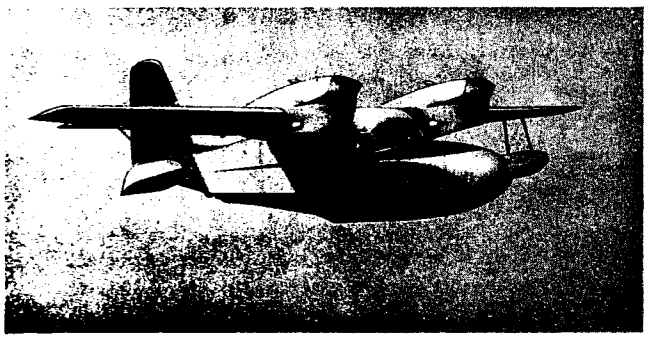
SERVICE MANUAL



Grumman

WIDGEON

Model G-44A

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
BETHPAGE, LONG ISLAND, N. Y.

GRUMMAN WARRANTY

We warrant each new airplane sold by us to be free from defects in material and workmanship, our obligation under this warranty being limited to making good at the Grumman factories any part or parts thereof which shall, within three months after delivery of such airplane to the original purchaser, be returned to us with transportation charges prepaid, and which our examination shall disclose to our satisfaction to have been thus defective; this warranty being expressly in lieu of all other warranties and representations expressed or implied and all other obligations or liabilities on our part, and we neither assume nor authorize any other person to assume for us any other liability, in connection with the sale or use of our airplanes.

This warranty shall not apply to any airplane which shall have been repaired or altered outside of the Grumman factories in any way so as, in our judgment, to affect its stability or reliability, nor which has been subject to misuse, negligence or accident, nor to any airplane sold by us which shall have been loaded beyond the factory rated load capacity.

We make no warranty whatever in respect to motors, tires, brakes, ignition appartatus, starting devices, generators, batteries, instruments or other accessories, inasmuch as they are usually warranted separately by their respective manufacturers.

ALL ORDERS TAKEN BY THIS COMPANY ARE SUBJECT TO THE FOLLOWING TERMS and CONDITIONS:

If delivery is not made within 60 days after the delivery date specified, subject however to the contingencies and extensions hereinafter provided for, this purchase may be cancelled by purchaser by giving written notice to the seller of his election so to do, within five days after said period of sixty days. Failure on the part of the purchaser to give written notice as provided herein will reinstate the order for an additional period of 60 days. Changes in specifications and orders for extra equipment not included in the original order shall serve to extend the delivery if and when considered necessary by the seller.

In case delivery is not made as above permitted, the deposit herein acknowledged will be returned to the purchaser subject to the following conditions:

(1) In the event of cancellation by the purchaser as hereinbefore provided, the deposit will be returned to the purchaser.

(2) If the purchaser fails to comply with each and every condition of this contract, the deposit will be returned less any loss incurred upon a resale of the airplane by the seller and less any expense which the seller in its sole, uncontrolled judgment may deem it expedient to incur upon the airplane in order to more readily effect such resale and less any damages which the seller may suffer and/or incur as a result of the breach of the contract by the purchaser; the seller shall have the rights of chattel mortgagee in any property of the purchaser in the seller's possession to secure the payment of such losses, expenses and/or damages, and to deduct the amount of such losses, expenses and/or damages, from any moneys in the hands of or due from the seller to which the purchaser may be entitled or in which the purcahser may have any interest whatsoever; and in the event of any deficiency as a result of any of the foregoing, the purchaser agrees to remain liable for and to pay such deficiency upon demand.

(3) Delivery terms and all other stipulations are made subject to strikes, lockouts, fires, delays in transportation or receipt of materials, and any other circumstances and conditions beyond the seller's control whether or not here specifically enumerated: nor will the seller be liable in any manner nor for any cause whatsoever to the purchaser for the seller's inability or failure for any reason whatsoever whether because of the wiful default of the seller or otherwise beyond the return of any actual moneys paid on account by the purchaser, subject always, however, to the provisions of article (2) hereof.

In the event the airplane fails to meet the performance guarantees of this contract within 5%, the seller agrees to immediately make such changes as are necessary to make the airplane meet such guarantees at no cost to the purchaser, provided, however, that notification of such performance deficiency be received by the seller within two weeks of delivery of the airplane to the purchaser, and provided that the airplane be returned to the seller's plant for such changes within this period, and further provided that the airplane when returned is in the same condition as when delivered with reasonable allowance for normal wear and tear. Due allowance must be made for extra equipment added by the purchaser and for any changes in specifications from the standard airplane made by the purchaser where it is recognized that such changes affect the performance of the airplane.

In the event an employee of the seller is furnished to operate the airplane for the purpose of instruction, or for any other reason, the purchaser agrees to assume full responsibility for any damage to the airplane, any other property, or to any person, including such employee incurred while such employee is so engaged, and agrees to indemnify and save harmless the seller from any such damages.

This contract is personal to the purchaser and cannot be transferred nor encumbered without the seller's written consent. The purchaser agrees to accept the airplane subject to any usage or wear and tear resulting from delivery. All deliveries are made flyaway at works, Bethpage, Long Island, New York, where purchaser shall accept and pay for the airplane. Nothing herein contained whereby the seller undertakes to assist the purchaser in transportation of the airplane from Bethpage, Long Island, New York to any other place shall be construed as changing the place of delivery or the passage of title to the airplane from Bethpage, Long Island, New York.

Failure on the part of the purchaser to accept delivery of this order upon proper notification by the seller renders the purchaser liable for any expenses incurred in storage, handling or other expenses or losses in holding this order pending delivery.

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
Bethpage, Long Island, New York.

PRINTED IN U. S. A.
CORYDON M. JOHNSON CO., INC.
BETHPAGE, L. I., N. Y.

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SPECIFICATIONS

Length	31 feet
Span	40 feet
Height (three point)	9 feet
Wheel Tread	7 feet 6 inches
Wing Area	245 square feet
Weight Empty	3240 lbs
Useful Load	1285 lbs
Gross Weight	4525 lbs
Cruising Speed at Sea Level at 75 % HP	142 MPH
Cruising Speed at Sea Level at 62½% HP	130 MPH
Cruising Speed at 6000 feet at 62½% HP	138 MPH
Rate of Climb at Sea Level	1000 ft-min
Climb to 10,000 feet	15 min
Service Ceiling	15,000 feet
Take-off Run at Sea Level	895 ft
Take-off from Glassy Water	25 seconds
Landing Speed	50 MPH

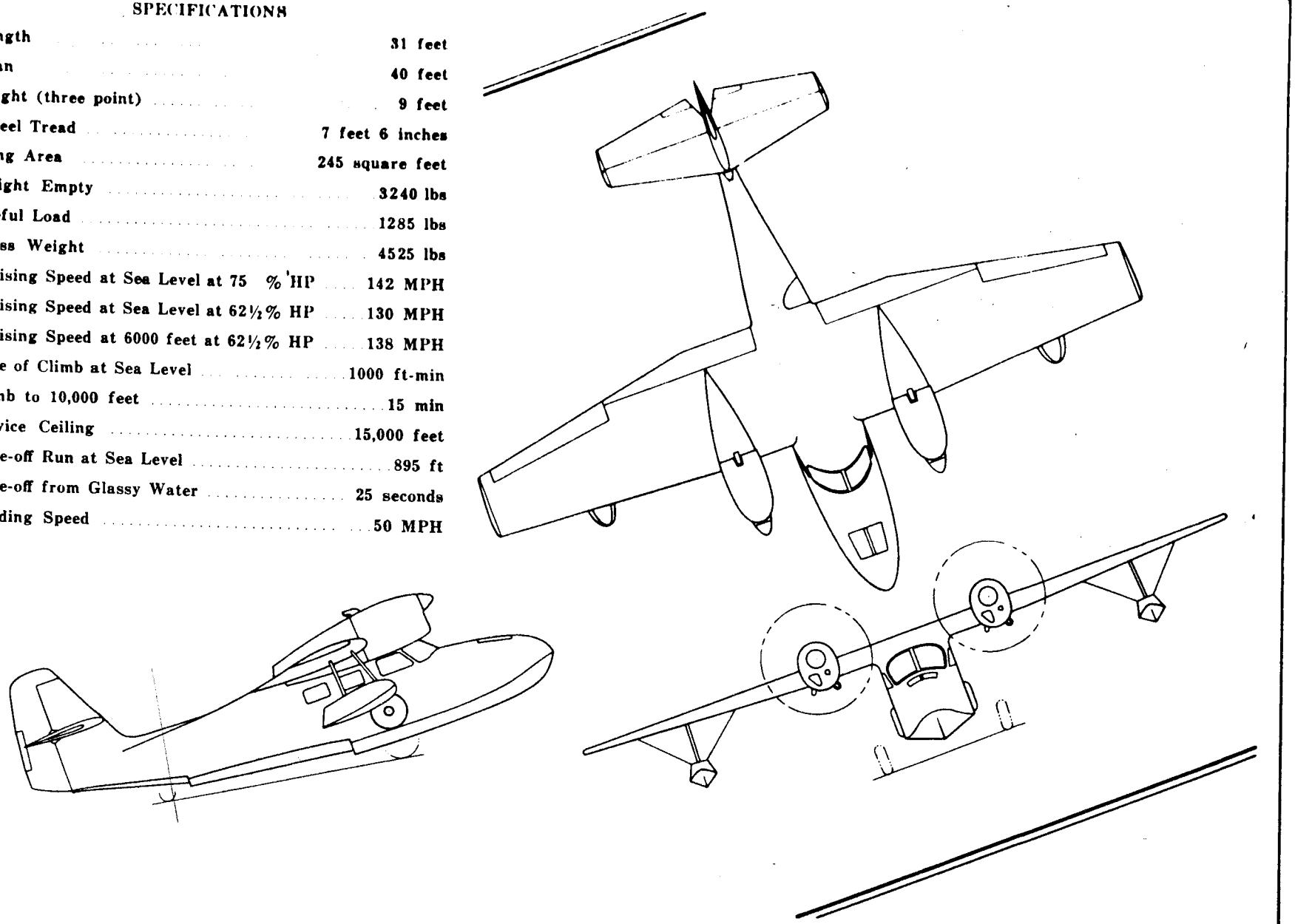
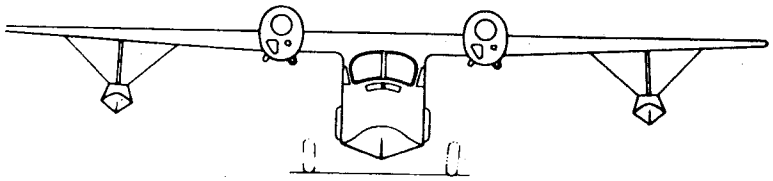


Figure 1—Airplane Specifications

Section I



DESCRIPTION OF THE WIDGEON

THE WIDGEON is a five-place, metal, twin-engine, amphibian monoplane. The hull is constructed with water-tight bulkheads and built-in wheel wells for housing the landing gear when retracted. There are three compartments in the hull: the bow for the anchor, mooring rope, bilge pump and baggage; the cockpit with two seats and controls; and the cabin with three seats and a baggage rack. The radio equipment is located in the cabin immediately aft of the co-pilot's seat.

The wing consists of a center section and the left and right outer panels. The center section, a permanent installation on the hull, is of all-metal construction and houses the power plant and the two integral 54 gallon fuel tanks. The flaps, ailerons, and wing tip floats are attached to the outer panels. The fixed tail surfaces are of all-metal construction and are attached to the hull by bolts and struts. The fabric-covered, movable tail surfaces are of metal frame construction.

The airplane is powered with two Ranger Model 6-440C-5, six-cylinder, direct-drive, inverted in-line, air-cooled engines. Each engine is rated at 200 hp at 2450 rpm for sea level operation. The engines drive two-bladed, Sensenich 81-RS-72, wooden propellers.

The landing gear and wing flaps are operated by the hydraulic system.

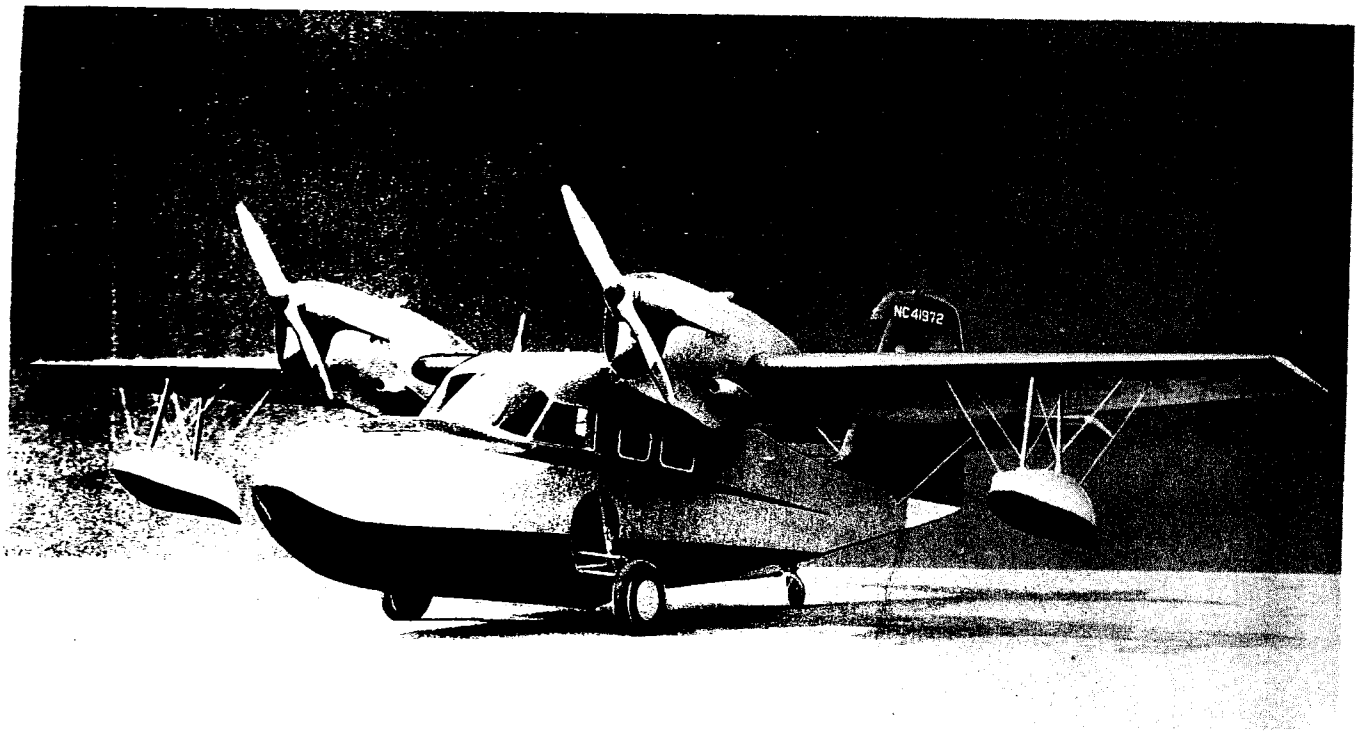


Figure 2—Airplane—Three Quarter Left Front View

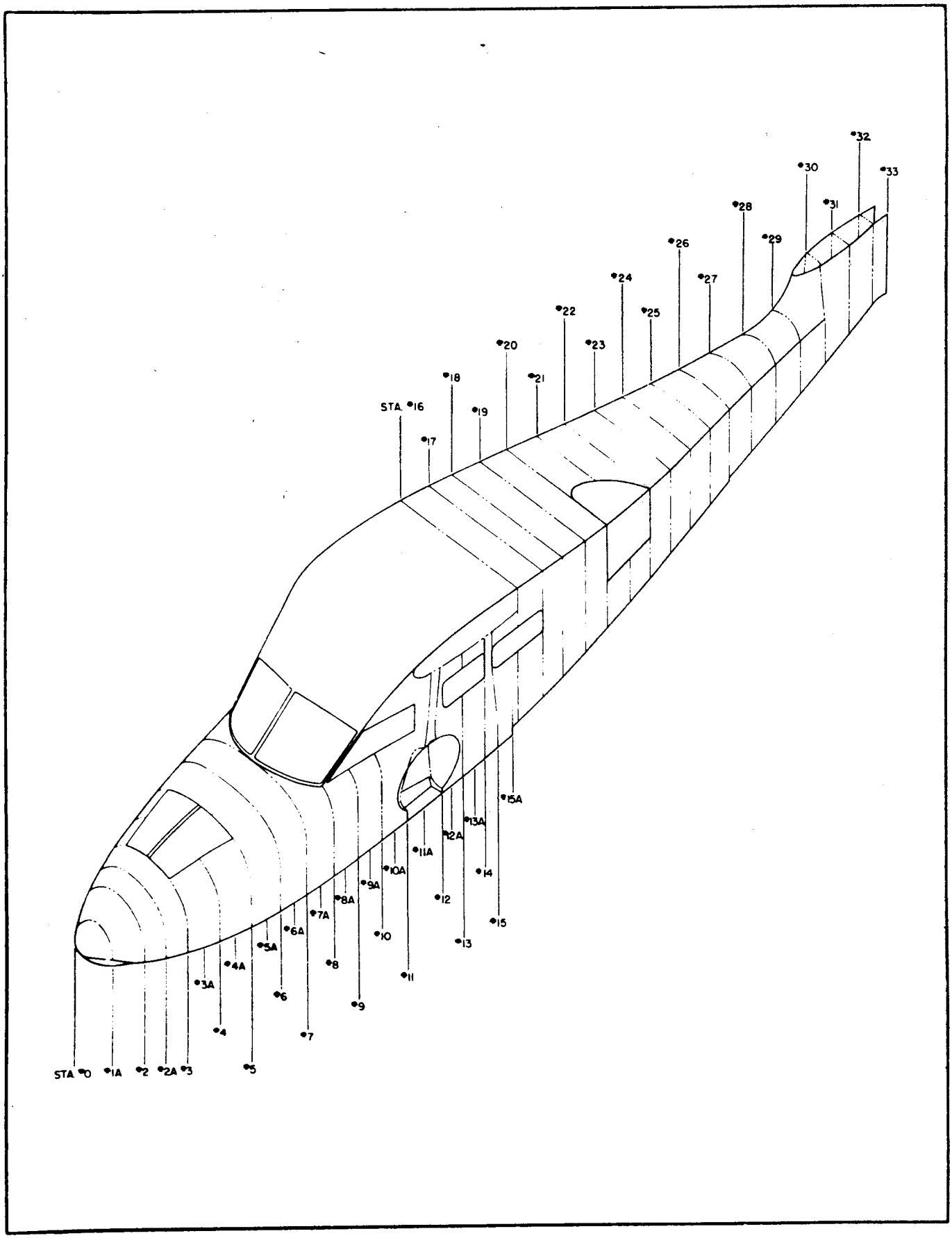


Figure 3—Hull Stations Diagram

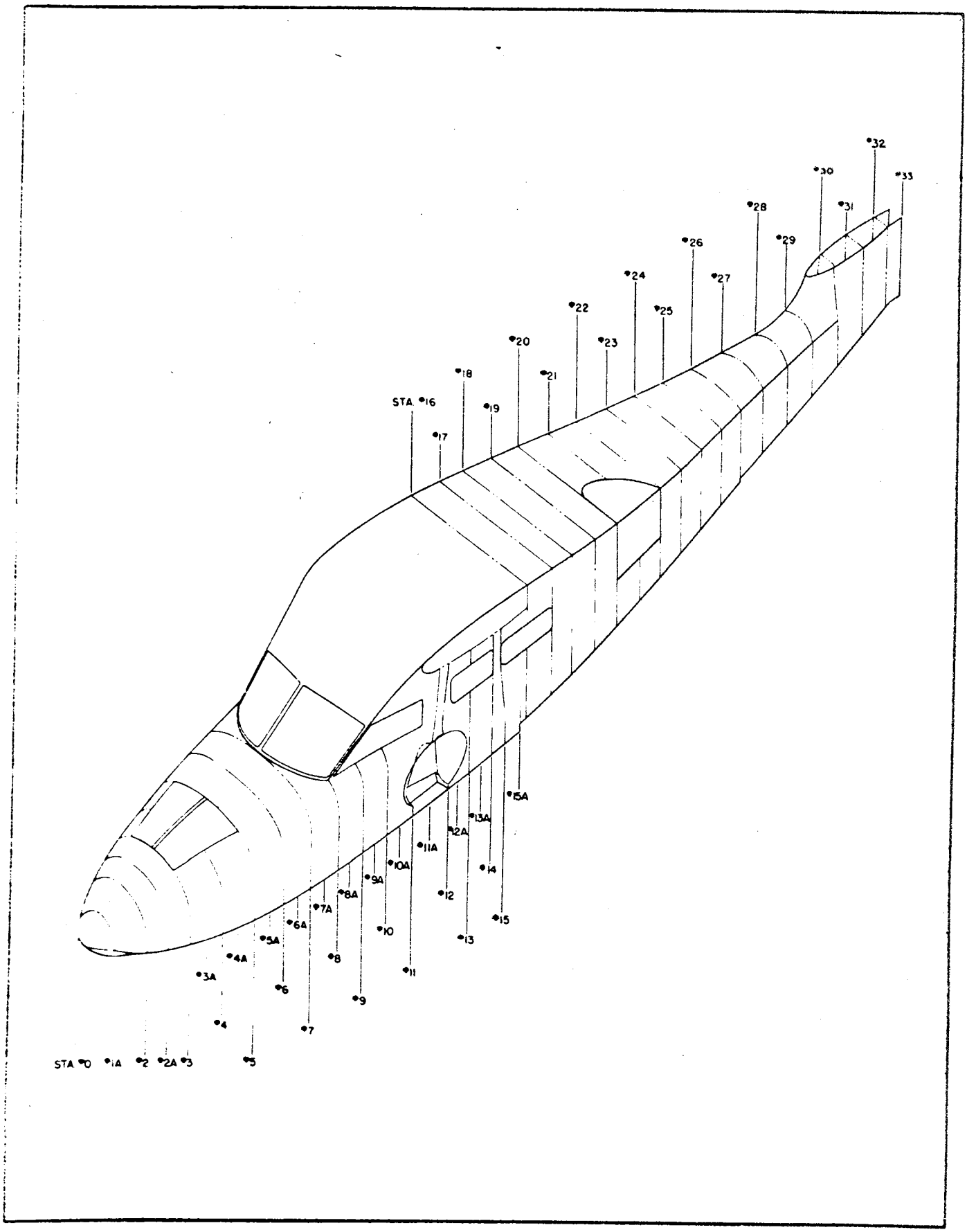


Figure 3—Hull Stations Diagram

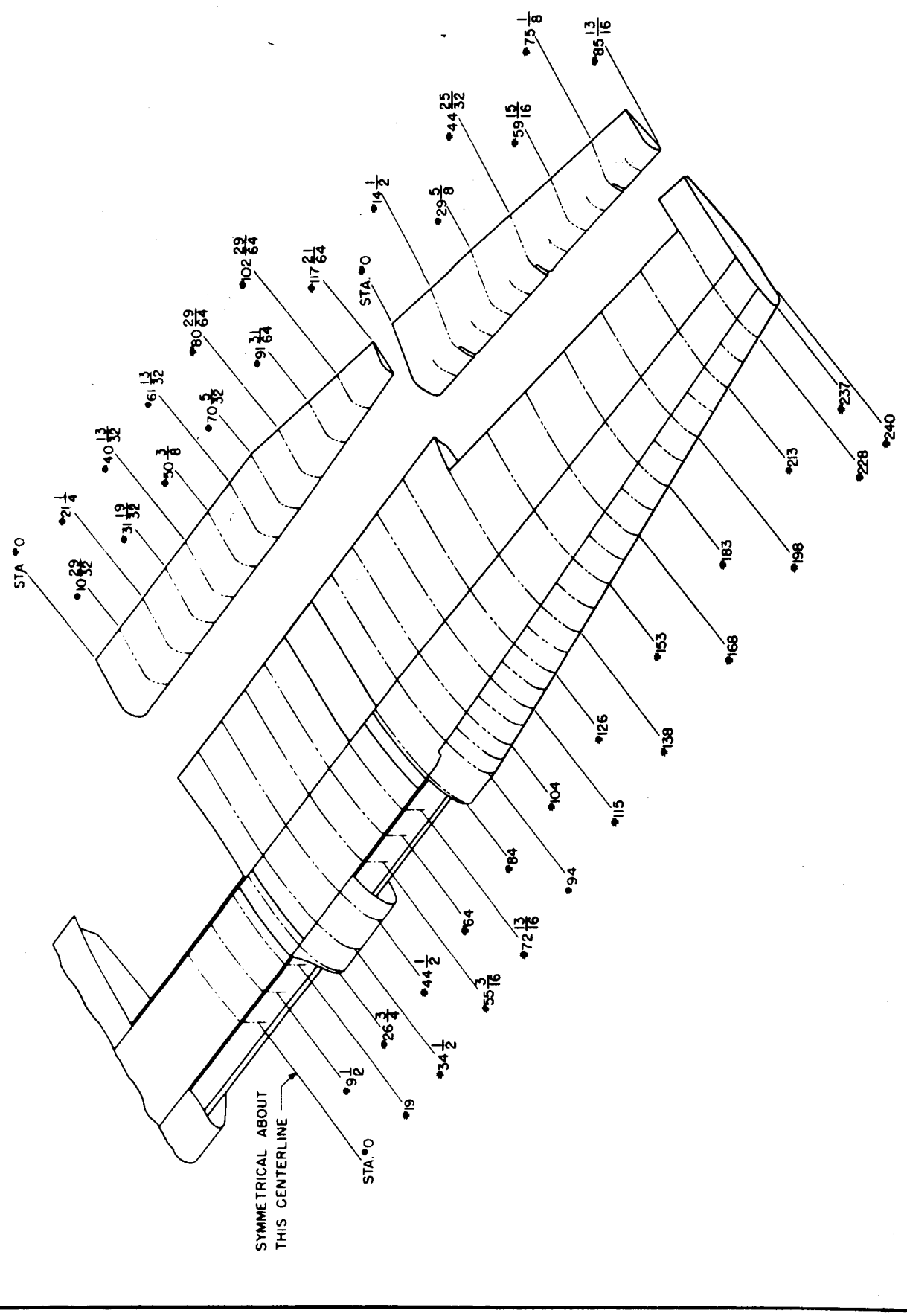


Figure 4—Wing Stations Diagram

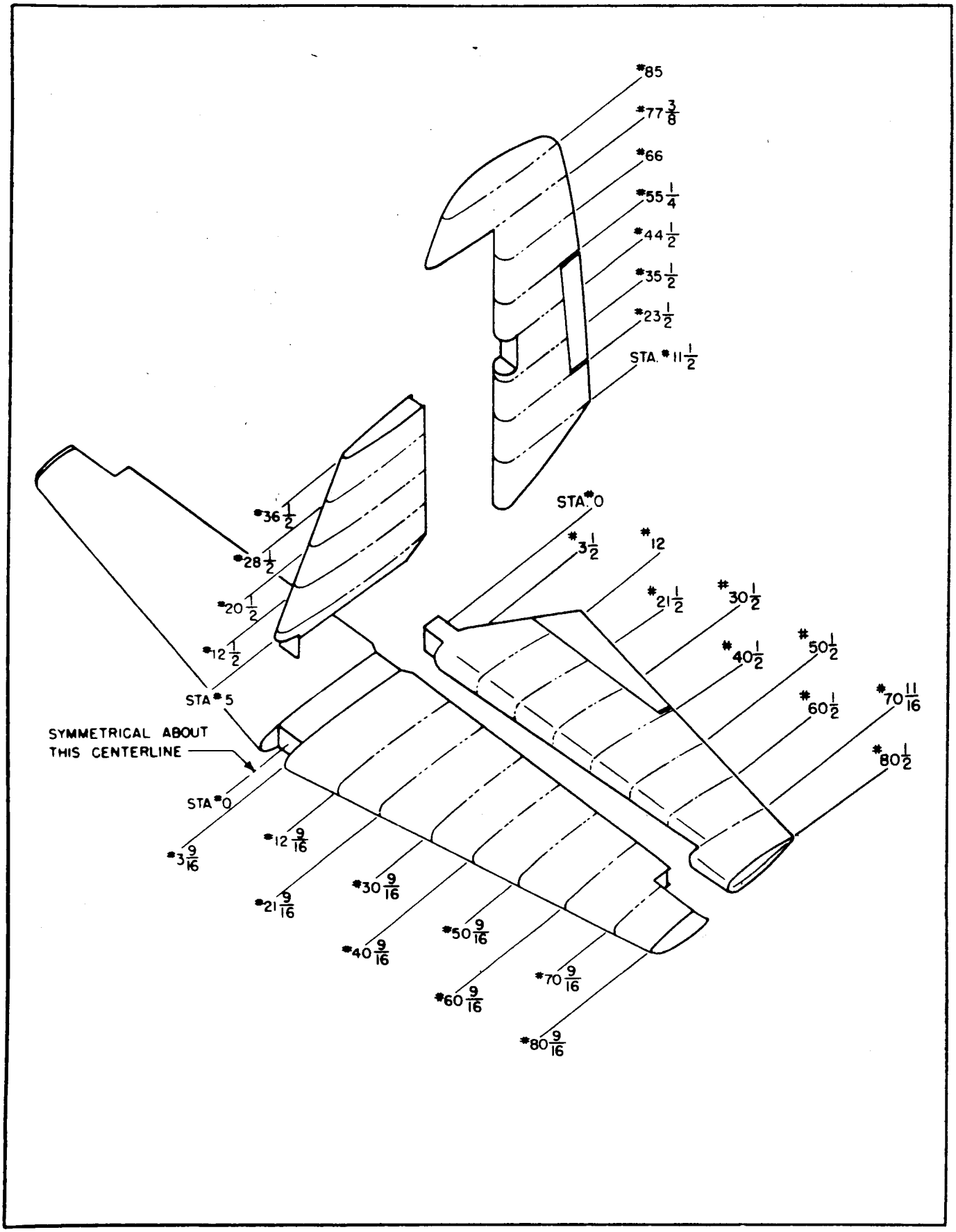
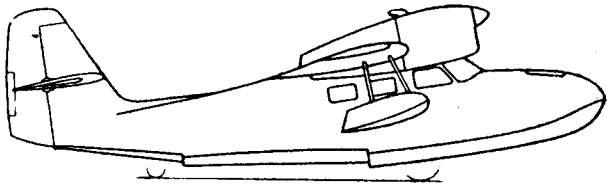


Figure 5—Tail Surfaces Stations Diagram

Section II



GROUND HANDLING AND SERVICING

1. ACCESS AND HANDLING PROVISIONS.

Access and inspection plates are located throughout the hull, wings, and tail surfaces of the airplane in order to facilitate inspection and maintenance. The upholstered cockpit panels are attached by snap fasteners while the cabin panels are installed with screws. The cockpit and cabin flooring is readily removable. Refer to the Access and Inspection Plates Diagram.

2. GROUND HANDLING.

a. HOISTING.—The hoisting sling should be attached to the hoisting fitting on the wing center section. The airplane is normally slightly nose heavy; however, the amount of tilt will depend on the loading at the time of hoisting.

b. JACKING.—To remove or service a main wheel, use the axle as a jacking point. The tail wheel and its assembly can be serviced by placing a jack under the tie-down fitting at the aft end of the hull. Be certain that the main wheels are properly chocked and the parking brake is set.

A drawing of the hull supports, used at the factory, is shown herein. Owners are urged to build a set so that adjustments to the landing gear and hull maintenance may be carried out conveniently. These supports are of a size that they may be placed easily under the hull without a hoist. Proceed as follows:

(1) Run the airplane up the inclined platform then lift tail high enough to place a support under the center line of Station #15.

(2) Pull tail down far enough to place a support under Station #7.

(3) Slide a support under the tail and push forward to approximately Station #22.

Note

Make certain that all supports are centered directly under the stations to prevent possible damage to structure.

c. MOORING AND TOWING. — The airplane should be moored in such a way that with shifting currents or possible wind change, it will not be subject to contact with docks or other objects which might cause damage.

On the water use the bow cleat for securing the anchor or tow line. The bow compartment doors are opened from inside the hull.

Note

The slope of the anchor rope should be approximately 7-10 to 1 for the anchor to hold firmly.

On land the airplane may be towed nose first by attaching lines to the left and right landing gear lower drag links. Do not secure the lines over the brake flexible tubing. The plane may be towed tail first by securing a line to the tie-down fitting at the aft end of the hull. While towing on land, it is recommended that someone remain in the cockpit to use the brakes in case they are needed to stop or slow down the plane.

Note

Before towing, release the tail wheel lock and parking brake control.

d. PARKING.—To set the brakes for parking, pull UP the parking brake control lever, located between the rudder pedals, and then push the brake pedals as hard as possible. This action will lock the brakes firmly.

To unlock the brakes, first press the control lever downward then again push the toe pedals as far as they will go. This action releases the brakes and they are now ready for regular use.

When the airplane is parked or tied down, it is recommended that the control's locking harness #12203 be installed.

e. TIE-DOWN.—Tie-down rings are located on the under surface of the wings just outboard of the floats. The bracket, at the aft end of the hull, can also be utilized as a securing point. Ropes may be tied to the landing gear lower drag links providing they do not pass over the flexible brake lines.

f. LEVELING.—Two spirit levels are located in the hull for lateral and longitudinal leveling. One is on the wall at the pilot's left elbow, and the other under the upholstery on the aft side of the right landing gear wheel-well bulkhead.

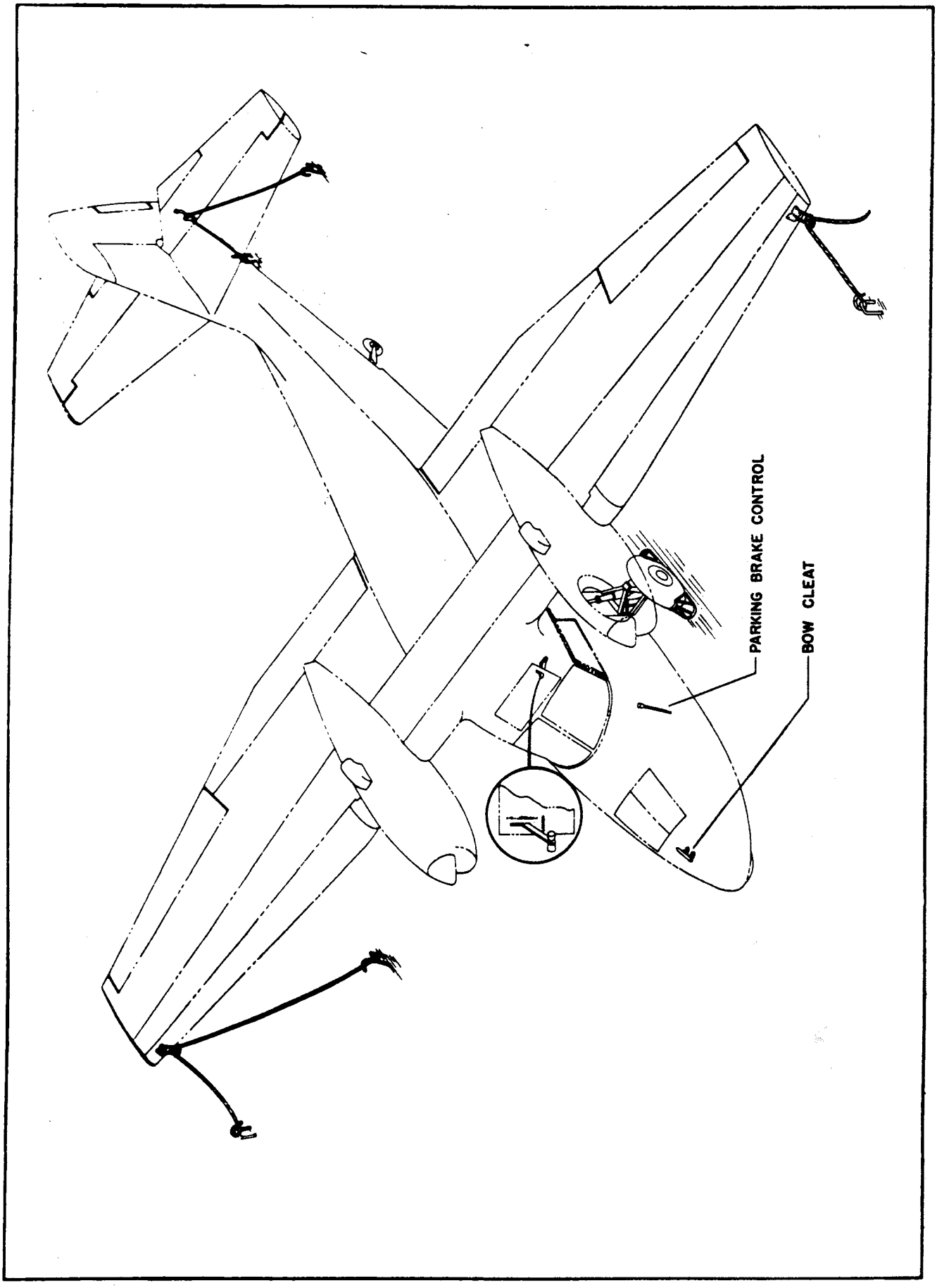


Figure 6—Parking and Tie-Down

3. SERVICING PROCEDURE.

a. FILLING FUEL TANKS.—A fuel tank fillerneck is located on the inboard side of each nacelle. Access is gained by loosening the turn fasteners which secures each hinged door. Refuel with 87 or 91 octane gasoline—filling capacity is 54 gallons per tank. The electrically operated fuel quantity gages are located on the lower part of the main instrument panel.

Drain approximately a pint of fuel from each fuel strainer (located on forward face of firewall) before each day's flying. A snap clamp secures the drain cock handle in the CLOSED position.

CAUTION

Before filling the fuel tanks, make certain that the airplane is grounded and the hose nozzle is bonded to the airplane. If refueling from a truck, ground the airplane to the truck. Do not charge or change the battery, or test radio or electrical equipment during refueling.

b. FILLING OIL TANKS.—The oil tank fillerneck is accessible through a hinged door located on the left hand side of each nacelle. Fill with grade SAE #50 oil. A sounding rod is secured to the filler cap. Filling capacity is 3½ gallons.

Note

The curvature of the nacelle prevents a long fillerneck. Hence, if the wind is blowing during the filling operation, oil may be spilled inside the nacelle. It is suggested that a rag be placed below the filler to catch the spillage.

c. FILLING HYDRAULIC TANK.—The hydraulic fluid tank filler plug is accessible by removing the upper aft panel of the left hand engine nacelle. Fill with mineral oil (red color), Univis #40 or equivalent—filling capacity is ¾ gallon.

CAUTION

Do not use a vegetable base oil—this type is usually identified by its blue color.

d. BRAKE RESERVOIRS.—Check the brake master cylinder reservoirs for fluid every 25 flight hours. Use only mineral oil (red color).

e. BATTERY.—Check specific gravity of electrolyte and add distilled water if the fluid level is below normal. The battery is located in the right hand nacelle.

f. TIRE PRESSURES.—Main wheels tire pressure—40 psi; tail wheel tire pressure—50 psi. For beach operation on soft sand, use a main wheels tire pressure of 25-30 psi.

g. CLEANING AIRPLANE.

(1) GENERAL.—This airplane is delivered from the factory with a high gloss finish. It is important that this finish be retained if the best flight performance is expected. A good wax polish is an excellent preservative.

(2) WINDSHIELD AND WINDOWS.—The windows and windshield are Plexiglas, a superior plastic material of exceptional clearness. This material is not affected by sunlight, salt water, gasoline or oil (in moderate quantity), and will not discolor with age. Maintain the Plexiglas as follows:

(a) Flush with plenty of water, using the bare hand gently to feel and dislodge any dirt, salt or mud.

(b) Wash with soap and water. Be sure the water is free of dirt or other possible abrasives. A soft cloth, sponge or chamois may be used in washing; but only as a means of carrying soapy water to the plastic. Go over the surface with the bare hand so that any dirt can be quickly detected and removed before it scratches the surface.

(c) Dry, preferably with a clean damp chamois. However, cheese cloth or soft tissues may be used if care is taken not to continue rubbing the plastic after it is dry.

(d) Remove oil and grease by rubbing lightly with a cloth wet with kerosene.

CAUTION

Do not use the following materials on this plastic: acetone, benzine, carbon tetrachloride, fire extinguisher fluids, gasoline, lacquer thinners or window cleaning sprays because they will soften and cause crazing.

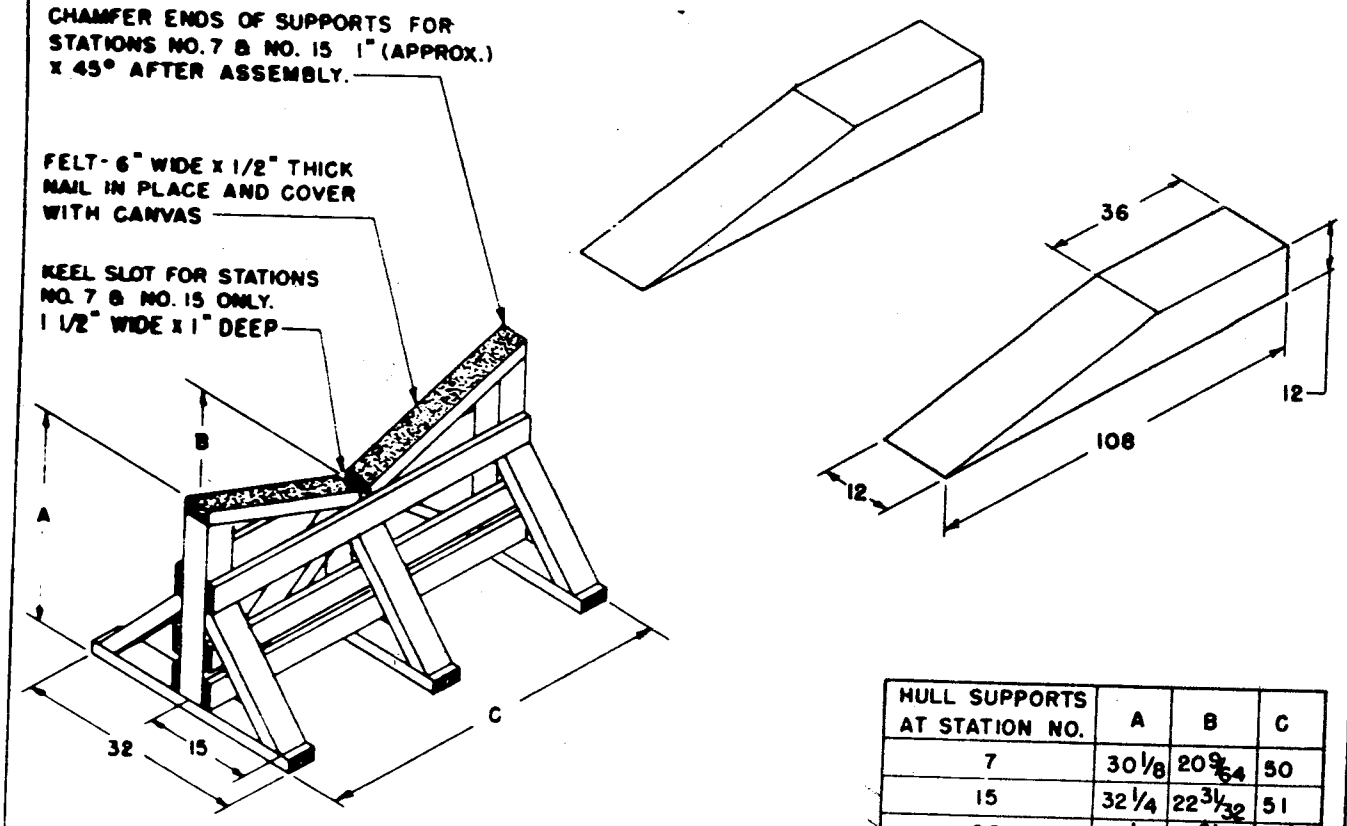
(e) Do not rub the plastic with a dry cloth since this is not only likely to cause scratches, but it also builds up an electrostatic charge which attracts dust particles to the surface. If the surface becomes charged, patting or gently blotting with a clean damp chamois will remove the charge as well as the dust.

h. CORROSION PREVENTION.—Regular inspection for the presence of bilge water should be made after overnight mooring. A standard bilge pump is supplied with each airplane.

The airplane is prepared throughout for salt water use by anodizing the aluminum, complete painting, and use of Par-al-ketone B, a rust proofing compound which is brushed onto fittings and exposed parts particularly steel bolts not protected by paint, and into crevices where moisture is likely to remain.

A can of Par-al-ketone B should be kept available at the hangar to be brushed on to these points during the periodic checks.

A clean airplane will not corrode. If used steadily in salt water there should be periodic cleaning of the control surface crevices, inside the main and tail wheel pockets, and all recesses. After each exposure to salt water the entire airplane should be hosed thoroughly with fresh water. Remove the drain plugs from the hull bottom and wing tip floats; and if there is water inside, flush affected compartments with fresh water.



HULL SUPPORTS AT STATION NO.	A	B	C
7	30 1/8	20 9/64	50
15	32 1/4	22 3/32	51
22	45 1/2	38 21/32	37 1/2

NOTES:

1. SIDE PIECES 1 x 4 DRESSED SPRUCE.
   ANGULAR SUPPORTS & BASE 2 x 4 DRESSED FIR.
   PERPENDICULAR PIECES 4 x 4 DRESSED FIR.
2. ALL JOINTS GLUED, AIDED BY NO. 10 FLATHEAD WOODSCREWS & 8 OR 10 PENNY NAILS.
3. ALL DIMENSIONS ARE GIVEN IN INCHES.

Figure 7—Hull Supports

KEY TO FIGURE 8

ACCESS AND INSPECTION PLATES DIAGRAM

1. Airspeed Tube
2. Aileron Bellcrank and Cables (L/R)
3. Aileron Hinge Bolts (L/R)
4. Aft Nacelle—Battery, Oil Tank, and Generator Cut-out and Voltage Regulator
5. Oil Tank Fillernecks (L/R)
6. Fuel Tank Fillernecks (L/R)
7. Fuel Tank Inspection and Repair (L/R)
8. Flap Hydraulic Cylinders (L/R)
9. Aileron Center Bellcrank and Cables
10. Tab Control Cables
11. Float Inspection and Repair (L/R)
12. Airspeed (R Wing) and Electrical Lines (L/R)
13. Electric Fuel Pumps (L/R)
14. Landing Gear Drag Link Bolts (L/R)
15. Elevator and Rudder Cables and Hull Inspection
16. Rudder Pedals and Brake Controls
17. Bow Inspection
18. Center Section Inspection
19. Elevator and Rudder Cables and Adjustment Turnbuckles
20. Aileron Cables
21. Tail Wheel Compartment Access Inspection Disc Plate
22. Tail Wheel Pocket
23. Tail Wheel Drag Link Bolts (L/R)
24. Cables—Elevator, Rudder and Tabs Tab Chains and Stops
25. Cable and Hull Inspection
26. Left Elevator and Rudder Tabs Flexible Shafts
27. Elevator Balance Tab Mechanism
28. Rudder Tab Actuator
29. Left Elevator Tab Actuator
30. Aileron Cables
31. Aft Nacelle—Oil and Hydraulic Tanks
32. Wing Gap Plates—For Outer Panel Removal (L/R)

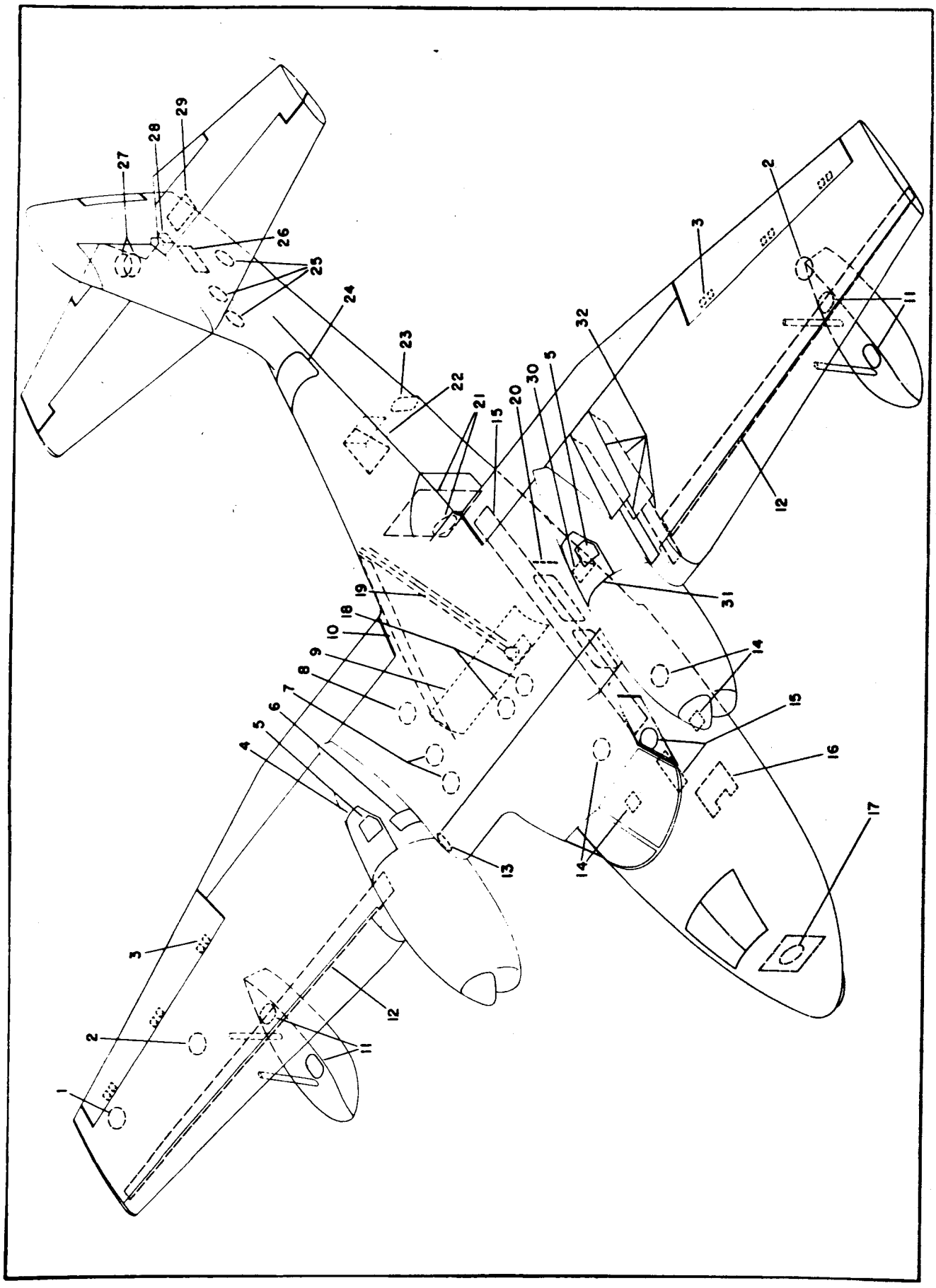


Figure 8—Access and Inspection Plates Diagram

If operating conditions require postponement of this service, a more thorough and complete washing and cleaning should be made. A good rule is that all the hangar rent saved, over the period of time the airplane is based in the water, should be applied to the labor of the ensuing clean up and check.

The engine nacelles should be carefully checked for corrosion particularly under the nose cowls. Keep an oily film over all the parts inside the cowlings. If the engines run too dry, a film should be applied by spraying a light fog of mystery oil and kerosene, or the equivalent over the crankcases, engine mounts and all tubing, using an insect spray gun.

CAUTION

Also when operating in salt water, all lubricators should be pressure lubricated frequently after exposure in order to force the water from the joints, thus preventing corrosion and subsequent jamming.

(1) DRAIN PLUGS.

1—Forward of bulkhead at Sta. #7.
1—Forward of bulkhead at Sta. #11.
1—Forward of bulkhead at Sta. #12.
1—Forward of bulkhead at Sta. #13.
2—Aft of tail wheel pocket at Sta. #22.
1—Aft of tail wheel pocket at Sta. #28.
1—Aft of bulkhead at Sta. #30.
2—Wing tip floats.

Note

It is advisable to put the drain plugs in a prominent place when removed in order that they will not be forgotten. Suggest placing them in a cloth bag, and tying it to the control wheel. When replacing the plugs, coat the threads with Seal Lube instead of Par-al-ketone in order to prevent seizure in the fittings.

4. LUBRICATION.

It is important that the airplane be lubricated periodically with the proper grade lubricant. The following chart indicates clearly the units, points of lubrication, lubricants to be used, and the time interval. All gun type lubricators are painted yellow.

5. ENGINE OPERATION.

a. STARTING.—It is recommended that the engines, after standing as long as over night, be pulled through several complete revolutions by hand before starting. The starter buttons, for the Eclipse starters, are located on the electrical switch panel.

The right engine should be started first as the generator is located on this engine. If the battery is low, with the right engine running at approx. 1200 rpm, the generator will be supplying sufficient current to start the left engine.

Proceed as follows:

(1) Carburetor air control on full COLD.

(2) Select the best combination of fuel valves; however, at least two valves must be ON. Valve must be closed on an empty tank.

(3) Put master battery switch to ON position.

(4) Set mixture control to FULL RICH position.

(5) The selective primer is connected to the left fuel system. To assure filling the primer, operate the left wobble pump until a pressure of 3½—4½ psi shows on the fuel pressure gage. Later model airplanes are equipped with electric fuel pumps. In planes so equipped, use the electric pump to obtain the required fuel pressure. Normally hand primer pump operation is not necessary unless the weather is extremely cold. The primer pump should be turned off immediately after using.

(6) Pump the throttle several strokes through its complete throw. Throttle and wobble pump should be operated together until fuel is seen coming from the drain line located at the bottom of the nacelle. Overpriming is not indicated at all times by fuel coming from the carburetor drain unless in a continual flow while trying to start.

(7) With the throttle partly open, PUSH-IN the master ignition switch marked PULL-OFF, and turn the individual switch to the LEFT position as this magneto is equipped with an impulse unit. Press the starter button and hold it in the ON position while the throttle is still pumped slightly. As soon as the engine starts, turn the individual ignition switch to the BOTH position. When the engine catches, the throttle is brought to almost fully closed position and the engine set to run at approximately 800 to 900 rpm. If the engine stops, the throttle should be pumped for about 3 or 4 short strokes and the starter button pressed again.

Note

As soon as the engine starts, check the oil pressure gage. If no pressure is indicated after 30 seconds running, the engine should be stopped and checked.

(8) If the engine, after starting, shows any indication of missing or lean running, it will be necessary to pump the throttle at the closed position, using very short strokes.

(9) If the engine is overprimed, the throttle should be opened wide and the engine turned backward several revolutions by hand with the master ignition switch OFF. Also the throttle can be opened wide with the ignition switch OFF and the starter used to turn over the engine.

(10) For extremely cold weather operation, the engines may be preheated with conventional heater pots and blowers. The in-line engine does not require the elaborate hood necessary for a radial. The only

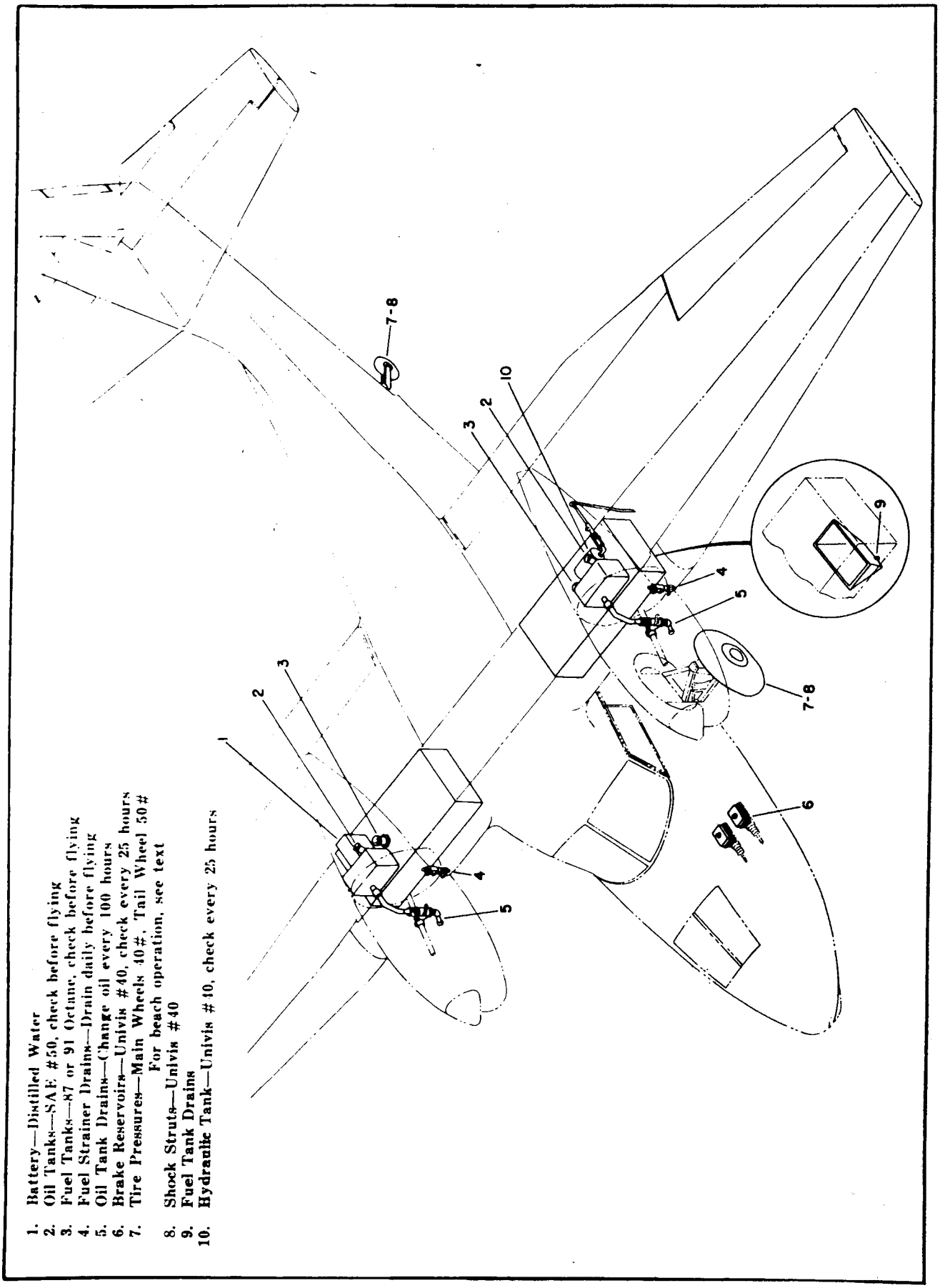
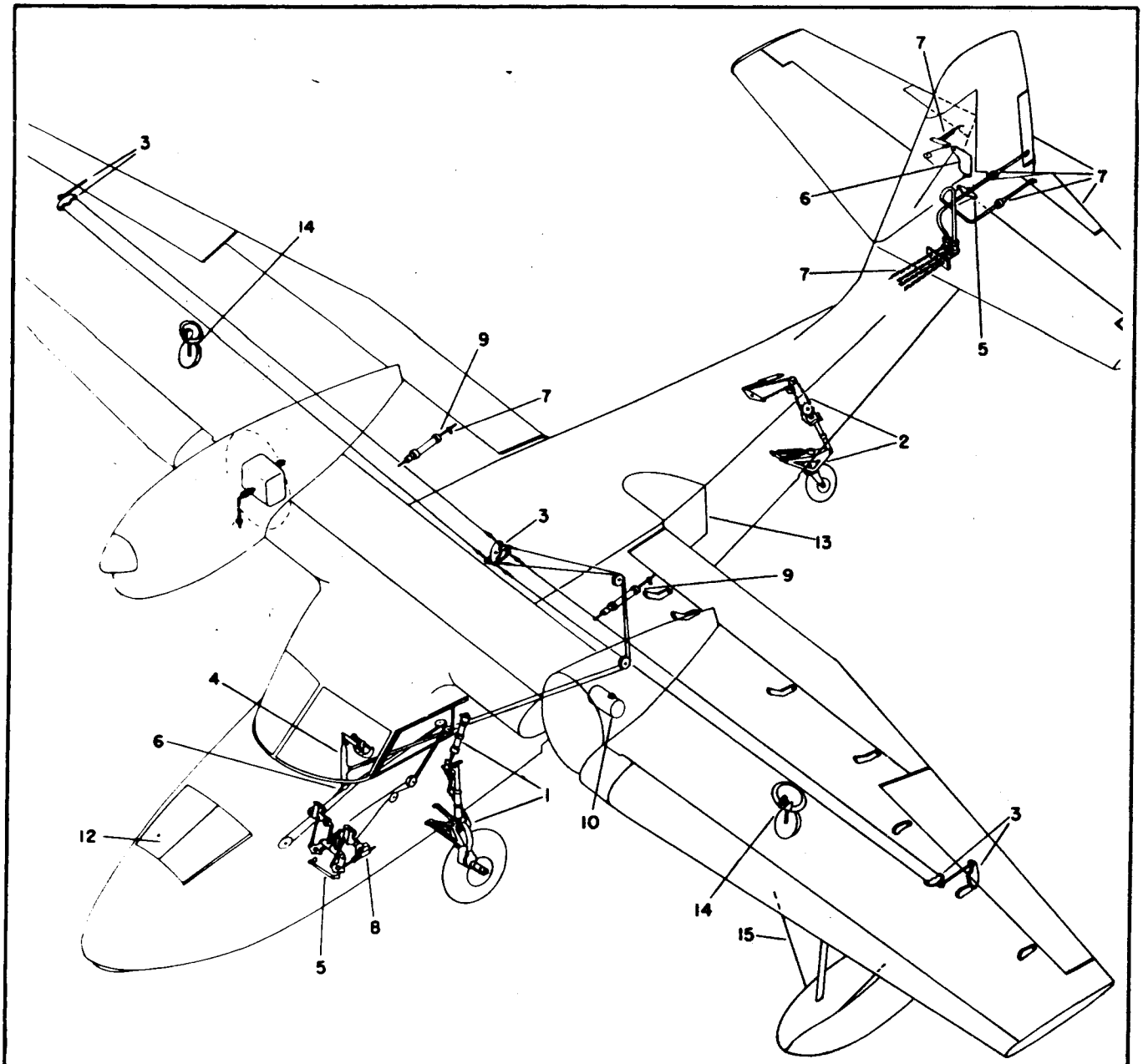


Figure 9—Service Diagram

KEY TO FIGURE 10

LUBRICATION CHART

LANDING GEAR	POINT	APPLICATION	LUBRICANT
1. MAIN WHEELS ASSEMBLY (L/R)			
Wheel bearings (clean bearings)	4 points		GWPG
Axles	4 points	gun	M#2
Lower drag truss	6 points	gun	M#2
Upper drag truss	4 points	gun	M#2
Shock strut oil	2 points		Univis #40
Shock strut hinge	2 points	gun	M#2
Compression strut	2 points	gun	M#2
Hydraulic actuating linkage			LO
Hydraulic cylinder terminals and shaft			LO
Indicator cable terminals			LO—P
2. TAIL WHEEL ASSEMBLY			
Wheel bearings (clean bearings)	1 point	gun	GWPG
Caster	2 points	gun	M#2
Lock pin plunger	1 point		M#2
Lock pin cable terminals			LO—P
Drag strut pivots	2 points	gun	M#2
Shock strut terminals	1 point	gun	M#2
Shock strut oil	1 point	gun	M#2
Compression strut	2 points	gun	Univis #40
Compression strut hinge	1 point		LO
Chain			M#2
SURFACE CONTROLS			
3. AILERON CONTROL (L/R)			
Push rod at ailerons	2 points		LO
Cable terminals, outboard bellcrank	4 points		LO—P
Cable terminals, cabin ceiling bellcrank	6 points		LO—P
4. CONTROL COLUMN			
Chain and idlers	2 points		LO
Cable and terminals	2 points		LO—P
Rotating joint at floor	1 point		LO
5. RUDDER CONTROL			
Pedal unit and axles—all moving joints			LO
Cable terminals at pedals bellcrank	2 points		LO—P
Cable terminals at rudder horn	2 points		LO—P
6. ELEVATOR CONTROL			
Cable terminals at base of control column	2 points		LO—P
Cable terminals at elevator horn	2 points		LO—P
7. RUDDER (1) AND ELEVATOR (2) TABS			
Tab hinges	3 points		LO
Tab push rod terminals	6 points		LO
Tab actuator units, flexible shafts ends	4 points		M#2
Tab control chains, in aft hull			SAE #50 oil
Tab bellcrank mechanism, right elevator			LO
Tab cable terminals			LO—P
Tab cable terminal, right wing flap cylinder			LO—P
8. BRAKE CONTROLS			
Master cylinders	2 points		Univis #40 25 hours
Parking control mechanism			LO
9. WING FLAPS			
Hydraulic cylinder shafts	2 points		LO
10. HYDRAULIC SYSTEM			
Hydraulic tank			Univis #40 25 hours
11. ENGINE AND FUEL SYSTEM			
Control rods—pilot's compartment overhead and firewalls			LO
MISCELLANEOUS			
12. Bow latch hinges	2 points		LO
13. Cabin door hinges	1 point		LO
14. Landing light gears	2 points		LO
14. Landing light chrome plating and seat	2 points		P
15. Float tie-rod terminals			P



NOTE

1. Lubrication Period—All items should be lubricated every 50 flight hours unless otherwise noted.
2. Lubricants—GWPG: Gulf Water Proof Grease
   M#2: Texaco Marfak #2 Grease
   LO: Mixture of SAE #50 Oil and Marvel Mystery Oil
   P: Par-al-ketone B Rust Preventive
   Univis #40: Colonial Beacon, Hydraulic Mineral Oil (Red Color).
3. All exposed bolts, tie rod terminals, and cables should be coated with Par-al-ketone B every 50 flight hours. After salt water operation all GUN TYPE LUBRICATORS (painted yellow) should be greased to eject possible water and prevent corrosion.
4. All pulleys are greased and sealed during assembly and normally require no further lubrication.

Figure 10—Lubrication Chart

caution should be that the directed emission of the hot air does not blister the insulation of the front plug lead. It should be either disconnected and pushed aside, or covered with a temporary metal deflector if the air blast is extremely hot.

In cold weather when the oil has not been preheated, keep the engine throttled as low as possible until a temperature rise is registered (approx. 600-700 rpm).

CAUTION

During cold weather starting if the battery is low after starting the right engine, follow the above procedure on this engine before attempting to start the left. Only after the required oil temperature and pressure are reached, increase the rpm on the right engine to 1200 in order to cut-in the generator. This output will then assist in starting the left engine without a serious drain on the battery.

b. WARM-UP.—The warm-up period is most important in order to allow all parts to expand properly to their normal running clearances.

The carburetor heat control should be left in the full COLD position except when actual carburetor icing is experienced.

After the oil gage indicates pressure, run the engine at 800 to 900 rpm until the pressure is normal for this speed which will be between 50 and 70 lbs. This warm-up period should be extended for at least 5 minutes after reaching normal temperature and pressure at which time increase the rpm to 1000. It is recommended that these speeds not be exceeded until the oil temperature registers 100°F. Use FULL RICH mixture for all speeds when running on the ground near sea level.

The rpm check is made as follows:

These engines are rated at sea level; and therefore, should be checked at full throttle. As cooling of the engine is insufficient while on the ground, any prolonged running at or near full throttle should be avoided. Check oil pressure and temperature. Note drop in rpm when switching to one magneto at a time. Drop in engine speed when operating on either magneto alone should not exceed 50 rpm.

Check for acceleration being sure that the mixture control is in the FULL RICH position.

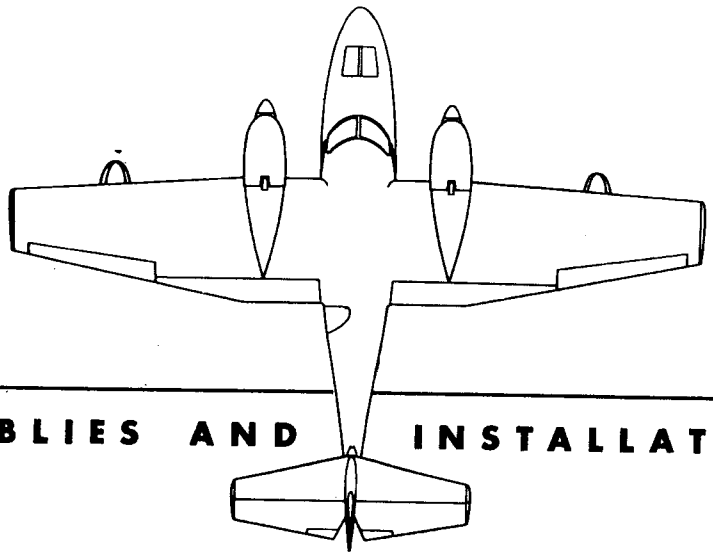
c. STOPPING.—When the airplane is parked and is to be left with no one in the cockpit, both engines should be shut down in the following manner:

(1) Brakes should be on PARKING. Tail wheel in alignment and LOCKED. Put mixture controls in IDLE CUT-OFF.

(2) Advance throttles to about half way and allow engines to starve for gas. When fully stopped, pull throttles to CLOSED position—turn both ignition switches to OFF position. Pull main ignition button OUT. Then shut OFF master battery switch and close valves to L & R gas tanks.

(3) Do not touch the propellers until the engines have cooled down. With a hot engine, there is always the possibility of the engine firing when the propeller is turned.

Section III



SYSTEMS, ASSEMBLIES AND INSTALLATIONS

1. TUBING AND COLOR CODE.

The tubing or lines of the various systems in the airplane are identified by colored bands.

TUBE	COLOR BAND
Fuel	Red
Fuel Vent	Red - Black
Hydraulic Oil	Light Blue-Yellow-Light Blue
Manifold Pressure	White - Light Blue
Engine Oil	Yellow
Pitot Pressure	Black
Static Pressure	Black - Light Green
Vacuum	White - Light Green

2. HULL.

a. GENERAL.—The hull is of stressed skin semi-monocoque construction, consisting essentially of channel and angle type frames and stringers; and angle and stamped bulkheads covered with an aluminum alloy skin. The bottom of the hull is .040 and .051 24ST and the sides and deck are .025 and .032 sheeting. PAW tape and LC264 cement (DuPont DeNemours) are used between sheets and members at all water-tight joints. Bulkheads at Stations #3, #7, #11 and #12, #22 and #30 are water-tight. Water-tight inspection plates and/or doors are located in the above bulkheads. Wheelwells are built into the hull to house the landing gear when retracted.

Removable floorings are installed under the cockpit and cabin carpeting. The walls and ceilings are soundproofed and upholstered with standard aircraft fabric. The soundproofing is cemented to the hull plating and the fabric is fastened to a muslin.

3. WING.

a. GENERAL.—The wing structure consists of a center section, which carries the engine nacelles and the integral fuel tanks; and the outer panels, to which are attached the ailerons, flaps and wing tip floats.

The wings are of aluminum alloy box beam construction, metal and fabric covered. The center section is covered entirely with metal; and the outer panels are metal covered forward of the rear beam and fabric from the rear beam to the trailing edge.

b. ASSEMBLY.—Wing erection of this airplane is specifically a factory job. The center section is attached at the box beam to strength members in the hull by eight vertically installed bolts. The portions fore and aft of the box beam are permanently attached to the hull by extended angular brackets and gap bands secured by rivets.

The outer panels are attached to the center section box beam by beam connectors and angle splice plates with a series of clevis and hex. head bolts. The joint between the outer wing panel and the center section is covered with gap plates fastened with corrosion resistant button head steel screws. See Wing Assembly Illustration.

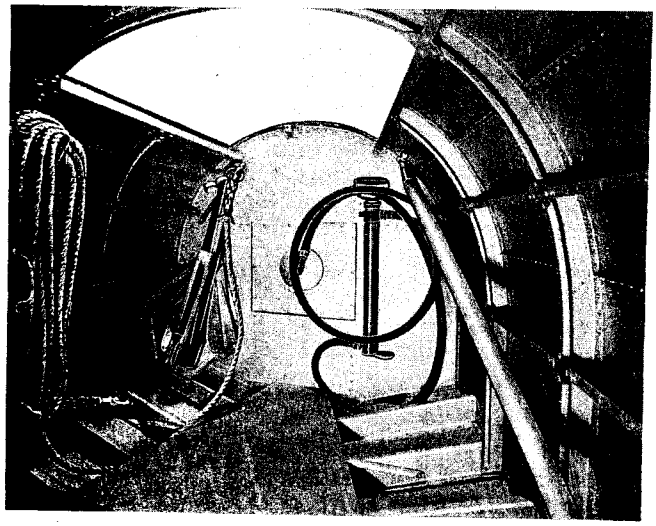
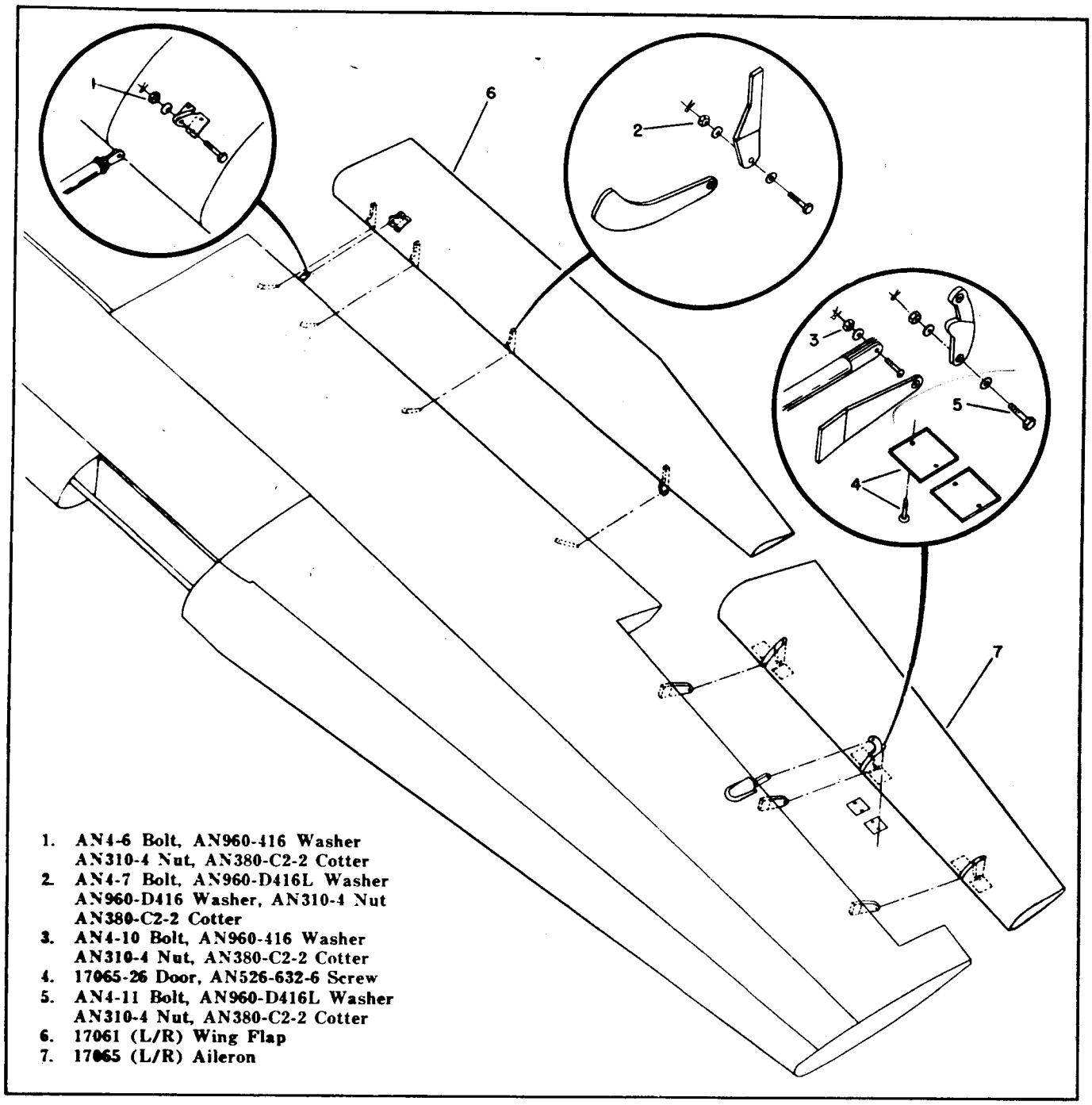


Figure 11—Bow Compartment



1. AN4-6 Bolt, AN960-416 Washer
   AN310-4 Nut, AN380-C2-2 Cotter
2. AN4-7 Bolt, AN960-D416L Washer
   AN960-D416 Washer, AN310-4 Nut
   AN380-C2-2 Cotter
3. AN4-10 Bolt, AN960-416 Washer
   AN310-4 Nut, AN380-C2-2 Cotter
4. 17065-26 Door, AN526-632-6 Screw
5. AN4-11 Bolt, AN960-D416L Washer
   AN310-4 Nut, AN380-C2-2 Cotter
6. 17061 (L/R) Wing Flap
7. 17065 (L/R) Aileron

Figure 12—Aileron and Flap Installation

c. FLAPS. — The NACA Standard fabric covered wing flaps facilitate both landing and take-off. These surfaces, which are hydraulically operated to the DOWN position and returned to the UP position by springs within the operating cylinders, extend from the inboard end of the ailerons to the hull. They are attached to the center section and outer panel at the four hinges by hex. head bolts. All flap hinges are equipped with grease packed ball bearings.

The flap hydraulic actuating cylinders are pivotally attached to the rear face of the box beam and are located just outboard of the hull. They are bolted in position with hex. head bolts. The right flap cylinder is interconnected with the right elevator tab. See paragraph 12., Surface Controls.

d. AILERONS. — Each aileron is attached to the outer wing panel by means of hex. head bolts at the three hinges. The control horn is located near the center of the aileron leading edge. The push-pull control tube, which mates with the horn, extends directly into the wing, being faired at this point by a fabric boot. All aileron hinges are equipped with grease packed ball bearings.

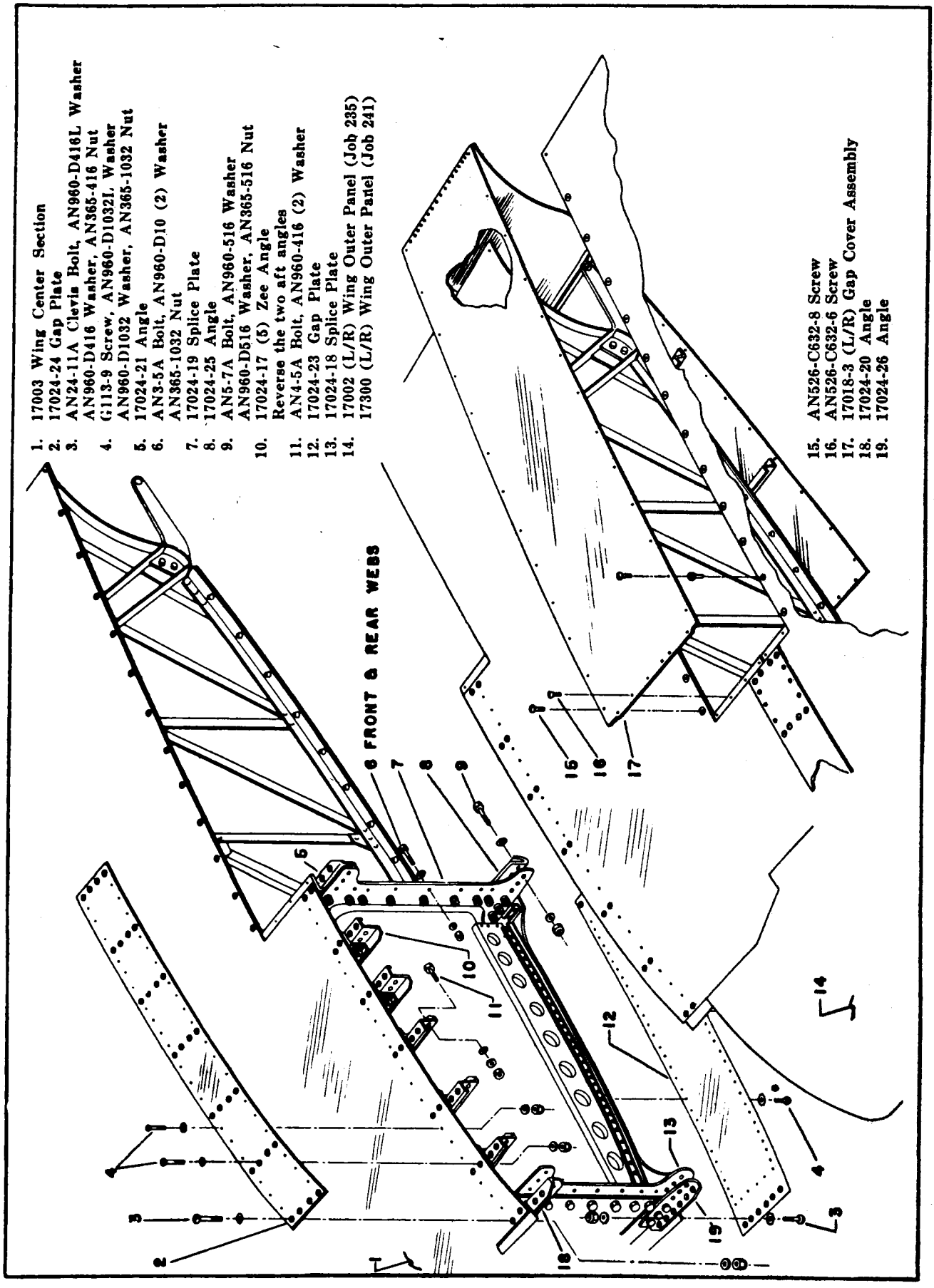


Figure 13—Wing Outer Panel Installation

1. 17592-1 (2) Front Tie Rod
2. 17586 Forward Strut
3. 17577 Float
4. 17592-4 Anti-Drag Tie Rod
5. 17592-3 Drag Tie Rod
6. 17592-2 (2) Rear Tie Rod
7. Fore and Aft Tie Rods
   AN23-10 Bolt, AN960-10 Washer
   AN320-3 Nut, AN380-C2-2 Cotter
   Drag Tie Rods
   AN24-12 Bolt, AN960-416 Washer
   AN320-4 Nut, AN380-C2-2 Cotter
8. AN25-19 Bolt, AN960-D516L Washer
   AN960-D516 Washer, AN320-5 Nut
   AN380-C2-2 Cotter
9. AN4-25 Bolt, AN960-D416L Washer
   AN365-428 Nut
10. 17587 Rear Strut

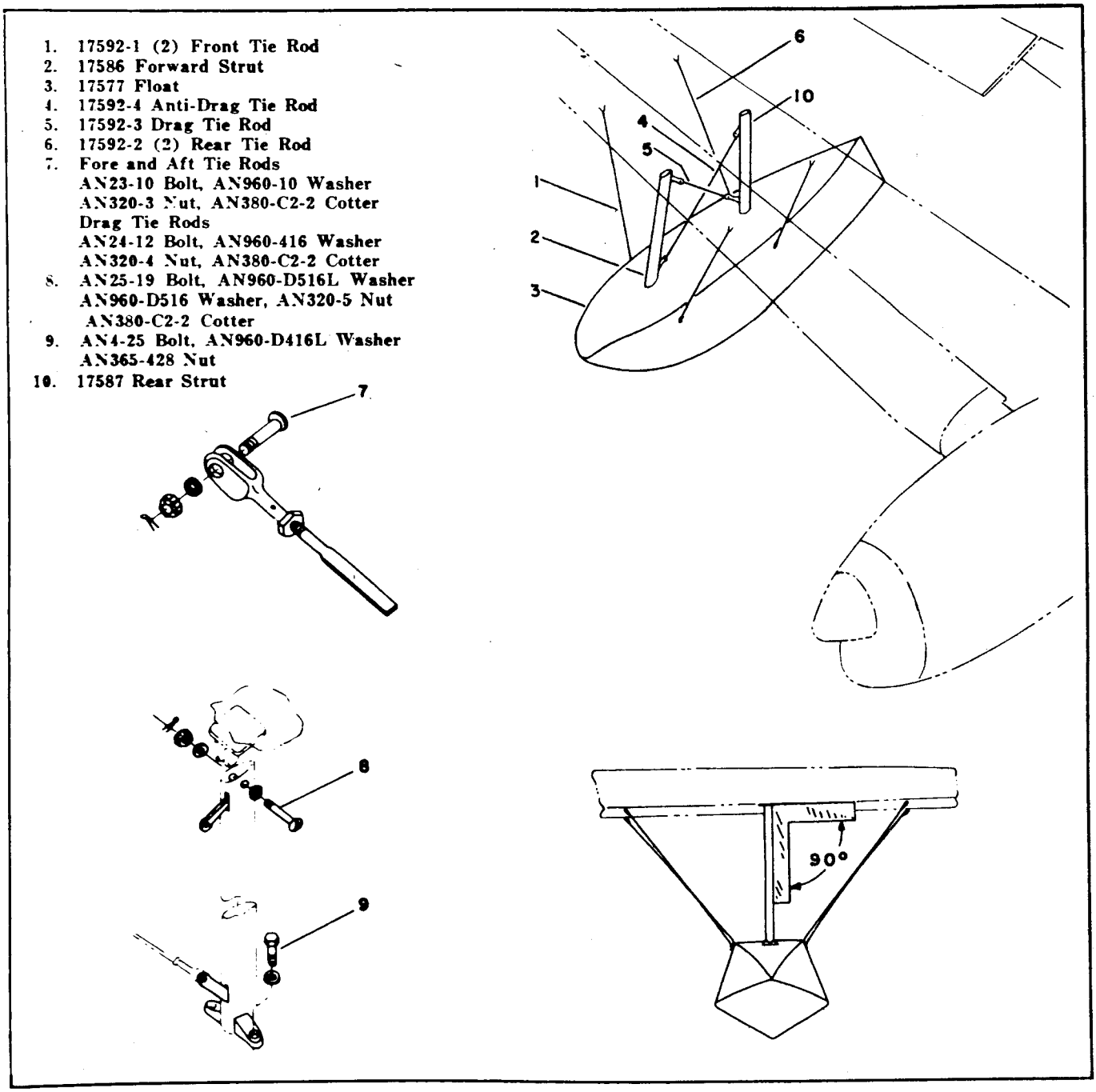


Figure 14—Wing Tip Float Attachment

e. AILERON TAB.—If flight testing shows the airplane to be wing-heavy, this condition may be quickly and effectively remedied by bending the fixed aileron tab in the proper direction.

Note

Care should be taken not to bend the tab too severely as a slight deflection compensates for a considerable amount of wing heaviness.

f. MISCELLANEOUS WING CONNECTIONS.

(1) WIRING.—All electrical wiring in the wing is enclosed in solid wall aluminum alloy conduit—flexible conduit is used at light fixtures and panel connections. Each wire is individually marked with an identification number in accordance with the Electrical Wiring Diagram.

Both the left and right outer panels are fitted with provisions for a retractable landing light and motor assembly in the lower surface. Running lights are installed in the left and right wing tips.

(2) AILERON CONTROLS.—The aileron control in the wing consists of push-pull rods and bellcranks which are cable operated from a central bellcrank located in the cabin on the rear face of the wing box beam. Connect the aileron cables to the bellcrank on the rear face of the beam. See Surface Controls for aileron adjustment.

(3) AIRSPEED TUBING.—The L shaped airspeed pitot-static tube is located on the lower surface of the right wing near the tip. The lines in the wing to the pitot-static tube are aluminum alloy tubing connected by aluminum alloy compression fittings. They run through the wing leading edge to the hull. Drain tees are located on the right hand side of the hull between Stations #7 and #8. See paragraph 10., Instruments.

(4) WING TIP FLOAT ATTACHMENT.—The wing tip floats, of standard lines and construction, are attached to the outer wing panels by two vertical struts and streamlined tie-rods. The left and right floats are interchangeable.

Coat the tie-rod threads with a mixture of linseed oil and white lead for corrosion protection. Wires should be started evenly with the right hand threads in downward position. The wires should be run-up by hand to the inspection hole opening. Fasten them in a streamlined position to avoid vibration.

To assemble the float, first attach the struts and the fore and aft tie-rods to the float, then attach the assembly as a unit to the outer panel. Install the transverse tie-rod braces. Adjust the tie-rods as shown on the Float Installation in order to align it properly.

Note

Draw up the wires until they are snug. If the wires are too tight, wing flexing during flight will cause them to snap. Also make sure both sides are drawn up as evenly as possible. Uneven drawing up, of the wires, will cause the float to be pulled out of line.

4. TAIL SURFACES.

a. GENERAL.—The tail unit, comprising a cantilever fin with hinged rudder and strut-braced stabilizers with hinged elevators, is supported at the aft end of the hull.

b. FIN.—The fin, constructed with a single beam, stamped ribs and stressed aluminum alloy skin, is bolted to the hull. The fin post or beam supports the upper rudder hinge.

c. RUDDER.—The rudder is a fabric covered internally braced aluminum alloy structure, provided with three hinges fitted with grease packed ball bearings. The upper hinge is bolted to the rear beam of the fin and the two lower hinges are bolted to the stern post.

The rudder is fitted with electrical conduit and is wired for the anchor and running lights. A fairlead fitting is provided on the top of the rudder for the radio antenna.

The control horn is rigidly attached to the rudder and should not be disconnected when removing this control surface from the airplane. The control cables, tab control shaft and electric wiring should be disconnected at tail junction box before removing rudder.

d. STABILIZERS.—The stabilizer, which is the same type structure as the fin, is attached to the hull at Station #30 and to the stern post by hex. head bolts. The stabilizer brace struts, located below these surfaces, are attached by hex. head bolts.

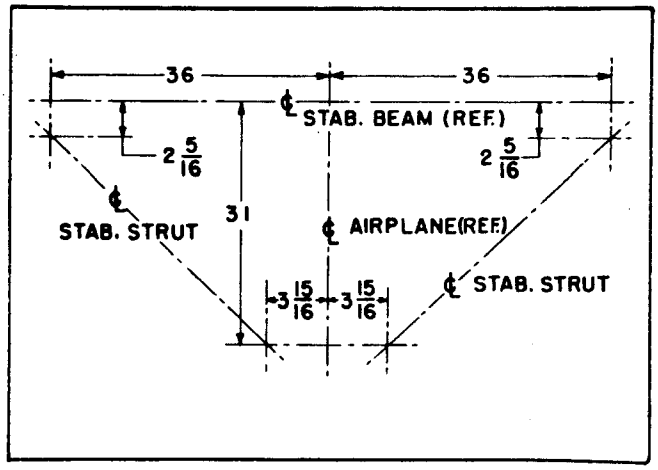


Figure 15—Stabilizer Rigging Diagram

e. ELEVATORS.—The fabric covered, aluminum frame elevators are provided with four hinges, fitted with grease packed ball bearings, which are bolted to the stabilizer rear beam. The elevators are bolted to the control horn but may be removed from it individually.

Note

Combined elevators must show an underbalance of 50 ±10 in-lb when fully assembled with mass balances and tabs installed (elevator cables disconnected).

f. TABS.—The rudder and left elevator are fitted with trimming tabs which are controllable from the pilot's overhead control panel.

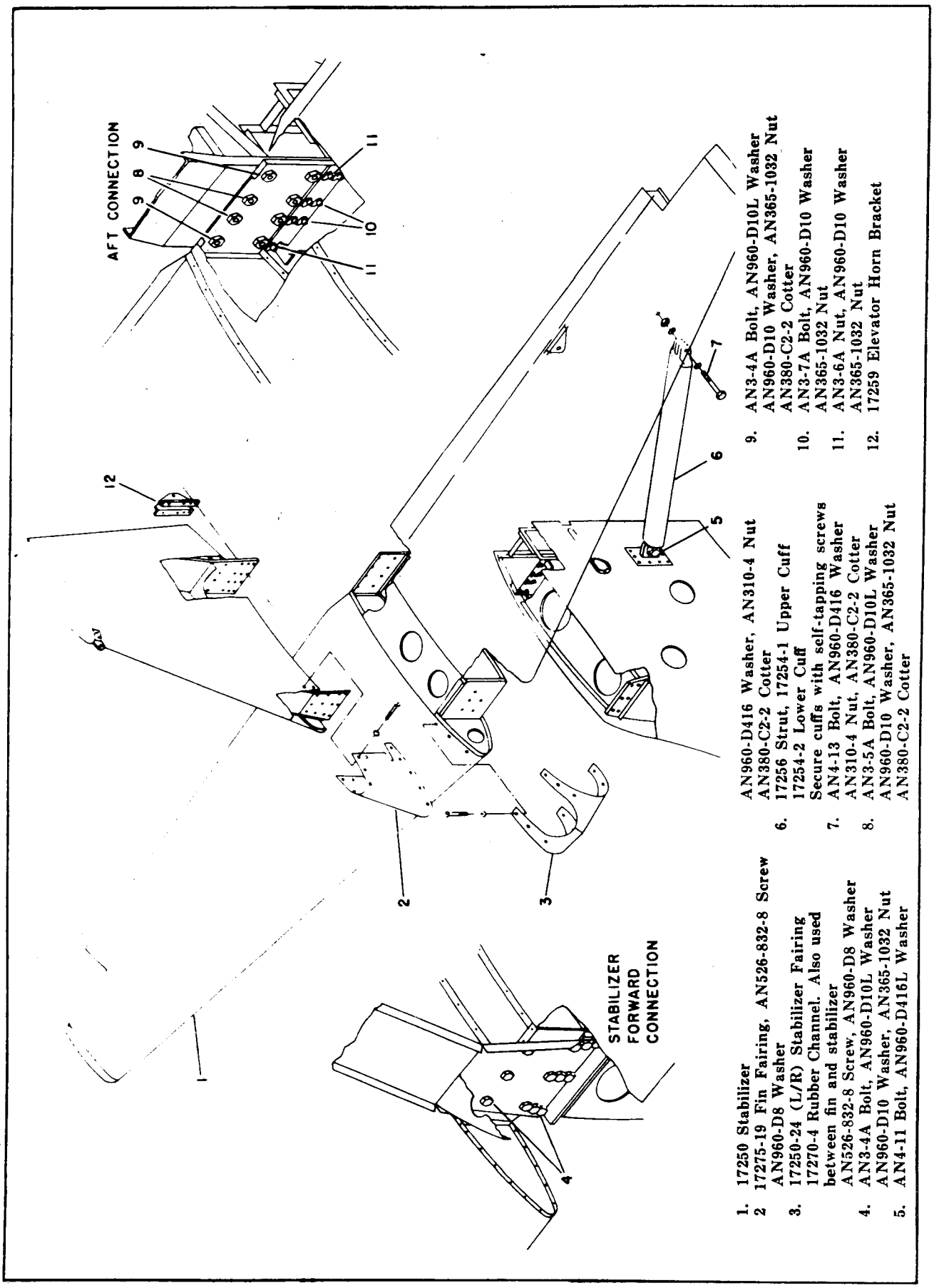
The right elevator is interconnected with the wing flap control and operates in conjunction with it. This tab is lowered with the wing flaps thus counteracting "nose heaviness" which is consequent to wing flap operation. See paragraph 12, Surface Controls.

5. POWER PLANT.

a. GENERAL.—The Ranger Model 6-440C-5 direct drive, six cylinder, inverted air cooled engines are rated at 200 bhp at 2450 rpm at sea level, using 87 or 91 octane fuel.

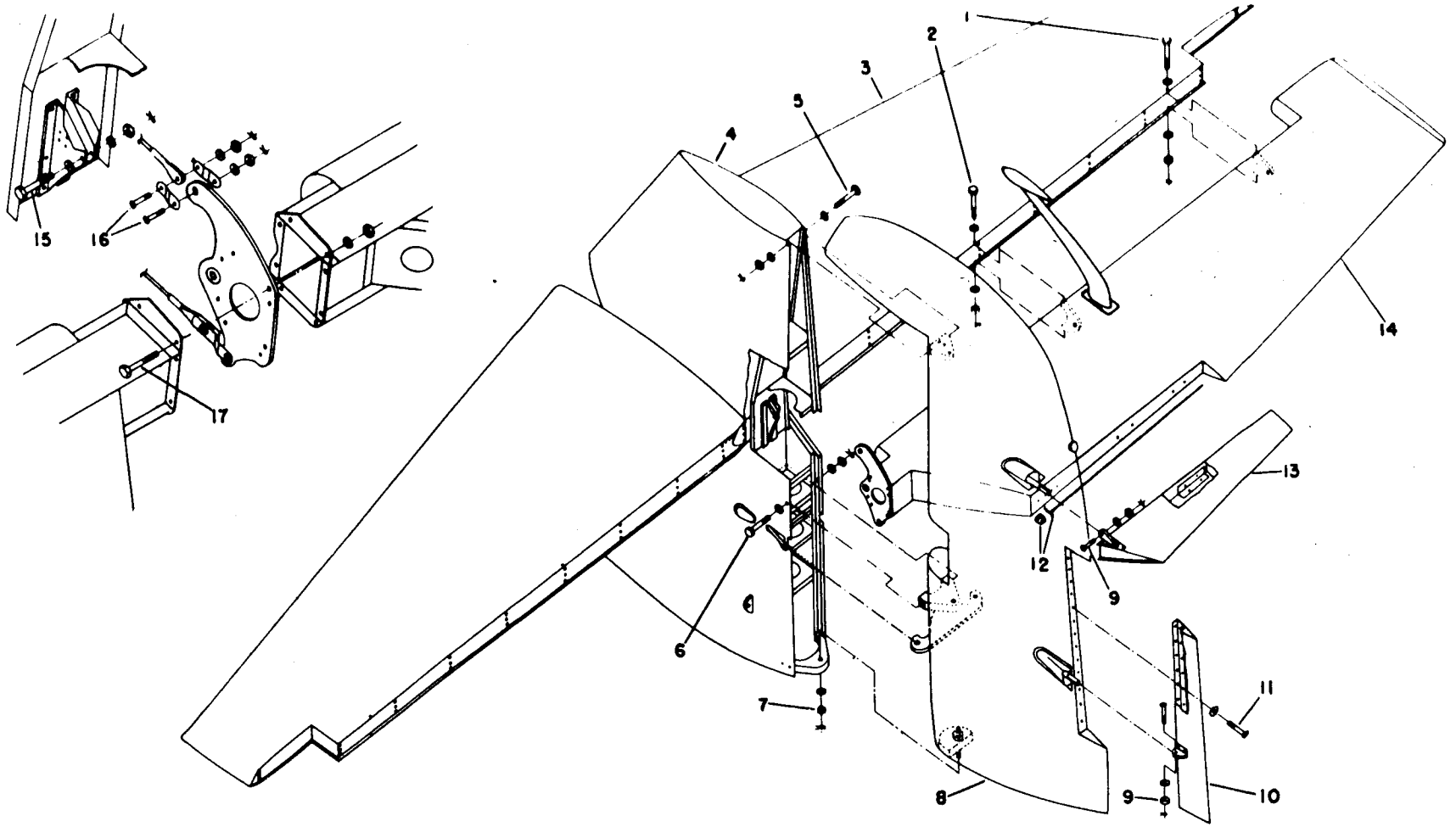
For information relative to the care, maintenance, inspection, and lubrication of the engines, refer to the Instruction Book for Ranger Aircraft Engines.

b. ENGINE MOUNTS.—The engine mounts, constructed of chrome molybdenum steel sheet and tubing, are connected by six bolts to the wing center section box beam. The mount is provided with four mounting brackets, shock absorber bushings and pressure



1. 17250 Stabilizer
2. 17275-19 Fin Fairing, AN526-832-8 Screw
   AN960-D8 Washer
3. 17250-24 (L/R) Stabilizer Fairing
   17270-4 Rubber Channel. Also used between fin and stabilizer
   AN526-832-8 Screw, AN960-D8 Washer
4. AN3-4A Bolt, AN960-D10L Washer
   AN960-D10 Washer, AN365-1032 Nut
5. AN4-11 Bolt, AN960-D416L Washer
   AN960-D416 Washer, AN310-4 Nut
   AN380-C2-2 Cotter
6. 17256 Strut, 17254-1 Upper Cuff
   17254-2 Lower Cuff
   Secure cuffs with self-tapping screws
7. AN4-13 Bolt, AN960-D416 Washer
   AN310-4 Nut, AN380-C2-2 Cotter
8. AN3-5A Bolt, AN960-D10L Washer
   AN960-D10 Washer, AN365-1032 Nut
   AN380-C2-2 Cotter
9. AN3-4A Bolt, AN960-D10L Washer
   AN960-D10 Washer, AN365-1032 Nut
   AN380-C2-2 Cotter
10. AN3-7A Bolt, AN960-D10 Washer
    AN365-1032 Nut
11. AN3-6A Nut, AN960-D10 Washer
    AN365-1032 Nut
12. 17259 Elevator Horn Bracket

Figure 16—Fin and Stabilizer Installation



1. AN4-32 Bolt, AN960-D416 (2) Washer
   AN310-4 Nut, AN380-C2-2 Cotter
2. AN4-41 Bolt, AN960-D416 (2) Washer
   AN310-4 Nut, AN380-C2-2 Cotter
3. 17250 Stabilizer
4. 17275 Fin
5. AN4-35 Bolt, AN960-D416 (2) Washer
   AN310-4 Nut, AN380-C2-2 Cotter
6. AN4-57 Bolt, AN960-D416 (2)
   AN310-4 Nut, AN380-C2-2 Cotter
7. 17281 Bolt (Ref)—AN960-516 Washer
   AN310-5 Nut, AN380-C2-2 Cotter
8. 17280 Rudder
9. AN23-10 Bolt, AN960-D10 Washer
   AN310 Nut, AN380-C2-2 Cotter
10. 17268 Rudder Tab
11. AN526-8-6 Screw and Shake-proof Washer
12. Hinge Pin and Retaining Clip
13. 17265 Left Elevator Tab
    17266 Right Elevator Tab
14. 17252-71 Left Elevator
    17252-72 Right Elevator
15. AN4-11 Bolt, AN960-D416 (2) Washer
    AN310-4 Nut, AN380-C2-2 Cotter
16. 17869 Attachment Fitting
    AN24-10 Bolt, AN960-D416 Washer
    AN310-4 Nut, AN380-C2-2 Cotter
    AN24-14 Bolt, AN960-D416 Washer
    AN310-4 Nut, AN380-C2-2 Cotter
17. AN3-7 Bolt, AN960-D10L Washer
    AN960-D10 Washer, AN365-1032
    AN380-C2-2 Cotter

Figure 17—Elevator and Rudder Installation

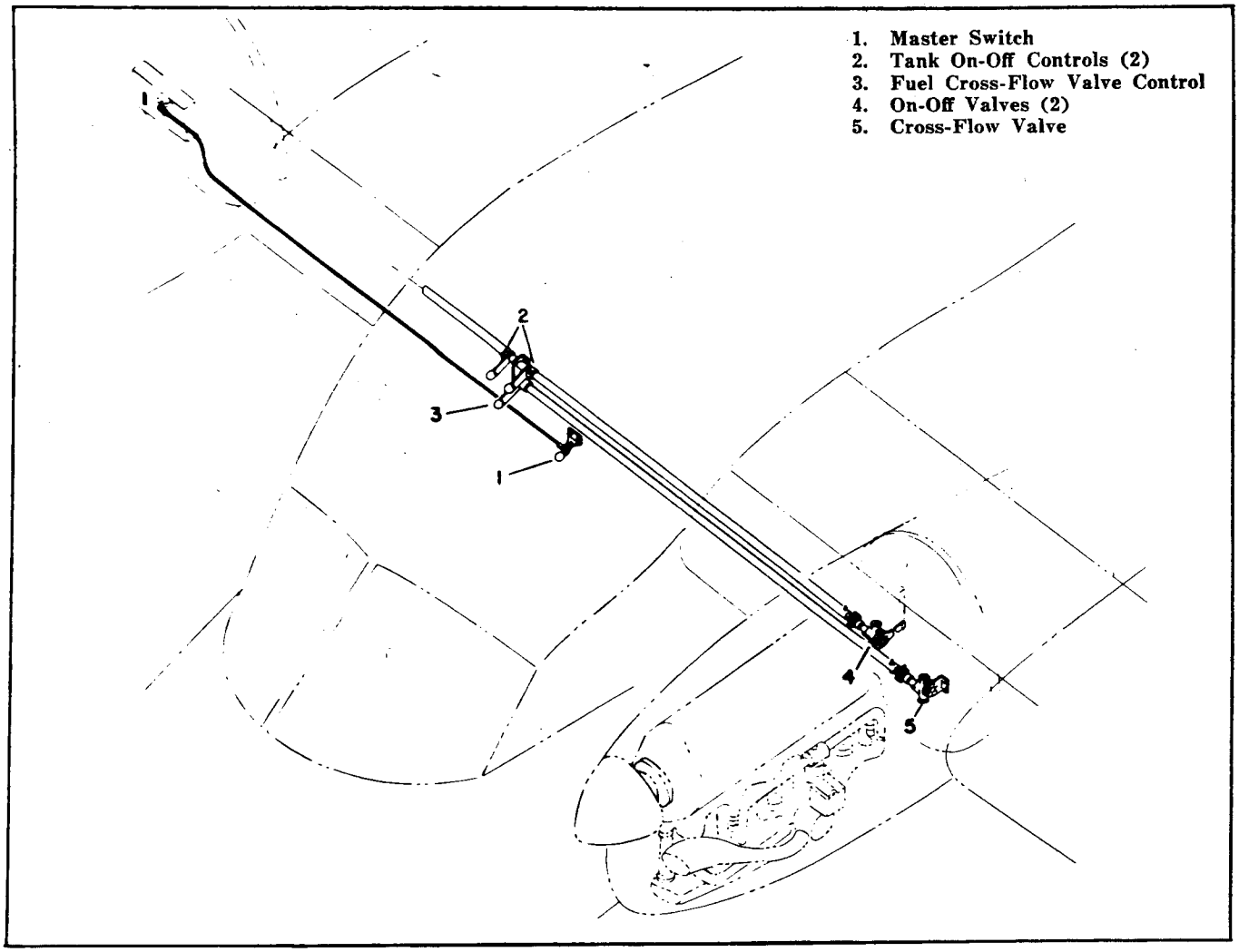


Figure 18—Engine Controls: Master Switch, Fuel Tanks On-Off and Fuel Cross Flow Valves

plates, comprising a resilient mounting for the engine assembly.

Note

All bolts and nuts should be carefully checked for tightness at the standard inspection periods.

c. EXHAUST SYSTEM.—Each engine exhaust system consists of six short stacks with flanges, leading into the welded manifold unit which exhausts under the wing to the right of the nacelle. A cowling muff is provided adjacent to the center of the exhaust manifold for hot air pick-up for the carburetor air preheat A tube is welded to the exhaust manifold for carrying heat to the carburetor hot spot. The heat intensifier tube, in each exhaust manifold, supplies the cabin with heated air through a cockpit control valve unit.

d. STARTERS.—The engines are fitted with Eclipse electric starters. The starter push buttons, with hinged cover flap, are located on the electrical panel above the pilot's head. An outside power plug is installed on the bulkhead behind the pilot, thus making provision for connecting an external power source for starting the engines and checking electrical equipment.

e. ENGINE CONTROLS.—The dual throttle control quadrant is located just forward of the upper control panel and the mixture controls are on the upper rear control panel. These controls are connected to the carburetors by a system of push rods and torque tubes. The torque tubes run inside the leading edges of the wing to the nacelles, and the push rods are located in the engine compartments. The adjustable push rods in the nacelles connect the torque tube lever arms with the carburetor levers.

The throttles are arranged so that the engines may be throttled individually or simultaneously. Their movement is conventional: i.e., FQRWARD—OPEN and AFT—CLOSED. The right hand throttle is interconnected with the landing gear warning system. See paragraph 11., Landing Gear.

The two wobble pumps, two tank shut-off fuel valves, and the cross-flow fuel valve are operated from the upper rear control panel by torque tubes. The cross-flow valve is located in the left engine nacelle; and a wobble pump and shut-off valve are installed in

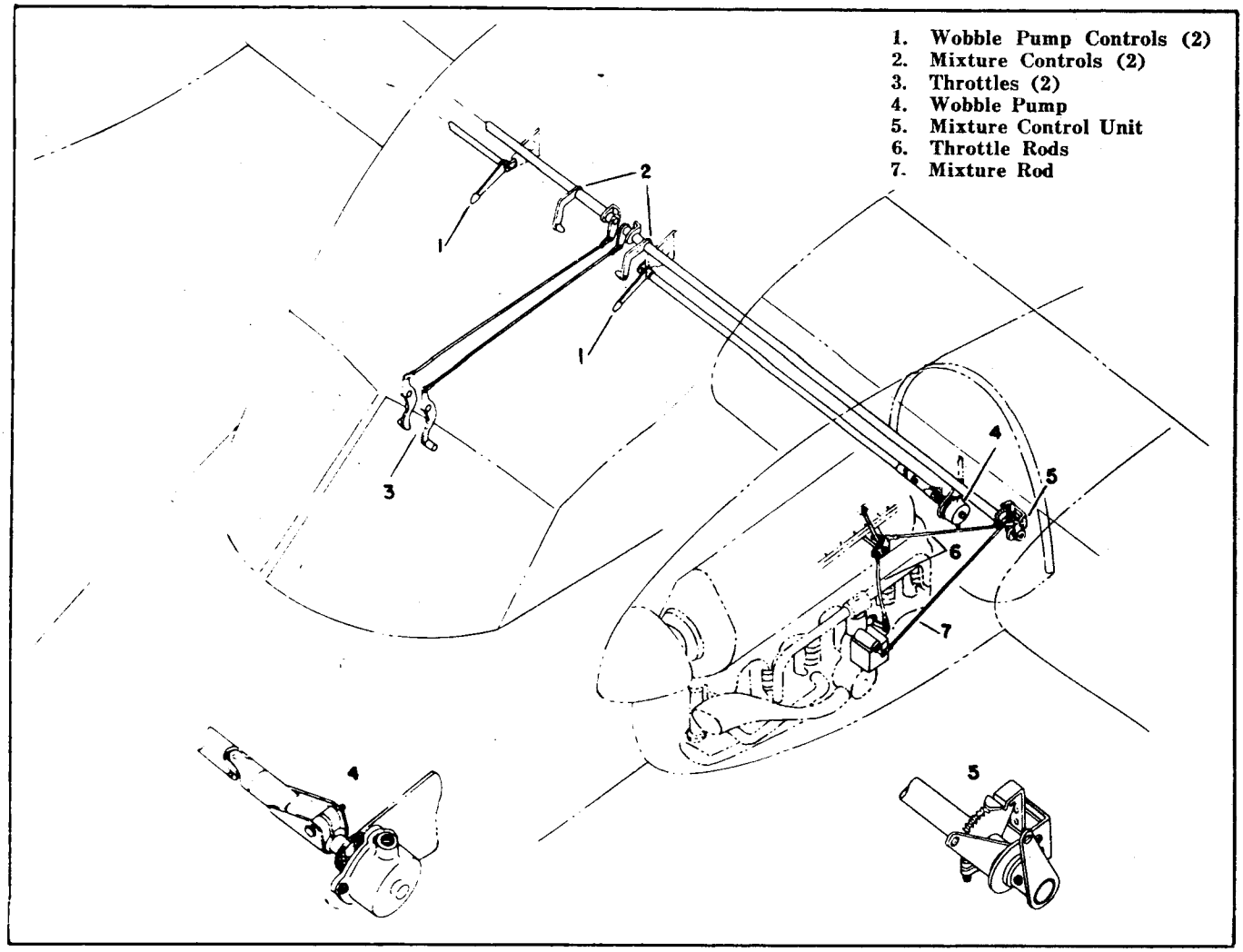


Figure 19—Engine Controls: Throttle, Wobble Pump and Mixture

each nacelle. On later airplanes electric fuel pumps replace the wobble pumps.

The carburetor air preheat controls are located on the left hand side of the upper rear control panel. These controls are connected to the preheat mixing valves on the left side of the engine by encased push-pull control wires.

In general, the controls and their operation are indicated by the adjacent nameplates.

f. CARBURETOR IDLE CUT-OFF.—This unit provides for stopping the engine by moving the mixture control lever into the red painted topmost section of the control slots, which are marked CUT-OFF.

g. PRIMERS.—Priming is accomplished by the priming pump control handle at the lower left hand side of the main instrument panel. Fuel is taken from the system on the carburetor side of the left engine by-pass relief valve, and distributed via this pump and tubing to the engine cylinders. The pump control handle should be rotated to the left to prime the left engine, and to the right for the right engine. The left wobble pump (or left electric fuel pump) must be operated in order to supply fuel for pump priming.

h. CARBURETOR AIR INTAKE.—The air preheat mixing chamber, mounted below the up-draft carburetor, is fitted with a valve arrangement, which consists of a mixing valve and lever. This unit is operated from a push-pull control "T" handle, located on the upper rear control panel. Pull forward for hot air then rotate to lock in position.

The hot air is taken from the exhaust manifold muff and the cold air is supplied from the nose cowling of the nacelle through a large duct to the mixing chamber.

The system is so designed that hot or cold air or any desired mixture of both may be supplied to the carburetor. An air temperature thermometer bulb is located in each mixing chamber and the gages are on the main instrument panel.

i. PROPELLERS.—The two-bladed propellers are fixed pitch Sensenich Model 82-RS-72. They are wood, with metal leading edges and tips, and are 82 in. in diameter with a 72 in. pitch at the ¾ radius.

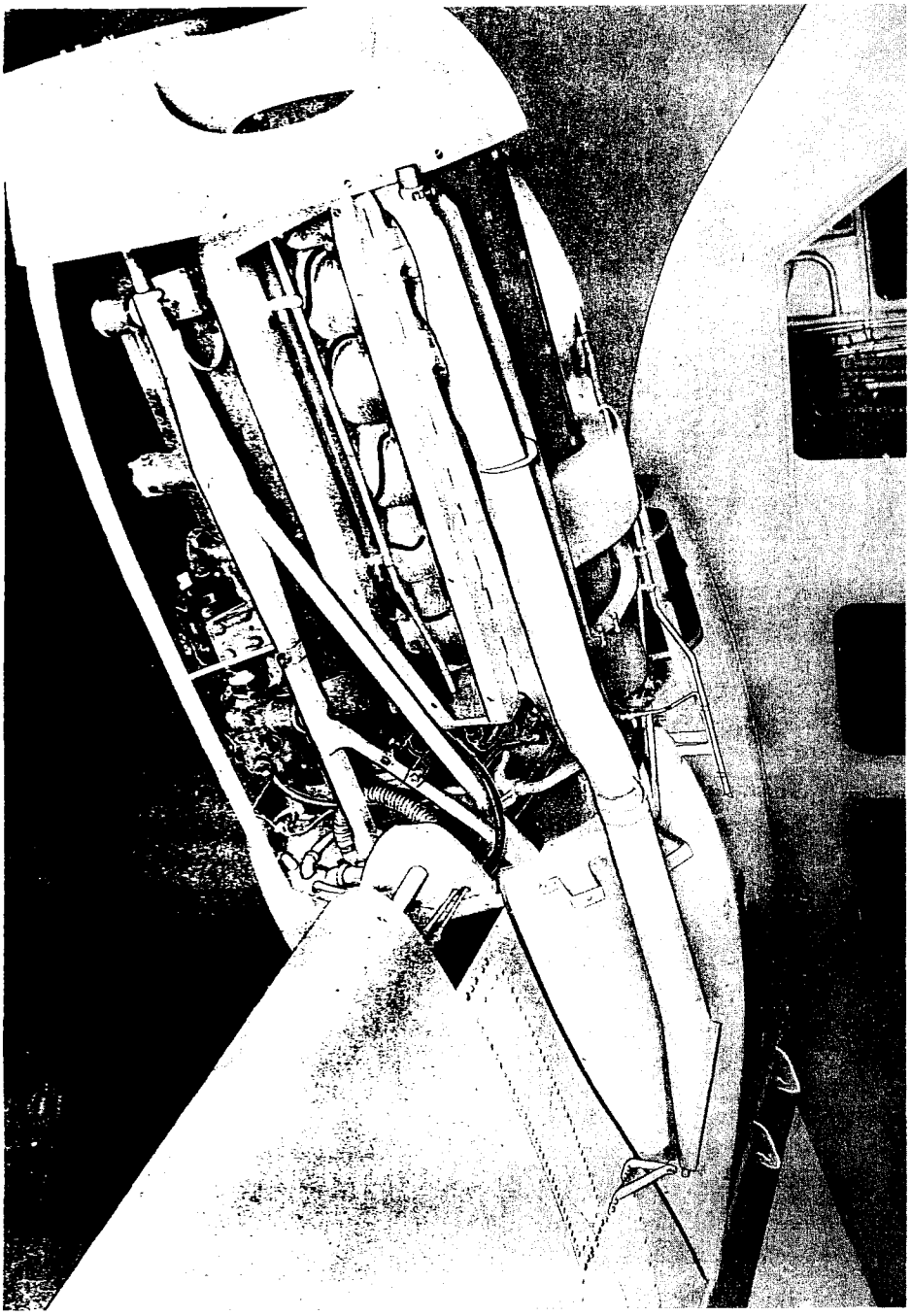
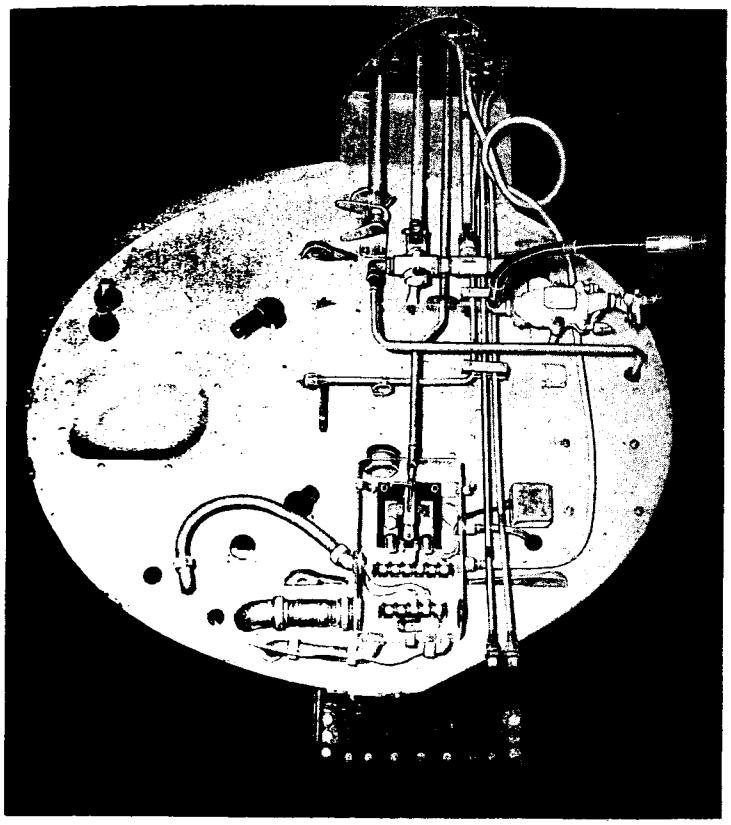


Figure 20—Engine Installation



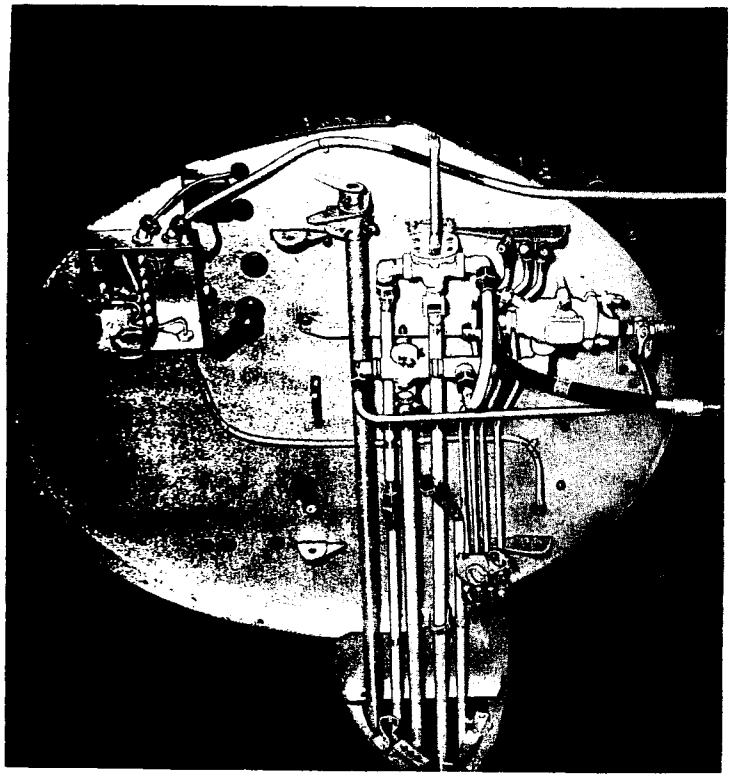


Figure 21—Firewalls—Left and Right Nacelles

Temperature and humidity conditions affect wood propellers even after short periods without use. The blades will sometimes warp slightly and not alike on either side thus changing the speed characteristics of their respective engines. This is the probable explanation if one engine does not turn up as fast as the other, and normally does not indicate a power loss. Several hours of running will usually bring the propellers back to their former speed. It is the usual practice on twin engine airplanes to synchronize the speed of the engines by their sound, even though the tachometer readings may be slightly different.

If the propellers change into steeper pitch (slower speed), the rpm limits shown on the Power Output Table will exceed the Ranger Aircraft Engine Company's maximum and recommended cruising limits; therefore, lower rpms should be used. This condition may be checked by running at full throttle in level flight at 500 ft. for several minutes. If the rpms are less than 2500, reduce the rpm listed on table by the number of revolutions lost. With manifold pressure gages, it is only necessary to follow the manifold pressure column on the following table:

POWER OUTPUT TABLE

Cruising Power	*Level Flight*	*Altitude*				
		0	2000	4000	6000	8000
Maximum	RPM	2260	2300	2330	2350	2370
75%	Man. Press.	23.5	23.0	22.5	22.0	21.5
Recommended	RPM	2150	2180	2200	2225	2250
62½%	Man. Press.	22.0	21.5	21.0	20.5	20.0
Economical	RPM	1975	2000	2025	2050	2075
50%	Man. Press.	19.5	19.0	18.5	18.0	17.5

(1) PAIRING OF NEW PROPELLERS.—The rpm tolerance of any shipment of wooden propellers is approximately ± 40 rpm from the specified static rpm. Thus it would be possible to select a pair that would run 80 revs apart under the same conditions on the same airplane. To prevent this, it is customary to run-up a new shipment of propellers and rate their static rpm's. The propellers should be run-up to maximum rpm on the same engine one after the other, as fast as they can be changed so that the same test conditions will prevail. The plane should be cross-wind to avoid the effect of the wind. The average maximum rpm of all the propellers in the test, should be calculated; and the plus or minus revs from this average listed for each propeller and painted on the hub for reference. If six or more propellers are used for such a run, the average should be reliable for comparison with other test runs under different barometric and temperature conditions. That is, the ratings above and below the average of one run are comparable with the above or below ratings of another run, even though the averages (due to variable test conditions) are different.

In assigning propellers to the airplane thereafter, they should be matched in pairs, as closely as possible, with equal ratings. Selections not more than 20, or at the most, 30 revs apart should be made.

If speed is desired, choose propellers with low rpm ratings, and keep the cruising revs lower than shown in the Pilot's Handbook. If quick take-off is desired, choose propellers with high rpm ratings and when cruising, revs may be used slightly above the table values.

(2) PROPELLER HUB BOLTS.—The propeller hub bolts should be installed with the nuts on the rear flange. If replacements are needed, note that the bolts are Warner Aircraft Corporation Part No. 7366, and are not standard AN bolts.

Note

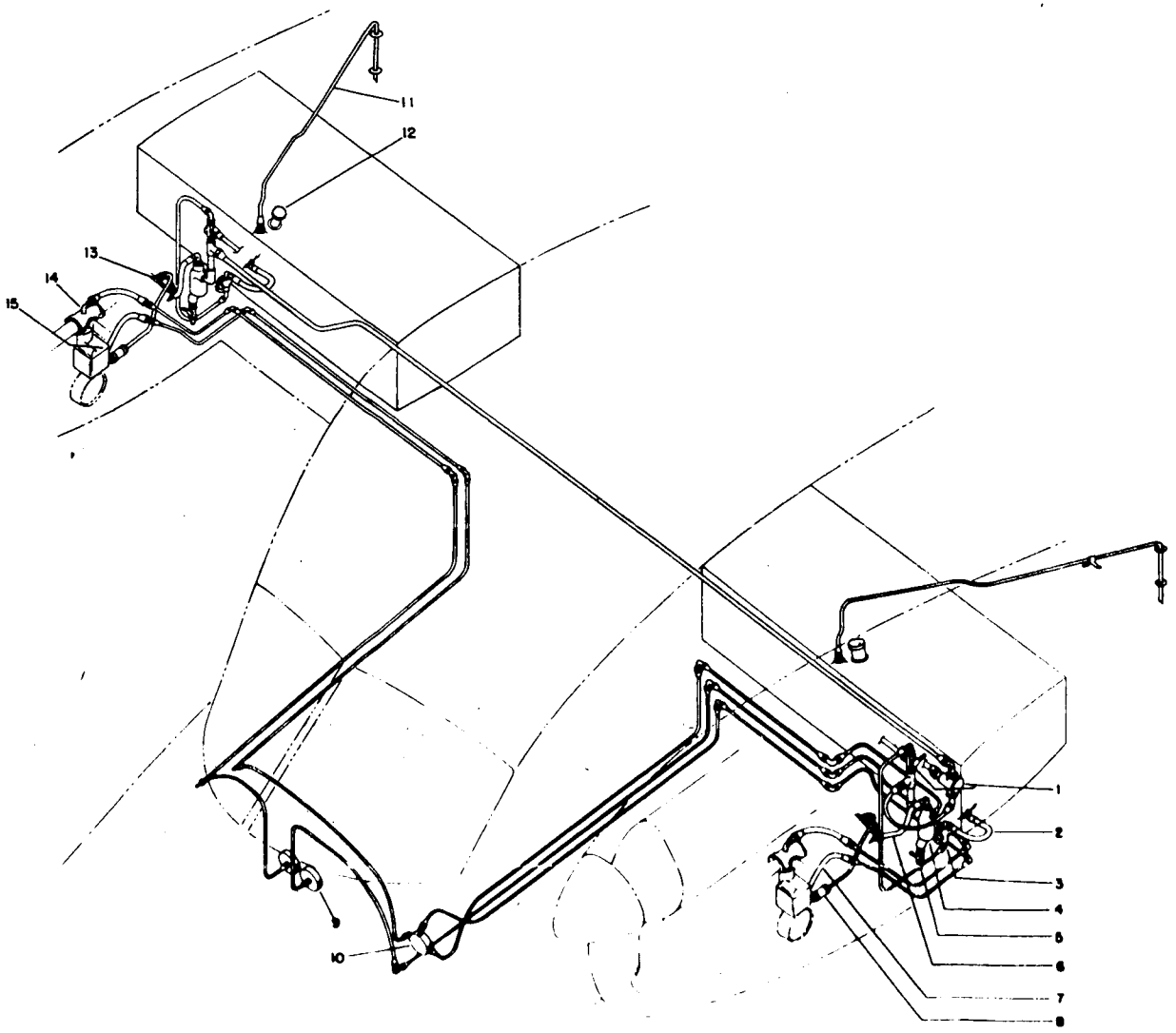
The seat of the propeller hub on the hub cone should be checked every 100 hours. The tightness of the propeller hub bolts should be checked after the first 25 hours of operation and every 50 hours thereafter.

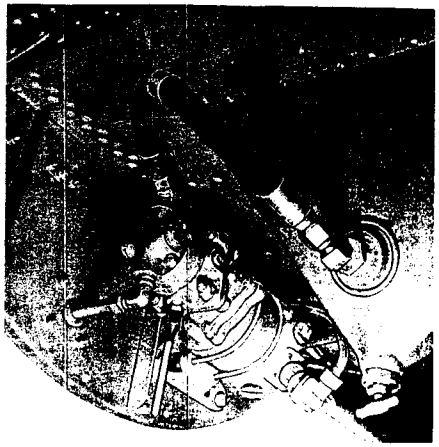
6. FUEL SYSTEM.

a. GENERAL.—Each fuel system consists of an integral wing tank, tank outlet strainer, tank filler, wobble pump and strainer (later model airplanes one equipped with electric fuel pumps), quantity gage, fuel pressure gage, engine-driven fuel pump with integral relief and by-pass valve, fuel valve and controls, and vent lines.

The fuel system is essentially a complete separate unit or assembly for each engine, and is normally used as such with each tank feeding its own engine directly. There is, however, a cross-flow connection with a shut-off valve, enabling both engines to be run simultaneously from either tank. To do this, the valve on the tank not being used should be closed. If three valves are open and one of the tanks should run dry, air will enter both systems, resulting in momentary failure of the engines. Closing the valve on the empty tank, thereby cutting it out of the system, will return engine operation to normal.

It should be remembered that for both engines to run two valves must be ON, and that three valves should not be ON at once if the fuel is very low.





Electric Fuel Pump Installation

1. 64415 Type D-3 Aero Supply Shut-Off and Cross Flow Valves
2. AN6260-6-12½ Flexible Hose Assembly
3. Electric Fuel Pump
4. C-1A Strainer
5. AN702-G-4D Drain Valve
6. AN6260-6-12½ Flexible Hose Assembly
7. AN856-4A-12 Flexible Hose Assembly
8. AN884 Flexible Hose
9. Fuel Pressure Gages
10. 401-2A Parker Two Engine Primer
11. Vent Line
12. Tank Filler Cap
13. Engine Driven Fuel Pump
14. 17620-3 Restriction Fitting
15. 17620-7 Restriction Fitting

NOTE: Metal lines are .035 wall, 5280 Tubing

Figure 22—Fuel System Diagram

b. FUEL.—Use 87 or 91 octane gasoline.

c. TANKS.—The tanks are built as an integral part of the wing center section and are located between Stations =26 3/4—=2 13/16. Neoprene sealing tape, set in neoprene cement, is used at the tank seams during construction. Each tank is equipped with a float type electric fuel quantity unit, sump, strainer and drain cock.

Left tank	54 U.S. gals.
Right tank	54 U.S. gals.

When leaking tanks are encountered, it is recommended that they be sprayed or hand brushed on the interior of the leaking seams or rivets with Fuller's Fuel Tank Slushing Compound TL-284. The compound dries in 12 hours and forms a resinous film which is impervious to gasoline. No prior cleaning is necessary other than the removal of loose particles. This compound is sprayed on the inside of all tanks in later production airplanes.

d. FUEL VALVES.—A two-way, ON-OFF, fuel valve is located in each engine nacelle. The control handles are located on the upper rear control panel.

The cross-flow valve is located in the left engine nacelle just outboard of the wobble pump. Its control handle is also located on the upper rear control panel.

e. STRAINERS AND DRAINS.—The fuel strainers, located in each engine nacelle, can be drained directly to the ground. These units should be drained every day before flying.

Each tank is drained individually by means of the fuel system drain which is located at the base of the tank sump.

CAUTION

When it is necessary to pre-heat the engine or do welding around the engine compartment, the engine should be run dry and the carburetor checked to see that it is completely drained.

f. FILLING TANKS.—Fuel tanks should be filled before placing the airplane in the hangar. This has the advantage of reducing the possibility of moisture condensing in the tank.

The tanks should NOT be filled to capacity in cold weather if the airplane is to be parked in a warm hangar, as the gasoline will expand and overflow through the vents. A fifty degree difference in temperature will cause an expansion of about 2½ gallons per 100 gallons.

CAUTION

Before filling the tanks, make certain that the airplane is grounded and the hose nozzle is bonded to the airplane. If the plane is refueled from a truck, ground the truck to the airplane. The bond between the hose nozzle and plane must be left connected until refueling has been completed and the tank cover closed. Do not charge battery or test the radio transmitter in the plane during refueling.

g. FUEL AND VENT LINES. — See Fuel System Diagram for lines and fittings, unit numbers and general layout. All solid lines are 52SO aluminum alloy tubing.

h. HAND PUMP UNITS.—A type D-2 wobble pump is located in each nacelle on the front of the firewall. They are operated by their respective control handles, on the upper rear control panel. (Electric fuel pumps will replace the wobble pumps in the later model airplanes.)

i. FUEL PUMPS.

(1) ENGINE PUMP. — The engine-driven fuel pump pressure relief valve is set to maintain an operating pressure of 3½—4½ psi.

(2) ELECTRIC PUMP.—The electric fuel pumps and motors are located on the lower aft side of the firewalls. These pumps are an emergency means of maintaining fuel pressure. They should be used whenever the fuel pressure gage needles drop below 2 psi. It is advisable to utilize these pumps during take-offs and landings at extreme altitudes and temperatures.

Pump pressure is set at 2.5 psi.

7. OIL SYSTEM.

a. GENERAL.—The oil system for each engine consists of a single tank, 5 in. dia. oil cooler with automatic thermostatic control and check valve, system lines with flexible connections where required, drain plug, oil pressure and oil-in temperature gages.

b. OIL.—Use Grade SAE #50 oil.

c. TANKS.—The tanks are provided with filler caps equipped with sounding rods and drain valve with tubes. They are installed on the top of the wings just aft of the firewalls. Capacity of each tank—3½ U.S. gal. Foaming space—1 U.S. gal.

d. OIL COOLERS.—An oil cooler is installed (in each nacelle) outside of the engine cowling and is attached to the engine mount tubes. Air for the cooler enters through a scoop on the left hand side of each nacelle and exits at the aft end of the scoop. The thermostatic oil temperature regulator, attached to each cooler, is correctly set at the factory and normally requires no attention.

e. PRESSURE RELIEF VALVES.—The oil pressure should be maintained within the limits set by the engine manufacturer. It is regulated by adjusting the oil pressure relief valve located on the right rear of the engine crankcase.

1. Oil Pressure Gage
2. Oil Temperature Gage
3. ¼ x .035 Oil Pressure Line
4. 2001-Fx14′ Oil Temperature Line (U.S. Gage Co.)
5. AN856-4A-12 Flexible Hose Assembly
6. ¾ x .049 Oil In Line
   AN884-12 (2) Flexible Hose
7. Oil Separator (Ref.)
8. ⅜ x .049 Drain Line
   AN884-10 Flexible Hose
9. 702-HB-10D Drain Valve
10. ¾ x .049 Engine Out Line
    AN884-12 (2) Flexible Hose
11. 17603 Oil Tank
12. 17734-2 Tee
    AN884-10 (2) Flexible Hose
    AN884-8 Flexible Hose
13. ¾ x .049 Oil Cooler Out Line
    AN884-12 Flexible Hose
14. 5″ D #3150 Oil Cooler
    #U3255 Type D5 Thermostatic Relief Valve
    (United Aircraft Products)

NOTE

Cut AN884 hoses to length on assembly.

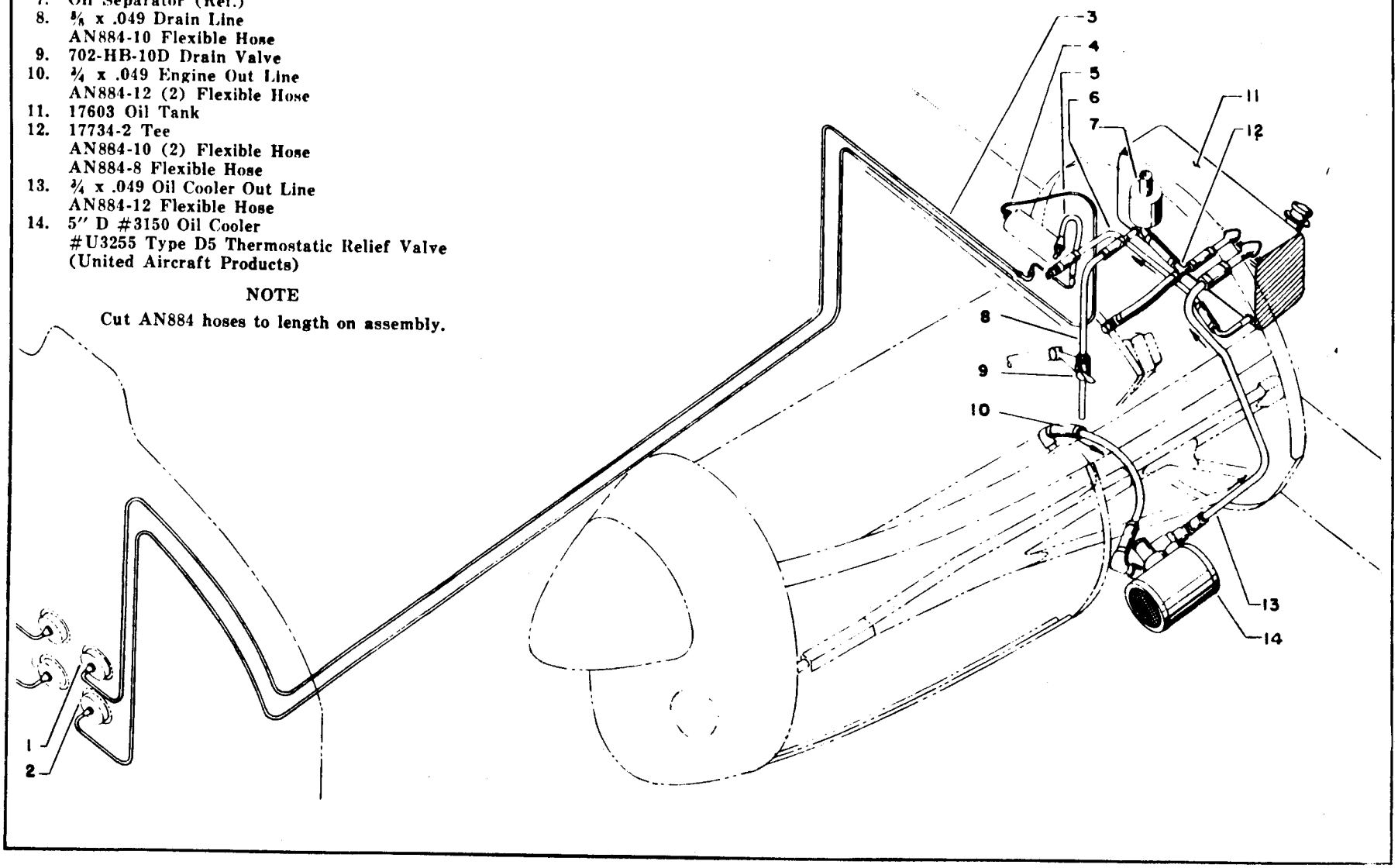


Figure 23—Oil System Diagram

f. OIL PRESSURES—PSI.

Maximum—70 Minimum cruising—50
Desired —60 Minimum idling —15

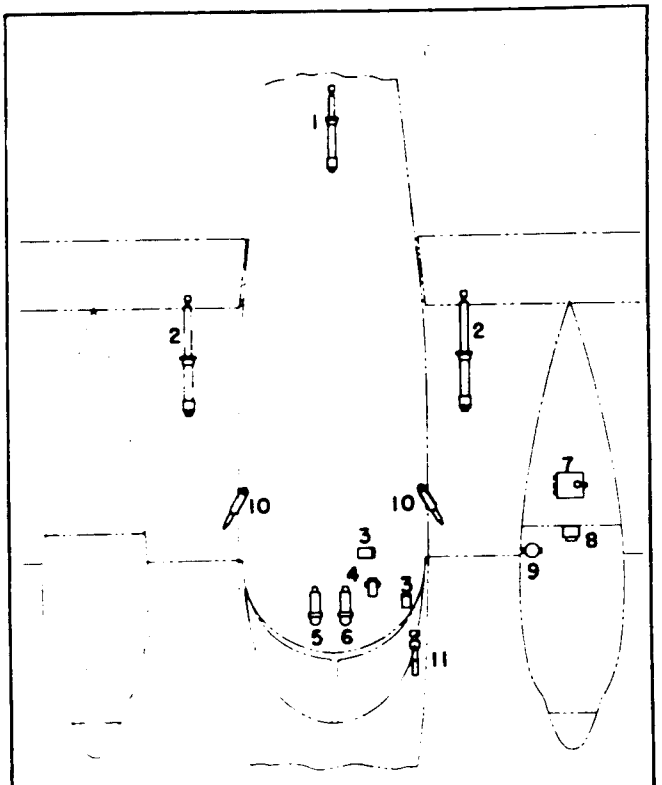
g. DRAIN VALVES.—Before filling the tanks, check to see that the drain valves are lockwired in the closed position.

h. OIL LINES.—All lines are 52SO aluminum alloy tubing connected with flexible neoprene tubing and stainless steel clamps.

i. OIL GAGE.—Oil-in temperature and oil pressure gages are located on the main instrument panel.

8. HYDRAULIC SYSTEM.

a. GENERAL.—The hydraulic system operates the landing gear, main and tail wheel, and the wing flaps. In normal operation the engine driven pump supplies the pressure for the operation of the hydraulic system. If the engine is not operating, use the hand pump to build up pressure in the system for operating the various units. The system consists of a fluid tank, engine-driven pump, hand pump, check valves, relief valve, selector valves, restrictors, (in wing flap cylinders only) filters, actuating cylinders, tubing, flexible hose and a pressure gage.



1. Tail Wheel Actuating Cylinder
2. Flap Actuating Cylinders
3. Check Valves
4. Pressure Relief Valve
5. Flap Selector Valve
6. Landing Gear Selector Valve
7. Fluid Reservoir
8. Hydraulic Pump—Engine
9. Strainer
10. Main Wheels Actuating Cylinders
11. Hydraulic Pump—Hand

Figure 24—Hydraulic Units Location

b. FLUID.—The fluid used in this system is mineral oil (red color)—Univis #40 or equivalent. Tank filling capacity is ¾ gallon.

c. FLUID RESERVOIR.—The reservoir is located aft of left engine firewall on the wing upper surface.

CAUTION

Do not use a vegetable base oil—this type can be identified by its blue color.

d. ENGINE DRIVEN PUMP.—The fluid is circulated steadily by the engine-driven pump which is attached to the generator drive of the left engine. Should the pump fail or if the engine is not operating, the hand pump, located on the floor at the left of the pilot's seat, is used to supply pressure when operating the various actuating cylinders. Approximately twenty-four (24) cycles of the hand pump are required to operate the landing gear.

e. PRESSURE RELIEF BY-PASS VALVE.—The system pressure relief by-pass valve, located behind the upper control panel, is set to open at approximately 950 psi.

f. SELECTOR VALVES.—These units are directional valves which determine the end of the particular cylinder which shall receive pressure, and that which shall be exhausted; i.e., in which direction the piston will be moved. The valves are located behind the upper control panel. The wing flap control valve is mounted at the right hand side of this panel, and the landing gear control valve on the left hand side. These valves are connected in series with the main hydraulic line.

The landing gear valve is a four port, two-way unit operating the main wheels and tail wheel actuating cylinders. In the NEUTRAL position, there is free flow through the valve. In the DOWN position, the pressure is directed to actuate the main wheels and tail wheel cylinders; the oil from the free side of the actuating piston being returned to the hydraulic fluid reservoir. In the UP position, the pressure is directed to raise the landing gear, again returning the oil that is on the non-pressure side of the piston to the fluid reservoir.

The flap valve is a three port, one-way unit. In the NEUTRAL position, there is free flow through the valve. In the DOWN position, the pressure is directed to lower the flaps; and since these actuating cylinders are single acting, there is no oil returned to the reservoir during this action. In the UP position, there is again free flow through the valve, and the flap cylinder port is open thus permitting the spring return action of the actuating cylinders to return the oil to the reservoir as the flaps retract.

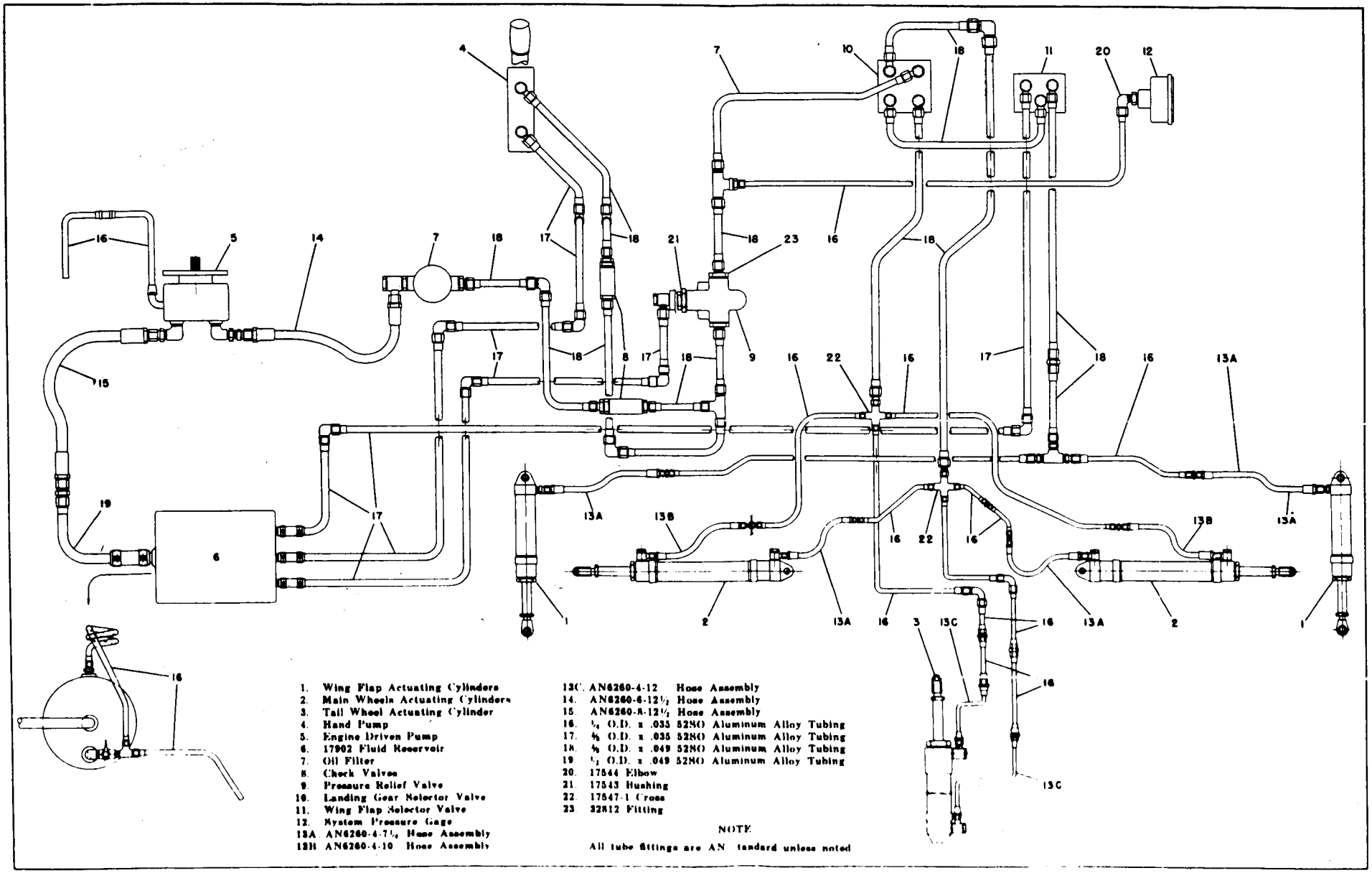
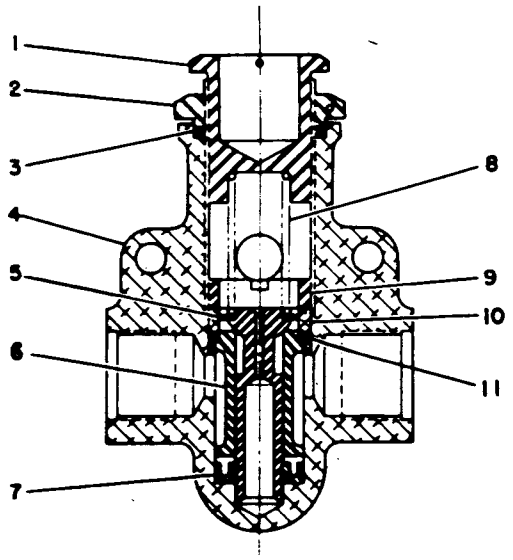
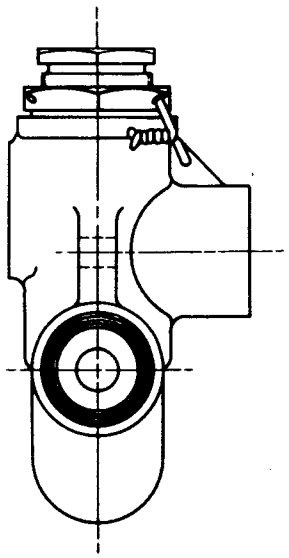


Figure 25- Hydraulic System Diagram





1. A-1899 Screw
2. 2-1594 Nut
3. ELB14-15 Seal
4. B-1897 Body
5. A-2211 Washer
6. A-2659 Poppet and Seat Assembly
7. ELB50-12 "U" Cup
8. A-2301 Spring
9. A-2137 Locking Screw
10. A-2134 Spacer
11. ELB14-11 Seal

Figure 26—Pressure Relief Valve, Electrol No. 165 Pressure Relief Set at 950 psi

In order to prevent too rapid retraction of the flaps, there is a restricting orifice installed in the flap port; however, under pressure during the lowering of the flaps, the action is rapid.

In normal operation, the time to complete the raising or lowering of either the flaps or landing gear is so short that there is no need to latch the valve handles in the operating position. However, latches are provided to lock the handles when emergency conditions require use of the hand pump, thus freeing the pilot's left hand. These latches should NOT be left on after the completion of the operation or while the engine pump is running. In the case of the landing gear valve, this would prevent flow to the flap valve thus making it inoperative. In the case of the flap valve, this would throw back pressure to the landing gear valve resulting in uncertain and erratic operation of both main wheels and tail wheel.

The exception to the above statements is the UP latch on the flap valve handle. This is normally used when retracting the flaps on the ground and does not subject the system to pressure.

g. CHECK VALVES.—Two check valves are installed in the system; one, located in the ceiling at the rear of the pilot's compartment, isolates the engine-driven pump in case it becomes inoperative; and the second, located under the cockpit flooring at the hand pump, isolates this pump.

h. FILTER.—A Purolator strainer, located in the left engine nacelle adjacent to the engine driven hydraulic pump, is connected into the pressure line between the pump and the pump check valve.

The filter is cleaned by turning the handle thus removing sludge and dirty oil from the strainer without allowing air to enter the hydraulic system.

Note

Two complete turns should be made every twenty operating hours.

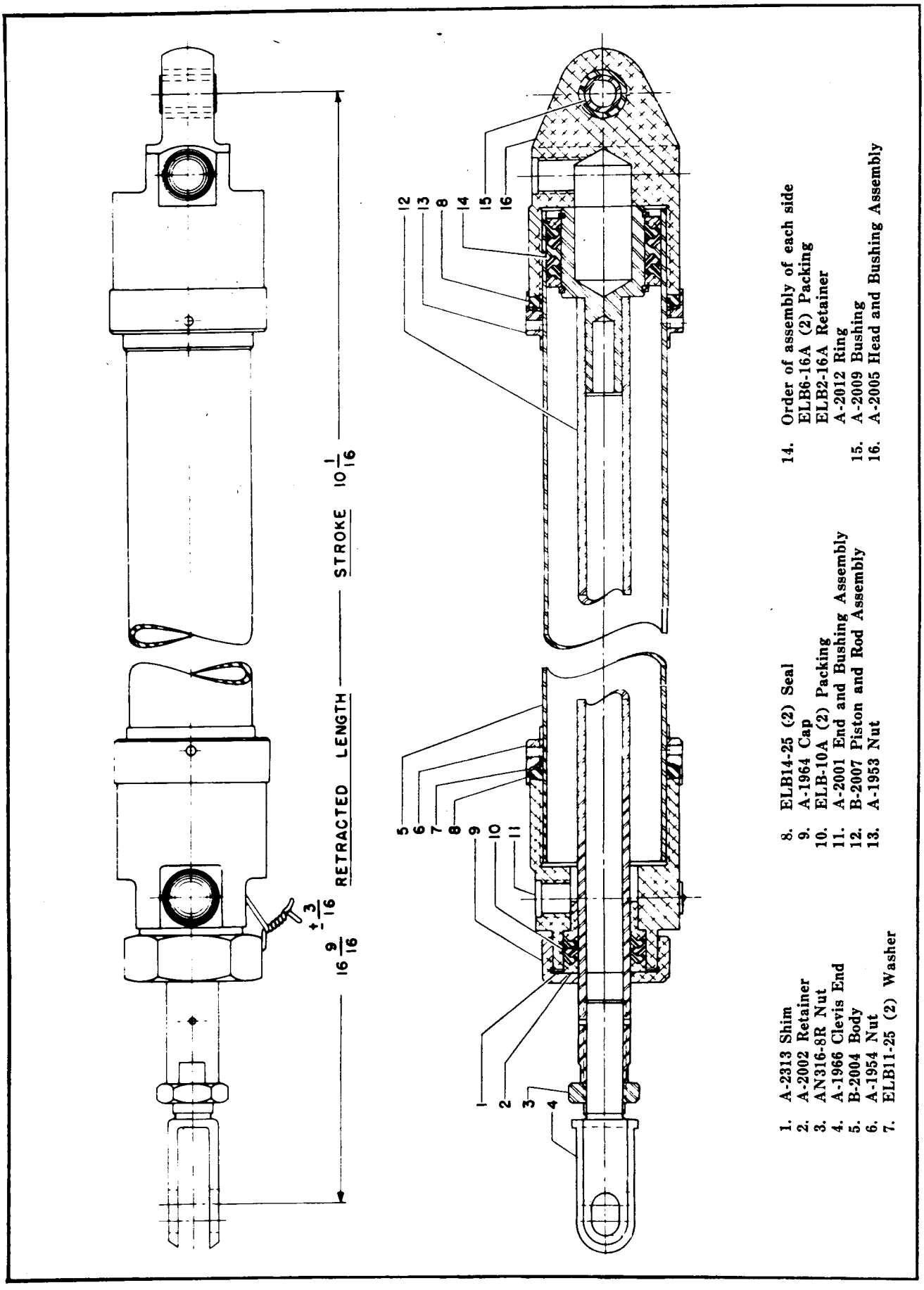
i. LINES.—The lines throughout the system are solid wall aluminum alloy tubing except at the actuating cylinders and the engine-driven pump, where flexible hose assemblies are installed to allow for movement of the units. All system lines are identified by yellow—light blue—yellow color bands.

j. PRESSURE GAGE.—The hydraulic system gage is located on the right hand side of the upper control panel. The gage registers the system pressure—950 psi.

k. ACTUATING CYLINDERS.—The actuating cylinders are of the single and double acting types as follows:

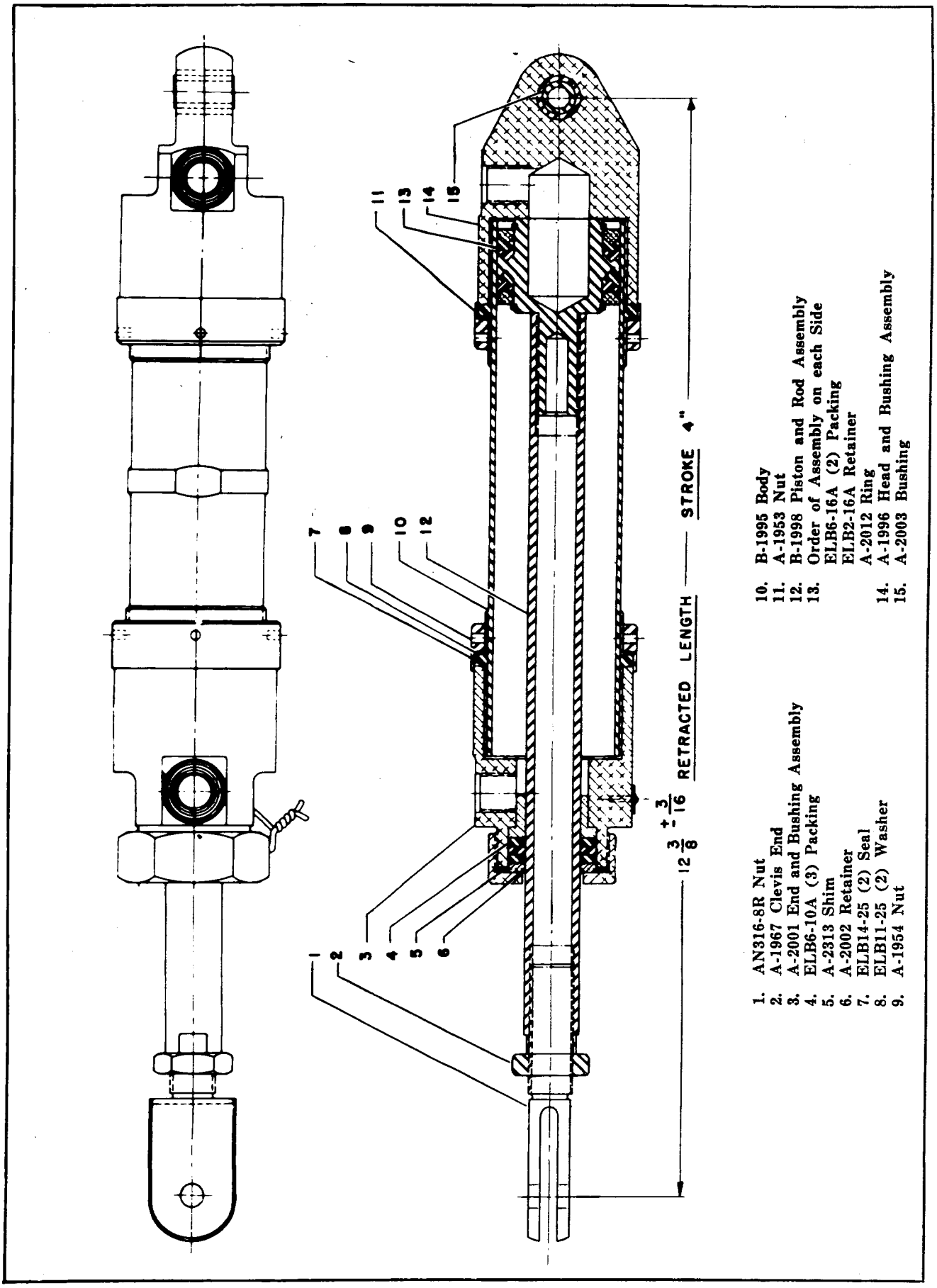
	Electrol Part No.	*Quantity*	*Type*
Landing Gear	166	(2)	Double Acting
Tail Wheel	167	(1)	Double Acting
Wing Flaps	169	(2)	Single Acting

l. SEALS AND PACKINGS. — For hydraulic seal and packing part numbers, refer to the cross-sectioned views of the hydraulic units.



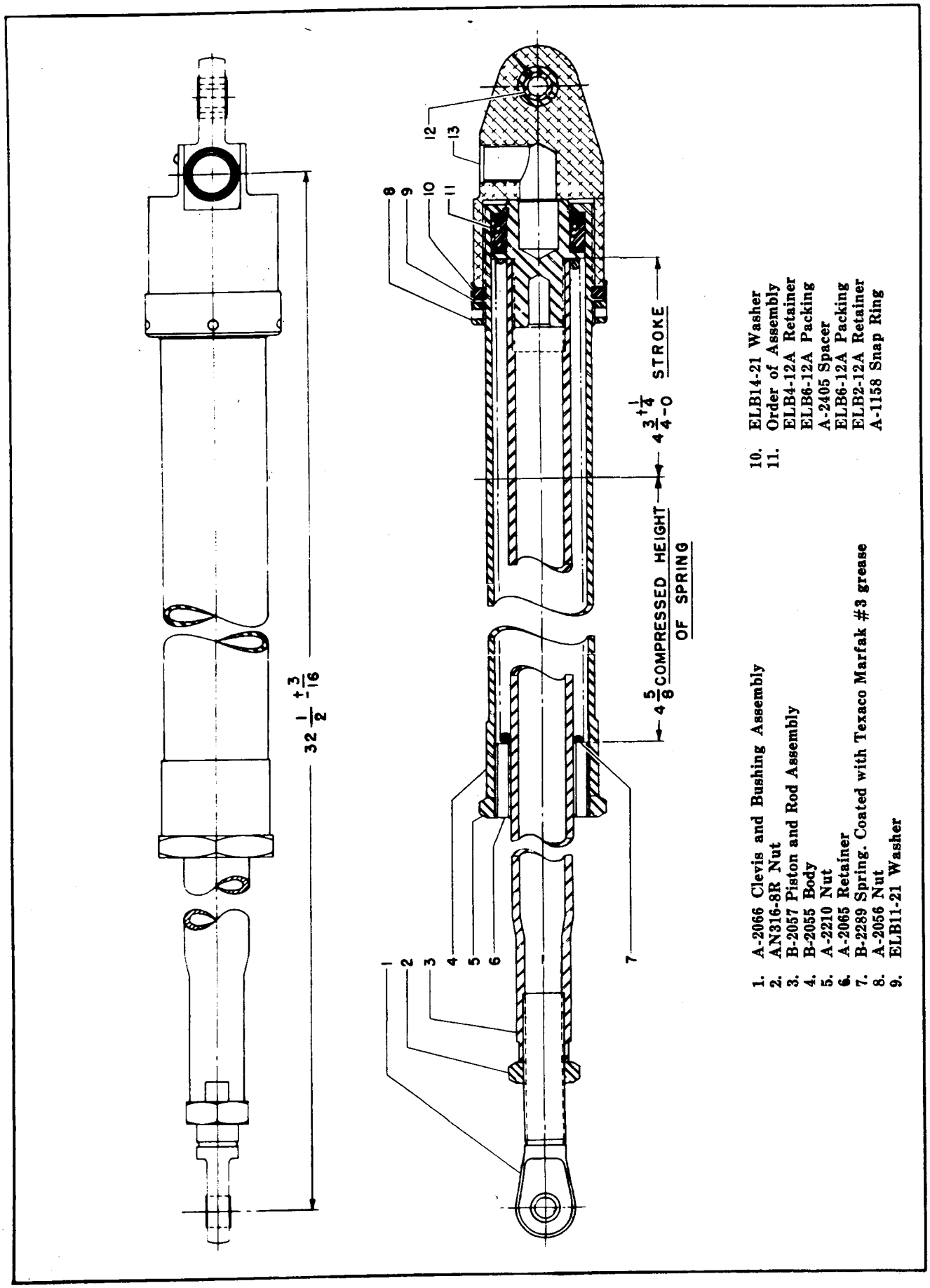
1. A-2313 Shim
2. A-2002 Retainer
3. AN316-8R Nut
4. A-1966 Clevis End
5. B-2004 Body
6. A-1954 Nut
7. ELB11-25 (2) Washer
8. ELB14-25 (2) Seal
9. A-1964 Cap
10. ELB-10A (2) Packing
11. A-2001 End and Bushing Assembly
12. B-2007 Piston and Rod Assembly
13. A-1953 Nut
14. Order of assembly of each side
    ELB6-16A (2) Packing
    ELB2-16A Retainer
    A-2012 Ring
15. A-2009 Bushing
16. A-2005 Head and Bushing Assembly

Figure 27—Main Wheels Actuating Cylinder, Electrol No. 166



1. AN316-8R Nut
2. A-1967 Clevis End
3. A-2001 End and Bushing Assembly
4. ELB6-10A (3) Packing
5. A-2313 Shim
6. A-2002 Retainer
7. ELB14-25 (2) Seal
8. ELB11-25 (2) Washer
9. A-1954 Nut
10. B-1995 Body
11. A-1953 Nut
12. B-1998 Piston and Rod Assembly
13. Order of Assembly on each Side
    ELB6-16A (2) Packing
    ELB2-16A Retainer
    A-2012 Ring
14. A-1996 Head and Bushing Assembly
15. A-2003 Bushing

Figure 28—Tail Wheel Actuating Cylinder, Electrol No. 167



1. A-2066 Clevis and Bushing Assembly
2. AN316-8R Nut
3. B-2057 Piston and Rod Assembly
4. B-2055 Body
5. A-2210 Nut
6. A-2065 Retainer
7. B-2289 Spring. Coated with Texaco Marfak #3 grease
8. A-2056 Nut
9. ELB11-21 Washer
10. ELB14-21 Washer
11. Order of Assembly
    - ELB4-12A Retainer
    - ELB6-12A Packing
    - A-2405 Spacer
    - ELB6-12A Packing
    - ELB2-12A Retainer
    - A-1158 Snap Ring

Figure 29—Wing Flap Actuating Cylinder, Electrol No. 169

1. A-1992 (2) Screw
   A-1991 (2) Gasket
2. ELA16-8 (2) Ball
3. A-1993 (2) Spring
4. A-2593 Plunger
5. AN6227-15 Packing
6. A-1988 Adapter
7. A-1220 Stop
   ELB17-17A Split Ring
   A-1163 Retainer Packing
   A-2596 Toroid Seal
   A-2595 Washer Seal
8. A-1990 Retainer
   AC566-A6-3 Screw
9. A-1167 Lock Ring
10. A-1120 Pin
11. A-1985 Link and Bushing Assembly
12. B-1984 Handle Assembly

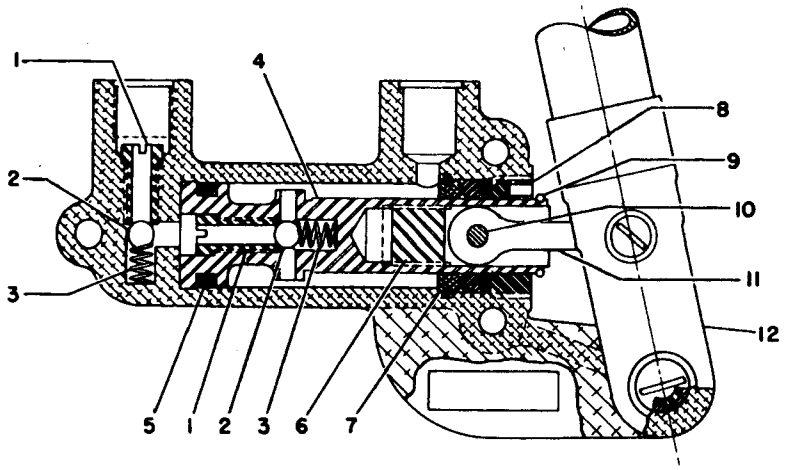
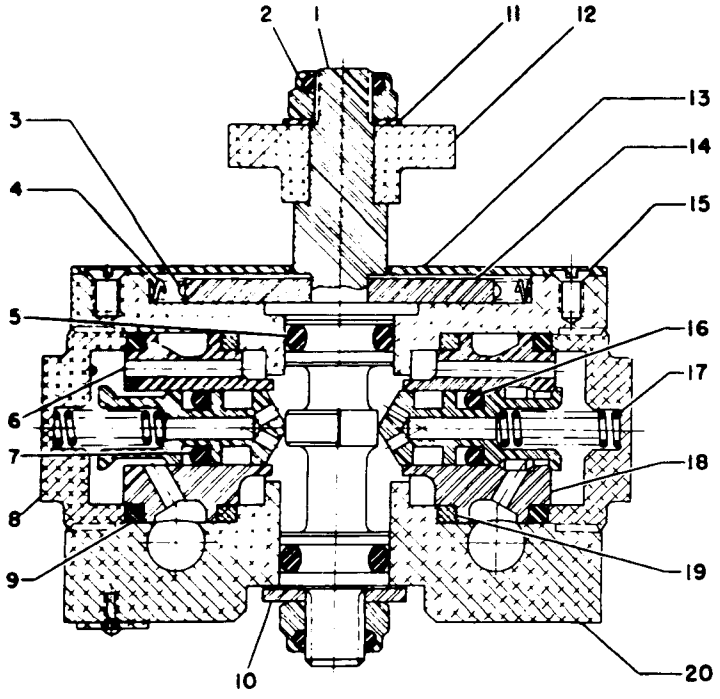


Figure 30—Hydraulic Hand Pump Electrol No. 176-T



1. D-2513 Shaft
2. AC364-524 (2) Nut
3. A-2369 (4) Pin
4. A-2366 (4) Spring
5. A-2514 (2) Seal
6. A-2517 Seat and Poppet Assembly
7. A-2482 Seal
8. A-2085 (2) Plug
9. ELB14-13 (2) Seal
10. AC940-516 Washer
11. A-2385 Washer
12. A-2365 Adapter
13. B-2362 Plate
14. A-2367 (2) Slider
15. AN505-6-3 (2) Screw
16. Use AN6227-5 "O" ring or A-2482 Seal. Do not use both.
17. A-2375 (2) Spring
18. A-2518 Seat and Poppet Assembly
19. A-2250 (2) Seal
20. D-2512 Body

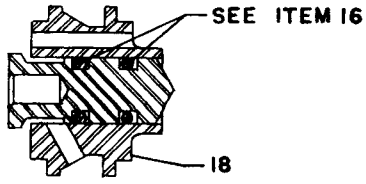
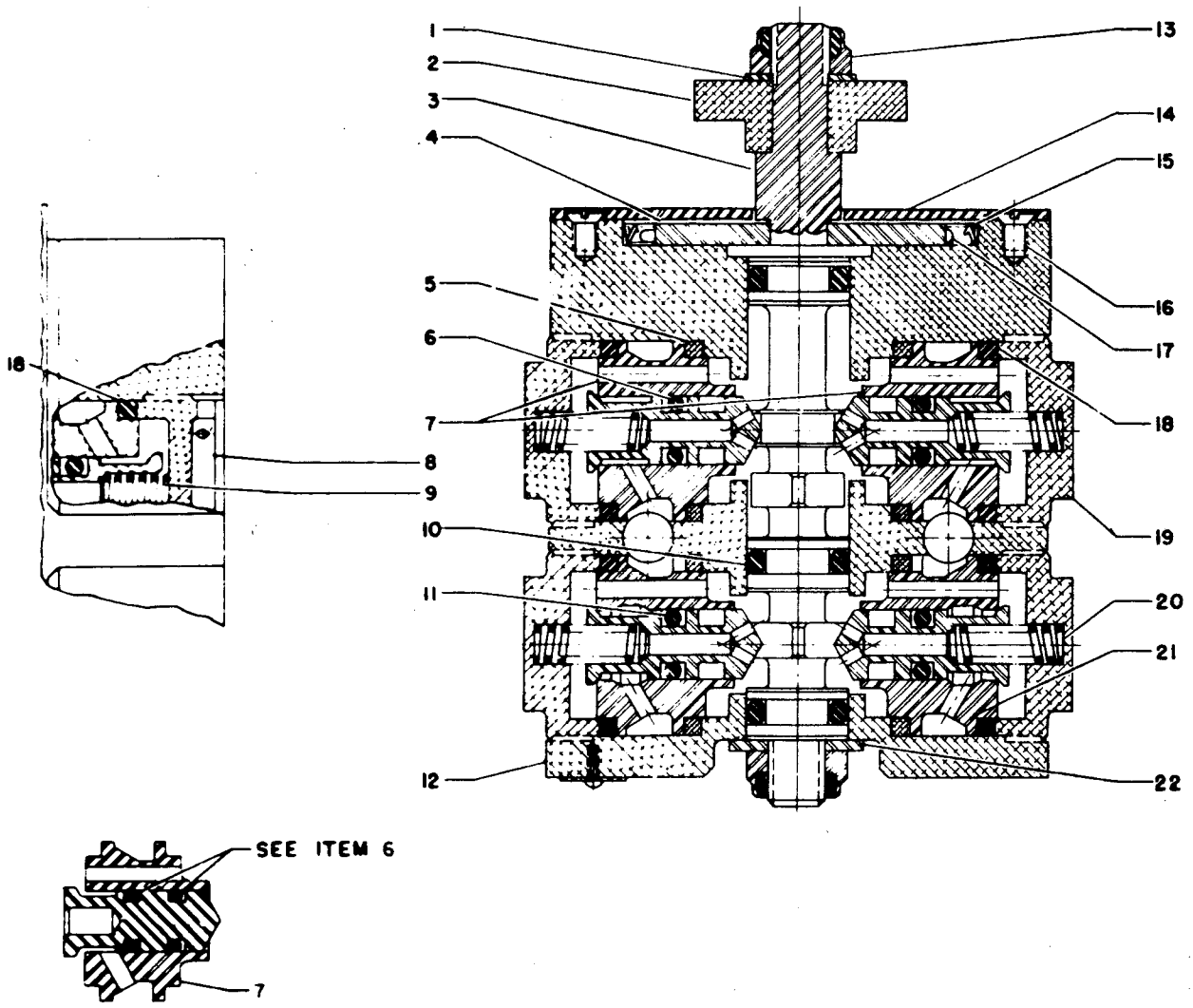
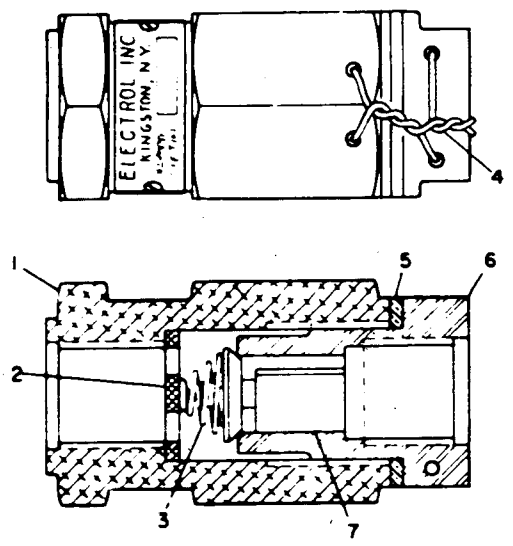


Figure 31—Wing Flap Selector Valve, Electrol No. 170-T



1. A-2385 Washer
2. A-2365 Adapter
3. D-2506 Cam Shaft
4. A-2367 (2) Slider
5. A-2250 (5) Seal
6. Use AN2667-5 (3) "O" Ring or A-2482 (3) Seal. Do not use both.
7. A-2517 (3) Seat and Poppet Assembly
8. A-1094 Plug
9. A-2207 Spring
10. A-2514 (3) Seal
11. A-2482 (2) Seal for A-2518
12. D-2511 Body
13. AC364-524 (2) Nut
14. B-2362 Plate
15. A-2366 (4) Spring
16. AN505-6-3 (2) Screw
17. A-2369 (4) Pin
18. ELB14-13 (5) Seal
19. A-2085 (4) Plug
20. A-2375 (4) Spring
21. A-2518 (2) Seat and Poppet Assembly
22. AC940-516 Washer

Figure 32—Landing Gear Selector Valve, Electrol No. 171-T



1. B-2391 Body
2. A-2388
3. A-2336 Spring
4. Lockwire
5. AN901-8A Gasket
6. B-2390 Valve Seat
7. A-2389 Poppet

Figure 33—Check Valve, Electrol No. 211

9. ELECTRICAL SYSTEM.

a. GENERAL.—The electrical system consists of a battery, generator and control box (voltage regulator and reverse current cut-out) pilot's switch panel, master switch, switches, lights, junction boxes, wiring and conduit.

b. POWER EQUIPMENT.—The engine driven dc generator supplies the energy for the electrical system (right engine operating) and also maintains the 12 volt, 34 ampere hour battery. The generator is installed on the right engine; and its control box and the battery are located abaft the firewall on top of the wing.

An outside power plug, for connecting an external power source, is installed on the bulkhead abaft the pilot.

Operation of the volt-ammeter button will show generator output and the condition of the battery.

Note

Under normal cruising conditions, the volt-ammeter reading should be 12.5—14 volts.

c. WIRING.—A single wire grounded return system is used. Wires are numbered, conforming with those on the wiring diagram, for identification. All wiring is carried in conduit with junction boxes located at the distribution points.

Note

Make certain that the master switch is on OFF position before connecting or disconnecting the battery. Check that the cables are connected to their proper terminal posts.

d. CIRCUIT BREAKERS.—These units automatically open a circuit when an overload occurs, thus preventing damage to the electrical devices in the circuit. If the overload is only momentary, resetting the circuit breaker by pushing its reset button, will restore normal operation. Repeated opening of the circuit breaker indicates an electrical or mechanical defect in the circuit which requires that repairs be made.

e. PILOT'S SWITCH PANEL.—This panel, located above the pilot's head, contains the following:

SWITCHES	CIRCUIT BREAKERS
Landing Light (Left)	Landing Light (2)
Navigation Lights	Navigation Lights
Pitot Heat	Instruments
Anchor Light	Transmitter
Generator	Receiver
Landing Light (Right)	Electric Fuel Pumps
Flectric Fuel Pumps	Compass Light
Starter Buttons	Cockpit Lights
RHEOSTATS	**INSTRUMENTS**
Compass Light	Volt-Ammeter
Cockpit Lights	

f. LIGHTS.

(1) INTERIOR LIGHTS.—The Main Instrument Panel is directly illuminated by two Griff-Ho lights which are installed on the upper control panel. The cabin is illuminated by a dome light.

Separate lights are provided for the compass and landing gear warning indicator.

(2) EXTERIOR LIGHTS.—The anchor light is installed at the top of the rudder. A tail light is located on the trailing edge of the rudder, and the wing running lights are on the left and right wing tips.

A Grimes electrically operated sealed beam landing light is located in the lower surface of each outer wing panel. Each light is controlled by a three-position switch on the electrical switch panel. These are installed at each end of the line of switches in order to locate them readily at night.

g. MAINTENANCE.—Do not use acid core solder on the system wires or bonding. A resin core solder should be used under all circumstances. Be sure to replace all bonding wires. Paint or other protective finish should be removed before bonding and soldering.

Keep battery terminals clean and coat with a corrosion resistant grease.

Spare bulbs and fuses are stowed on the forward side of the instrument panel along the base.

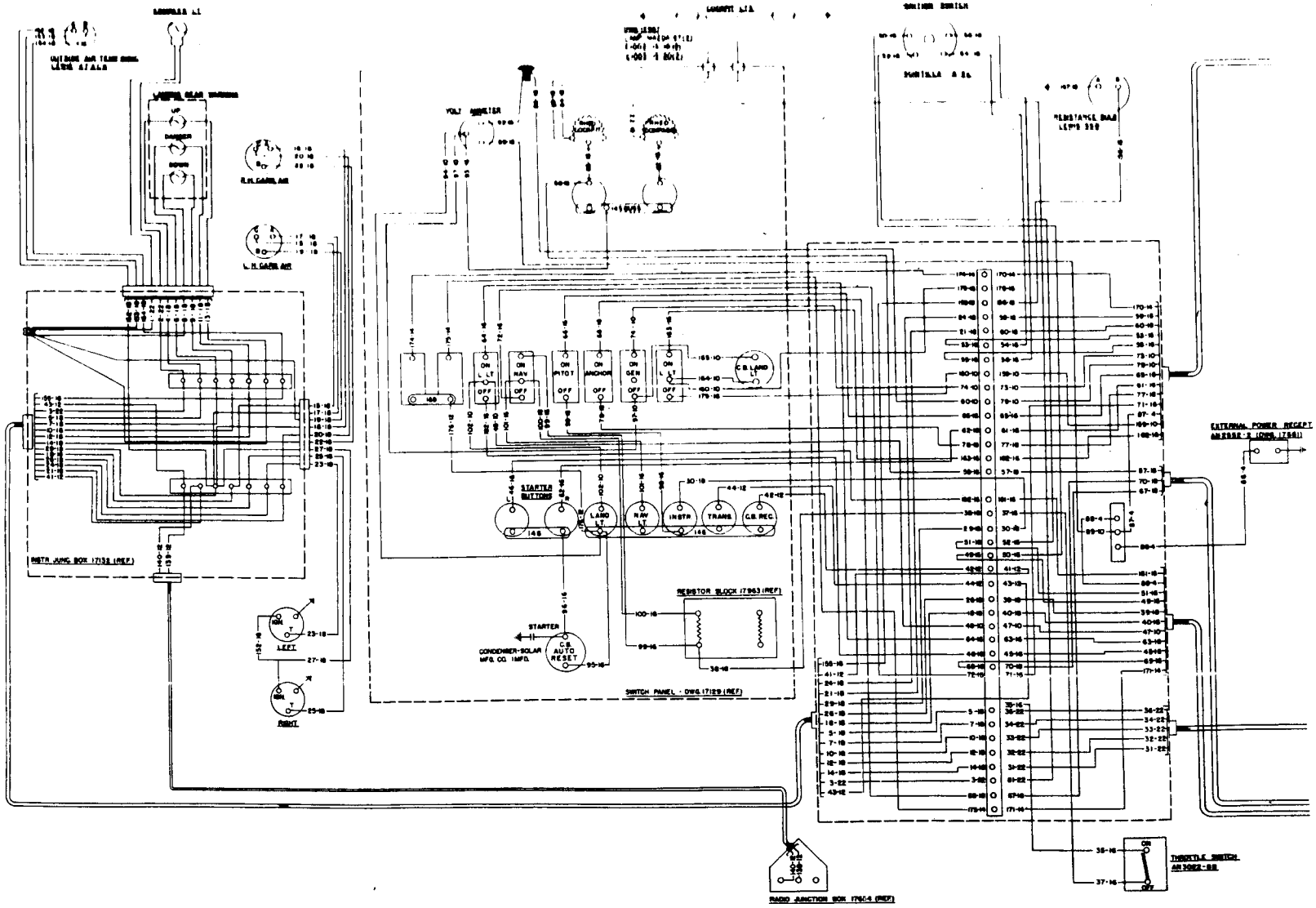
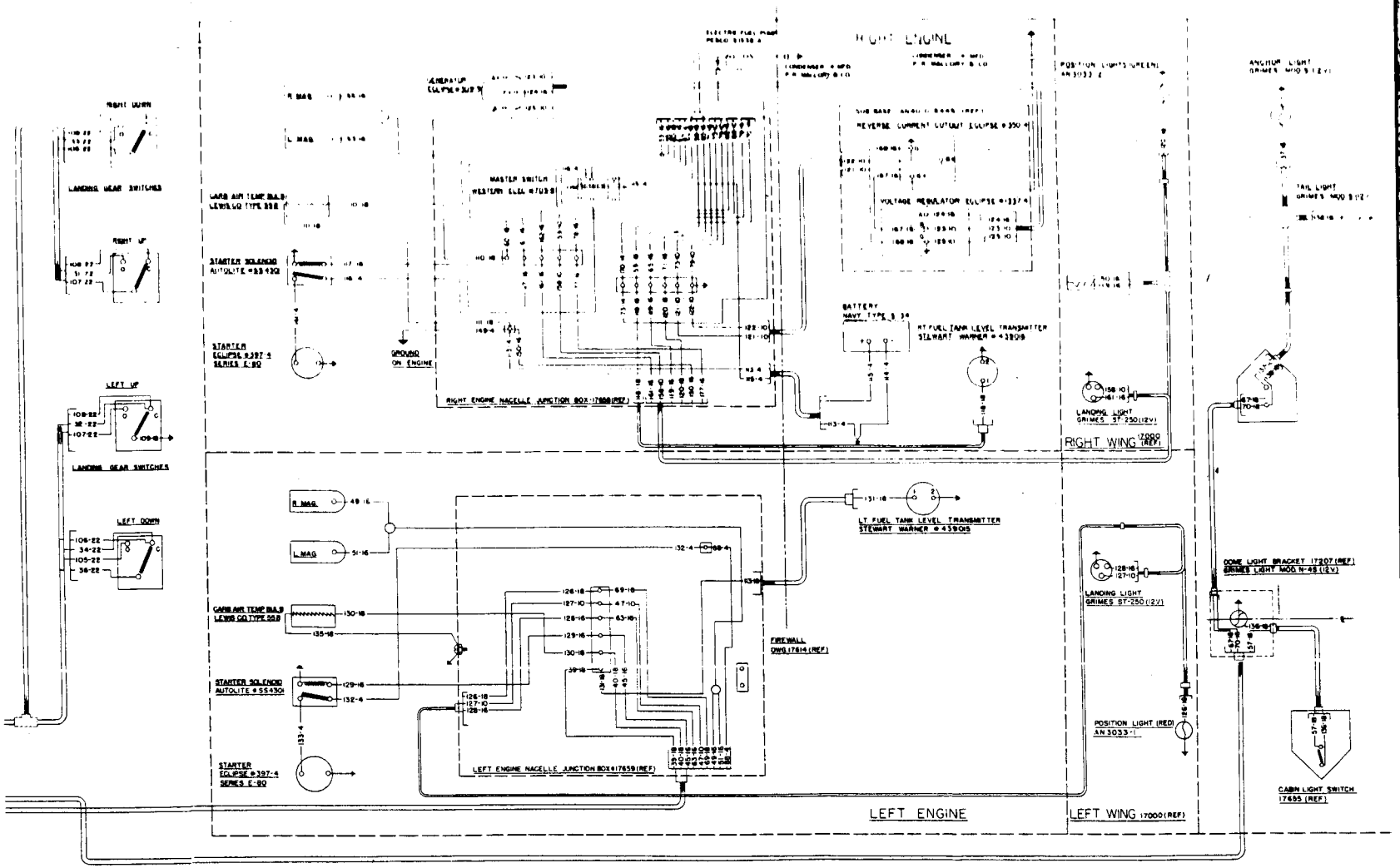


Figure 34—Wiring Diagram


RIGHT ENGINE
RIGHT WING 17000 (REF)
LEFT ENGINE
LEFT WING 17000 (REF)
RIGHT DOWN
LANDING GEAR SWITCHES
RIGHT UP
LEFT UP
LANDING GEAR SWITCHES
LEFT DOWN
R MAG.
L MAG.
CARB AIR TEMP BULB
LEWIS CO TYPE 228
STARTER SOLENOID
AUTOLITE #55430
STARTER
ECLIPSE #397-4
SERIES E-80
GROUND ON ENGINE
MASTER SWITCH
WESTERN ELEC. #7028
GENERATOR
ECLIPSE #360
REVERSE CURRENT CUTOUT ECLIPSE #350
VOLTAGE REGULATOR ECLIPSE #1337-4
BATTERY
NAVY TYPE 3.30
RT FUEL TANK LEVEL TRANSMITTER
STEWART WARNER #43808
RIGHT ENGINE NACELLE JUNCTION BOX-17688(REF)
LT FUEL TANK LEVEL TRANSMITTER
STEWART WARNER #43805
FIREWALL
DWG.17614 (REF)
LEFT ENGINE NACELLE JUNCTION BOX#17659(REF)
POSITION LIGHTS (GREEN)
AN 3033-2
LANDING LIGHT
GRIMES ST-250 (12V)
POSITION LIGHT (RED)
AN 3033-1
ANCHOR LIGHT
GRIMES MOD 9-12V
TAIL LIGHT
GRIMES MOD 9-12V
DOME LIGHT BRACKET 17207 (REF)
GRIMES LIGHT MOD N-48 (12V)
CABIN LIGHT SWITCH
17655 (REF)

LIGHT BULB CHART

LIGHT	BULB	VOLTAGE	CANDLEPOWER	FINISH
Anchor	Mazda #89	12-16	6	Clear
Cabin Dome	Mazda #1141	12-16	21	Silver Base
Landing Light	Grimes #D3040	12		Clear
Tail	Mazda #93	12		Clear
L.G. Warning Indicator	Tung Sol #57	12	1½	2 Clear, 1 Red
Wing Tip (2)	Grimes #1512	12		Clear
Cockpit	Mazda #67	12	21	Clear

b. VOLTAGE REGULATOR ADJUSTMENT.—The following information applies to airplanes serial No. 1427 and up and any previous airplane which may have had Eclipse type 1337 carbon pile voltage regulators installed in service.

In order to avoid overheating the battery with consequent damage to it and adjacent parts of the airplane, it is essential to know the following facts and methods of adjustment.

The proper setting of this regulator is 14 volts which should be read with an accurate portable voltmeter. Do not use the voltmeter furnished with the airplane. Connect the portable voltmeter between the "B" and "G" terminals of the voltage regulator base. Run the engine until the generator and regulator are warmed up completely. This normally takes about 15 minutes. Adjust voltage to 14 volts by turning the rheostat adjusting screw clockwise (to increase the voltage) or counterclockwise (to decrease the voltage). The factory setting of the regulator is 14.5 volts but because of the small size of the Widgeon battery Eclipse has recommended that it be reduced to 14.

Be certain that the generator is operating above its minimum rate of speed of 2200 rpm. This corresponds to about 1500 rpm engine speed.

A check of this setting should be made at periodic service intervals. If the voltage of the system gradually "drifts" in service from the initial setting of 14 volts, do not alter the setting of the rheostat adjusting screw. The maximum permissable "drift" is .3 of a volt in either direction after which the regulator should be sent to an authorized CAA overhaul base. The voltage will be slightly lower when the regulator is cold than when it is hot.

10. INSTRUMENTS.

a. GENERAL.—The flight, engine, and equipment instruments are mounted on the main instrument panel and the overhead control panel.

b. PANEL FURNISHINGS.

(1) FLIGHT PANEL.
- Airspeed Indicator
- Turn and Bank
- Rate of Climb
- Altimeter, Sensitive
- Directional Gyro
- Artificial Horizon

(2) MAIN (CENTER) PANEL.
- Compass
- Landing Gear Indicator
- Clock
- Outside Air Temperature
- Tachometer (2)
- Manifold Pressure (2)
- Fuel Pressure (2)
- Oil Pressure (2)
- Oil Temperature (2)
- Carburetor Air Temperature (2)
- Fuel Quantity Gage (2)
- Vacuum Gage

(3) OVERHEAD PANEL.
- Volt-Ammeter
- Hydraulic Pressure Gage

KEY TO FIGURE 35
ELECTRICAL UNITS LOCATION

1. Wing Running Lights (2)
2. Airspeed Tube Heater Element
3. Landing Lights (2)
4. Right Nacelle Junction Box—Master Switch
5. Magnetos (L/R)
6. Generator—Right Engine
7. Reverse Current Cut-out—Voltage Regulator
8. Battery
9. Dome Light
10. Landing Gear Position Switches (4) (Aft Side of Pilot's Bulkhead)
11. Main Junction Box
12. Landing Gear Throttle Switch
13. Ignition Switch—Grif Ho Lights (2)
14. Radio Junction Box
15. Instrument Junction Box
16. Outside Power Plug
17. Carburetor Air Temperature Bulbs (2)
18. Starters (2)
19. Starter Solenoids (2)
20. Electric Fuel Pumps (2)
21. Dome Light Junction Box
22. Left Nacelle Junction Box
23. Fuel Quantity Transmitter (2)
24. Anchor Light
25. Tail Running Light
26. Tail Junction Box
27. Outside Air Temperature Bulb

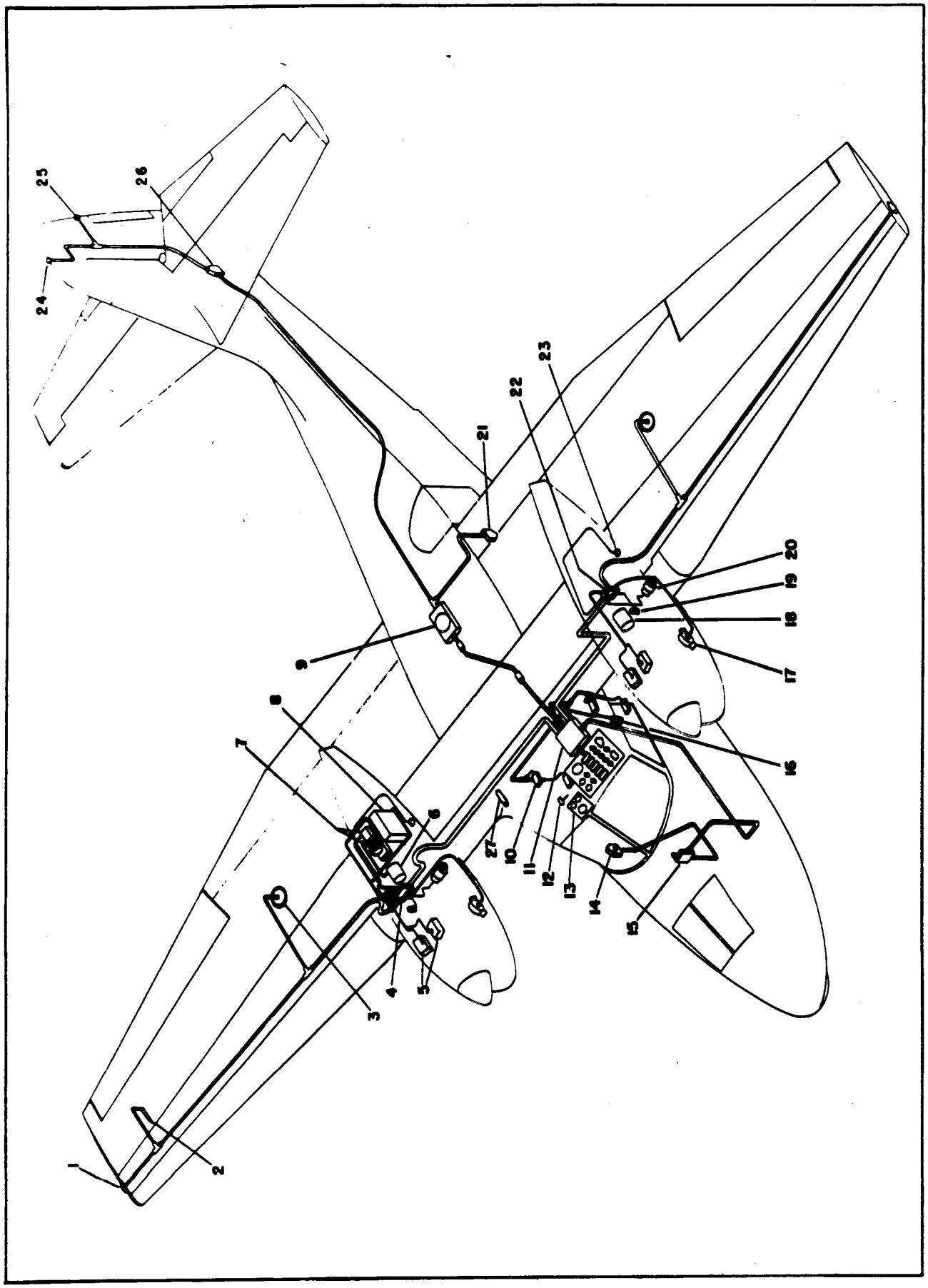
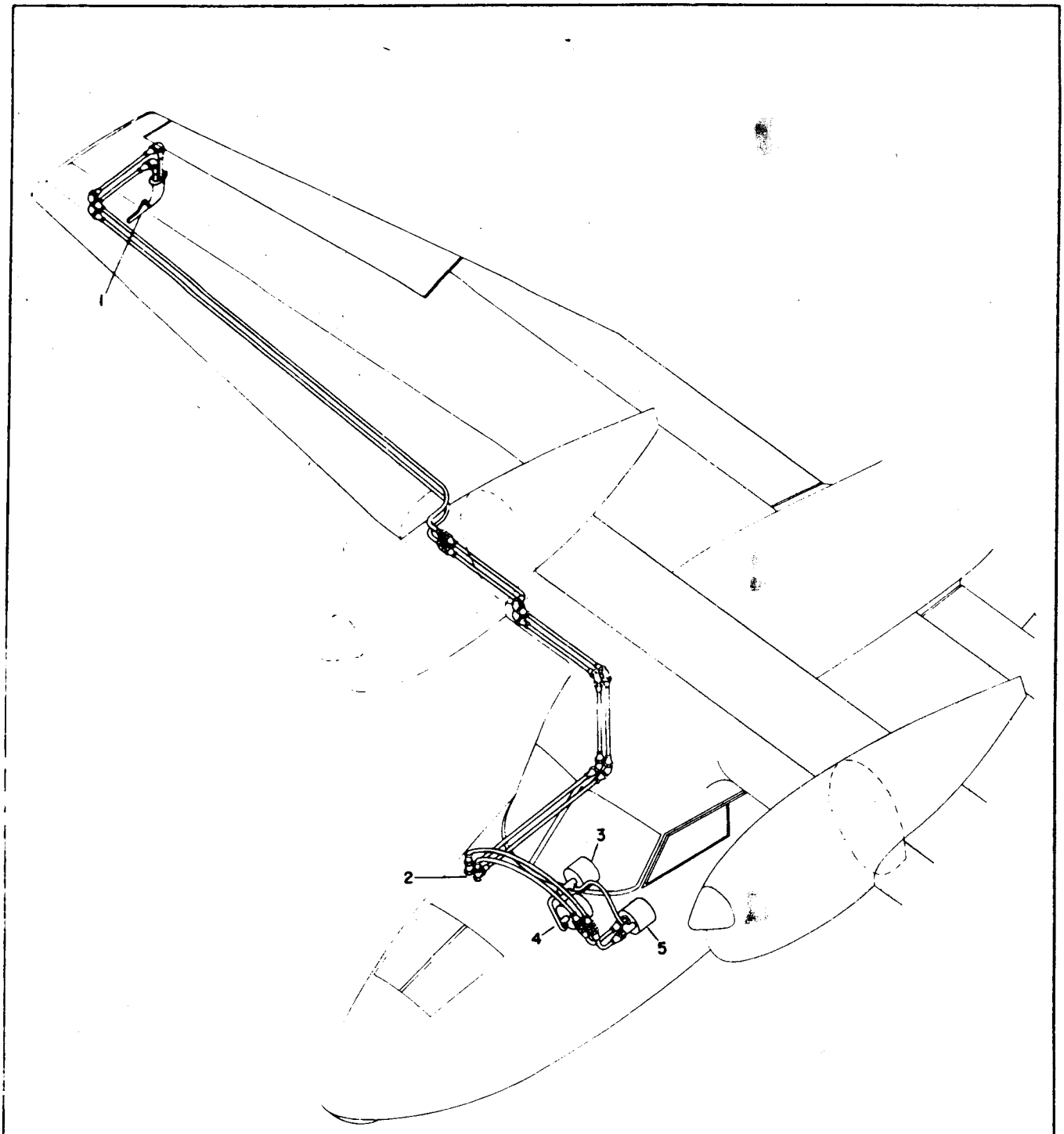
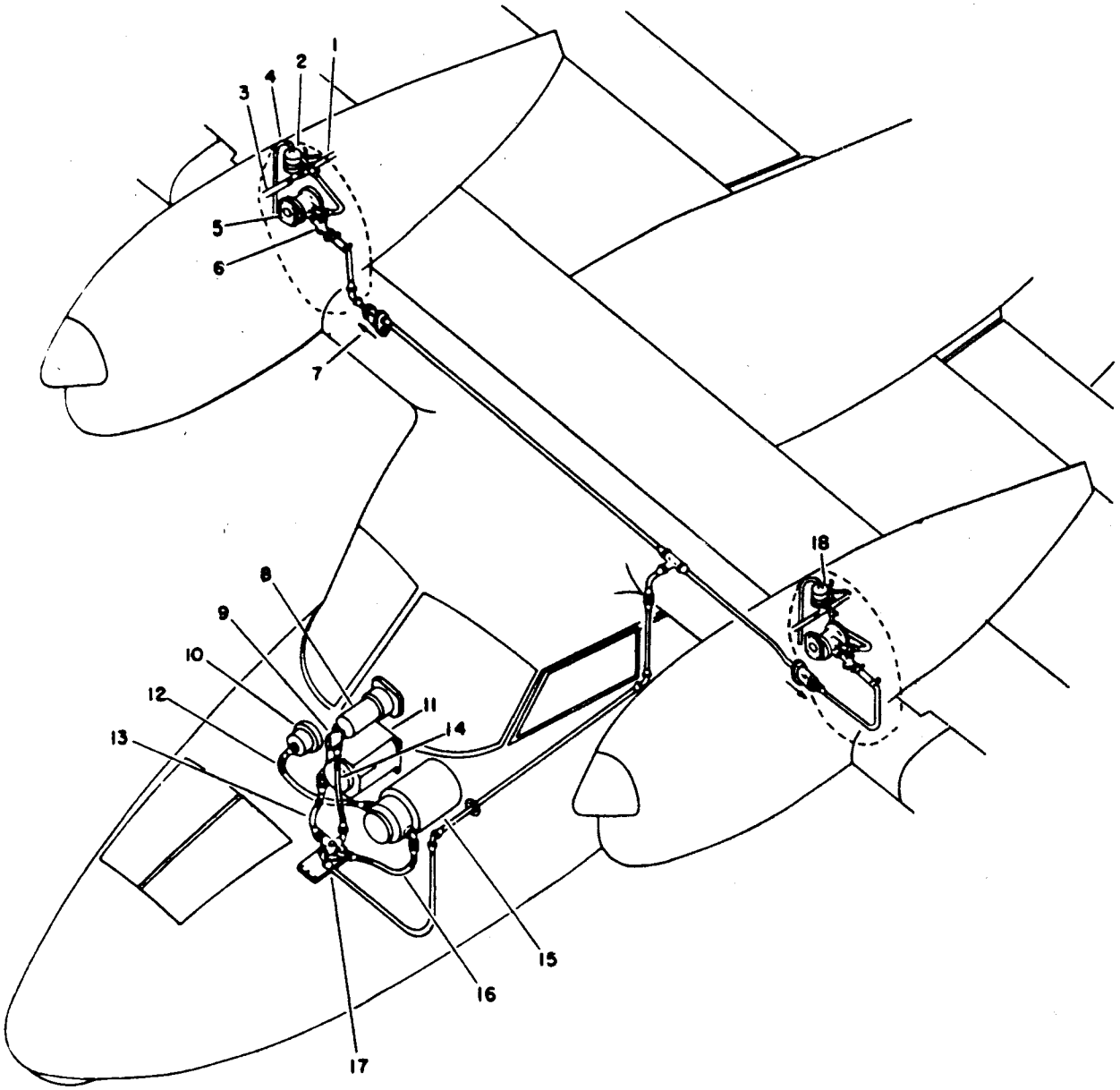


Figure 35—Electrical Units Location



1. #782-01 (12 volt) Kollsman Pitot Tube
2. Drain Plugs
3. Rate of Climb Indicator
4. Altimeter
5. Airspeed Indicator

Figure 36—Instrument Installation, Airspeed, Altimeter and Rate of Climb Indicators



1. Oil Return Line to Tank
2. 17734-15 Oil Separator (R.H.)
3. Line to Engine Vent
4. Oil Vapor Exhaust Line
5. Vacuum Pumps (2)
6. #RA2110-R (2) Romec Relief Valves
7. #14-100-1 (2) Kenyon Check Valves. Install with flap hinge at top and arrow head outboard.
8. Bank and Turn Indicator
9. #20-100 Kenyon Needle Valve
10. Vacuum Gage—17547-3 Fitting
11. Directional Gyro
12. AN856-4-11 Flexible Hose Assembly
13. AN856-6-10 Flexible Hose Assembly
14. AN856-4-12D Flexible Hose Assembly
15. Artificial Horizon
16. AN856-6-10 Flexible Hose Assembly
17. #551-2A Eclipse Suction Regulating Valve
18. 17734-1 Oil Separator (L.H.)

Figure 37—Instrument Vacuum System Installation

c. VACUUM SYSTEM.—The engine-driven vacuum pumps, one installed on each engine, operate the turn and bank indicator, gyro horizon, and directional gyro. The pressure lead from the pump is connected to a centrifugal oil separator, mounted above the pump, which returns the oil to the engine crankcase and exhausts the air combined with the remaining oil vapor through the top of the nacelle. The suction line leads from the pump to a check valve at the front of the firewall. From here the lines run through the leading edge to the suction regulating valve on the instrument panel. Flexible tubing connects the instruments and vacuum gage with the regulator.

The suction regulating valve maintains a constant load of 3½" Hg. which is necessary for the proper functioning of the gyro horizon and directional gyro. An adjustable needle valve is installed in the turn and bank indicator line which is set for 2" Hg.

(1) VACUUM SYSTEM ADJUSTMENT. — For adjustment of the system, it is recommended that the suction regulating valve behind the instrument panel be restricted as much as possible and the suction relief valve adjacent to each vacuum pump be adjusted to give 3.8" Hg. on the instrument panel vacuum gage. Only one engine should be run at a time when making this adjustment. With both pumps operating simultaneously, the suction will rise to approximately 4.0" Hg. The bank and turn instrument setting of 2" Hg. should be made with the needle valve and a portable gage.

d. AIRSPEED LINES.—The airspeed lines drain tees are located on the right hand side of the hull between Stations #7 and #8. The altimeter and rate of climb indicator are vented into the airspeed static line.

e. MAINTENANCE.—Remove and clean the oil separators with gasoline every 200 hours. The screens in the turn and bank and gyro instruments should be kept free of dust in order to insure proper functioning.

Inspect periodically the Lord mounting bushings on the flight panel and replace before appreciable deterioration takes place.

11. LANDING GEAR.

a. GENERAL.—This airplane is equipped with hydraulically operated main and tail wheels which are retracted or extended simultaneously by double acting hydraulic cylinders. The operating pressure is supplied normally by the engine-driven hydraulic pump or by the hydraulic hand pump for emergency operation. The landing gear consists of the main wheels, tail wheel, shock struts, actuating assemblies, hydraulic cylinders and cockpit controls.

b. MAIN WHEELS ASSEMBLY.

(1) NORMAL OPERATION.—The main and tail wheels are retracted or extended by the manual operation of the landing gear control lever on the upper control panel.

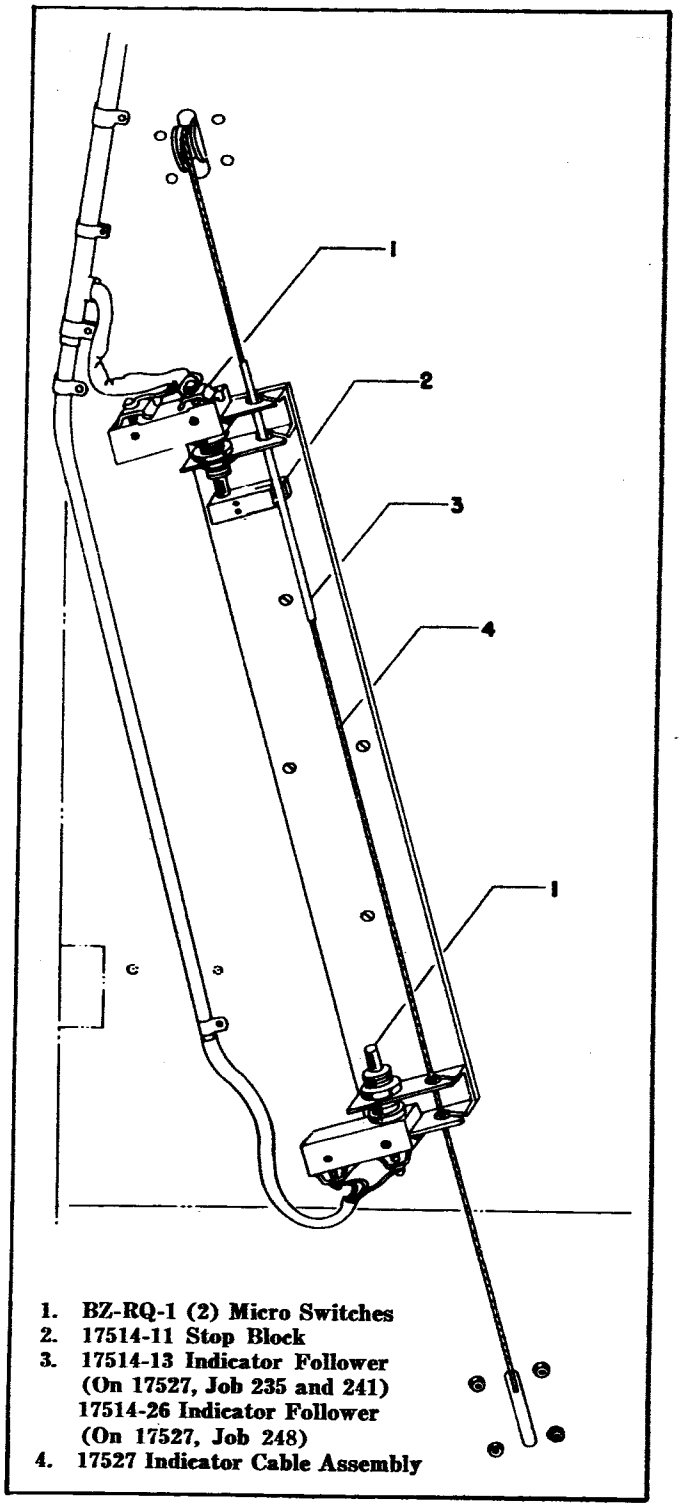
LEVER UP—WHEELS RETRACT

LEVER CENTER—NEUTRAL

LEVER DOWN—WHEELS EXTEND

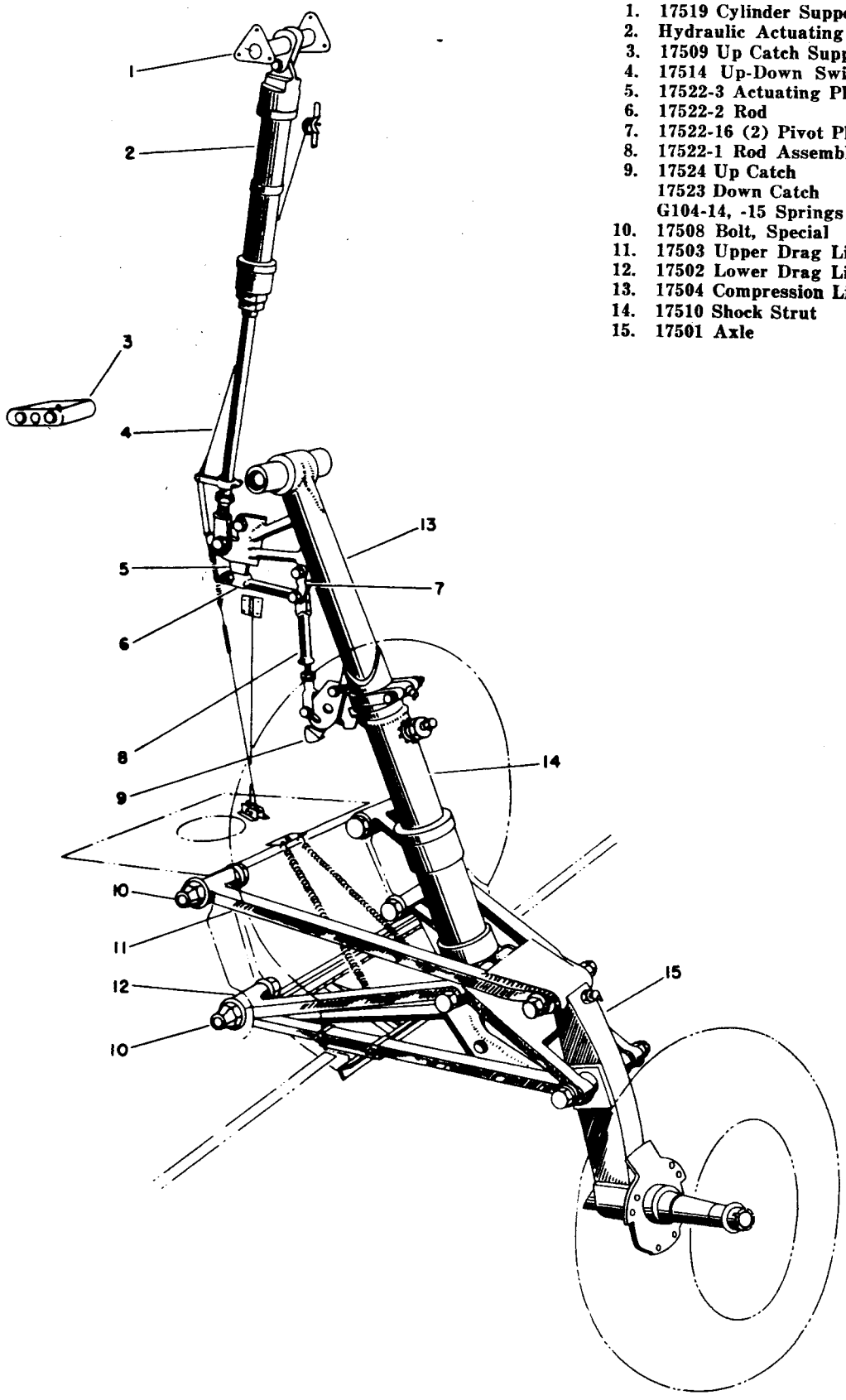
Time required to raise—approximately **6** seconds (at flight rpm .

Time required to lower—approximately **6** seconds (at flight rpm).



1. BZ-RQ-1 (2) Micro Switches
2. 17514-11 Stop Block
3. 17514-13 Indicator Follower (On 17527, Job 235 and 241) 17514-26 Indicator Follower (On 17527, Job 248)
4. 17527 Indicator Cable Assembly

Figure 38—Main Wheels Warning Switch Unit



1. 17519 Cylinder Support
2. Hydraulic Actuating Cylinder
3. 17509 Up Catch Support
4. 17514 Up-Down Switch Installation
5. 17522-3 Actuating Plate
6. 17522-2 Rod
7. 17522-16 (2) Pivot Plates
8. 17522-1 Rod Assembly
9. 17524 Up Catch
   17523 Down Catch
   G104-14, -15 Springs
10. 17508 Bolt, Special
11. 17503 Upper Drag Link
12. 17502 Lower Drag Link
13. 17504 Compression Link
14. 17510 Shock Strut
15. 17501 Axle

Figure 39—Landing Gear—Main Wheels Installation

(2) EMERGENCY OPERATION.—In the event that the engine-driven pump is not operating, the wheels may be raised or lowered by the hydraulic hand pump—approximately 24 strokes are required to retract or extend the landing gear. Two red thumb latches are provided at the right of the lever slot to lock the landing gear control lever in the desired operating position, thus enabling the pilot to have one hand free if hand pump operation is required.

CAUTION

The red latches should be used only when operating the hand pump and released immediately after pumping; otherwise, there is no flow through the hydraulic valves and unreliable operation occurs.

Time required to raise wheels—approximately 30 seconds.

Time required to lower wheels—approximately 30 seconds.

(3) INSPECTION PLACES.—Inspection windows are located at the wheel pockets for checking wheel position. The hinged covers of the wheel pockets may be raised for inspection of the latch mechanism.

(4) LANDING GEAR INDICATOR.

(a) INDICATOR.—This instrument, designed to help prevent inadvertent landings with the landing gear in the incorrect position, is located at the top center of the main instrument panel. The signal lights when the right engine is throttled below approximately 1550 rpm. In the event that the wheels are neither completely UP or DOWN—DANGER WHEELS is lighted; if the wheels are in the retracted position—WHEELS UP is lighted; and if they are extended—WHEELS DOWN is lighted.

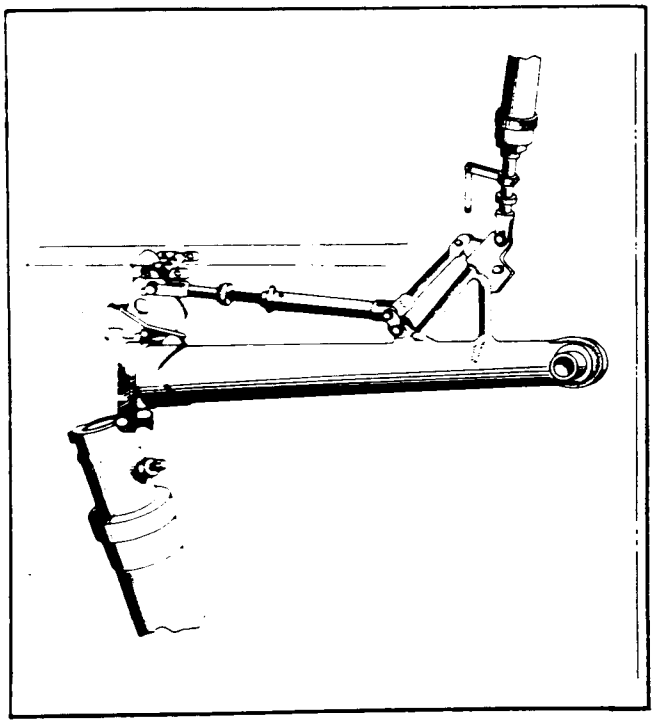


Figure 40—Main Wheels Actuating Mechanism Retracted Position

(b) INDICATOR ADJUSTMENT. — The indicator lights are operated by a micro-switch and cable system located under the upholstery on the aft side of each wheel pocket.

The micro-switches should be set by their adjusting nuts so that the WHEELS UP or WHEELS DOWN light comes ON just as the landing gear latches close. Note that during retraction the cable will travel approximately one-half inch before the latches open. It is permissible that the WHEELS DOWN light may continue to show during the first one-eighth inch (⅛") of this motion provided that, while the wheels are lowering, it does not come ON before the latches snap shut.

(5) LATCHES.—Spring actuated latches are installed on the main wheels and tail wheel strut assemblies as a precaution against their inadvertent retraction while on the ground. Inspect the latches frequently to make sure that they are functioning properly and are protected by a coating of corrosion resistant grease. The latter is very important in salt water operation due to the corrosive action of the salt.

(6) WHEELS.—The Hayes #G-3-175A or G-3-45A main wheels are a one-piece aluminum alloy casting. The hub, cast through the wheel between the bearings, serves to take the compression loads of the bearings as well as to exclude dirt. The hub cap, which protects the outboard bearing, is held in place by a fairing secured by turn fasteners, while the inboard bearing is protected from the entrance of dirt and loss of grease by a grease seal which is replaceable. The wheels are equipped with Timken roller bearings.

(a) MAINTENANCE.—During the regular airframe inspection period, a check should be made to see that the protective coating of paint has not chipped off the wheels. All bare spots must be repainted in order to protect the metal against corrosion. Remove the wheels every 50 hours, and clean and lubricate the bearings. They require only a small quantity of waterproof grease. If an excessive amount is used, it may leak by the grease seal; get on the brake drum; and adversely affect brake performance. Refer to the Lubrication Chart.

(b) BEARING REPLACEMENT. — If it is necessary to replace the bearing cups, the wheel should be submerged in boiling water in order to expand it then the old cones can be driven out with a brass rod. Take care to drive them out uniformly. Re-submerge the wheel in boiling water until it reaches approximately the same temperature as the water. At the same time, the bearing cones should be put in dry ice to become thoroughly cooled and to shrink. The cones can then be dropped into the bearing bore.

When the wheel cools and the cones rise to normal temperature, they will be tight in the bearing bore. It is very important that the cones are dropped in squarely and are not allowed to heat up before they are all the way in.

(c) BRAKE DRUM REPLACEMENT. — The sleeve type drum is chrome plate and should be replaced when the plating has worn through. This state of wear is determined easily since the chrome plating will remain bright until worn through, whereupon rusting will be evident.

In order to replace the drum, remove the fastening bolt and elastic stop nuts then heat the wheel in boiling water, and remove the drum by prying out by the inner flange. If this fails, the drum may be cut with a cold chisel, taking care not to damage the wheel. Repeat the process by heating the wheel in boiling water, after which the new drum can be dropped in, making certain that the bolt holes are aligned. If the drum is received without the holes, it should be drilled only after installation in order to use the wheel holes as a jig. It will be necessary to use an extension on the standard length drill in order to reach through the wheel.

All wheels are balanced before leaving the factory. It may be necessary to rebalance the wheel assembly after the tube and tire are remounted. This can be accomplished by adding to or removing the balance weights located under the brake drum bolt nuts.

The tires have a red spot indicating the balance point to be matched with the tube valve and valve hole in the wheel.

c. TAIL WHEEL ASSEMBLY.—The tail wheel is the self-aligning swivel type, fitted with a controllable caster lock mechanism, a Bendix Pneudraulic shock strut and a 10 in.—6 ply pneumatic tire on a Hayes ⌀B-3-127 wheel. The tail wheel assembly is installed as a unit to the fittings provided. To perform this operation the tail of the airplane may be supported at hull bulkhead, Station ⌀22.

(1) OPERATION.—The tail wheel unit is retracted or extended simultaneously with the main wheels by the double-acting hydraulic cylinder which is controlled by the landing gear selector valve. This motion is accomplished by a chain which runs over a sprocket fitted to a compression link and attaches at both ends to a bellcrank. The bellcrank is actuated by the hydraulic cylinder.

An automatic spring-loaded hook type latch locks the strut hinge when closed, thus preventing the possibility of wheel retraction during landing or take-off. No separate control is required for the latch, as it automatically disengages during the initial movement of the retracting mechanism.

(2) CASTER LOCK.—The tail wheel drag link is equipped with a lockpin which locks the 360° swivel type caster in the trailing position. The lockpin is controlled by a cable from the lever at the left hand side of the upper control panel.

LEVER UP—CASTER UNLOCKED
LEVER DOWN—CASTER LOCKED

The primary purpose of the lock is to reduce the possibility of ground looping in landing. The lock also assists in taxiing cross-wind and up and down ramps.

(3) ADJUSTMENT. — After installing the tail wheel assembly in the hull and/or after changing the operating chain, the following adjustment is recommended:

(a) Disconnect piston rod from bellcrank and push FULL IN, bottoming in the cylinder.

(b) Rotate bellcrank until tail wheel is locked FULL DOWN.

(c) Adjust the chain turnbuckles until the bellcrank bolt hole is $\frac{1}{16}$ in. forward of the bolt hole in the piston rod.

(d) Pull piston rod forward $\frac{1}{16}$ in. and insert bolt through bellcrank and piston rod.

(e) With tail wheel in mid-position have chain adjusted until just snug.

Note

This $\frac{1}{16}$ in. cylinder adjustment permits the tail wheel to lock in the FULL DOWN position while the piston still has $\frac{1}{16}$ in. movement.

d. LUBRICATION.—Refer to the Lubrication Chart for points of lubrication and lubricants to be used. For the landing gear assembly, a plate covered opening in the upper forward section of the tail wheel pocket affords access for inspection.

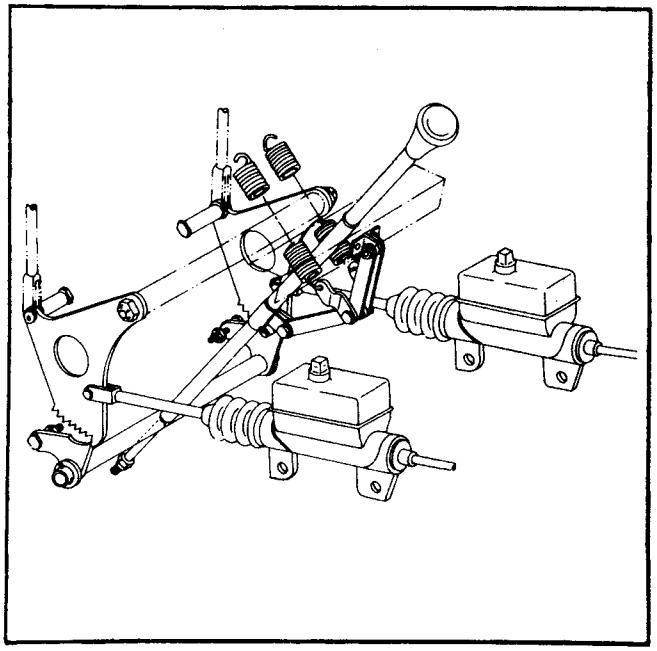


Figure 41—Parking Brake Control

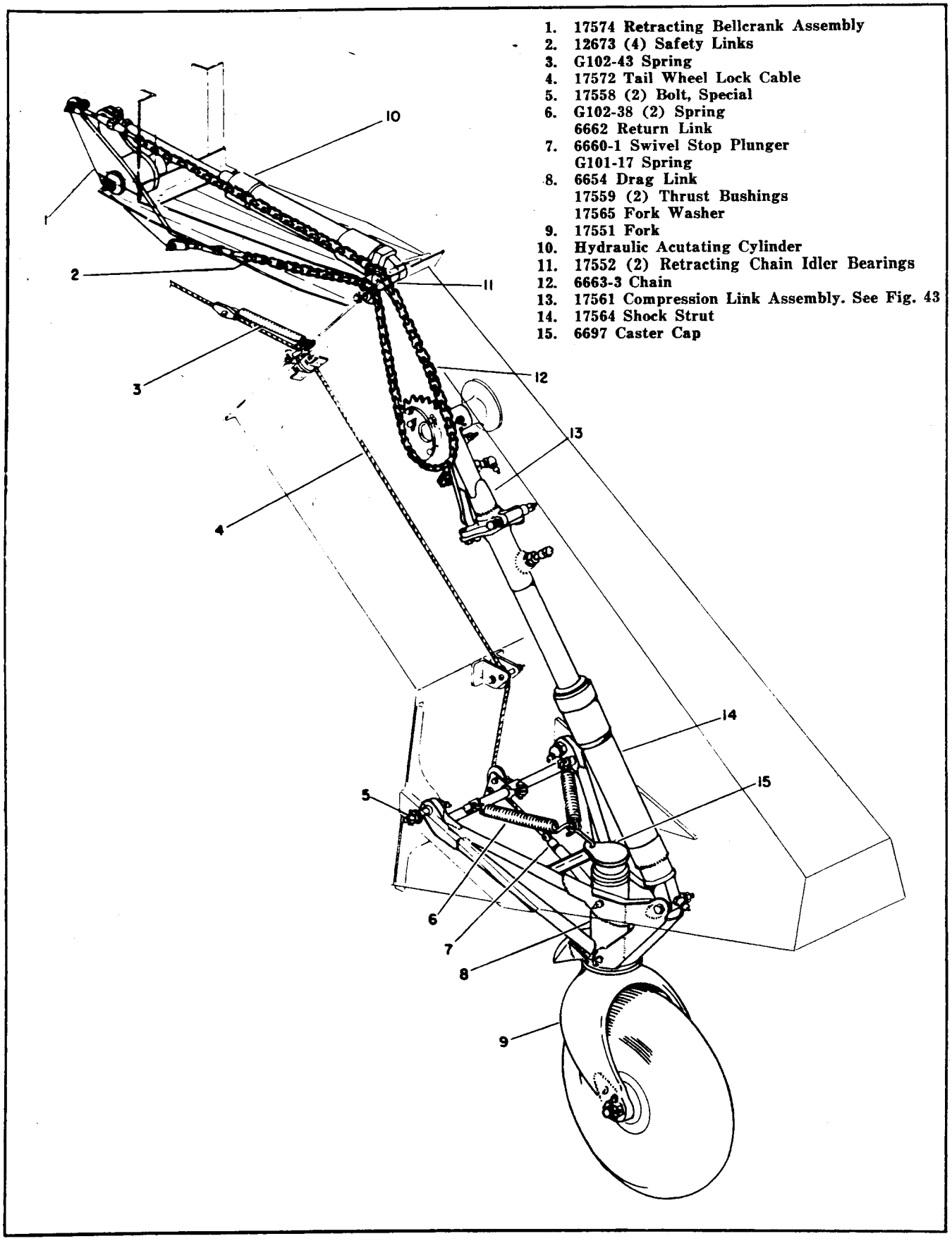


Figure 42—Landing Gear—Tail Wheel Installation

1. Tail Wheel Pocket Skin
2. 17419 (2) Compression Link Fitting
3. AN4-25 Bolt
   AC940-416 Washer
   G5-4-12 Spacer
   AN960-416 Washer
   AN960-416T Washer
   AN310-4 Nut
   AN380-C2-2 Cotter
4. AN4-7 Bolt
   AC940-416 Washer
   G5-4-12 Spacer
   AN960-416 Washer
   AN310-4 Nut
   AN380-C2-2 Cotter
5. AN4-17 Bolt
   AN960-416 Washer
   G5-4-56 Spacer
   AC940-416 Washer
   AN310-4 Nut
   AN380-C2-2 Cotter
6. 6672 Sprocket
7. 6646 Latch Hook
8. G104-55 Spring
9. 17561 Compression Link Assembly
10. 6668 Torque Tube Hinge Pin
11. AN4-15 Bolt
    AN960-D416 (2) Washer
    AN310-4 Nut
    AN380-C2-2 Cotter
12. 17568 Latch Bolt
    G5-5-8 Spacer
    AC940-516 Washer
    AN320-5 Nut
    AN380-C2-2 Cotter

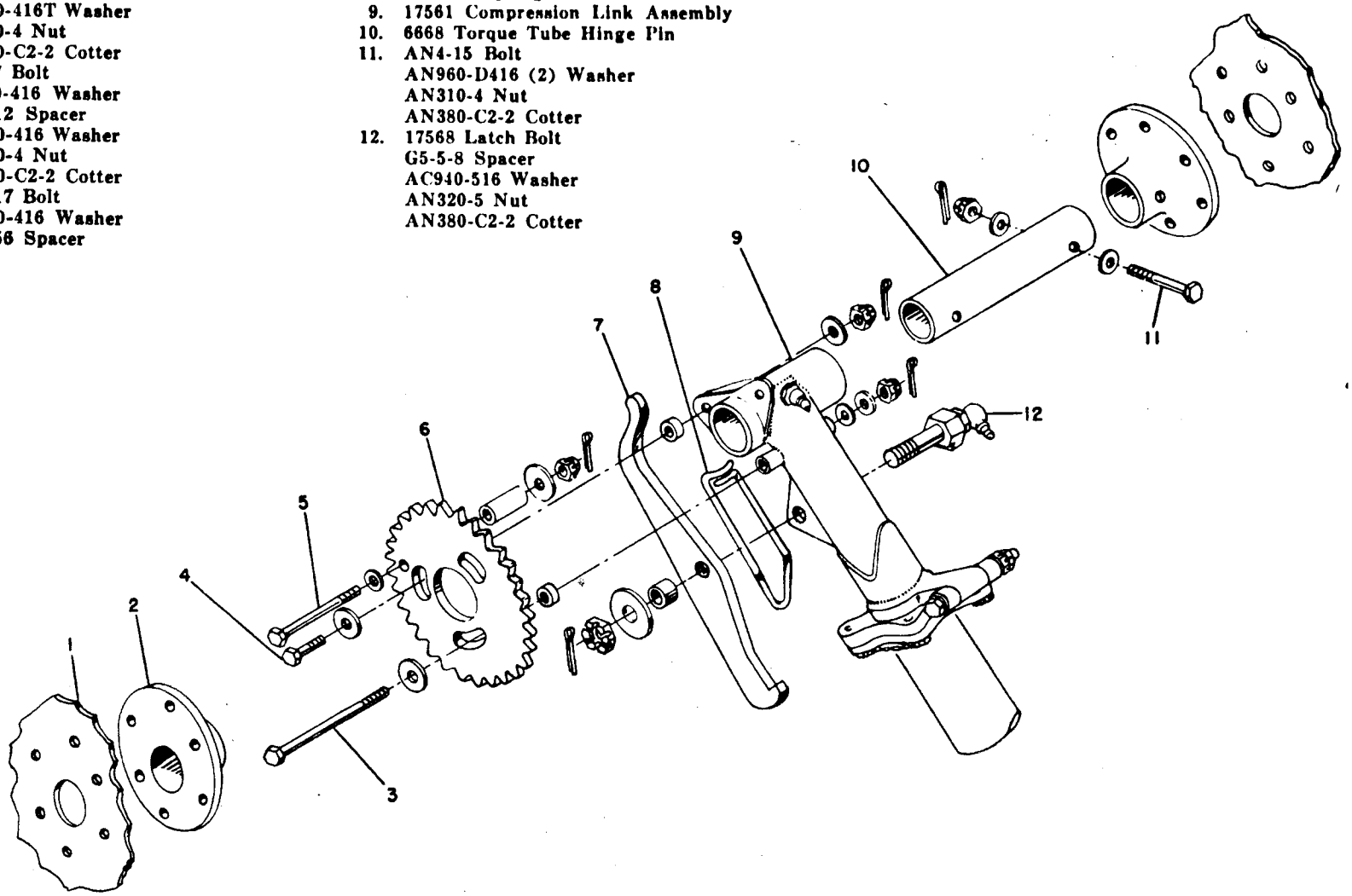


Figure 43—Tail Wheel Operating Mechanism—Exploded View

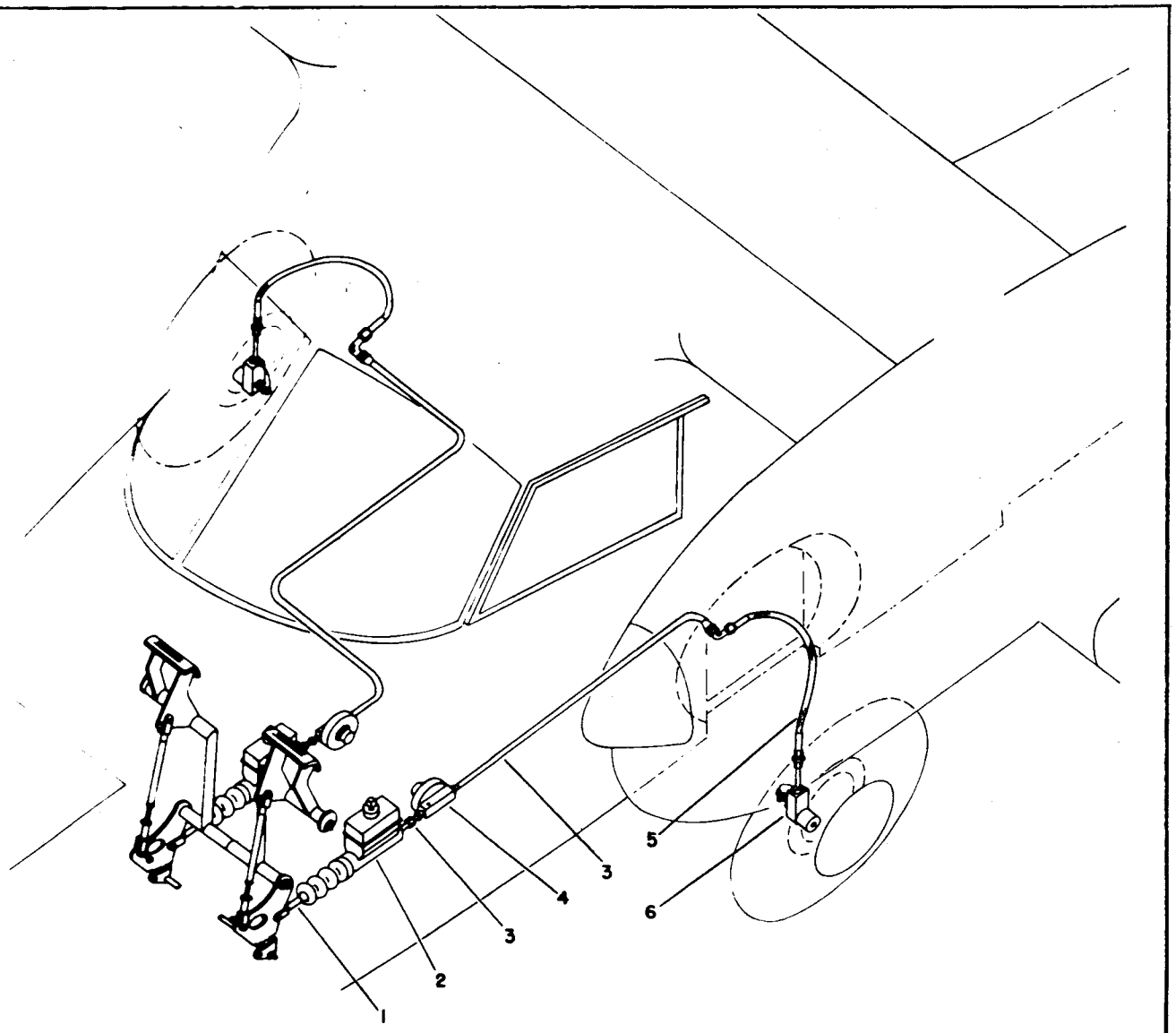
e. BRAKE SYSTEM.—Hayes #G-2-201—9x1½ hydraulic expander tube brakes, #D-87-36 master cylinders, and #B-107-19 brake adjusters are installed. The brake toe pedals are mounted above the rudder pedals.

(1) FLUID.—The fluid, in this system, is mineral oil (may be identified by its red color).

(2) LINES.—Flexible lines, with neoprene lining, are installed at the main wheels. The solid lines are 52SO, ¼ in. O.D. x .035 wall aluminum alloy tubing. The Parker triple compression flared type fittings, used in this installation, are so designed that a sleeve is between the tubing flare and the nut.

(3) PARKING CONTROL.—The brakes may be applied individually or simultaneously by pressing on the toe bars. For parking set the brakes by pulling the parking brake control lever UP then press both pedals to lock the brakes. To release, depress control and press both pedals to unlock.

(4) MASTER CYLINDER.—The master cylinders and their brake adjusters are located under the cockpit flooring aft of the control column assembly. The cylinder piston is immersed in fluid as the integral supply reservoir is connected by ports to the cylinder proper. This prevents the entrance of air into the line under



1. 17833 Push Rod
2. B-87-36 Hayes Master Cylinder
3. ¼ O.D. x .035 (52SO) Tubing
4. D-107-19 Hayes Brake Adjuster
5. AN6260-4-26 Flexible Hose
6. A-84-1 Bleeder Screw
   B-27-55 Banjo Fitting
   A-58-5 Bolt
   Copper Washers, Cadmium Plated

Figure 44—Brake System Installation

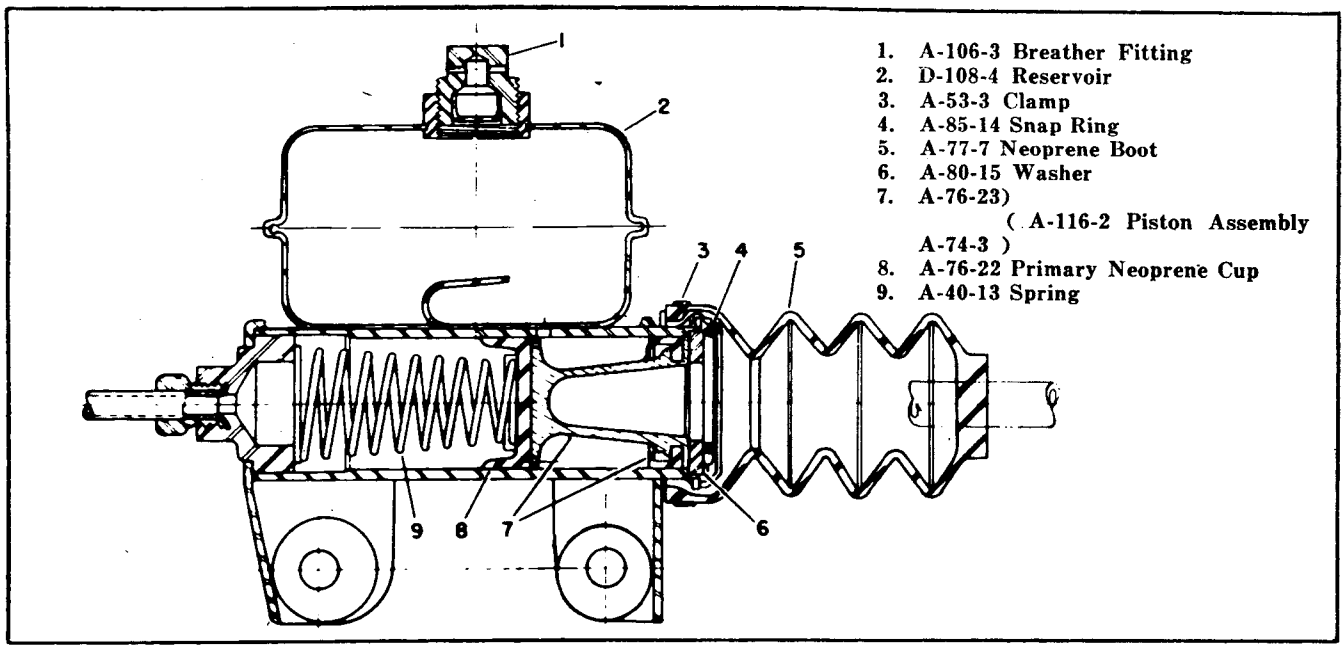


Figure 45—Brake Master Cylinder, Hayes No. D-87-36

normal conditions. The high pressure line is connected to the head end of the cylinder. There is a small port just in front of the piston cup in the off position. This port connects the fluid line to the reservoir whenever the brake is in the OFF position; thus allowing the high pressure line to accommodate itself to changes in the volume of fluid due to temperature changes or fluid seepage.

(a) MAINTENANCE. — The master cylinders normally require little servicing. The primary neoprene cup and secondary neoprene seal, which serve to keep the cylinder from leaking, are the parts most likely to need replacement. The lips of these cups sometimes become worn or scratched due to dirt in the fluid and thus develop leaks. In order to replace these parts, remove clamp A-53-3 and boot A-77-7 after which lock ring A-85-14 can be removed, and the cylinder parts pulled out of the bore. The cylinder should then be thoroughly cleaned with fresh brake fluid and inspected; and before assembling, lubricated with clean fluid.

In reassembling, first install spring A-40-13, after which the primary cup should be put into the bore; and the piston, with the secondary seal assembled on it, can be forced in by a rod. Hold the piston in the cylinder, drop washer A-80-15 over the rod, and hook snap ring A-85-14 into place. This will hold the assembly together. Then reinstall the boot on the cylinder.

After the cylinder is bolted in the hull, the fit at the end of the piston rod (Grumman part #17883) should be such that there is a slight amount of play between the rod and the piston. If the rod is too long and does not let the piston come back against washer A-80-15, the primary cup will project over the hole (in the cylinder wall); and if there is any expansion of the fluid after the brake is released, it may cause the brake to lock and drag.

The following is an additional contributing cause of brake dragging and locking. This assembly is so designed that some fluid is added to the pressure side of the piston during the return stroke. Hence, if the relief port is not opened by the complete return of the piston when the brake is released, pressure is apt to build up in the system with consequent dragging and/or locking.

(5) PEDAL ADJUSTMENT.—The brake pedals may be adjusted relative to the rudder pedals by altering the length of the brake pedal connecting rod. Also the brake adjusters enable adjustment of the toe pedals so that the pilot's instep will bear on the rudder pedals in flight instead of the toes bearing on the brake pedals.

(6) LINING CLEARANCE.—No adjustment is provided on the wheels for changing the radial clearance between the brake lining blocks and drum. The radial clearance should be .010—.015 and must not be allowed to drop below .010. If the clearance becomes too great, the pedal travel will increase thus clearly indicating the necessity of relining the brakes.

Decrease in clearance may be caused; either by inward growth of the drum or swelling of the expander tube. Under normal operation, however, the wear on the lining offsets the expander tube growth, and the clearance remains fairly constant. If the tube swelling exceeds the lining's wear, sand the blocks lightly.

Varying clearances can be obtained between the lining and drum by turning the adjustment screw on the brake adjuster; in for less clearance and out for

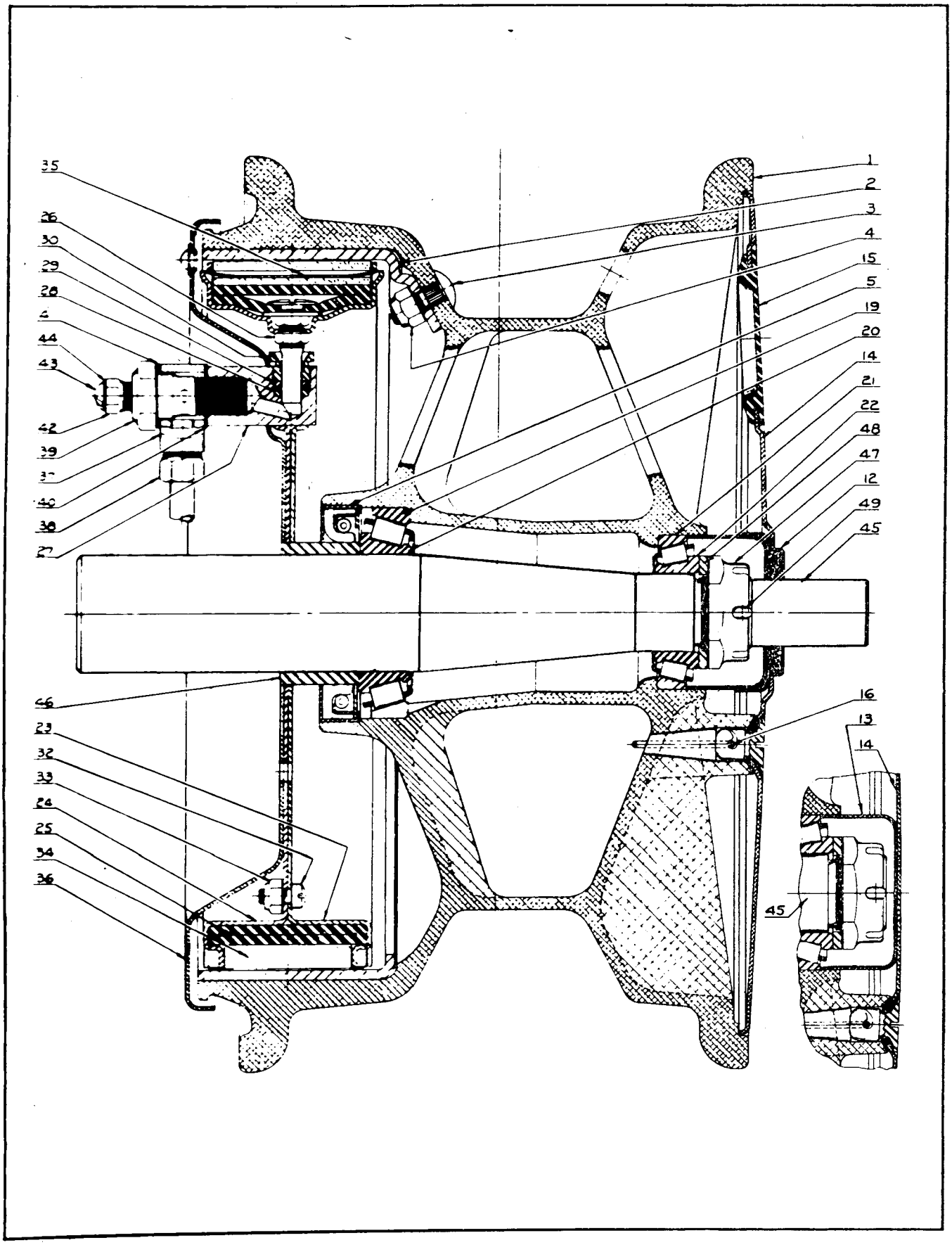


Figure 46—Wheel and Expander Tube Brake

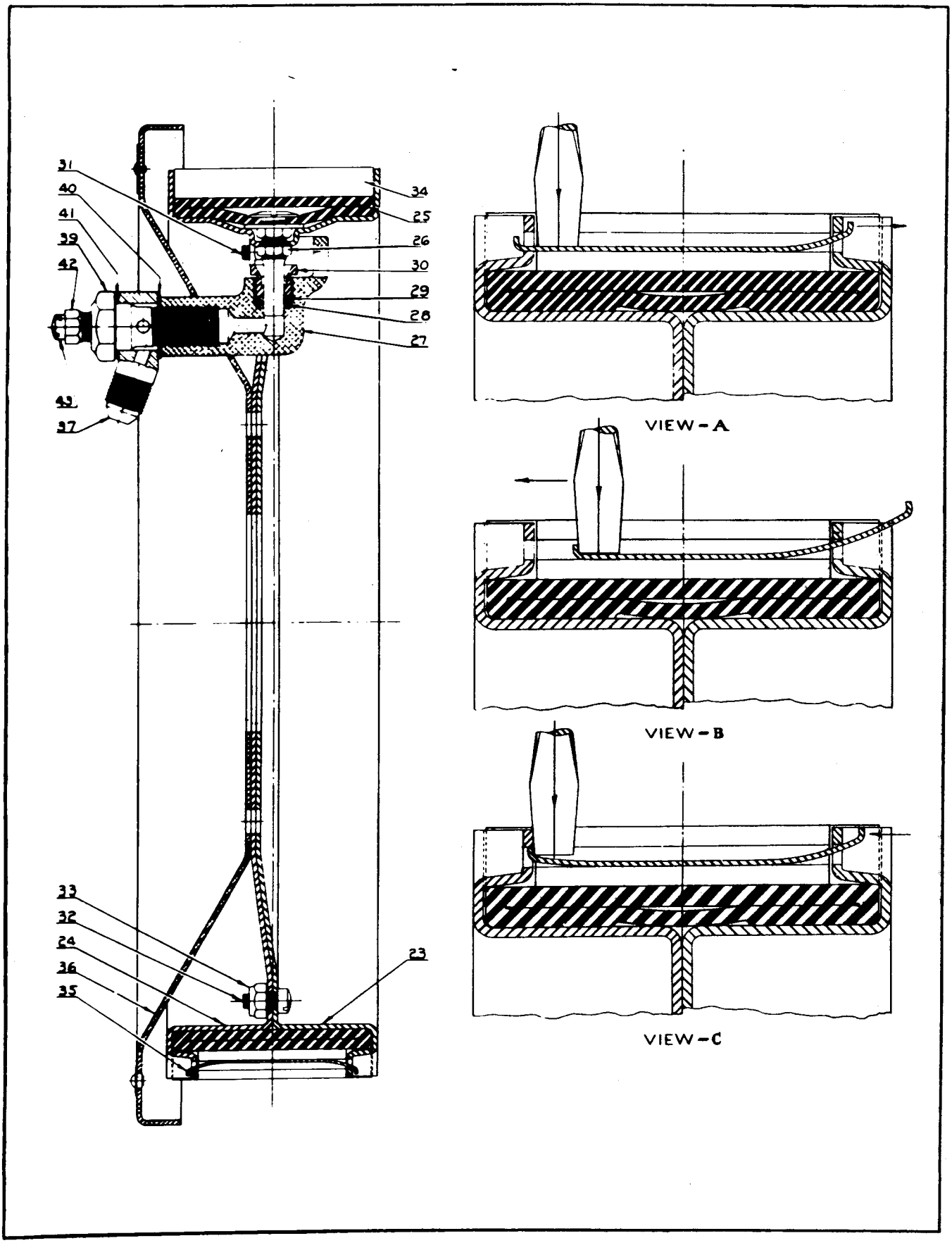


Figure 47—Expander Tube Brake

more clearance. See (5) Pedal Adjustment, above. Check clearance by inserting a feeler gage in the three slots on the inboard side of the brake assembly—.010—.015.

(7) BLEEDING THE BRAKES.—When installing a brake, copper gaskets "40" and "41" must be inserted between the line connection fitting "27," connection bolt "39," and connector "37" in the position shown on the brake illustration. Washers "40" and "41" should not be used a second time.

During the bleeding operation have one man in the cockpit and another at the brake. Remove screw and washer "43" and "44" from the bleeder fitting "42," and screw the bleeder hose into place. Put the other end of this hose into a container which has been partly filled with mineral oil. While applying the brake pedal in the cockpit (on the side being worked on) loosen the bleeder fitting "42" to allow air in the system to bleed into the container. When the pedal reaches the full down position, it should be held until part "42" is tightened thus preventing any air being drawn back into the system. This operation should be continued in the above sequence until there is a clear flow of oil without bubbles appearing in the container. During this operation the hydraulic reservoir must be checked and kept full. After it has been ascertained that all air has been expelled from the system, bleeder screw "42" should be tightened securely. Then remove the bleeder hose from this fitting, and reinstall the washer and screw "44" and "43" to keep out dirt.

After bleeding the brakes, inspect around the nozzle packing for leaks with the brake pedal full on. If there is a leak tighten packing nut "30."

CAUTION

Do not apply the brake unless it is in the brake drum; otherwise, the blocks will be blown out and the expander tube damaged. Do not get brake fluid on the lining.

(8) RELINING BRAKES. — Remove the wheel from the axle and take off the brake assembly. Take out screws and nuts "32" and "33" which hold the two halves of the frame together. Loosen nut "26" on the tube nozzle and packing nut "30" where the nozzle is inserted into the fluid connection. Drain the fluid.

After separating the frame halves, remove the blocks and tube. It may be advisable to install a new tube depending on its condition. The block retractor springs should be cleaned, and if any show signs of cracking or loss of tension, they should be replaced.

To reassemble the brake, use the following procedure:

Check the expander tube to see that the nut, which holds the nozzle, is tight. When tightening this nut, hold the nozzle with a wrench. Install the tube by first putting the nozzle into the fluid connection, which should be in its slot in the inner half of the frame. Press the other half of the frame into the tube, leaving ¼ in. greater width than the width of blocks between the frame edges.

The new brake blocks should have one retractor spring (cadmium plated) inserted in the slot in one end of each block. These retractor springs should be installed with the spring arched inward (opposite to curve of block) so that when the ends of the springs are located in the spring grooves in the brake frame, the spring will force the block inward.

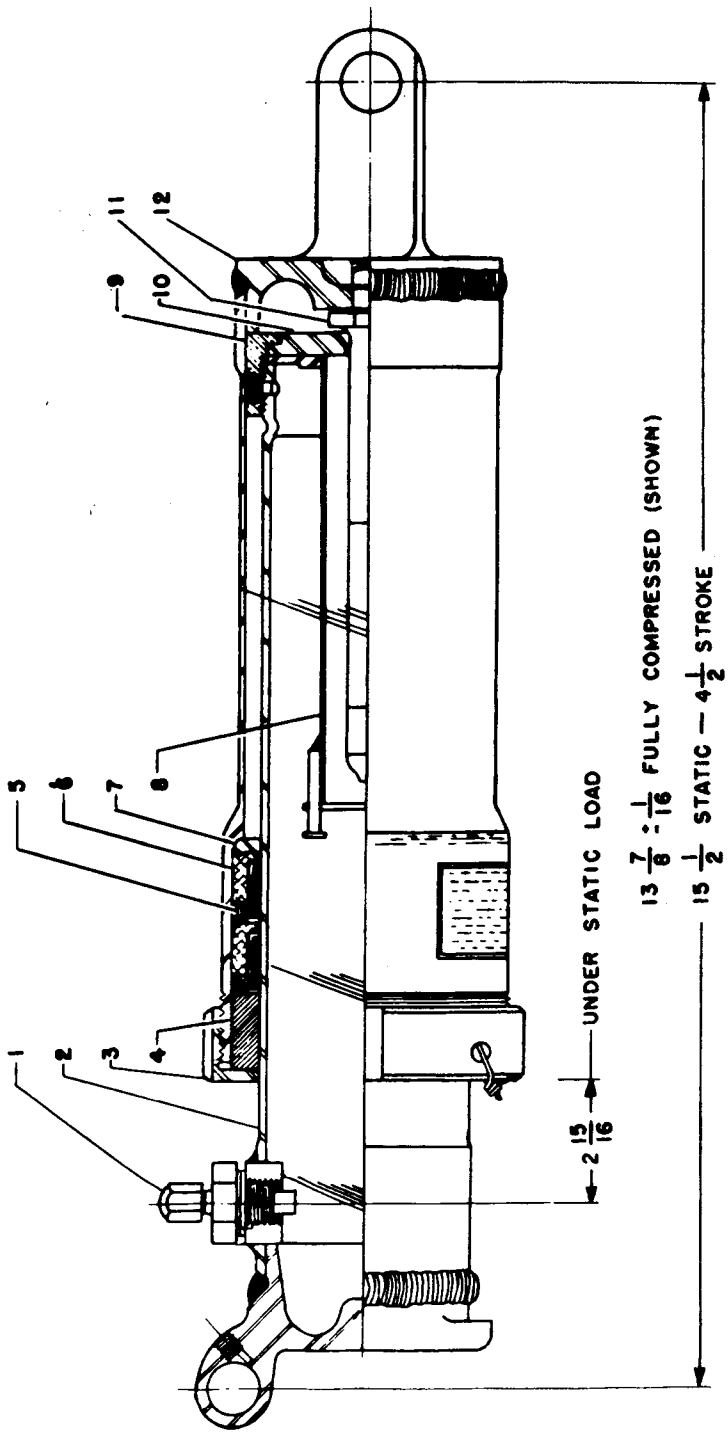
The blocks can now be installed by locating the end of the retractor spring in the proper grooves in the inner brake frame, installing each block successively until all are installed, sliding the last block down the retractor spring of the first block installed. Place a rubber band around the brakes to hold the blocks which have already been installed. After this is done, check to see that all retractor springs are in their slots in the inner frame as far as they will go. Push the other half of the frame into the tube and put in one bolt to hold the frames against the ends of the springs. With a screw driver (see brake illustration), push one of the springs in radially until its end is caught in the spring notch in the outer half of the frame. Hold the frame down at this point and proceed around the frame in both directions, pushing in the springs and clamping the frame tightly until all springs are in their slots. The screws should be tightened up only after checking that all springs are in their slots.

The packing nuts should be tightened securely in order to eliminate any chance of leakage. Be sure the fluid connector is at the bottom of its socket, before tightening the packing nut. If the fluid connection is not at the bottom of its socket, it will not line up properly with the hole in the inner fairing. The brake is now ready for installation on the airplane.

f. SHOCK STRUTS. — The Bendix Pneudraulic shock struts are of the combined hydraulic and pneumatic type. Impact loads are dissipated mainly through the hydraulic unit by forcing fluid through the annular orifice, the size of which is controlled by the position of the metering pin in the orifice. Taxiing loads are carried mainly by the compressed air.

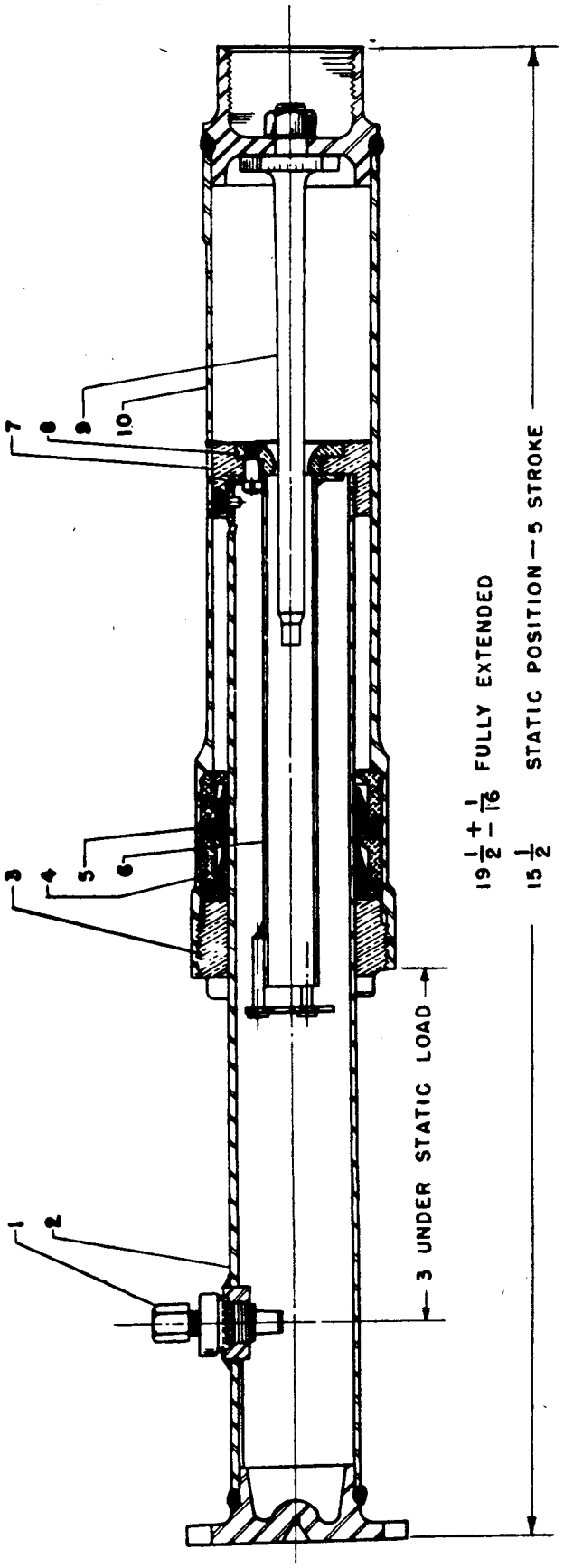
When the load is applied to the strut and compression starts, the piston forces fluid through the orifice into the upper chamber where the rising fluid level compresses the air above it. When the strut has made a stroke sufficient to absorb the energy of the impact, the air at the top expands and forces the fluid back. On the return stroke a valve, which is open on the compression stroke, is closed; and the fluid is forced back from one chamber to another through small holes. This acts as a snubber preventing quick rebounds.

(1) FLUID.—Use mineral oil (red color), in the struts. A certain amount of fluid loss, due to seepage past the packing rings, is to be expected and the fluid level in the strut will vary according to the amount



1. AN809-1 Core
   AN812-1 Body
   AN813-1 Cap
   AN901-5C Gasket
2. 65444 Inner Cylinder
3. 65432 Bearing Nut
4. 65436 Bearing
5. 66110 Packing
6. 53042 Packing Ring
7. 53043 Packing Washer
8. 65440 Snubber Tube Assembly
9. 65438 Piston
10. 65437 Piston Insert
11. 65446 Metering Pin
    53051 Gasket
    76-S-27 Lockwasher
    AN315-6R Nut
12. 65450 Outer Cylinder

Figure 48—Main Wheels Shock Strut



1. AN809-1 Core
   AN812-1 Body
   AN813-1 Cap
   AN901-5C Gasket
2. 53279 Inner Cylinder
3. 65674 Packing Nut
4. 53276 Packing Ring
5. 66111 Packing
6. 53281 Snubber Tube Assembly
7. 53277 Piston
8. 53284 Piston Insert
9. 65924 Metering Pin
   53051 Gasket
   76-S-27 Lockwasher
   AN315-6R Nut
10. 53286 Outer Cylinder

Figure 49—Tail Wheel Shock Strut

of seepage, which may not be the same for both struts. In general, however, the fluid level should be checked whenever the strut strikes bottom or top with ordinary usage when inflated to the proper extension. This indicates that the proportion of fluid to air has been decreased to a point where the air does not build up sufficient pressure to prevent bottoming. To check the fluid level, deflate the strut by depressing the valve core, then back off the filler plug one turn until all the fizzing of air and fluid stops. Remove the filler plug and check the fluid level, which should be flush with the filler plug hole when the strut is fully compressed.

When an empty strut is filled, care should be taken to completely extend and compress the strut several times to be certain that all air pockets are eliminated before the final fluid check is made. If the strut is not in place on the airplane when it is filled, care should be taken to place it under the same angular conditions as on the airplane when final fluid level is checked.

(2) INFLATION.—Due to the small quantity of air in the strut and the relatively high pressure required, it is not advisable to attempt to measure the pressure with a gage. This is not necessary as the correct pressure is indicated when the specified extension of the strut is obtained under the full load. If it is more convenient to check pressures under a light load, the actual extension under this load should be noted after the strut has been properly inflated under the full load. The correct extension under full load is specified on the Instruction Plate.

CAUTION

USE COMPRESSED AIR — NEVER OXYGEN.

Either a Bendix Booster Pump or a high pressure air bottle may be used for inflating the struts. For first inflation, the distance should be approximately $\frac{1}{4}$ in. greater than specified as moving the airplane around will cause some absorption of the air by the fluid. A variation of $\frac{1}{4}$ in. either way for final reading should not be considered of importance. Adjustment should be made with the airplane out of the wind; without the slip-stream from the propellers; and after the airplane has been moving forward, tail on the ground. The airplane should also be rocked occasionally while inflating to overcome packing friction, thus preventing inadvertent over-inflation. Do not over-inflate, as hard taxiing and bouncing on contact will result. The filler plug, which also contains the air valve, is provided with an annular ring on the under side of the hex. A soft copper gasket is provided between this ring and the plug seat on the strut. These seats must be free from dirt and marks, and the plug must be seated snugly to prevent air leaks at this point. If needed, a new gasket should be used each time the plug is replaced.

(3) AIR VALVES.—Two types of air valves are suitable for use in these struts. Both are special types, developed for this purpose, one by Schrader's Sons and the other by Dill Mfg. Co. These valves function like those in an automobile tire. The hex cap provided with this type of valve has a soft metal seat to furnish a secondary seal. It should be screwed down tightly, but not so tight that the tin seat in the cap is forced inward, thereby depressing the valve core stem. The cores are replaceable.

The valve core and the seat around the filler plug should be tested for leaks by putting a little oil on these joints to show the presence of air bubbles.

If the air pressure is especially high, it is desirable to not over-inflate struts as experience shows the valve cores are more easily damaged by the releasing of high pressure air through them than in any other way. Under the pressure ordinarily used, no difficulty results from this condition.

(4) PACKING.—The packing used in the strut is a special aircraft packing, designed especially for this work. Two moulded composition rings separated by aluminum alloy spacer rings are used. One type of design of the packing box requires rings with inside flexible sealing lips, and the other type requires rings with the flexible lips on the outside.

Sealing on the lip side of the packing is accomplished automatically by the hydraulic pressure; hence, any leakage on this side of the packing cannot be remedied by tightening down on the packing nuts. However, leakage past the fixed side of the packing can usually be eliminated by tightening down on the packing nut as the heel of the ring is thus forced firmly against the packing gland wall.

Packing rings, which will, of course, wear out in service, may be replaced as follows:

(a) Release all air from the strut by depressing valve core stem.

(b) Remove filler plug and pour out fluid.

(c) Unscrew nut at end of cylinder.

(d) Pull out piston tube assembly using a slight bumping action to break rings loose, if necessary.

(e) Remove old rings and replace with new ones.

(f) After the rings are installed, tighten packing nut down firmly to provide seal at heel of ring on side opposite lip. The packing nut is tightened down as the last assembly operation.

(5) STORAGE.—Struts should be kept in storage in the deflated condition, except for short periods or when desired for immediate replacement, as the packing deteriorates as much when under air pressure in storage as in service. When struts are to be stored for long periods as spare parts, it is recommended that the inside be coated with a rust preventative and that the struts be assembled without packing or fluid.

It is very important that the rust preventative be thoroughly cleaned out before the strut is provided with new packing, filled and reassembled for service.

12. SURFACE CONTROLS.

a. AILERON CONTROL. — The aileron control wheel, mounted on the control column, is arranged to throw-over, and can be locked in position for either the pilot or co-pilot. The wheel is fitted with a sprocket and chain from which cables are led aft under the cabin floor over ball bearing pulleys and fairleads; and up the left hand side of the cabin at approximately Station #18 to a central bellcrank on the aft face of the rear wing beam. Cables are led from this central bellcrank to bellcranks in the wings at Station #182 which operate the adjustable pushpull tubes connecting to the ailerons. A fixed control stop is provided for the central bellcrank on the face of the rear wing beam. The cables are 5/32 in. dia., 7 x 19 extra flexible tinned carbon steel.

b. ELEVATOR CONTROL.—Two 5/32 in. dia., 7 x 19 extra flexible tinned carbon steel cables are attached to the control column extension below the anchorage at the floor. One cable is led over a ball bearing idler pulley attached to the forward bulkhead of the pilot's compartment and then, together with the other cable, is led aft under the flooring to approximately Station #18, up the right hand side of the cabin, and along the top of the hull to the elevator control horn.

Adjustable control column stops are located in the cockpit, one below and one above the floor. Additional stops of laminated phenol are fitted at the tail.

Note

The control stops should be adjusted so the cockpit stops act first when there is no load on the system.

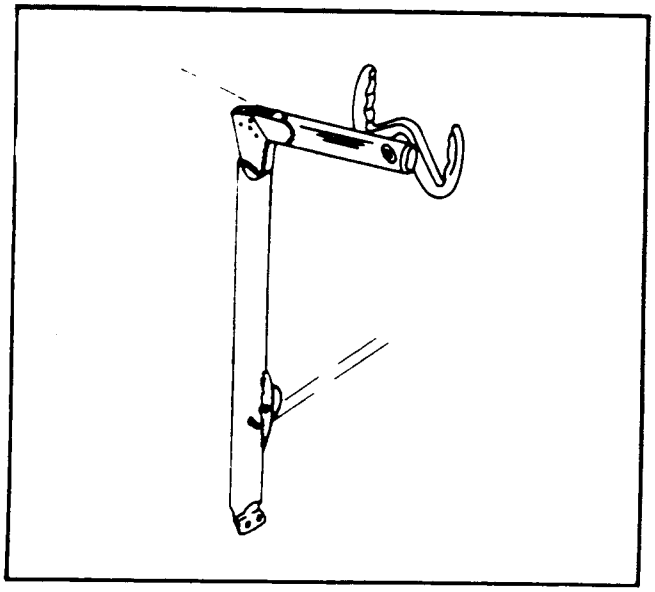


Figure 50—Control Column

c. ELEVATOR TABS.—The elevator tabs are hinged to the elevator trailing edge. The left, a trimming tab, is manually controlled from the cockpit; and the right, a balance tab, is interconnected with the right wing flap control system.

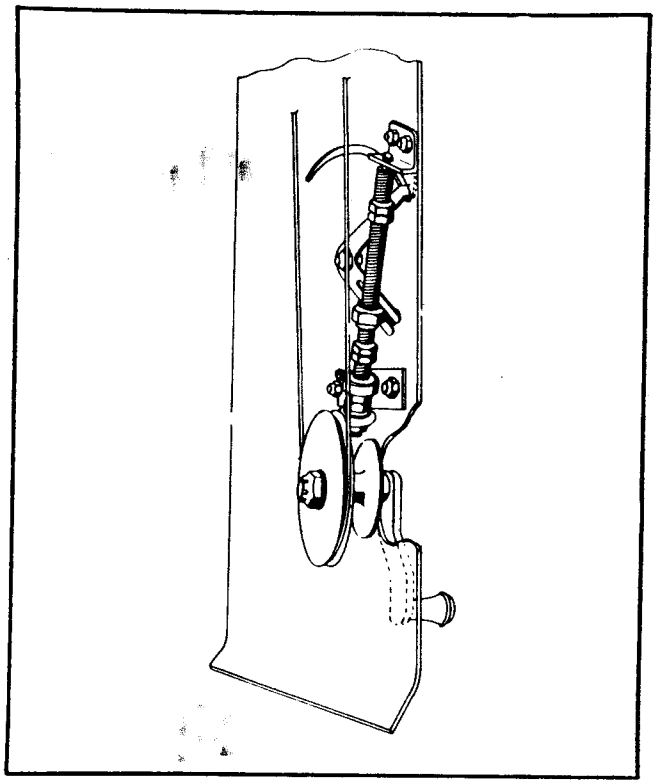


Figure 51—Tab Unit Indicator

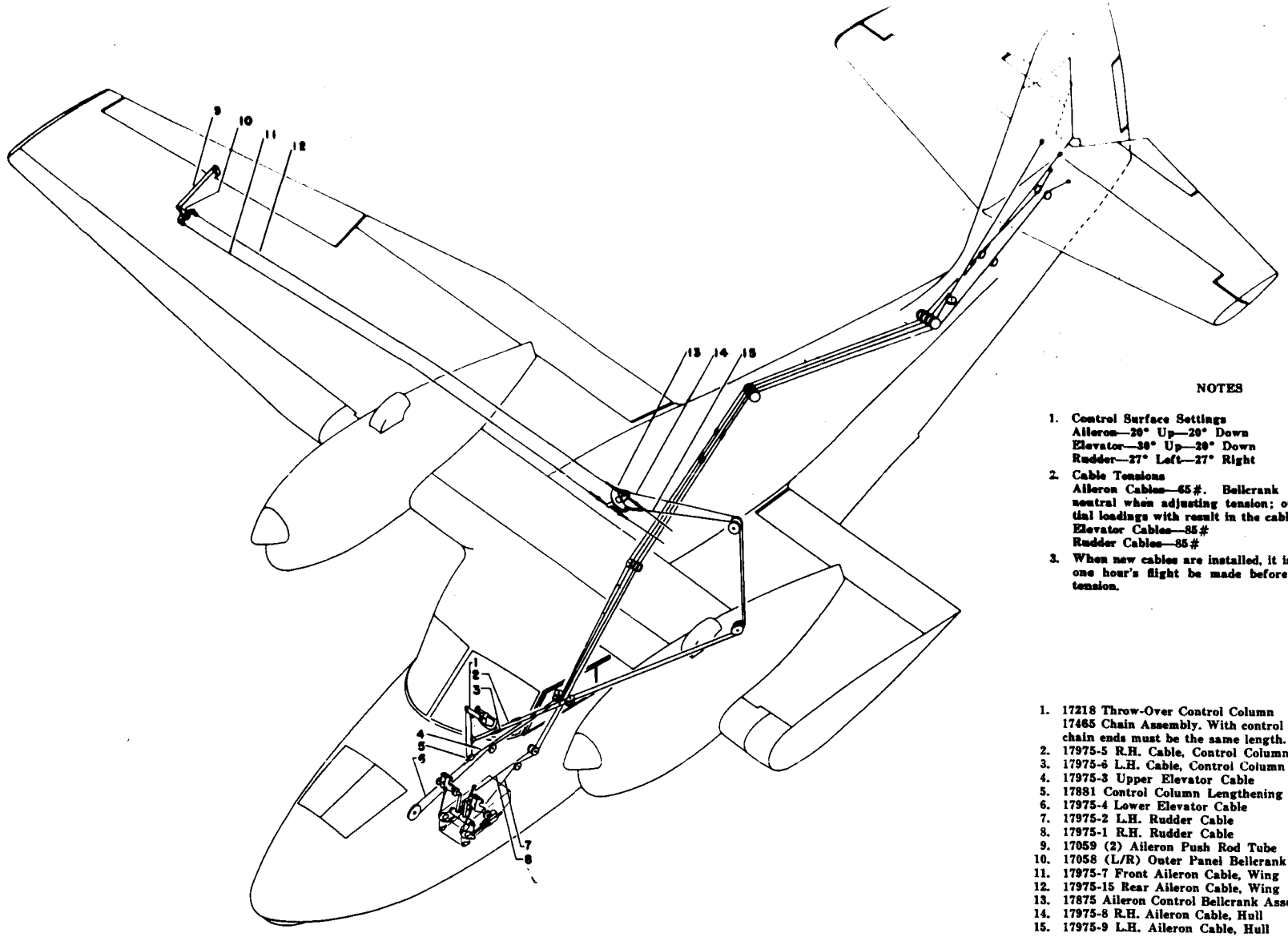
(1) TRIMMING TAB.—The trimming tab control mechanism (left elevator) consists of a handcrank on the left hand side of the upper control panel which is attached directly to a pulley behind the panel. From the pulley, cables are led through fairleads in the cabin ceiling to a pulley attached to the actuator unit at Station #32. The rotation of the pulley axle is converted by this actuating unit into push-pull motion of a flexible shaft which is attached to the tab control horn. This push-pull motion in the control is also transmitted forward by a cable to the tab position indicator on the upper control panel adjacent to the tab control handcrank.

The handcrank is turned clockwise to lower the tab (nose up) counterclockwise to raise it (nose down.) Position of the tab can be checked by the indicator located just above the handcrank. The average take-off position is indicated on the scale.

(2) BALANCE TAB.—This tab is hinged at the lower surface of the right elevator and is designed for downward movement only. It is lowered with the right wing flap thus counteracting nose heaviness which is consequent to wing flap operation.

The right elevator tab control cable is spliced into the wing flap position indicator cable in the right wing just inboard of the pulley at the flap actuating cylinder; and operates automatically in conjunction with the flaps.

The tab control cable is attached to a bellcrank in the elevator which actuates a push-pull tube connecting to the tab. As the wing flaps return to the

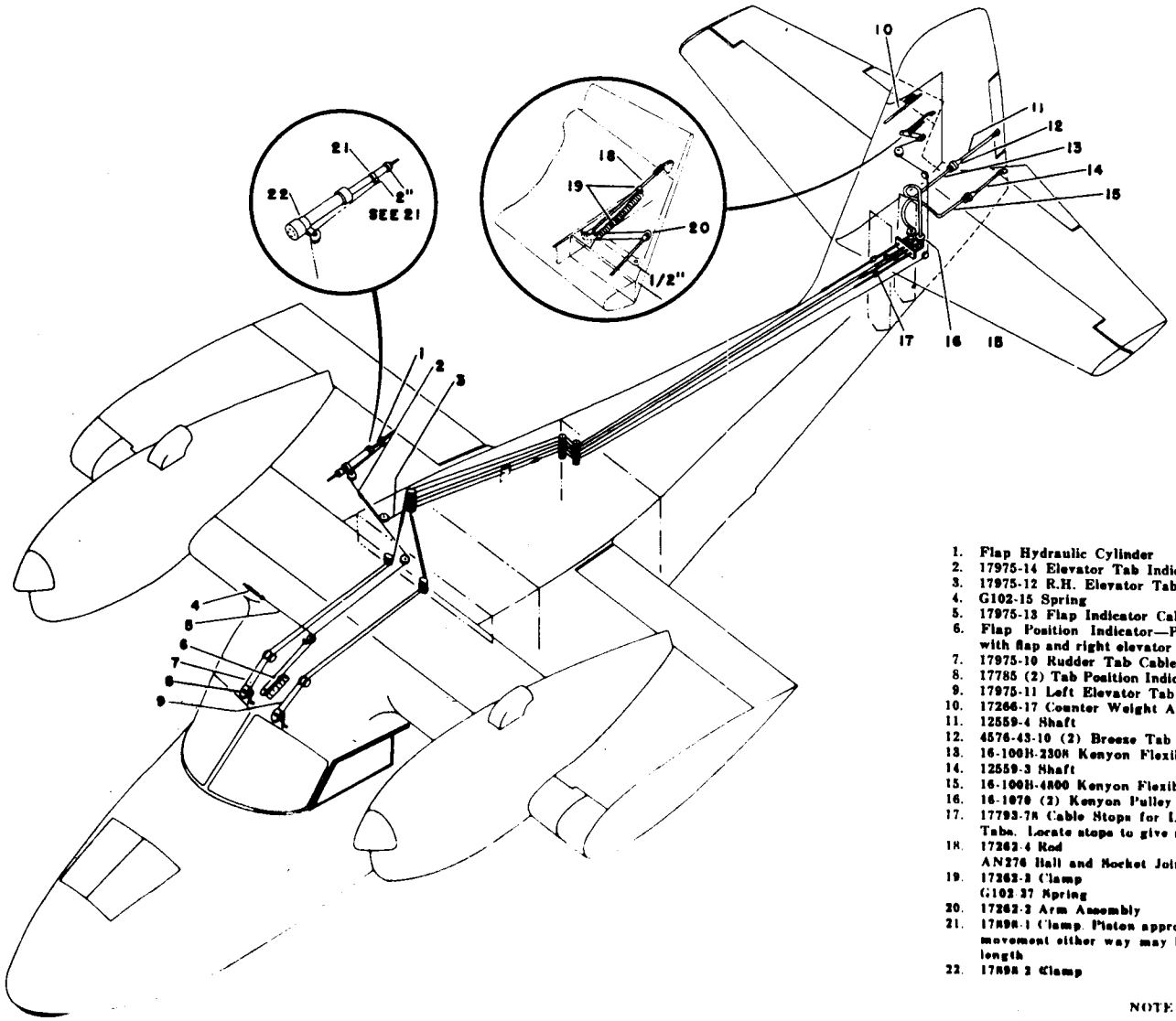


NOTES

1. Control Surface Settings
   Aileron—20° Up—20° Down
   Elevator—30° Up—20° Down
   Rudder—27° Left—27° Right
2. Cable Tensions
   Aileron Cables—65#. Bellcrank 17875 must be in neutral when adjusting tension; otherwise, differential loadings with result in the cables.
   Elevator Cables—85#
   Rudder Cables—85#
3. When new cables are installed, it is important that a one hour's flight be made before setting the final tension.

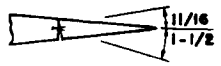
1. 17218 Throw-Over Control Column
   17465 Chain Assembly. With control wheel in neutral, chain ends must be the same length.
2. 17975-5 R.H. Cable, Control Column
3. 17975-6 L.H. Cable, Control Column
4. 17975-3 Upper Elevator Cable
5. 17881 Control Column Lengthening Arm
6. 17975-4 Lower Elevator Cable
7. 17975-2 L.H. Rudder Cable
8. 17975-1 R.H. Rudder Cable
9. 17059 (2) Aileron Push Rod Tube
10. 17058 (L/R) Outer Panel Bellcrank Assembly
11. 17975-7 Front Aileron Cable, Wing
12. 17975-15 Rear Aileron Cable, Wing
13. 17875 Aileron Control Bellcrank Assembly
14. 17975-8 R.H. Aileron Cable, Hull
15. 17975-9 L.H. Aileron Cable, Hull

Figure 52—Surface Control Installation—Aileron, Elevator and Rudder

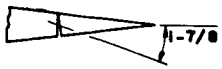


TAB SETTINGS

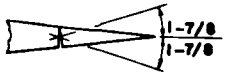
ROD MUST BE 1/2"(MIN.) IN TAB ACTUATOR



LEFT ELEVATOR



RIGHT ELEVATOR



RUDDER

1. Flap Hydraulic Cylinder
2. 17975-14 Elevator Tab Indicator Cable
3. 17975-12 R.H. Elevator Tab Cable
4. G102-15 Spring
5. 17975-13 Flap Indicator Cable
6. Flap Position Indicator—Pointer must be at "O" with flap and right elevator tab in NEUTRAL
7. 17975-10 Rudder Tab Cable
8. 17785 (2) Tab Position Indicator Assemblies
9. 17975-11 Left Elevator Tab Cable
10. 17266-17 Counter Weight Assembly (Static Balance)
11. 12559-4 Shaft
12. 4576-43-10 (2) Breese Tab Actuators
13. 16-100B-2308 Kenyon Flexible Shaft Assembly
14. 12559-3 Shaft
15. 16-100B-4800 Kenyon Flexible Shaft Assembly
16. 16-1070 (2) Kenyon Pulley Drives
17. 17793-78 Cable Stops for Left Elevator and Rudder Tabs. Locate stops to give required travel.
18. 17262-4 Rod
    AN276 Ball and Socket Joint
19. 17262-2 Clamp
    G102-37 Spring
20. 17262-3 Arm Assembly
21. 17898-1 Clamp. Piston approx. 2" as shown. A slight movement either way may be necessary due to cable length
22. 17898-2 Clamp

NOTE

Tab cables should be adjusted until they are snug

Figure 53—Tab Controls Installation Elevator and Rudder

UP position, tension in the control cable is released and a tension spring, in the elevator, returns the tab to neutral.

A tube, acting both as a static balance and stop, is riveted to the upper surface of the tab and extends forward over the elevator.

CAUTION

This tube must always be securely in place.

d. RUDDER CONTROL.—The rudder pedals are located on the left hand side of the cockpit. A linkage connects the pedal units to a torque tube bellcrank below the floor. Control from the bellcrank is by $^{5}/_{32}$ in. dia., 7 x 19 extra flexible tinned carbon steel cables running over ball bearing pulleys, which are supported in metal brackets under the flooring at approximately Station #18, thence up the right hand side of the cabin and along the ceiling to the rudder horn.

The cables are adjustable by turnbuckles which are accessible by removing the diagonal metal panel on the right cabin wall. The rudder pedals, themselves, are not adjustable.

The torque tube, to which the rudder pedal's bellcrank is attached, extended to the right hand side of the cockpit where a removable rudder bar may be fitted for control from the right hand seat.

Control stops are provided at the pedal linkage system below the floor and at the aft end of the hull.

Note

The control stops should be adjusted so the cockpit stops act first when there is no load on the system.

(1) TRIMMING TAB.—This tab is hinged to the right hand side of the rudder's trailing edge and is controlled by a handcrank on the right hand side of the upper control panel. The handcrank is turned clockwise for left tab (nose right) and counterclockwise for right tab (nose left). Position of the tab can be checked by the indicator located just above the handcrank.

The control mechanism for the rudder tab is identical with that of the left elevator trimming tab. From the pulley on the handcrank, a flexible cable is led through fairleads in the cabin ceiling to the tail at Station #32, where it is attached to the tab actuator unit.

e. WING FLAPS CONTROL.—The wing flap operating system is a part of the main hydraulic system and consists of a cockpit control lever with locking latches, flap position indicator, selector valve, two single acting hydraulic cylinders with self contained return springs, and aluminum alloy lines with flexible hose connections at the cylinders.

Pressure for lowering the flaps is furnished by the engine-driven hydraulic pump.

(1) NORMAL OPERATION.—The flaps are controlled by the three position flap control lever on the right side of the upper control panel. The flap position indicator is installed above the lever.

LEVER UP—FLAPS DOWN
LEVER CENTER—NEUTRAL
LEVER DOWN—FLAPS DOWN

The flaps are controlled downward from 0° to 40°. Movement may be stopped at the desired angle of droop by returning the lever to the NEUTRAL position.

(2) EMERGENCY OPERATION.—Thumb latches are provided to lock the flap control lever in the operating positions thus permitting the pilot to have one hand free if emergency hand pump operation is needed. Above seven strokes are required to lower the flaps. The white UP latch is located to the left of the control lever slot at the UP position, and the red DOWN latch, at the DOWN position. The white UP latch may be left locked since the flaps are returned to the UP position by the action of the springs in the actuating cylinders.

CAUTION

The red DOWN latch should be used only when operating the hand pump and released immediately after pumping; otherwise, there is no flow through the valves and unreliable operation occurs.

f. INSPECTION PLATES.

(1) Under surface of wing, outboard at aileron rod. For inspecting aileron control units.

(2) Under surface of wings between engine nacelles and hull, (2 plates). For inspecting wing flap actuating cylinder and fittings.

(3) On top of hull between Stations #27—#28. For inspecting tabs, elevator and rudder cables.

(4) Left hand side of rudder. For inspecting tab control.

(5) Left and right hand sides of fin below stabilizer, (3 plates). For inspecting tab, elevator and rudder cables and tab actuating units.

13. HEATING AND VENTILATING

a. HEATING.—Air, heated by an exhaust manifold heater tube in each engine nacelle, is carried by tubing through the wing leading edges to the regulator valves at the cockpit ceiling. These valves regulate the mixture of hot and cold air which is distributed at two outlets; one under the pilot's seat, and the other under the cabin auxiliary seat. The left valve regulates cockpit air and the right valve cabin air.

b. VENTILATING.—Two adjustable cabin fresh ventilators are located at the cabin ceiling for the passengers. Air for these ventilators is taken through an opening in the right wing leading edge inboard of the

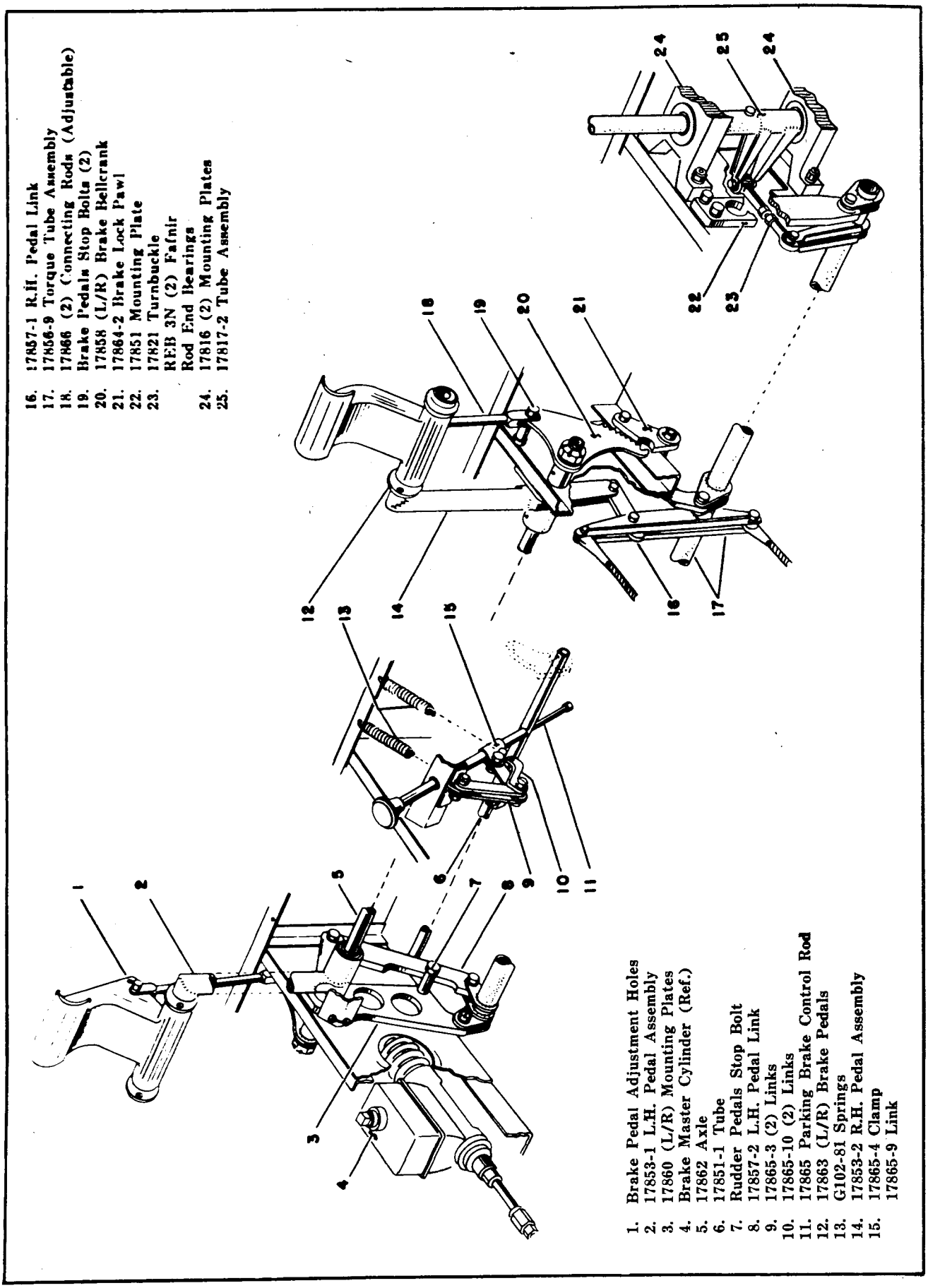


Figure 54—Rudder and Brake Controls Installation

nacelle. A similar type unit is also located above the co-pilot's side window. An adjustable air vent is installed in the cabin ceiling.

CAUTION

The exhaust manifold heater tubes should be removed and inspected carefully every 40 hours, or at least every 2 months. Regardless of their condition, they should be replaced at the end of each 300 hours of operations. The tubes are INCONEL a material which is best suited for this use, but as they are continuously subjected to hot exhaust blasts, their life is limited.

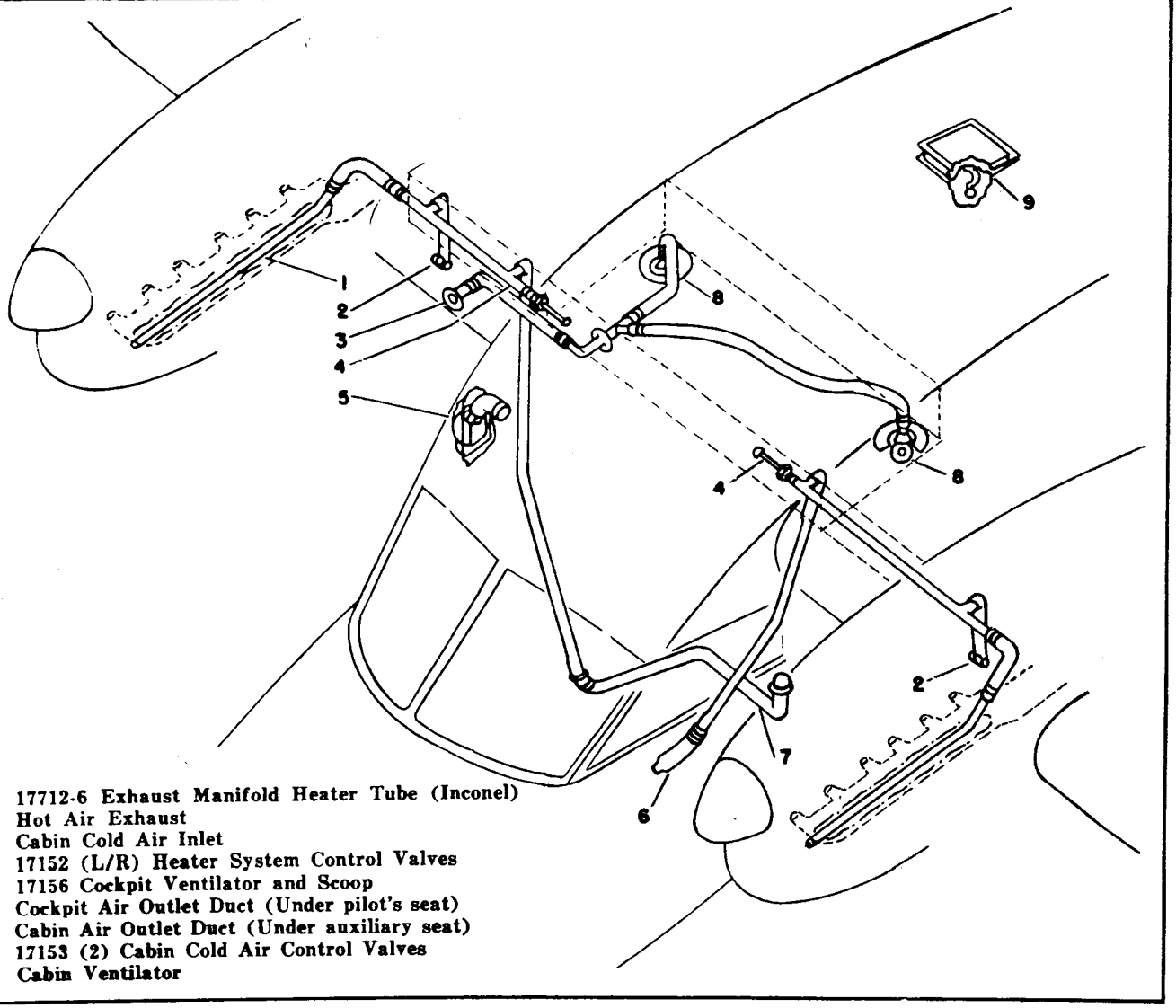
The importance of checking the condition of the tubes at regular short intervals cannot be overemphasized, as any leak or crack will allow poisonous exhaust gases to be conducted directly to the cockpit and cabin.

14. RADIO.

The following radio equipment is installed:

Item	*Lear Part No.*
Transmitter	T-30
Receiver	RCBB
Power Pack	G-30-AB
Load Coil	3934-A
Crystal	A2572-V3105-T-KC
Microphone	1454-Y
Headphone	4306-Y
Antenna Reel	Sr. Unihand 68-75

The transmitter, receiver, and load coil are installed in the bulkhead behind the co-pilot's seat. The power pack (dynamotor) for the equipment is under the co-pilot's seat. The trailing antenna reel wire is connected to a Lear 883-A Vac-Drag Rubber at the Lear 7721-A Tail Post Fairlead.



1. 17712-6 Exhaust Manifold Heater Tube (Inconel)
2. Hot Air Exhaust
3. Cabin Cold Air Inlet
4. 17152 (L/R) Heater System Control Valves
5. 17156 Cockpit Ventilator and Scoop
6. Cockpit Air Outlet Duct (Under pilot's seat)
7. Cabin Air Outlet Duct (Under auxiliary seat)
8. 17153 (2) Cabin Cold Air Control Valves
9. Cabin Ventilator

Figure 55—Heating and Ventilating Installation

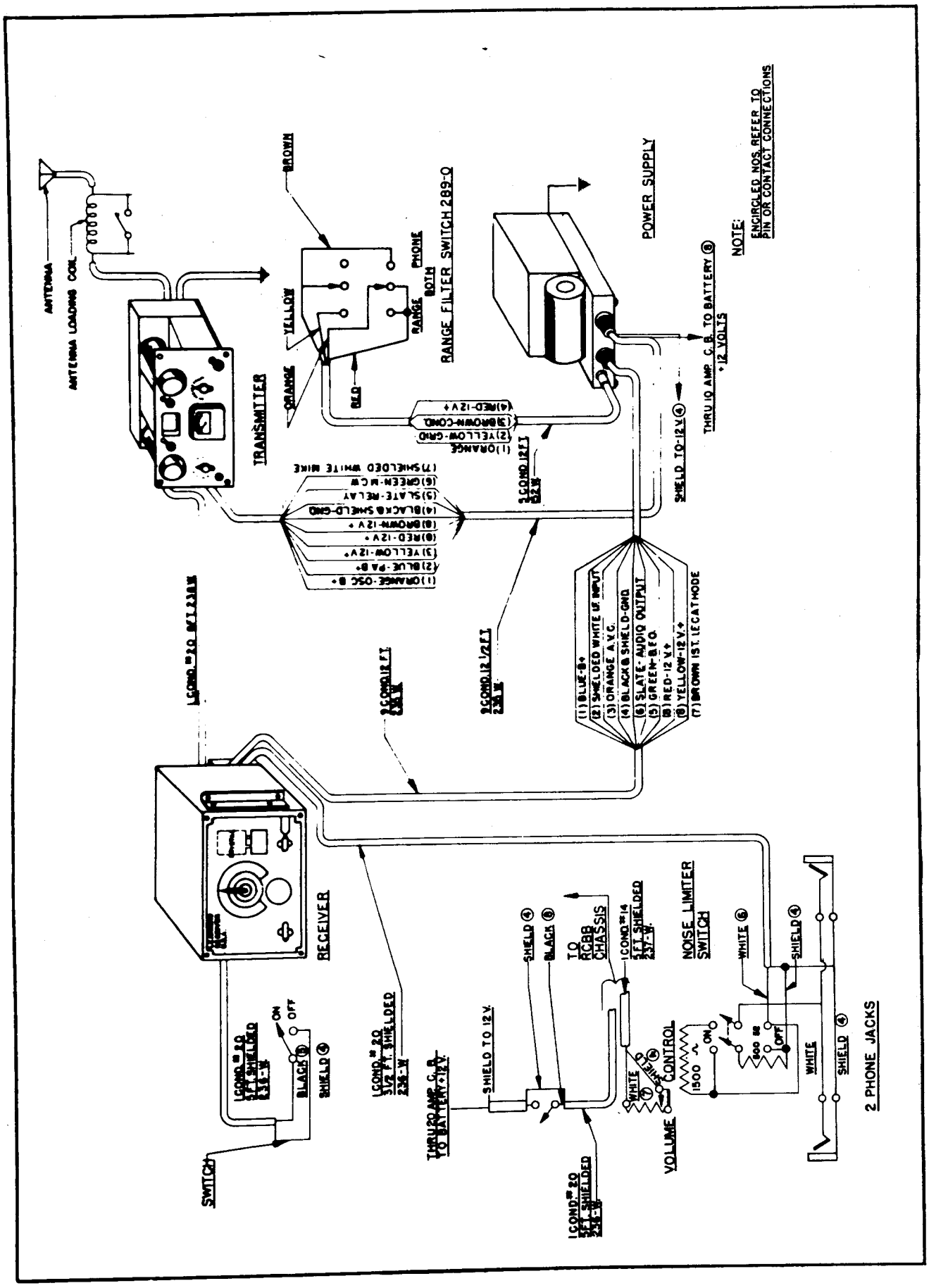
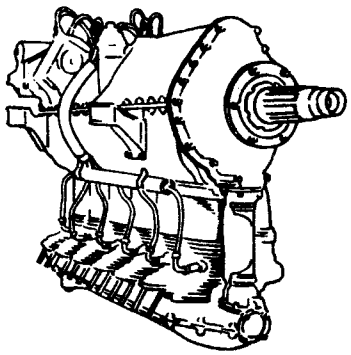


Figure 56—Radio Cordage Diagram

Section IV



100-HOUR INSPECTION AND CAA REPORT

1. PERIODIC INSPECTION.

It is recommended that the following Periodic Engine Inspection, used at the factory, should be completed along with the CAA 100-hour Periodic Aircraft Inspection Report.

1. Wash engine.					
2. Clean main oil screen.					
3. Clean scavenger oil screen.					
4. Drain main oil sump.					
5. Check magnetic plugs.					
6. Change oil.					
7. Clean and adjust spark plugs.					
8. Inspect ignition harness.					
9. Check magneto ground connections.					
10. Check magneto breakers.					
11. Check magneto breaker oiler.					
12. Check thermocouple connection.					
13. Check all nuts and screws for tightness and safetying.					
14. Check engine controls.					
15. Check intake pipe packing nut.					
16. Check oil lines and clamps.					
17. Clean fuel strainers.					
18. Check fuel lines and clamps.					
19. Check carburetor air scoop.					
20. Check alternate air valve.					
21. Check exhaust pipes and supports.					
22. Check valve housings and push rod tubes for leaks.					

23. Check engine mount fittings, bushings, and bolts.										
24. Check propeller shaft end play.										
25. Check propeller track.										
26. Check propeller bolts.										
27. Check accessories:										
a. Fuel pumps.										
b. Vacuum pumps.										
c. Hydraulic pump.										
d. Generator.										
e. Starters.										
f. Tachometer cable on generators.										
28. Check inter-cylinder baffles.										
29. Check primer lines.										
30. Check hot spot intensifier tubes.										
31. Check hydraulic strainer.										
32. Run up engine:										
a. RPM										
b. Magneto drop	L		R							
c. Oil pressure	Max.		Idle							
d. RPM	Max.		Idle							
e. Fuel pressure	Max.		Idle							
f. Idle cut-off										
g. Manifold pressure										
h. Idling										

Note

Valve adjustment check on Ranger engines is recommended at first periodic inspection only.

SECTION IV

2. CAA REPORT.

UNITED STATES OF AMERICA
DEPARTMENT OF COMMERCE
CIVIL AERONAUTICS ADMINISTRATION
WASHINGTON

PERIODIC AIRCRAFT INSPECTION REPORT

	(Identification mark)
	(Serial number)
	(Date)
	(Recommendation)

_____ (Owner)

_____ (Make and model)

CERTIFICATES:

Is Registration Certificate in aircraft? _____ In name of owner above _____

Is Airworthiness Certificate in aircraft? _____ Effective until _____

LOG BOOKS:

Is aircraft log book available? _____ Current and in proper condition _____

Is log book for each engine available? _____ Current and in proper condition _____

Has proper entry of this inspection been made in the appropriate log book? _____

GENERAL CONDITION AND INFORMATION:

Do the aircraft and power plant indicate satisfactory maintenance and repair? _____

Are aircraft, power plant, and power-plant compartments thoroughly cleaned? _____

Are sufficient and adequate inspection openings provided? _____

CARGO COMPARTMENTS (location and *placarded* capacity) _____

_____

FUEL TANKS (location and *marked* capacity) _____

_____

OIL TANKS (number and *marked* capacity) _____

OCCUPANTS (number of seats and safety belts for which certificated) _____

ENGINES (number installed—make and model of each) _____

PROPELLERS (make and model of hubs and blades) _____

UPON INSPECTION OF THE FOLLOWING LISTED ITEMS AND UNITS, EXCEPT WHERE MORE SPECIFIC INFORMATION IS REQUESTED, THE CONDITION WILL BE INDICATED AS:

Airworthy by check mark "√," Unairworthy by the sign "X." If indicated as "Unairworthy," explain reasons therefor under remarks.

(Strike out items not applying to the aircraft being inspected)

POWER PLANT (indicate condition of the following):

Engine throughout range of operating r. p. m. _____

Engine installation _____ Speed ring _____ Cowling _____ Attachment _____

Engine assembly bolts, studs, and safety devices _____

Magnetos _____ Ignition cables _____ Ground wires _____ Spark plugs _____

Booster _____ Wiring _____ Ground _____ Starter _____ Generator _____ Shielding _____

Exhaust collector ring _____ Exhaust stack _____ Engine radiator _____ Oil radiator _____ Carburetor heater _____ Cabin heater _____ Heater valves and control units _____ Fuel drains _____ Oil drains _____ Drains safetied _____

Controls for engine accessories and appliances _____

Any openings through firewall permitting fumes to enter cockpit or cabin _____

REMARKS: _____

Propellers _____ Installation _____ Alinement _____ Controls _____ Condition _____

REMARKS: _____

SECTION IV

ENGINE NACELLES (indicate condition of the following):

Engine mount _____ Ring _____ Bearers _____ Fittings _____ Attachment _____
Welds _____ Bolts _____ Rivets _____ Rubber dampers _____
Any indication of rust _____ Corrosion _____ Damaged structure _____

COCKPIT (indicate condition of the following):

Seats _____ Safety belts _____ Fire extinguishers _____ Windows _____ Windshield _____
Power-plant instruments _____ Are they properly marked? _____ Operate properly? _____
Flight instruments _____ Are they properly marked? _____ Ignition switches _____
Instrument lights _____ Fuses _____ Spare fuses _____ Fuses marked _____
Emergency exit _____ Door with lock to passenger compartment _____
Is pressure extinguisher installed? _____ Operating _____ Full _____
Control marked _____ Flare control properly marked _____
REMARKS: _____

CONTROLS (indicate condition of the following):

Engine controls _____ Propeller controls _____ Properly marked? _____ Friction locks _____
Control columns, sticks _____ Rudder bar, pedals _____ Control linkage _____
Cables _____ Bell cranks _____ Guides _____ Pulleys _____ Retainers _____
Sprockets _____ Bolts and clevises _____ Properly mounted and safetied? _____
Any looseness, binding, chafing, or interference in operation of controls? _____
Are stops provided for all controls? _____ Stabilizer, flap and tab controls _____
Properly marked for position and direction of control? _____
Worn or cracked bolts or fittings _____
REMARKS: _____

FUEL SYSTEM (indicate condition of the following):

Tanks securely mounted _____ Any signs of leakage? _____ Caps properly marked _____
Sumps drained and safetied _____ Vents open _____ Hose connections _____
Any sharp bends in fuel lines? _____ Lines properly supported _____ Signs of chafing _____
Grommet or liner through firewall _____ Sediment trap and strainer drained and safetied _____
Hose liners installed _____ Lines properly annealed _____
Fuel gages marked and working _____ Valves marked and working _____ Any leaks? _____
Fuel dumping mechanism operating properly _____ Properly marked _____
Filler necks protected to prevent gas overflow entering structure _____
Oil tanks securely mounted _____ Caps properly marked _____ Connections _____
Lines properly supported _____ Any indications of excessive oil leakage? _____
Oil radiator _____ Drain safetied _____
REMARKS: _____

PASSENGER COMPARTMENT (indicate condition of the following):

Seats _____ Safety belts _____ Windows _____ Ventilation _____ Heater controls _____
Fire extinguishers _____ First aid kit _____ Emergency exits _____
Gas fumes _____ Door hinges _____ Latch _____
REMARKS: _____

UNDERCARRIAGE (indicate condition of the following):

Shock units _____ Axles _____ Struts _____ Wheels _____ Tires _____ Pants _____
Fairing _____ Brakes _____ Brake cables, rods, and connections _____ Controls _____
Locking device _____ Fittings _____ Bolts, nuts, and clevises _____ Safetied _____
Signs of looseness or excessive wear in bolts and fittings _____
Retracting mechanism _____ Operating satisfactorily _____ Properly marked _____
Limit gages and warning signals operating and properly marked _____
Evidence of rust, corrosion, bends, dents, or other damage _____ Alinement _____
Was aircraft hoisted for checking condition of undercarriage? _____
REMARKS: _____

SECTION IV

FUSELAGE (indicate condition of the following):

Covering _____ Protective application _____ Tubing _____ Structure _____ Bulkheads _____
Floor _____ Landing gear fittings _____ Wing fittings _____ Tail surface
fittings _____ External brace fittings _____ Engine mount attachment fittings _____
Tail wheel or skid fittings _____ Welding _____ Bolts _____ Rivets _____
Cracked, loose, or worn fittings _____ Signs of rust, corrosion, bends, dents, or other damage to structure _____
Wrinkles in covering _____ Acid or excess oil on belly _____ Adequate open drains provided _____
Rotten wood in structure _____ Trash collected in tail _____ Proper protective application to structure _____
REMARKS: _____

TAIL WHEEL OR SKID (indicate condition of the following):

Shock strut _____ Wheel _____ Skid _____ Fittings _____ Tire _____
REMARKS: _____

WINGS (indicate condition of the following):

Left upper _____
Left lower _____
Right upper _____
Right lower _____
Spars _____ Ribs _____ Compression members _____ Drag trussing _____ Fittings _____
Bolts _____ Rivets _____ Internal structure _____ Protective application _____
Glue _____ Leading edge _____ Trailing edge _____ Wing tip former _____
Covering _____ Finish _____ Sewing _____ Rib stitching _____ Drains and grommets _____
External bracing _____ Flying and landing wires _____ Fittings _____
Bolts _____ Pins _____ All holes properly repaired _____
Signs of rust, corrosion, dents, wrinkles, or other damage _____ Position lights _____
Landing lights _____ Wiring _____ Lights properly mounted and secured _____
Operate satisfactorily _____
REMARKS: _____

AILERONS AND FLAPS (indicate condition of the following):

Left upper _____
Left lower _____
Right upper _____
Right lower _____
Spars _____ Ribs _____ Internal bracing _____ Glue _____ Bolts _____
Rivets _____ Protective application _____ Cover _____ Drains and grommets _____
Hinges _____ Leading edge _____ Trailing edge _____ Horns _____
Actuating mechanism _____ Any signs of rust, corrosion, wood rot? _____
Wrinkles, bends, dents, or other signs of damage _____ Condition of finish _____
REMARKS: _____

TAIL SURFACES (indicate condition of the following):

Stabilizer _____
Vertical fin _____
Rudder _____
Elevators _____
Spars _____ Ribs _____ Internal structure and bracing _____ Protective application _____
Glue _____ Bolts _____ Rivets _____ Covering _____ Drains and grommets _____
Protective application and finish _____ Hinges _____ Horns _____ Fittings _____
External braces _____ Actuating mechanism _____ Adjusting mechanism _____
Any signs of rust, corrosion, or wood rot? _____ Wrinkles, bends, dents, or other signs of damage _____
Bolts, nuts, pins, and rivets _____ Safetied _____
REMARKS: _____

SECTION IV

FLOATS AND SKIS (indicate condition of the following):

Skis ..... Material ..... Braces ..... Shock devices ..... Pedestal .....
Fittings ..... Bolts, nuts, and rivets ..... Alinement .....
Floats ..... Material ..... Internal structure ..... Protective application .....
Bolts, nuts, pins, rivets ..... External braces ..... Fittings ..... Cables .....
Rudders ..... Controls ..... External protective application .....
Any signs of rust, corrosion, wood rot? ..... Wrinkles, bends, dents, or other signs of damage .....
REMARKS: .....

MISCELLANEOUS (indicate condition of installation and maintenance of following):

Battery ..... Battery box ..... Drain ..... Vent .....
Adjacent protective application on structure ..... Flares ..... Installation .....
Controls ..... Number ..... Type ..... Lights ..... Wiring .....
Conduits ..... Switches ..... Markings ..... Antenna ..... Type .....
Bonding ..... Shielding ..... Loop ..... De-icers ..... Where installed? .....
.....
Number of seats having parachutes installed therein ..... Parachutes were last packed .....
Is wobble pump installed? ..... Operating satisfactorily? .....
Accessories, such as: Radio receiver, transmitter, etc., properly installed and secured .....
Are required equipment and accessories installed in accordance with provisions of Part 04 of the C. A. R., for the classification of certificate issued? .....
REMARKS: .....

REPAIR AND ALTERATION:

Have all replacements and repairs recommended as a result of this inspection been made in a satisfactory manner?
..... Describe: .....
.....
.....

Describe any other major repairs or replacements made to this aircraft since last inspected by a Civil Aeronautics Inspector .....
.....
.....

Describe any structural or equipment alterations which may have been made to this aircraft since last inspected by a Civil Aeronautics Inspector .....
.....
.....

Conformity of the above is established by .....
.....

Properly executed forms and information covering repairs and alterations listed above are attached .....
Were submitted to ..... Date .....

This inspection was conducted for the following reason:

Endorsement for continuation of certificate ☐
Endorsement following major repair ☐
Endorsement following major alteration ☐
At request of an inspector of the C. A. A. ☐
100-hour periodic inspection ☐

.....
(Signature of mechanic)

.....
(Rating and certificate number)

No copy required. Signed form to be turned over to aircraft owner or operator, or if Certificate is to be endorsed, submit to an inspector of the Civil Aeronautics Administration.

Additional sheets may be attached hereto where more space is required.

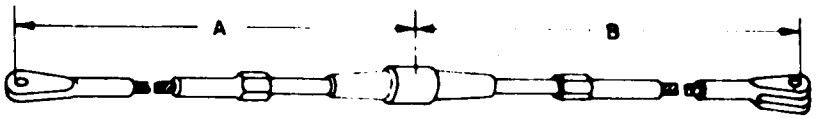
16—8179 U. S. GOVERNMENT PRINTING OFFICE

2. HEAT TREAT LIST.

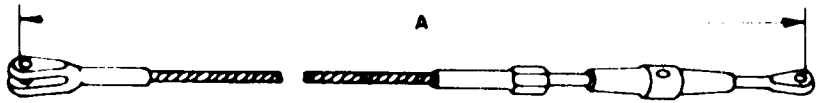
The airplane is constructed of 24ST aluminum alloy sheets, extrusions, bar and tubing. These materials are fabricated in accordance with U.S. Navy Specifications.

The following is a list of the heat treated parts:

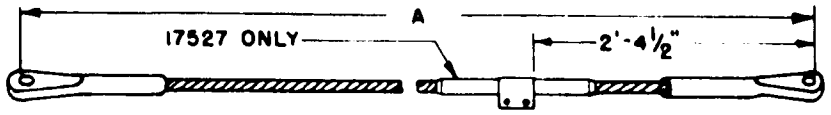
Part No.	*Name*	*H.T. psi*	*Material*
WING.			
17020-1	Support Fitting—Wing Front and Rear Beam	125,000	Chr. Moly. Steel
17020-2	Support Fitting—Wing Front and Rear Beam	125,000	Chr. Moly. Steel
17020-3	Support Fitting—Wing Front and Rear Beam	125,000	Chr. Moly. Steel
17020-4	Support Fitting—Wing Front and Rear Beam	125,000	Chr. Moly. Steel
17021	Fitting—Wing Hoisting Sling	125,000	Chr. Moly. Steel
17024-17	Splice Plate—Beam, Wing Center Section and Outer Panels	125,000	Chr. Moly. Steel
17024-20	Splice Plate—Beam, Wing Center Section and Outer Panels	125,000	Chr. Moly. Steel
17024-21	Splice Plate—Beam, Wing Center Section and Outer Panels	125,000	Chr. Moly. Steel
17024-25	Splice Plate—Beam, Wing Center Section and Outer Panels	125,000	Chr. Moly. Steel
17024-26	Splice Plate—Beam, Wing Center Section and Outer Panels	125,000	Chr. Moly. Steel
17041-2	Fittings—Wing Tip Float Connection	150,000	Chr. Moly. Steel
17041-3	Fittings—Wing Tip Float Connection	150,000	Chr. Moly. Steel
17578	Angle Clip—Wing Tip Float	150,000	Chr. Moly. Steel
LANDING GEAR—MAIN AND TAIL WHEELS.			
6646	Hook—Tail Wheel Latch	150,000	Chr. Moly. Steel
6654	Drag Link—Tail Wheel Assembly	125,000	Chr. Moly. Steel
6659	Bushing—Tail Wheel Torque Tube	125,000	Chr. Moly. Steel
6660-1	Plunger—Tail Wheel Swivel Stop	150,000	Chr. Moly. Steel
6669-1	Bushing—Tail Wheel Assembly	125,000	Chr. Moly. Steel
6669-3	Bushing—Tail Wheel Assembly	125,000	Chr. Moly. Steel
6669-4	Bushing—Tail Wheel End Strut	125,000	Chr. Moly. Steel
17067	Bushings—Aileron and Tail Wheel Bellcranks	125,000	Chr. Moly. Steel
17378-1	Fitting—Landing Gear Support	125,000	Chr. Moly. Steel
17278-2	Fitting—Landing Gear Support	125,000	Chr. Moly. Steel
17378-3	Fitting—Landing Gear Support	125,000	Chr. Moly. Steel
17378-4	Fitting—Landing Gear Support	125,000	Chr. Moly. Steel
17501	Axle Member—Landing Gear	180,000	Chr. Moly. Steel
17502	Truss—Landing Gear Lower Drag (Assem.)	150,000	Chr. Moly. Steel
17503	Link—Landing Gear Upper Drag	150,000	Chr. Moly. Steel
17504	Link—Landing Gear Compression	150,000	Chr. Moly. Steel
17509	Support—Landing Gear UP Catch	150,000	Chr. Moly. Steel
17516	Tube—Landing Gear Compression Link Support	125,000	Chr. Moly. Steel
17521	Terminal—Hyd. System L.G. Actuating Cylinder Lower	125,000	Chr. Moly. Steel
17523	Catch—Landing Gear Actuating Linkage	150,000	Chr. Moly. Steel
17528	Washer—Landing Gear Assembly	150,000	Chr. Moly. Steel
17551	Fork—Tail Wheel	150,000	Chr. Moly. Steel
17558	Blot—Tail Wheel Drag Link	125,000	Chr. Moly. Steel
MISCELLANEOUS			
17257-3	Stabilizer Strut—Adjustable End	125,000	Chr. Moly. Steel
17281	Bolt—Lower Rudder Hinge	125,000	Nickel Steel
17853	Pedal—Pilot's Rudder	125,000	Chr. Moly. Steel
17854	Pedal—Co-pilot's Rudder	125,000	Chr. Moly. Steel
17864	Pawl—Rudder Pedal Lock	125,000	Chr. Moly. Steel



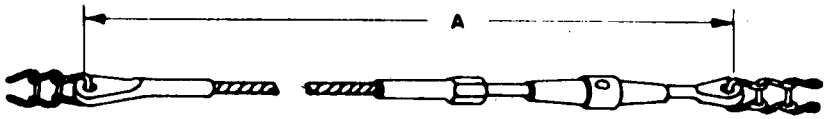
17975-1,-2,-3,-4,-12



17975-7,-8,-9,-15



17975-5,-6,-13,-14 & 17527



17975-10,-11

PART NO.	CABLE	A	B
17527	Landing Gear Up-Down Switch	6' 10¼"	
17925-1	Rudder—R.H.	12' 11"	11' 10"
-2	Rudder—L.H.	12' ½"	12' 8¼"
-3	Elevator—Upper	10' 1⅜"	12' 10¾"
-4	Elevator—Lower	15' ⅝"	11' 11¼"
-5	Column—R.H. Control	2' 3-15/16"	
-6	Column—L.H. Control	1' 9"	
-7	Aileron—Wing, Forward	14' 9⅝"	
-8	Aileron—Hull R.H.	14' ⅞"	
-9	Aileron—Hull L.H.	14' 7¼"	
-10	Rudder Tab	37' 3½"	
-11	Elevator Tab—L.H.	38' 10¼"	
-12	Elevator Tab—R.H.	6' ⅞"	13' 5½"
-13	Flap Indicator	9' 13/16"	
-14	Elevator Tab Indicator	1' 10-1/16"	
17975-15	Aileron—Wing, Aft	14' 10"	
17465	Chain, Control Column		

Note: #1 High Tensile Steel Boston Ladder Chain

TERMINAL	BARREL	TERMINAL	CABLE
1. AN668-2		2. AN668-2	1/16D—7 x 7
1. AN668-5 2. AN669-5S R.H.	AN155-32S	3. AN669-5S L.H. 4. AN667-5	5/32D—7 x 19
1. AN668-5 2. AN669-5S R.H.	AN155-32S	3. AN669-5S L.H. 4. AN667-5	5/32D—7 x 19
1. AN668-5 2. AN669-5S R.H.	AN155-32S	3. AN669-5S L.H. 4. AN667-5	5/32D—7 x 19
1. AN668-5 2. AN669-5S R.H.	AN155-32S	3. AN669-5S L.H. 4. AN667-5	5/32D—7 x 19
1. AN668-4		2. AN668-4	1/8 D—7 x 19
1. AN668-4		2. AN668-4	1/8 D—7 x 19
1. AN667-5 2. AN669-5S L.H.	AN155-32S	3. Turnbuckle Fork AN160-32S	5/32D—7 x 19
1. AN667-5 2. AN669-5S L.H.	AN155-32S	3. Turnbuckle Fork AN160-32S	5/32D—7 x 19
1. AN667-5 2. AN669-5S L.H.	AN155-32S	3. Turnbuckle Fork AN160-32S	5/32D—7 x 19
1. AN668-2 2. AN669-2 L.H.	AN155-8S	3. Turnbuckle Eye AN165-8SR	1/16D—7 x 7
1. AN668-2 2. AN669-2 L.H.	AN155-8S	3. Turnbuckle Eye AN165-8SR	1/16D—7 x 7
1. AN667-2 2. AN669-2 R.H.	AN155-8S	3. AN669-2 L.H. 4. AN668-2	1/16D—7 x 7
1. AN668-2		2. AN668-2	1/16D—7 x 7
1. AN668-2		2. AN668-2	1/16D—7 x 7
1. AN667-5 2. AN669-5S L.H.	AN155-32S	3. Turnbuckle Fork AN160-32S	5/32D—7 x 19

Figure 57—Cable Chart