing the blades from the hub and laying them over a level knife edge; the center of gravity of each blade should be determined and marked on the blade. The center of gravity of each blade must be within 1/16 inch when measured from the inner end of the blade.

If this condition does not exist, it may be obtained by matching blades until a pair is obtained that balance, after which the blades may be assembled to the hub.

d. If, in the final balance check before installation on the engine, the propeller is found to need vertical balance correction, it may be secured by rotating the clamp rings on the hub to bring the bolt on the light side of the propeller hub boss.

e. During assembly of the propeller blades, care must be exercised to tighten the clamp ring bolts to the specified value of 1100 (±100) inch-pounds.

2. ABRASIONS.—Small nicks or scratches on the blades may be dressed out using a fine file and finishing with crocus cloth or stone. After dressing the scratch, the surface must be finished with black lacquer.

3. A light coat of engine oil should be applied to the propeller daily. This will greatly increase the service life of the propeller by preventing rust.

(c) INSTALLATION.

1. The rear cone, propeller, front cone, hub retaining nut and snap ring should be assembled on the engine shaft in the sequence given.

2. The hub retaining nut should be tightened to 450 foot-pounds. This torque may be applied by a man of approximately 175 pounds using a 31-inch rod. If 450 foot-pounds will not allow the lock pin holes to align, the nut may further be tightened to 500 foot-pounds in order to align these holes.

3. The snap ring should be inserted over retaining nut and the nut secured with the clevis pin and cotter.

(3) WOODEN PROPELLER.

(a) REMOVAL.—Instructions for removing wooden propeller from engine shaft are the same as for metal propeller above.

(b) MAINTENANCE REPAIRS.

1. EXCESSIVE ENGINE VIBRATION.—Should excessive vibration develop, the ignition system and carburetor should first be checked for proper functioning. If this does not eliminate the vibration, the following is recommended:

a. The blades should be checked to determine if they track within 1/16 inch of each other. Should the blades be found out of track, in most instances they may be brought into correct alignment by tightening the hub bolt nuts on the side of hub adjacent to the blade that requires alignment. A torque wrench should be used to tighten the nuts to a reading of 250 inch-pounds (±25).

Note

It is important that the nuts should not be tightened to beyond the recommended value in order that the surface of the wood propeller hub is not fractured.

b. If the propeller is not out of track, the propeller and hub should be removed from the plane as a unit and carefully checked for a balance.

c. If one blade is heavy when placed in a horizontal position, varnish should be applied to the flat side of the light blade until balance is obtained. It should not be necessary to add more than two coats. If two coats are necessary, a drying period of about 48 hours should be allowed between coats.

d. If, in the final balance check before installation on the engine, the propeller is found to need vertical balance correction, it may be secured by placing a brass plate on the light side of the propeller hub boss.

2. REPAIRS OF SMALL CRACKS AND CUTS.—Small cracks parallel to the grains that do not run through a lamination may be repaired by filling them with glue and thoroughly working it into all portions of the crack. After the glue has dried, it should be sanded smooth and flush with the surface of the propeller. This also applies to small cuts.

3. REPAIRS OF DENTS AND SCARS.—Appreciable dents or scars which have rough surfaces or shapes that will hold a filler and will not induce failure, may be filled with a mixture of casein glue and clean, fine sawdust thoroughly worked and packed into the defect, dried and then sanded flush with the surface of the propeller. In any case, all loose splinters should be removed.

4. A light coat of good polishing wax should be rubbed on the propeller daily. This will greatly increase the service life of the propeller by keeping out moisture.

(c) INSTALLATION.—Procedure for installing the wooden propeller on the engine is the same as for the metal propeller above.

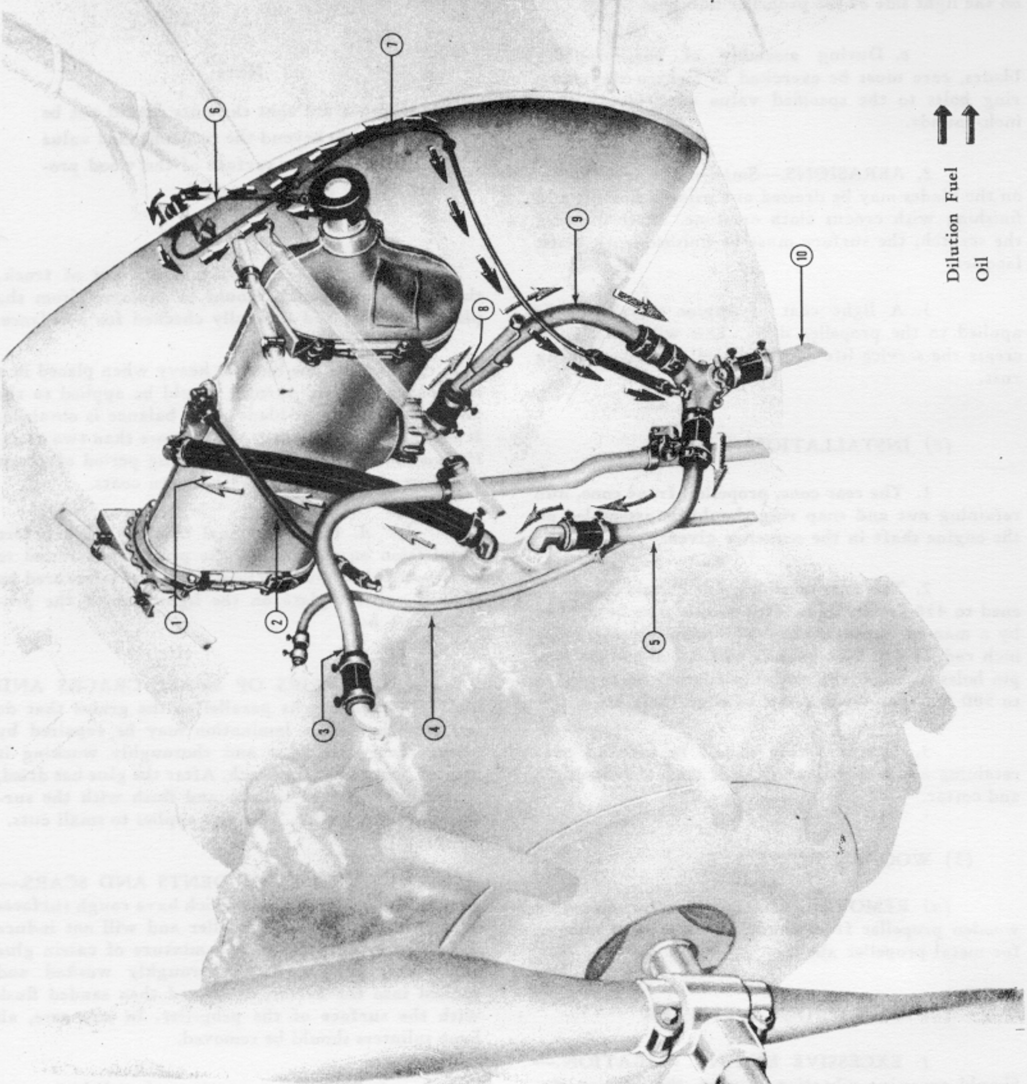


Figure 127—Oil System Diagram and Tubing Identification Chart (Sheet 1 of 2 Sheets)

INDEX NO.	ASSY. NO.	NO. REQD.	NAME	TUBE DASH NO.	LENGTH	I. D.	WALL THICK-NESS	MATERIAL AND SPEC.	NUTS AND SLEEVES	NO. REQD. PER ASSY.	FITTINGS	NO. REQD. PER ASSY.	MISC.	No. Reqd.
1	AN884-16-84	1	Hose		21"	1.000	.156	Syn. Rubber AN-ZZ-H-456			A75N1-3030 Elbow Assy.	2	AN746-11 Clamp	2
2	E75N1-3012	1	Line—Oil Tank Vent	−0	14 11/16"	.416	.042	Al. Alloy WW-T-787 ANN.			AC850-8 Elbow AC851-8 Elbow 45°	1 1	AN746-7 Clamp AN884-8-9 Hose	4 2
3	75-3027	1	Line—Engine Breather	−0	39 11/16"	.902	.049	Al. Alloy WW-T-787					AN746-11 Clamp AN884-16-11 Hose	2 1
4	75-3026	1	Line—Engine Vent-Oil	−0	28¼"	.416	.042	Al. Alloy WW-T-787			AC851-8 Elbow	1	AN746-7 Clamp AN884-8-9 Hose	2 1
5	E75N1-3007	1	Line—Drain "Y" to Engine Oil	−0	10 1/16"	.902	.049	Al. Alloy WW-T-787			A75N1-3030 Elbow Assy.	1	AN746-11 Clamp AN884-16-11 Hose AN884-16-12 Hose	4 1 1
6	E75N1-3004	1	Line Assy.—Oil Dilution Fuel to Solenoid	−1	5⅛"	.180	.035	Copper WW-T-799	AC811BT-4B Nut AC811T-4CS Sleeve	2 2	AN4077-1 Fitting AN914-1 Elbow AC811FT-4 Nipple AC811CT-4 Elbow	1 1 1 1	AN912-3 Reducer AN913-1 Plug	1 1
7	E75N1-3003-1	1	Line Assy.—Solenoid to 'Y' Oil Dilution Fuel	−2	38⅝"	.180	.035	Copper WW-T-799	AC811BT-4B Nut AC811T-4CS Sleeve	1 1	AC811CT-4 Elbow AC851-4 Elbow 45°	1 1	AN884-4-9 Hose AN746-5 Clamp AC995C-40-3 Wire	1 2 1
8	E75N1-3006	1	Line Assy.—Thermo Well Oil Inlet	−1	5¾"	.902	.049	Al. Alloy WW-T-787			75-3005 Elbow Assy.	1	AN746-11 Clamp AN884-16-11 Hose	2 1
9	E75N1-3006	1	Line Assy.—Thermo Well Oil Inlet	−2	10 25/32"	.902	.049	Al. Alloy WW-T-787					A75N1-3008 Well AN746-11 Clamp A75N1-3007 Plug AN884-16-12 Hose	2 2 2 1
10	E75N1-3024	1	Line—Oil Drain	−0	5¼"	.902	.049	Al. Alloy WW-T-787					AN746-11 Clamp AN884-16-11 Hose	2 1

NOTE: Tubing Cut in Length for Replacement Purposes Should Be 10% Longer Than the Actual Lengths Specified.

Figure 127—Oil Syste[illegible]gram and Tubing Identification Chart (Sheet 2 of 2 Sheets)

d. OIL SYSTEM.

(1) DESCRIPTION.—The oil system consists of an oil tank, "Y" drain, oil temperature wells and incorprates an oil dilution system.

(a) The oil tank is fabricated of aluminum alloy and has an oil capacity of 4.76 U. S. gallons (3.96 Imperial) with an addition 1.60 U. S. gallons (1.34 Imperial) expansion space. A standpipe sump in the bottom of the tank prevents sediment in the oil tank from flowing into the engine. A hopper installed within the tank in conjunction with the oil dilution system aids in starting and warm-up of the engine.

(b) The oil dilution system consists of an oil dilution solenoid valve with a fuel line extending to the "Y" drain in the oil-in line of the oil system. The oil dilution valve is controlled by a toggle switch mounted on the left side of the instrument panel. Oil dilution should be employed before stopping the engine when a cold weather start is anticipated. *(See figure 127* for Oil System Diagram and Tubing Identification Chart.)

(2) REMOVAL.—Removal of the oil system consists of removing the oil tank, oil dilution solenoids and connecting lines and fittings. The oil tank is easily removed by disconnecting the oil-in and oil-out lines and removing the attaching brackets. Line ends should be taped upon removal to prevent entrance of foreign particles.

(3) MAINTENANCE REPAIRS.—All oil lines, hose couplings and fittings should be checked frequently for leaks, and hoses and clamps showing signs of deterioration should be replaced. The oil tank and supports should be examined for cracks and the tank support straps drawn snug at all times.

(4) ASSEMBLY AND INSTALLATION.—Care should be exercised when reassembling the oil system to make certain that all connections fit properly and that all clamps are tight to prevent leaks. The tank strap turnbuckles should be drawn tight enough to assure a snug fit of the tank against the supports.

e. FUEL SYSTEM.

(1) DESCRIPTION.—The fuel system is of the gravity feed type and includes an aluminum alloy tank, fuel strainer, fuel valve and aluminum alloy fuel lines. The fuel tank is located in the upper wing center section, with supply lines attached to each rear corner of the fuel tank to insure continuous fuel flow in all flight attitudes with the exception of inverted flight. The fuel strainer is located at the lowest point in the fuel system just ahead of the firewall. The fuel valve, actuated by a control unit in either cockpit, is installed in the fuel line at the firewall. *(See figure 131* for Fuel System Diagram and Tubing Identification Chart.)

(a) The tank has a capacity of 46 U. S. gallons (38.3 Imperial) with a 1.38 U. S. gallons (1.15 Imperial) expansion space. Sumps are provided at the two aft corners incorporating cocks to drain accumulated sediment and water.

(b) A sight type fuel gage is provided on the lower side of the fuel tank visible from both front and rear cockpits. Reading calibrations are in fourths of tank capacity and can be read accurately when the airplane is in level flight attitude only. A drain cock is incorporated to allow collected sediment and water to be drawn off.

(c) The fuel valve, located just aft of the firewall, is controlled from either cockpit by connecting cranks and torque rods. The fuel strainer embodies a screen and drain cock for removal of sediment and water.

(2) REMOVAL AND DISASSEMBLY.

(a) TANK.—The following is the recommended procedure for removing the fuel tank from the center section:

1. All fuel lines and the vent line should be disconnected from the fuel tank fittings.

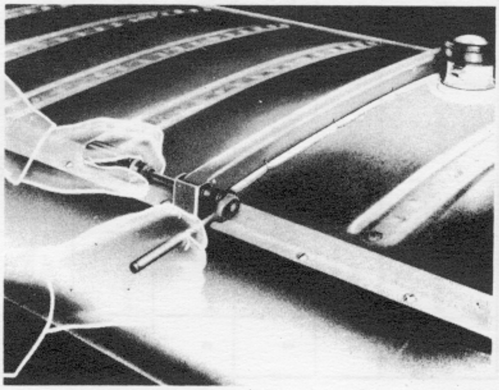


Figure 128—Center Section Stiffener Removal

2. Closure strips around edge of tank should be removed and all bonding jumpers disconnected.

3. Center section stiffener must be removed from over fuel tank. *(See figure 128.)*

4. Turnbuckles connecting straps over top of tank should be disconnected and the straps removed. *(See figure 129.)*

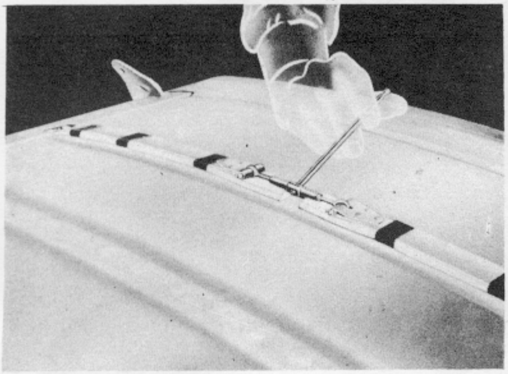


Figure 129—Tank Strap Turnbuckle

5. By placing one hand on the underside of each sump, the tank should be carefully worked loose from center section and lifted out.

(b) Fuel lines, fuel valve, and strainer are easily removed by disconnecting fuel line and the mounting brackets. Upon removal, all lines should be taped to prevent foreign matter from entering tubes.

(3) MAINTENANCE REPAIRS.

(a) With the fuel tank removed from the center section, the felt cushioning pads should be inspected for wear and replaced if necessary.

(b) Fuel sumps should be cleaned regularly by removing sump cock and allowing sediment to drain off. If further cleaning is necessary, sump should be removed and cleaned in a suitable solution.

(c) If leaks occur around sumps, the sump gaskets should be examined and replaced if necessary.

(d) The fuel strainer should be cleaned at regular intervals. When removing the screen for cleaning, the gasket should be replaced.

(e) All line connections, supporting clamps and brackets should be maintained secure at all times.

(f) If the fuel gage becomes discolored and the drain cock clogged it should be cleaned by swabbing the inside of the gage with a solution of 50 per cent dope thinner, AN Specification No. AN-TT-T-256, and 50 per cent methyl alcohol, AN Specification No. AN-M-32. The swab is inserted with a twisting motion and drawn out *straight*. The swab must be removed at once, as deterioration results if dope thinner is allowed to remain in contact with the material of the fuel gage. The red indicator within the gage should be brightened by buffing lightly with fine sandpaper. Transparency may be restored to the checked outer surface of the fuel gage by spraying lightly with dope thinner at full strength.

CAUTION

As much care as possible should be taken to prevent dope thinner from coming in contact with threaded portions of the gage as the material will be softened and the threads distorted.

(4) ASSEMBLY AND INSTALLATION.

(a) Care should be exercised when reassembling the fuel system to make certain that all connections fit properly and that all clamps fit tight to prevent leaks.

(b) To reinstall the fuel tanks, the above removal procedure should be reversed; however, care should be taken to tighten the tank straps only sufficiently to hold the tank snug.

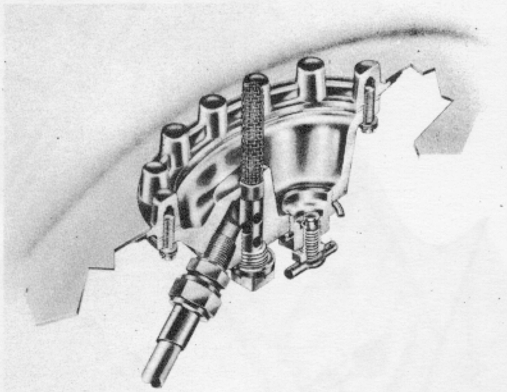


Figure 130—Fuel Tank Sump

f. AIR INTAKE SYSTEM.

(1) DESCRIPTION.

(a) The air intake system consists of a cast aluminum alloy carburetor air intake housing, *figure 132* (1), a welded aluminum alloy cold air intake stack which includes the lower cold air intake pipe (2), an air cleaner housing (3) incorporating an Air Maze filter (4), an upper cold air intake pipe (5), an air scoop and screen (6) and a welded aluminum alloy hot air intake pipe (7).

(b) Cold air enters the system at the air scoop above the engine cowl and is forced down the cold air stack through the Air Maze filter and into the air intake housing containing the regulating valve. If desired, heated air from the exhaust shroud may be mixed with cold air entering the carburetor by regulating butterfly valves within this housing.

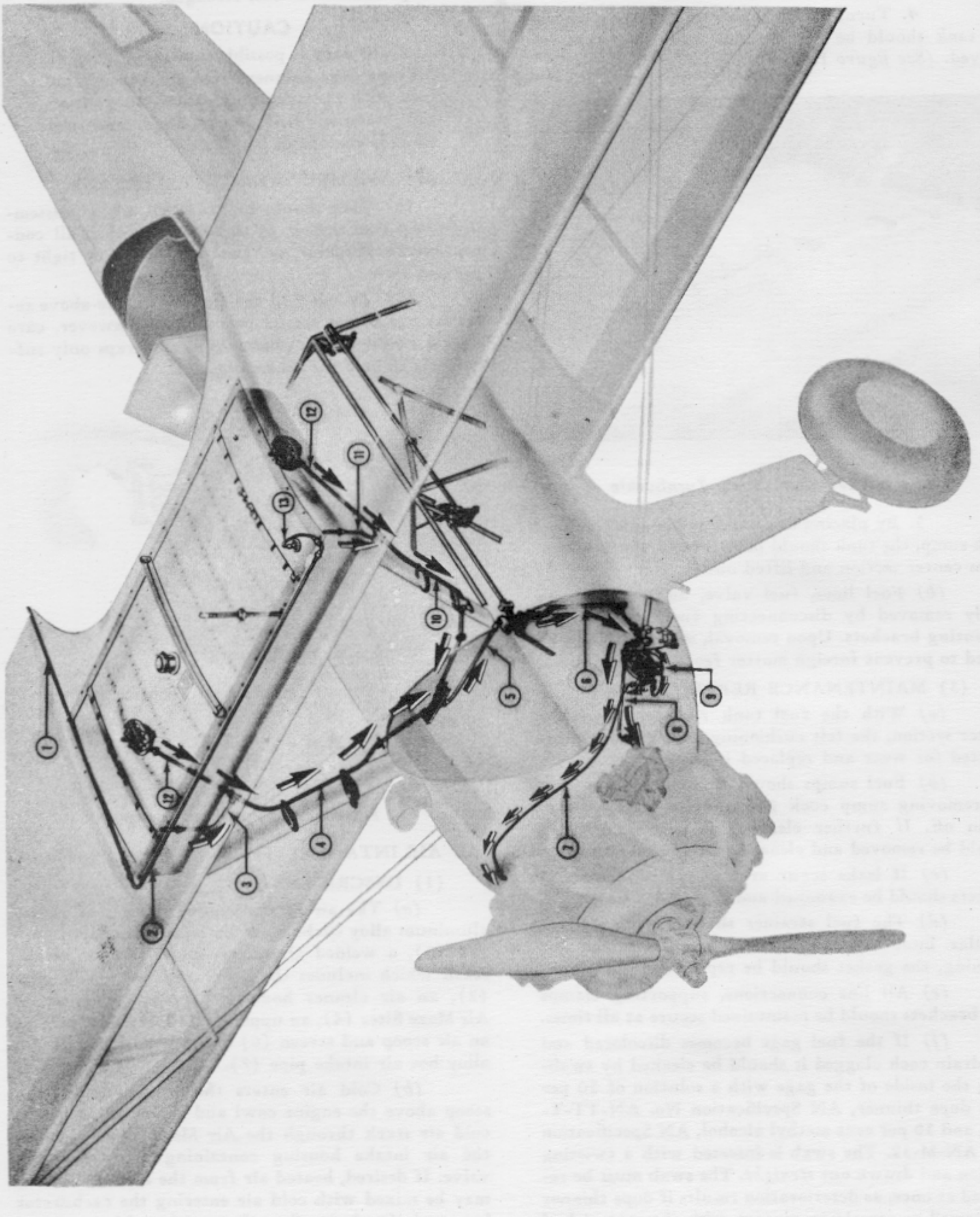


Figure 131—Fuel System Diagram and Tubing Identification Chart (Sheet 1 of 2 Sheets)

INDEX NO.	ASSY. NO.	NO. REQD.	NAME	TUBE DASH NO.	LENGTH	I. D.	WALL THICK-NESS	MATERIAL AND SPEC.	NUTS AND SLEEVES	NO. REQD. PER ASSY.	FITTINGS	NO. REQD. PER ASSY.	MISC.	No. Reqd.
1	75-3131-3	1	Fuel Tank Vent from –3 Tube to Trailing Edge	–6	52¼"	.180	.035	Al. Alloy WW-T-787	AC811BT-4D Nut AC811T-4CS Sleeve	1 1				
2	75-3131-2	1	Fuel Tank Vent from –1 to –3 Tube	–5	74¼"	.180	.035	Al. Alloy WW-T-787	AC811BT-4D Nut AC811T-4CS Sleeve	2 2	AC811ET-4D Elbow AC811HT-4D Union	1 1		
3	75-3125-1	1	Fuel Line—Tank to Tee —Front	–3	9"	.416	.042	Al. Alloy WW-T-787	AC811BT-8D Nut AC811T-8CS Sleeve	2 2	AC811JT-8D Tee	1		
4	75-3127-1	1	Fuel Line Assy.— Tee to Tee	–3	36 15/16"	.416	.042	Al. Alloy WW-T-787	AC811BT-8D Nut AC811T-8CS Sleeve	2 2			75-3151-1 Hose 75-3151-2 Hose	1 1
5	75-3128	1	Fuel Line— Tee to Fuel Cock	–1	11 7/16"	.416	.042	Al. Alloy WW-T-787 Ann.	AC811BT-8D Nut AC811T-8CS Sleeve	2 2	AC811CT-8 Elbow	1		
6	E75N1-3102	1	Fuel Line— Fuel Cock to Strainer	–0	18 31/32"	.416	.042	Al. Alloy WW-T-787 Ann.			A75N1-3112 Elbow AN917-3 Tee AN911-3 Nipple	2 1 1	AN746-7 Clamp AC895-84 Reducer 75-3151-2 Hose AN884-8-9 Hose	4 2 1 2
7	75-3168-2	1	Line Assy.— Primer to Engine	–4	34"	.055	.035	Copper WW-T-799 Type - N	AN805-2 Nut	2	AN790-2 Elbow	2	AN800-2 Cone	2
8	75-3162	1	Fuel Line— Type C2-A Strainer to Engine	–0	14 11/16"	.416	.042	Al. Alloy WW-T-787			E75N1-3112 Elbow E75N1-3111 Elbow	1 1	AN746-7 Clamp AN884-8-9 Hose AC895-84 Reducer	4 2 2
9	75-3168-1	1	Line Assy.— Primer to Strainer	–3	22"	.055	.035	Copper WW-T-799 Type - N	AN805-2 Nut	2	AN790-2 Elbow	2	AN800-2 Cone	2
10	75-3127	1	Fuel Line Assy.— Tee to Tee	–2	36 15/16"	.416	.042	Al. Alloy WW-T-787	AC811BT-8D Nut AC811T-8CS Sleeve	2 2	AC811JT-8D Tee	1	75-3151-1 Hose 75-3151-2 Hose	1 1
11	75-3125	1	Fuel Line— Tank to Tee —Front	–2	9"	.416	.042	Al. Alloy WW-T-787	AC811BT-8D Nut AC811T-8CS Sleeve	2 2	AC811JT-8D Tee	1		
12	75-3166	2	Line Assy.— Tank to Tee Rear Fuel	–1	12 19/32"	.416	.042	Al. Alloy WW-T-787 Ann.	AC811BT-8D Nut AC811T-8CS Sleeve	2 2	AC811FT-8 Nipple	1		
13	75-3131-1	1	Line—Fuel Tank Vent	–4	7 13/16"	.180	.035	Al. Alloy WW-T-787	AC811BT-4D Nut AC811T-4CS Sleeve	2 2	AC811FT-4 Nipple	1		

NOTE: Tubing Cut in Lengths for Replacement Purposes Should Be 10% Longer Than the Actual Lengths Specified.

Figure 131—Fuel System Diagram and Tubing Identification Chart (Sheet 2 of 2 Sheets)

(2) REMOVAL AND DISASSEMBLY.

(a) The housing assembly drain tube (8) should be removed by loosening the upper clamp.

(b) By detaching the clamp (9), the housing (3), pipe (5), and scoop (6) can be removed as a unit. There are no screws or bolts attaching this upper portion. A synthetic rubber sleeve closes the gap between the housing and lower pipe.

(c) The lower pipe (2), housing (1), and hot air intake pipe (7) may also be removed as a unit by detaching carburetor air control arm (10) and removing the bolts which attach the housing to the carburetor. Care should be taken not to damage the gaskets and screen between the housing and carburetor.

(d) The Air Maze filter may be removed from its housing by breaking lockwire and removing the wing nut which secures it in the housing.

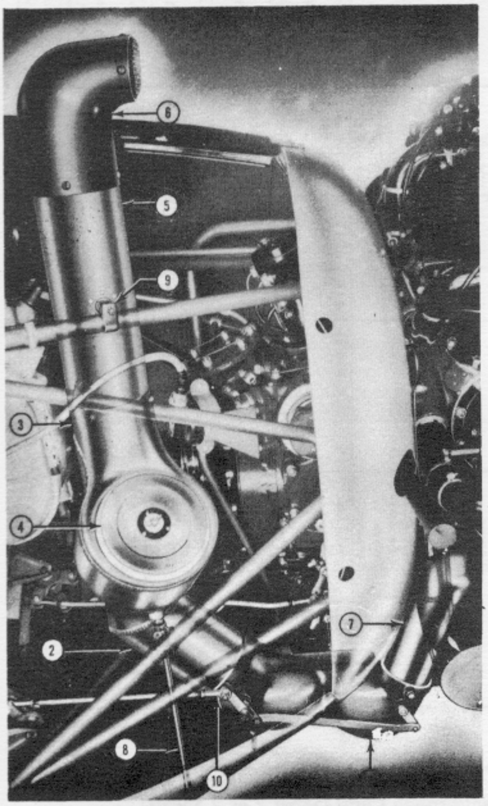


Figure 132—Carburetor Air Intake System

(3) MAINTENANCE REPAIRS.

(a) The entire air intake system should be inspected regularly for cracks and loose bolts or fittings.

(b) The wire mesh in the Air Maze filter should be cleaned and re-oiled at 30-hour intervals, or daily if the airplane is flown in dusty or sandy localities, in the following manner:

1. The mesh element should be washed in gasoline, kerosene, or other suitable volatile cleaning fluid. While cleaning, the element should be rocked or fluid agitated to insure cleaning of the innermost part.

2. The element should be thoroughly dried.

3. When dry, the element should be immersed in oil, AN Specification No. AN-VV-O-446, grade 1120 or lighter.

4. The element should be allowed to drain two hours prior to reinstallation to remove excess oil.

(4) ASSEMBLY AND INSTALLATION.

(a) The reassembly and installation of the air intake system will be the reverse of the procedure for removal and disassembly with the exception that the air intake scoop, *figure 132*, (6), should not be attached to the stack until the bolt through the securing clamp (9) has been tightened. This allows access to the bolt head while it is being secured.

(b) When attaching the control rod to the air control housing, *figure 132* (1), the carburetor air control adjustment procedure outlined above under "Engine Controls," paragraph 5.*b.*(3)*(a)*3, preceding, should be used.

6. FIXED EQUIPMENT GROUP.

a. FLIGHT CONTROLS.

(1) DESCRIPTION.—Surface controls for the PT-13D/N2S-5 airplane are of the stick and rudder pedal type with a duplicate set of controls in each cockpit.

(a) ELEVATOR CONTROLS.—The elevator is operated by inter-connected control sticks mounted on a large diameter chrome-molybdenum steel torque tube supported at the front and rear by self-aligning bearings in housing bolted to the bottom fuselage truss. Each control stick is made from one piece solid

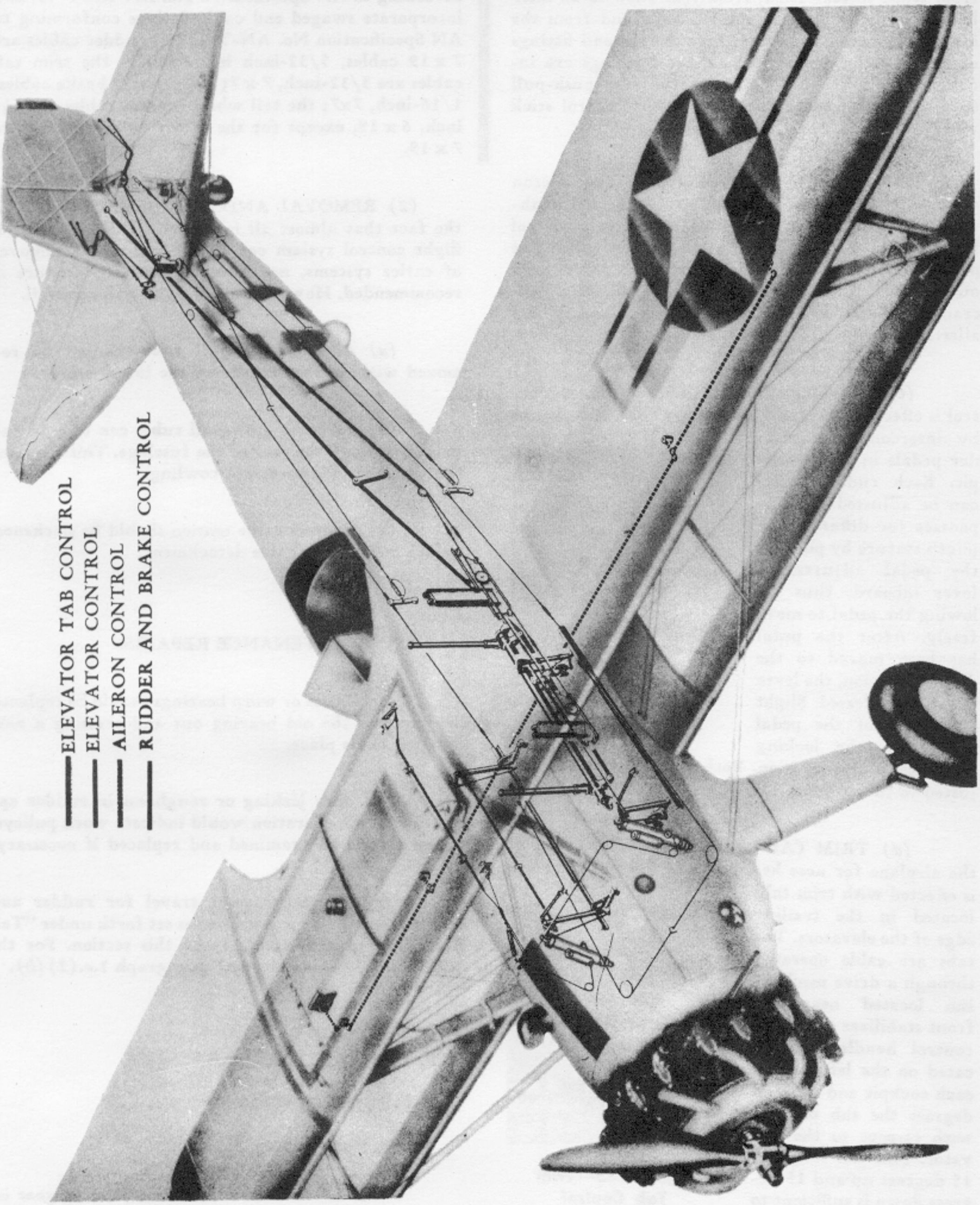


Figure 133—Flight Controls Installation

or laminated turned hickory, mounted in aluminum alloy sockets. Interconnecting push-pull tubes extend from front to rear stick, from rear stick to an idler located midway back in the fuselage, and from the idler to a single horn bolted between the end fittings of the elevator spars. Lord rubber bushings are incorporated in the connection of the rear push-pull tube and the elevator horn to prevent control stick vibration.

(b) AILERON CONTROLS. — The aileron control system is composed of interconnected push-pull tubes attached at their inboard end to a control horn bolted to the control stick torque tube. The push-pull tubes extend from the aileron control horn outboard to an idler in the lower wing and to a bellcrank at the aileron semi-span. The bellcrank and aileron are connected by a short link.

(c) RUDDER CONTROLS. — Rudder control is effected through a system of cables and pulleys by interconnected rudder pedals in each cockpit. Each rudder pedal can be adjusted to compensate for difference in pilot's stature by pushing the pedal adjustment lever inboard, thus allowing the pedal to move freely. After the pedal has been moved to the desired location, the lever should be released. Slight movement of the pedal will allow the locking pin to snap into position. Both pedals should be adjusted to the same setting.

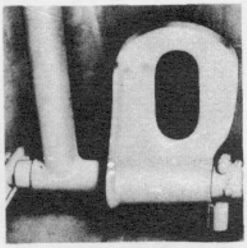


Figure 134—Rudder Pedal Adjustment

(d) TRIM TAB CONTROLS.—Trimming of the airplane for nose heavy or tail heavy conditions is effected with trim tabs located in the trailing edge of the elevators. The tabs are cable operated through a drive mechanism located near the front stabilizer spar. Tab control handles are located on the left side of each cockpit and show in degrees the tab position with respect to the elevator. Full tab range of 15 degrees up and 15 degrees down is sufficient to trim the airplane under all normal load and flight conditions. "AFT" movement of the control handle corrects tail heaviness.

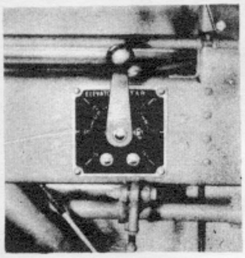


Figure 135—Trim Tab Control

(e) CONTROL CABLES.—All control cables are made of extra flexible carbon steel, fabricated according to AN Specification No. AN-RR-C-43, and incorporate swaged end cable fittings conforming to AN Specification No. AN-T-2. The rudder cables are 7 x 19 cables, 5/32-inch in diameter; the trim tab cables are 3/32-inch, 7 x 7; the parking brake cables, 1/16-inch, 7x7; the tail wheel control cables are 1/8-inch, 6 x 19, except for the safety cables, which are 7 x 19.

(2) REMOVAL AND DISASSEMBLY.—Due to the fact that almost all replacement of parts of the flight control system can be made without removal of entire systems, no express removal procedure is recommended. However, a few basic rules prevail.

(a) Aileron push-pull tubes cannot be removed without first removing the lower wing.

(b) Elevator push-pull tubes can only be removed through the rear of the fuselage. This requires the removal of empennage cowling.

(c) Control cable tension should be slackened before attempting cable detachment.

(3) MAINTENANCE REPAIRS.

(a) Loose or worn bearings should be replaced by pressing the old bearing out and pressing a new bearing in its place.

(b) Any jerking or roughness in rudder operation or tab operation would indicate worn pulleys. These should be examined and replaced if necessary.

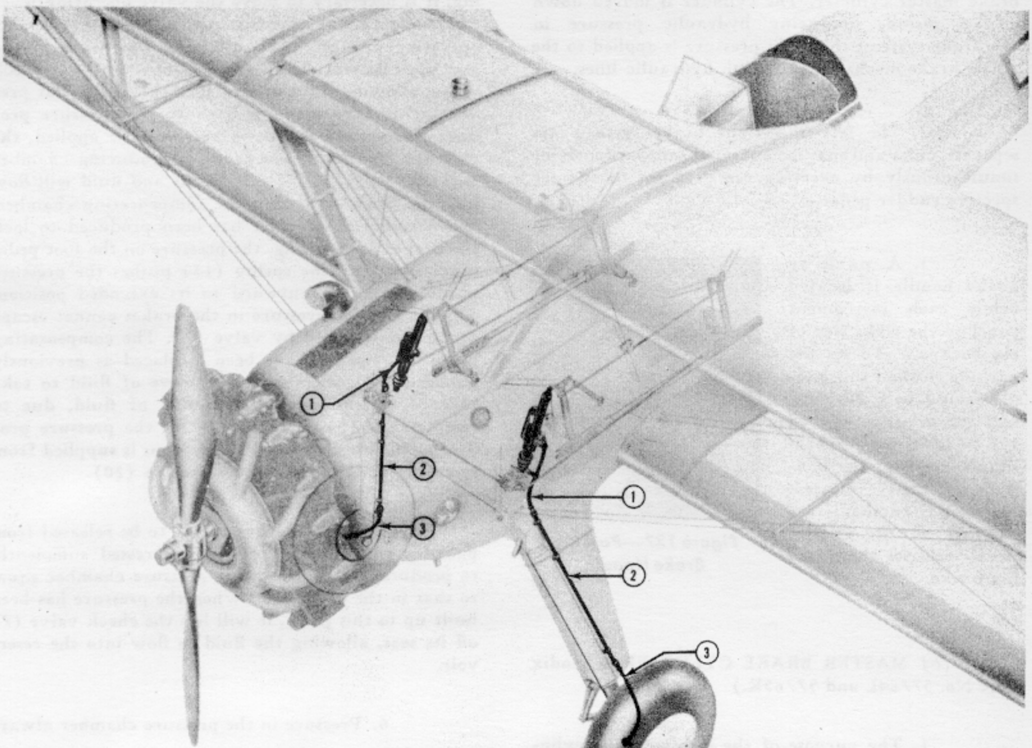
(c) Correct control travel for rudder and elevator should be maintained as set forth under "Tail Group," paragraph 2.*d*.(8) of this section. For the ailerons, see "Wing Group," paragraph 1.*e*.(2) *(b)*.

b. HYDRAULIC BRAKE SYSTEM.

(1) DESCRIPTION.

(a) GENERAL.

1. Each wheel of the main landing gear incorporates a hydraulically-operated brake with a Bendix combination master cylinder unit for each brake. Pressure applied to the brake pedals in either



INDEX NO.	ASSY NO.	NO. REQD.	NAME	TUBE DASH NO.	LENGTH	I. D.	WALL THICK-NESS	MATERIAL AND SPEC.	NUTS AND SLEEVES	NO. REQD. PER ASSY.
1	163-S-160	2	Upper Tube Assy. (Bendix)		13¾″	.125	.188	Spec. No. 033		
2	75-3473	2	Tube Assy.—Upper and Lower Connecting	–1	30″	.2485	.032	Al. Alloy WW-T-787 Ann.	AC811BT-5D or 50419 Bendix Nut AC811T-5CS or 50420 Bendix Sleeve	2 2
3	163-S-150	2	Lower Tube Assy. (Bendix)		12¾″	.125	.188	Spec. No. 033		

NOTE: Tubing Cut in Lengths for Replacement Purposes Should Be 10% Longer Than the Actual Lengths Specified.

Figure 136—Hydraulic Brake System

cockpit is transferred by a mechanical linkage to the brake master cylinder. The cylinder is moved down on its piston, producing hydraulic pressure in the brake system; this fluid pressure is applied to the wheel brake mechanism through hydraulic lines.

2. The left and right brake systems are separate units and may be operated independently or simultaneously by exerting toe pressure to the respective rudder pedals.

3. A parking brake handle is located below each instrument panel on the right side of the cockpits. To set the parking brakes, this handle should be pulled out and toe pressure applied to each rudder pedal simultaneously; the handle is then released. Exerting further toe pressure to the rudder pedals releases the parking brake.

Figure 137—Parking Brake Handle

(b) MASTER BRAKE CYLINDER. (Bendix Part No. 57764L and 57765R.)

1. The purpose of the master brake cylinder, shown in cutaway, *figure 138*, is to operate the brakes by means of hydraulic pressure. Operation of the cylinder is as follows:

2. The reservoir (22) stores excess fluid. A check valve (20) is provided to permit the fluid to flow from the reservoir (22) into the pressure chamber, but not from the pressure chamber back into the reservoir. When the piston (18) is in its extended position, the rubber cup (14) uncovers port (26), allowing any excess fluid in the braking system to flow back into the reservoir. Upon application of the brakes, the cup (14) seals the port (26).

3. In the position shown, the check valve (7) is held open by its tapered operating plunger (21), thus the fluid is free to flow back and forth through the valve (7) so the brakes are at all times connected to the pressure producing chamber. As pressure is built up, part of the fluid will flow into the compensating chamber ahead of the compensating piston cup (3). The pressure of this fluid will compress the spring (1), moving the compensating piston (2), thus producing a reserve of fluid in the compensating cylinder.

4. In order to lock the brakes when parking, it is necessary to move the valve operating lever (11) inboard, thus forcing inward the tapered valve operating plunger (21), allowing the valve (7) to rest upon its seat. The valve (7) now acts as a check valve, allowing fluid to flow into the brake, but preventing it from flowing back to the pressure producing chamber. If the brakes are now applied, the pressure created in the pressure producing chamber will lift the valve (7) off its seat and fluid will flow into the brakes and into the compensating chamber. When sufficient pressure has been produced to lock the brakes for parking, the pressure on the foot pedal is released, and the spring (13) pushes the pressure producing piston outward to its extended position. The fluid under pressure in the brakes cannot escape because it is sealed by valve (7). The compensating piston and spring have been displaced as previously outlined to accommodate a reserve of fluid to take care of expansion or contraction of fluid, due to temperature change. Fluid, to fill the pressure producing chamber as the piston returns is supplied from reservoir (22) through check valve (20).

5. When the brakes are to be released from parking position, the pedal is depressed sufficiently to produce a pressure in the pressure chamber equal to that in the brake line. When the pressure has been built up to this point, it will lift the check valve (7) off its seat, allowing the fluid to flow into the reservoir.

6. Pressure in the pressure chamber always

1. Compensator Spring.
2. Compensator Piston.
3. Compensator Cup.
4. Valve Cage Lock Plug.
5. Fluid Outlet Hole.
6. Valve Cage.
7. Parking Valve.
8. Packing—Valve Operating Plunger.
9. Valve Control Guide.
10. Valve Lever Bracket.
11. Valve Operating Lever.
12. Washer.
13. Piston Return Spring.
14. Master Cylinder Cup.
15. Piston Seal Ring.
16. Cylinder Boot.
17. Snap Ring.
18. Master Cylinder Piston.
19. Reservoir Plug.
20. Check Valve.
21. Valve Operating Plünger.
22. Fluid Reservoir.
23. Reservoir Cap.
24. End Cap.
25. Bleeder Plug.
26. Fluid Port Hole.
27. Reservoir Plug.
28. Valve Control Spring.

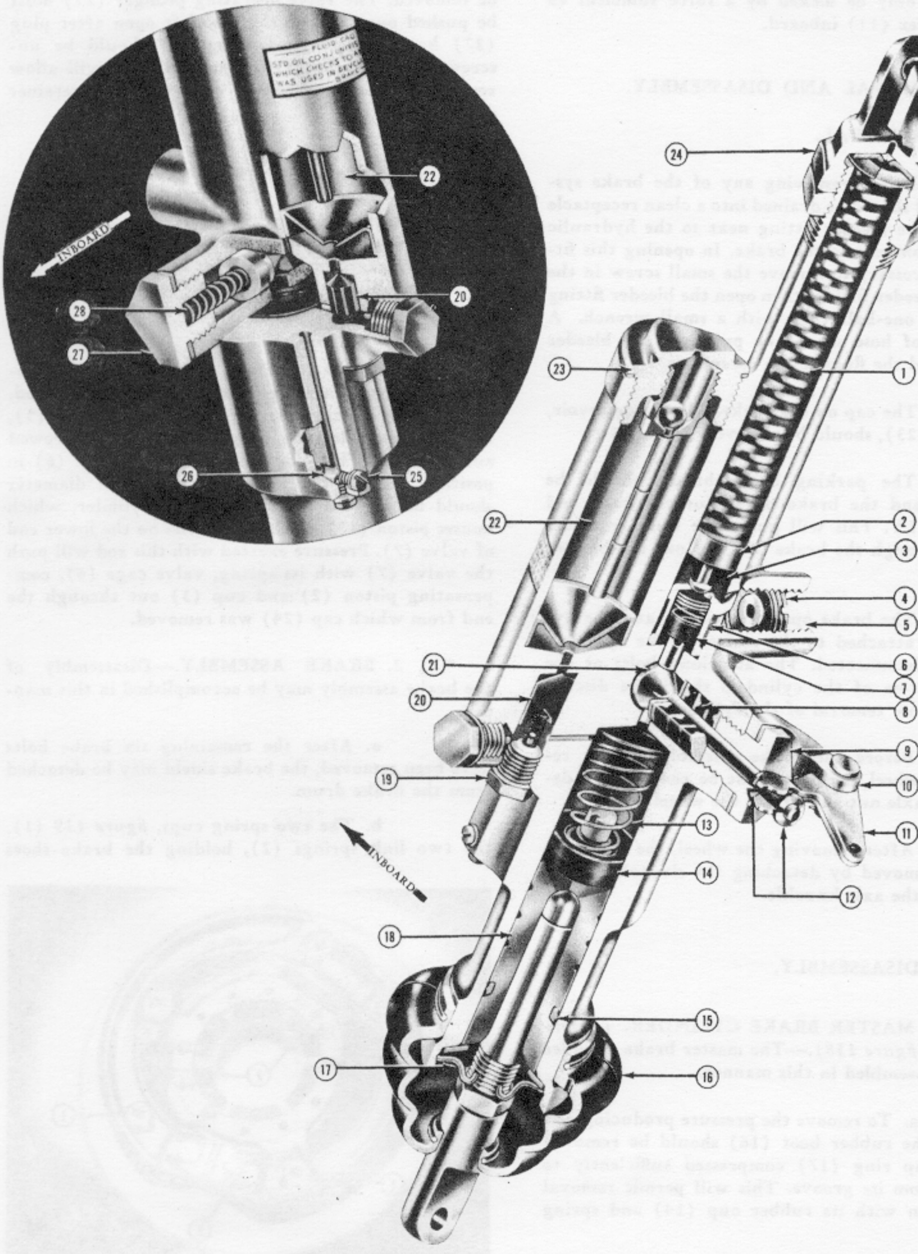


Figure 138—Master Brake Cylinder

tends to force the valve operating plunger (21) outward into the position which holds the valve (7) open; thus, the brakes cannot be accidentally locked as they can only be locked by a force sufficient to move the lever (11) inboard.

(2) REMOVAL AND DISASSEMBLY.

(a) REMOVAL.

1. Before removing any of the brake system, the fluid should be drained into a clean receptacle by opening the bleeder fitting next to the hydraulic line which connects to the brake. In opening this fitting, it is necessary to remove the small screw in the end of the bleeder fitting, then open the bleeder fitting valve about one-half turn with a small wrench. A small piece of hose should be put over the bleeder fitting to lead the fluid to the receptacle.

2. The cap on the brake cylinder reservoir, *figure 138*, (23), should be removed.

3. The parking brake handle should be pulled out and the brake pedal pumped back and forth SLOWLY. This will pump the fluid from the reservoir through the brake line and out the bleeder fitting.

4. The brake operating cables and the hydraulic line attached to the master brake cylinders should be disconnected. The attaching bolts at the top and bottom of the cylinders should be disconnected to allow removal of the cylinder.

5. Before the brake assembly can be removed, the wheel assembly must be removed by detaching the axle nut and lifting the wheel off.

6. After removing the wheel, the brake assembly is removed by detaching the six bolts which attach it to the axle knuckle.

(b) DISASSEMBLY.

1. MASTER BRAKE CYLINDER. *(References are to figure 138)*.—The master brake cylinder may be disassembled in this manner.

a. To remove the pressure producing piston (18), the rubber boot (16) should be removed and the snap ring (17) compressed sufficiently to release it from its groove. This will permit removal of the piston with its rubber cup (14) and spring (13).

b. The reservoir check valve (20) will slip out upon removal of the plug (19).

c. The two split washers (12) should be pried open and removed from the valve operating plunger (21). The plug (27) and spring (28) should be removed. The valve operating plunger (21) must be pushed out through the hole left open after plug (27) has been removed. Plug (9) should be unscrewed and bracket (10) removed. This will allow removal of the three rubber cups and their retainer parts (8).

Note

The feather edges of the rubber piston cups act as seals to prevent leakage and if they are damaged or turned over in removing or reassembling, the unit will not function properly.

d. After the end cap (24) has been removed, the compensating spring (1) may be removed. By inserting a screw driver in the outlet hole (5), the valve cage locking plug (4) can be unscrewed and removed. This plug locks the valve cage (6) in position. A long bar about 3/16 inch in diameter should be inserted in the operating cylinder, which houses piston (18), so that it presses on the lower end of valve (7). Pressure exerted with this rod will push the valve (7) with its spring, valve cage (6), compensating piston (2) and cup (3) out through the end from which cap (24) was removed.

2. BRAKE ASSEMBLY.—Disassembly of the brake assembly may be accomplished in this manner:

a. After the remaining six brake bolts have been removed, the brake shield may be detached from the brake drum.

b. The two spring cups, *figure 139* (1), the two link springs (2), holding the brake shoes

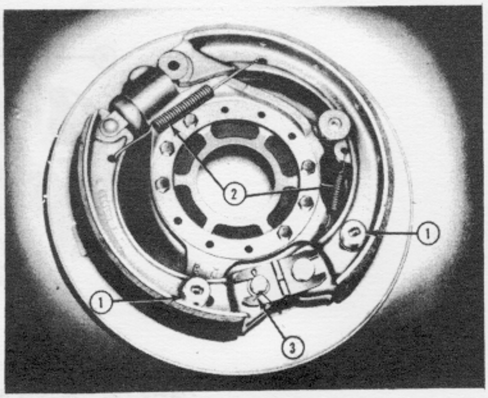


Figure 139—Brake Shoe Removal

together, and the link cotter pin (3) should be removed to allow removal of the brake shoes.

(3) MAINTENANCE REPAIRS.

(a) Outlined in the chart below is a list of trouble shooting operations to be performed on the Bendix master brake cylinder when irregularities and difficulties in operation are observed. *(References are to figure 138.)*

CONDITION	CHECK	CORRECTION
I. Failure to produce operating pressure at the brake.	1. Brake lines and brake cylinders should be examined for leaks. If there are leaks in brake lines and brake cylinders:	Adjustments or replacments must be made as needed to eliminate such leaks.
	2. Inside of boot (16) should be examined. If inside of boot contains fluid that has leaked past piston cup (14) and piston seal ring (15):	Piston cup (14) and seal ring (15) should be replaced.
	3. Remove fitting (24). If after removal of fitting, fluid is found in cylinder due to leakage of piston cup (3):	Piston cup (3) should be replaced.
	4. Leakage of valve (20) will permit fluid to escape from the pressure chamber back into reservoir (22) while the brakes are being applied. Fitting (19) should be removed to inspect valve (20). If it appears swollen or cut so as to allow leakage:	Check valve should be replaced with new part, No. 59100.
II. Parking brake pressure cannot be maintained.	1. Parking valve (7) must seat properly to prevent fluid from leaking back from the brakes into the master cylinder when the brakes are parked. Valves should be inspected and if found to be damaged so as not to seat properly:	Valve should be replaced, part No. 56890.
III. Parking brakes cannot be released. Operating plunger (21) does not return to off position.	1. The parking brakes cannot be released unless valve operating plunger (21) returns to off position. If plunger fails to return when an attempt is made to release the brakes, the cable linkage connected to (11) should be examined. If friction of linkage is found to be great enough to prevent return of plunger (21):	A return spring should be installed on parking linkage to offset friction.
	2. If adequate provision has been made to offset friction in parking linkage and plunger (21) still does not return to the off position:	Plunger (21) should be removed and reseated in its cylinder.
IV. Parking brakes cannot be released, but operating plunger (21) *does* return to off position.	1. Cup (14) should be checked to see if it is uncovering port (26). If port (26) is stopped up or is covered by cup (14), the brakes cannot be released. The fluid under pressure remains trapped in the cylinder and cannot return to the reservoir. To check for this condition, fitting (23) should be removed from the top of reservoir (22) and a small rod inserted into the reservoir to open check valve (20). If the brakes instantly release, faulty operation is due either to port (26) being stopped up or cup (14) being swollen sufficiently to prevent opening of the port. If this condition is found to exist:	A new cup (14) should be installed on pressure producing piston (18).

(*b*) ADJUSTMENTS FOR BENDIX BRAKE.—The main landing wheel brakes should be adjusted in the following manner:

1. The main landing gear should be raised on jacks enough to allow wheel rotation.

2. Starwheel access plate should be opened and the starwheel backed off 10 notches. This will allow free, easy turning of the wheel.

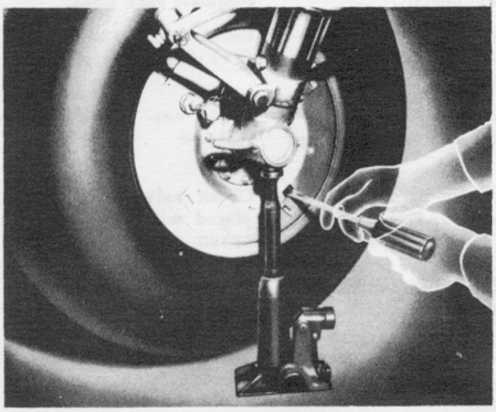


Figure 140—Starwheel Access

3. The lock nut should be loosened and the eccentric nut tightened until the wheel has a slight drag when revolved in its normal direction.

Note

The eccentric nut should be turned in the direction the wheel normally turns.

4. Using a medium size screw driver, the starwheel should be tightened as tight as possible.

5. The starwheel should then be backed off 13 notches. This will usually provide an .008- to .010-inch clearance at each of the two feeler gage slots. *(See figure 141.)*

(4) ASSEMBLY AND INSTALLATION.

(*a*) BRAKE ASSEMBLY.—Reassembly procedure for the brake shoes and shield will be the reverse of the disassembly procedure outlined above; however, the following information will facilitate their reassembly:

1. When assembling the left brake shoe and shield, the first bolt should be inserted at the hydraulic bleeder plug and two more bolts should be installed in the next two consecutive holes to the right. The next three consecutive holes to the right should be skipped and bolts inserted in the following three consecutive holes.

2. When assembling the right brake shoe and shield, the first bolt should be inserted at the hydraulic bleeder plug and two more bolts should be installed in the next two consecutive holes to the left. The next three consecutive holes to the left should be skipped and bolts inserted in the following three consecutive holes.

3. The brake assemblies should be installed on their respective axles in a position so that the bleeder fitting on the inboard side is in line with the Zerk fitting on the lower torque link.

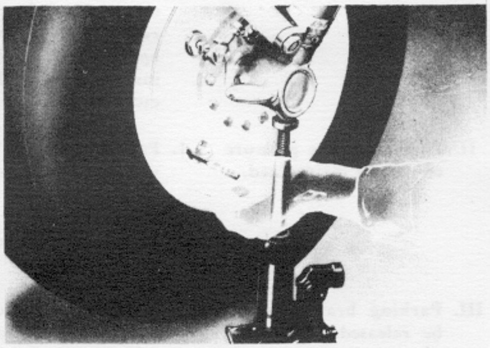


Figure 141—Feeler Gage Access

(*b*) MASTER BRAKE CYLINDER. *(References are to figure 138.)*

1. In reassembling the master cylinder, the pressure producing piston (18) with its cup (14) and spring (13) should be replaced and secured in position by the washer and snap ring (17).

2. The boot assembly (16) is then installed and secured by lockwire.

3. The reservoir check valve (20) and spring should be inserted and the plug (19) replaced.

4. The valve operating plunger (21) should be inserted from the inboard side of the cylinder and the spring (28), plug (27) and washer replaced.

5. Special attention should be given to the assembling of the packing (8) which should be replaced as shown in *figure 142* and as outlined below.

Note

The feather edges of the rubber cups in this packing act as seals to prevent fluid leakage and if damaged or turned over, the unit is sure to leak. Damaged cups should be replaced with Bendix part No. 56889.

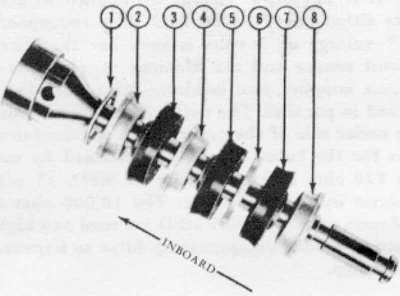


Figure 142—Parking Brake Control Rod and Seals

a. The flat washer, *figure 142* (1), should be inserted over the valve operating plunger. This washer has a 1/4-inch hole in the center.

b. Cup spacer (2) is to be inserted with the lips pointing outboard.

c. Rubber cup (3) should be inserted with its lips pointing inboard. Care should be taken not to tear lips on the threads of cylinder body.

d. Cup spacer (4) is to be inserted with lips pointing outboard.

e. Rubber cup (5) is then inserted with lips pointing inboard.

f. Washer (6) with 13/64-inch center hole is placed over plunger.

g. Rubber cup (7) should then be inserted with lips pointing outboard.

h. Cup spacer (8) is then fitted into rubber cup with lips pointing inboard.

***6.* The bracket, *figure 138* (10), washer and plug (9) should be reinstalled, replacing the split washers (12) with new ones.**

***7.* The parking valve (7) should be replaced, making sure it seats properly in the hole provided. The valve cage (6) can then be returned to its position and secured by the locking plug (4).**

***8.* The rubber cup (3), compensating piston (2) and spring (1) should be returned to the compensating chamber and the washers and fitting (24) replaced.**

***9.* The cup should be replaced in the reservoir (22) and the reservoir cap and gage assembly (23) replaced but not secured.**

***10.* The brake master cylinder should now be reinstalled on the fuselage frame and the parking brake control cable attached to the valve operating lever (11).**

***11.* The hydraulic line should be replaced at the outlet hole (5) and to the brake assembly fitting.**

(*c*) REPLENISHING FLUID IN HYDRAULIC SYSTEM.—After a hydraulic brake system has been disconnected and reconnected, the fluid must be replenished and the air eliminated from the system. This air must be eliminated, since its presence in the line will result in increased pedal travel and "spongy" brakes due to the compression of the air. References are to *figure 138*.

The compression chamber and operating piston (18) can be used as a pump if the parking handle is held in the parking position allowing the valve (7) to rest on its seat. This pump action is possible because valve (20) acts as an intake valve between the pump and fluid reservoir (22) and valve (7) acts as an exhaust valve. Therefore, by pumping the brake pedal slowly, fluid can be passed from the reservoir through braking line and exhaust to the bleeder fitting at the brake.

The procedure for returning fluid to the system is as follows:

***1.* The bleeder fitting, next to the hydraulic line which connects to the brake, should be opened. In opening this fitting, it is necessary to remove the small screw in the end of the bleeder fitting. The bleeder fitting valve should be opened about 1/2 turn with a small wrench. A piece of hose over the bleeder fitting valve should be led into a receptacle to receive the fluid which will be pumped out.**

CAUTION

Use only *red brake fluid* conforming to AN Specification No. AN-VV-O-366 for brake system.

2. The reservoir (22) on the master cylinder should be filled. This fluid may be gaged by removing the cap (23) at the top of the reservoir and gaging the height of the fluid with the fluid gage attached to the cap.

3. The parking brake handle should be pulled out and the rudder pedal pumped back and forth SLOWLY. This will pump fluid from the reservoir (22) through the brake line and out of the bleeder fitting at the brake. This operation should be continued until the fluid coming out of the bleeder is entirely free of air bubbles and then should be continued further until about one-half pint of fluid, free of air bubbles, has been pumped out.

4. The bleeder fitting valve should be closed tightly and the small screw replaced in the end of the valve.

5. Since the reservoir is of small capacity it will be necessary to keep it full at all times while bleeding the line, because, if the reservoir becomes empty, air will be introduced in the line and bleeding will have to be started over again. Usually not more than three strokes are required to completely empty the reservoir.

An auxiliary can of brake fluid should be maintained to keep the reservoir completely filled at all times. This can be accomplished quite easily by using a quart container with a fitting soldered into the bottom and a short length of hose connected to this fitting so the hose can be introduced into the reservoir.

6. Upon completion of the above operation, the reservoir cap (23) should be replaced and secured in position.

c. FURNISHINGS.

(1) INTERPHONE SYSTEM.

(a) DESCRIPTION.

1. Two-place, type RC-73 interphone equipment has been installed incorporating a BC-709-A interphone amplifier located forward of the fire extinguisher. *(See figure 144* (6).*)* This amplifier does not incorporate a volume control. Two pairs of plugs may be inserted into the four jacks on the under side of the amplifier with microphone plugs in the outside jacks and phone plugs in the center jacks. This amplifier is designed for two sets of microphones and two headsets, but may be used with a single microphone and either one or two headsets. Clips, mounted on the fuselage structure just aft of the instrument light in the front cockpit and aft of the fire extinguisher in the rear cockpit, secure the headset and microphone jacks when not in use. A "push-to-talk" microphone switch, type SW-210, is mounted on each throttle control handle.

2. The interphone amplifier BC-709-A, is a single stage, audio amplifier utilizing one tube, type VT-174. The input circuit is designed to accommodate either the T-30 or T-17 type microphone. The "A" voltage of 3 volts is used for the microphone circuit source and the filament supply. The output circuit supplies two headsets HS-23 or HS-18 connected in parallel. The entire assembly is mounted on the under side of the cover and is self-contained. Self bias for the tube, VT-174, is obtained by means of the 820 ohm resistor and its 20 MFD, 25 volt electrolytic by-pass capacitor. The 10,000 ohm resistor and mica capacitor .005 MFD are used as a high audio frequency bond compensating filter to improve overall fidelity.

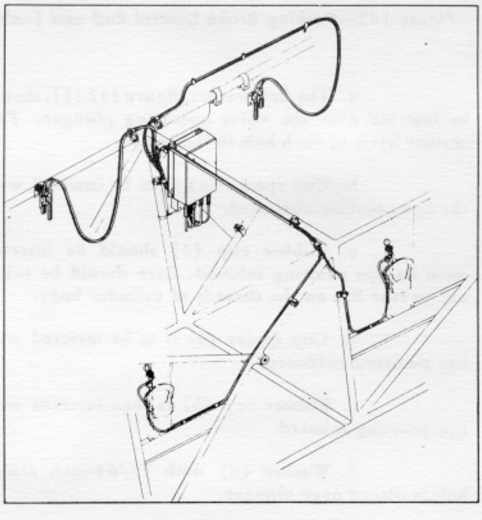


Figure 143—Interphone System

(b) REMOVAL AND DISASSEMBLY.

1. Remove the interphone amplifier box cover and then remove the box at each of the four snap slide connections.

CAUTION

Be sure all wiring has been disconnected before removing the interphone amplifier.

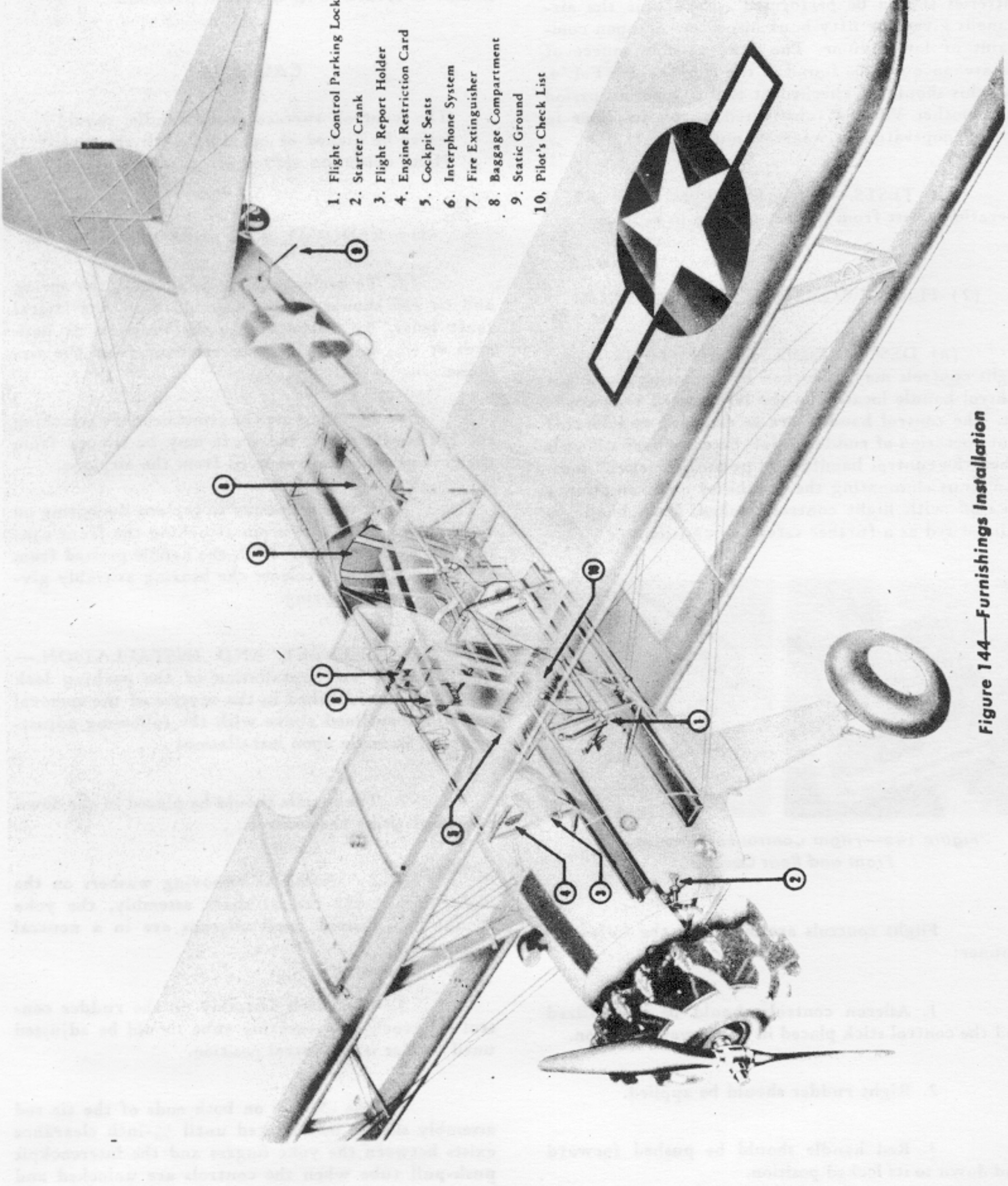


Figure 144—Furnishings Installation

2. The interphone switch may be removed after removal of only two attaching screws.

(c) MAINTENANCE REPAIRS.—Inasmuch as the interphone amplifier, BC-709-A, is operated from "portable" type batteries whose service life is relatively short, a periodic check up and renewal of batteries should be performed at the time the airplane is given the fifty-hour inspection or upon complaint of low volume. The next possible source of maintenance will be found in the tube, type VT-174, and this should be checked at each inspection period and another VT-174 substituted in the amplifier in case of inoperation or weak output.

(d) TESTS.—Before each flight, make an oral operational test from the microphone in each cockpit.

(2) FLIGHT CONTROL PARKING LOCK.

(a) DESCRIPTION. *(Figure 144* (1).*)*—All flight controls may be locked by operating the flight control handle located on the left side of each cockpit. The control handles are so designed and located that operation of rudder pedals becomes very difficult when the control handles are in their "locked" position, thus eliminating the possibility of attempting a take-off with flight controls locked. Each handle is painted red as a further safety precaution.

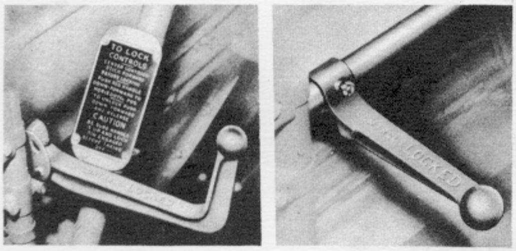


Figure 145—Flight Control Lock Handles—
Front and Rear Cockpits

Flight controls are locked in the following manner:

1. Aileron controls should be neutralized and the control stick placed in its forward position.

2. Right rudder should be applied.

3. Red handle should be pushed forward and down to its locked position.

4. Left rudder should be applied until locking pin snaps into place.

The flight controls are unlocked by pushing down and forward on the control handle, simultaneously applying pressure to the left rudder pedal until the handle is free of the lock, then releasing the handle to return to its unlocked position.

CAUTION

The control surface lock handle should never be kicked or operated with the feet. Hand operation *only* is permissible.

(b) REMOVAL AND DISASSEMBLY.

1. To remove the parking lock, the spring and tie rod should be disconnected from the lateral shaft lever. By disconnecting the brackets at both ends of this shaft, it may be removed from the airplane.

2. By removing the front bracket attaching the horizontal shaft, the shaft may be slipped from the rear bearing and removed from the airplane.

3. If it is necessary to replace the spring on the side shaft, the clevis pin attaching the front control handle must be removed, the handle pressed from the shaft. This will release the bearing assembly giving access to the spring.

(c) ASSEMBLY AND INSTALLATION.—The assembly and installation of the parking lock should be accomplished in the reverse of the removal procedure outlined above with the following adjustments to be made upon installation:

1. The handle should be placed in the down position locking the controls.

2. By adding or removing washers on the right side of the lateral shaft assembly, the yoke should be adjusted until ailerons are in a neutral position.

3. The catch assembly on the rudder control intercockpit connecting tube should be adjusted until rudder is in neutral position.

4. The clevises on both ends of the tie rod assembly should be adjusted until ⅛-inch clearance exists between the yoke fingers and the intercockpit push-pull tube when the controls are unlocked and

2. The interphone switch may be removed after removal of only two attaching screws.

(c) MAINTENANCE REPAIRS.—Inasmuch as the interphone amplifier, BC-709-A, is operated from "portable" type batteries whose service life is relatively short, a periodic check up and renewal of batteries should be performed at the time the airplane is given the fifty-hour inspection or upon complaint of low volume. The next possible source of maintenance will be found in the tube, type VT-174, and this should be checked at each inspection period and another VT-174 substituted in the amplifier in case of inoperation or weak output.

(d) TESTS.—Before each flight, make an oral operational test from the microphone in each cockpit.

(2) FLIGHT CONTROL PARKING LOCK.

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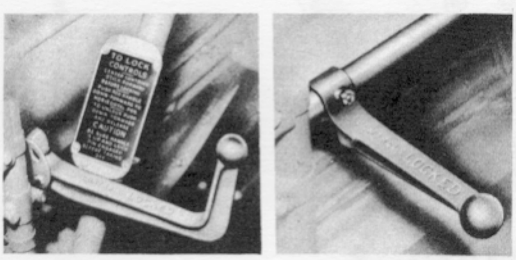

Figure 145—Flight Control Lock Handles— Front and Rear Cockpits

Flight controls are locked in the following manner:

1. Aileron controls should be neutralized and the control stick placed in its forward position.

2. Right rudder should be applied.

3. Red handle should be pushed forward and down to its locked position.

4. Left rudder should be applied until locking pin snaps into place.

The flight controls are unlocked by pushing down and forward on the control handle, simultaneously applying pressure to the left rudder pedal until the handle is free of the lock, then releasing the handle to return to its unlocked position.

CAUTION

The control surface lock handle should never be kicked or operated with the feet. Hand operation *only* is permissible.

(b) REMOVAL AND DISASSEMBLY.

1. To remove the parking lock, the spring and tie rod should be disconnected from the lateral shaft lever. By disconnecting the brackets at both ends of this shaft, it may be removed from the airplane.

2. By removing the front bracket attaching the horizontal shaft, the shaft may be slipped from the rear bearing and removed from the airplane.

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