ERECTION AND MAINTENANCE INSTRUCTIONS HANDBOOK

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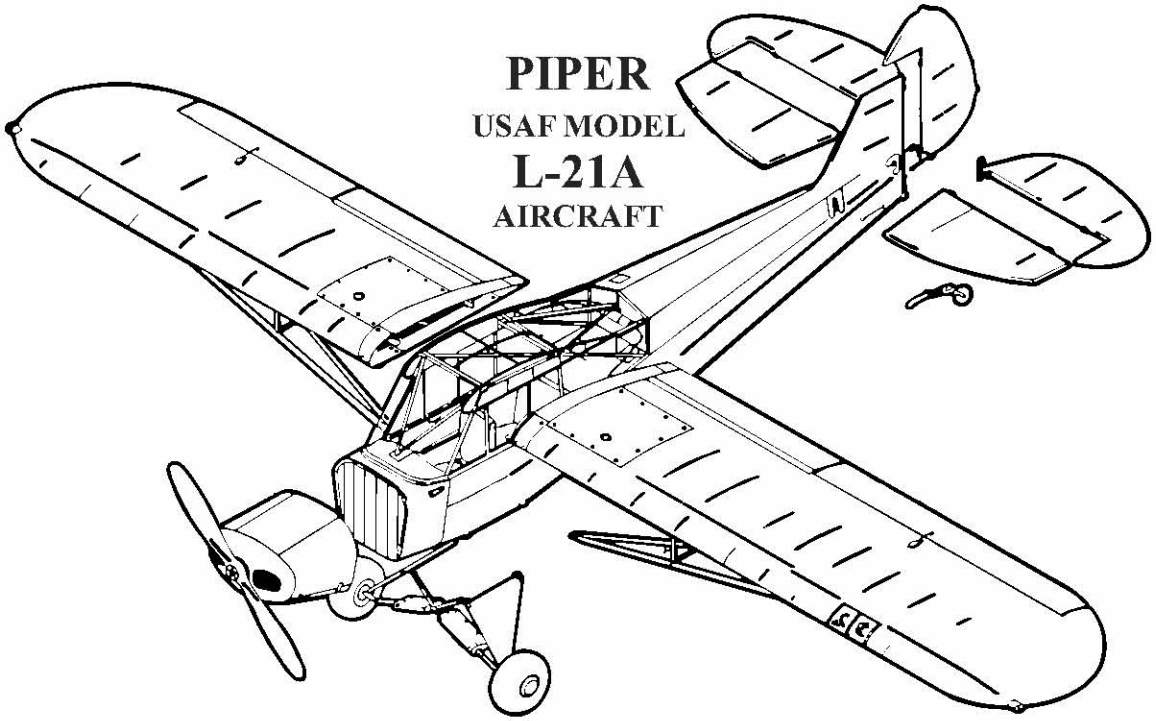

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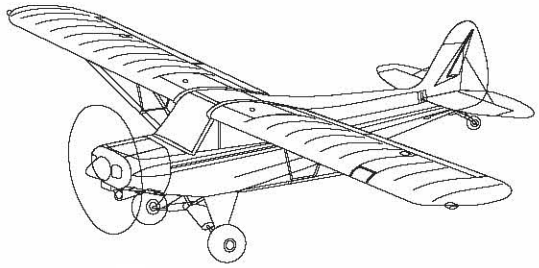

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INTRODUCTION

This Handbook of Erection and Maintenance instructions has been compiled to provide a source of field information for the L-21A airplane. It contains instructions for ground handling, maintenance, and general servicing procedures for the various systems and component parts of the airplane.

The L-21A airplane is manufactured by the Piper Aircraft Corporation, Lock Haven, Pennsylvania. The airplane is designed for duties such as front line reconnaissance and air observation missions to assist ground troops in combat operations. It is also adaptable for use in the training of pilots.

The first section contains general information such as dimensions, ground handling procedures, lubrication points, and servicing instructions. Sections II through VII describe procedures for the removal, installation, and field servicing of major components and systems of the airplane. Information for minor repairs and replacement of worn or damaged parts, together with adjustment and testing of these parts, is also provided in Sections II through VII. Remaining sections contain information relating to the electrical systems.

Reference should be made to the operational drawings and exploded views which supplement procedures given in the text.

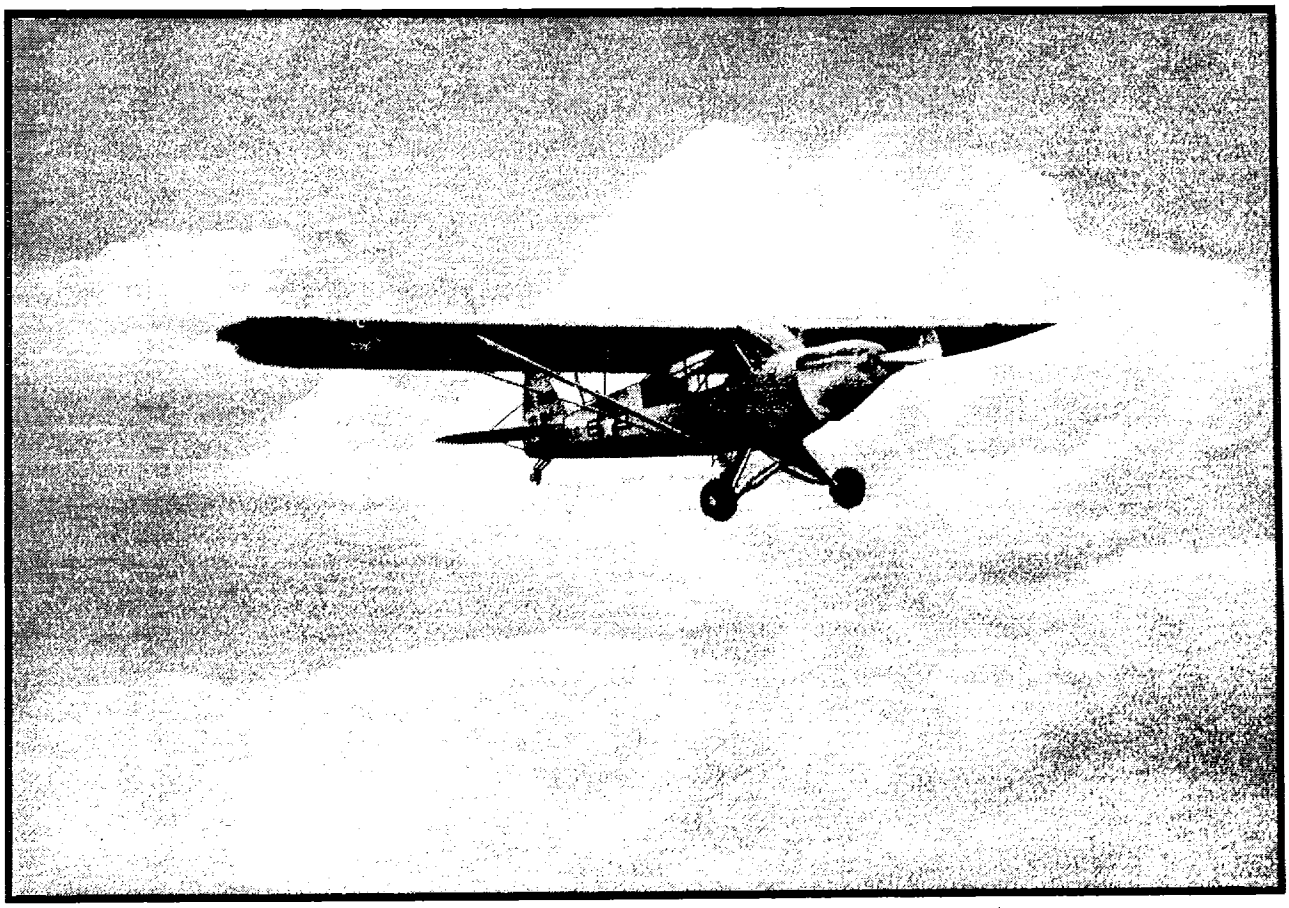

Figure 1-1. L-21A Airplane (Right Front Three-Quarter View)

SECTION I

GENERAL INFORMATION

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1-1. DESCRIPTION.

1-2. GENERAL. (See figures 1-1 and 1-2.) The L-21A is a two-place short range observation and liaison airplane manufactured by the Piper Aircraft Corporation.

1-3. The airplane is a light monoplane with high strut-braced wings equipped with flaps. The fuselage is of welded tubular steel, fabric-covered construction. The pilots' compartment enclosure is covered with transparent plastic sheets on the top and sides. The fixed split-vee type landing gear incorporates individually sprung, hydraulic brake equipped wheels. The wheels are mounted by low-pressure 8.00 x 4-inch tires. The steerable 8 x 3.00 tail wheel is mounted on steel spring leaves. Tail surfaces are conventional, with a manually controlled adjustment provided for the stabilizer.

1-4. The airplane is powered with a Lycoming O-290-D air-cooled, horizontally opposed engine. The engine is rated at 125 HP at 2600 RPM at sea level.

1-5. The directly driven, fixed pitch, Sensenich M76AM-2 metal propeller has a diameter of 6 feet 2 inches and a ground clearance of 10 inches in level flight position.

1-6. AIRCRAFT DIMENSIONS. (See figure 1-3.)

1-7. STATIONS AND FRAMES. (See figure 1-4.) Figure 1-4 illustrates the stations and frames of the airplane referenced from station zero to the opposite end of the particular structure in inches. With respect to the fuselage, station zero is at the edge of its cowl assembly. Station zero for the wing is an imaginary line drawn along the longitudinal centerline of the airplane.

1-8. ACCESS AND INSPECTION PROVISIONS. (See figure 1-5.) Provision is made for inspection access to the wings, drag wires, engine, tail, and those wing ribs which adjoin the fuselage in the pilots' compartment.

1-9. GROUND HANDLING.

a. Do not run up engine with the surface controls in a "LOCKED" position.

b. Avoid operating engine while towing equipment is attached.

c. Never have flight surface controls locked while towing or taxiing.

d. Do not set parking brakes while hot.

e. A special preflight inspection will be made before the aircraft is flown whenever control surfaces are caught by wind or propeller blast sufficient to cause violent movement against their stops, or driven abruptly to the limit of their travel under any condition.

NOTE

When all surfaces are so subjected to violent wind, controlling parts and mechanisms will be inspected for cracks or evidence of failure, i.e., hinges, hinge brackets, control horns, attachment of surfaces to torque tubes etc., with particular attention being paid to the possibility that rivets and bolts might have been sheared or become loosened. Necessary corrective action will be taken before the aircraft is flown.

1-10. HOISTING. Provision is made for hoisting the engine out of the airplane in the event major repair and overhaul becomes necessary. Once the engine is disconnected from the frame, it is hoisted out by a ring provided on the top of the engine casing. (See figure 1-6.)

1-11. PUSH POINTS. Wing struts are used as hand push points for moving the airplane on the ground.

1-12. LIFT HANDLE. The lift handle is the only lift point provided for on the L-21A airplane. (See figure 1-7.) The lift handle is located on the right hand side of the fuselage, just ahead of the stabilizer. It can also be used as an aid in steering. In order to move the airplane, grasp the lift handle firmly and lift up. One man can lift the airplane at this point.

1-13. JACKING. (See figure 1-7.) There are three jacking points on the L-21A airplane. Grasp the lift handle and raise the airplane a sufficient height to place a tripod or wooden horse under the tail wheel as indicated. Make sure that in raising the tail wheel, the propeller continues to clear the ground. Place jacks under the landing gear as indicated and raise to a sufficient height. Jacking both wheels simultaneously is to be avoided.

CAUTION

Do not attempt to jack the airplane at any point except as described in the preceding instructions.

1-14. LEVELING. (See figure 1-7.) Jack the airplane as indicated in the illustration and in accordance with instructions given in the preceding paragraph. Attach a plumb bob to the screw (7, figure 2-17) on the top channel door frame directly above the rear enclosure door hinge as illustrated. Adjust the plumb bob so that it clears the hinge and so that its supporting string

TABLE I. PRINCIPAL DIMENSIONS

(Aircraft in level flight position unless otherwise stated)

GENERAL	
Span	35 ft. -2-1/2 in.
Length (overall)	22 ft. -7 in.
Length (overall on the ground)	22 ft. -11 in.
Height	9 ft. -11 in.
Height (tail wheel on ground, propeller blade vertical at top)	7 ft. -11-3/4 in.
Propeller Ground Clearance	0 ft. -10 in.
Design Gross Weight	1500 lbs.
WINGS	
Type	Externally Braced, High Wing
Airfoil Section	USA 35B Mod at Root and Tip
Chord at Root	5 ft. -3 in.
Incidence - Root	$2^{o}2$ in.
Incidence - Tip	$1^{o}1$ in.
Dihedral (measured on underside of front spar)	$0^{o}45$ in.
Aspect Ratio	6.944
STABILIZER	
Span	8 ft. -9 in.
Maximum Chord	27 in.
Incidence	-2-1/2^{o}
Dihedral	0 ^{o}
FUSELAGE	
Width (maximum)	28 in.
Height (maximum)	52-1/2 in.
Length (without engine mount)	214-3/4 in.
Height of Door Level Above Ground (static)	36-1/4 in.
Door Dimensions	30 in. x 46 in.
Total Cubic Foot Stowage Space Available	4-1/2 cu. ft.
AREAS	
Wings	159.70 sq. ft.
Ailerons (total)	18.80 sq. ft.
Flaps (total)	11.5 sq. ft.
Stabilizers (including elevators)	15.90 sq. ft.
Elevators (two, including tabs)	14.10 sq. ft.
Fin	4.66 sq. ft.
Rudder (including tabs)	6.76 sq. ft.

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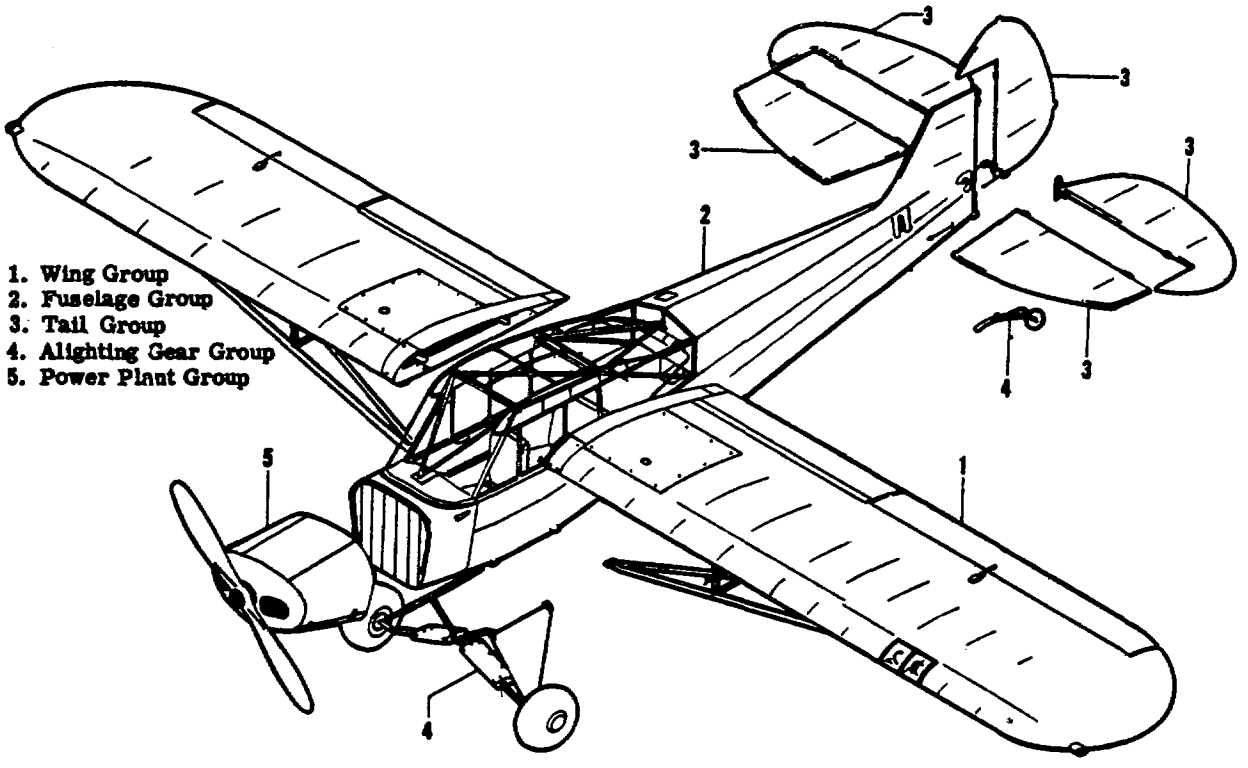

Figure 1-2. Major Components of Airplane

centers over the screw head. Level the airplane longitudinally by raising or lowering the tail until the plumb bob is laterally in line with the punch mark on the rear enclosure door hinge. Level the airplane laterally by raising or lowering either of the jacks supporting the landing gear until the plumb bob is centered over the punch mark on the rear enclosure door hinge as shown in figure 1-7.

1-15. MOORING. (See figure 1-8.)

a. If practicable, before tying down the airplane, position it so that tail is pointed into the wind.

b. Use mooring ropes that are 3/8-inch manila or larger.

c. Do not use slipknots in tying mooring ropes. Anti-slipknots, such as the square and/or bowline, will be used.

d. Allow only enough slack in mooring ropes to compensate for tightening action due to moisture absorption.

e. Use kit-mooring, part No. AN8015-2, stock No. 8200-416300, Class 19-A (which contains components in sufficient quantity to establish 15 mooring points) when tie-down rings are not available on hard surface areas and aircraft is moored where use of kit is necessary. Tie-down kit D-1, furnished in original loose equipment, may be used.

f. Place wheel chocks fore and aft of both front wheels.

g. Install spoilers of the fabric bag type, part No. 43D22262, stock No. 9900-43D22262, filled with sand or facsimile, when prevailing or forecast velocities of surface winds or gusts are expected to attain or exceed 30 mph.

NOTE

Spoilers should extend approximately 75 per cent of the wing span, starting at the wing butt, and should be located 10 to 15 per cent of the average chord aft and parallel to the leading edge of the wing. Spoilers will be tied securely, and positioned with flat twill tape, Class 21-A. Exercise care and allow for tightening action due to moisture absorption to prevent damage to surfaces.

h. Additional mooring ropes and stakes (one at each mooring position, see figure 1-8) will be added when conditions exist as mentioned in NOTE above. Stakes will be driven a suitable distance apart to give maximum tie down security.

i. Consult TIO. 1L-21A-7 and the applicable appendix thereto when aircraft are being moored for storage purposes.

1-16. PARKING is defined as the condition under which aircraft will be secured while on the ground.

a. Position airplane with tail into wind and lower the flaps to prevent buffeting.

b. Hold pressure on both brake pedals and lock brakes by pulling backward both parking brake control rods located below the front seat.

c. Disengage the control stick lock assembly from its spring retaining clip under the instrument panel. Swing the lock assembly from under the panel and secure it over the forward control stick. This will lock the forward control stick.

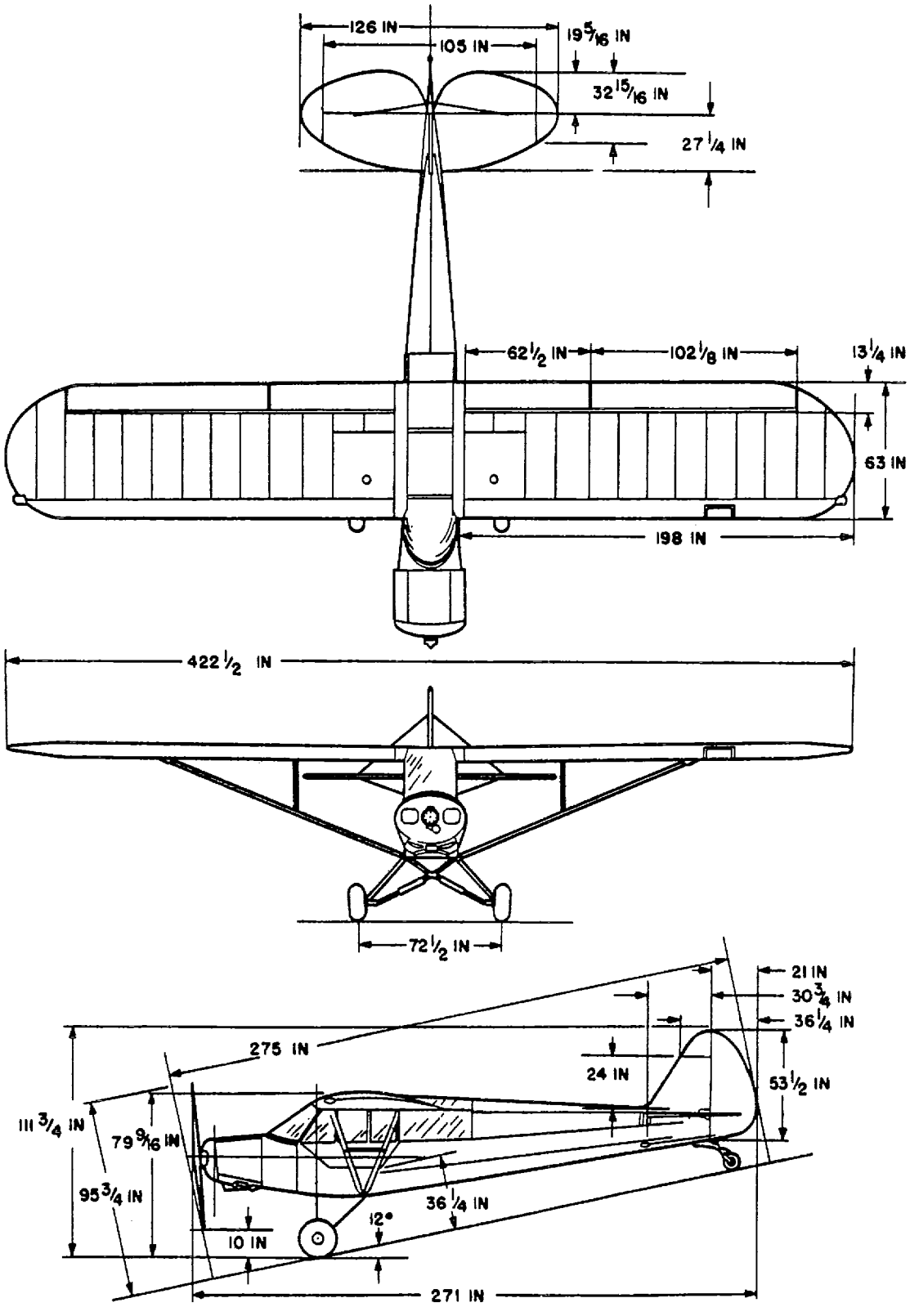

Figure 1-3. Aircraft Dimensions

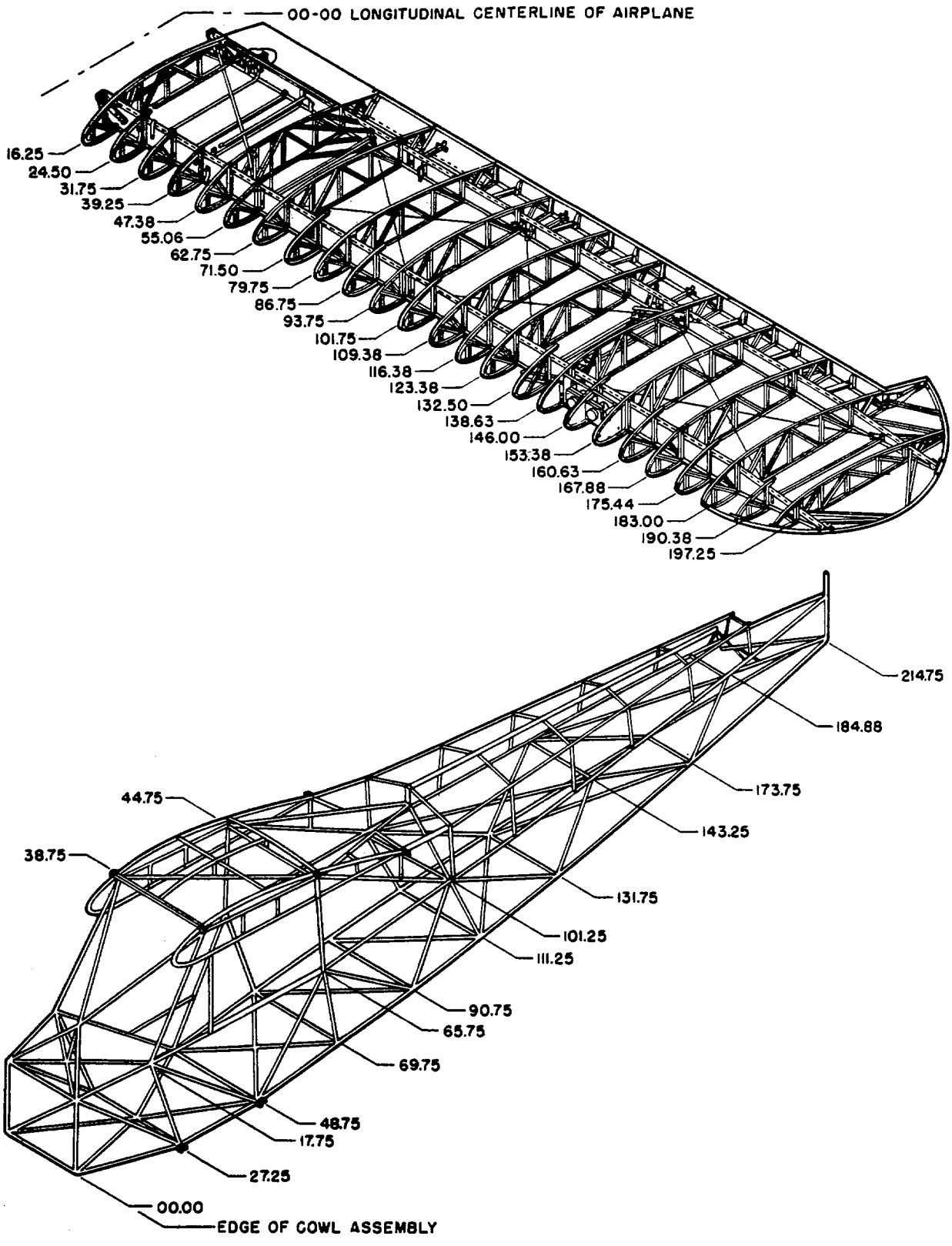

Figure 1-4. Station and Frames Diagram

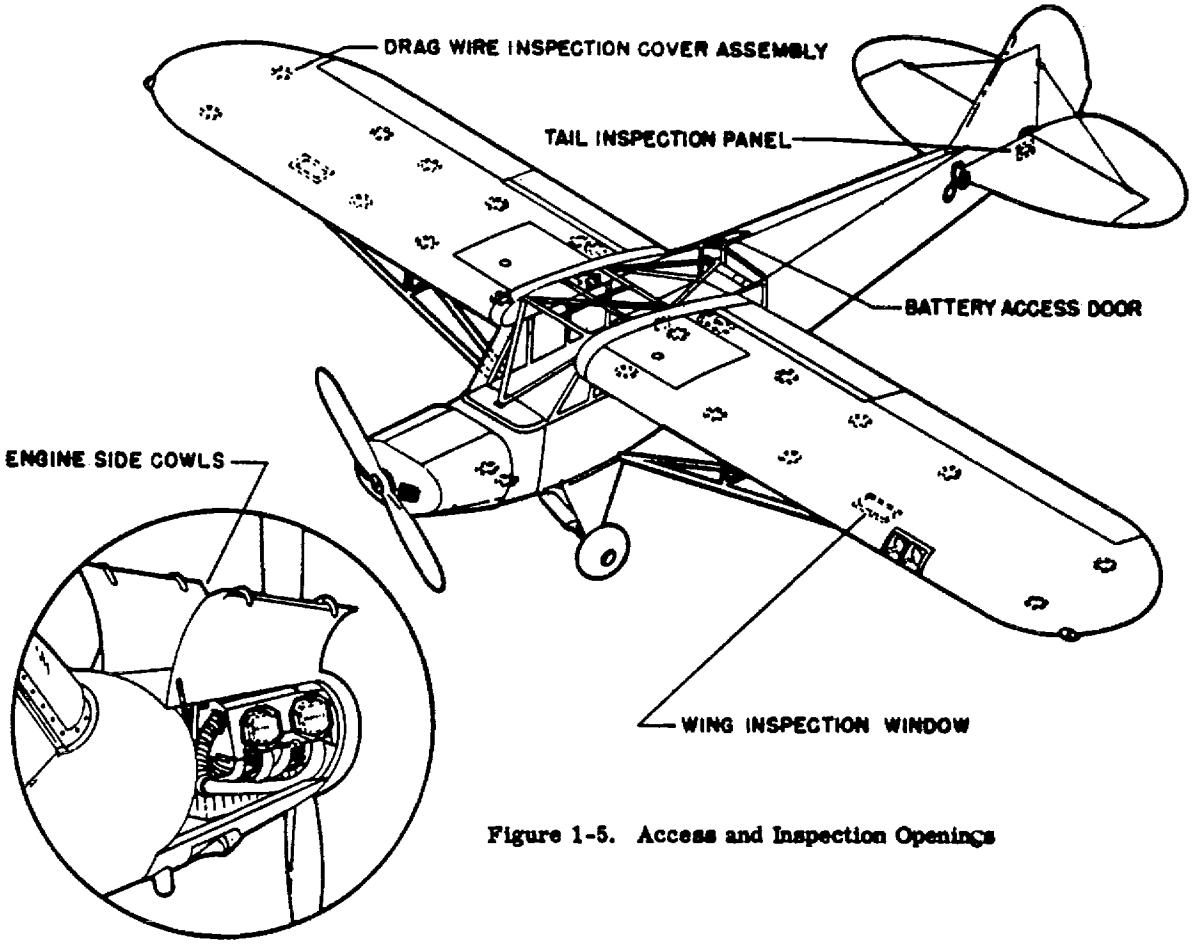

Figure 1-5. Access and Inspection Openings

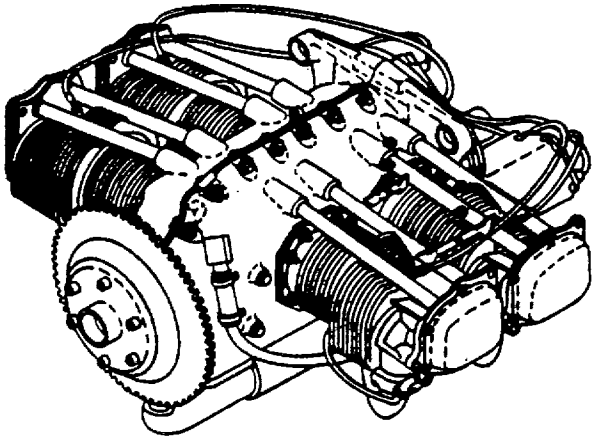

Figure 1-6. Location of Hoisting Ring on Engine

d. Turn fuel shut-off control to "OFF" position.
e. Turn throttle control arm to "CLOSED" position.
f. Turn ignition switch to "OFF" position.
g. Push carburetor heat control rod to "OFF" position.
h. Push cabin heat control rod in.
i. Chock both front wheels.

1-17. TOWING.

a. Care will be taken if towing becomes necessary as there are no towing eyes, lugs, or rings by which an L-21A aircraft can be towed in the conventional manner. See that the propeller, fairings, and other parts of the aircraft are not damaged.

NOTE

The length of the tow ropes will be long enough to clear the nose and/or tail by not less than 15 feet. This extra length is required to preclude the aircraft over-running the towing vehicle.

b. Place a qualified person in the cockpit when an aircraft is being towed in order to maintain control by use of the brakes.

c. Keep towing speeds slow, avoiding sudden starts and stops, especially over snow, ice, rough, soggy, or muddy terrain. Avoid short turns and always keep the inside wheel turning while towing.

d. Do not operate engine or have the control surfaces in the locked position while towing the aircraft.

e. When a towing vehicle is not used, the aircraft is moved on the ground by using the wing struts as hand push points.

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1-17A. PARKING. Parking is defined as the condition under which aircraft will be secured while on the ground. These conditions are based on gross weight and corresponding wind velocity. (See Table I.)

1-17B. When prevailing or forecast velocities of surface winds or gusts do not exceed the values shown in Table I, and the corresponding gross weight of the aircraft is equal to or greater than shown therein, the procedures prescribed under Condition "A" will apply.

1-17C. When velocities of surface winds or gusts are forecast or prevail which exceed the values of Table I, and the corresponding gross weight of the aircraft is less than shown therein, the procedures prescribed under Condition "B" will apply.

1-17D. When the aircraft is not in extended parking status (storage), and facilities or personnel are inadequate to moor the aircraft in accordance with Condition "B," the aircraft will be evacuated to a safe weather area.

1-17E. When parking, the aircraft will be positioned to provide adequate clearance for maintenance, servicing, and fire lanes, and will be moored not closer than 750 feet from the center line of landing strips. The aircraft will not be parked in areas that are in line with or extending beyond the ends of such landing strips within the flying field boundaries, and will not be closer than 250 feet from the farthest edge of connecting taxi strips. Aircraft will be spaced slightly more than wing span distance from adjacent aircraft. At the discretion of the Commander, aircraft may be parked closer when sufficient space is not available.

a. Chock the main wheels, using one-piece wood chocks. See paragraph 1-17I.b.

b. When mooring the aircraft with rope, anti-slip knots only will be used. (See figure 1-8A.)

1-17F. PARKING BRAKES.

NOTE

Allow the brakes to cool before setting the parking brakes.

a. Position the aircraft by heading it into the wind, unless this is considered not practical. There should be at least wing span distance between adjacent aircraft.

b. Apply pressure on brake pedals, and lock the brakes by pulling back on the parking brake control rods which are located below the front seat.

c. After the aircraft has been taxied to the location for parking and mooring, and the aircraft has been positioned, the following will be accomplished:

(1) Turn fuel shut-off valve control to "OFF" position.

(2) Turn the throttle control arm to "CLOSED" position.

(3) Place ignition switch in the "OFF" position.

(4) Push carburetor heat control to the "OFF" position.

(5) Push cabin heat control rod forward.

1-17G. CONTROL SURFACE (LOCKING).

a. The elevator and aileron surfaces are simultaneously locked by disengaging the control stick lock assembly from the spring retaining clip which is located under the instrument panel. Swing the lock assembly from under the panel and secure it to the forward control stick, thus locking the elevator and aileron surfaces.

b. Lock the rudder control surfaces by using ropes of sufficient length to tie down each rudder pedal in the rear seat to the legs of the forward sea .

c. Retract wing flaps, if extended.

d. Fill all fuel tanks to capacity, if time permits. This will serve as added ballast and assist in anchoring the aircraft to withstand increased wind velocities.

1-17H. MOORING PROVISIONS.

a. A tie-down ring is provided on the forward lift strut assembly at the strut to the wing attaching points (Station 132.50) of each wing panel.

b. The tail wheel spring is utilized as a tie-down point although a tie-down ring is not incorporated.

1-17I. MOORING EQUIPMENT. Equipment necessary to moor the aircraft, in addition to the standard driving tools, consists of:

a. Mooring cables, manufactured locally of 1/4-inch aircraft cable and clamps, stock No. 6700-195150, 1/4-inch clip-wire rope, or 5/8-inch rope. The length of the mooring cables or ropes will be dependent upon existing circumstances.

b. One-piece wheel chocks, locally manufactured from wood, will be necessary to chock the main landing gear wheels. The chocks will be equipped with rope or wood cleats to prevent them from being blown away from the tire.

NOTE

When conditions comparable to arctic conditions prevail, wheel collapsible chock assembly, Type A-1, stock No. 8200-159006, AF Drawing No. 50D6602, will be used. Sandbags may be used in place of chocks when parking or mooring the aircraft on steel mats or when required chocks are not available.

c. Spoilers of the fabric bag type, stock No. 9900-43D22262, part No. 43D22262, or the wooden type consisting of 2 x 4's which, when lying flat, should be

secured in place with flat twill tape to prevent damage to wing surfaces.

d. Mooring kits, part No. AN8051-2, stock No. 8200-416300, Type D-1, are used as follows: Anchor, part No. 36A4468, is screwed into the arrow, part No. 36A-4467, and driving rod, part No. 36B4466, is placed over the anchor rod and into the socket of the arrow. The cam on the driving rod will be turned so that the prongs of the arrow will not be spread by driving. If the ground is hard, the surface will be broken by using the ground breaking pin, part No. 38B3323. Care will be taken to align the rod with the point of attachment on the aircraft. The arrow will be driven into the ground until the anchor rod mooring eye is approximately 3 inches off the ground. The driving rod handle should then be rotated 90° and the driving rod given a sharp blow to spread the prongs of the arrow. The driving rod is then turned to the driving position and withdrawn. The squared socket of the eye assembly, part No. 36A4469, will then be aligned with the squared end of the anchor rod, fitted into place, and the knurled nut screwed down until a minimum of 1/8-inch of the squared end of the anchor is protruding into the inside diameter of the eye assembly. The mooring cables or ropes will then be secured as prescribed in this technical order. To withdraw the anchor rod, detach the mooring ropes, free the anchor rods from the arrows by turning the ring of the eye assemblies counterclockwise and remove the rods from the ground.

NOTE

When kit, part No. AN8015-2, is not available, metal stakes or dead-man type anchor may be used, providing a pull of 3,000-pounds minimum may be sustained without failure on such installed anchor.

1-17J. MOORING PROCEDURE (CONDITION "A").

a. Attach the mooring cable or rope, whichever is available, to the tail wheel spring assembly (see figure 1-8) and the tie-down ring of the ground mooring anchor. The ground mooring anchor will be located as closely as possible to the tailwheel assembly. Make certain that as little slack or backlash as possible exists in the cable.

b. Attach a separate mooring cable or rope to the tie-down ring located at each lift strut assembly. (See figure 1-8.) Connect the cable or rope to the ground mooring anchor located approximately 3 feet toward the wing tip.

1-17K. MOORING PROCEDURE (CONDITION "B").

NOTE

The following mooring procedures are applicable when the aircraft is being parked for an extended period of time and when the conditions of Chart I are exceeded. All procedures of Condition "A" apply also to Condition "B." (See paragraph 1-17.)

a. An additional mooring cable or rope will be added to each wing. The ground mooring anchors will be located fore and aft of the wing. The cables will be at an angle of approximately 45° to the ground.

NOTE

If cable or chain is not available, manila rope of not less than 3/8-inch may be used. Larger rope, however, will be used when available. Allow enough slack in mooring to compensate for tightening action due to moisture absorption.

CAUTION

Do not use slip knots. Use either square or bowline knots. (See figure 1-8A.)

b. The tail wheel will have two tie-down cables. The ground anchors will be located as closely as possible to the right and left sides of the tail wheel.

c. Spoilers will be added to each wing. They will extend approximately 75% of the wing span, starting at the wing butt, and will be located 10 to 15% of the average cord aft and parallel to the leading edge of the wing. Spoilers will be tied securely, and positioned with flat twill tape. Allow for tightening action due to moisture absorption to prevent damage to surfaces.

d. Disconnect battery.

e. Close all access doors and windows.

f. Install protective covers.

g. Secure all maintenance stands and loose equipment.

NOTE

After high winds and propeller blast sufficient in magnitude to cause violent movement of control surfaces against their stops, a special preflight inspection will be accomplished. Check all surface controls throughout their full range of travel. Controlling parts and mechanisms will be inspected for cracks or evidence of failure, i.e., hinges, hinge brackets, control arms, and attachments of surfaces to torque tubes, etc., with particular attention given to the possibility that rivets and bolts might have been sheared or become loosened. Inspect the aircraft for damage from flying debris. Necessary corrective action will be taken before aircraft is flown. If winds are expected to be in excess of 50 knots per hour, the aircraft will be flown out or hangared.

1-18. SERVICING.

1-19. FUEL. The L-21A airplane is equipped with two wing tanks, one in each wing. (See figure 1-9.) Each tank has a capacity of 18 US gallons, 14.9 Imperial gallons, or 68.1 litres. Refer to table II for fuel specifications.

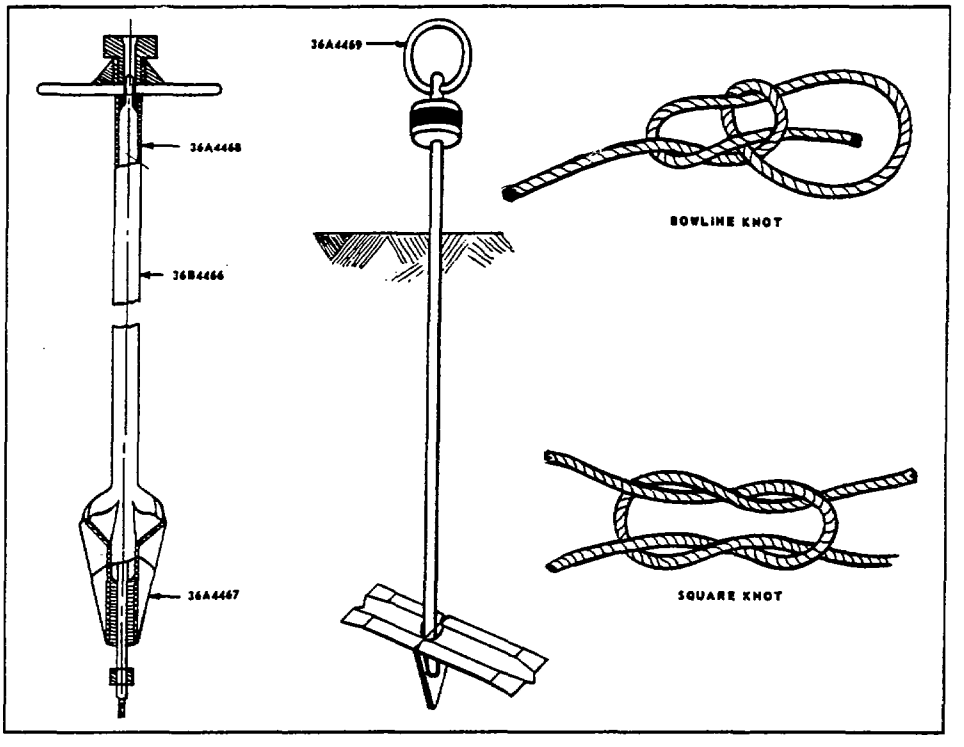


Figure 1-8A

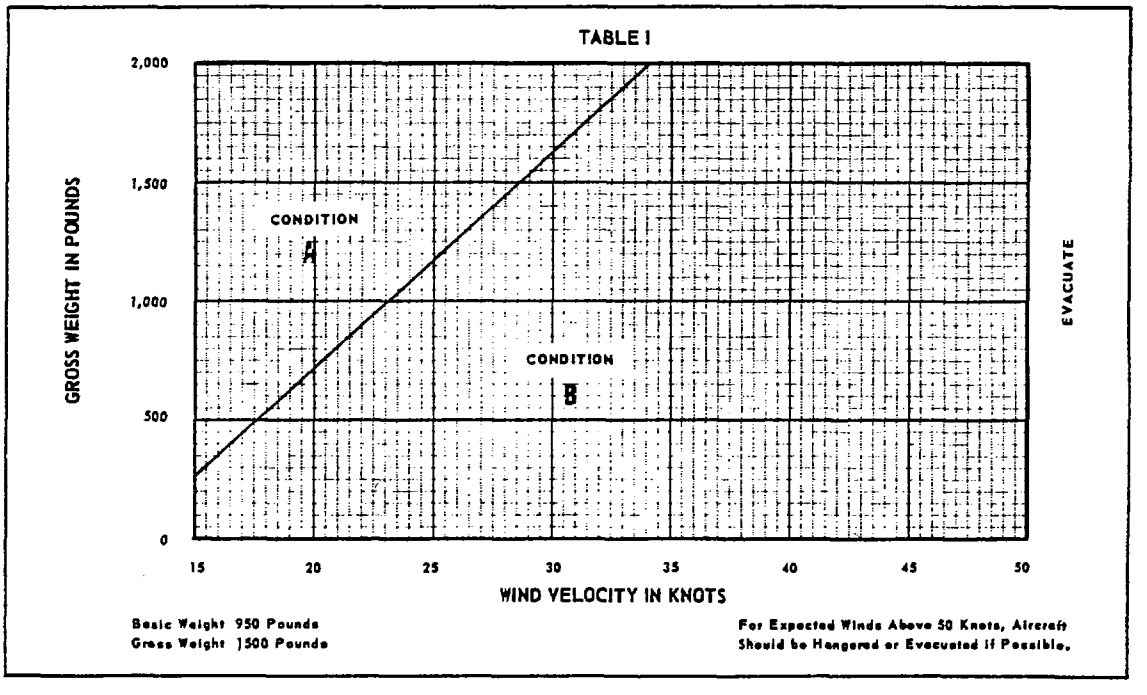


TABLE II. SERVICING CHART

MAIN GEAR

Type	Split Axle, Non-Retractable
Tread	6 ft. -1/2 in.
Wheels	8.00 x 4
Tires	8.00 x 4
Tire Inflation Pressure	18 lbs.
Brake Fluid	Univis 40 (MIL-0-5606)

TAIL GEAR

Type	Steerable, Spring Mounted
Wheel	8 in.
Tire	8 x 3.00
Tire Inflation Pressure	50 lbs.

ENGINE

Manufacturer and Model Number	Lycoming 0-290-D
Gear Ratio	Direct Drive
Fuel	80 Octane (MIL-G-3056)
Oil	Grade 100 and 1080 (MIL-0-6082)
	Use SAE-50 Above 40 degrees F.
	Use SAE-40 30-75 degrees F.
	Use SAE-30 10-55 degrees F.
	Use SAE-20 Below 30 degrees F.

PROPELLER

Manufacturer and Model Number	Sensenich M76AM-2
Type	Metal
Diameter	6 ft. -2 in.
Pitch Setting	Fixed Pitch

TANK CAPACITIES

Fuel	37 US gals., 30.82 Imperial gals.
Engine Oil	2 US gals., 1.66 Imperial gals.

WARNING

Before removing a gas tank filler cap, make certain that the airplane and gas supply nozzle are electrically grounded. After filling a gas tank, remove the nozzle and replace filler cap before disconnecting electrical ground connections. The grounding receptacle is located 6 inches under the leading edge of the left wing and 1½ inches from the fuselage.

a. Alcohol *will not* be added to aviation fuels for use in aircraft regardless of the type of fuel cells or tanks installed. Addition of approved type alcohol to the fuel system by means of the de-icing system for the filter to engine control and the engine water injection system is acceptable, but under no circumstances will alcohol be added to the fuel system via the fuel cells or tanks.

1-20. FUEL DRAINS. There is one fuel drain plug to each wing tank. (See figure 1-9.) Each drain plug is located on the underside of the wing and is secured to the tank with a cotter pin.

NOTE

Before the first flight of the day, draw off a few ounces of fuel from each tank to remove any water and sediment that may have collected. After draining, make certain that the cotter pin is reinserted through the drain plug.

1-21. ENGINE OIL. Before each flight, measure the quantity of oil in the engine with the engine oil level gage. (See figure 1-9.) Add oil as required through the oil filler opening. Engine oil may be drained by removing the oil sump plug located beneath the engine crankcase. (See figure 1-9.) Refer to Table II for oil specifications.

NOTE

In cold weather it is recommended that the engine oil be drained after the last flight of the day. Keep the oil warm and re-use it before the next flight.

1-22. BRAKE SYSTEM. Check the fluid level in each brake master cylinder. (See figure 1-9.) Add brake fluid to overflow point, as required. See Table II for

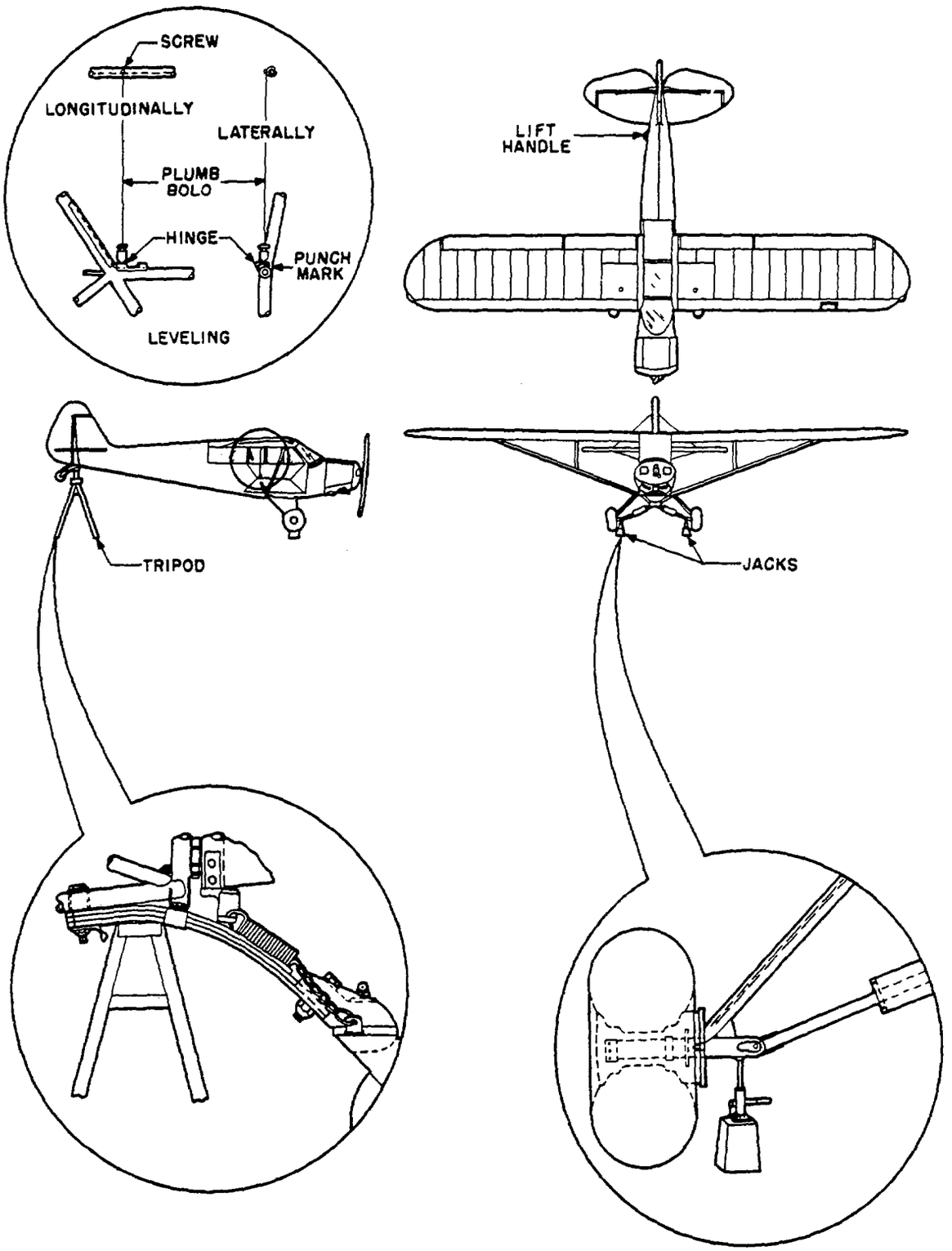


Figure 1-7. Jacking and Leveling Airplane

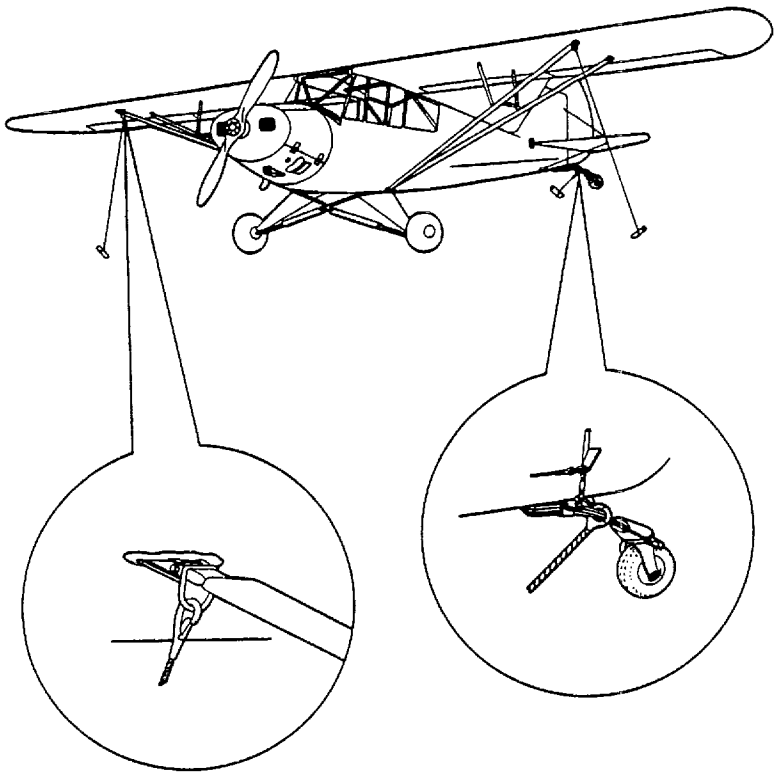


Figure 1-8. Tieing Down the Airplane

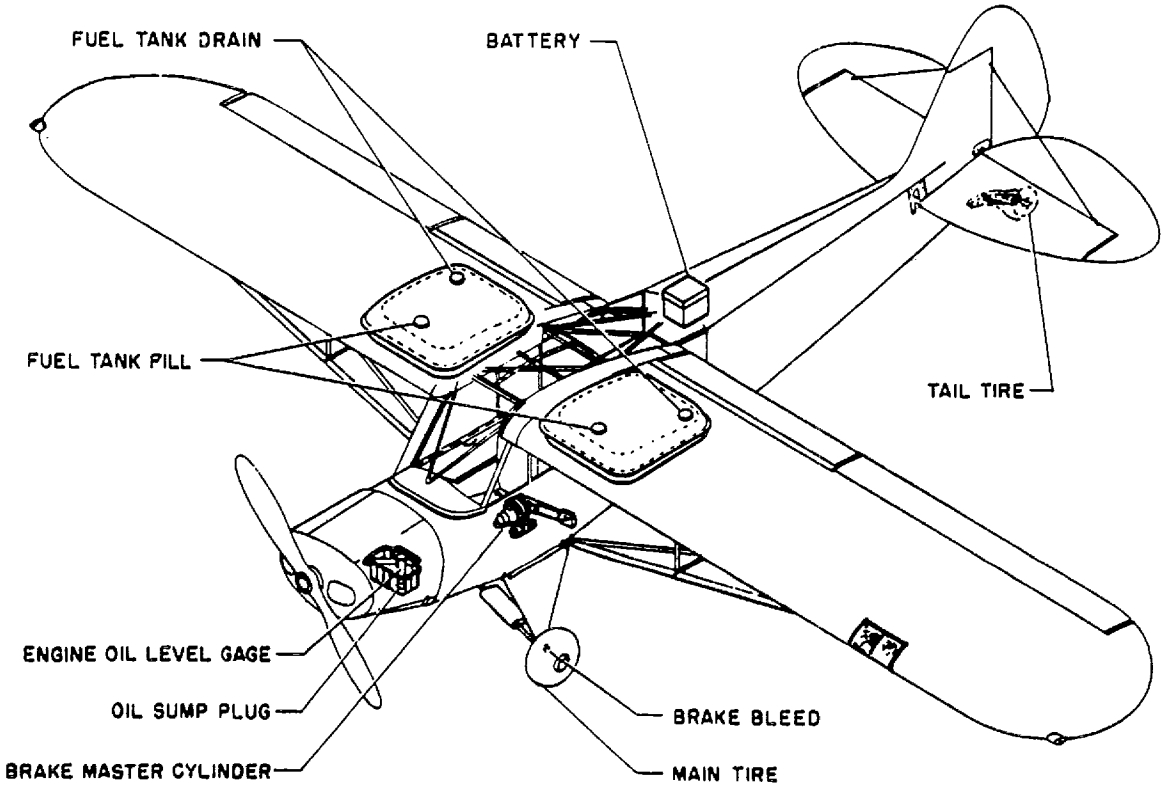
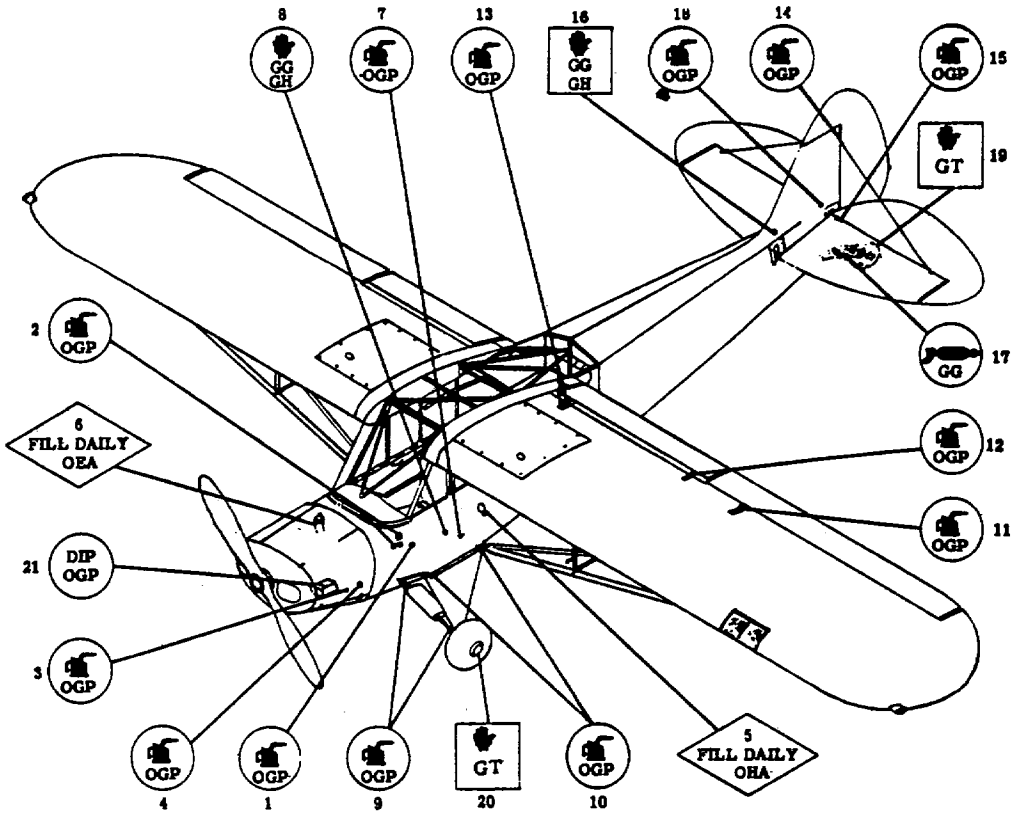


Figure 1-9. Servicing Points on the Airplane



SPECIAL SERVICE NOTES

FITTINGS. Clean fittings before and after lubricating. Lubricate until new grease appears at the part being lubricated.

PIANO TYPE HINGES. Lubricate piano type hinges every 500 hours with general purpose oil, Specification AN-0-6. Remove excess oil.

CONTROL SYSTEM PULLEY BEARINGS. Lubricate all control system pulley bearings every 100 hours with general purpose oil, Specification AN-0-6. Remove oil.

FLEXIBLE CONTROLS. Lubricate flexible control cables every 1000 hours with general purpose oil, Specification AN-0-6.

FREQUENCY SYMBOLS

Daily ◇ 100/120 Hours ○ 250 Hours □

APPLICATION SYMBOLS

Alemite Gun — Oil Can — Hand

TABLE OF LUBRICANTS

Identification Letter	Basic Specification	Type of Lubricant
GH	AN-G-5	Grease; Water Resistant
GG	AN-G-6	Grease; Lubricating, Graphite
OGP	AN-O-6	Oil; General Purpose, Low Temperature
OHA	MIL-O-5606	Oil; Hydraulic, Aircraft Petroleum Base
OEA	MIL-O-6082	Oil; Lubricating, Aircraft Engine
GT	MIL-L-3545	Grease; Lubricating, High Temperature

PARTS NOMENCLATURE KEY

1. Torque tube bearing
2. Control stick bearings
3. Rudder pedal bearings
4. Brake pedal bearing
5. Brake master cylinders
6. Engine oil system
7. Flap handle bearing
8. Flap handle ratchet
9. Shock strut pivots
10. Landing gear hinges
11. Aileron hinge bearings
12. Flap hinge bearings
13. Flap bell crank and push rod bearings
14. Rudder hinge bearings
15. Elevator hinge bearings
16. Stabilizer adjustment screw
17. Tail wheel full-swivel steering arm
18. Stabilizer connector tubes
19. Tail wheel bearings
20. Landing gear wheel bearings
21. Carburetor air filter

Figure 1-10. Lubrication Chart

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brake fluid specifications. If, after adding brake fluid, one or both brake pedals act soft or spongy when depressed, the faulty hydraulic line must be bled to remove entrapped air. Refer to paragraph 2-97 for instructions on performing this operation.

1-23. BATTERY. The battery is located to the rear of the pilots' compartment. (See figure 1-9.) Remove battery box lid and check all leads for tightness and corrosion. Inspect each cell for level and specific gravity of the electrolyte. The specific gravity of the electrolyte must be maintained between 1.275 and 1.300. If this value falls below 1.240, remove the battery and recharge it. The level of the electrolyte must be maintained at 1/4-inch above the plates. Add distilled water if necessary; but add distilled water only before the airplane is to be used so that the battery will be recharged.

NOTE

Any corrosion due to action of the electrolyte can be removed by using a solution of sodium bicarbonate and water.

1-23A. REMOVAL OF BATTERY. When removing battery from the aircraft, disconnect battery ground cable from the negative terminal post first, as a precaution against fire resulting from electrical arc.

1-24. LUBRICATION REQUIREMENTS. Complete lubrication requirements for the L-21A airplane are shown in the lubrication diagram. (See figure 1-10.) This diagram indicates the lubrication point, type of component requiring lubrication, method of application, and lubrication intervals. Before adding or applying lubricant, make certain that surrounding areas are clean. After lubricant has been applied, wipe all excess oil or grease from the surrounding areas with a clean cloth.

1-25. SPECIAL TOOLS. There are no special tools provided with the L-21A airplane.

1-26. SAFETY PRECAUTIONS. When using an approved cleaning solvent to remove grease and oil from parts, observe all safety regulations, etc. Be sure to wear protective gloves when cleaning parts with approved solvents.

SECTION II

AIRFRAME GROUP

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2-1. WING.

2-2. DESCRIPTION. (See figure 2-1.) The wing consists of an externally-braced high wing monoplane structure incorporating two extruded aluminum spars. The left wing panel contains a landing light. The wing panels are fabric covered. The fabric is attached to the ribs by conventional rib stitching. The wing incorporates slotted wing flaps inboard of the ailerons.

2-3. DRAG BRACING. Drag bracing consists of steel and aluminum tubular compression struts and round adjustable steel tie-rods.

2-4. WING RIBS. Wing full ribs and other special-purpose ribs are fabricated according to varying design to accomplish support at given points on the wing panel. The function and design of wing ribs are given by their descriptions in the legend for figure 2-1. The wing full ribs are fabricated of drawn sections of aluminum alloy riveted into a truss-type structure and are attached to the spars by means of self-tapping sheet metal screws.

2-5. LEADING EDGE. The leading edge is covered with a light gage aluminum alloy sheet. It extends back to the front spar on the upper and lower surfaces from the inboard rib to the strut attachment point and about halfway to the front spar on the upper and lower surfaces from the strut attachment point outboard to the tip rib.

2-6. WING-TIP BOW. The wing-tip bow consists of a formed ash strip attached to the front and rear wing spars by means of steel fittings. This member is also secured to the aluminum leading edge and to the trailing edge of the wing-tip rib and wing aileron outboard rib.

2-7. WING FALSE SPARS. The wing false spars are constructed of aluminum alloy and are secured to the wing ribs. The false spars consist of an inboard and outboard section on each wing panel.

2-8. AILERON HINGE BRACKETS. Aileron hinge brackets are constructed of steel channels and are bolted to the rear wing spar.

2-9. SPAR FITTINGS. Spar fittings for attachments at the wing root are constructed of aluminum extrusions, while at the strut points they are constructed of strip steel.

2-10. LIFT STRUTS. (See figure 2-4.) The lift strut installation consists of front and rear members constructed of streamlined steel tubing, with welded attachment fittings in the ends. A jury strut system is also used to reduce the column length of the strut bracing structure.

2-11. WING FLAPS. (See figures2-2 and 2-3.) The fabric-covered slotted wing flaps are located inboard of the ailerons and are constructed of riveted aluminum alloy. A channel runs the length of each flap to serve as the main support to which are attached wing ribs, hinges, horn fittings, and cover. The fabric cover is stitched to the wing ribs. Downward movement of the flap is controlled by means of a flexible steel control cable which runs from a bellcrank in the wing to a flap control lever located in the left side of the cockpit adjacent to the pilot's seat. (See figure 2-19.) By moving the flap control lever to the rear, the flap is lowered and held in position by a flap lever ratchet. The ratchet is located at the base of the flap control lever and is actuated by means of a push button on the top of the lever. Moving the flap control lever forward automatically raises the flaps by means of a spring attached between the bellcrank arm and the rear wing spar. Maximum flap travel is 50 degrees down.

2-12. REMOVAL OF WING PANELS AND LIFT STRUTS. To accomplish removal and installation properly, three men will be required for the handling of a wing panel. If only the lift struts are to be removed, follow the instructions of steps e, g, h, i and j (below) and support the wing panel at the outboard portion with a brace. If the left strut is to be removed, disconnect air bleed fitting on the left front jury strut. To remove the wing panels and lift struts, proceed as follows:

a. Remove the front wing root fairing (3, figure 2-3), wing root upper fairing (7), lower wing root fairing (5), and lower rear wing root fairing (10) from the wing root.

b. Drain the fuel tank (66) and disconnect the fuel supply and vent lines (13, 16, and 17) at the wing root. Remove the fuel gage assembly (21 through 29). Cover all exposed ends of tubing with tape to prevent contamination of the fuel lines with dirt or debris.

c. Disassemble cockpit upper right trim panel (23, figure 2-16) and upper left trim panel (24) from the fuselage structure. It will be necessary to remove the cockpit light (52, figure 7-1), switch panel (31), and landing light switch panel (21) when removing the right wing panel assembly. This is accomplished after removal of the upper right trim panel.

d. Disconnect the air bleed fittings at the wing root and at the left front jury strut respectively if the left wing panel assembly is to be removed. (See figure 6-2.)

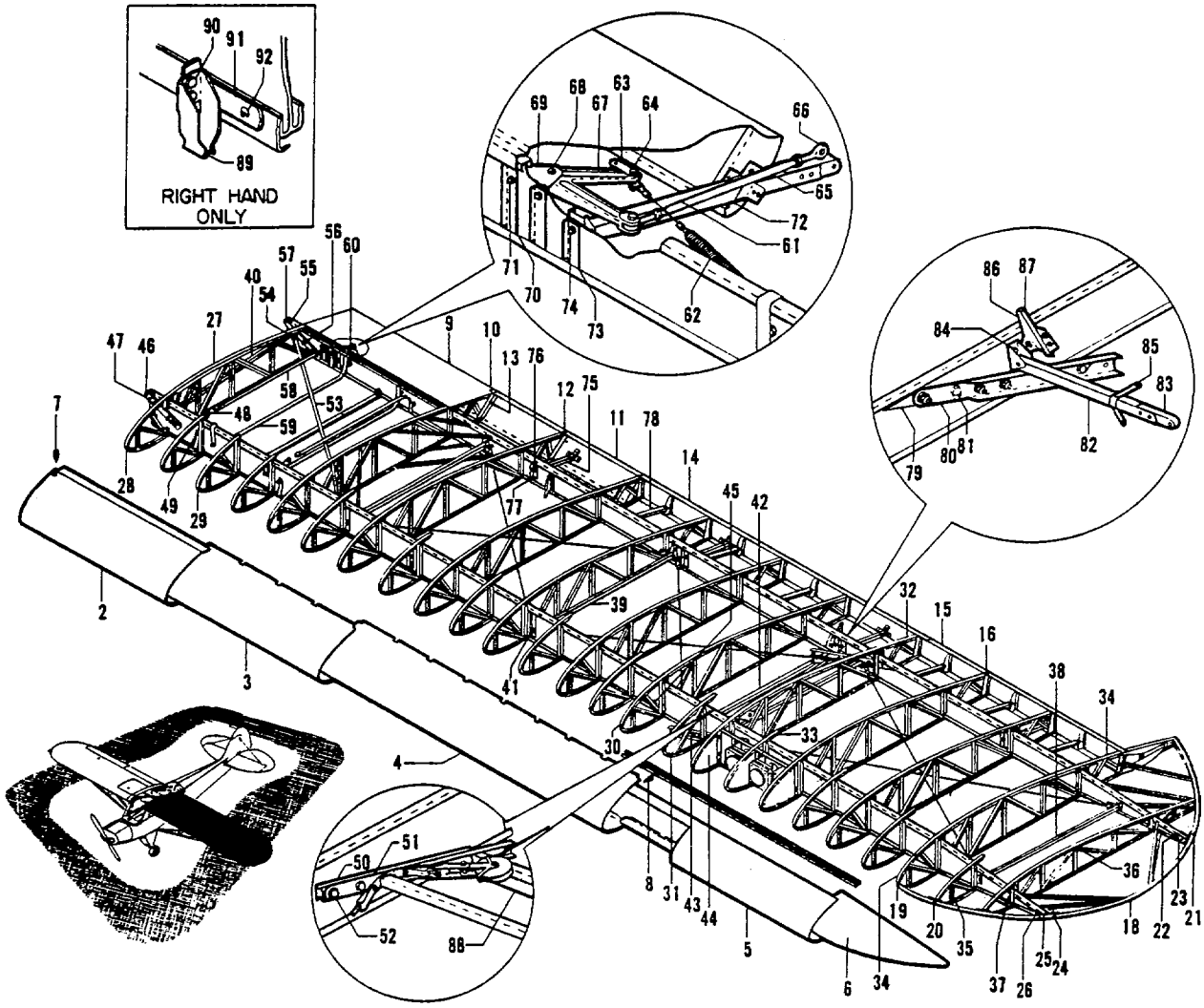
e. Disconnect the aileron control cables running to the lower aileron horn from the link (36, figure 2-3) and the control cables running to the upper aileron horn from the control cables link (3, figure 2-7). Disassemble inspection plate and wing pulley cover (56, figure 2-3) from the wing panel. Remove pulleys (58, figure 2-3 and 17, figure 2-7) from their housings. Carefully guide the upper aileron control cable (2, figure 2-7) through and out of the wing panel just above the points of attachment to the front lift struts. Remove the pulley covers from the floorboards and disassemble pulleys (7, figure 2-7) from their housings so that the cables may be withdrawn from the fuselage structure.

f. Disengage the control cable (5, figure 2-2) which is part of the flap control system. Disassemble pulley (9) from its housing so that the cable may be drawn out through the fuselage structure.

NOTE

Use one man to support the outboard portion of the wing panel being removed for the following operations, (steps g through j).

g. Detach the front lift strut (1-4, figure 2-4) and the rear strut (26) from the fuselage by removing bolt, nut,



1. Landing light installation
2. LH and RH leading edge cover
3. LH and RH leading edge cover
4. LH and RH leading edge center cover
5. Leading edge cover
6. Leading edge cover
7. Screw
8. Screw
9. LH and RH wing inboard false spar
10. Screw
11. LH and RH wing false spar
12. Screw
13. Screw, nut, and washer
14. LH and RH wing false spar (inboard section)
15. LH and RH wing false spar (outboard section)
16. Screw
17. Wing leading edge reinforcement and wing tip bow installation
18. Wing tip bow
19. Screw
20. Screw, nut, and lockwasher
21. Screw, nut, and lockwasher
22. Rear spar bow rear fitting
23. Rear spar bow front fitting
24. Front spar bow rear fitting
25. Front spar bow front fitting
26. Screw, nut, and washer
27. LH and RH wing full rib
28. Wing full rib
29. Wing rib
30. Wing three-quarter rib
31. Wing nose special rib
32. Wing three-quarter rib
33. LH and RH wing nose rib
34. LH and RH wing aileron outboard rib
35. LH and RH wing tip nose rib
36. LH and RH wing tip rib
37. Screw
38. Drag strut
39. Drag strut
40. Drag strut
41. Bolt and lock plate
42. LH and RH strut point "N" brace
43. Bolt and lock plate

Figure 2-1. Wing Panel Assembly

and cotter pin (15).

h. Separate the front jury strut (1) and wing jury strut (2) from the wing panel assembly.

i. Disconnect the front lift strut (14) and the rear lift strut (26) from the wing panel by removing bolts, lift strut fitting spacer, nuts, and cotter pin (21 and 27) and then carefully separating the lift and jury strut assembly from the airplane.

j. Disengage and separate the wing panel (71, figure 2-3) from the fuselage by removing bolts, washers, and nuts (1 and 2). The wing panel must be supported at both the outboard portion and at the wing root during this operation. When removed, rest the wing on its leading edge, using soft pads under the leading edge and other points so as not to cause any damage to the surfaces.

2-13. WING FLAP TROUBLE SHOOTING CHART.

TROUBLE	PROBABLE CAUSE	REMEDY
Flaps do not move when flap control arm is actuated	No tension in flap control cables	Adjust tension of flap control cables (1 and 5, figure 2-2).
	Broken flap control cables	Replace flap control cables (1 and 5, figure 2-2).
	Flap control cables too taut	Adjust tension on flap control cables (1 and 5, figure 2-2).
	Broken pulley	Replace pulley (9, figure 2-2).
	Bellcrank distorted, damaged, or broken	Repair or replace bellcrank (67, figure 2-1).
	Bent flap control rod	Replace flap control rod. (65, figure 2-1)
Flap control arm cannot be actuated	Flap control arm release button not working properly	Repair release mechanism (16, figure 2-2).
	Bellcrank distorted, damaged, or broken	Repair or replace bellcrank (67, figure 2-1).
Flaps do not move in unison	Flap control cables improperly adjusted	Readjust tension on flap control cables (1 and 5, figure 2-2).

44. Bolt and Lock plate
45. Clamp mounting clip
46. Front spar butt hinge fitting
47. Bolt, washer, and nut
48. Front fuel tank strap
49. Bolt, washers, and nut
50. Front spar lift strut fitting filler block
51. Front spar lift strut fitting
52. Bolt, washer, nut, and cotter pin
53. Drag brace tube
54. Bolt, washer, and nut
55. Rear spar butt hinge fitting
56. Bolt, washer, and nut
57. Bushing
58. Rear fuel tank strap
59. Fuel tank strap
60. Bolt, washers, and nut
61. Flap return cable
62. Bungee spring
63. Link
64. Bolt, washer, nut, and cotter pin
65. Flap control rod
66. Bearing assembly
67. LH and RH aileron bellcrank
68. Bolt, washer, nut, and cotter pin
69. Flap bellcrank bracket
70. Spar reinforcement angle
71. Bolt, washer, and nut
72. Aileron hinge bracket
73. Spar reinforcement angle
74. Bolt, washer, and nut
75. Aileron hinge bracket
76. Spar reinforcement angle
77. Bolt, washer, nut, and cotter pin
78. Aileron false spar brace
79. Rear spar lift strut fitting filler block
80. Rear spar lift strut fitting
81. Bolt, washers, nut, and cotter pin
82. Aileron long hinge bracket
83. Aileron hinge bearing block
84. Bolt, washer, and nut
85. Aileron horn stop
86. LH and RH aileron pulley (outboard half) bracket
87. LH and RH aileron pulley (inboard half) bracket
88. Control cable assembly
89. RH catch spring
90. Screw and nut
91. RH door catch mounting bracket
92. Screw

Legend for Figure 2-1.

2-14. REMOVAL OF WING FLAPS.

a. Separate the flap control rod (65, figure 2-1) from its hinge.

b. Disassemble flat-head pin, washer, and cotter pin (43, figure 2-3) from the hinge assembly and carefully remove the flaps.

2-15. CLEANING OF WING PANELS, LIFT STRUTS, AND WING FLAPS. (See figure 2-3.)

2-16. CLEANING OF FABRIC SURFACES. Fabric surfaces should be washed down with fresh water and dried off with a clean cloth. If the fabric is exceptionally dirty, use a non-alkali soap such as castile soap in warm water and then follow with a fresh water rinse. Use solvent, Spec P-S-661, for dry cleaning purposes on oil and grease spots.

2-17. CLEANING OF METAL SURFACES. Wash the metal surface with soap, Specification No. 18001, and a water solution to remove dust and grease stains. Use a ratio of three pounds of soap to 100 U.S. (83.3 Imperial) gallons of water. Rub as necessary to remove the accumulated material and rinse with clear water. Allow the metal surfaces to dry in a shaded location. If the soap and water solution does not remove all grease stains, use dry-cleaning solvent, Specification No. P-S-661. Let the surfaces dry.

NOTE

Corrosion of all aluminum parts or fittings may be retarded and stopped by cleaning the corroded surface down to good metal and then coating with lionoil, Specification No. AN-TT-V-118.

2-18. INSPECTION OF WING PANELS, LIFT STRUTS, AND WING FLAPS. (See figures 2-3 and 2-5.)

a. Check wing panels for obvious minor damage such as tears or holes in the fabric. Refer to paragraph 2-19 for the proper repair procedure.

b. Examine all drain grommets. These grommets must be open at all times so that the accumulations of moisture will drain out of the wing.

c. Remove all inspection hole and pulley covers in the wing panels. Inspect all pulleys and cables for damage, cracks or misalignment. Check that the pulleys turn freely. Replace damaged or binding pulleys or cables that are cracked.

d. Check all control cables for frayed ends or corrosion. Inspect all turnbuckles for cracks, corrosion, improper safetying, and freedom of movement. Damaged or cracked turnbuckles and control cables must be replaced.

e. Examine all drag bracing for corrosion or other damage. Removal of the drag wire inspection covers (6, figure 2-5) will facilitate inspection of the drag bracing.

f. Inspect all hinges, hinge brackets, and attachment fittings for wear, cracks, or corrosion. Check for proper safetying. Reinstall all inspection hole and pulley covers.

g. Examine lift and jury struts for distortion, dents, and damage beyond repair. Check surfaces and attachment fittings for cracks, wear, or corrosion. Replace damaged attachment fittings. Corroded spots on the streamlined tubes should be sanded down to good metal with primer, Specification No. AN-TT-656. After the primer dries, apply coloring, Specification No. 98-24113-B.

2-19. MINOR REPAIR OF WING PANELS, LIFT STRUTS, AND WING FLAPS. (See figures 2-6 and 2-7.)

a. There are no repairs for the metal parts outside of stopping any corrosive action and realigning minor dents and bends. All severely damaged or buckled metal parts must be replaced.

b. Repair of tears in the fabric is accomplished as follows: Cross-stitch the tear as shown in figure 2-6. Use paint remover, Specification No. 14119C to clean an area extending 1-1/2-inches from all sides of the tear. Scrape off all foreign matter and softened paint. Apply dope to the cleaned area with dope, Specification No. 98-24100-U. Apply a doped patch of pinked edge finishing tape over the area with the warp of the patch coinciding with the warp of the area. Smooth the patch and reapply dope over it. When dry, apply coloring. For larger tears, follow the same procedure except that the patch should be oblong with a 1/4-inch frayed edge all around.

c. Holes are patched in a similar manner except that the edges of the holes are trimmed and a piece of fabric is stitched into the hole as illustrated in figure 2-7.

2-20. REPLACEMENT OF PARTS. Replace all safety wires and cotter pins that have been removed with new ones.

NOTE

Replacement of other parts depends upon their serviceability; refer to inspection instructions (paragraph 2-18) for this information.

2-21. INSTALLATION OF WING FLAPS.

a. Position wing flaps onto the wing panels, carefully inserting the flap control rod (65, figure 2-1) into its hinge.

b. Secure the flaps in place by assembling flat-head pin, washer, and cotter pin (43, figure 2-3) into its hinge.

c. Reinstall inspection hole cover.

NOTE

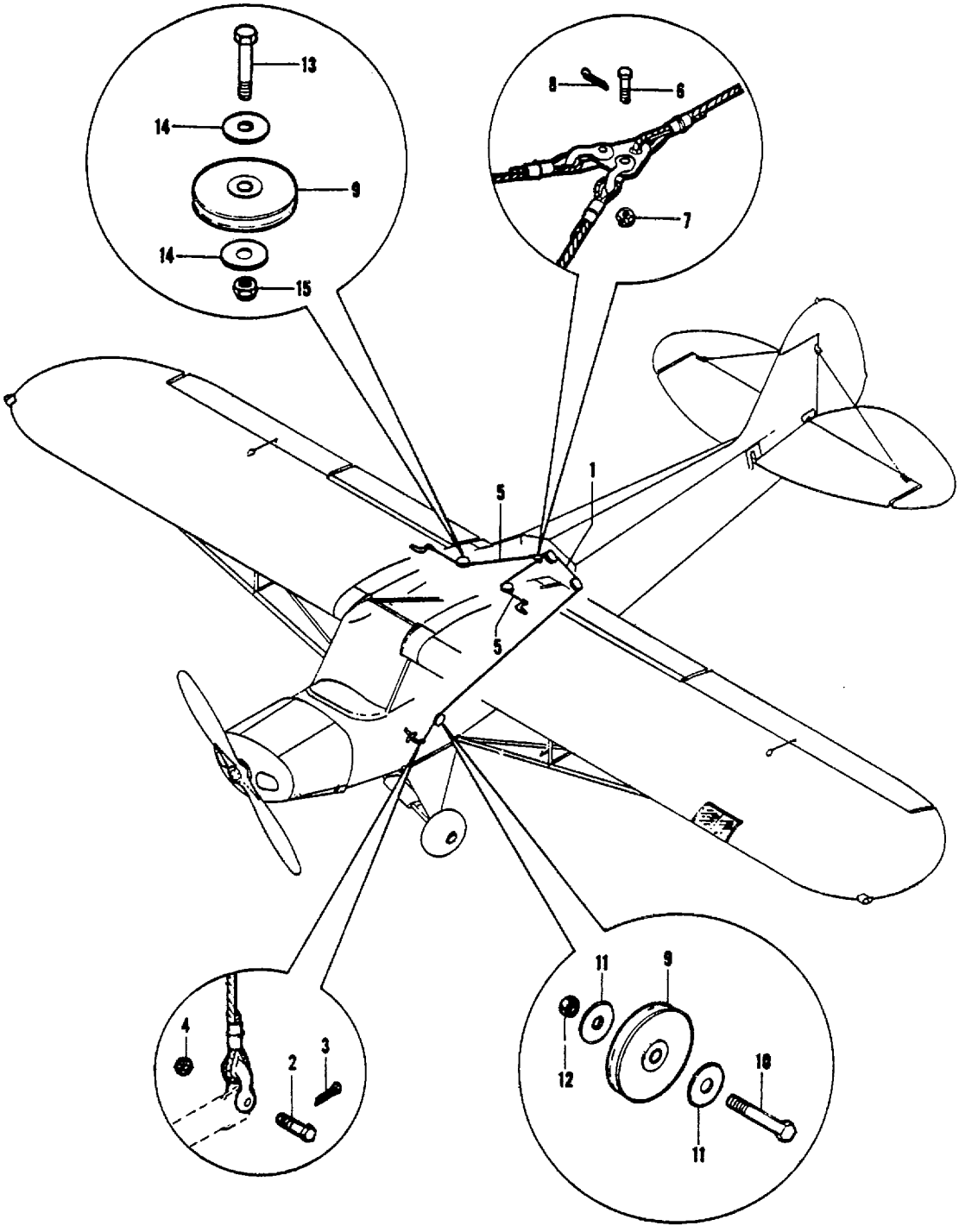
Before attaching the flap control rod to its hinge, depress the flap control arm (16, figure 2-2) in the pilots' compartment to facilitate installation procedure.

2-22. INSTALLATION OF WING PANELS AND LIFT STRUTS.

NOTE

If the lift struts alone are to be installed, refer to the procedure outlined in steps b, c, e and j (below). Connect the air bleed fitting on the left front jury strut if the left front strut is removed.

a. Position the wing panel to the fuselage and attach it there to the bolts, nuts, and washers (1 and 3, figure



1. Flap Cable
2. Bolt
3. Cotter pin
4. Nut
5. Control cable
6. Bolt
7. Nut
8. Cotter pin
9. Pulley
10. Bolt
11. Washer
12. Nut
13. Bolt
14. Washer
15. Nut
16. Flap control arm
17. Link

Figure 2-2. Flap Control System

2-3). During this operation, the wing panel must be supported at both the outboard portion and at the wing root. Refer to the Table III for the proper torque values.

TABLE III. TORQUE VALUES

Item and Location	Torque Value (foot-pounds)
Wing root rear hinge bolt (L & R)	5-6
Wing root front hinge bolt (L & R)	6-7
Front lift strut to spar fitting (L & R) 1 bolt	3-5
Rear lift strut to spar fitting (L & R) 1 bolt	3-5
Front and rear lift strut to fuselage bolts (L & R) 2 bolts	3
Elevator upper connector link (upper bolt)	1
Elevator upper connector link (lower bolt)	5
Stabilizer to adjustment control (L & R) 1 bolt	2
Stabilizer to fuselage link tube	2
Left landing gear vee to fuselage (2 bolts)	11
Right landing gear vee to fuselage (2 bolts)	11
Cabane vee to fuselage (2 bolts)	8
Shock struts to cabane vee (2 bolts)	10-11
Shock strut to right axle (1 bolt)	10
Shock struts to left axle (1 bolt)	10
Steerable tail wheel to spring (1 bolt)	20-35
Tail wheel spring to fuselage (1 bolt)	15-18
Tail wheel spring "U" -bracket	8-10
Propeller to engine (6 bolts)	25-30
Engine mount to firewall attaching bolts	13-15
Engine to engine mount attaching bolts	40-57

1. Bolt, nut, and washer assembly
2. Bolt, nut, and washer assembly
3. LH and RH front wing root fairing assembly
4. Screw
5. LH and RH lower wing root fairing
6. Screw
7. Wing root upper fairing
8. Screw
9. Screw
10. LH and RH lower rear wing root fairing
11. Screw and nut
12. Screw
13. Flexible hose
14. 3/4-inch hose clamp
15. Adapter
16. Flexible hose
17. Flexible hose
18. 5/8-inch hose clamp
19. Fuel gage assembly
20. Elbow
21. Elbow
22. Elbow
23. Fuel gage bushing
24. Cork fuel gage float
25. Washer
26. Glass fuel gage tube
27. Fuel gage
28. Flexible hose
29. 5/8-inch hose clamp
30. Tube assembly
31. Inverted male connector
32. Header tank finger strainer
33. Flexible hose
34. 5/8-inch hose clamp
35. Tee
36. Link
37. Bolt, washer, and nut
38. Bolt and nut
39. LH and RH flap fairing
40. Screw
41. LH and RH cover flap
42. Bolt, washer, and nut
43. Flat-head pin, washer, and cotter pin
44. Flat-head pin, washer, and cotter pin
45. Grommet
46. Bolt, nut, washer, and cotter pin
47. LH and RH covered alleron
48. Flat-head pin, washers, and cotter pin
49. Lift and jury strut installation
50. LH and RH wing rib butt plate
51. Screw
52. Landing light window
53. Landing light window attachment strip
54. Landing light window attachment strip
55. Screw and nut
56. Wing pulley cover
57. Screw
58. Pulley
59. Bolt, nut, bushing, and cotter pin
60. Fuel tank cap
61. Fuel tank cover
62. Screw
63. Screw
64. Fuel tank filler cap flange
65. Washer
66. LH and RH fuel tank
67. Stainless steel stud
68. Nut
69. Drag brace tube cover
70. LH and RH covered wing
71. LH and RH wing panel

Legend for Figure 2-3.

Revised 14 October 1955

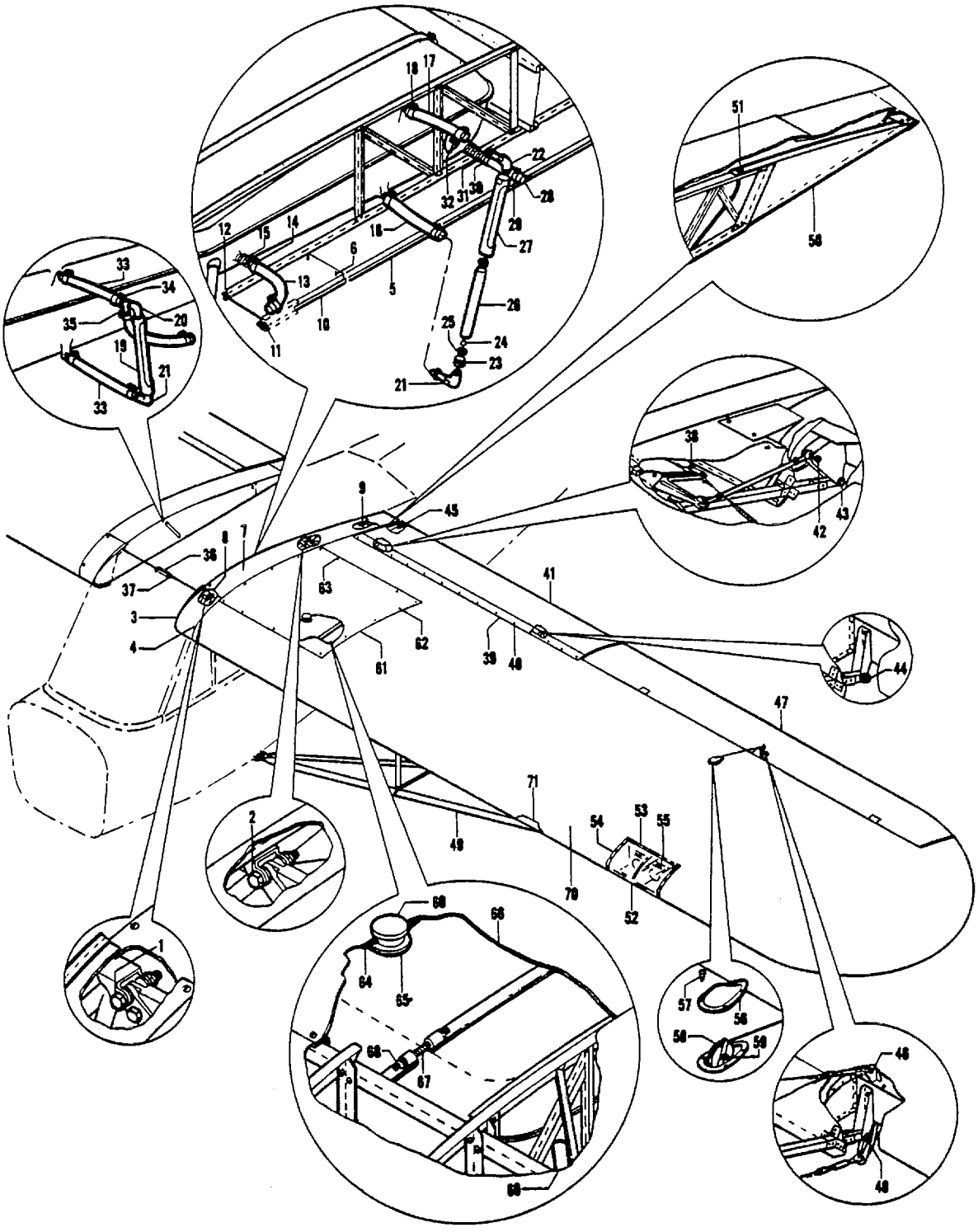
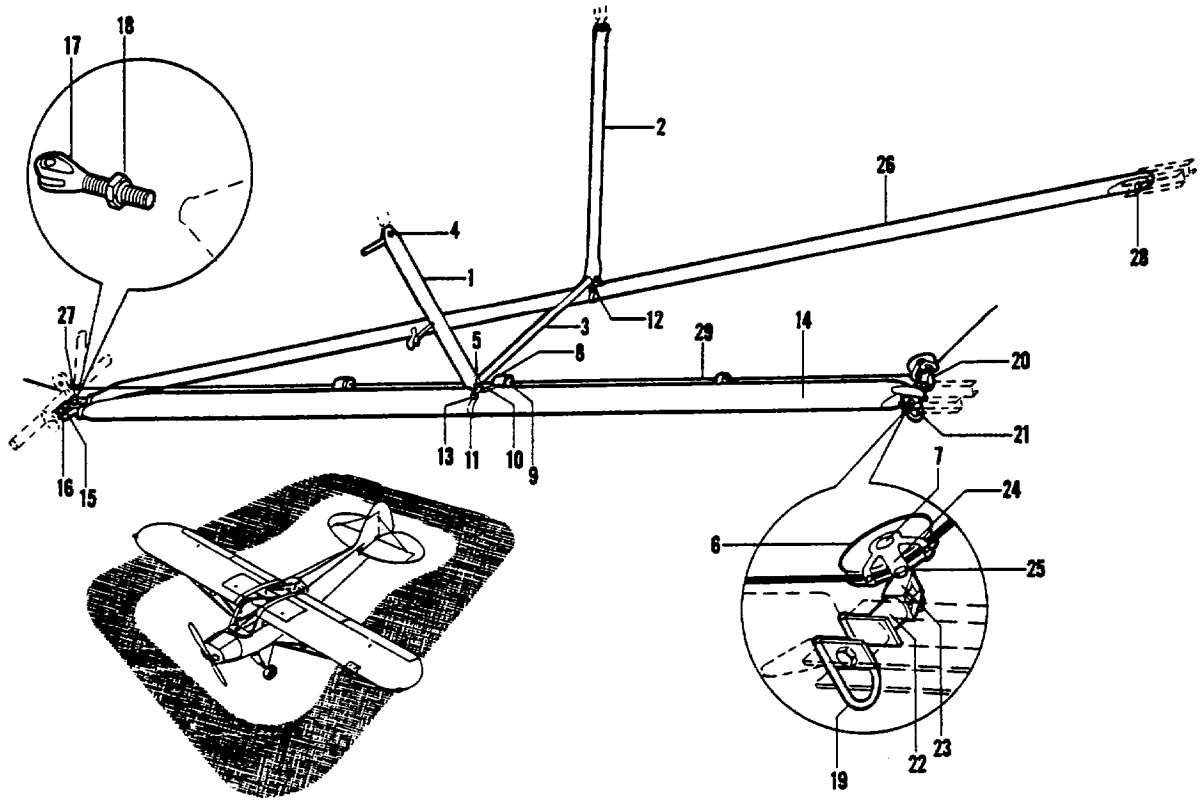


Figure 2-3. Wing Installation



1. LH front jury strut
2. Wing jury strut
3. Jury strut spacer tube
4. Bolt, washer, and nut
5. Bolt, washer, and nut
6. Pulley
7. Flat-head pin and cotter pin
8. Cable fairlead segment
9. Fairlead snap ring
10. Round clamp
11. Front strut jury strut clamp
12. Rear strut jury strut clamp
13. Bolt, washer, and nut
14. Front lift strut
15. Bolt, nut, and cotter pin
16. Fork
17. Lift strut fork
18. Nut
19. Tie-down fitting
20. LH and RH pulley housing
21. Bolt, lift strut fitting spacer and nut
22. Lift strut fitting spacer
23. Aileron pulley bracket
24. Wing aileron cable pulley housing
25. Bolt, nut, washer, and cotter pin
26. Rear lift strut
27. Bolt, nut, and cotter pin
28. Bolt, washer, and nut
29. Control cable

Figure 2-4. Strut Installation

b. Attach the front and rear lift struts (14 and 26, figure 2-4) to the fuselage with bolts, washers, and nuts (15, 25, and 27). Refer to Table IV for proper torque values.

c. Assemble the front jury strut (1, figure 2-4) and wing jury strut (2) to the wing panel. See Table IV for proper torque values. Follow the procedure of steps a, b and c for the opposite wing panel.

d. Draw flap control cables (1 and 5, figure 2-2) through the fuselage, thread them around the pulleys (9), and secure the pulleys to their housings. Connect control cables to the line (17).

e. Connect the aileron control cables running to the lower aileron horns with link (36, figure 2-3). Thread aileron control cables running to the upper aileron horns through and out of the wing panels at the pulley housings on the upper wing surface. Position the cables on their pulleys (58, figure 2-3 and 17, figure 2-8) and mount the pulleys in their housings. Attach the cables to the upper aileron horns. Thread the same cables around the pulleys that attach to the wing panels just above the points of attachment of the front lift struts to the underside of the wing panels. Mount these pulleys in their housings. Insert the cables running from the upper aileron horns down along the front lift struts in through the fuselage. Position the cables in their pulleys (7, figure 2-8) and mount these pulleys in their housings. Attach these cables to the link (3, figure 2-8) with bolt (4), nut (5), and cotter pin (6). Assemble the aileron pulley housing covers (54, figure 2-17) to the floorboards.

f. Connect the airbleed fittings (see figure 6-2) at the wing root and the left front jury strut (1, figure 2-4) if the left wing panel is being installed.

g. Position the upper right and upper left trim panels (23 and 24, figure 2-17) in the fuselage. Refer to Section X for wiring instructions. Assemble cockpit light (52, figure 7-1), switch panel (31), and landing light switch panel (21) to the upper right trim panel. Attach trim panels to the fuselage structure.

TABLE IV.

SURFACE	MOVEMENT			TOLERANCE	
	Degrees	Inches	Reference	Degrees	Inches
Ailerons	18° Up	3-1/2	Travel relative to trailing edge of wing	±2°	±3/8
	18° Down	3-1/2		±2°	±3/8
Stabilizers	2-1/2° Up	1-1/16	Travel relative to horizontal reference line	±1/2°	±1/2
	4° Down	2		±1/2°	±1/2
	normal setting	-2-1/2° relative to longitudinal axis			
Elevators	25° Up	8-7/16	Travel relative to horizontal reference line	±2°	±3/4
	15° Down	5		±2°	±3/4
Fin	0° Right 0° Left				
	normal setting	0 Degrees			
Rudder	20° Right	7-1/4	Travel relative to centerline of airplane	±2°	±5/8
	20° Left	7-1/4		±2°	±5/8

h. Clean the ends of all tubing and connect the fuel supply and fuel vent lines at the wing root. Reassemble the fuel gages (21 through 29, figure 2-3) to their fittings.

i. Attach the front wing root fairing (3, figure 2-3), wing root upper fairing (7), lower wing root fairing (5), and lower rear wing root fairing (10) to the wing root.

j. Check that all nuts and bolts that were removed are secured with safety wire or cotter pins as required.

k. Reinstall all inspection hole and pulley housing covers that were removed.

l. Check that wing flaps and ailerons work properly when actuating the control stick. Refer to the wing flap trouble shooting chart (paragraph 2-13) and to the aileron trouble shooting chart (paragraph 2-34).

2-23. ADJUSTMENT OF WING PANELS, LIFT STRUTS, AND WING FLAPS. All rigging dimensions concerning wings and wing flaps must be checked following the installation of any of these components. Refer to paragraph 2-71 on rigging instructions and see figure 2-21 for rigging dimensions.

2-24. CONTROL SURFACES.

2-25. DESCRIPTION. (See figures 2-2 and 2-8 through 2-16.) For limits and tolerances of control surface movements, refer to Table IV.

2-26. AILERONS. (See figure 2-3.) The fabric-covered aileron structure is constructed of riveted aluminum alloy. A channel runs the length of the aileron and serves as the main support to which are attached ribs, hinges, horn fittings, and cover. The fabric covering is stitched to the ribs in conventional manner.

2-27. The lateral motion of the control stick rotates the torque tube (figure 2-14) to the rear of which is attached the aileron control cable arm. Control cables are attached to this control arm and pass around a series of pulleys before attaching to the upper aileron horns by means of turnbuckles and clevis bolts. A balance cable connecting the lower aileron horn in each wing passes along the rear of the front spar.

2-28. VERTICAL FIN. (See figure 2-17.) The vertical fin has a steel tubular leading edge and rear spar connected by steel channel ribs.

2-29. RUDDER. (See figure 2-15.) The rudder is constructed in a manner identical to that of the vertical fin. Rudder controls are provided for front and rear seats in the pilots' compartment. The pedals are hinged below the floor and the cables connected directly to the rudder horn are attached to the outer ends of the rudder pedals. (See figure 2-10.)

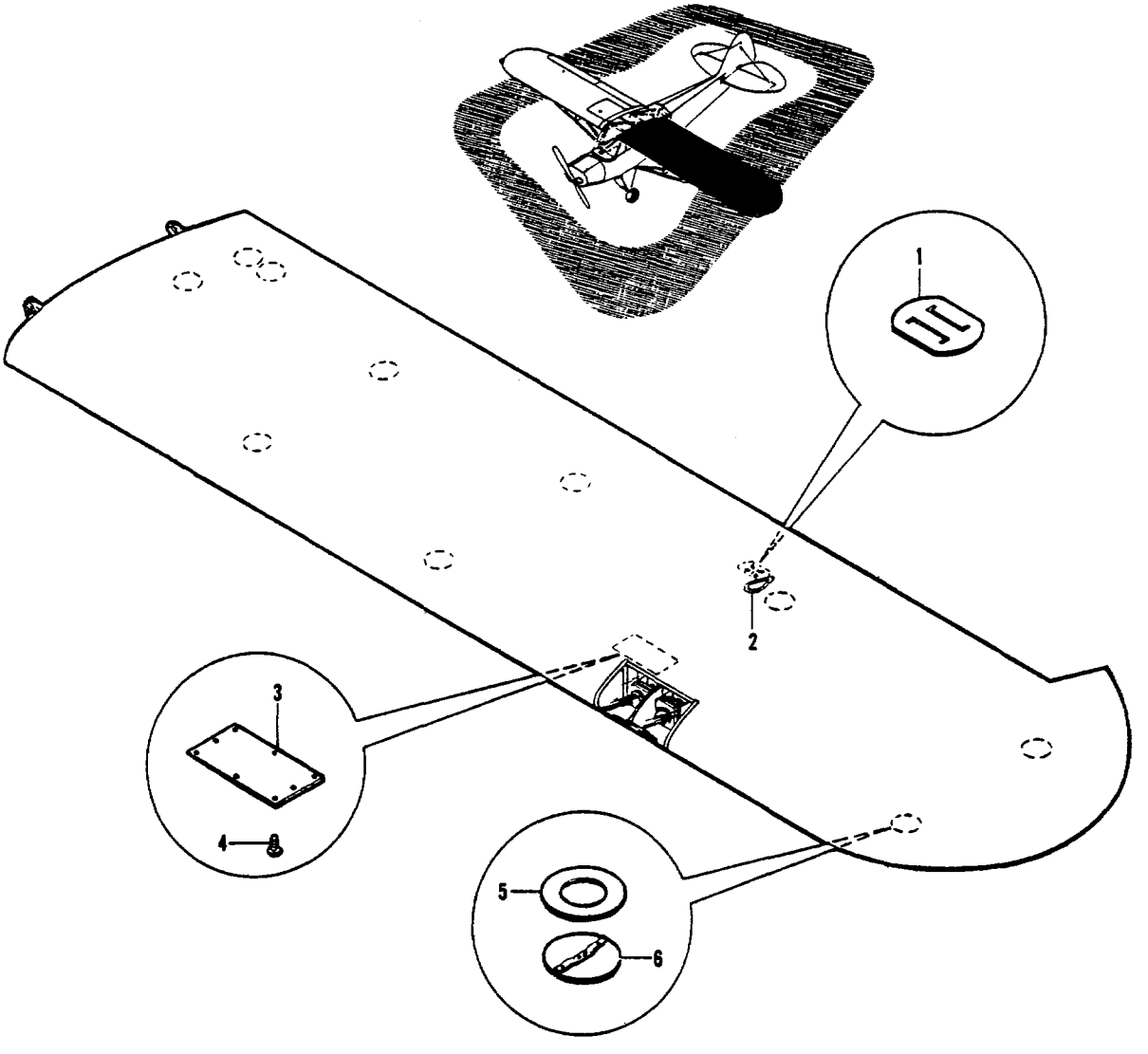
2-30. STABILIZER. (See figure 2-15.) The stabilizer consists of steel tubular leading and training edges joined by steel channel ribs welded at the ends. Hinges are welded directly to the trailing edge and the structure is covered with fabric stitched to the steel channel ribs.

2-31. The stabilizer's angle of incidence may be varied to compensate for nose or tail heaviness, thereby trimming the airplane for a level course. This stabilizer

adjustment control (see figure 2-16) is operated by a crank on the left side of the cockpit (figure 2-12). An endless flexible steel cable passes around a pulley attached to the crank, then back through the fuselage to another pulley on the lower end of the stabilizer adjusting screw. Turning the crank rotates the screw which in turn raises or lowers a stabilizer yoke to which is attached the stabilizer front spar.

2-32. ELEVATORS. (See figure 2-15.) The elevators are fabricated of steel tubular leading and trailing edges joined by steel channel ribs welded at the ends. Hinges are welded directly to the spars. The fabric covering is stitched to the steel channel ribs.

2-33. The fore and aft motion of the control sticks is transmitted back through the fuselage by means of the following linkage, (figure 2-13). The sticks are mounted on a torque tubs which passes beneath the front seat above the floorboards. The lower ends of the sticks are connected by a push-pull tube which passes through the torque tube. A flexible steel cable attached to the forward end of the push-pull tube travels forward over a pulley, back through the fuselage and is connected at the rear to the lower elevator horn by means of turnbuckles and clevis bolts. The upper elevator horn is connected to the aft end of the push-pull tube by means of a flexible steel cable running back through the fuselage.



1. Wing fabric reinforcement
2. Grommet
3. Wing inspection window
4. Screw
5. Pyralin washer
6. Dragwire inspection cover

Figure 2-5. Covered Wing Assembly

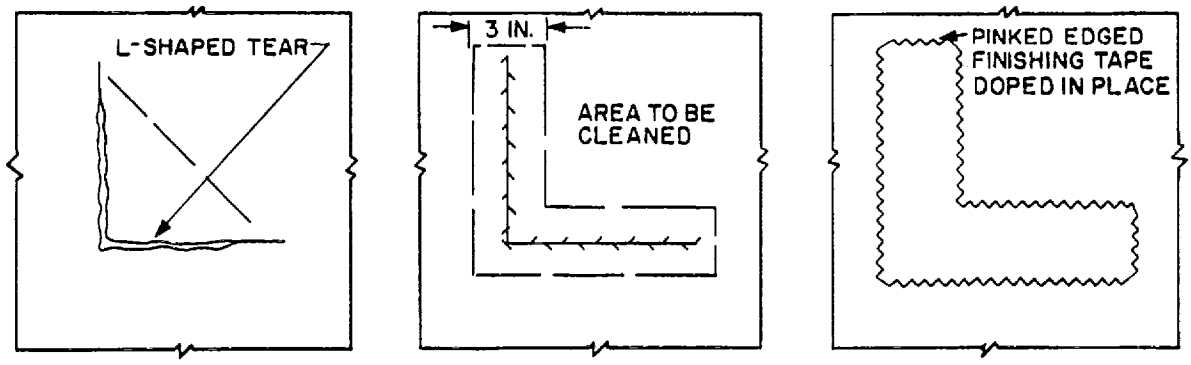


Figure 2-6. Repair of Tears in Fabric Covering

2-34. AILERON TROUBLE SHOOTING CHART.

TROUBLE	PROBABLE CAUSE	REMEDY
LOST MOTION IN CONTROL STICKS	Loose control cables	Take up slack on control cables (1 and 2, figure 2-8). Refer to paragraph 2-75.
	Broken pulley	Replace pulley (17, figure 2-8).
CONTROL STICKS ARE DISPLACED WHEN AILERONS ARE IN NEUTRAL	Control cables improperly adjusted	Adjust control cables (1 and 3, figure 2-8). Refer to paragraph 2-75.
IMPROPER AILERON TRAVEL	Control cables improperly adjusted	Adjust control cables (1 and 2, figure 2-8). Refer to paragraph 2-75.
	Torque tube incorrectly adjusted	Readjust torque tube (18, figure 2-14).
RESISTANCE TO MOVEMENT OF CONTROL STICKS	Control cables too taut	Adjust control cables (1 and 2, figure 2-8). Refer to paragraph 2-75.
	Pulleys bind	Replace damaged pulleys (17, figure 2-8).

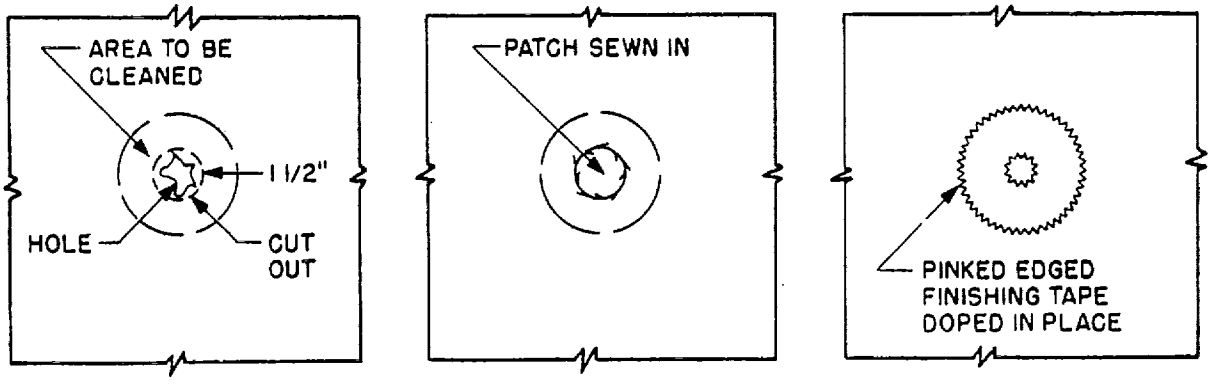


Figure 2-7. Repair of Holes in Fabric Covering

2-35. REMOVAL OF AILERONS.

a. Disconnect aileron control cables (1 and 2, figure 2-8) from their attaching upper and lower aileron horns.

b. Disassemble bolt, nut, washer, and cotter pin (46, figure 2-3) and flat-head pin, washers, and cotter pin (48).

c. Carefully remove the aileron from the wing panel.

2-36. RUDDER TROUBLE SHOOTING CHART.

TROUBLE	PROBABLE CAUSE	REMEDY
RUDDER PEDAL BINDS	Rudder pedal clamp loose and misaligned.	Realign pedal clamps (3, figure 2-10.) Oil and tighten.
	Binding in rudder links.	Remove links (9, figure 2-10.) Oil and reinstall them.
	Broken or damaged pulley.	Replace pulley (12, figure 2-9).
	Binding in cable fittings.	Replace cable fittings (3, 4, and 8, figure 2-9).
RUDDER SWINGS OUT OF NEUTRAL POSITION WHEN PRESSURE ON RUDDER PEDALS IS RELEASED	Broken rudder torsion spring.	Replace rudder torsion spring (5, figure 2-10).
	Rudder torsion springs exert unequal force.	Replace weak rudder torsion spring (5, figure 2-10).

2-37. REMOVAL OF FIN. The fin is bolted to the fuselage and it cannot be repaired on the operating unit level since such repairs may involve structural changes.

2-38. REMOVAL OF RUDDER.

a. Unhook tail wheel steering springs (1, figure 2-24) from the attaching rudder arm.

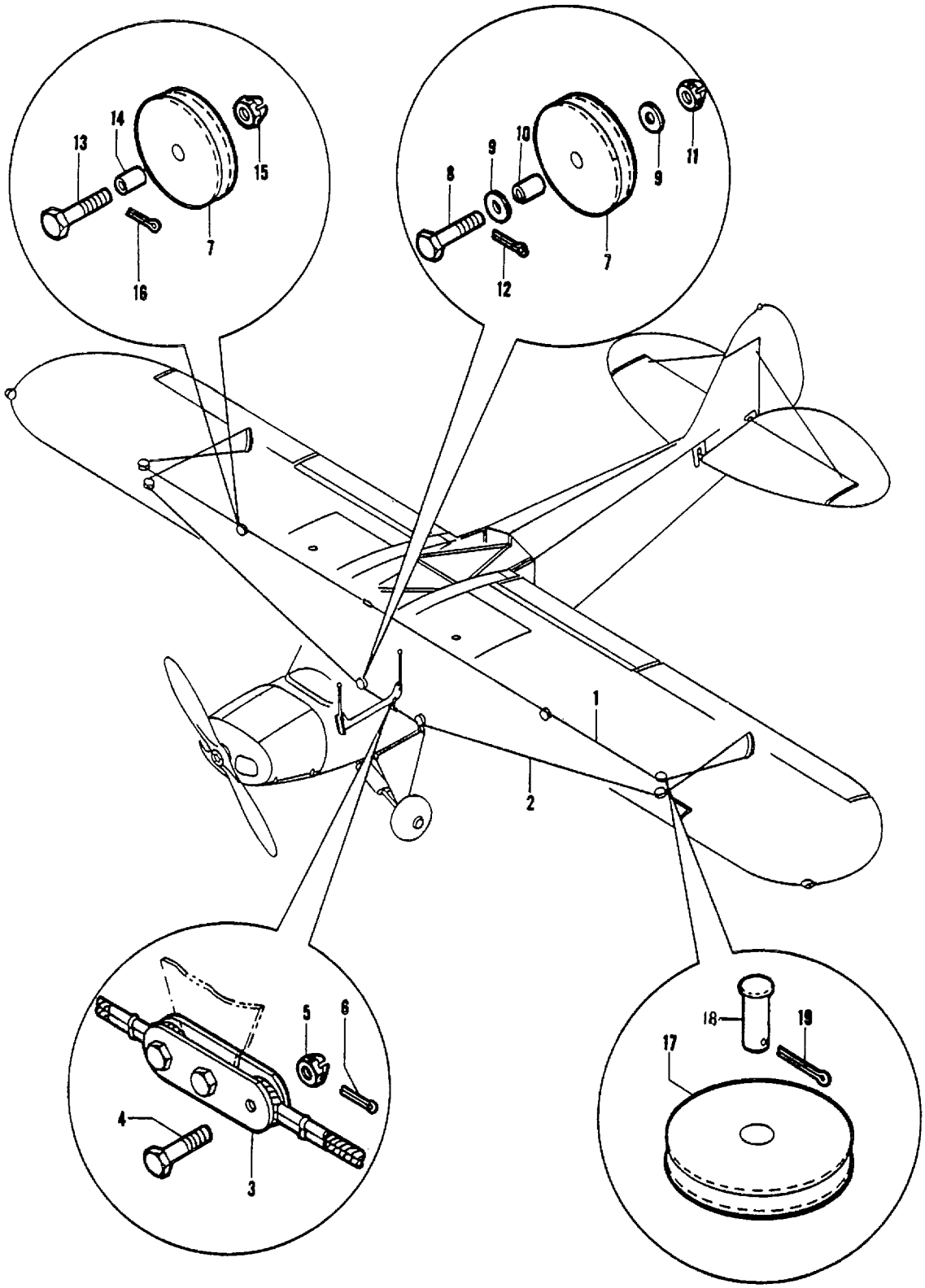
b. Disconnect rudder cable (1, figure 2-9) from the rudder horn.

c. Disconnect the electrical wiring to the tail assembly (figure 7-1).

d. Remove flat-head pin (38, figure 2-15), cotter pin (39), and washer (40), and separate the rudder assembly from the fin.

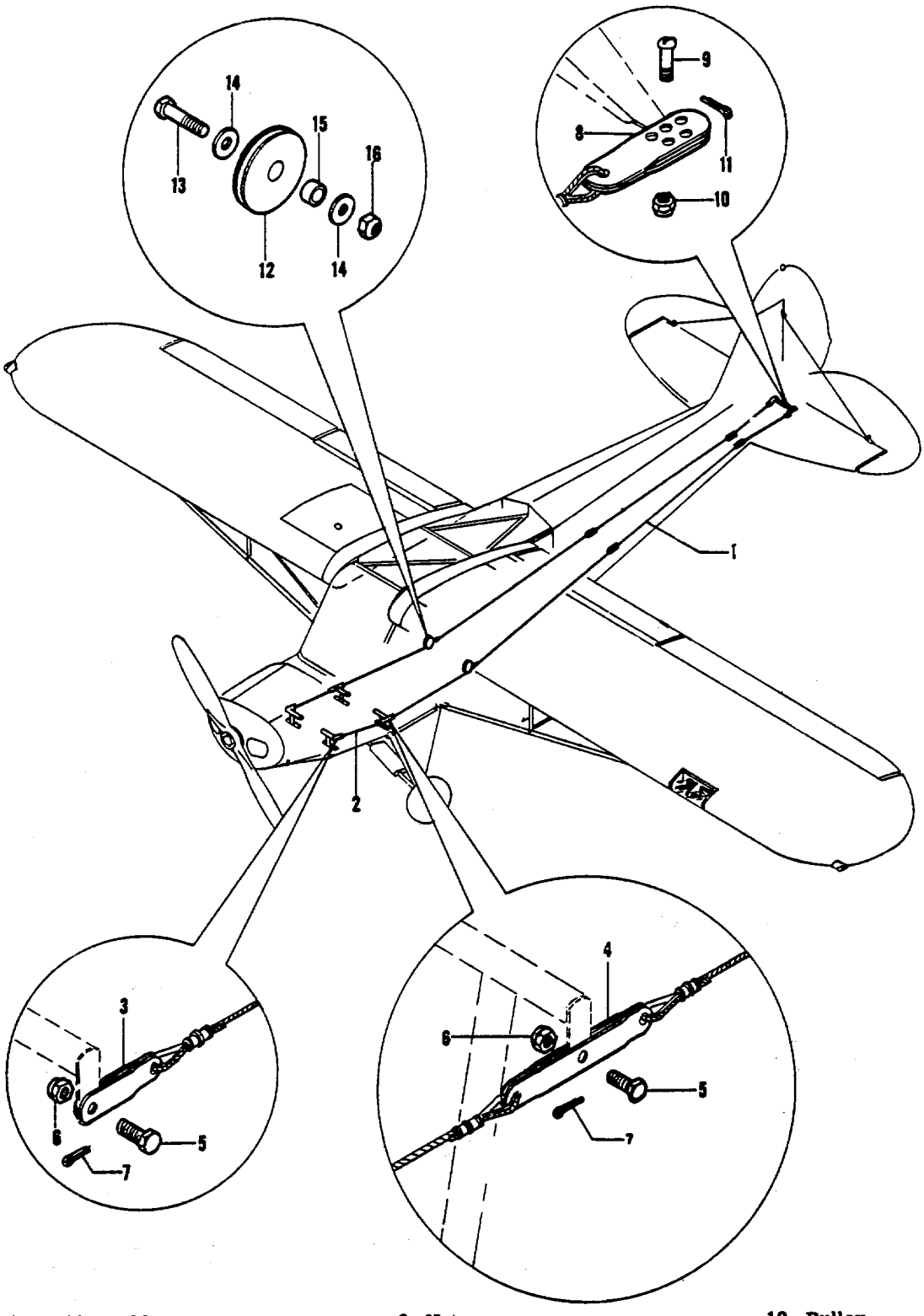
2-39. ELEVATOR TROUBLE SHOOTING CHART.

TROUBLE	PROBABLE CAUSE	REMEDY
LOST MOTION IN CONTROL STICKS	Loose control cables.	Take up on control cable (1, figure 2-13) or elevator cables (5 and 6, figure 2-13).
	Broken pulley.	Replace broken pulley (12, figure 2-13).
	Worn holes in control stick stub or torque tube at point where they attach to each other.	Replace worn, control stick stub (6, figure 2-14) or torque tube (18, figure 2-14).
EXCESSIVE RESISTANCE TO MOVEMENT OF CONTROL STICKS	Control cables too taut.	Adjust control cables (5 and 6, figure 2-13). Refer to paragraph 2-80.
	Pulleys bind.	Replace damaged pulleys (12, figure 2-13).
FULL ELEVATOR TRAVEL CANNOT BE ACHIEVED	Pulleys bind.	Replace damaged pulleys (12, figure 2-13).



1. Control cable
2. Control cable
3. Control cable link
4. Bolt
5. Nut
6. Cotter pin
7. Pulley
8. Bolt
9. Washer
10. Bushing
11. Nut
12. Cotter pin
13. Bolt
14. Bushing
15. Nut
16. Cotter pin
17. Pulley
18. Flat-head pin
19. Cotter pin

Figure 2-8. Aileron Control System



1. Rudder cable
2. Rudder cable
3. Rudder cable front fitting
4. Rudder cable center fitting
5. Bolt
6. Nut
7. Cotter pin
8. Rudder cable rear fitting
9. Bolt
10. Nut
11. Cotter pin
12. Pulley
13. Bolt
14. Washer
15. Bushing
16. Nut

Figure 2-9. Rudder Control System

2-40. REMOVAL OF ELEVATOR.

a. Remove LH and RH tail inspection panel (17, figure 2-15).

b. Disconnect spring (30, figure 2-16) from elevator horn upper link (29).

c. Disconnect control cable (1, figure 2-13).

d. Disassemble bolt (20, 23, and 29, figure 2-15), washers (21 and 25), cotter pin (28), and nuts (22, 26, and 30). Remove flathead pin (38), cotter pin (39), and washer (40) and carefully separate the elevator section (19) from the stabilizer (31) and fuselage.

2-41. REMOVAL OF STABILIZER.

a. Disassemble the upper tail brace wire, (1, figure 2-15) and lower tail brace wire (11) assemblies.

b. Unfasten bolts (32 and 35), nuts (34), and washers (33) and carefully remove the stabilizer (31) from the fuselage.

2-42. STABILIZER ADJUSTMENT YOKE AND BUNGEE INSTALLATION TROUBLE SHOOTING CHART.

TROUBLE	PROBABLE CAUSE	REMEDY
STABILIZER DOES NOT MOVE UP OR DOWN WHEN ACTUATING STABILIZER ADJUSTMENT CRANK	Control cable slips on pulleys because of oil or grease coating	Clean oil or grease from cable (1, figure 2-11) with cloth moistened in clean gasoline.
	Broken control cable	Replace broken control cable (1, figure 2-11).
	Loose control cable	Replace weak or broken bungee spring (1, figure 2-16).
	Broken pulley	Replace broken pulley (3, figure 2-16).
	Stabilizer adjustment screw sheared	Replace stabilizer adjustment screw (11, figure 2-16).
	Stabilizer screw key broken or sheared	Replace stabilizer screw key (18, figure 2-16).
STABILIZER MOVES ONLY WITH EXCESSIVE RESISTANCE	Pulleys bind	Replace damaged pulleys (5, figure 2-11).
	Cable guide block damaged or misaligned	Realign or replace damaged cable guide block (47, figure 2-17).
	Indicator wire pulleys damaged or broken	Replace broken or damaged indicator wire pulleys (5, figure 2-11).
	Screw and yoke assembly jammed	Disassemble, clean and reassemble screw, and yoke assembly (25, figure 2-16).
	Tube frozen to link assembly	Disassemble, clean, and reassemble tube (24, figure 2-16) to link assembly (19, figure 2-16).

2-43. REMOVAL OF STABILIZER ADJUSTMENT YOKE AND BUNGEE INSTALLATION.

a. Remove LH and RH stabilizer yoke cover plate (15, figure 2-51).

b. To remove the stabilizer adjustment yoke, disassemble cotter pin (12, figure 2-16), nut (13), and washer (14) from the stabilizer adjustment screw (11). Carefully remove pulley (17), washers (15 and 16), and stabilizer screw key (18).

c. Detach indicator wire (33, figure 2-16) from link

(19) and separate the assembly from the stabilizer yoke (25) by removing cotter pin (21), bolt (20), washer (22), and nut (23). Remove tube (24) from link (19).

d. In order to get at the stabilizer adjustment screw (11, figure 2-16), remove the area of tape and fabric covering hole A (shown in figure 2-16) in the fin leading edge fairing. Unscrew the stabilizer adjustment screw (11) out of the stabilizer yoke (25) and up through hole A while holding on to the stabilizer yoke. Disassemble the bungee pulley housing (32) from the assembly and remove the yoke (25).

e. If the bungee installation must be disassembled further for replacement of parts, proceed as follows: Remove the pulley (31, figure 2-16) from its housing. Disassemble the elevator horn spring (30) from the elevator horn (29).

2-44. CLEANING OF CONTROL SURFACES. (See figure 2-3 and figures 2-8 through 2-16.)

a. Wash down the control surfaces with fresh water and dry with a clean cloth. If exceptionally dirty, use a non-alkali soap such as castile soap in warm water and rinse with clean water.

NOTE

Use solvent, Spec P-S-661, for dry cleaning purposes on oil and grease spots.

b. Clean all metal parts and all pulleys with a cloth moistened in dry cleaning solvent Specification No. P-S-661.

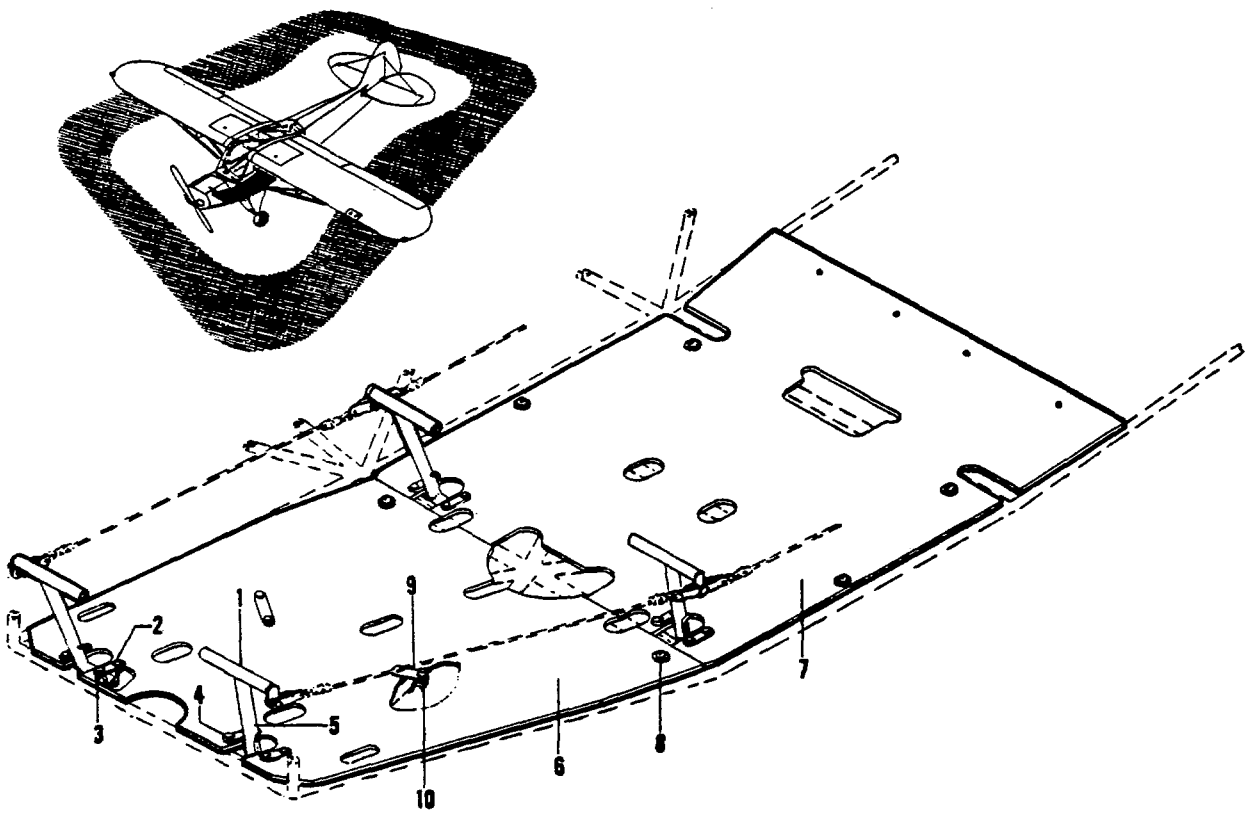
c. Clean all cables by wiping with a clean cloth. Remove all oil or grease by wiping with a cloth moistened in clean gasoline.

2-45. INSPECTION OF CONTROL SURFACES.

a. Check control surfaces for minor damage such as tears or holes in the fabric. Refer to paragraph 2-19 for the proper repair procedure.

b. Examine all control surface drain grommets. These grommets must be kept open at all times so that accumulations of moisture will drain out of the control surfaces.

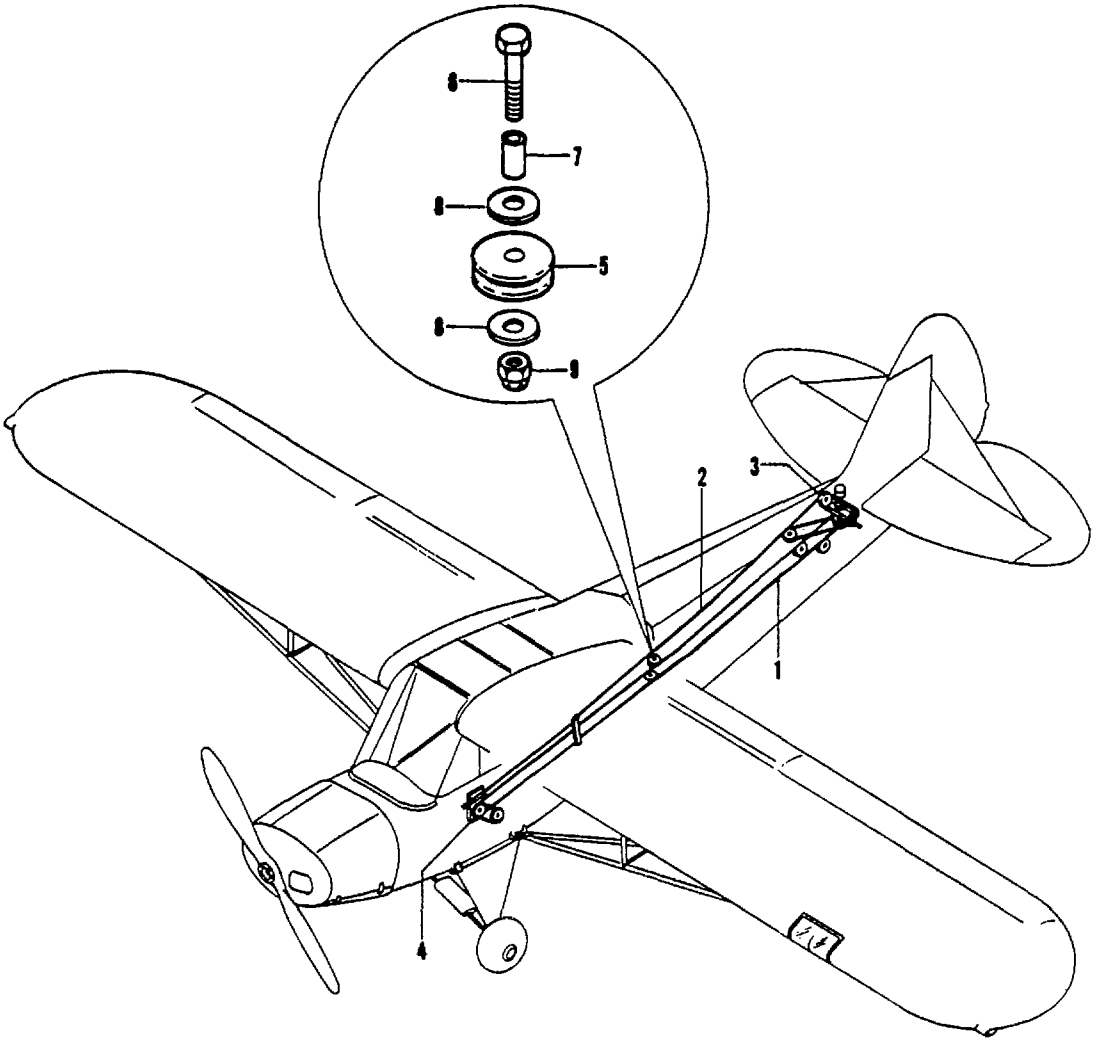
c. Inspect all pulleys, guides and fairleads for damage, cracks or misalignment. Check that the pulleys



1. LH rudder pedal
2. Plate
3. Clamp
4. Bolt, steel washers, and nut
5. Rudder pedal torsion spring
6. Front floorboard
7. Rear floorboard
8. Screw, washer, and nut
9. Link
10. Clamp

Figure 2-10. Rudder Pedals and Floorboards Installation

Revised 27 December 1954



1. Stabilizer adjustment cable
2. Indicator Wire
3. Stabilizer adjustment yoke installation
4. Stabilizer adjustment crank installation
5. Pulley
6. Bolt
7. Bushing
8. Washer
9. Nut

Figure 2-11. Stabilizer Adjustment Control

turn freely. Replace damaged pulleys or pulleys that bind and guides or fairleads that are cracked.

d. Check all control cables for frayed ends or corrosion. Inspect all turnbuckles and turnbuckle terminals for cracks, corrosion, improper safetying and freedom of movement. Damaged or cracked turnbuckles and control cables must be replaced.

NOTE

Corrosion of all aluminum parts or fittings may be retarded and stopped by cleaning the corroded surface down to good metal and then coating with lionoil, Specification No. AN-TT-V-118.

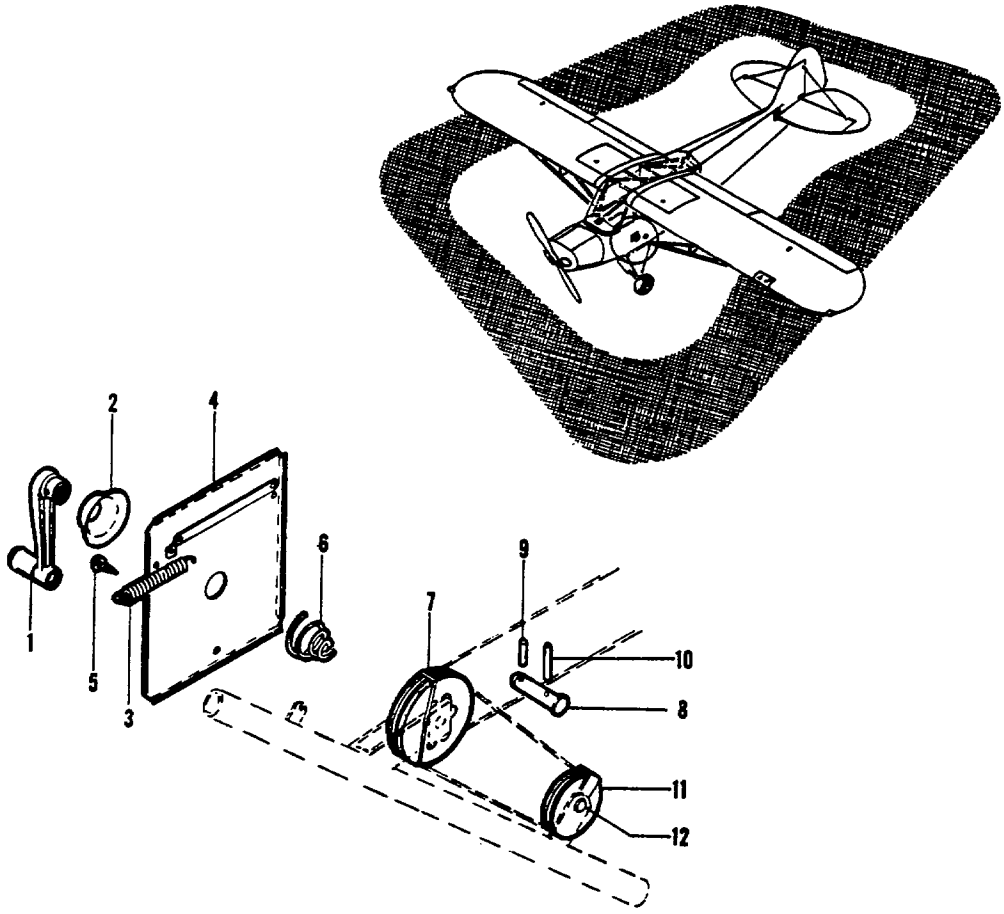
e. Examine the upper and lower tail brace wire assemblies (1 and 11, figure 2-15) for damage such as deep scratches or cuts. Replace damaged wire assemblies.

f. Inspect the fin for sturdiness. Check that the attaching bolts are properly safetywired (figure 2-15).

2-46. MINOR REPAIR OF CONTROL SURFACES. (See figure 2-3 and figures 2-8 through 2-16.)

a. No repairs are to be undertaken on metal parts outside of stopping corrosion and realigning minor dents and bends. All severely damaged or buckled metal parts are to be replaced.

b. Repair of tears or holes in the fabric covering are to be accomplished according to steps b and c of paragraph 2-19.



1. Stabilizer adjustment crank
2. Stabilizer adjustment crank escutcheon plate
3. Stabilizer indicator return spring
4. Stabilizer indicator cover plate
5. Screw
6. Stabilizer crank escutcheon plate spring
7. Pulley
8. Stabilizer adjustment crank pin
9. Steel pin
10. Steel pin
11. Pulley
12. Bolt, bushing, washer, and nut

Figure 2-12. Stabilizer Adjustment Crank Installation

2-47. REPLACEMENT OF PARTS. Replace all safety wires and cotter pins that have been removed with new ones.

NOTE

Replacement of other parts depends upon their serviceability; refer to paragraph 2-45 for this information.

2-48. INSTALLATION OF STABILIZER ADJUSTMENT YOKE AND BUNGEE INSTALLATION. (See figures 2-15 and 2-16.)

a. Position the stabilizer yoke (25, figure 2-16) and insert stabilizer adjustment screw (11) into it through hole A in the fin leading edge fairing (shown in figure 2-16). Thread stabilizer adjustment screw (11) through washer (16). Position the control cable on pulley (17)

1. Control cable
2. Bolt
3. Nut
4. Cotter pin
5. Elevator cable
6. Elevator cable
7. Bolt
8. Washer
9. Nut
10. Cotter pin
11. Stabilizer adjustment yoke installation
12. Pulley
13. Bolt
14. Bushing
15. Washer
16. Washer
17. Nut
18. Elevator and aileron control installation
19. Pulley
20. Pulley guard
21. Bolt
22. Washer
23. Nut

Legend for Figure 2-13.

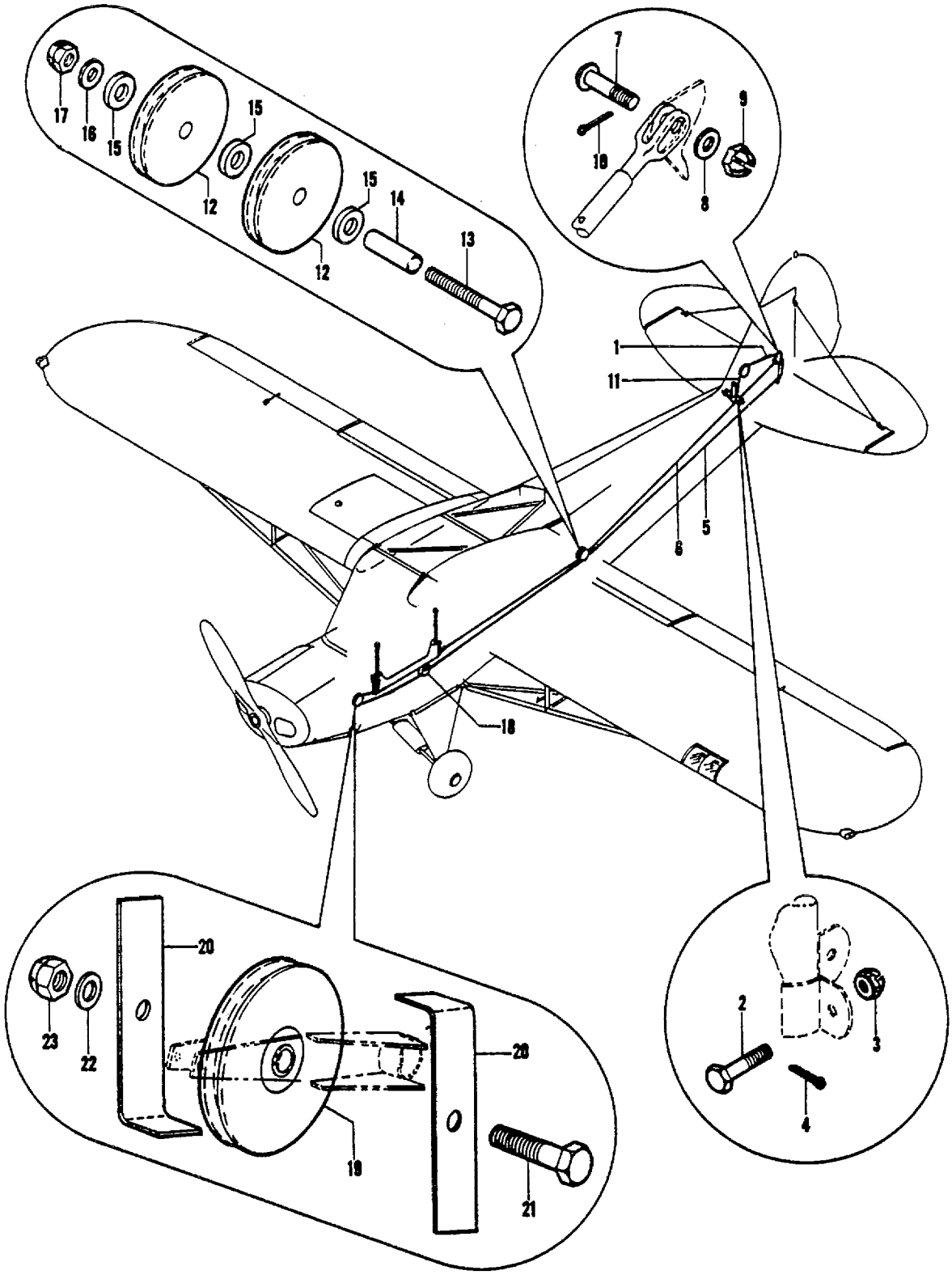
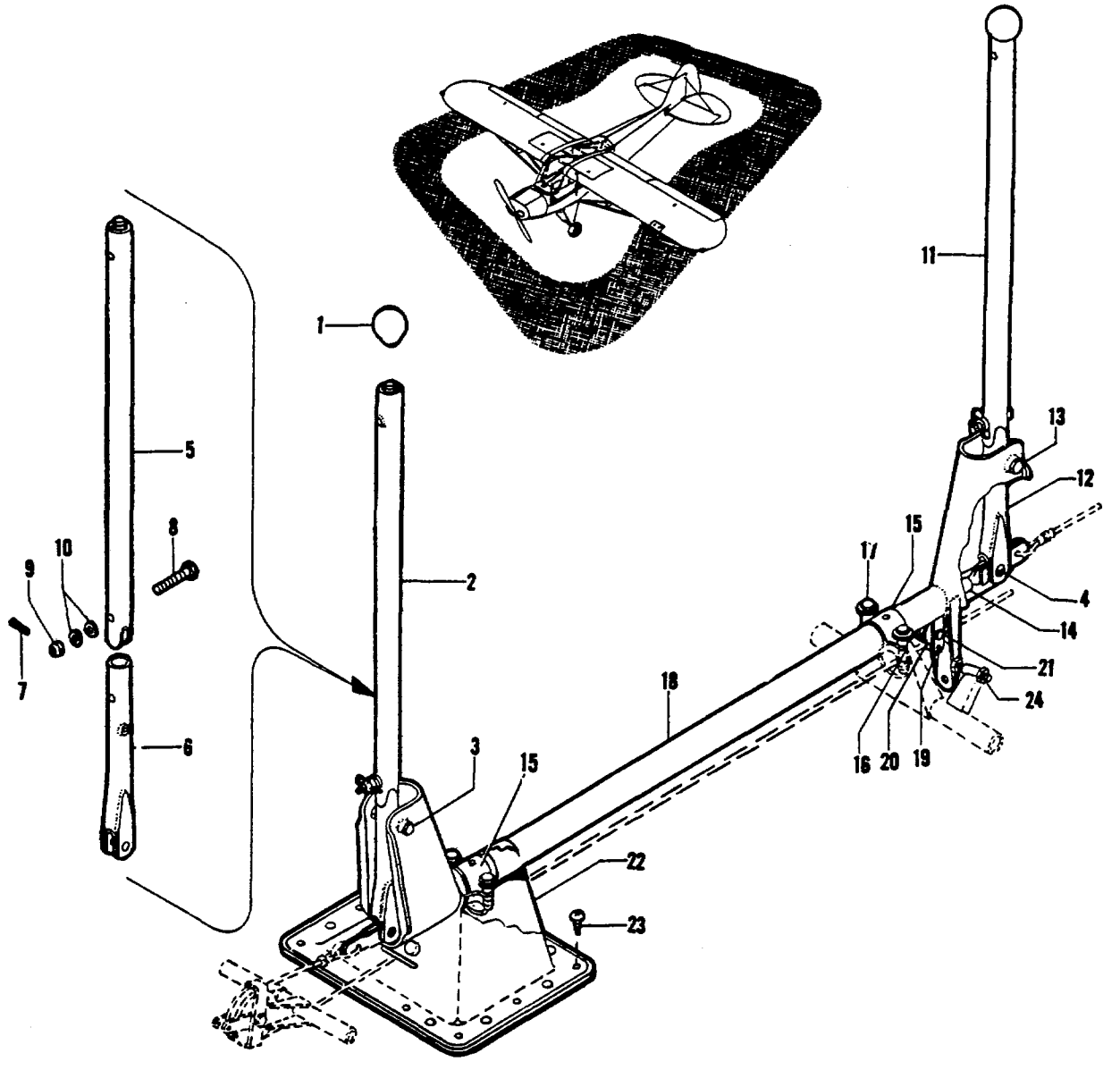


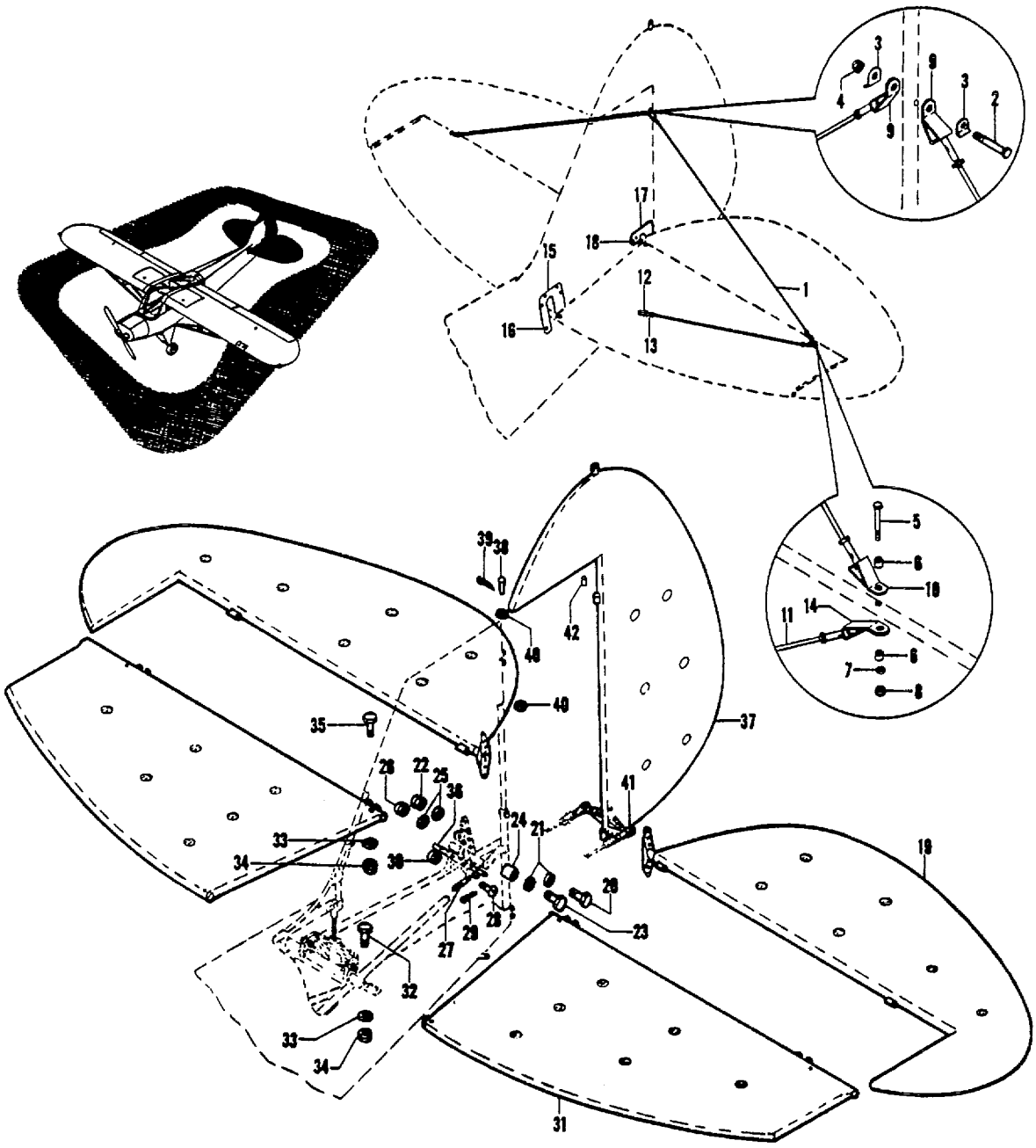
Figure 2-13. Elevator Control System



1. Knob
2. Front control stick
3. Bolt, nut, and cotter pin
4. Bolt, nut, and cotter pin
5. Control stick front
6. Front control stick stub
7. Cotter pin
8. Bolt
9. Nut
10. Washer
11. Rear control stick
12. Rear control stick stub
13. Bolt, wing nut, and cowl clip
14. Torque tube connector
15. Upper bearing
16. Shims
17. Bolt, washer, and nut
18. Torque tube
19. Cotter pin
20. Pulley
21. Bolt, steel bushing, washer, and nut
22. Control stick boot
23. Screw
24. Torque tube aileron stop

Figure.2-14. Elevator and Aileron Control Installation

Revised 14 October 1955



1. Upper tail brace wire
2. Bolt
3. Washer
4. Nut
5. Bolt
6. Bushing
7. Washer
8. Nut
9. Clevis
10. Clevis
11. Lower tail brace wire
12. Bolt and nut
13. Fuselage tie rod clevis
14. Clevis
15. LH and RH stabilizer yoke cover plate
16. Screw
17. LH and RH tail inspection
18. Screw
19. LH and RH covered elevator
20. Bolt
21. Washer
22. Nut
23. Bolt
24. Bushing
25. Washer
26. Nut
27. Elevator horn lower link
28. Bolt
29. Cotter pin
30. Nut
31. LH and RH covered stabilizer
32. Bolt
33. Washer
34. Nut
35. Bolt
36. Tube
37. Covered rudder
38. Flat-head pin
39. Cotter pin
40. Washer
41. Bolt, cotter pin and nut
42. Bronze bushing

Figure 2-15. Tail Surface Installation

according to figure 2-16 and assemble washers (15 and 16), stabilizer screw key (18), pulley (17), washer (14), and nut (13) on stabilizer adjustment screw (11). Lock the assembly with cotter pin (12).

b. Attach link (19) to the stabilizer yoke (25). Lock the assembly with cotter pin (21). Assemble indicator wire (33) to link (19).

c. Lubricate stabilizer adjustment screw (11) with a thin coat of grease, Specification No. AN-G-6, and apply a few drops of oil, Specification No. AN-O-6 to the oil holes in the link (19).

d. Reassemble the elevator horn cable (34) to the stabilizer yoke assembly (25). Reassemble pulley (31) to its housing after positioning the cable (34). Reassemble bungee spring (1) and pulley (3) to the stabilizer adjustment yoke (25).

e. Reassemble LH and RH stabilizer yoke cover plates (15, figure 2-15) to the fuselage.

2-49. INSTALLATION OF STABILIZER. (See figures 2-15 and 2-16.)

a. Position and assemble the LH and RH covered stabilizer (31, figure 2-15) to the stabilizer yoke (25, figure 2-16) and onto the rear stabilizer-to-fuselage link tube (36, figure 2-15). Secure with bolts (32 and 35, figure 2-15) and nuts (34). See Table III for proper torque values on bolts.

b. Reassemble the upper tail brace wire (1, figure 2-15) and lower tail brace wire (11).

c. Refer to paragraph 2-79 for a rigging check of the stabilizer assembly.

d. Lubricate the stabilizer-to-fuselage link tube with a few drops of oil, Specification No. AN-O-6.

2-50. INSTALLATION OF ELEVATOR. (See figure 2-15.)

a. Carefully assemble the LH and RH covered elevator (19, figure 2-15) and fasten the elevator horn cable (34, figure 2-16) and elevator horn spring (30) to the elevator horn upper link (29).

b. Connect bolts (20 and 23, figure 2-15). See Table III for proper torque value on bolts. Make sure that the connections pivot freely.

NOTE

Turnbuckles must be safetywired with 0.040 brass safety wire. Not more than two threads should be visible at each end of the turnbuckle barrel.

c. Reassemble LH and RH tail inspection panel (17, figure 2-15) to the fuselage.

d. Refer to paragraph 2-80 for a rigging check of the elevator assembly.

2-51. INSTALLATION OF RUDDER. (See figure 2-15.)

a. Position the covered rudder (37, figure 2-15) to the fin and fasten with flat-head pin, cotter pin, and washer (38, 39, and 40 respectively), and with bolt, cotter pin, and nut (41).

b. Reconnect the electrical wiring to the tail light figure 7-1).

c. Attach rudder cable(1, figure 2-9) to the rudder horn. Make certain that the connections pivot freely. Make sure that cotter pins are used to lock all nuts.

d. Hook the tail wheel steering springs (1, figure 2-24) to the rudder arm. Lubricate hinges (53, 54, and 55) with a few drops of oil, Specification No. AN-O-6.

e. Refer to paragraph 2-78 for a rigging check of the rudder.

2-52. INSTALLATION OF AILERONS. (See figures 2-3 and 2-8.)

a. Position the ailerons to the wing panels and secure assemblies with flat-head pin, washers, and cotter pin (48, figure 2-3) and bolt, nut, washer, and cotter pin (46).

b. Attach the aileron control cables (1 and 2, figure 2-8) to the aileron horns.

NOTE

Turnbuckles must be secured with 0.040 brass safety wire. Not more than two threads should be visible at each end of the turnbuckle barrel.

c. Lubricate aileron hinges (48, figure 2-3) with a few drops of oil, Specification No. AN-O-6.

d. Refer to paragraph 2-75 for a rigging check of the ailerons.

2-53. FUSELAGE.

2-54. DESCRIPTION. (See figure 2-71.) The primary fuselage structure consists of a welded steel tubular framework employing four longerons and warren truss-type shear bracing. Wing attachment fittings, tail surface attachment fittings, landing gear attachment fittings, and engine mount fittings are welded to the primary fuselage structure. The fuselage is fabric covered.

1. Bungee spring
2. Pulley bracket
3. Pulley
4. Bolt, washer, bushing and nut
5. Parking brake idler pulley
6. Bolt, washers, bushing, and nut
7. Pulley and bracket
8. Screw and nut
9. Pulley
10. Bolt, nut and cotter pin
11. Stabilizer adjustment screw
12. Cotter pin
13. Nut
14. Washer
15. Washer
16. Washer
17. Pulley
18. Stabilizer screw key
19. Link
20. Bolt
21. Cotter pin
22. Washer
23. Nut
24. Tube
25. Stabilizer yoke
26. Clamp
27. Screw
28. Nut
29. Elevator horn upper link
30. Elevator horn spring
31. Pulley
32. Bungee pulley housing
33. Indicator wire
34. Elevator horn cable

Legend for Figure 2-16.

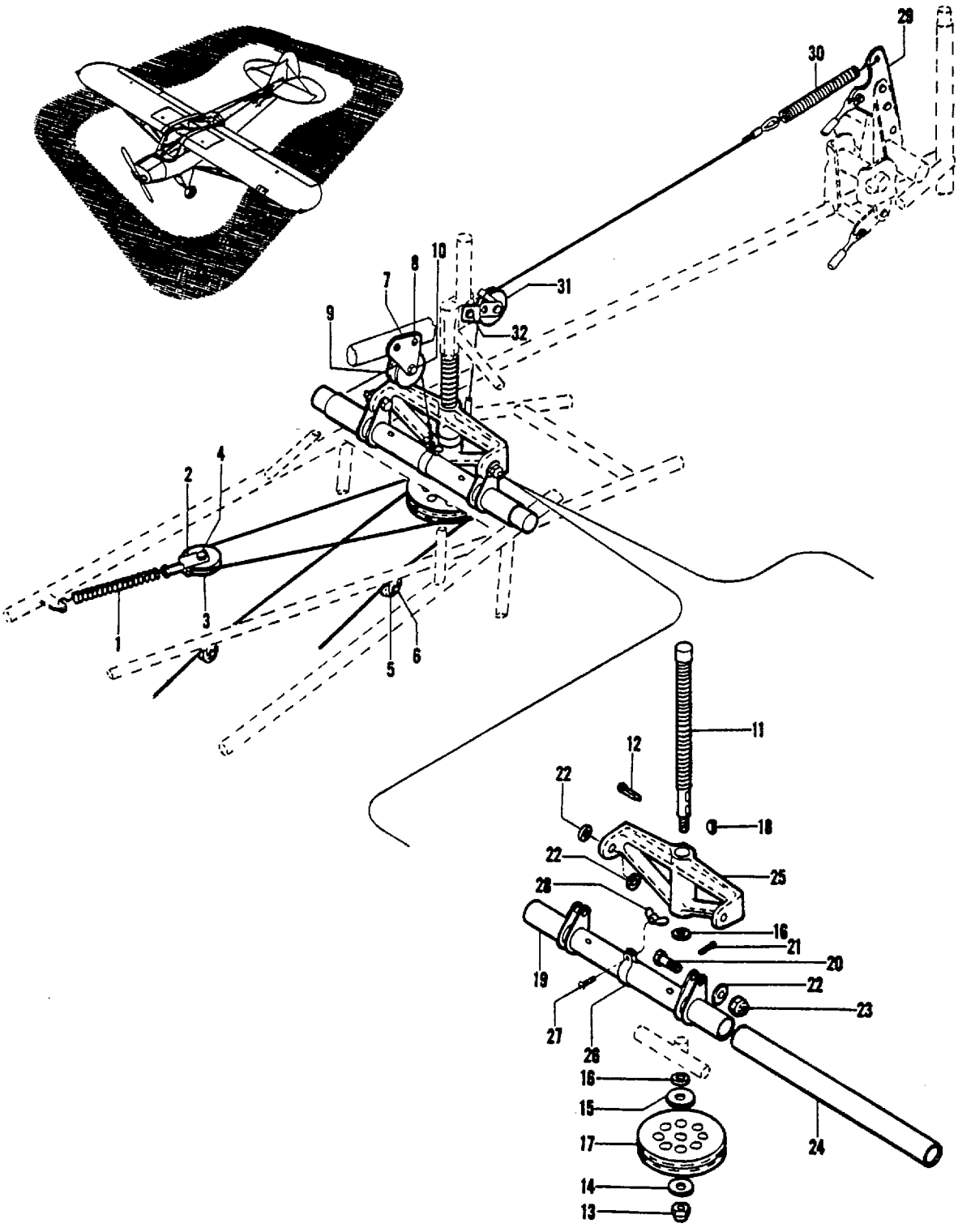


Figure 2-16. Stabilizer Adjustment Yoke and Bungee Installation

NOTE

Accumulations of dirt in the cockpit and in crevices between fuselage tubes and the fabric covering will collect moisture and cause corrosion of the metal or rotting of the fabric. Clean regularly as a preventive maintenance measure. Inspect the lower longerons near the tail post periodically to forestall corrosion.

2-55. COCKPIT ENCLOSURE. (See figure 2-17.) The cockpit enclosure is fabricated of a steel channel framework welded to the fuselage structure. The framework is covered with plexiglas. The enclosure extends from the windshield to a point approximately twenty inches aft of the wing trailing edge.

2-56. ENGINE MOUNTING. (See figure 5-3.) The engine mount consists of a welded steel tubular frame. The engine is bolted to this frame. In turn, the frame is supported by engine mount attachment brackets secured to the fuselage cowl assembly. The mounting frame and its supporting brackets are so designed that the engine can be swung away from the fuselage cowl on one side to provide ready access to the engine by maintenance personnel.

2-57. REMOVAL OF COCKPIT UPPER AND LOWER DOOR ENCLOSURES. (See figure 2-17.)

a. Open lower door enclosure (1, figure 2-17). Remove the door enclosure weather strip (2). Straighten and remove hinge pins and then separate the lower door from the fuselage.

b. Disassemble the upper door enclosure (5, figure 2-17) from the fuselage following the same procedure.

2-58. CLEANING OF COCKPIT UPPER AND LOWER DOOR ENCLOSURES. (See figure 2-17.)

a. Wipe the lower door fabric with clean cloth. If exceptionally dirty, wash the fabric with a non-alkali soap such as castile soap in warm water and rinse with clean water.

NOTE

Use solvent, Spec P-S-661, for dry cleaning purposes on oil and grease spots.

b. Clean dust and dirt from the upper door plastic panel with a solution of mild soap, Specification No. C-120 in warm water. Rinse well with clean water. Never wipe a transparent plastic panel when it is dry. Use clean water generously to wet the plastic surfaces before wiping. Oil or grease spots should be dissolved with aliphatic naptha, Specification No. AN-N-3, applied with a soft grit-free cloth.

CAUTION

Use only aliphatic naptha, Specification No. AN-N-3 to clean transparent plastic surfaces on the L-21A airplane since any other cleaning solution will destroy the transparency.

c. When the plastic surfaces are dry, use wax, Specification No. VV-P-121a, to obtain maximum transparency.

2-59. INSPECTION OF COCKPIT UPPER AND LOWER DOOR. (See figure 2-17.)

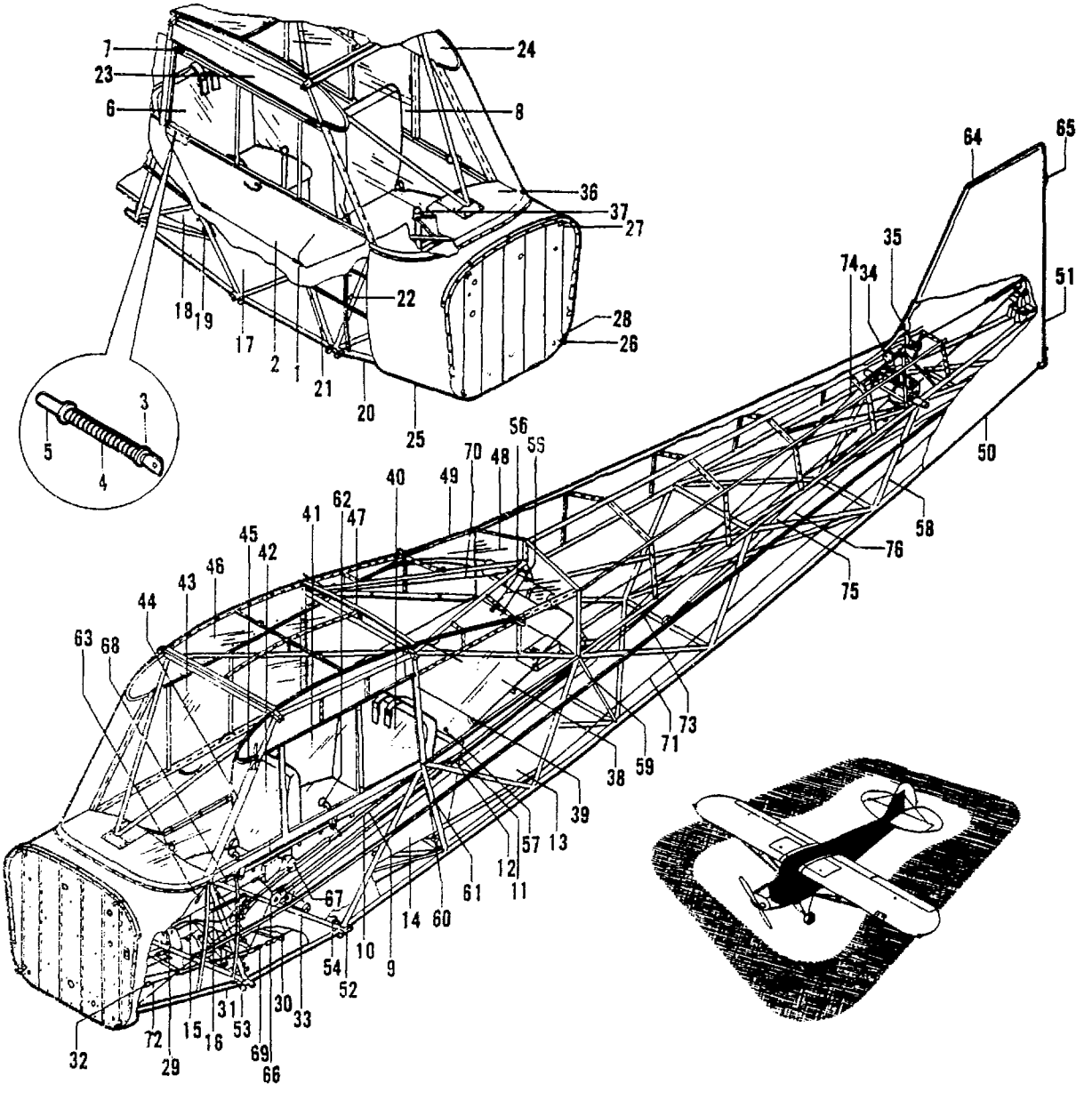
a. Examine the lower door assembly for tears or holes in the fabric. Refer to paragraph 2-19 for the proper repair procedure.

b. Inspect the lower door handle and door plunger rod and spring assembly for proper operation. The plungers should retract freely to a point just inside the ends of the door channel. If either or both door plunger mechanisms are not functioning properly they may be replaced by cutting back a four inch width of

1. Lower door enclosure
2. Door enclosure weather strip
3. Washer
4. Door plunger spring
5. Door plunger rod
6. Upper door enclosure
7. Screw and nut
8. Seats installation
9. Cockpit left top panel
10. Screw and nut
11. Cockpit top rear panel
12. Screw and nut
13. Cockpit left rear panel
14. Cockpit left panel
15. Cockpit left front panel
16. Screw, washer, and nut
17. Cockpit right center panel
18. Cockpit right rear panel
19. Screw
20. Cockpit right front panel
21. Screw and nut
22. Screw, washer, and nut
23. Cockpit upper right trim panel
24. Cockpit upper left trim panel
25. Fuselage cowl
26. Cowl channel attachment angle
27. Cowl channel attachment angle
28. Screw, nut, and washer
29. Elevator and aileron control installation
30. Brake Installation
31. Floorboards installation
32. Rudder pedals installation
33. Stabilizer adjustment
34. Stabilizer adjustment
35. Bungee installation
36. Instrument panel installation
37. Control stick lock
38. Rear enclosure window
39. LH and RH window trim strip
40. Rear sliding window
41. Front sliding window
42. Front enclosure window
43. Plexiglas window
44. LH and RH trim strip
45. LH and RH window trim strip
46. Topdeck front window

Legend for Figure 2-17.

Revised 27 December 1954



47. Window trim strip
48. Topdeck rear window
49. LH and RH window trim strip
50. Fuselage frame
51. Tail post
52. LH and RH landing gear and lift strut fitting
53. Landing gear front fitting
54. Aileron pulley housing cover
55. Deck
56. Screw, washer, clamp, and nut
57. Screw, washer, and nut
58. Fairlead segment
59. Fairlead cable
60. Stabilizer adjustment control cable guide block
61. Stabilizer adjustment control cable rub plate
62. Aft throttle control knob
63. Airspeed tube
64. Vertical fin
65. Bronze bushing
66. Control cable
67. Ignition switch
68. Throttle control
69. Flap control cable
70. Flap control cable
71. Rudder control cable
72. Rudder control cable
73. Stabilizer adjustment cable
74. Indicator wire
75. Elevator control cable
76. Elevator control cable

Figure 2-17. Fuselage Assembly

fabric on the inside of the door (see figure 2-17). Repair fabric according to steps b and c of paragraph 2-19.

c. Examine the catch spring assembly (89, figure 2-1). Replace damaged parts.

d. Check the upper door enclosure plastic panel for damage such as scratches, cuts, cracks or holes. Replace the plastic panel if it cannot be repaired according to step c of paragraph 2-60.

2-60. MINOR REPAIR OF COCKPIT UPPER AND LOWER DOOR ENCLOSURES. (See figure 2-17.)

a. No repairs other than realigning minor dents and bends in metal parts are to be undertaken. Severely damaged, buckled or inoperative parts are to be replaced. A faulty door plunger (rod and spring) assembly must be replaced (see references 3, 4, and 5, figure 2-17 and refer to step b of paragraph 2-59).

b. Repair tears or holes in fabric according to steps b and c of paragraph 2-19.

c. Repair scratches in the plastic panel as follows: Hairline scratches may be removed by rubbing with a commercial automobile-body cleaner. Deeper scratches must be sanded with No. 320 or finer sandpaper wrapped around a rubber or wood block. Sand the plastic surface with a circular motion as illustrated in figure 2-18 always wetting the abrasive with water to prevent scratching the surface further. Do not exert excessive pressure. The sanding operation would be continued using progressively finer abrasives until the scratches disappear. Wash the sanded area with clean water to remove gritty particles. The sanded area will be cloudy in appearance. Restore full transparency by using a buffing wheel loaded with protective coating, Specification No. MIL-C-6799. Use a moderate surface speed since excessive wheel speed will produce heating and distortion of the plastic surface. When the cloudiness has disappeared, wash the area thoroughly and dry with a soft cloth.

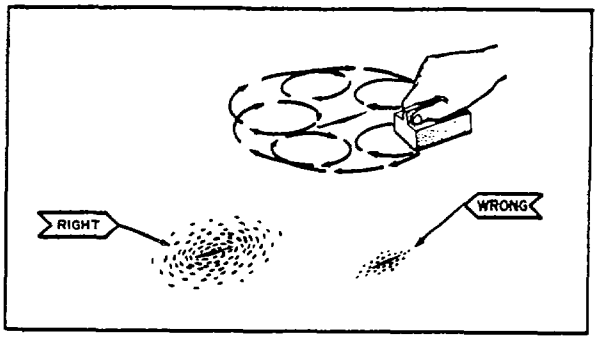


Figure 2-18. Hand Setting of Transparent Plastic Panels

d. Cracks in the plastic panel may be repaired as follows: Drill a hole at the end of the crack to relieve stress and thereby prevent spreading of the crack. A temporary repair may be effected by cementing a fabric patch over the crack as illustrated in figure 2-19 with either dope, Specification No. AN-D-1 or lacquer, Specification No. AN-TT-L-61. Permanent repairs can be accomplished by heating a thin sheet of Plexiglas and forming it to the area to be patched. Bevel the edges of the patch. Polish both patch and damaged area until fully transparent. Cement the patch in place with monomeric-methyl-methacrylate cement (No. 1A, Rohm & Hass Company, or equal)

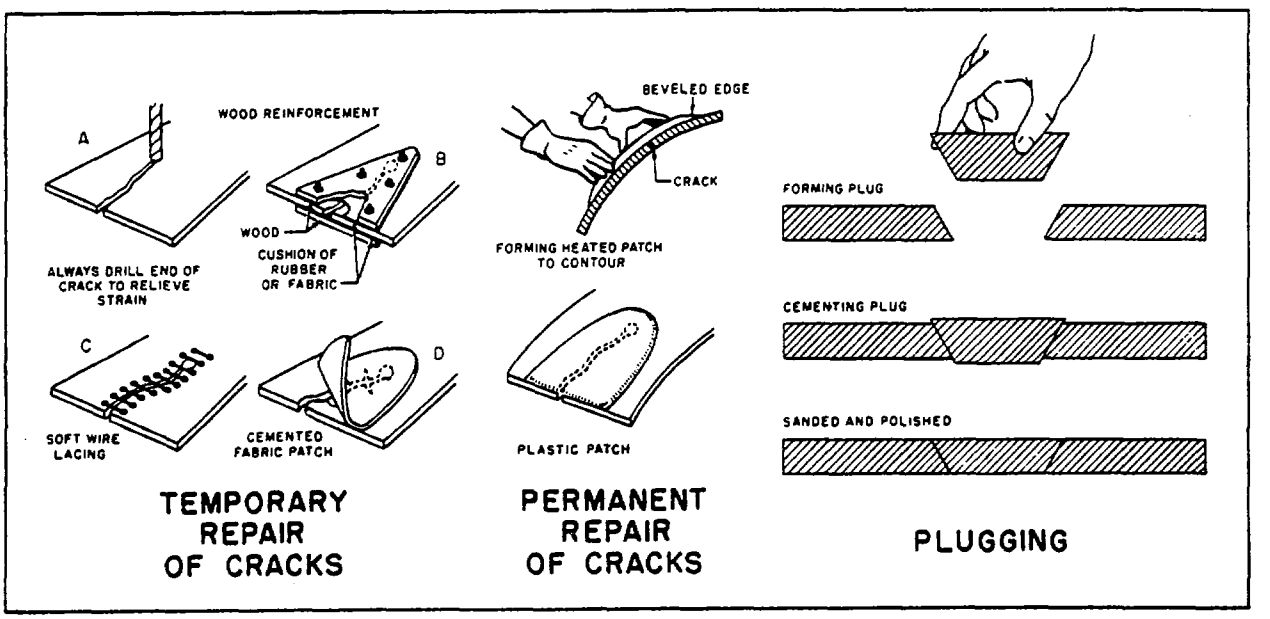


Figure 2-19. Plastic Repairs

and apply pressure until the cement is dry. (See figure 2-19.) When dry polish in accordance with step c above.

e. Holes, cracks, and imperfections covering small areas can be permanently repaired by plugging in accordance with the following instructions:

Clean out the damaged area by cutting a circular hole large enough to include all damaged material. Bevel the edges of the hole toward the outside approximately 60 degrees.

Form the circular plug of the same material as the damaged panel and about 1/16-inch thicker than the panel.

Bevel the edges of the plug slightly more than the bevel in the panel.

Heat the edge of the plug until it is soft and pliable and press it into the hole sufficiently hard to cause it to take the exact shape of the hole.

Allow the plug to cool and remove.

NOTE

Heating is accomplished most effectively in an oven or over an alcohol lamp. Bring the plug temperature to between 121° C (250° F) and 149° C (300°F).

Cover both surfaces of the fitted plug with masking tape and trim the tape flush around the edges of the plug. Soak the plug in plastic cement, Specification No. MIL-C-3116, until the edges are soft.

Press the plug into the hole and allow it to set under pressure. Approximately 24 to 26 hours will be required before the surface can be sanded and polished.

Remove the tape and file or sand the plug down until its surface is level with the surface of the panel. Then polish both surfaces of the patch in accordance with paragraph 2-60.

2-61. REPLACEMENT OF PARTS. (See figure 2-17.) Replacement of parts depends upon their serviceability. Refer to paragraph 2-59 for this information.

2-61A. CRITERIA FOR LIMITS AND TOLERANCES OF PLASTIC PANEL DEFECTS.

2-61B. DEFINITIONS.

a. Nicks. Broken identations or cavities having sharp edges.

b. Dents. Depressions or hollows left by blows or concentrated pressures.

c. Conchodial Fracture. The cavity left by the loss of a chip in the form of a clam shell.

d. Scratches. Tears in the surface made by a pointed object.

e. Cracks. Narrow fractures extending deeper than scratches.

f. Crazing. A pattern or area of tiny fissures or splits.

g. Discoloration. Occurs as a brown to dark brown color.

h. Reparable Defects. Those capable of and approved for repair.

i. Permissible Defects. Those acceptable without repair or rework.

2-61C. NICKS, DENTS AND CONCHODIAL FRACTURES.

a. Critical Vision Area (Windshield and Window Inclosures Front)

(1) Reparable nicks, dents, etc.
None allowable.

(2) Permissible nicks, dents, etc.
Length - 0.250 inch maximum.
Width - 0.125 inch maximum.
Depth - 10% of thickness up to 0.100.
Frequency - 2 per area.

b. Non-Critical Area (All Windows Other Than Critical Vision Area)

(1) Reparable nicks, dents, etc.
Length - 0.250 inch maximum.
Width - 0.100 inch maximum.
Depth - 20% of thickness up to 0.100.
Frequency - 2 per square feet of area maximum.

(2) Permissible nicks, dents, etc.
Length - 0.125 inch maximum.
Width - 0.016 inch maximum.
Depth - 10% of thickness up to 0.100.
Frequency - 1 per square foot of area maximum.

2-61D. SCRATCHES.

a. Critical Vision Area (Windshield and Window Inclosures Front)

(1) Reparable scratches.
Length - 5.00 inch total per area maximum.
Width - 0.02 inch maximum.
Depth - 20% of thickness up to 0.100.
Frequency - See length above.

NOTE

Repair shall be such as to cause no impairment in optical characteristics.

(2) Permissible scratches.
Length - 5.0 inch maximum.
Width - 0.02 inch maximum.
Depth - 10% of thickness up to 0.100.
Frequency - 1 per area. Hairline scratches (depth of 0.001 or less) are acceptable in any amount and area so long as they do not cause vision blur or create undesirable glare.

NOTE

Waxing is required to minimize impairment of vision.

b. Non-Critical Area (All Windows Other Than Critical Vision Area)

(1) Reparable scratches.
Length - 24 inch maximum.
Width - 0.05 inch maximum.
Depth - 20% of thickness up to 0.100.
Frequency - 20% of total area maximum.

(2) Permissible scratches.
Length - 24 inch maximum.
Width - 0.02 inch maximum.
Depth - 10% of thickness up to 0.100.
Frequency - Total length of scratches 3 times longest dimension of area maximum.

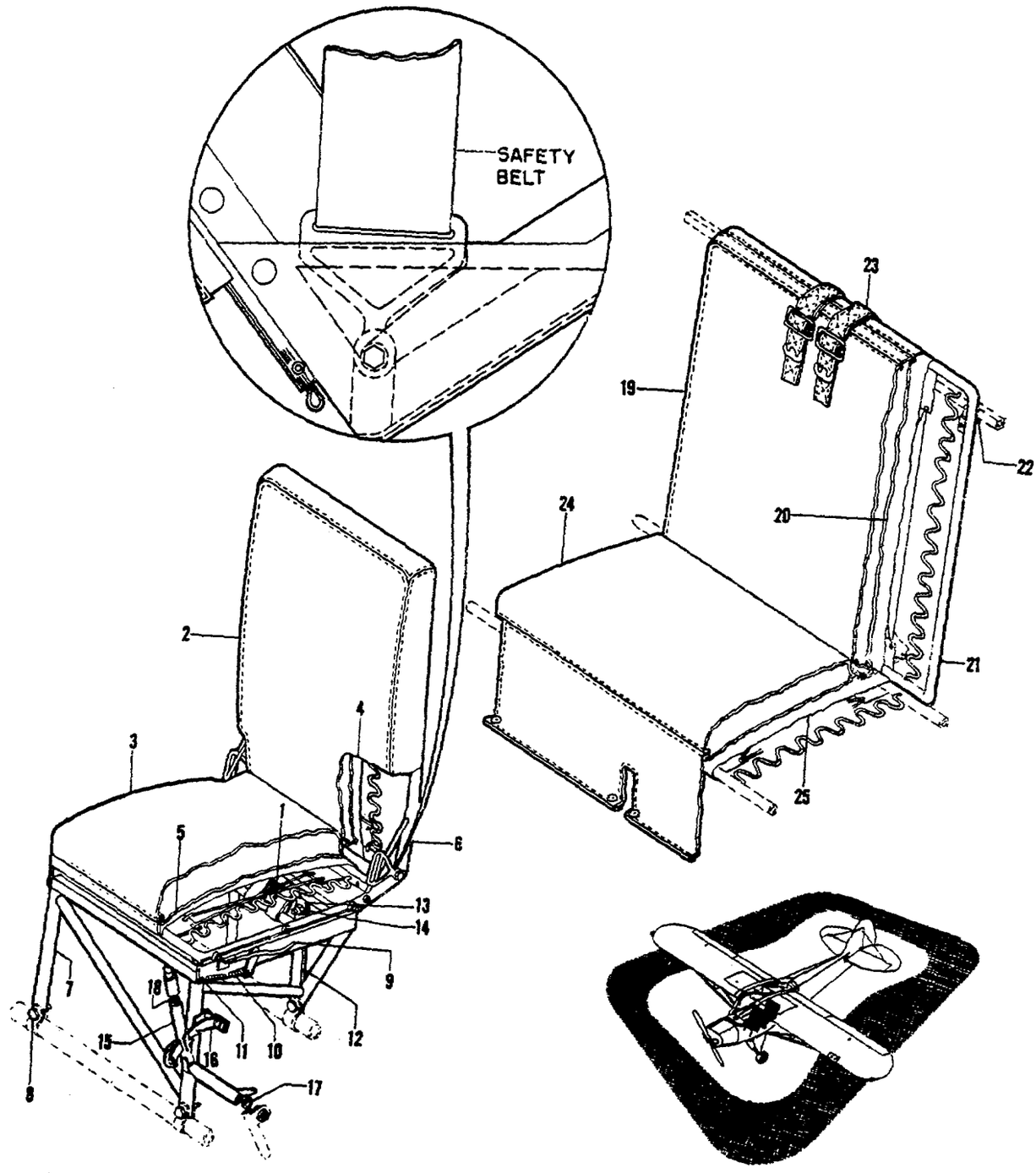


Figure 2-20. Seats Installation

2-61E. CRACKS.

a. Critical Vision Area (Windshield and Window Inclosures Front)

(1) Reparable cracks.
None allowable..

(2) Permissible cracks.
None allowable.

b. Non-Critical Area (All Windows Other Than Critical Vision Area)

(1) Reparable cracks.
Length - 12 inch maximum.
Width - 0.05 inch maximum.
Frequency - Repaired area equal 10% total area maximum.

(2) Permissible cracks.
Length - 2 inch maximum.
Width - 0.02-inch maximum.
Frequency - 6 of maximum lengths or 12 inch total per area maximum.

NOTE

All cracks shall be stop drilled. See Technical Order 1-1A-12.

2-61F. CRAZING.

a. Critical Vision Area (Windshield and Window Inclosures Front)

(1) Reparable crazing.
None allowable.

(2) Permissible crazing.
None allowable.

b. Non-Critical Area (All Windows Other Than Critical Vision Area)

(1) Reparable crazing.
Slight - no requirements.
Severe - 10% of area maximum.

(2) Permissible crazing.
Slight - 25% of area maximum.
Severe - 5% of area maximum.

2-61G. DISCOLORATION.

a. All Areas.

(1) Reparable discoloration.
None allowable - not reparable.

(2) Permissible discoloration.
May extend 1 inch from the entire edge area of the plastic inclosure unless otherwise noted.

2-62. INSTALLATION OF COCKPIT UPPER AND LOWER DOOR ENCLOSURES. (See figure 2-17.)

a. Position the lower door enclosure (1, figure 2-17) to the fuselage by inserting the hinge pins. Bend both ends of each hinge pin to prevent them from sliding out of the hinge. Attach the upper door enclosure to the fuselage in the same manner.

b. Assemble the weather strip (2, figure 2-17) to the lower door assembly. Lubricate all hinges with a few drops of oil, Specification No. AN-O-6.

2-63. REMOVAL OF SEAT ASSEMBLIES. (See figure 2-20.)

a. The front seat frame assembly (6, figure 2-20) may be removed as a unit by disassembling bolt and nut (8). Remove cowl clip (22) and pull out seat stop pin (27). Slide the frame assembly (6) off the front seat base (7) after releasing seat catch lever assembly (9).

b. Remove the front seat bottom cushion (3) by unsnapping the snap fasteners. Remove the front seat back cushion (2) by unsnapping the fasteners and pulling it off the frame.

c. The front seat may be disassembled further if necessary for repair or replacement of parts.

d. Remove the rear seat bottom cushion assembly (24) by removing its snap fasteners. The back cushion assembly may be removed by sliding it off the frame. The rear seat may be disassembled further if necessary for repair or replacement of parts.

2-64. CLEANING OF SEAT ASSEMBLIES. (See figure 2-20.)

a. Clean all metal parts with a cloth moistened in dry cleaning solvent, Specification No. P-S-661.

b. Wash seat cushions with soap and water. Rinse thoroughly.

NOTE

Use solvent, Spec P-S-661, for dry cleaning purposes on oil and grease spots.

2-65. INSPECTION AND REPAIR OF SEAT ASSEMBLIES. (See figure 2-20.)

a. Inspect each shoulder harness strap assembly (23, figure 2-20) and safety belt (26) for damage or wear. These assemblies must be replaced if damaged or worn.

b. Examine all cushion assemblies for tears, holes, or other damage. Repair damaged cushions with suitable patches.

c. Inspect seat frames for minor damage. Repair damaged parts. Check operation of front seat adjustment. Wipe the front seat tracks with a rag, moistened in oil, Specification No. AN-O-6.

2-66. INSTALLATION OF SEAT ASSEMBLIES. Both front and rear seat assemblies may be reinstalled in the reverse order of their removal. (See figure 2-20.)

2-67. REMOVAL OF WINDSHIELD, ENCLOSURE SIDE WINDOWS, AND TOPDECK WINDOWS. All windshield and window plastic panels may be disassembled by removing their attaching screw according to figure 2-17. Do not remove windshield or windows unless necessary for repair or replacement of parts.

2-68. CLEANING OF WINDSHIELD, ENCLOSURE SIDE WINDOWS, AND TOPDECK WINDOWS. (See figure 2-17.) Repair plastic windows according to steps c, d, and e of paragraph 2-60.

2-69. Repairs on the curved sections of the plastic windshields are not recommended since these curved areas are stressed and the process of heating and patching will result in severe optical distortion. The windshield should be replaced when damaged beyond full serviceability.

2-70. INSTALLATION OF WINDSHIELD, ENCLOSURE SIDE WINDOWS, AND TOPDECK WINDOWS. Install windshield and plastic window panels according to figure 2-17 by securing them to the fuselage frame with their attaching screws.

2-71. RIGGING THE AIRPLANE.

2-72. RIGGING DIMENSIONS. (See figure 2-21.) Level the airplane laterally and longitudinally as explained in paragraph 1-14. Check alignment of the wings and tail surfaces according to figure 2-21. Perform all adjustments according to paragraphs 2-72 through 2-80.

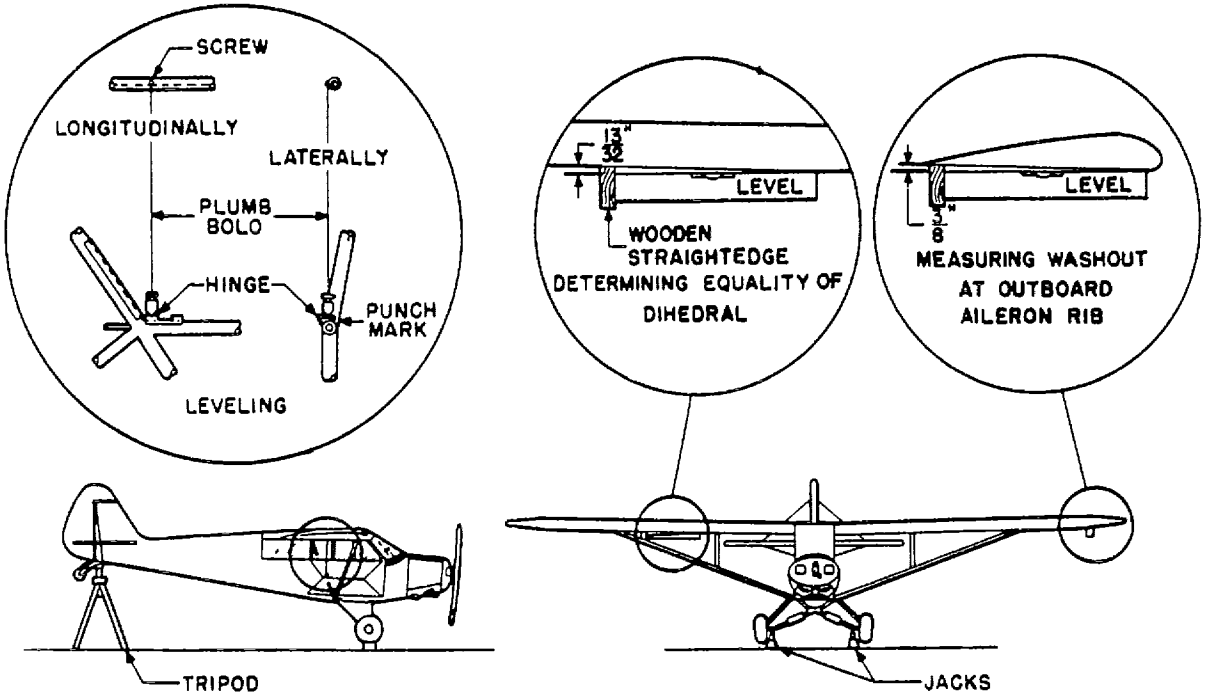


Figure 2-21. Rigging Diagram

2-73. DIHEDRAL ANGLE. (See figure 2-21.)

a. With front wing root fairing (3, figure 2-3) removed, stretch a string from wing tip to wing tip above the front spar and measure down from the string to the top of the fuselage front spar butt hinge fitting (46, figure 2-1). The measurement should be three inches plus or minus 1/8-inch.

b. To determine the equality of dihedral of each wing panel, hold a wooden straightedge on the end of a 30-inch level so that one end of the straightedge protrudes 13/22 of an inch above the level (see figure 2-21) and place the combination along the front spar bottom between the lift strut and jury strut attachment fittings as illustrated in figure 2-21. The bubble should be approximately centered. Check the opposite wing panel in the same manner.

c. If the dihedral angle is not equal for both wing panels, let out on the threaded fork of the lower end of strut until the dihedral angle for each panel is equalized. Be careful to let out one strut exactly the same number of turns as the other strut is taken in. Recheck the total dihedral according to step a and readjust if necessary.

2-74. WASHOUT. (See figure 2-21.)

a. Check the washout of each wing by holding a wooden straightedge on the end of a 30-inch level so that one end of the straightedge protrudes 3/8 of an inch above the level (see figure 2-21) and placing this combination along the undersurface of the full rib next to the outer end of the aileron. The level end with straightedge spacer should be to the rear of the rib while the other end of the level should be placed under the front spar. Correct washout exists when the bubble is centered.

b. To obtain the proper washout, let out on the threaded fork at the lower end of the strut at the fuselage end until the bubble is centered according to step a.

2-75. AILERONS. The ailerons must be rigged so that their trailing edges do not extend more than 1/8-inch above or 3/8-inch below the wing trailing edge with control sticks in neutral position. These adjustments are accomplished by taking up on the turnbuckles running to the upper aileron horns and simultaneously letting out the turnbuckles running to the lower aileron horns to raise the aileron trailing edge. The aileron trailing edge may be lowered by reversing the

1. Shoulder harness strap
2. Front seat back cushion
3. Front seat bottom cushion
4. Seat back canvas
5. Seat bottom canvas
6. Front seat frame
7. Front seat base
8. Bolt and nut
9. Seat catch lever
10. Spring
11. Screw
12. Shoulder harness attachment bracket
13. Squared offset clamp
14. Bolt and nut
15. Flap control lever
16. Flap lever ratchet
17. Washer
18. Washer
19. Rear seat back cushion
20. Rear seat back canvas
21. Rear seat back
22. Cowl clip
23. Shoulder harness strap
24. Rear seat bottom cushion
25. Rear seat bottom canvas
26. Safety belt
27. Seat stop pin

Legend for Figure 2-20.

Revised 15 October 1956

procedure. Adjust the aileron stops (24, figure 2-14) until the clearance between stop bolts and torque tube aileron arm is 3/32-inch when ailerons have reached the limits of their travel. Check that control cables are properly adjusted. Tight cables make stick action stiff while loose cables result in stick action that is too free and uncertain. Properly adjusted cables should not slap or wobble when stick is moved back and forth in rapid succession.

NOTE

Do not draw turnbuckles tightly against the horns; turnbuckles should move freely over the horns in all positions. When adjusting turnbuckles, not more than two threads should be visible at each end of turnbuckle barrel. Turnbuckles must be safety-wired with 0.040 brass safety wire.

2-76. FLAPS. Position flap control arm so that flaps are in "UP" position. Adjust turnbuckles on flap control cable (5) until flap trailing edges line up with the wing trailing edge. Move flap control arms to "DOWN" position and similarly adjust the flaps until their undersurfaces make an angle of 50 degrees with the undersurface of the wing. Recheck flap trailing edge position when flaps are up.

NOTE

When adjusting turnbuckles, not more than two threads should be visible at each end of turnbuckle barrel. Turnbuckles must be safety-wired with 0.040 brass safety wire.

2-77. FIN. Plumb the fin at the rudder hinges and make any necessary adjustments.

2-78. RUDDER. Check that the rudder is centered when rudder pedals are in neutral position and that full rudder travel to the left and right is obtainable. Make all adjustments on control cable turnbuckles at rudder horn. Make certain that not more than two threads are visible at each end of turnbuckle barrel and safety-wire the assembly. Plumb the fin at the rudder hinges.

2-79. STABILIZER. Level the stabilizer laterally at the rear spars. The tolerance is plus or minus 1/2 degree. Check that the stabilizer travel is 2 degrees 31 minutes UP and 4 degrees plus or minus 30 minutes DOWN from the neutral position.

NOTE

(Level airplane, see figure 2-21.) The tension of the tail brace wires will be adjusted to obtain 7/16 inch plus or minus 1/16 inch deflection when a load of 10 pounds plus or minus 1 pound is applied at right angles at the center of the wire. The rear spar of the stabilizer will be level and the elevator hinge line straight. The fin will be vertical at the rudder hinge center line.

2-80. ELEVATORS. Check that the elevators are in neutral position when the control sticks are in neutral. Check that full elevator travel is realized.

2-81. MAIN LANDING GEAR.

2-82. DESCRIPTION. (See figure 2-22.) The main landing gear incorporates individually sprung wheels mounting low pressure 8.00 x 4 tires. The landing gear vee is hinged at the fuselage and the axles are welded directly to the lower ends of the vee. The shock absorbing struts consist of steel tubes incorporating shock absorbing hydraulic units and rubber shock cord rings. The hydraulic brake system brakes each wheel individually for easy ground maneuvering. Heel-type brake pedals are mounted on each side of the cockpit. The rear set of brake pedals are directly connected to the master cylinders and the front pedals are connected to the rear pedals by means of wire tire rods. The right front-and-rear pedals are connected to the right master cylinder actuating the right wheel brake and the left set of pedals are connected to the master cylinder actuating the left wheel brake. Parking brake control rods are provided for handlocking the brakes. In order to set the parking brake, pull back on the parking brake control rods (42, figure 2-23).

2-83. REMOVAL OF MAIN LANDING GEAR. (See figure 2-22.)

a. Place the fuselage on a padded horse of sufficient height so that the main landing wheels clear the ground. The horse should contact the fuselage at a point just behind the rear landing gear fittings.

1. Landing gear cabane vee
2. Bolt, washer and nut
3. Shock strut
4. Shock cord cover
5. Screw
6. Shock strut tube
7. Bolt, washer and nut
8. Shock cord cover end plate
9. Grommet
10. Shock strut end fitting
11. Shock strut end fitting
12. Rubber durometer washer
13. Shock cord ring
14. Shock strut
15. Bolt, nut, cotter pin and washer
16. Bolt, nut, cotter pin and washer
17. LH and RH covered landing gear vee
18. LH and RH landing gear vee
19. Brake line
20. Bolt
21. Bolt, washer, nut and cotter pin
22. Bushing
23. Hub cap
24. Screw
25. Tire and tube
26. Wheel
27. Cotter pin
28. Axle nut
29. Brake
30. Bolt
31. Nut
32. Plate
33. Expander tube
34. Clip
35. Brake shoe
36. Plate
37. Dust cap
38. Connector
39. Bolt
40. Nut
41. Cabin mounting step
42. Bolt, nut and cotter pin

Legend for Figure 2-22.

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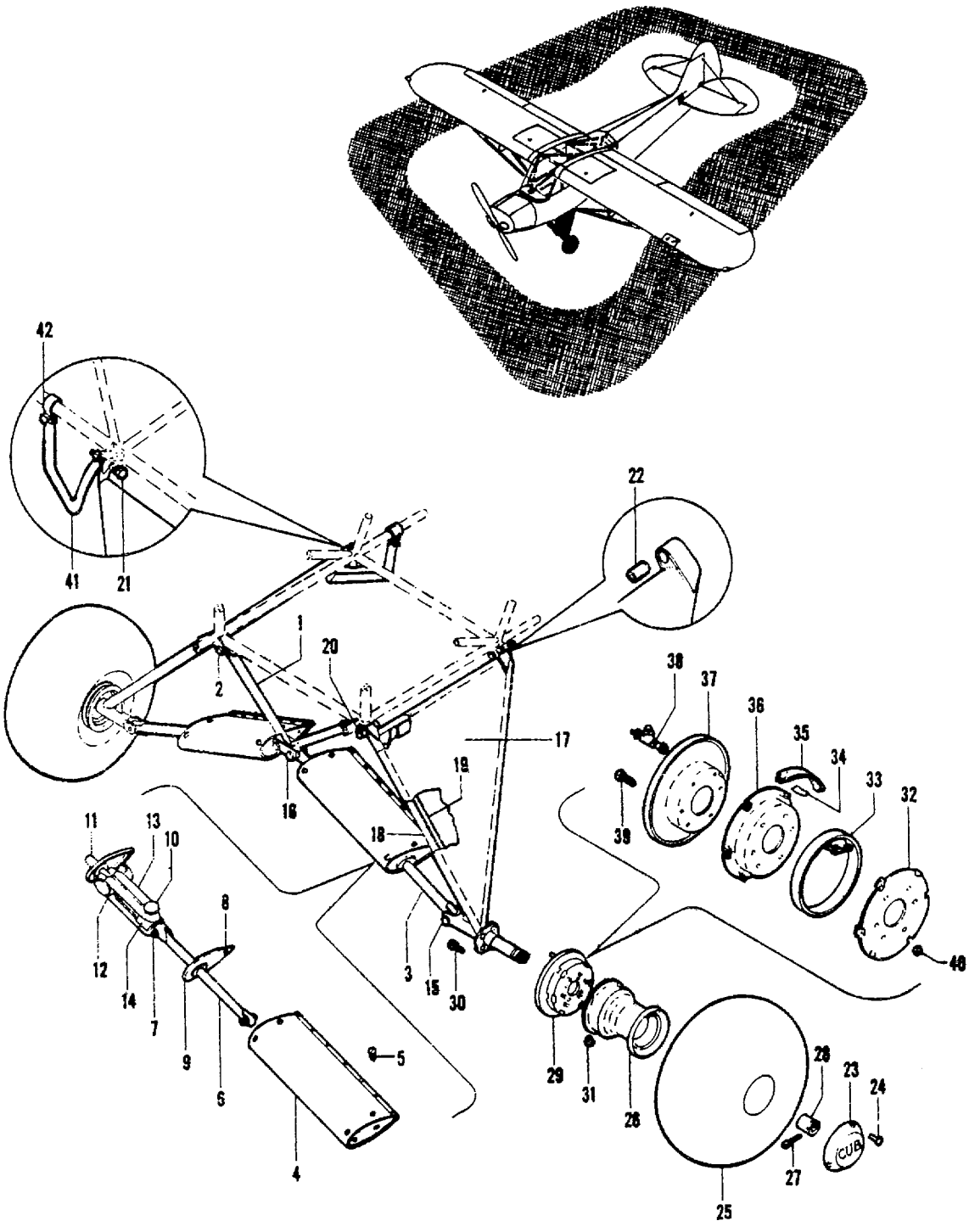

Figure 2-22. Landing Gear Installation

b. Disconnect the LH and RH brake line assemblies (19, figure 2-22) at the fuselage.

c. Remove bolt, washer, and nut (2, figure 2-22), bolt (20), bolt, washer, nut and cotter pin (21), and bushing (22). Roll the main landing gear away from the airplane for further dismantling work.

d. Remove bolts, nuts, cotter pins, and washers (15 and 16) and separate shock struts (3 and 14) from the covered landing gear vee (17). Disassemble the shock strut assemblies according to figure 2-22.

2-84. CLEANING OF MAIN LANDING GEAR. (See figure 2-22.)

a. Clean all metal parts with a cloth moistened in dry cleaning solvent, Specification No. P-S-661.

b. Wipe shock cord rings (13, figure 2-22) with a clean cloth. Oil or grease should be removed with a soap and water solution. Rinse with clear water and wipe dry. Similarly, clean the LH and RH brake line assemblies (19).

2-85. INSPECTION OF MAIN LANDING GEAR. (See figure 2-22.)

a. Examine all attaching nuts and bolts for wear, distortion, and damaged threads. Replace damaged parts.

b. Inspect all metal parts for cracks, distortion, corrosion, and other damage. Replace parts that are damaged beyond repair. Corroded spots must be sanded down to good metal and coated with primer, Specification No. AN-TT-P-656. After the primer dries, apply suitable coloring.

c. Examine shock cord rings (13, figure 2-22) for cuts and deterioration. Replace any cut or deteriorated shock cord rings.

d. Check the shock struts (14) for evidences of leakage. Replace faulty shock struts.

e. Inspect the LH and RH brake line assemblies (19) for deterioration or other damage. Replace a brake line if deteriorated or damaged.

2-86. MINOR REPAIR OF MAIN LANDING GEAR. (See figure 2-22.) There are no repairs for metal parts outside of forestalling corrosion and realigning minor dents or bends. All severely damaged or buckled metal parts must be replaced.

2-87. REPLACEMENT OF PARTS. Replace all cotter pins that have been removed with new ones. Replacement of other parts depends upon their serviceability; refer to paragraph 2-85 for this information.

2-88. INSTALLATION OF MAIN LANDING GEAR. (See figure 2-22.)

a. Reassemble shock struts according to figure 2-22.

b. With the fuselage resting on the padded horse as described in step a of paragraph 2-83, attach covered landing gear vee assemblies (17, figure 2-22) (with the wheels assembled) to the fuselage. Position all bolts with their heads forward. Fasten cabin mounting step (41) with bolt, washer, nut, and cotter pin (21) on the RH side of the fuselage. See Table III for torque values to be applied to bolt (20) and bolt, washer, nut, and cotter pin assembly (21).

c. Carefully assemble shock struts to landing gear cabane vee (1) and to the LH and RH axles. Position all bolts with their heads forward. See Table III for torque values to be applied to bolts (2, 15, and 16). Lock all bolts with cotter pins.

d. Reconnect the LH and RH brake line assemblies (19) to the fuselage end.

e. Carefully lift the fuselage and remove the padded horse which has been supporting it during the repair work.

2-89. BRAKE SYSTEM TROUBLESHOOTING CHART.

TROUBLE	PROBABLE CAUSE	REMEDY
SOFT BRAKES (SPONGY PEDAL ACTION)	Air in brake system.	Bleed system according to paragraph 2-97.
	Flexible hose old, deteriorated and expanded.	Install new hose (21, figure 2-23) and check system for leaks.
EXCESSIVE PEDAL TRAVEL	Worn and/or burned brake blocks.	Replace worn and/or burned brake blocks (35 and 39, figure 2-23).
BRAKES DRAG	Brake shoes fail to release.	Repair wheel brake according to step c of paragraph 2-96.
	Excessive fluid pressure "locked in".	Adjust brake system by releasing "locked in" pressure.
	Parking mechanism does not release properly.	Check parking brake value (20, figure 2-25 and parring crane). Clean control rod (42) for binding and oil linkages.

TROUBLE	PROBABLE CAUSE	REMEDY
BRAKES FAIL TO HOLD	Brake shoes burned.	Replace burned brake shoes (35, figure 2-22).
	Oil or grease on brake shoes or drum.	Disassemble wheel brake (29, figure 2-22) remove grease or oil and reassemble.
	Brake shoes frozen to retainers due to freezing temperatures after water leakage into wheel brake.	Remove wheel and free brake (35, figure 2-22) shoes from retainers.
BRAKES GRAB	Wet brake shoes.	Allow brake shoes (35, figure 2-22) to dry.
	Foreign material imbedded in brake shoes or drum.	Disassemble wheel brake (29, figure 2-22) extract foreign material and remove all burrs or high spots from brake blocks (35) or drum (36) with sandpaper.
PARKING BRAKES DO NOT HOLD	Hydraulic fluid leakage in lines and/or fittings.	Replace defective lines and/or fittings (31, figure 2-23).
	Parking brake valve leaks	Repair parking brake valve according to step "e" of paragraph 2-95.

2-90. REMOVAL OF MAIN WHEEL AND BRAKE ASSEMBLIES. (See figure 2-22.)

a. Remove hub cap (23, figure 2-22). Extract cotter pin (27) and remove axle nut (28). Separate the main wheel (26) from the axle.

b. The tire and tube assembly (25) may be removed from wheel (26) by first deflating the tire.

NOTE

Before removing the brake assembly, disconnect the hydraulic line running to the expander tube inlet (33, figure 2-22) and plug the line connector (38) with tape to prevent any loss of fluid.

c. Separate brake (29) from the axle by removing bolts (30) and nut (31).

d. To disassemble the brake (29), remove bolt (39) and nut (40), extract clip (34) and separate the dust cap (37) from plate (36). Lift plate (32) off the assembly and carefully remove brake shoe (35).

e. Disassemble connector (38) from expander tube (33) inlet. Remove nut on expander tube inlet and separate expander tube (33) from plate (36). Similarly disassemble other wheel and brake assembly.

2-91. CLEANING OF MAIN WHEEL AND BRAKE ASSEMBLIES. (See figure 2-22.)

a. Clean all metal parts with a cloth moistened in dry cleaning solvent, Specification No. P-S-661.

b. Wipe all grease, oil or foreign material off the brake shoe surfaces with a cloth moistened in dry cleaning solvent, Specification No. P-S-661.

c. Clean expander tube (33, figure 2-22) with a clean, dry cloth. Remove oil or grease by washing with a soap and water solution. Rinse with clean water and dry thoroughly with a clean cloth. Follow the same procedure to clean the tires.

2-92. INSPECTION OF MAIN WHEEL AND BRAKE ASSEMBLIES. (See figure 2-22.)

a. Examine all nuts and bolts for worn or damaged threads. Replace damaged parts.

b. Inspect main wheels for corrosion, cracks, distortion and unevenly or excessively worn brake drums. Replace parts damaged or worn beyond repair.

c. Check the wheel bearings and bearing cones for excessive wear or damage. Replace worn or damaged bearings or cones. Pack bearings with grease, Specification MIL-L-3545, and reassemble to wheels.

d. Examine expander tube (33, figure 2-22) for dete-

rioration or leakage, replace unserviceable tubes.

e. Inspect brake shoes (35) for excessive wear, cracks or other damage. Check clips (34) and remaining metal parts for damage. Replace all parts damaged beyond repair.

f. Examine tires for wear and the tubes for chafing. Replace worn tires. If a tube is chafed, examine the inside of the tire for surface damage. Replace both tire and tube if inner surface of tire is damaged.

2-93. MINOR REPAIR OF MAIN WHEEL AND BRAKE ASSEMBLIES. (See figure 2-22.) Metal parts may be repaires to the extent of realigning minor dents and forestalling corrosion. Sand corroded spots on aluminum alloy parts down to good metal and coat with Lionoil, Specification No. AN-TT-118. Repairs and adjustments to brakes and parking brake valves are described following reassembly of main wheel and brake assemblies, paragraph 2-96.

2-94. REPLACEMENT OF PARTS. Replace all cotter pins that have been removed with new ones. Replacement of other parts depends on their serviceability; refer to paragraph 2-92 for this information.

2-95. INSTALLATION OF MAIN WHEEL AND BRAKE ASSEMBLIES. (See figure 2-22.)

a. Assemble expander tube (33, figure 2-22) to plate (36) and fasten the assembly by attaching connector (38).

b. Position plate (32), plate (36) and dust cap (37) to each other and fasten with bolts (39) and nut (40).

c. Position brake shoe (35) on the assembly and secure them with clips (34). Assemble brake (29) on the axle and fasten with bolts (30) and nut (31). Reconnect hydraulic line to expander tube inlet (33).

d. Assemble tire and tube (25) on wheel (26) and position the assembly on the axle. Install axle nut (28) taking up on it until the wheel has no end play. Back off the nut until first cotter pin hole in the axle is aligned with cotter pin hole in axle nut. Insert cotter pin (27) and check for freedom of rotation of the wheel. Assemble the hub cap (23). Similarly reassemble the other wheel and brake assembly.

2-96. ADJUSTMENT OF MAIN WHEEL AND BRAKE ASSEMBLIES. (See figure 2-22.) Test the brakes after reassembly for all of the following defects and observe the corrective procedures outlined. Instructions for bleeding and refilling the brake system are covered in paragraph 2-97.

a. Soft Brakes (Spongy Pedal Action): This condition is usually caused by either air trapped in the system or deteriorated hydraulic lines. Replace unserviceable lines and bleed the brake system according to paragraph 2-97.

b. Excessive Pedal Travel: Usually due to worn brake blocks and/or drums, deteriorated hose or air trapped in system. Check brake shoes or drums for wear and hydraulic hose for deterioration. Replace damaged parts. If defect is not corrected or if parts are not worn, bleed the system to remove entrapped air.

c. Brakes Drag: Common causes are: brake shoes fail to release: too much fluid pressure "locked in"; or parking brake mechanism does not release properly. If brakes continue to drag after checking the parking mechanism (figure 2-23), remove the wheels and sand down any high spots on the brake drum. Remove brake shoes and sand down any high spots on the brake drum. Remove brake shoes and sand down burrs on edges of retaining plates. If brake shoes fit tightly or are rough on the sides, sand them down. Make certain the spring return clips are in good condition and that the shoes are not broken at the spring slots.

d. Brakes Fail to Hold: If pedal travel is normal and not soft, the cause is usually burned brake shoes and/or oil and grease on the shoes and drum. The brake shoes may be frozen into the retainers, and not operating if the temperature is below freezing and the airplane has traveled through mud and water. These conditions can be easily corrected after removing the wheel.

e. Brakes Grab: Common causes are: wet shoes, scored brake drums with bits of stone or metal imbedded into the rubbing surfaces of the shoes. Disassemble the wheel and remove foreign material.

f. Parking Brakes Do Not Hold: Examine parking lever mechanism. Check parking brake valve lines and fittings. If the valve shows evidence of leakage, disassemble according to figure 2-23, replace O-rings (25 and 28) and reassemble. If brakes still fail to hold and the defects of steps a through d have been eliminated, check for leaks around compression cover (11, figure 2-23). Disassemble the master cylinder according to figure 2-23, replace worn or damaged diaphragm (17) and reassemble.

2-97. BLEEDING THE HYDRAULIC BRAKE SYSTEM. Observe the following procedure to bleed the hydraulic brake system properly:

1. LH master brake cylinder
2. RH master brake cylinder
3. Bolt
4. Washer
5. Washer
6. Nut
7. LH and RH pedals
8. Bushing
9. Bolt
10. Lock nut
11. Compression cover
12. Vent screw
13. Vent screw gasket
14. Screw
15. Spring
16. Diaphragm pad
17. Diaphragm
18. Piston
19. LH and RH bracket
20. Parking brake valve
21. Arm
22. Rivet
23. Washer
24. Speed nut
25. O-ring
26. Valve seat
27. Valve seat gasket
28. O-ring
29. Stem
30. Body
31. Resistorflex flexible hose
32. LH and RH front brake pedal
33. Bolt
34. Link
35. Front brake pedal bearing block (inboard)
36. Washers
37. Clamp
38. Nut
39. Front brake pedal bearing block (outboard)
40. Front brake pedal stop
41. Brake pedal tie rod
42. Parking brake control rod

Legend for Figure 2-23.

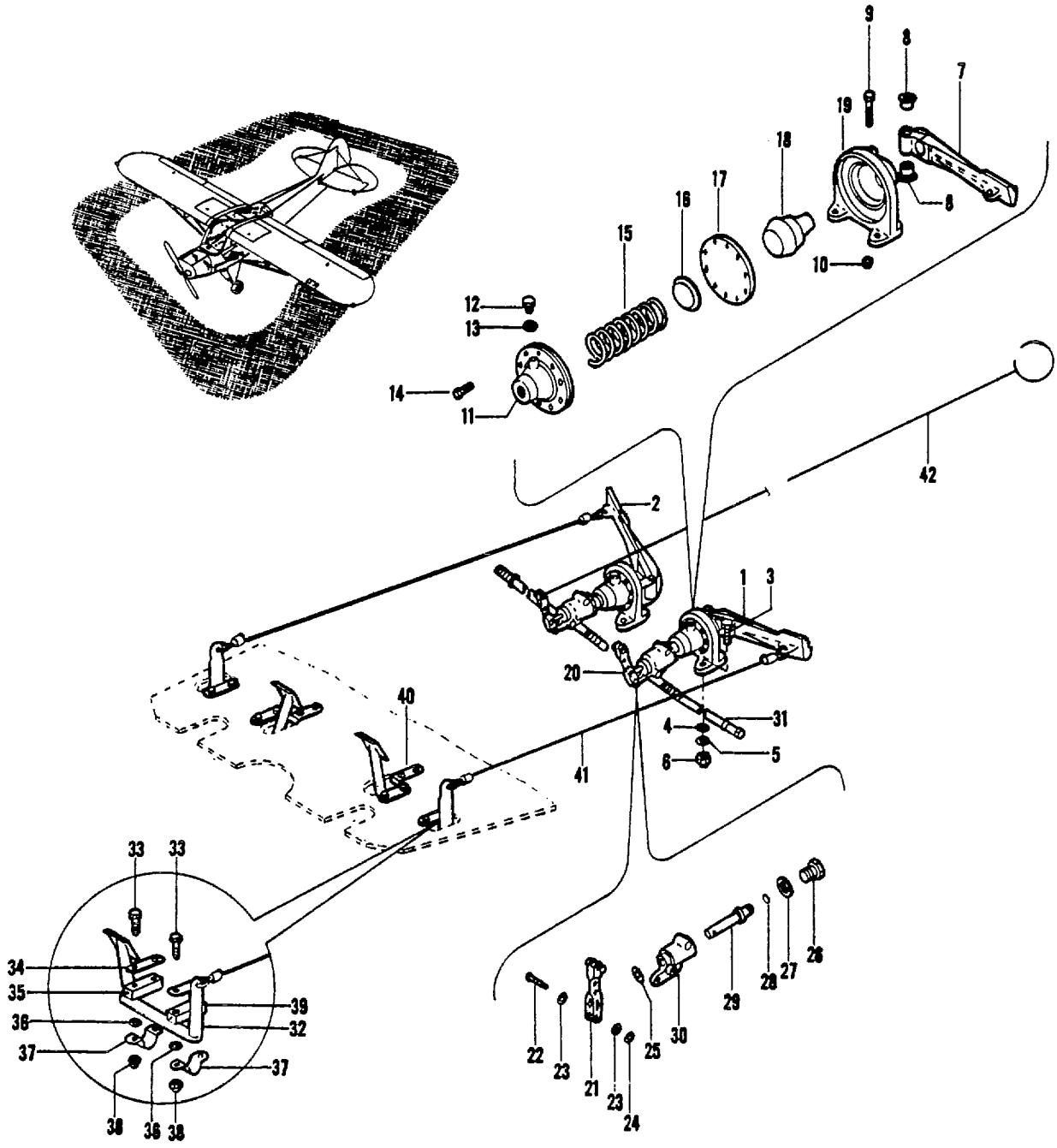

Figure 2-23. Brake Installation

a. Remove the vent screw (12, figure 2-23) from the master cylinder and attach a short length of rubber hose to it to direct the fluid into a container.
b. Connect a pump containing brake fluid that is free of air bubbles to the bleeder valve connection at the wheel brake. Open the bleeder valve and slowly force the fluid up through the system until the fluid emitted at the actuator is free of air bubbles.

NOTE

Make sure that the parking brake valves are off or open before attempting to fill the system. The fluid forced through may be used for refilling if left standing until all of the small air-bubbles have disappeared. Make certain that the pump used is not forcing air in with the fluid. Use a fluid that conforms to Specification No. MIL-O-5606.

c. Follow the same procedure when refilling a brake system completely.

2-98. TAIL WHEEL.

2-99. DESCRIPTION. (See figure 2-24.) The steerable tail wheel is mounted on shock-absorbing steel spring leaves which are bolted to the tail post of the fuselage structure. The tail wheel mounts on 8 x 4.4 four ply, pneumatic static grounded tire. Steering of the tail wheel is accomplished through spring loaded chains running from (26, figure 2-24) on fork (32) to the rudder arm (4). A static ground wire assembly (56) is provided to discharge any static electrical charges when landing the airplane.

2-100. TAIL WHEEL TROUBLE SHOOTING CHART.

TROUBLE	PROBABLE CAUSE	REMEDY
TAIL WHEEL DOES NOT RESPOND TO RUDDER PEDAL MOVEMENT	Broken steering chains, links or springs	Replace defective steering chain (2, figure 2-24) link (3), or spring (53, 54, or 55).
	Broken rudder control cables	Replace broken rudder control cables (1 and 2, figure 2-9).
TAIL WHEEL SHIMMIES	Steering springs have weakened.	Replace weakened steering spring (1, figure 2-24).
TAIL WHEEL DOES NOT SWIVEL	Fork binds in bracket because of dirt or lack of lubricant	Disassemble fork (32, figure 2-24) and bracket (15). Clean, reassemble and lubricate.
TAIL WHEEL DOES NOT ABSORB SHOCK	Broken leaf spring	Replace broken leaf, spring (53, 54 or 55, figure 2-24).
	Tail wheel tire over-inflated	Reduce inflation pressure to 50 pounds.

2-101. REMOVAL OF TAIL WHEEL. (See figure 2-24.)
a. Jack the tail section of the airplane so that the tail clears the ground.
b. Disengage and remove the tail wheel steering spring (1, figure 2-14), clean (2), and link (3) from fork (32).
c. Remove tail wheel springs (53, 54, and 55), static ground wire (56), spacer (12), and tail wheel (6) by re-

1. Tail wheel steering spring
2. Chain
3. Link
4. Rudder arm
5. Bolt, washer and nut
6. Tail wheel
7. Bolt
8. Cotter pin
9. Washer
10. Washer
11. Bushing
12. Spacer
13. Washer
14. Nut
15. Bracket
16. Nut
17. Cotter pin
18. Washer
19. Grease fitting
20. Thrust washer
21. Thrust plate
22. Compression spring
23. Upper dust cap
24. Pawl
25. Thrust washer
26. Arm assembly
27. Spring
28. Lower dust cap
29. Spacer
30. Grease retainer
31. Bearing
32. Fork
33. Axle
34. Lock washer
35. Washer
36. Nut
37. Cotter pin
38. Spacer
39. Grease retainer
40. Spacer
41. Wheel hub
42. Gasket
43. Bolt
44. Nut
45. Tube
46. Tire
47. Tail wheel spring clamp
48. Bolt
49. Cotter pin
50. Washer
51. Nut
52. Tail wheel spring pad
53. Tail wheel spring
54. Tail wheel spring
55. Tail wheel spring
56. Static ground wire
57. Bolt
58. Cotter pin
59. Washer
60. Nut

Legend for Figure 2-24.

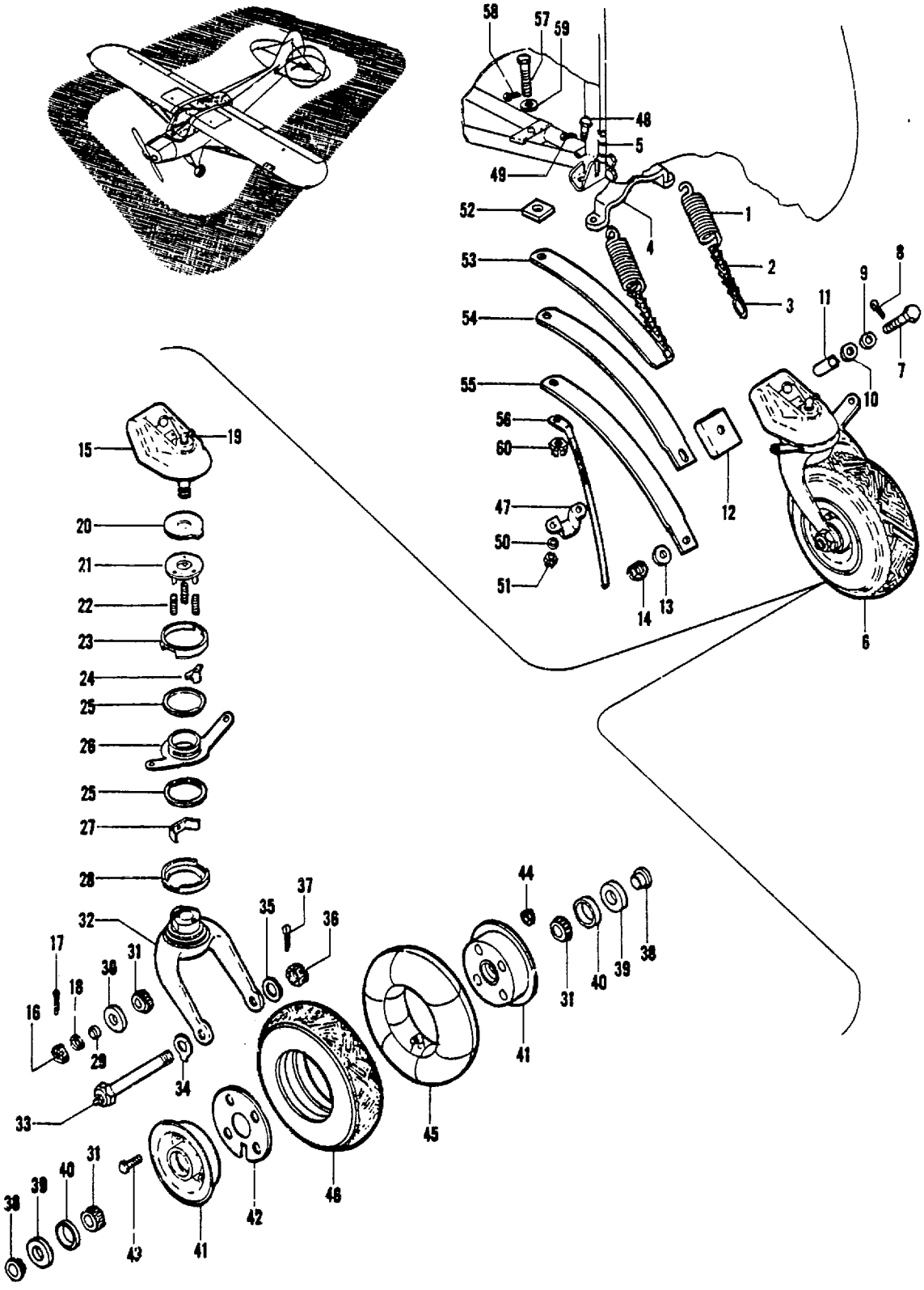

Figure 2-24. Tail Wheel Assembly

moving bolts (7, 48, and 57) according to figure 2-24.

2-102. DISASSEMBLY OF TAIL WHEEL. (See figure 2-24.)

a. Remove tail wheel (6) from fork (32) by removing axle (33).

b. Deflate tube (45), separate wheelhubs (41), and remove tube (45) from tire (46). Extract spacer (38), grease retainer (39), spacer (40), and bearing (31) from each wheel hub (41).

2-103. DISASSEMBLY OF TAIL WHEEL BRACKET AND FORK. (See figure 2-24.)

a. Extract cotter pin (17) and remove nut (16). Disassemble washer (18), spacer (29), grease retainer (30) and bearing (31) from the fork (32).

b. Carefully pull bracket (15) out of the fork (32). Disengage lower dust cap (28), spring (27), arm assembly (26), thrust washer (25), pawl (24), upper dust cap (23), compressor springs (22), thrust plate (21) and thrust washer (20) from bracket (15).

2-104. CLEANING OF TAIL WHEEL COMPONENTS. (See figure 2-24.)

a. Clean all metal parts (bearings included) in dry cleaning solvent, Specification No. P-S-661. Dry all parts with compressed air.

b. Wipe tire and tube with a dry cloth. If tire or tube is spotted with grease, oil or other deposits, wash in a soap and water solution. Rinse with clean water and dry with a clean cloth.

2-105. INSPECTION OF TAIL WHEEL COMPONENTS. (See figure 2-24.)

a. Inspect arm assembly (26), fork (32), and bracket (15) for excessive wear, cracks or other damage. Replace damaged parts.

b. Check compression springs (22). Replace springs that have taken a "set".

c. Examine thrust washers (20) for wear, scoring or other damage. Replace damaged thrust washers.

d. Inspect all bearings (31) for wear or damage. Replace worn or damaged bearings.

e. Examine the tire for wear and the tube for chafing. Replace a worn tire. If the tube is chafed, examine the inside of the tire for surface damage. Replace both tire and tube if inner surface of tire is damaged.

2-106. MINOR REPAIR OF TAIL WHEEL COMPONENTS. (See figure 2-24.) There are no repairs for the tail gear components outside of realigning minor dents and bends. All severely damaged metal parts must be replaced.

2-107. REPLACEMENT OF PARTS. Replace all cotter pins that have been removed with new ones. Replacement of other parts depends on their serviceability; refer to paragraph 2-104 for this information.

2-108. REASSEMBLY OF TAIL WHEEL BRACKET AND FORK. (See figure 2-24.)

a. Place lower dust cap (28) on fork (32) and attach spring (27) to the fork.

b. Position remaining parts (20 through 26) and bracket (15) on the fork (32) maintaining alignment with the bracket. Place bearing (31), grease retainer (30), spacer (29), and washer (18) in the fork (32). Exert pressure on bracket (15) to engage nut (16) with threads on the bracket post. Tighten nut (16) securely, back off to the first cotter pin hole in the bracket post and insert cotter pin (17). Lubricate the fork according to requirements of figure 1-10.

2-109. REASSEMBLY OF TAIL WHEEL. (See figure 2-24.)

a. Place tube (45) in tire (46) and assemble wheel hubs with gasket (42) to the tire and tube assembly. Make certain gasket (42) is properly aligned with tube valve and hub bolt holes. Inflate tire to 50 pounds.

b. Pack bearing (31) and bearing cones in hubs, with grease, Specification MIL-L-3545. Assemble bearing (31) spacer (40), grease retainer (49) and spacer (38) to the wheel hubs. Insert the assembly according to figure 2-24. Tighten nut (36) back off to first cotter pin hole in axle assembly (33) and insert cotter pin (37).

2-110. INSTALLATION OF TAIL GEAR. (See figure 2-24.)

a. Assemble tail wheel springs (53, 54, and 55) and static ground wire (56) to the fuselage tail section with bolt (57), nut (60), clamp (47), bolt (48) and nut (51). Tighten nuts (51 and 60), back off to first cotter pin holes in the bolts to secure the assemblies with cotter pins (49 and 58).

b. Position tail wheel (6) on spacer (12) and tail wheel springs (53, 54 and 55) and fasten the assembly according to figure 2-24. Tighten nut (14) (reference Table III) to 20 foot-pounds, insert Cotter pin (8) at first Cotter pin hole in bolt (7) after reaching 20 pounds, but before reaching 35 foot-pounds.

c. Reassemble tail wheel steering spring assemblies (1, 2 and 3) and lower the tail section to the ground.

SECTION III

HYDRAULIC SYSTEM

NOTE

The brake system is the only hydraulic system in the L-21A airplane. Refer to Section II, paragraphs 2-89 through 2-97 for maintenance procedures on the brake system.

SECTION IV

UTILITIES SYSTEMS

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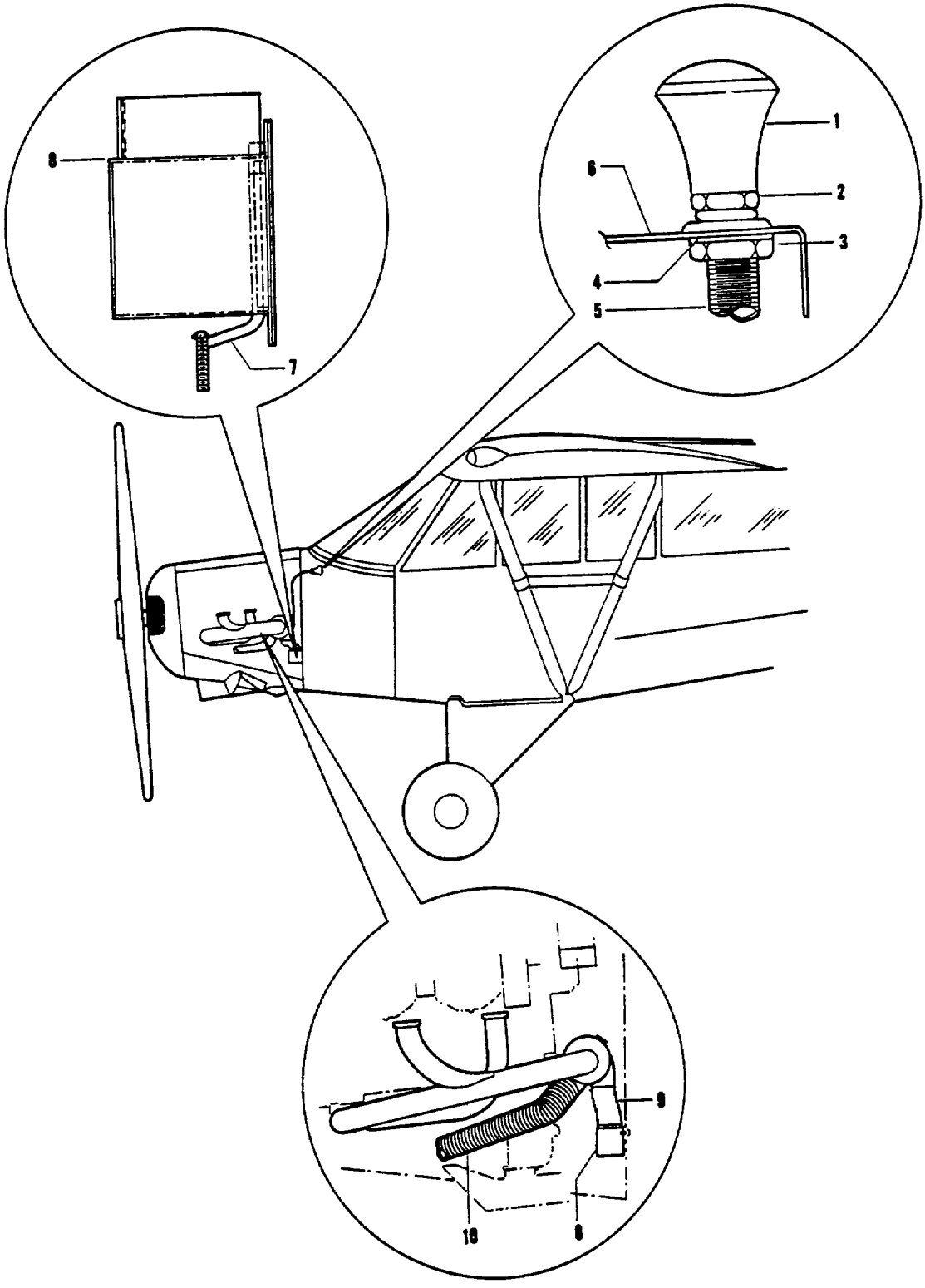
4-1. HEATING AND VENTILATING SYSTEM. (See figure 4-1 and 5-3.)

4-2. DESCRIPTION. The pilot's compartment is heated by air that has been warmed by the heat of the engine. The system consists of an air scoop on the bottom engine cowl (4, figure 5-1) that carries air to a compartment surrounding the exhauster silencer where the air is heated by exhaust gases. The warm air is then conducted by an air duct hose (22, figure 5-3) to the pilot's compartment through the cabin heat box (40, figure 5-3). Control of the heat is accomplished by a cabin heat pull rod mounted on the instrument panel (27, figure 6-1). The cabin heat pull rod is connected through a control cable assembly to the cabin heat box mounted on the inside wall of the fuselage firewall. When the cabin heat pull rod is pushed out by grasping its knob (1, figure 4-1), it opens a valve in the cabin heat box, thereby permitting warm air to enter the pilot's compartment. When the knob is depressed toward the instrument panel (figure 6-1), the valve is shut and the flow of heated air ceases. The pilot can ventilate the compartment by adjusting the sliding window panel on the left side of the cockpit.

4-3. HEAT SYSTEM TROUBLE SHOOTING CHART.

TROUBLE	PROBABLE CAUSE	REMEDY
INSUFFICIENT HEAT SUPPLY	Leaks in air supply system due to loose duct connections	Tighten all duct connections (see figure 4-1).
	Leak in air duct hose or cabin heat box	Replace air duct hose (22, figure 5-3) or cabin heat box (40).
	Obstruction in air duct hose	Disassemble, clean, and reassemble hose (22, figure 5-3).
	Cabin heat control cable loose at arm in cabin heat box	Tighten connections at this joint (see figure 4-1).



1. Knob
2. Nut
3. Nut
4. Washer
5. Control Cable Assembly
6. Instrument Panel
7. Valve Arm Assembly
8. Cabin Heat Box
9. Air Duct Hose
10. Flexible Tubing

Figure 4-1. Heating System

TROUBLE	PROBABLE CAUSE	REMEDY
	Cabin heat box valve jammed	Loosen valve (see figure 4-1) with a few drops of penetrating oil, clean, and reassemble.
EXHAUST GASES INTRODUCED INTO CABIN WITH HEATED AIR	Heat exchange portion of muffler assembly corroded or damaged	Replace damaged muffler assembly (26, figure 5-3).

4-4. SERVICING THE HEATING SYSTEM. (See figure 4-1.)

a. Refer to the heating system trouble shooting chart (paragraph 4-3) for common troubles and their remedies.

b. Periodically examine the heating system for cracks and corrosion and check the cabin heat pull rod for freedom of operation.

c. To disassemble the heating system as far as the engine muffler assembly, proceed as follows: Remove knob (1, figure 4-1) from nut (2). Loosen nut (3) and washer (4) and then disengage the control cable assembly (5) from the instrument panel (6). Pull the control cable away from the instrument panel on the inside of the fuselage firewall. Disengage the control cable from the valve arm assembly (7) mounted on the cabin heat box (8). Disconnect the air duct hose (9) and the flexible tubing (10) from the muffler assembly.

d. In order to install the heating system, proceed in the reverse order.

4-5. FIRE EXTINGUISHER.

4-6. DESCRIPTION. (See figure 4-2.) A one-quart hand-operated fire extinguisher is mounted on the cabin floor between the front and rear seat on the left side of the control sticks installation. It is secured to the cabin floor by a clamp and bracket assembly.

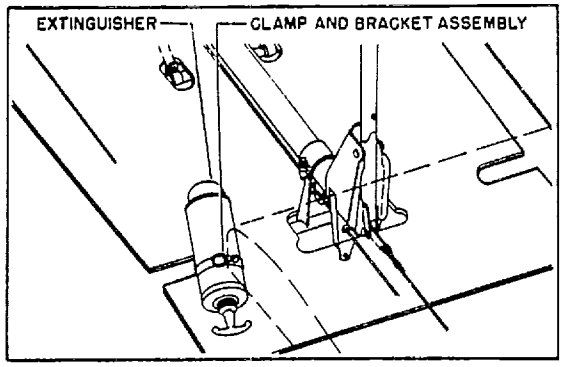


Figure 4-2. Fire Extinguisher

4-7. SERVICING THE FIRE EXTINGUISHER. Periodically inspect the fire extinguisher for evidence of leakage, proper safetying (seal wire taut and lead seal affixed) and for security in the clamp and mounting bracket. Replace a damaged fire extinguisher or defective clamp and mounting bracket.

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POWER PLANT AND RELATED SYSTEMS

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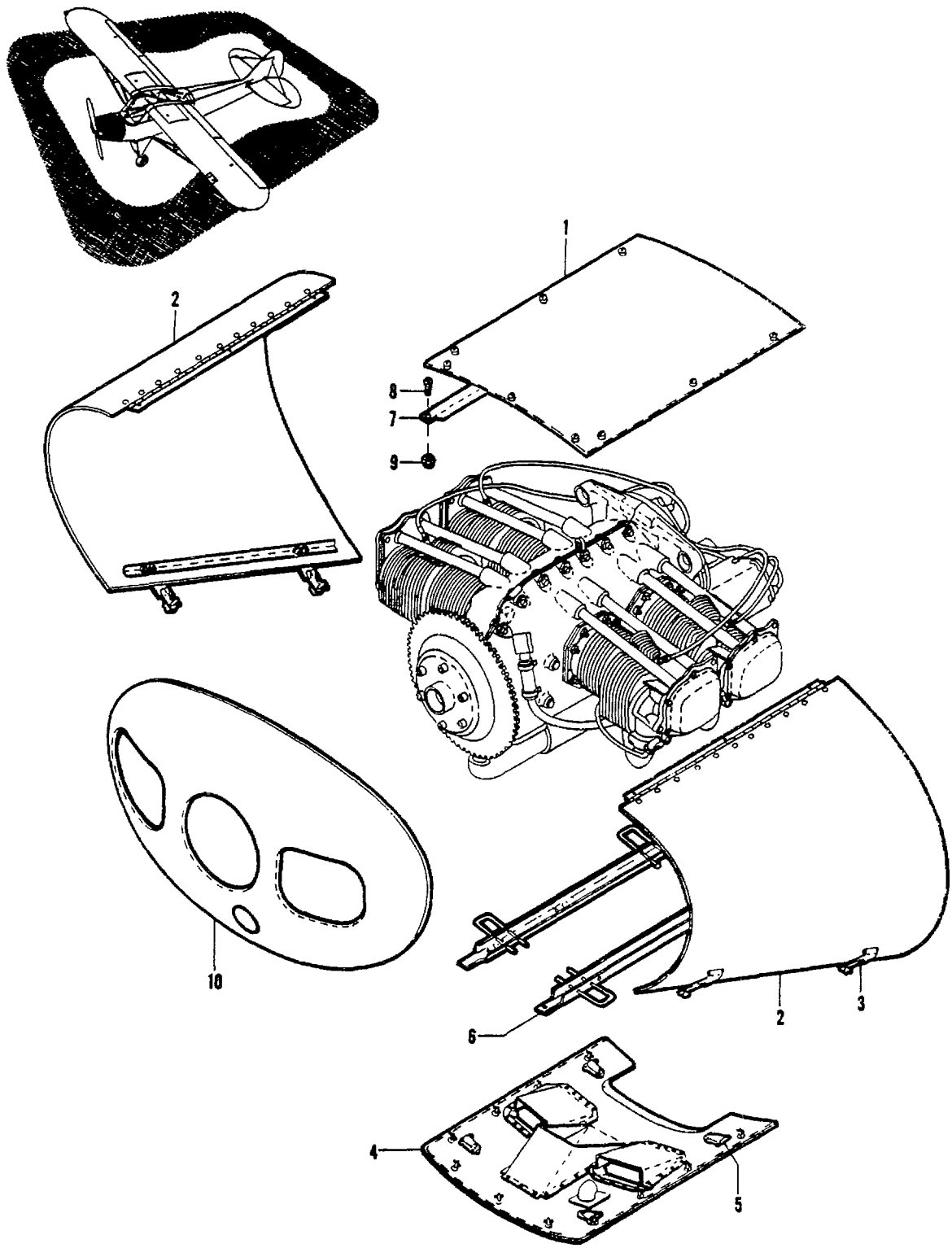


1. Engine top cowl
2. RH and LH engine side cowls
3. Cowl fastener
4. Engine bottom cowl
5. Cowl fastener cup
6. Cowl lower mounting channel
7. Cowl upper mounting channel
8. Screw
9. Nut
10. Engine nose cowl

Figure 5-1. Cowl Installation

5-1. ENGINE COWLING.

5-2. DESCRIPTION. (See figure 5-1.) The engine cowling consists of five formed aluminum alloy sections. The bottom cowl assembly (3, figure 5-1) is formed to contain two air scoops and two vents. The central air scoop houses the carburetor air box assembly while the smaller scoop on the left side supplies air which is heated in the muffler assembly and delivered to the pilot's compartment. The two vents serve to exhaust the air admitted through the front cowl after cooling the engine. The two side cowl assemblies (2) are hinged to the top cowl and latched to the bottom cowl, providing easy access to the engine.

5-3. REMOVAL OF ENGINE COWLING. (See figure 5-1.)

a. Disassemble the top cowl assembly by releasing the cowl fasteners (3, figure 5-1).

b. Unlatch the side cowls (2) and remove them from the airplane.

c. Detach the carburetor air box assembly and the air scoop assembly from the bottom cowl. Remove screws (7) and separate the bottom cowl from the lower mounting channels (5).

d. Disassemble the propeller from its shaft. Remove screws (7) and disassemble front cowl (9) from cowl mounting channels (5 and 6). The mounting channels may now be removed from the firewall.

5-4. CLEANING OF ENGINE COWLING. (See figure 5-1.) Wipe all cowling with a cloth dipped in dry cleaning solvent, Specification P-S-661. Remove all foreign matter and dry with a clean cloth.

5-5. MINOR REPAIR OF ENGINE COWLING. (See figure 5-1.) Realign minor dents and bends in the cowling. If there is evidence of corrosion, treat the corroded parts in accordance with paragraph 2-17. Repair the cowl fasteners if necessary. If any section of the cowling is cracked or damaged beyond repair or if the fastener latches are badly damaged, replace the cowl section.

5-6. INSTALLATION OF ENGINE COWLING. (See figure 5-1.)

a. Assemble the cowl lower mounting channel (6) and cowl upper mounting channel (7) to the fuselage firewall if previously disassembled. Attach the engine nose cowl (10) to the mounting channels.

b. Attach the engine bottom cowl (4) to the lower mounting channels (6). Fasten the carburetor air box and the air scoop assemblies to the engine bottom cowl.

c. Reassemble the side and top cowls (1 and 2) according to figure 5-1.

d. Assemble the propeller to the engine according to paragraph 5-65.

5-7. ENGINE BAFFLES.

5-8. DESCRIPTION. (See figure 5-2.) A fixed type of engine baffling is employed for cylinder and cylinder head cooling. The baffle assemblies are fabricated of sheet metal and are attached directly to the engine.

5-9. REMOVAL OF ENGINE BAFFLES. (See figure 5-2.) In order to remove the engine baffles, proceed as follows:

a. Remove the cowl installation (figure 5-1) for easy access to the engine baffles.

b. Remove right side front baffle (1, figure 5-1), right side rear baffle (2), left side front baffle (3), and left side rear baffle (4) by disengaging screw and washer assembly (5) and screw, washers, and nut assembly (6).

c. Disassemble the baffle hanger supports (9 and 21) by releasing nuts (11 and 23).

d. Remove engine inter cylinder baffle (20) by disassembling engine baffles tie rods (18 and 22) and nuts (19).

e. Remove engine baffle hanger rod (10) and release right front baffle (7) and left front baffle (8).

f. Disassemble rear baffle bracket by disengaging screw (15), washer (16), and nut (17).

g. Remove left rear baffle (12) and right rear baffle (13).

5-10. INSTALLATION OF ENGINE BAFFLES. (See figure 5-2.) Reverse the order in procedure in paragraph 5-9 to reinstall the engine baffle assembly.

5-11. POWER PLANT.

5-12. DESCRIPTION. (See figure 5-3.) The power plant consists of a Lycoming 0-290-D aircraft engine. The engine is four-cylinder unsupercharged, horizontally opposed, air-cooled engine rated at 125 sea-level H.P. at 2600 RPM. The engine is located forward of the fuselage firewall on an engine mount assembly that may be swung away from the firewall, thereby providing access to components mounted on the rear of the engine. The engine is accessible through either or both engine side cowls (figure 5-1) or by removing the entire cowling assembly.

5-13. POWER PLANT TROUBLE SHOOTING CHART.

TROUBLE	PROBABLE CAUSE	REMEDY
ENGINE FAILS TO START	Lack of fuel	Check fuel system (figure 5-6) for leaks. Fill fuel tanks, (See figure 5-8). Clean dirty lines, strainer 13, figure 5-6, and fuel selector valve (36).

TROUBLE	PROBABLE CAUSE	REMEDY
	Fuel valve pointer in OFF position	Turn fuel valve pointer (40, fig. 5-6) to ON position.
	Under priming	Prime with 2 or 3 strokes of primer (figure 5-7).
	Overpriming	Open throttle control (fig. 5-4) and "underload" engine by turning in counterclockwise direction.
	Improper throttle control setting	Open the throttle control (fig. 5-4) to one-tenth of its range.
	Defective spark plugs	Clean and adjust gaps or replace defective plug or plugs (fig. 5-11).
	Defective ignition wire or wires	Check and replace defective components (fig. 5-11).
	Defective battery	Replace with charged battery (4, fig. 7-1).
	Improper operation of magneto breaker points	Check points. Check condenser and internal timing of magneto (fig. 5-11).
	Water in carburetor	Check carburetor (see figure 5-11) and fuel lines (41 and 42, figure 5-6).
	Internal failure	Check oil sump strainer for metal particles. If found, complete overhaul of the engine is indicated.
FAILURE OF ENGINE TO IDLE PROPERLY	Incorrect carburetor idle adjustment	Adjust throttle stop (figure 5-4) to obtain correct idle speed or adjust carburetor idle adjustment (see fig. 5-11).
	Idle mixture	Adjust mixture (see paragraph 5-52).
	Leak in the induction system	Tighten all connections in the induction system (9, figure 5-3). Replace any parts that are defective.

TROUBLE	PROBABLE CAUSE	REMEDY
LOW POWER OUTPUT	Low cylinder compression	Check condition of piston rings and valve seats.
	Faulty ignition system	Check entire engine ignition system.
LOW POWER AND UNEVEN RUNNING	Mixture too rich, indicated by sluggish engine operation and red exhaust flame at night. Extreme cases indicated by black smoke from exhaust	Readjustment of carburetor is indicated (figure 5-1). Check primer shut-off. valve (fig. 5-10).
	Mixture too lean, indicated by overheating or backfiring	Check fuel lines (41 and 42, figure 5-6) for dirt or other restrictions. Check fuel supply system (figure 5-6).
	Leaks in induction system	Tighten all connections (19, figure 5-3). Replace defective parts.
	Defective spark plugs	Clean or replace spark plugs (figure 5-11).
	Magneto breaker points not working properly	Clean points (figure 5-11).
	Defective ignition wire	Check wire with electric tester. Replace defective wire. (figure 5-11).
	Improper ignition timing	Check magnetos for timing and synchronization (fig. 5-11).
	Defective spark plug terminal connectors	Replace connectors on spark plug wire (fig. 5-11).
	Incorrect valve clearance	Adjust valve clearance.
	Incorrect valve timing	Check valve timing.
FAILURE OF ENGINE TO DEVELOP FUEL POWER	Throttle control lever out of adjustment	Adjust throttle control (figure 5-4).
	Leak in the induction system	Tighten all connections and replace defective parts (9, figure 5-3).
	Restriction in carburetor air scoop	Examine air scoop and remove restrictions (figure 5-11).
	Improper fuel	Fill tank with recommended fuel (Table II).

TROUBLE	PROBABLE CAUSE	REMEDY
	Faulty ignition	Tighten all connections. Check system with tester. Check ignition timing.
ROUGH ENGINE	Cracked engine mount	Replace or repair mount (48, figure 5-3).
	Unbalanced propeller	Remove propeller and have it checked for balance (1, figure 5-3).
	Defective mounting brackets	Install new mounting bracket (52, figure 5-3) and washer (53).
	Malfunctioning engine	Check entire engine.
LOW OIL PRESSURE	Insufficient oil	Check oil supply (see figure 5-5).
	Leak in suction line or pressure line	Check gasket between accessory housing and crankcase.
	Dirty oil strainers	Remove and clean oil strainers. (Fig. 5-5).
	Air lock or dirt in relief valve	Remove and clean oil pressure relief valve.
	High oil temprerature	See "High Oil Temperature" in "Trouble" column.
	Defective pressure gage	Replace gage (8, fig. 6-1).
	Stoppage in oil pump intake passage	Check line for obstruction. Clean suction strainer.
HIGH OIL TEMPERATURE	Insufficient oil cooling	Check cowl air inlet and outlet for deformation or obstruction (figure 5-1).
	Insufficient oil supply	Fill oil sump to proper level (fig. 1-9).
	Clogged oil lines or strainers	Remove and clean oil strainers (fig. 5-5).
	Excessive blow-by	Usually unused by worn or stuck rings. Complete overhaul required.

TROUBLE	PROBABLE CAUSE	REMEDY
	Failing or failed bearing	Examine sump for metal particles. If found, overhaul of engine is indicated.
	Improper engine operation	Check entire engine.
	Defective temperature gage	Replace gage. (8, figure 6-1).
EXCESSIVE OIL CONSUMPTION	Failing or failed bearing	Check sump for metal particles and, if found, overhaul engine.
	Worn piston rings	Install new rings.
COLD WEATHER DIFFICULTIES	Cold oil	Move aircraft into a heated hangar. Heat oil.
	Inaccurate pressure readings	In extreme cold weather oil pressure readings up to approximately 100 lbs. do not necessarily indicate malfunctioning.
	Overpriming	Rotate crankshaft in counterclockwise direction with throttle "Full Open" and ignition switch "OFF". (figure 5-4).
	Weak battery	Install fully charged battery. (4, figure 7-1).

5-14. REMOVAL OF POWER PLANT. (See figure 5-3.)

a. Remove the propeller from the crankshaft following the instructions of paragraph 5-63.

b. Disassemble and remove engine cowling in accordance with paragraph 5-3.

c. Drain the engine lubricating oil and the oil remaining in the oil sump (figure 1-9).

d. Position the fuel selector valve in the cabin to OFF. Disconnect the fuel and fuel vent lines. Remove priming line at its connection to the engine and drain all fuel from the fuel strainer (13, figure 5-6).

e. Separate tachometer shaft, oil pressure line, throttle control, oil temperature line, mixture control, cabin heat control, carburetor heat control at their engine connections.

f. Remove the carburetor air box (6, figure 5-6) and the duct leading from the muffler heater to the cabin heat box (40). Disconnect lines from the oil cooler (41) at the engine.

g. Check that no other wires, controls or tubing are connected to the engine and attach hoist to hoisting ring (see figure 1-6).

h. Remove four cotter pins (50, figure 5-3), four nuts (51) and four bolts (49) and lift engine clear of fuselage.

5-15. REMOVAL OF ENGINE MOUNT ASSEMBLY. (See figure 5-3.)

a. Remove clamp assemblies (54 and 55, figure 5-3) from the mount assembly (48).

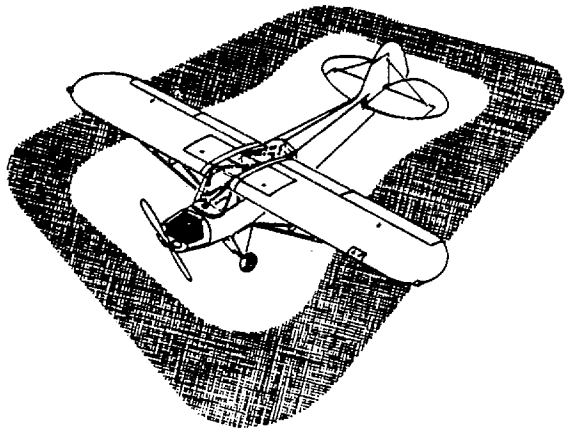
b. Separate oil cooler lines and oil cooler (41) and lock plate (42) from mount assembly. Remove any other control lines or wires that may interfere with removal of the mount assembly.

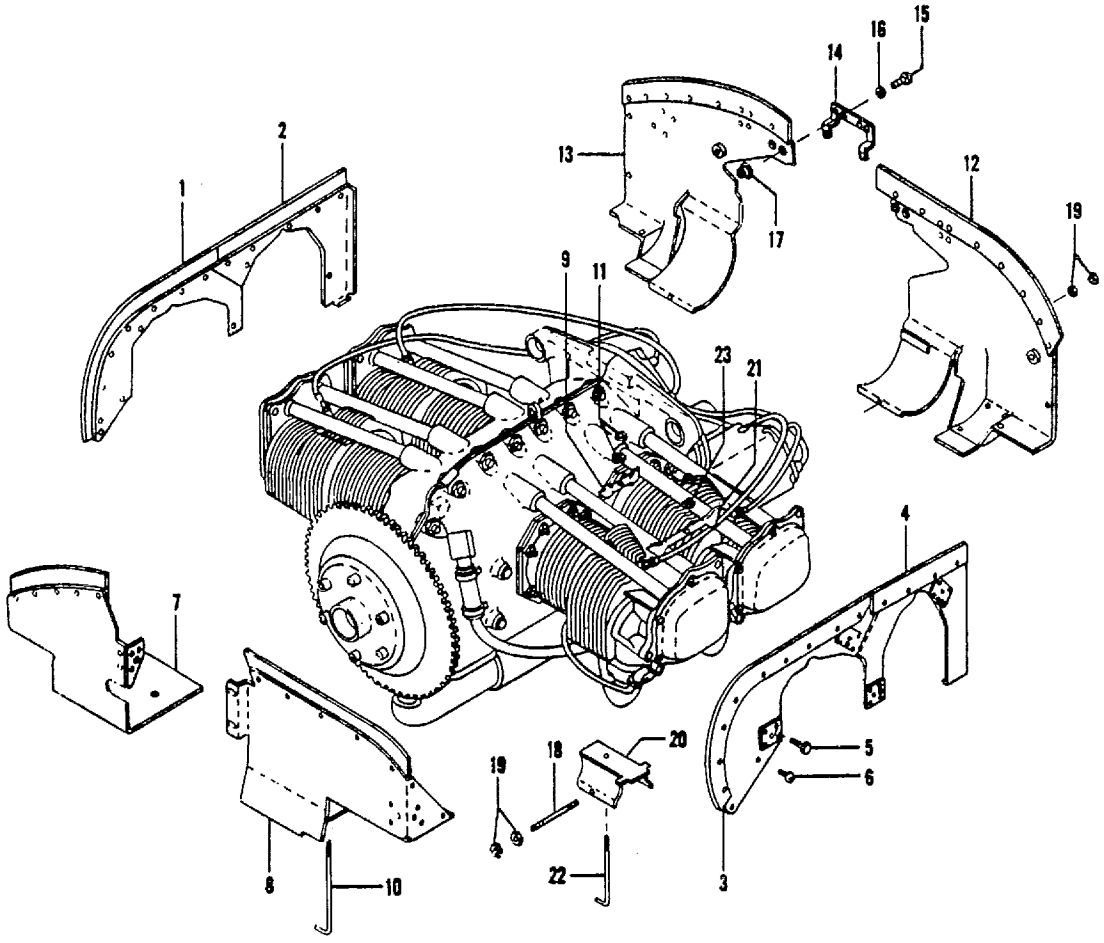
c. Remove four cotter pins (46), four nuts (47) and four bolts (45) and disengage mount assembly (48) from the firewall.

5-16. CLEANING OF POWER PLANT AND ENGINE MOUNT ASSEMBLY. (See figure 5-3.) Clean the exterior of the engine, accessories and mount assembly with dry cleaning solvent, Specification No. P-S-661. Dry with compressed air.

NOTE

Clean all electrical wiring and contact surfaces with a cloth moistened in the cleaning agent.





1. Engine right side from baffle
2. Engine right side rear baffle
3. Engine left side front baffle
4. Engine left side rear baffle
5. Screw and washers
6. Screw, washers, and nut
7. Engine right front baffle
8. Engine left front baffle
9. Baffle hanger support
10. Engine baffle hanger rod
11. Nut
12. Engine left rear baffle
13. Engine right rear baffle
14. Rear baffle bracket
15. Screw
16. Washer
17. Nut
18. Engine baffle tie rod
19. Nut
20. Engine inter cylinder baffle
21. Baffle hanger support
22. Engine baffle tie rod
23. Nut

Figure 5-2. Baffles Installation

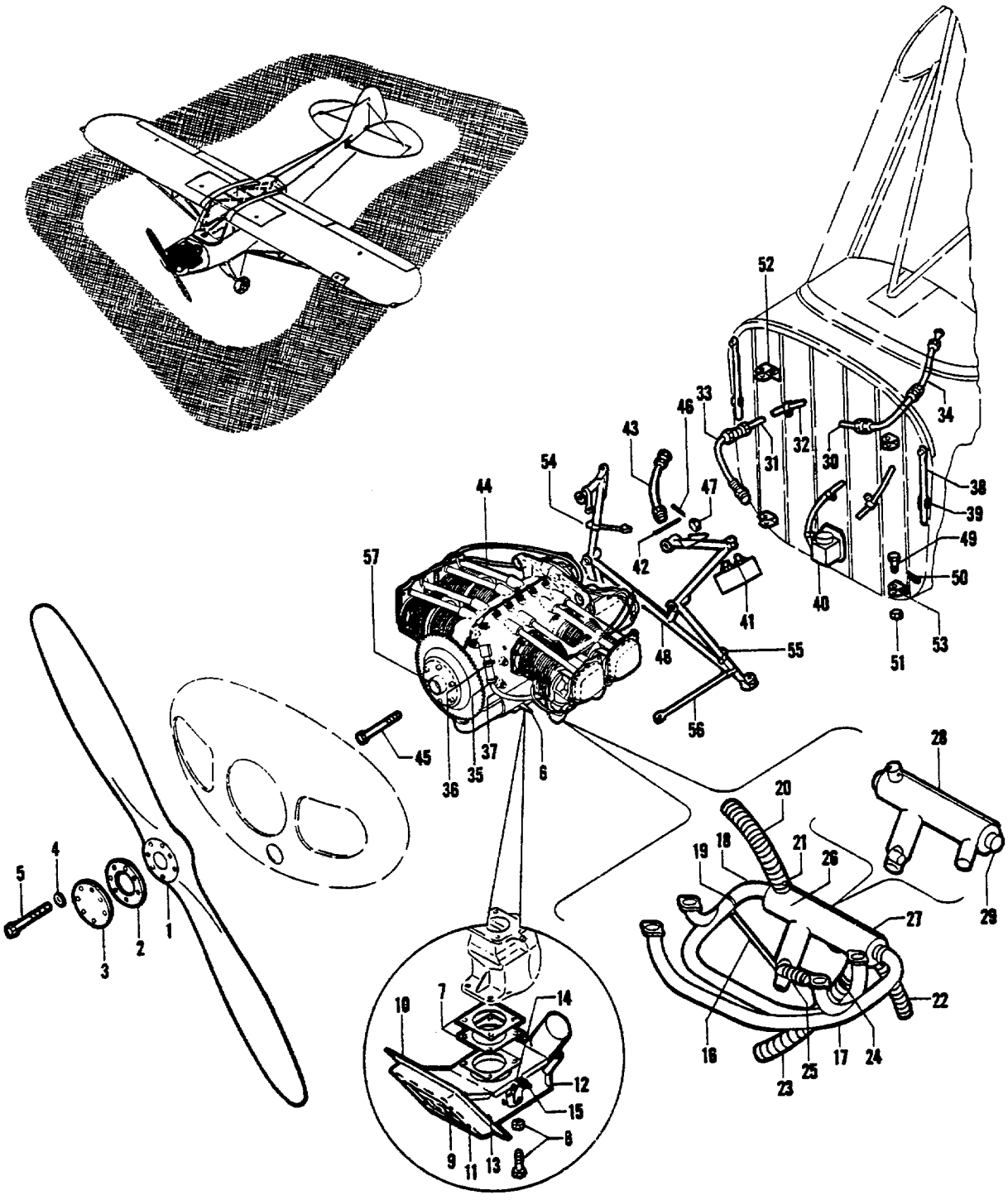


Figure 5-3. Power Plant

5-17. INSPECTION AND REPAIR OF POWER PLANT AND ENGINE MOUNT ASSEMBLY. (See figure 5-3.)

a. Examine the engine and accessories for obvious external damage such as cracks in the crankcase, cylinders, accessory mounting flanges, etc. and for damaged cylinder cooling fins. Replace damaged engine or accessories with new units.

NOTE

Do not attempt major repair or disassembly of engine or accessories since these operations must be undertaken only at an authorized overhaul base. Permissible corrective maintenance of engine accessories and power plant systems are outlined in the paragraphs following the power plant installation.

b. Remove oil sump plug and screen and inspect for metal particles. Numerous metal particles deposited on the screen indicates serious internal engine damage; replace the engine with a new one and send the damaged engine to an overhaul base.

c. Examine push-rod housings for leakage, severe dents and cracks. Replace damaged push-rod housings with new ones.

d. Inspect the crankcase breather for obstructions, dents and scratches. Clear the breather if obstructed. Replace a damaged breather with a new one.

e. Remove rocker arm covers and inspect condition of valve springs, retainers, keys and rocker arms. Make certain all parts are being lubricated.

f. Examine the flywheel and starter gears for broken or damaged teeth. Replace damaged parts with new ones.

g. Carefully inspect the engine mount for dents, cracks or bends. Replace a damaged engine mount with a new one.

NOTE

Do not attempt to repair a damaged engine mount. A distorted or misaligned engine mount will cause abnormal stresses both in the engine and in itself ultimately resulting in failure of the engine and the mount or both.

5-18. INSTALLATION OF ENGINE MOUNT ASSEMBLY. (See figure 5-3.)

a. Position the mount assembly (48, figure 5-3) to its firewall mountings and fasten with bolts (49) and nuts (51). Torque the bolts to the value indicated in Table III. Secure with new cotter pins (50).

b. Attach oil cooler (41), lock plate (42) and oil cooler lines to the mount assembly. Attach clamps (54 and 55) to the mount as indicated in figure 5-3.

5-19. INSTALLATION OF POWER PLANT. (See figure 5-3.)

a. Position the power plant to the engine mount and fasten with bolts (45) and nuts (47). Torque the bolts to the value indicated in Table III. Secure with new cotter pins (46).

b. Attach carburetor air box (6) to the engine. Assemble muffler heater duct to the cabin heat box (40) and connect the oil cooler lines to the engine.

c. Attach the throttle control to the right side of the carburetor and the mixture control on the rear. The cabin heat control assembly is connected to the valve arm on the cabin heat box (40). Connect the fuel line to the 0.250-18 pipe tapped hole in the carburetor. Connect the carburetor heat control line to the carburetor air box (16).

NOTE

After connecting the throttle and mixture control lines, move the controls several times from the cabin to ascertain that they move freely through the full arc of their travel.

1. Propeller
2. Propeller flange
3. Name insignal plate
4. Washer
5. Bolt
6. Carburetor air box
7. Carburetor air scoop attachment plates
8. Screw and washer
9. Filter
10. Baffle
11. Stud and cross pin
12. Carburetor air box
13. Receptacle
14. Swivel fitting
15. Stud
16. Tail pipe support tube
17. Exhaust stack
18. Exhaust stack
19. Clamp
20. Flexible tube
21. Screw and nut
22. Air duct hose
23. Flexible tube
24. Screw and nut
25. Air duct hose
26. Muffler assembly
27. Shroud slide clip
28. Muffler shroud
29. Engine muffler
30. Resistorflex flexible hose
31. 1/4-inch diameter tube assemblies
32. Clamp
33. Vent line flexible hose
34. 1/4-inch diameter tube assemblies
35. Breather line connector hose
36. Clamp
37. Engine breather tube
38. Cowl stop tube
39. Clip
40. Cabin heat box
41. Oil cooler
42. Oil cooler lock plate
43. Hose
44. Engine
45. Bolt
46. Cotter pin
47. Nut
48. Engine mount assembly
49. Bolt
50. Cotter pin
51. Nut
52. Engine mount attachment Bracket
53. Washer
54. Clamp
55. Clamp
56. Engine cowl support tube
57. Crankshaft

Legend for Figure 5-3.

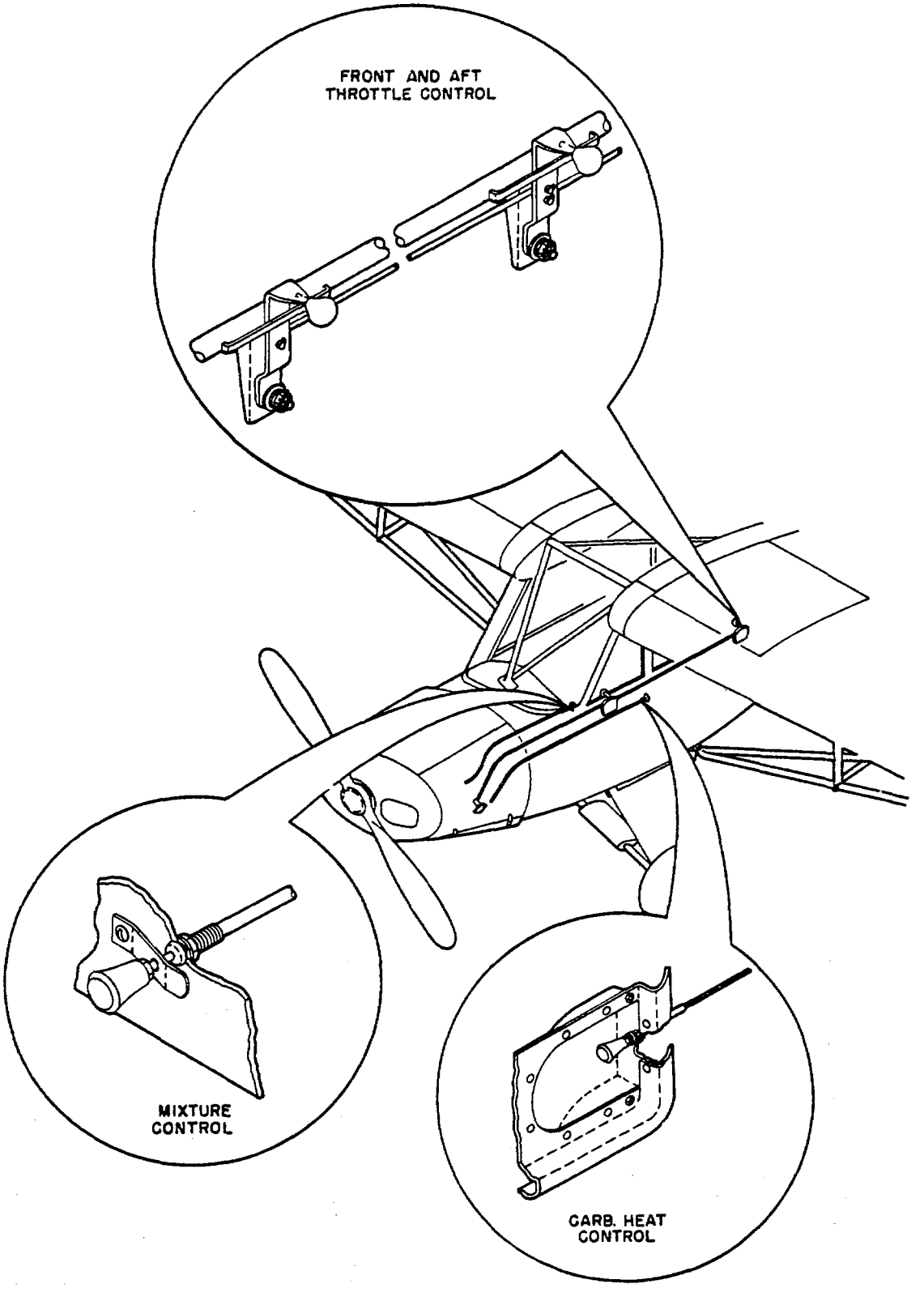


Figure 5-4. Engine Control System

d. Attach the thermometer tube from the oil temperature line to the 0-625-18 NF-3 tapped hole located to the rear and on the lower right hand side of the oil sump.
e. Connect the gage tube fitting on the oil pressure line to the 0.125-27 pipe tapped hole provided on the right side of the accessory housing above the right magneto.
f. Attach the tachometer cable to the SAE standard drive provided at the rear of the engine on the accessory housing between the magnetos.
g. Make all remaining electrical connections in accordance with the wiring diagrams in Section X.
h. Fill the engine with lubricating oil in accordance with specifications outlined in Table II.
i. Assemble the engine cowling in accordance with paragraph 5-3.
j. Install the propeller following the instructions outlined in paragraph 5-65.

5-20. ENGINE CONTROL SYSTEM.

5-21. DESCRIPTION. (See figure 5-4.) Engine controls manually operable from the cabin include the throttle control, carburetor air heater, and mixture controls. These controls employ flexible cables from the cabin to the engine proper and are located as shown in figure 5-4.

5-22. SERVICING THE ENGINE CONTROL SYSTEM. It is recommended that all sliding cable surfaces be coated periodically with a thin film of grease, Specification No. AN-G-8.

5-23. OIL SYSTEM.

5-24. DESCRIPTION. (See figure 5-5.) The engine lubricating oil system is of the pressure wet sump type. An oil pump directs oil through the oil cooler and then back to the engine.

5-25. SERVICING OF THE OIL SYSTEM. The oil system must be maintained full at all times with oil as specified in Table II.

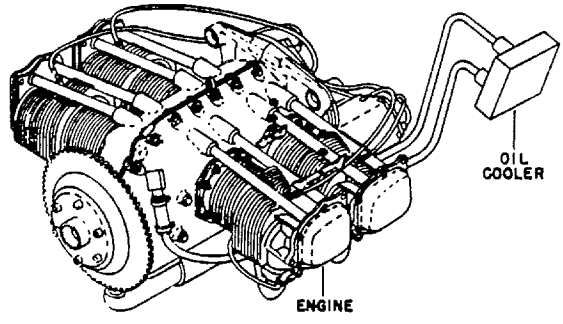


Figure 5-5. Oil System

NOTE

Engine overhaul procedures are described in the Lycoming Operator's Manual and exploded views for procedures in disassembly and reassembly are given in the Lycoming Parts Catalog.

5-26. FUEL SYSTEM.

5-27. DESCRIPTION. (See figures 5-6 and 5-7.) The fuel system consists of a 37 gallon gravity flow fuel system incorporating two 18 gallon wing tanks and two one-half gallon header tanks. A fuel shut-off valve is adjacent to the front seat. A fuel strainer equipped with a quick drain is mounted on the engine side of the firewall. The wing tanks incorporate visual type fuel gages extending into the cabin from each wing root. Since the fuel system has several components, servicing instructions will be provided separately for each individual component.

5-28. REMOVAL OF FUEL TANKS. (See figures 5-6, 2-1 and 5-8.)
a. Drain the fuel tanks through the drains located on the underside of the wing.
b. Disassemble the front, upper and lower fairing assemblies, fuel supply and fuel vent lines, fuel gages and the trim panels. Refer to steps a, b, and c of paragraph 2-14 for disassemble procedures.
c. Remove fuel tank cover (1, figure 5-8). Unfasten drag tubes (5) and pull them out through the fuel tank into the cabin as illustrated in figure 5-8. Unfasten the fuel tank straps (3) and carefully lift the tanks out of the wing panels.

5-29. CLEANING OF FUEL TANKS. Clean foreign material out of fuel tanks by pouring a small amount of gasoline into the tanks, swishing the gasoline around within the tanks and allowing it to pour out through the fuel cap opening. Clean the fuel tank strainers by dipping them in a gasoline bath and drying them with compressed air.

5-30. MINOR REPAIR OF FUEL TANKS. The only permissible repair to fuel tanks is to weld the aluminum where leaks or small cracks appear. This operation should be undertaken only if complete facilities for welding aluminum are available. If a fuel tank is severely damaged or if leaks exist and welding facilities are not available, replace the damaged tank with a new one.

WARNING

Before welding a fuel tank, rinse thoroughly with water, allow the tank to dry and uncover all tank openings.

5-31. INSTALLATION OF FUEL TANKS. (See figures 5-6, 2-1, and 5-8.)
a. Position the fuel tanks (8, figure 5-8) into the wing panels and thread the drag brace tubes (5) through them. Fasten the drag brace (5) with bolt (6) and nut (7). Secure the tanks with the fuel tank strap assemblies (3) and reinstall the fuel tank covers (1).
b. Reassemble fuel supply and fuel vent lines, fuel

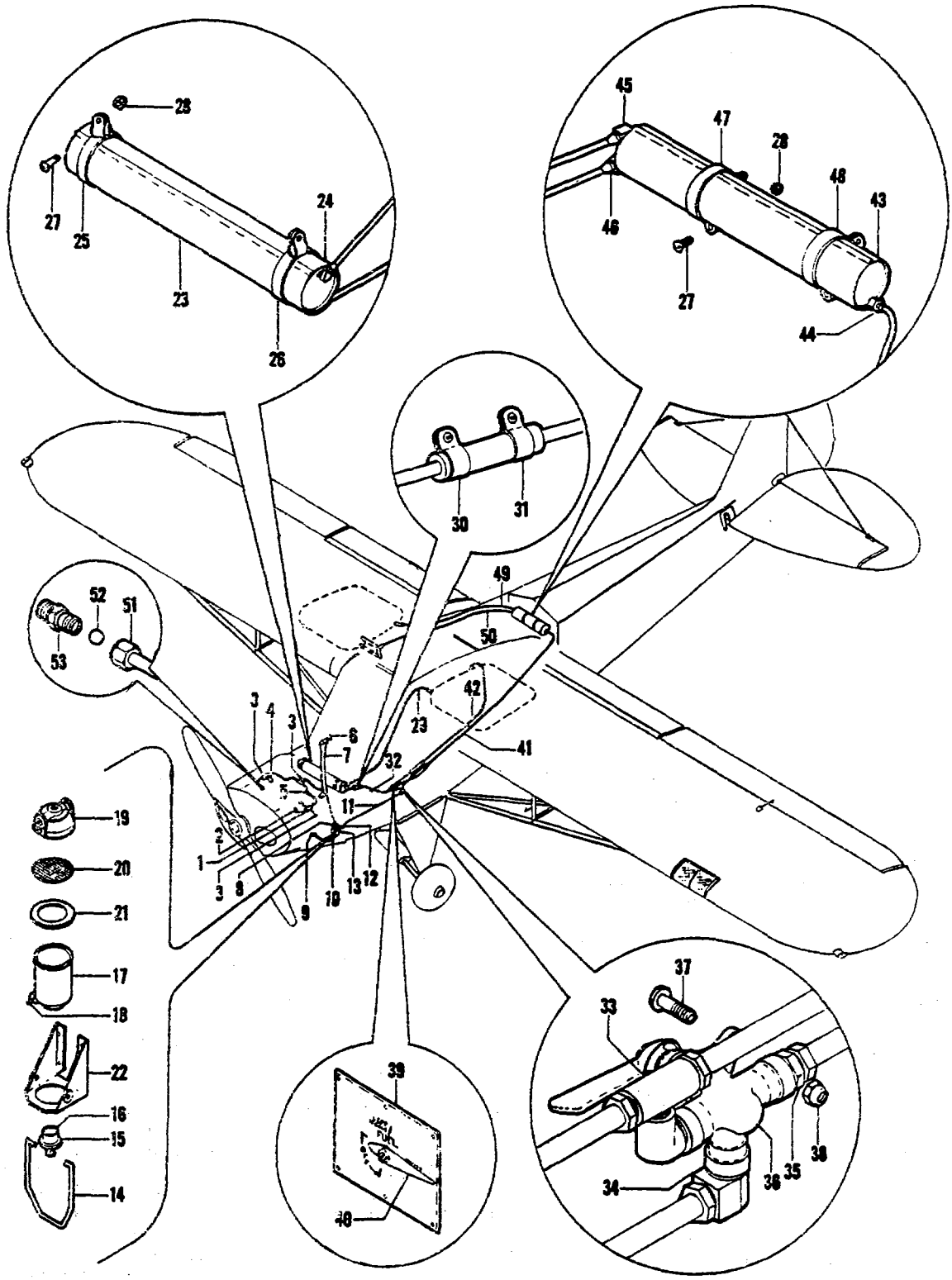


Figure 5-6. Fuel System Installation

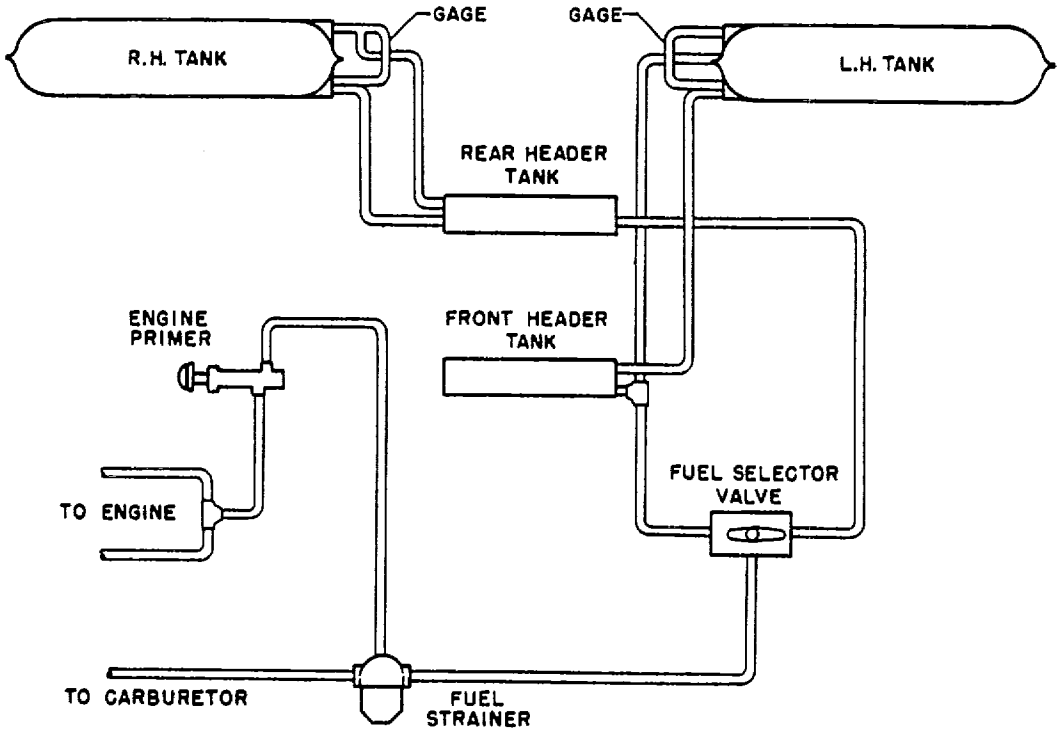


Figure 5-7. Fuel System Diagram

gages, trim panels and the front, upper and lower fairing assemblies according to steps g, h, and i of paragraph 2-22.

5-32. SERVICING THE FUEL HEADER TANKS. (See figure 5-6.) Examine the fuel header tanks (43, figure 5-6) and fittings for leaks, damage and insecurity of mounting. If a tank leaks or is severely dented or otherwise damaged, drain the fuel system and replace the tank with a new one.

NOTE

Examine all fuel systems, lines, hoses and connections for evidence of leakage or damage such as cuts, cracks, deterioration and insecurity of mounting. Replace damaged parts with new ones.

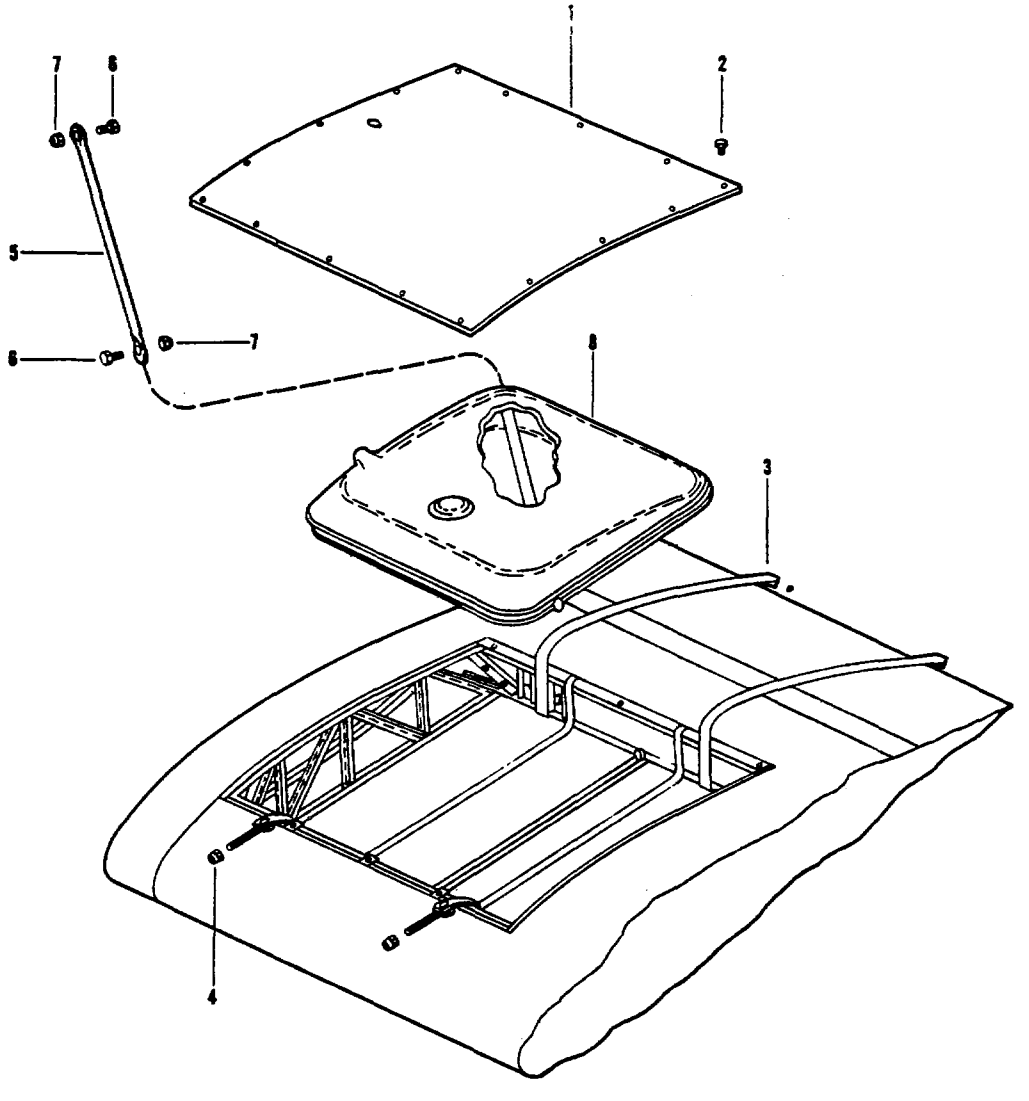
5-33. SERVICING THE FUEL VALVE. (See figure 5-9.) Inspect the fuel valve (figure 5-9) for evidence

1. Tube
2. Primer jet
3. Tee
4. Tube
5. Tube
6. Primer
7. Tube
8. Connector
9. Flexible fuel line
10. Elbow
11. Fuel line assembly
12. Elbow
13. Fuel strainer
14. Bale wire
15. Bale nut
16. Bowl seat
17. Fuel strainer bowl
18. Drain valve
19. Cover
20. Screen
21. Gasket
22. Fuel strainer bracket
23. Header tank
24. Inverted male elbow
25. Clamp
26. Clamp
27. Screw
28. Nut
29. Tube
30. Flexible hose
31. 3/4-inch hose
32. Tube
33. Tee
34. Elbow
35. Connector
36. Fuel valve
37. Screw
38. Nut
39. Fuel valve plate
40. Fuel valve pointer
41. Fuel line
42. Fuel line
43. Header tank
44. Inverted male connector
45. Inverted male elbow
46. Inverted male elbow
47. Header tank clamp
48. Header tank clamp
49. Tube
50. Tube
51. Compression nut
52. Ball sleeve
53. Primer jet

Legend for Figure 5-6

of leakage. If the valve leaks or if it does not function properly, drain the fuel system, disassemble the valve in accordance with figure 5-9 and clean the passages thoroughly. Reassemble the valve assembly and connect it to the fuel lines according to figure 5-16. Tighten selector valve head (3) until all evidence of leakage disappears. If the fuel selector valve does not function properly following these corrective measures, replace it with a new one.

5-34. SERVICING THE PRIMER. (See figure 5-10.) Inspect the primer for evidence of leakage. If leakage exists or if the primer does not function properly (does not exhibit a positive fuel delivery when pumped), turn the fuel selector valve to "OFF" and disassemble the primer in accordance with figure 5-10. Clean all parts thoroughly in dry cleaning solvent, Specification No. P-S-661. Clean the ball check valve and valve seat very carefully. If the valve seat is scored or otherwise



1. Fuel tank cover
2. Screw
3. Tank strap
4. Nut
5. Brace tube
6. Bolt
7. Nut
8. Fuel tank assembly

Figure 5-8. Wiring Tank Installation

damaged, reseat it. Discard and replace the ball with a new one if it is damaged. Replace the O-rings on the plunger and reassemble the primer according to figure 5-10. Reinstall the primer to the fuel system.

NOTE

When assembling the primer, use anti-seize compound, Specification No. MIL-C-5544 on all screw threads before assembly.

5-35. SERVICING THE FUEL STRAINER. (See figure 5-6.)

a. Turn the fuel valve to OFF.

b. Drain the fuel strainer (13, figure 5-6) by opening drain valve (18). Disassemble bale wire (14), bale nut (15), and bowl seat (16) from the fuel strainer bowl (17). Lift fuel strainer bowl from bracket (22). Remove cover (19), screen (20), and gasket (21) from the fuel strainer bowl. Clean all parts of the fuel strainer in gasoline. Replace damaged parts with new ones.

c. Reassemble the fuel strainer in reverse order of that given above.

5-36. IGNITION SYSTEM.

5-37. DESCRIPTION. (See figure 5-11 and 10-1.) Dual ignition is furnished by two magnetos; the left magneto incorporates an impulse coupling. The ignition wiring is arranged so that the left magneto fires the top plug in the LH cylinder and the bottom plug in the RH cylinder, while the right magneto fires the bottom plug of the LH cylinder and the top plug of the RH cylinder (figure 10-1). This design insures consistent drop-off when switching from both magnetos to either the right or left magneto.

5-38. IGNITION SYSTEM TROUBLE SHOOTING CHART. Refer to paragraph 5-13.

5-39. REMOVAL OF MAGNETOS.

a. Remove the terminal blocks from the magneto housings.

b. Disconnect the ground wires and ignition wires.

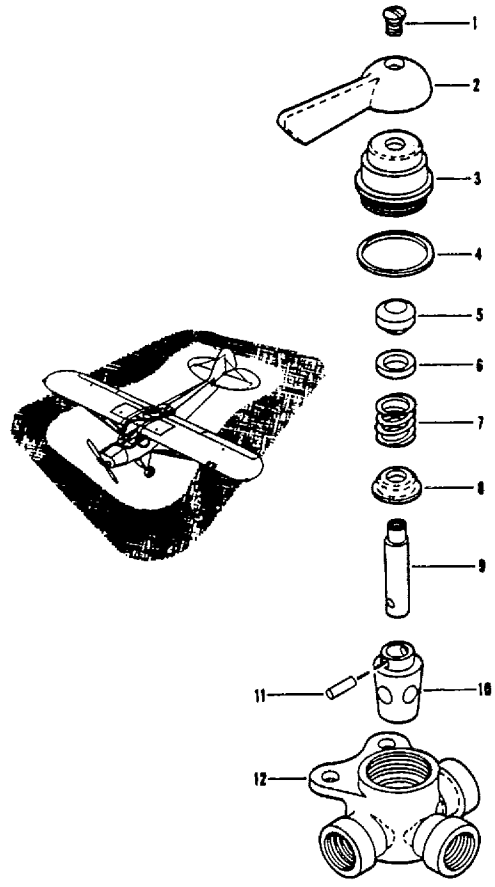
c. Remove the attaching bolts and separate the magnetos from the engine housing.

NOTE

Engine overhaul procedures are described in the Lycoming Operator's Manual, and exploded views for procedures in disassembly and reassembly are given in the Lycoming Parts Catalog.

5-40. CLEANING OF MAGNETOS. Clean the breaker compartments with a clean, dry cloth. Clean the ventilator screens with dry cleaning solvent, Specification No. P-S-661.

5-41. MINOR REPAIR OF MAGNETOS. Examine the breaker points for pitting. File slightly pitted points until flat. If points are excessively pitted, replace the breaker points and the condenser with new units. No further repairs should be undertaken. If other repairs are required, replace the defective magneto with a new one and forward the damaged one to a specified overhaul base.



1. Screw
2. Selector lever
3. Selector valve head
4. Gasket
5. Seal
6. Spring seat
7. Spring
8. Valve cap
9. Valve shaft
10. Selector valve
11. Pin
12. Selector valve body

Figure 5-9. Fuel Valve Assembly

5-42. INSTALLATION AND TIMING OF MAGNETOS. (See figure 5-11 and 10-1.) Time and reinstall the magnetos according to the following procedure:

a. Remove the top spark plug from the right front cylinder. Place the thumb of one hand over the spark plug hole and rotate the crankshaft in direction of normal rotation until the compression stroke is reached. The compression stroke is indicated by a positive pressure inside the cylinder tending to lift the thumb off of the spark plug hole.

b. Set the crankshaft at 25 degrees BTC on the compression stroke. This is accomplished by aligning the "ADV 25" mark on the rear propeller hub flange with the upper dividing line of the crankcase using a machinist's square. Leave the crankshaft in this position until magnetos are locked in position.

c. With the magneto gear and adapter on the magneto, turn the magneto gear until the chamfered tooth on the distributor gear inside the magneto aligns with the white

pointer as seen through the window in the front of the magneto cover. Without allowing the gear to turn from this position, assemble the magneto with adapter and gasket on the engine. Secure magneto in place with washers and nuts, tighten the nuts only finger tight.

d. Remove the breaker cover from the rear of the magneto housing. Rotate the magneto assembly clockwise as far as it will go through the range provided by the mounting slots. Insert a strip of 0.0015 inches shim stock between the breaker points. Apply a slight tension to the shim stock and at the same time rotate the magneto assembly in mounting slots very slowly in a clockwise direction until the exact breaker point opening is found as indicated by the shim stock being released. Lock the magneto in this position by tightening the mounting nuts.

NOTE

Breaker points on Bendix Scintilla S4LN type magnetos must not be adjusted to a given clearance. For proper S4LN magneto adjustments, refer to the applicable publication.

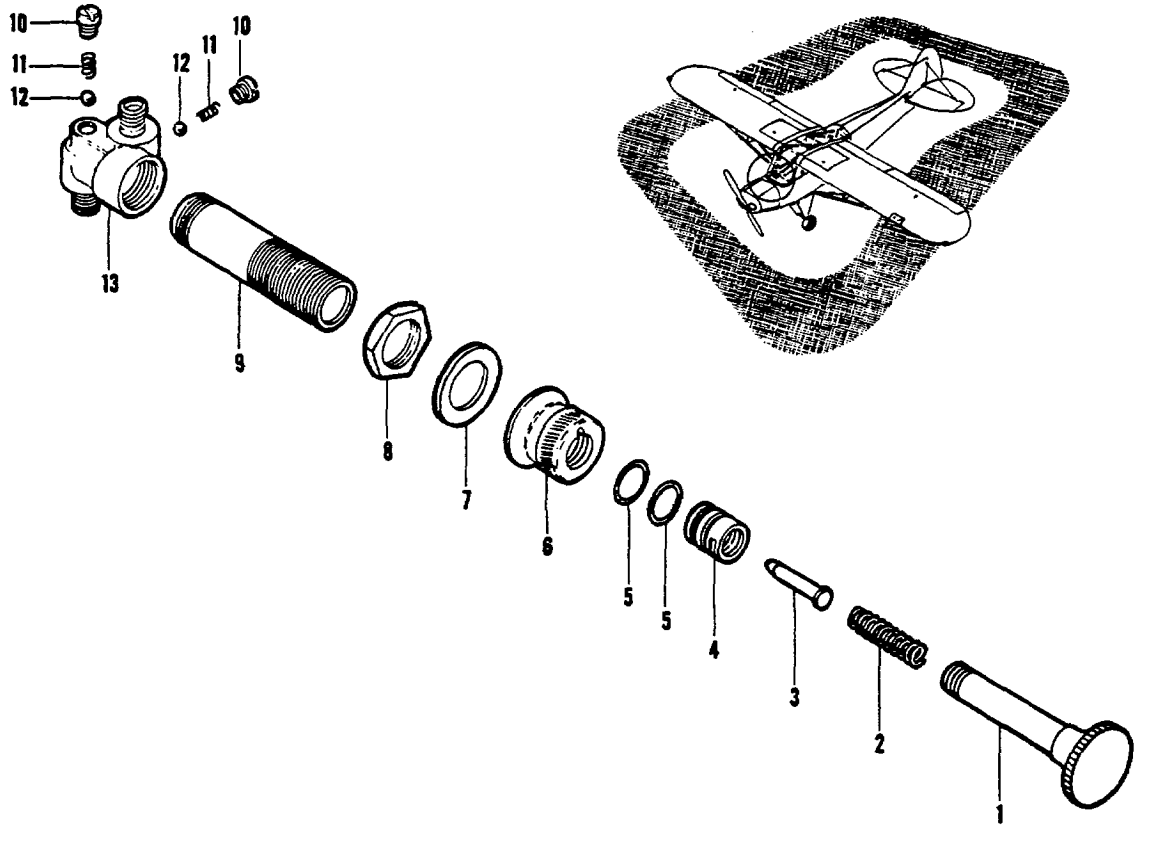
e. Repeat the above steps for the other magneto.

f. With both magnetos locked in position, rotate the crankshaft about 45 degrees in direction opposite normal rotation and insert shim stock between the breaker points as directed above. While one person exerts a slight tension on each strip of shim stock, a second person should rotate the crankshaft slowly in the direction of normal rotation. If the magnetos have been properly timed, both strips of shim stock will be released together. If this condition does not exist, the magneto which is incorrectly timed may be corrected by loosening the mounting nuts and rotating the magneto as required.

g. After magnetos have been properly timed, clean the breaker points to remove any trace of oil or dirt. Replace breaker cover and lock the retaining screws together with lockwire.

5-43. IGNITION HARNESS TROUBLE SHOOTING CHART. (Refer to paragraph 5-13.)

5-44. SERVICING THE IGNITION HARNESS. (See figure 10-1.) Clean all wires in the ignition harness by wiping with a clean dry cloth. Remove oil and grease deposits with dry cleaning solvent, Specification No. P-S-661. Examine all leads for signs of deterioration



1. Knob and piston rod
2. Sealing spring
3. Sealing pin
4. Nut
5. O-ring
6. Panel mounting and piston lock nut
7. Washer
8. Lock nut
9. Barrel
10. Spring retainer
11. Ball check spring
12. Check Ball
13. Body

Figure 5-10. Primer Pump Installation

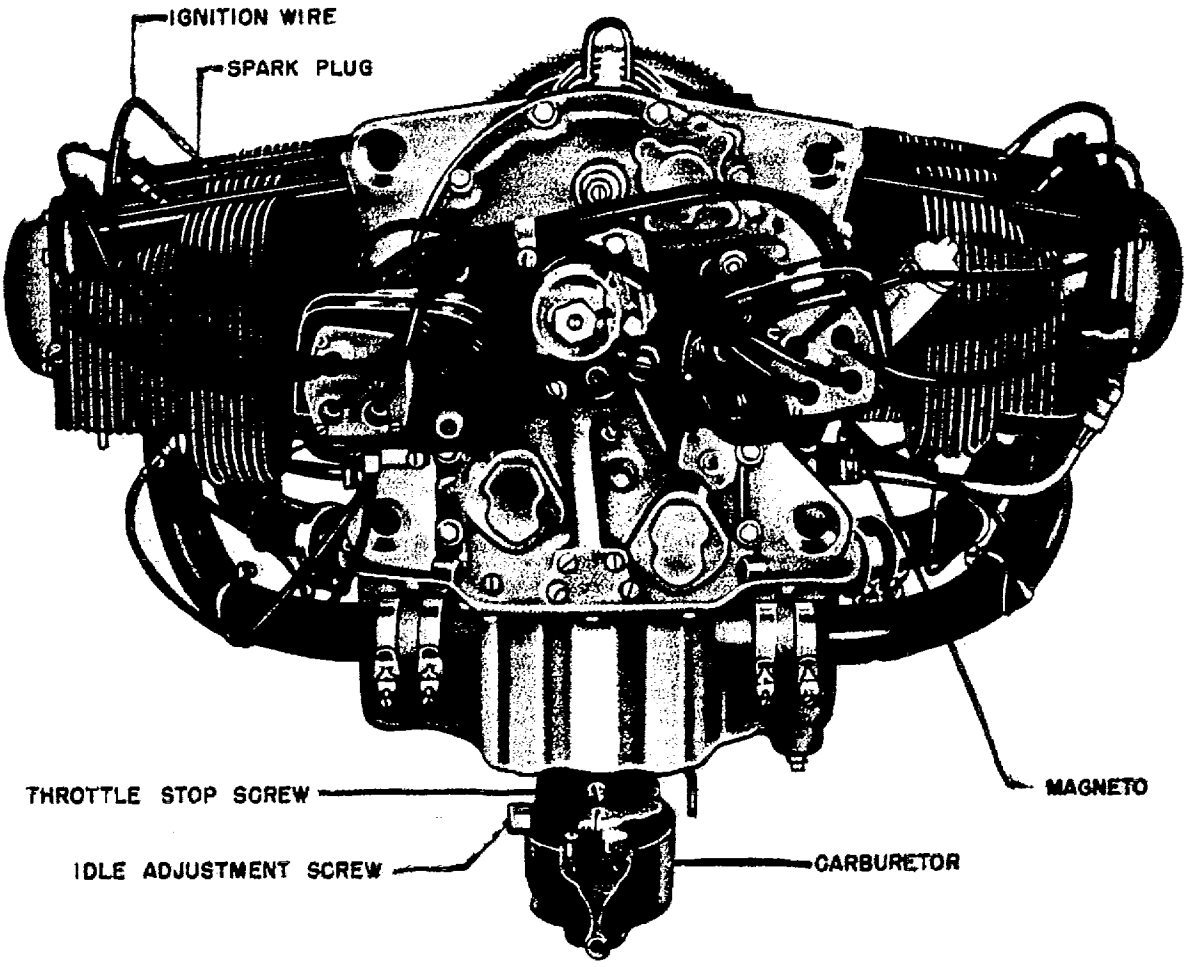


Figure 5-11. Lycoming Engine

cracks and other insulation damaged. Test all leads for continuity. Replace damaged leads with new ones.

5-45. SERVICING THE SPARK PLUGS. Remove the spark plugs and examine the electrodes and the insulation. Spark plugs with badly corroded terminals and/or cracked or otherwise damaged insulation must be replaced with new ones. If the plugs are still serviceable, clean the electrodes in unleaded gasoline and reset the gap to 0.025-0.018 inch with resetting tool and a wire gage. Replace all spark plug gaskets with new ones, coat spark plug threads with anti-seize compound Specification No. MIL-CO-5544 and insert them with their gaskets into the cylinders. Torque the plugs to 300-360 inch pounds.

5-46. SERVICING THE IGNITION SWITCH. The ignition switch is located (figure 10-1) on the left side wall in the cabin directly in back of the carburetor heat control. The only permissible maintenance on this switch is to clean the contacts and to test it for electrical continuity. Replace a defective ignition switch with a new one.

5-47. AIR INDUCTION SYSTEM.

5-48. DESCRIPTION. (See figure 5-3.) Cold air is induced into the carburetor air box (12, figure 5-3) through an air filter (9) which faces directly into the air stream. Heated air in regulated quantity may be introduced into the carburetor by means of the carburetor heat control (figure 5-4). When the carburetor heat control is pulled to the ON position, heated air is collected from the heat exchanger compartment of the exhaust silencer and fed to the carburetor by means of flexible tubing and through the carburetor air box.

5-49. SERVICING THE CARBURETOR AIR BOX. (See figure 5-3.) Disassemble the carburetor air box (12, figure 5-3) by removing the screws and washers (8) and then separating the carburetor air scoop attachment plates (7). It is usually sufficient to service the filter (9) only. Remove the filter and clean by immersing it in dry cleaning solvent, Specification No. P-S-661. Dry with compressed air. Immerse in a mixture composed of one part corrosion preventative compound, Spec AN-VV-C-576, and three parts of lubricating oil, Spec MIL-O-6082 (AN-0-8), Grade 1100, from 2 to 5 minutes. Remove from oil and drain at a 25° angle from 2 to 4 hours. When all the free excess oil has been drained off, reinstall filter and reassemble carburetor by reversing the procedure given above.

5-50. CARBURETOR TROUBLE SHOOTING CHART. (Refer to paragraph 5-13.)

5-51. SERVICING THE CARBURETOR. The carburetor is a Marvle-Shebler model MA 3SPA carburetor (figure 5-11). This carburetor is of the single barrel float type equipped with an altitude mixture control and an idle cut-off. Particularly good distribution of the fuel air mixture to each cylinder is obtained by the center zone induction system which is integral with the oil sump and is submerged in oil insuring a more uniform vaporization of fuel and aids in cooling the oil in the sump. From the riser the fuel air mixture is distributed to each cylinder by separated steel intake pipes.

NOTE

This carburetor is not to be repaired in any way. If the carburetor does not function properly, replace it with a new one.

5-52. CARBURETOR IDLING ADJUSTMENT. With exception of the idling adjustment no adjustment of the carburetor is necessary. The mixture is controlled by means of jets and air-passages that are not adjustable and are calibrated at the factory. Adjust the idle mixture and speed as follows:

a. With engine thoroughly warmed up, set throttle stop screw (see figure 5-11) so that engine idles at approximately 550 rpm.

b. Turn idle adjusting screw (figure 5-11) towards "RICH" position until engine "rolls" from richness, then turn screw slowly towards the "LEAN" position (indicated by letter "L") until engine "lags" or runs "irregularly" from leanness. This step will give an idea of the idle adjustment range and of how the engine operates under these extreme idle mixtures.

c. From the "lean" setting, turn screw slowly towards a "richer" setting, leaving the final setting at a mixture just lean enough to prevent a rich "roll" or uneven running from richness. This adjustment will in most cases give a slower idle speed than a slightly leaner adjustment with the same throttle stop screw setting, but will give smoothest idle operation. A change in idle mixture will change the idle speed, and it may be necessary to readjust the idle speed with the throttle stop screw to the desired point.

5-53. EXHAUST SYSTEM.

5-54. DESCRIPTION. (See figure 5-3.) Stainless steel tabular manifolding collects the exhaust discharge from each cylinder and conducts the discharge aft to a silencer which is mounted horizontally behind the engine. Cross over manifolding is utilized to obtain maximum power by efficient scavenging of exhaust gases. A single outlet pipe from the silencer discharges outside the cowling. The silencer is enclosed by a shroud through which cool air is circulated to be heated for carburetor air and for cabin heat.

5-55. SERVICING THE EXHAUST SYSTEM. (See figure 5-3.) The only maintenance required is to check and correct the following conditions:

a. Examine flexible tubing (20 and 23, figure 5-3) for evidence of cracks or holes.

b. Check all duct clamps (19, figure 5-3) for looseness, misalignment or evidence of leakage. Realign and tighten loose clamps and replace damaged clamps with new ones.

c. Examine exhaust stacks (17 and 18, figure 5-3) for evidence of burning, cracks or corrosion. Replace damaged exhaust stacks with new ones.

d. Inspect the muffler (26, figure 5-3) assembly for evidence of burning, cracks or corrosion. Replace a damaged muffler assembly with a new one.

5-56. STARTING SYSTEM.

5-57. DESCRIPTION. (See figure 10-2.) The starting system incorporates the engine starter, starter switch, starter solenoid relay, battery and interconnecting wiring.

5-58. SERVICING THE ENGINE STARTER. (See figure 10-2.) The starter is located in the lower left front side of the engine. Its Bendix type drive engages with a gear that is integral with the rear propeller flange. The only permissible servicing of the starter consists of an external cleaning and an inspection for obvious damage such as a cracked housing or damaged gear teeth. Replace a damaged starter with a new one and return the faulty starter to a specified overhaul base.

5-59. SERVICING THE STARTER SWITCH AND THE STARTER SOLENOID RELAY. (See figure 10-2.) The starter switch (11, figure 10-2) should be tested for continuity. The starter solenoid relay (15) should be checked for secureness of mounting and tightness of electrical connections. No repairs are authorized for these units, replace damaged units with new ones.

5-60. SERVICING THE BATTERY. (See figure 1-9 and 10-2.) Service the battery according to paragraph 1-23.

5-61. PROPELLER.

5-62. DESCRIPTION. An all-metal, directly driven, fixed pitch Sensenich M76AM-2 propeller, six feet two inches in diameter is employed.

5-63. REMOVAL OF PROPELLER. (See figure 5-3.) Clip all locking wire from bolt heads. Remove eight bolts, (5, figure 5-3), eight washers (4), nameplate (3), and propeller flange (2). Carefully slide the propeller (1) off the crankshaft (57).

5-64. INSPECTION OF PROPELLER.

a. Examine the propeller blades for corrosion, cracks, nicks or dents beyond permissible limits. If the propeller is unserviceable, replace it with a new one and return the damaged propeller to the factory.

b. Inspect the attaching bolts for worn or damaged threads and heads. Replace damaged bolts with new ones.

5-65. INSTALLATION OF PROPELLER. Turn crankshaft so that right front cylinder is at TDC. With crankshaft in this position, assemble propeller over pilot of crankshaft flange in the horizontal position. Place the propeller hub front flange on propeller hub and attach to crankshaft with six 3/8-inch bolts. In attaching the propeller, it is highly important that the mounting bolts be tightened evenly, and after tightening the bolts, the propeller must track within 1/8-inch and any deviation corrected by adjusting the tension on the mounting bolts. See Table III for proper torque values. After this adjustment is made, the propeller mounting bolts should be securely safety-wired.

SECTION VI

INSTRUMENTS

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6-1. INSTRUMENTS.

6-2. DESCRIPTION. (See figure 6-1.) The aluminum alloy instrument panel mounted on the front of the cockpit contains seven instruments: air-speed indicator, compass, tachometer, altimeter, turn and bank indicator, and combination oil pressure and oil temperature gage.

6-3. SERVICING THE INSTRUMENT PANEL. (See figure 6-1.) The instrument panel (23, figure 6-1) may be separated from its mounting to the fuselage structure. In order to do this, first disconnect all instruments on the reverse side of the panel. Then remove nuts (26), washers (25), and screws (24). Remove screw, bushing, and attachment lug assemblies (28). If the panel is severely damaged, remove the instruments, discard the damaged panel, reinstall instruments, and attach the new panel to the fuselage.

6-4. AIR-SPEED INDICATOR TROUBLE SHOOTING CHART.

TROUBLE	PROBABLE CAUSE	REMEDY
INDICATOR NEEDLE FAILS TO RESPOND	Pitot opening obstructed	Clean pitot opening of all foreign material (figure 6-2).
	Foreign material in air-speed indicator hose	Disconnect air-speed indicator hose (6, figure 6-1) from instrument panel and pitot head (figure 6-2). Clean all lines with compressed air and reinstall.
	Leak in air-speed indicator hose	Check all hose (figure 6-2) and connections for leakage and replace damaged parts.
INDICATOR NEEDLE VIBRATES	Accumulation of moisture in system	Disconnect air-speed indicator hose (6, figure 6-1) from the instrument panel and pitot head (figure 6-2). Clean all lines with compressed air.
	Instrument mounting is loose	Tighten the four screws holding air-speed indicator to the instrument panel. (See figure 6-1.)

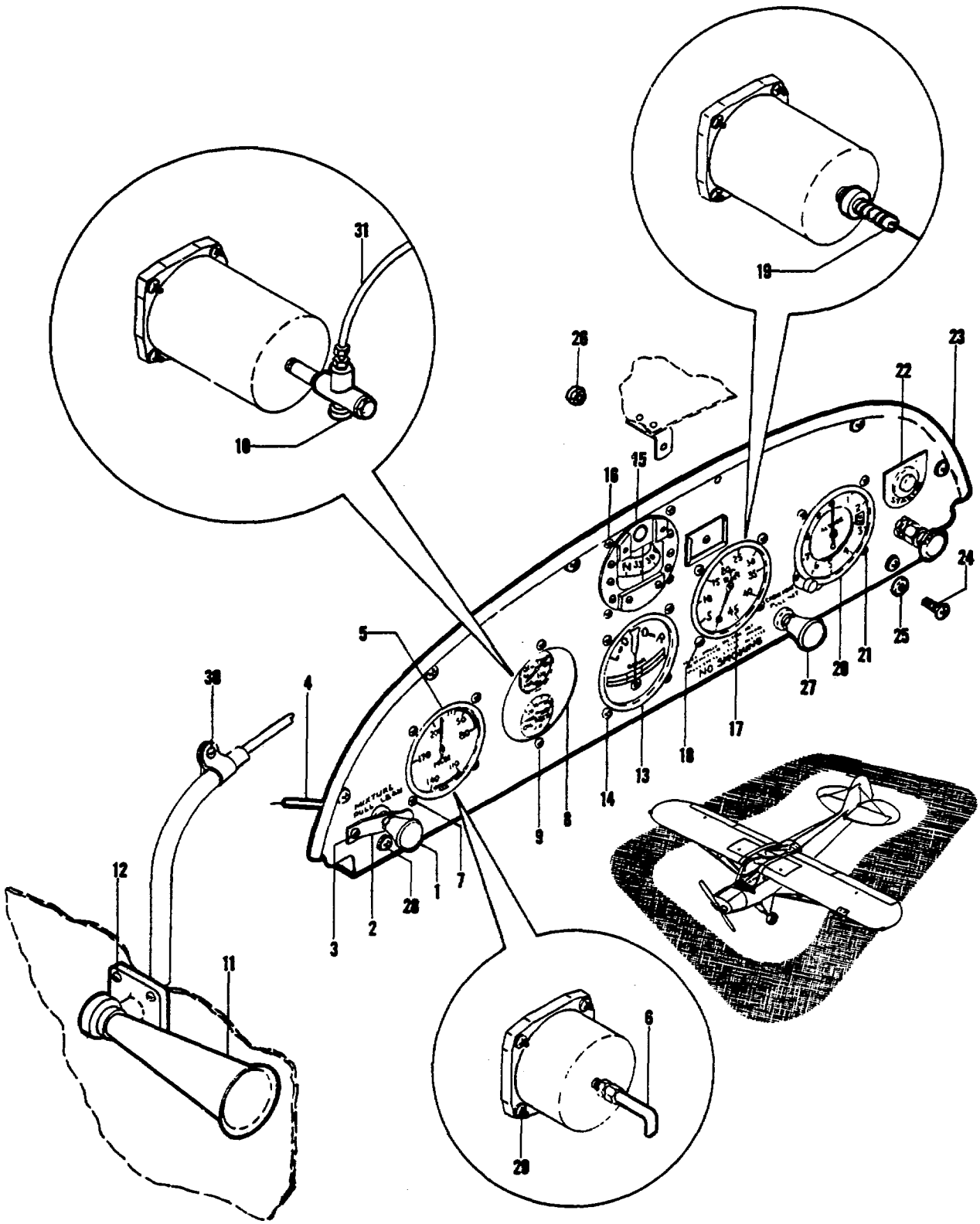

Figure 6-1. Instrument Panel Installation

6-5. SERVICING THE AIR-SPEED INDICATOR. (See figure 6-1 and 6-2.) The air-speed indicator is model USAF TYPE B-8.

a. Examine the air-speed indicator (5, figure 6-1) for obvious minor damage such as cracks, loose dial glass, damaged or corroded tubing, and for loose connections. Replace defective parts.

b. In order to remove the air-speed indicator, proceed as follows: Remove the four attaching screws and nuts (29) that hold the instrument to the instrument panel (23). Lift the air-speed indicator out of the instrument panel. Disconnect the air-speed indicator hose (6) on the back of the instrument.

c. In order to install the air-speed indicator, reverse the procedure given above.

NOTE

Coat all threads on fitting sparingly with anti-seize compound, Specification No. MIL-C-5544.

6-6. SERVICING THE COMPASS. (See figure 6-1.) The compass is model USAF TYPE B-16.

a. Examine the compass (15, figure 6-1) for any discoloration of the liquid, leakage, or air bubbles. Replace the entire unit if found defective in any way.

b. In order to remove the compass, proceed as follows: Remove the four assemblies of screws, nuts, and washers (16) that secure compass to instrument panel (23).

c. In order to install the compass, reverse the procedure given above.

d. Follow the instructions given in NOTE of paragraph 6-5.

6-7. SERVICING THE TACHOMETER. (See figure 6-1.) The tachometer is model USAF TYPE C-11.

a. Inspect the tachometer (17, figure 6-1) for obvious damage such as cracks, loose dial glass, insecure mounting, or a damaged tachometer shaft. Replace tachometer if found to be defective in any way.

b. In order to remove the tachometer, proceed as follows: Remove four sets of screws and nuts (18) that secure tachometer to the instrument panel (23). Lift the tachometer out of the instrument panel. Disengage the tachometer shaft (19) from the tachometer body.

c. In order to install the tachometer, reverse the procedure given above.

d. Follow the instructions given in NOTE of paragraph 6-5.

6-8. ALTIMETER TROUBLE SHOOTING CHART.

TROUBLE	PROBABLE CAUSE	REMEDY
INDICATOR NEEDLE FAILS TO RESPOND	Defective instrument	Replace altimeter (paragraph 6-9).
ALTIMETER READINGS ARE INCORRECT	Defective instrument	Replace altimeter (paragraph 6-9).
	Insecure mountage	Secure mounting screws (14, figure 6-1).

6-9. SERVICING THE ALTIMETER. (See figure 6-1.) The altimeter is model USAF TYPE C-13.

a. Inspect the altimeter (20, figure 6-1) for obvious damage and for security of mounting.

b. In order to remove the altimeter, proceed as follows: Remove the four attaching screws and nuts (21) that secure altimeter to the instrument panel (23).

c. In order to install the altimeter, reverse the procedure given above.

d. Follow the instructions given in NOTE of paragraph 6-5.

1. Engine primer knob
2. Flexible control lock plate
3. Screw and nut
4. Primer control cable assembly
5. Air-speed indicator
6. Air-speed indicator hose
7. Screw and nut
8. Oil temperature and oil pressure gage
9. Screw, bushing, and nut
10. Suction regulating valve
11. Venturi
12. Screw and nut
13. Turn and bank indicator
14. Screw and nut
15. Compass
16. Screw, nut and washer
17. Tachometer
18. Screw and nut
19. Tachometer shaft
20. Altimeter
21. Screw and nut
22. Starter switch button
23. Instrument panel
24. Screw
25. Washer
26. Nut
27. Cabin heat pull rod
28. Screw, bushing, and attachment lug
29. Screw and nut
30. Screw and nut
31. Oil pressure line

Legend for Figure 6-1.

6-10. TURN AND BANK INDICATOR TROUBLE SHOOTING CHART.

TROUBLE	PROBABLE CAUSE	REMEDY
BANK BALL DOES NOT FUNCTION	Damaged indicator	Remove and replace instrument. (paragraph 6-11).
TURN INDICATOR DOES NOT FUNCTION	Leak in control cable or connections to venturi	Locate leak and repair control cable or connections (12, figure 6-1).
	Obstructions in venturi or tubing to the instrument	Disconnect tubing and clean with compressed air. Clean venturi throat and opening (11, figure 6-1).
	Damaged turn indicator mechanism	Remove and replace instrument. (paragraph 6-11).

6-11. SERVICING THE TURN AND BANK INDICATOR. (See figure 6-1.) The turn and bank indicator is model USAF TYPE 1719.

a. Examine the turn and bank indicator (13, figure 6-1) for obvious damage and for security in its mounting. Replace this instrument if any defects are found.

b. In order to remove the turn and bank indicator, proceed as follows: Remove the four sets of screws and nuts (14) that secure the turn and bank indicator to the instrument panel (23). Disassemble screw and nut (12), remove venturi (11), release the screw and nut (30) holding the control cable, and pull the turn and bank indicator from the instrument panel.

c. In order to install the turn and bank indicator, reverse the procedure given above.

d. Follow the instructions given in NOTE of paragraph 6-5.

6-12. OIL PRESSURE AND OIL TEMPERATURE GAGE TROUBLE SHOOTING CHART.

TROUBLE	PROBABLE CAUSE	REMEDY
OIL PRESSURE GAGE DOES NOT READ PROPER VALUES	Obstruction in oil pressure line to gage	Disconnect oil pressure line (31, figure 6-1) and clear it with compressed air.
	Oil pressure relief valve not set properly.	Check oil pressure relief valve and reset. This valve is located at rear of right half of crankcase.
	Dirty or damaged suction regulating valve	Replace suction regulating valve (10, figure 6-1).
OIL TEMPERATURE GAGE DOES NOT REGISTER	Damaged oil pressure line	Replace damaged oil pressure line (31, figure 6-1).
	Oil pressure gage defective.	Replace instrument with new one (paragraph 6-13).

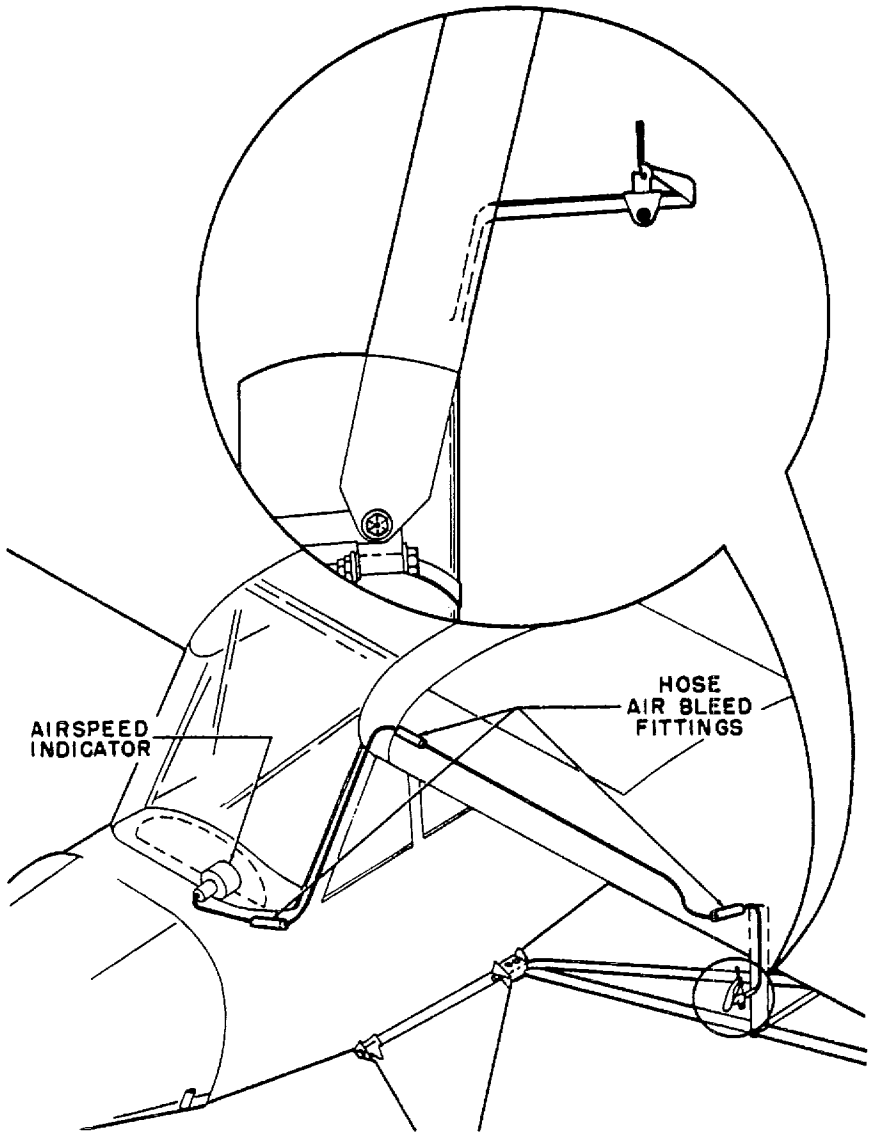

Figure 6-2. Pitot Static System (Wing Panel to Instrument Panel)

6-13. SERVICING THE OIL PRESSURE AND OIL TEMPERATURE GAGE. (See figure 6-1.) The oil pressure and oil temperature gage is model U. S. GAGE NO. BK-3-1/2-U-274.

a. Inspect the combination oil pressure and oil temperature gage (8, figure 6-1) for loose dial glass, insecure mounting, and damaged or deteriorated oil pressure line. Replace any defective parts with new units.

b. In order to remove the combination oil pressure and oil temperature gage, proceed as follows: Remove the two sets of screws, bushings, and nuts (9) which hold the gage to the instrument panel (23). Disassemble oil pressure line (31) and remove suction regulating valve (10). Lift the gage out of the instrument panel.

c. In order to install the combination oil pressure and oil temperature gage, reverse the procedure given above.

d. Follow the instructions given in NOTE of paragraph 6-5.

6-14. PITOT STATIC SYSTEM.

6-15. DESCRIPTION. (See figure 6-2.) The pitot static system serves the air speed indicator (5, figure 6-2). The dynamic pressure pitot head is located on the left front jury strut. The dynamic pressure line runs from the jury strut up into the left wing panel to the wing root and down along the left windshield post to the air speed indicator fitting (figure 6-2). There are no static pressure lines in this system. Since the cabin is not pressurized, the static pressure is obtained directly at the air speed indicator casing through a fitting equipped with an air filter. The pressure differential developed between the dynamic-pressure pitot head and the air speed indicator static-pressure fitting when the airplane is in motion operates a pressure sensitive mechanism reading indicated air speed.

6-16. SERVICING THE PITOT STATIC SYSTEM. (See figure 6-2.) Examine all hose and connections for leakage, deterioration, obstructions or damage. Replace damaged parts with new ones. To remove obstructions, disconnect hose from the pitot head and from the air-speed indicator and clear with compressed air. Clean the pitot head in a similar manner.

SECTION VII

ELECTRICAL SYSTEM

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7-1. ELECTRICAL SYSTEM.

7-2. DESCRIPTION. (See figure 7-1.) The electrical system is a 12 volt d-c system furnishing power for engine starting, navigation lights, landing lights and cockpit light. The system consists of a storage battery, generator, voltage regulator, switches, circuit breakers, ammeter, landing lights, navigation lights, cockpit light and interconnecting wiring (see paragraph 5-58 for information on the engine starter). Servicing instructions for these components will be furnished individually in the following paragraphs.

NOTE

When a particular electrical unit is suspected of malfunctioning, refer to the applicable wiring diagram in Section X and test the unit thoroughly as explained in the following paragraphs before removing it. Test all wiring serving the electrical unit for continuity. Replace broken or damaged wires with new ones. When replacing wires, mark the new wire with the proper code number. If a wire to be replaced is bound into a harness assembly, pull the faulty wire out and lace the new wire to the outside of the harness with friction tape. Inspect all fuse clips. Clean fuse clip contact surfaces and make certain spare fuses are available in spare fuse clips.

7-3. GENERATOR TROUBLE SHOOTING CHART.

NOTE

Reference should be made to the Lycoming Operator's Manual and Lycoming Parts Catalog for detailed maintenance procedures on the generator and for parts identification.

TROUBLE	PROBABLE CAUSE	REMEDY
GENERATOR DOES NOT CHARGE	Insecure electrical connections to generator	Clean and tighten electrical connections.
	Commutator contaminated with grease or oil	Remove grease or oil deposits with a cloth moistened in dry cleaning solvent, Specification No. P-S-661. Reface commutator with sandpaper but do not use emery cloth.

TROUBLE	PROBABLE CAUSE	REMEDY
	Brushes worn, chipped or otherwise damaged	Replace brushes with new ones.
	Open or shorted armature	Replace generator with a new one.
	Open or shorted field	Replace generator with a new one.
	Commutator pitted, scored or damaged beyond repair	Replace generator with a new one.
GENERATOR CHARGING RATE TOO LOW	Brushes worn, chipped or otherwise damaged	Replace brushes with new ones.
	Insecure or damaged connections in generator to voltage regulator circuit	Clean and tighten electrical connections. Replace damaged terminals or wires with new ones.
	Defective voltage regulator	Replace voltage regulator with new one.
	Damaged commutator	Replace generator with a new one.
	Generator drive belt slips	Adjust tension on generator drive belt.
GENERATOR CHARGING RATE TOO HIGH	Voltage regulator malfunctioning	Service voltage regulator. See paragraph 7-5.

7-4. SERVICING THE GENERATOR. The generator is a DELCO-REMY MODEL, 12 ampere, 12 volt. The generator (15, figure 10-4) is located on the lower right front side of the engine and is driven by a belt to a pulley which is concentric with and integral to the rear propeller flange. Examine the generator for security of mounting and cracked or broken mounting flanges and end housing. Replace a damaged generator. Inspect the brushes for damage or wear beyond limits and brush leads for deterioration or evidence of chafing. Replace damaged parts. Examine the commutator for pitting and evidence of oil or metal particles. Clean the commutator with a cloth moistened in dry-cleaning solvent, Specification No. P-S-661. Reface a pitted commutator with fine sandpaper but do not use emery cloth. Check the generator drive belt for proper tension and damage. Replace a damaged belt with a new one.

7-5. SERVICING THE VOLTAGE REGULATOR. The voltage regulator is a LYCOMING MODEL No. 63723. The voltage regulator (14, figure 10-4) is mounted on the firewall. Examine the regulator for obvious damage, security of mounting and deterioration of shock mounts. Replace damaged mounts. Clean the voltage regulator casing with a cloth moistened in dry-cleaning solvent, Specification No. P-S-661. Remove the cover and inspect the contact points for pitting or other damage. Replace the voltage regulator with a new one if the contact points are unserviceable. Clean and tighten all connections. Test the operation of the voltage regulator as follows: start and run the engine up to 1800 rpm. Turn off the master switch and place a load on the system by turning on the landing lights. Turn the master switch on and check to see that the voltage regulator operates. The ammeter should indicate charge at the same time. Turn landing lights off, shut down the engine and reassemble the voltage regulator cover. If the voltage regulator is inoperative, replace it with a new one but do not attempt to adjust the faulty regulator. Adjustment, calibration, and test of this regulator may be accomplished at field level, when adequate facilities and qualified personnel are available.

7-5A. MAINTENANCE, TESTING AND CALIBRATION INSTRUCTIONS FOR VOLTAGE REGULATOR, PART NR 1118383, LYCOMING MODEL NR 63723.

7-5B. GENERAL.

a. Mechanical checks and adjustments (air gaps, point opening) must be made with the battery disconnected and the regulator removed from the aircraft.

CAUTION

The cutout relay contact points must never be closed by hand with the battery connected to the regulator. This would cause a high current to flow through the units seriously damaging them.

b. All checks and adjustments of the regulator must be made using the same type generator with which the regulator is normally used. The regulator must be mounted in its operating position, and it must be at operating temperature before attempting to check or adjust the regulator.

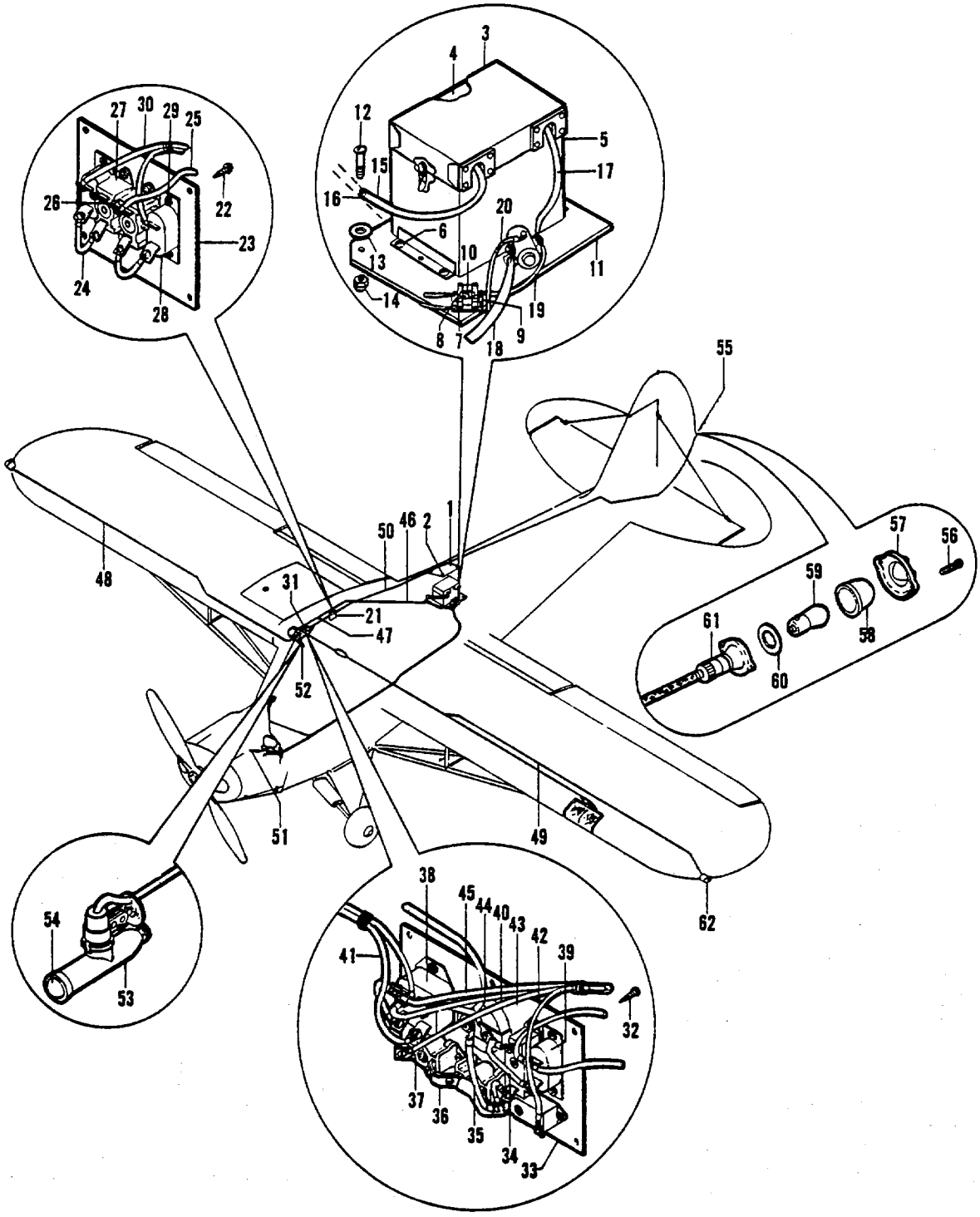


Figure 7-1. Electrical Systems Installation

7-5C. REPOLARIZING THE GENERATOR.

a. After any tests or adjustments, the generator on the airplane must be repolarized after the leads are connected, but before the engine is started.

b. After reconnecting the leads, momentarily, connect a jumper lead between the "GEN" and "BAT" terminals of the regulator. This allows a momentary surge of current to flow through the generator which correctly polarizes it. Failure to do this may result in severe damage to the equipment since reverse polarity causes vibration, arcing and burning of the relay contact points.

7-5D. QUICK CHECKS OF GENERATOR AND REGULATOR.

NOTE

In analyzing complaints of generator-regulator operation, any of several basic conditions may be found.

a. Fully Charged Battery and a Low Charging Rate. This indicates normal generator-regulator operation.

b. Fully Charged Battery and a High Charging Rate.

(1) This indicates that the voltage regulator is not reducing the generator output as it should. A high charging rate to a fully charged battery will damage the battery, and the accompanying high voltage is injurious to all of the electrical units. This operating condition may be the result of one of the following: improper voltage regulator setting; grounded generator field circuit in either the generator, the regulator or the wiring harness; poor ground connection at regulator and high speed operation of the generator; high temperature which reduces the resistance of the battery to charge so that it will accept a high charging rate even though the voltage regulator setting is normal.

(2) If the trouble is not due to high temperature, determine the cause of the trouble by disconnecting the lead from the regulator "F" terminal with the generator operating at medium speed. If the output remains high, the generator field is grounded either in the generator or in the wiring harness. If the output of the generator drops, the regulator is at fault and should be checked for a high voltage setting or grounds, and poor ground connections.

c. Low Battery and High Charging Rate. This is normal generator-regulator operation.

d. Low Battery and Low or No Charging Rate. This condition could be due to:

(1) Loose connections, frayed or damaged wires.
(2) Defective battery.
(3) High circuit resistance.
(4) Low regulator setting.
(5) Oxidized regulator contact points.
(6) Defects within the generator.

e. If the condition is not caused by loose connections, frayed or damaged wires, proceed as follows to locate cause of trouble: to determine whether the generator or regulator is at fault, momentarily ground the "F" terminal of the regulator and increase the generator speed. If the output does not increase, the generator is at fault. If the generator output increases, the trouble is due to:

(1) A low voltage (or current) regulator setting.

(2) Oxidized regulator contact points which insert excessive resistance into the generator field circuit so that output remains low.

(3) Generator field circuit open within the regulator at the connections or in the regulator winding.

f. Burned Resistances, Windings or Contacts. These result from open circuit operation, open resistance units or high resistance in the charging circuit. When burned resistances, windings or contacts are found, always check airplane wiring before installing a new regulator. Otherwise, the new regulator may also fail in the same way.

g. Burned Relay Contact Points. This may be due to reversed generator polarity. Generator polarity can be corrected as explained in paragraph 7-5C.

7-5E. CLEANING CONTACT POINTS. The contact points of a regulator will not operate indefinitely without some attention. It has been found that a great majority of all regulator trouble can be corrected by cleaning the contact points, plus some possible readjustment. The flat points should be cleaned with a spoon or riffler file. Loosen the contact bracket mounting screws so that the bracket can be tilted to one side. (See figure 7-1A.) Never use emery cloth or sandpaper to clean the contact points. Remove all the oxides from the contact points.

NOTE

It is not necessary to remove any cavity that may be developed.

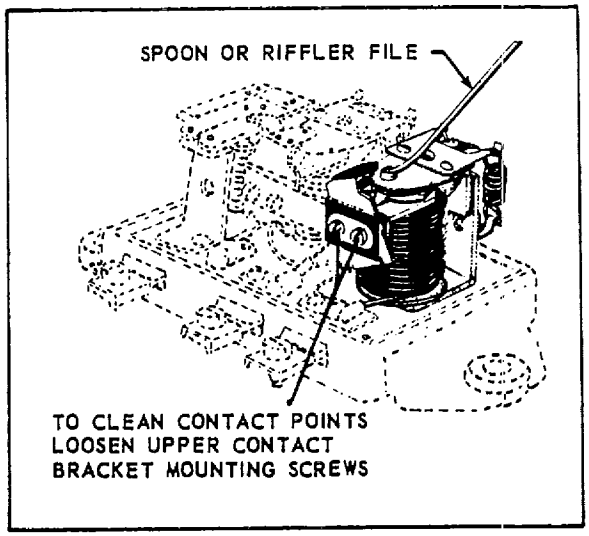


Figure 7-1A. Cleaning Voltage Regulator Points

7-5F. CUTOUT RELAY CHECKS AND ADJUSTMENTS. The cutout relay requires three checks and adjustments; the air gap, the point opening, and the closing voltage. The air gap point opening adjust-

ments must be made with the battery disconnected.

a. To check the air gap, place fingers on armature directly above the core and move armature down until points just close. Measure the air gap between the armature and the center of the core. (See figure 7-1B.) Make sure that both contact points close simultaneously. If they do not, bend spring finger as necessary. To adjust the air gap, loosen two screws at the back of relay and raise or lower the armature as required. (See Table V for the proper air gap setting.) Tighten screws securely after making final adjustment.

b. Check the relay point opening and adjust by bending the upper armature stop. (See figure 7-1C.) See Table V for proper point opening.

c. To check the closing voltage of the cutout relay, connect the regulator to the proper generator and battery, and connect a voltmeter between the regulator "GEN" terminal and the base, as shown in figure 7-1D. Slowly increase the generator speed and note relay closing voltage. Decrease generator speed and make sure that the cutout relay contact points open. (See Table VI for the proper drop in and drop out voltage.) Adjust the closing voltage by turning the adjusting screw clockwise to increase spring tension and closing voltage, or counter-clockwise to decrease spring tension and closing voltage. (See figure 7-1E.)

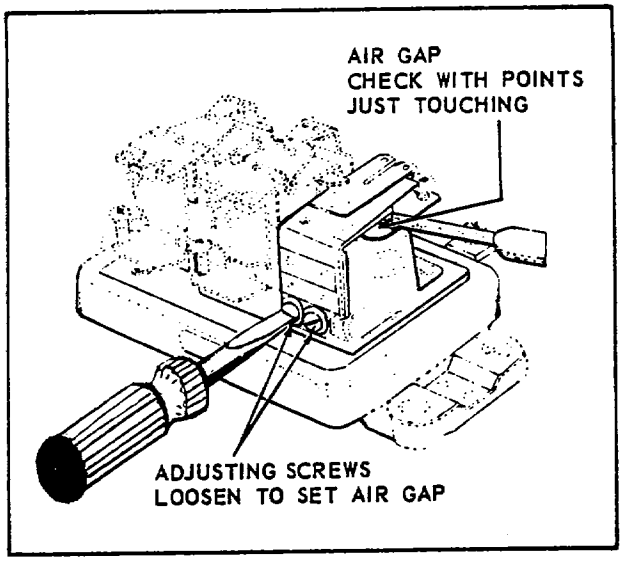


Figure 7-1B. Air Gap Adjustment

7-5G. VOLTAGE REGULATOR CHECKS AND ADJUSTMENTS. Two checks and adjustments are required on the voltage regulator, the air gap and the voltage setting.

a. To check the air gap, push armature down until the contact points are just touching and then measure the air gap. (See figure 7-1F.) Adjust by loosening the contact mounting screws and raising or lowering the contact bracket as required. (See Table V for the proper air gap setting.) Be sure the points are lined up and tighten screws after adjustment.

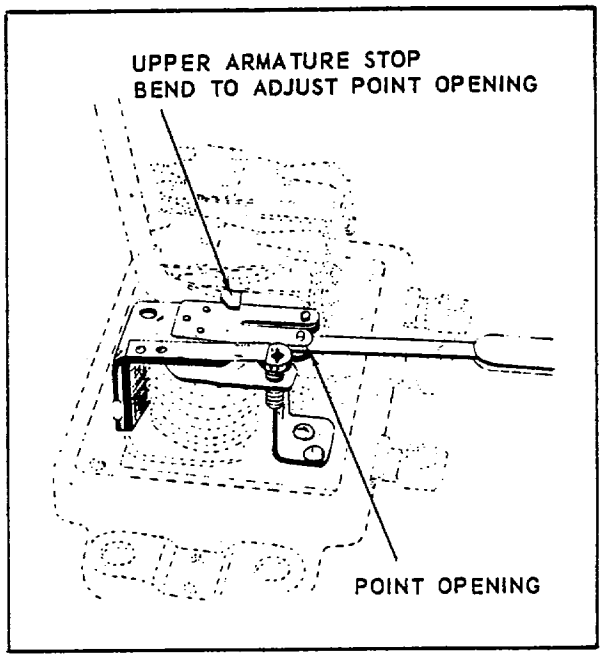


Figure 7-1C. Point Opening Adjustment

b. To check the voltage setting, a fixed resistor of 2.25 ohm must be substituted for the external charging circuit by disconnecting the battery lead at the regulator and connecting the resistor between the regulator "BAT" terminal and ground. A test voltmeter is connected in parallel with the fixed resistor as shown in figure 7-1G. The resistor must be capable of carrying 10 amperes without any change of resistance with temperature changes.

(1) With generator operating at specified speed and with the regulator at operating temperature, note voltage setting. Cover must be in place. (See Table VI

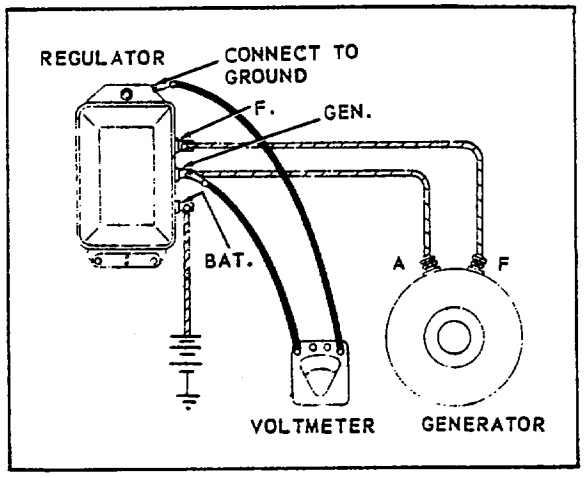


Figure 7-1D. Checking Closing Voltage of Cutout Relay

for proper voltage setting.) To adjust voltage setting, turn adjusting screw as shown in figure 7-1H, clockwise to increase voltage setting and counter-clockwise to decrease voltage setting.

CAUTION

If the adjusting screw is turned clockwise beyond normal adjustment range, the springs support may fail to return when the screw is turned counter-clockwise. In this case, turn screw counter-clockwise until approximately 1/8-inch clearance develops between the screw head and the spring support, then bend spring support upward until contact is made with the screw head.

(2) Final setting of the unit must always be approached by increasing the spring tension, never by reducing it. If setting is too high, adjust unit below required value and then raise to exact setting by increasing the spring tension.

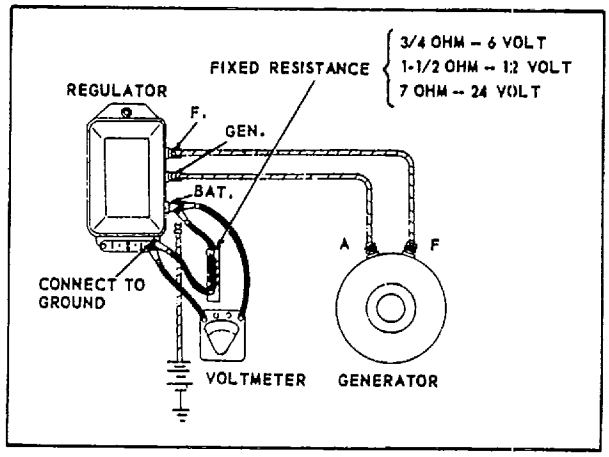


Figure 7-1G. Checking Voltage Setting of Voltage Regulator

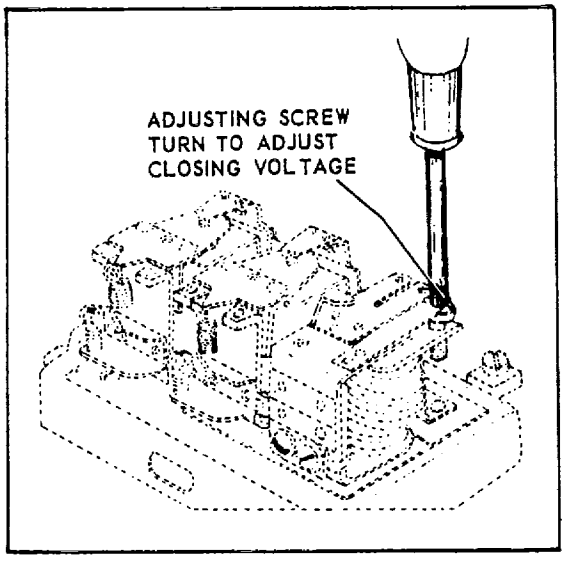


Figure 7-1E. Closing Voltage Adjustment

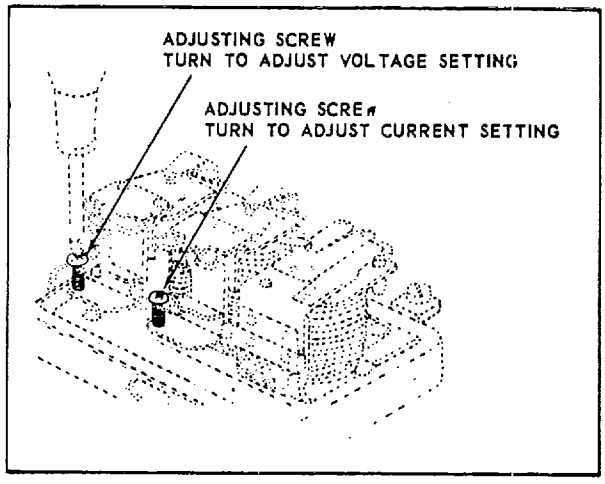


Figure 7-1H. Voltage and Current Adjustments

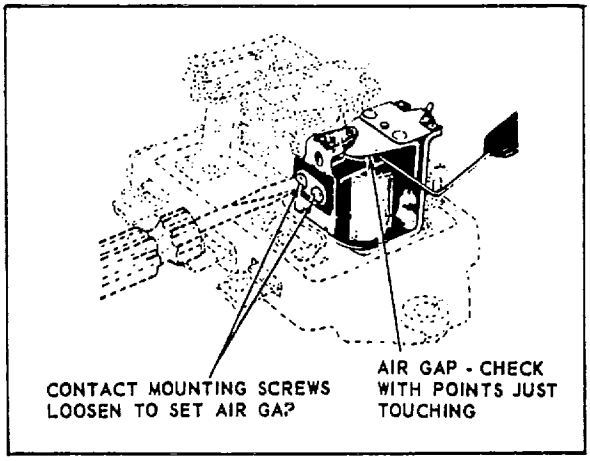


Figure 7-1F. Voltage Regulator Adjustment

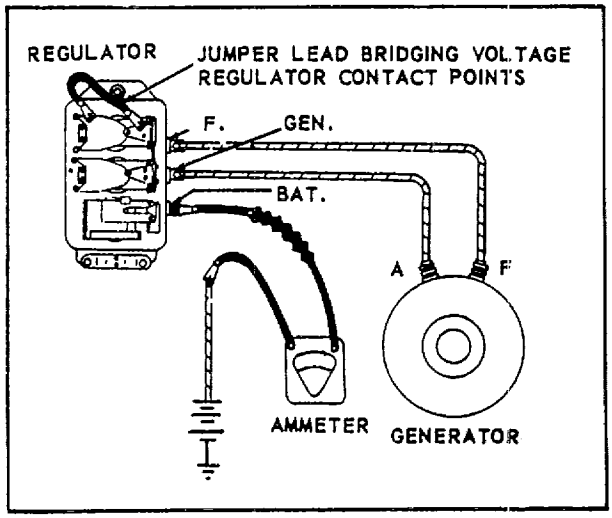


Figure 7-1J. Checking Current Setting of Current Regulator

Revised 14 October 1955

(3) After each adjustment and before taking voltage reading, replace the regulator cover, reduce generator speed until relay points open, then bring the generator back to speed again.

7-5H. CURRENT REGULATOR CHECKS AND ADJUSTMENTS. Two checks and adjustments are required on the current regulator, the air gap and the current setting.

a. The air gap on the current regulator is checked and adjusted in exactly the same manner as for the voltage regulator as described in paragraph 7-5G.*a.* (See Table VI for proper air gap setting.)

b. To check the current regulator setting, the voltage regulator must be prevented from operating. Remove the regulator cover and connect a jumper lead across the voltage contact points. Disconnect the battery lead at the regulator, connect the 2.25 ohm fixed resistor in series with a suitable ammeter and connect the battery lead to the ammeter. (See figure 7-1J.) Operate the generator at specified speed and note current setting. (See Table VI for proper current setting.) If necessary, adjust by turning the adjusting screw clockwise to increase current setting or counter-clockwise to decrease current setting. (See figure 7-1H.)

TABLE V

Voltage Regulator Air Gap	0.075 in.
Current Regulator Air Gap	0.075 in.
Cutout Relay Air Gap	0.020 in.
Cutout Relay Point Opening	0.020 in.

TABLE VI

Cutout Relay Closing Voltage		*Voltage Regulator Setting (Volts)*		*Current Regulator Setting (Amps)*	
Range	Adjust	Range	Adjust	Range	Adjust
11.8 - 13.6	12.8	13.9 - 14.9	14.3	10.5 - 13.5	12

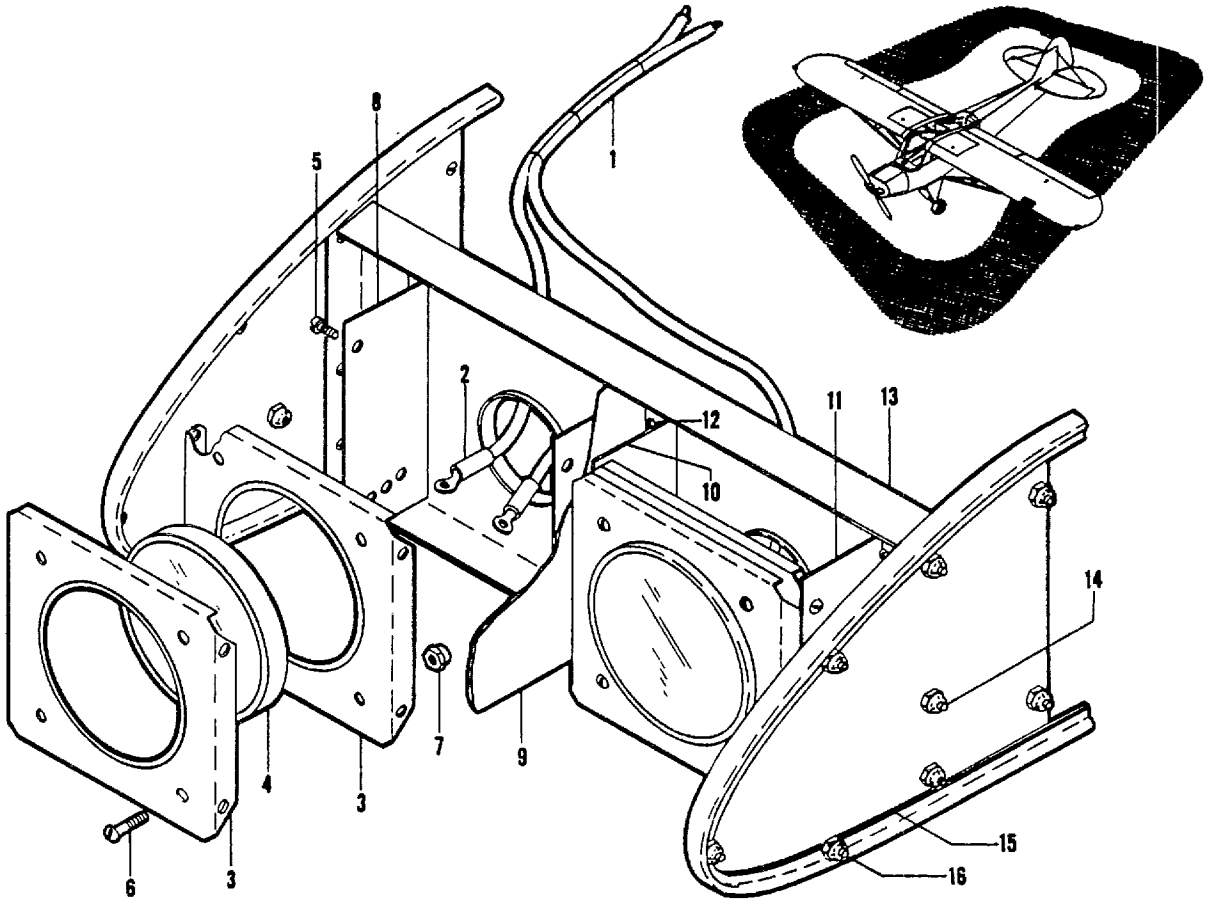
7-6. SERVICING THE BATTERY. (Refer to paragraph 1-23.)

7-7. SERVICING THE AMMETER. (See figure 10-4.) There is no permissible maintenance or repair for the ammeter (A.C. spark plug, model number AM-5183). Test the ammeter with engine running at 1800 rpm by turning master switch on and off with landing lights on. If the ammeter does not show charge and discharge, replace it with a new one. Forward the faulty ammeter to an overhaul base.

7-8. SERVICING SWITCHES AND CIRCUIT BREAKERS. (See figure 7-1.) Test all switches for continuity and replace inoperative switches with new ones. Examine all circuit breakers for obvious damage. Replace damaged circuit breakers with new ones. The circuit breakers are of the thermal type and therefore it is unadvisable to test them since the current required would place an excessive load on the battery. Replace a circuit breaker suspected of malfunctioning with a new one.

7-9. LANDING LIGHTS.

7-10. DESCRIPTION. (See figure 7-2.) The landing lights consisting of two 12 volt, 100 watt lights are



1. Harness assembly
2. Single wire
3. Landing light mountain plate
4. Landing light (100 watt, 12 volt)
5. Screw
6. Screw
7. Nut
8. Landing light mounting bracket
9. Rib reinforcement plate
10. Landing light mounting bracket
11. Landing light mounting bracket
12. Screw and nut
13. Landing light mounting plate
14. Screw and nut
15. Rib reinforcement plate
16. Screw and nut

Figure 7-2. Landing Light Installation

1. Battery access door
2. Stud and grommet
3. Battery lid
4. Battery
5. Battery box
6. Screw, washer, and nut
7. Fuse block
8. Screw, washer, and nut
9. Fuse terminal jumper
10. Fuse
11. Battery mounting board
12. Screw
13. Washer
14. Nut
15. Battery ground cable
16. Bolt, washer, and nut
17. Battery cable
18. Battery cable
19. Single wire
20. Single wire
21. Landing light switch panel
22. Screw
23. Landing light switch panel
24. Single wire
25. Single wire
26. Fuse terminal jumper
27. Circuit protector
28. Switch
29. Screw
30. Single wire and harness
31. Main switch panel
32. Screw
33. Switch panel
34. Single wire
35. Single wire
36. Circuit breaker jumper
37. Circuit protector
38. Switch
39. Circuit protector
40. Ammeter
41. Single wire and harness
42. Single wire and harness
43. Single wire
44. Single wire
45. Single wire
46. Single wire
47. Single wire
48. Single wire
49. Single wire
50. Single wire
51. Single wire
52. Cockpit light
53. Cockpit spotlight
54. Cockpit spot lens
55. Tail white light
56. Screw
57. Tail light lens retainer
58. Tail light white lens
59. Lamp
60. Position light gasket
61. Reflector and socket
62. Wing installation light

Legend for Figure 7-1.

mounted in the left wing panel leading edge. The assembly is protected by a plexiglas window shaped to conform to the leading edge contour. The landing lights are controlled by a switch (21, figure 7-1) located on the right trim panel at the wing root.

7-11. REMOVAL OF LANDING LIGHTS. (See figure 2-3 and 7-2.)

a. Remove landing light window attachment strips (53 and 54, figure 2-3) and landing light window (52).

b. Disassemble landing light mounting plates (3, figure 7-2) from mounting brackets (8), pull light assemblies out from the wing panel and disconnect the wiring (2).

7-12. CLEANING THE LANDING LIGHTS. (See figure 2-3 and 7-2.)

a. Wipe both landing lights with a clean cloth.

b. Clean the contact surfaces on the lights and on the wire terminals with fine sandpaper.

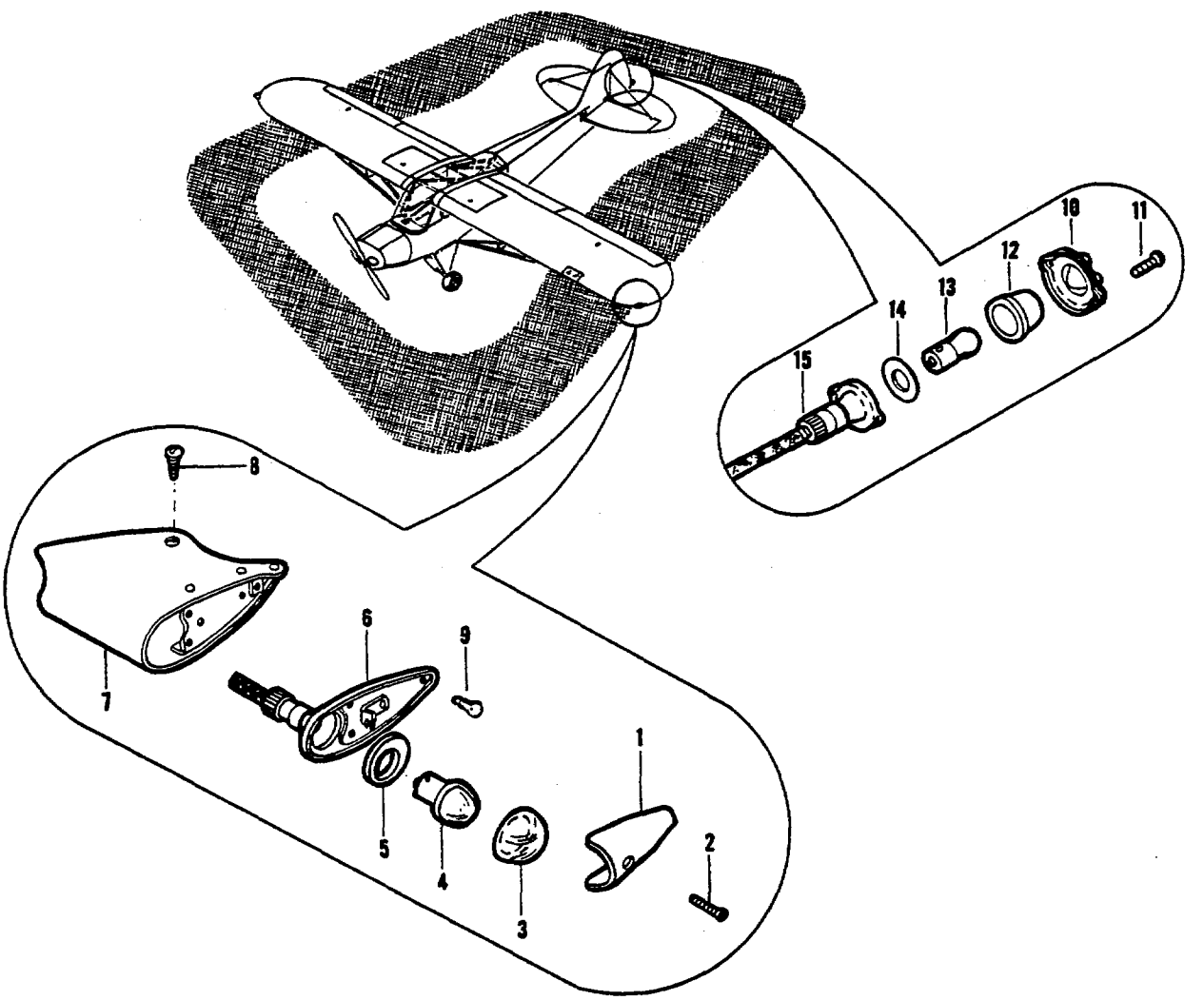
c. Wash the plexiglas window panel in a mild soap and water solution and rinse thoroughly with clean water. Dry with a clean cloth.

7-13. INSPECTION OF LANDING LIGHTS. (See figure 2-3 and 7-2.)

a. Examine the plexiglas window panel for deep cuts or scratches and cracks. Replace a damaged window with a new one.

b. Inspect the lights for damage. Replace damaged or inoperative lights.

c. Inspect the insulation of the wires for damage such



1. Wing position light shield
2. Screw
3. Lens (green and red)
4. Lamp
5. Globe basket
6. Position light base assembly
7. Navigation light bracket assembly
8. Screw
9. Screw
10. Tail light lens retainer
11. Screw
12. Lens
13. Lamp
14. Gasket
15. Tail light reflector and socket

Figure 7-3. Wing and Tail Light Installation

as cracks, cuts or deterioration and test the wires for continuity. Replace damaged or faulty wires with new ones.

7-14. INSTALLATION OF LANDING LIGHTS. (See figures 2-3 and 7-2.)

a. Thread the wires through landing light mounting plates (3, figure 7-2) and fasten them to lights (4). Fasten both rear mounting plates (3) to mounting brackets (8). Position both lights (4) and front mounting plates (3) onto rear mounting plates (3) and secure the assemblies with screws.

b. Mount the plexiglas window (52, figure 2-3) over the landing lights and fasten the window to the wing panel with landing light window attachment strips (53 and 54).

7-15. NAVIGATION LIGHTS.

7-16. DESCRIPTION. (See figure 7-3.) The navigation lights are located on the wing tips and on the rudder. The left wing light is red, the right wing light is green, and the tail light is white. The navigation lights are controlled by a switch (31, figure 7-1) located on the main switch panel secured to the right trim panel at the wing root.

7-17. REMOVAL OF NAVIGATION LIGHTS. (See figure 7-3.)

a. Remove wing navigation light by disassemblying shields (1, figure 7-3). Remove lens (3) and lamp (4).

b. The globe gasket (5), position light base assembly (6), and bracket (7) may be removed if necessary for replacement or repair.

c. Remove tail light by separating lens retainer (10) and lens (12) from reflector and socket assembly (15). Remove lamp (13). Gasket (14) and reflector and socket assembly (15) may be removed if necessary for replacement or repair.

7-18. INSTALLATION OF NAVIGATION LIGHTS. (See figure 7-3.)

a. To install the tail light assembly, reassemble reflector and socket assembly (15, figure 7-3) and gasket (14) if previously disassembled. Reassemble lamp (13), lens (12) and lens retainer (10).

b. To install the wing navigation lights, reassemble navigation light bracket assembly (7), base assembly (6) and gasket (5) if previously disassembled.

c. Insert lamp (4) in the base assembly (6), position red lens (3) to the left wing light and the green lens (3) to the right wing light and secure the assembly with wing position shield (1).

7-19. SERVICING THE COCKPIT LIGHT. (See figure 7-1.) Inspect the cockpit light (52, figure 7-1) for broken lens, broken or burned out bulb and broken switch. Replace damaged parts with new ones. If the cockpit light is damaged beyond repair, replace it with a new one.

SECTION VIII

RADIO AND RADAR EQUIPMENT

NOTE

Radio and radar maintenance instructions are not applicable since this airplane does not contain either system.

SECTION IX

ARMAMENT AND PHOTOGRAPHIC EQUIPMENT

NOTE

Maintenance instructions for armament and photographic equipment are not applicable since this airplane is not furnished with either of these components.

SECTION X

WIRING DATA

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Wiring Diagrams 86

Equipment List

Item No.	Name of Part and Description	Type of Drawing No. or Manufacturer's Name and No.
1	Ignition Switch	84132 Briggs and Stratton Corp.
2	Magneto	Supplied with Engine
3	Magneto	Supplied with Engine
4	Battery	Reading Batteries, Inc., S-24
5	Solenoid	Supplied with Engine
6	Fuse	3AG30 Little Fuse Company
7	Fuse	3AG30 Little Fuse Company
8	Master Switch	AN3023-1B
9	Ammeter	Stewart-Warner Corp., 402264
10	Circuit Breaker	Spencer Thermostat Co., PSM5
11	Starter Switch	Robbins and Myers, 1875-0
12	Starter	Supplied with Engine
13	Circuit Breaker	Spencer Thermostat Co., PSM15
14	Voltage Regulator	Supplied with Engine
15	Generator	Supplied with Engine
16	Circuit Breaker	Spencer Thermostat Co., PSM10
17	Circuit Breaker	Spencer Thermostat Co., PSM10
18	Switch	AN3022-2
19	Switch	AN3022-2
20	Landing Light	General Electric Co., 4509
21	Landing Light	General Electric Co., 4509
22	Circuit Breaker	Spencer Thermostat Co., PSM5
23	Light Switch	AN3022-2
24	Right Wing Light	Grimes Mfg. Co., A1285-G-12
25	Left Wing Light	Grimes Mfg. Co., A1285-G-12
26	Tail light	A-2064, Grimes Mfg. Co.
27	Cockpit Light	Grimes Mfg. Co., Model J Spot, A-1425

LIST OF WIRING DIAGRAMS

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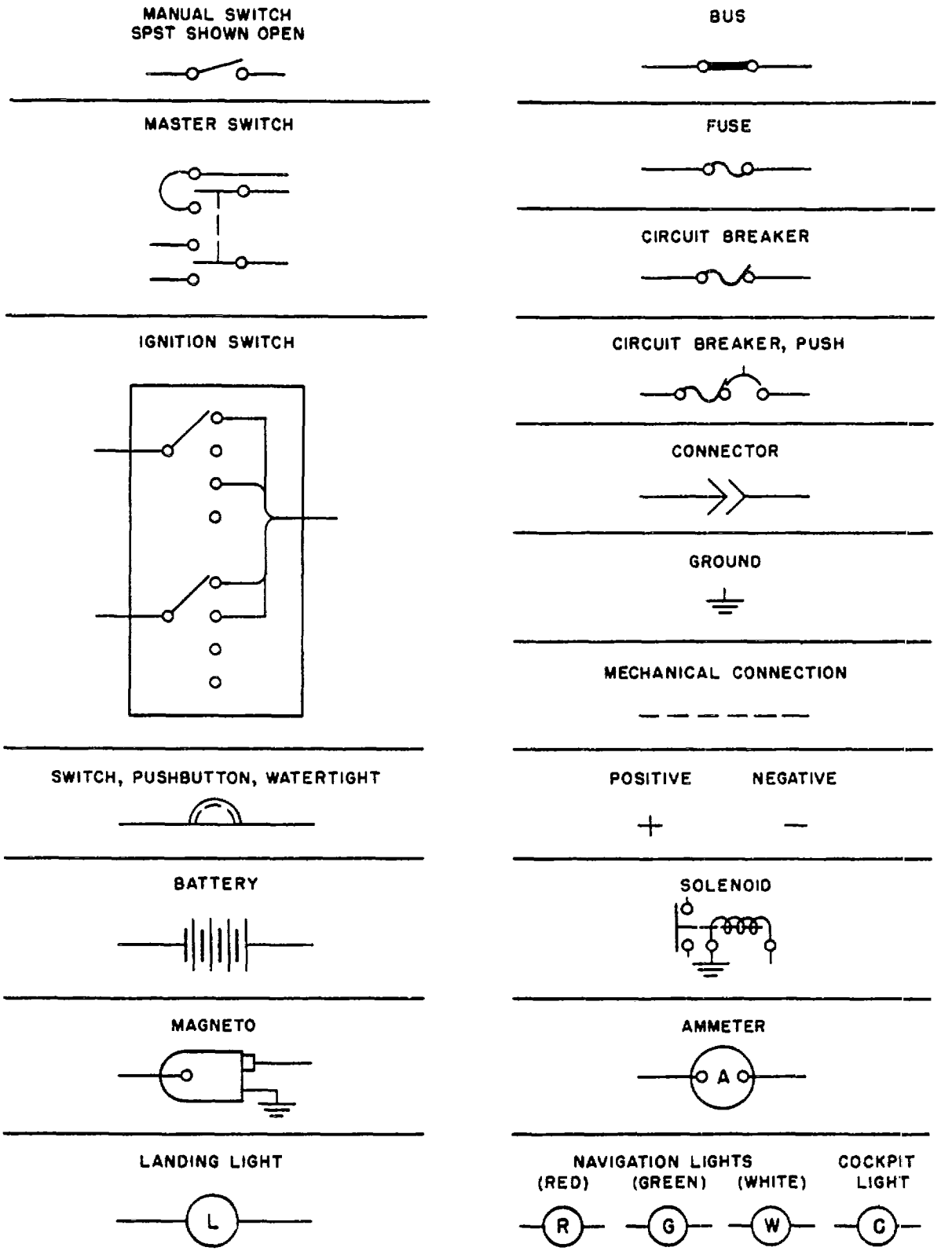
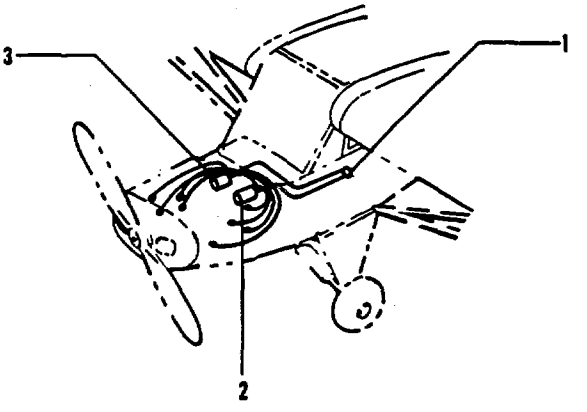


Figure 10-1. Wiring Diagram Symbols



Item No.	Name of Part and Description	Type of Drawing No. or Manufacturer's Name and No.
1	Ignition Switch	84132
2	Magneto	Supplied With Engine
3	Magneto	Supplied With Engine

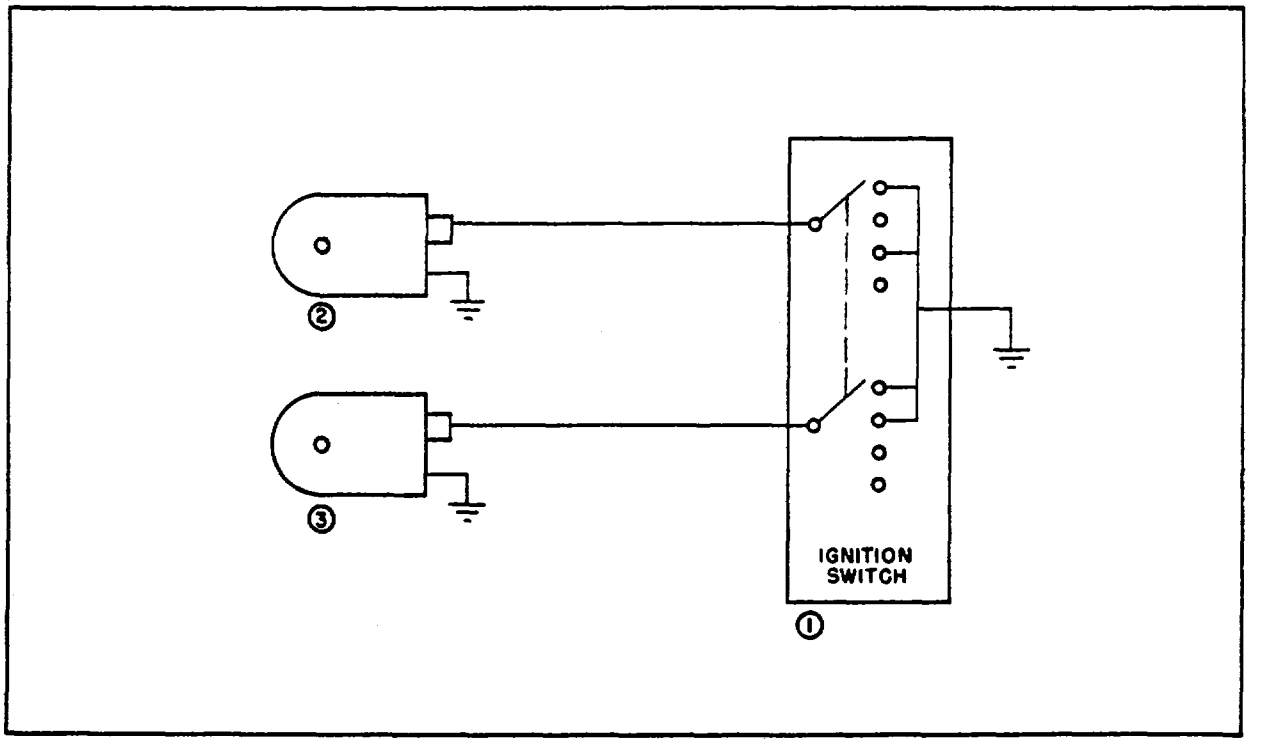
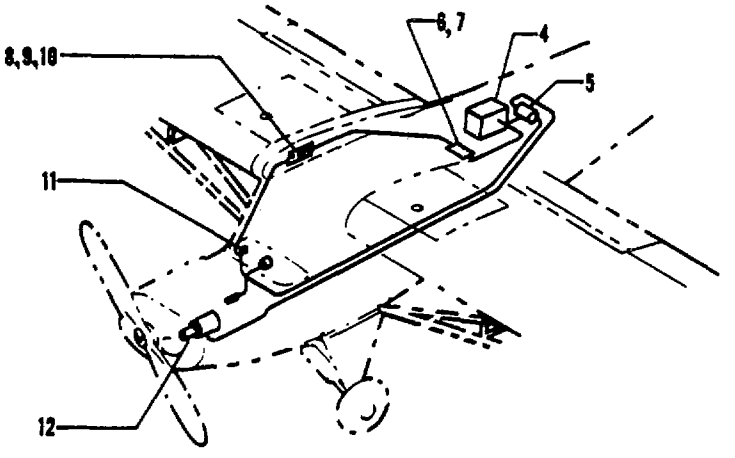


Figure 10-2. Ignition Circuit



Item No.	Name of Part and Description	Type of Drawing No. or Manufacturer's Name and No.
4	Battery	Reading Batteries, Inc. S-24
5	Solenoid	Supplied With Engine
6	Fuse	3AG30
7	Fuse	3AG30
8	Master Switch	AN3023-1B
9	Ammeter	Stewart-Warner Corp., 402264
10	Circuit Breaker	Spencer Thermostat Co., PSM5
11	Starter Switch	Robbins and Myers, 1875-0
12	Starter	Supplied With Engine

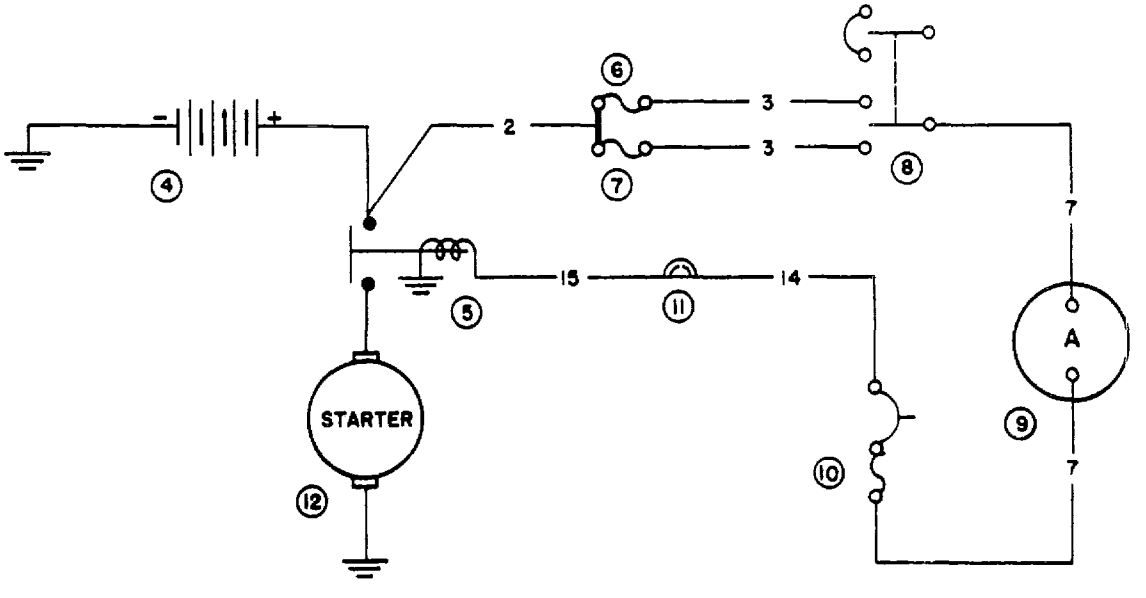
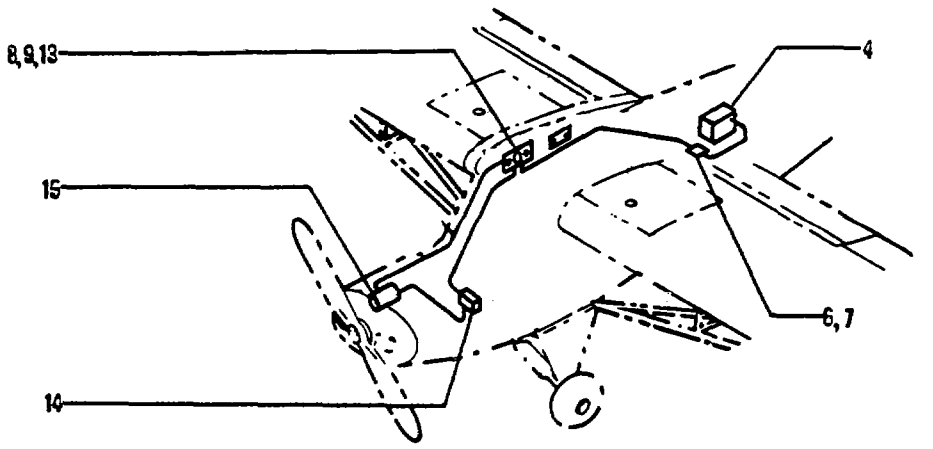


Figure 10-3. Starter Circuit



Item No.	Name of Part and Description	Type of Drawing No. or Manufacturer's Name and No.
4	Battery	Reading Batteries, Inc., S-24
6	Fuse	3AG30
7	Fuse	3AG30
8	Master Switch	AN3023-1B
9	Ammeter	Stewart-Warner Corp., 402264
13	Circuit Breaker	Spencer Thermostat Co., PSM15
14	Voltage Regulator	Supplied With Engine
15	Generator	Supplied With Engine

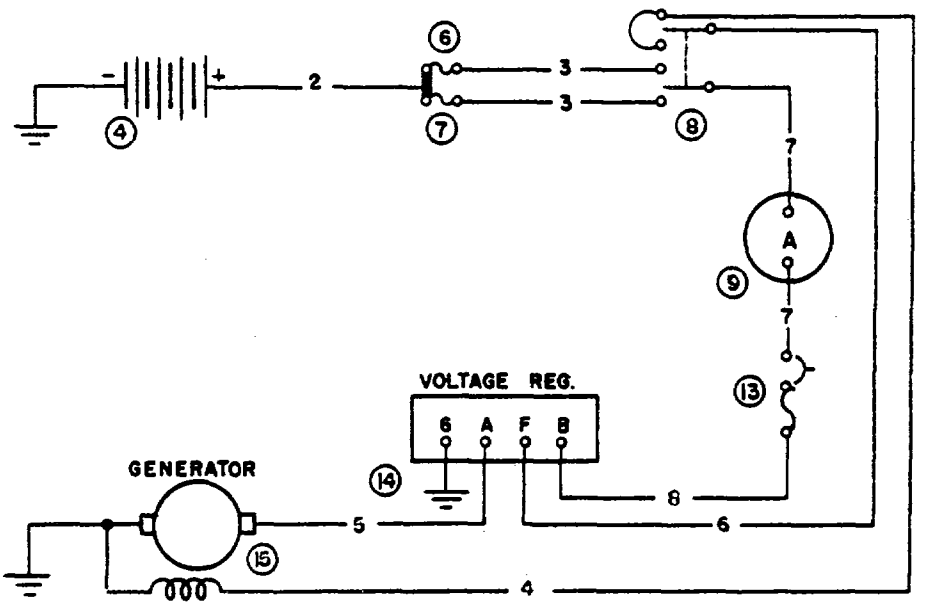
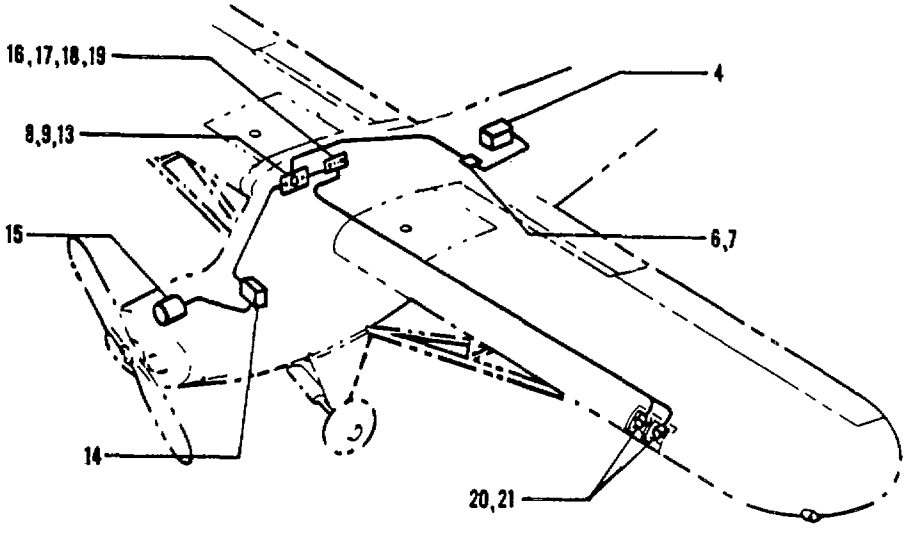


Figure 10-4. Power Circuit



tem No.	Name of Part and Description	Type of Drawing No. or Manufacturer's Name and No.
4	Battery	Reading Batteries, Inc., S-24
6	Fuse	3AG30
7	Fuse	3AG30
8	Master Switch	AN3023-1B
9	Ammeter	Stewart-Warner Corp., 402264
13	Circuit Breaker	Spencer Thermostat Co., PSM15
14	Voltage Regulator	Supplied With Engine
15	Generator	Supplied With Engine
16	Circuit Breaker	Spencer Thermostat Co., PSM10
17	Circuit Breaker	Spencer Thermostat Co., PSM10
18	Switch	AN3022-2
19	Switch	AN3022-2
20	Landing Light	General Electric Co., 4509
21	Landing Light	General Electric Co., 4509

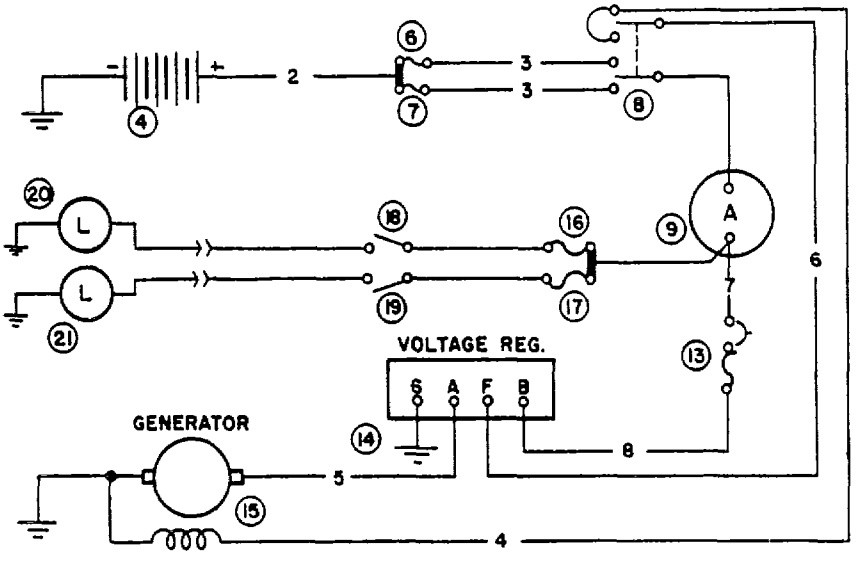
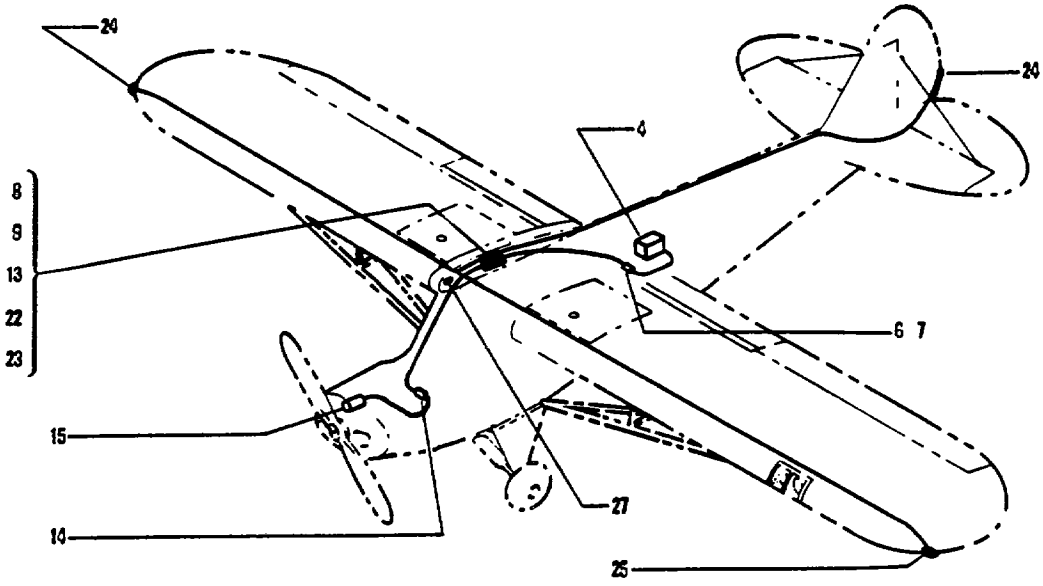


Figure 10-5. Landing Light Circuit



Item No.	Name of Part and Description	Type of Drawing No. or Manufacturer's Name and No.
4	Battery	Reading Batteries, Inc., S-24
6	Fuse	3AG30
7	Fuse	3AG30
8	Master Switch	AN3023-1B
9	Ammeter	Stewart-Warner Corp., 402264
13	Circuit Breaker	Spencer Thermostat Co., PSM15
14	Voltage Regulator	Supplied With Engine
15	Generator	Supplied With Engine
22	Circuit Breaker	Spencer Thermostat Co., PSM5
23	Light Switch	AN3022-2
24	Right Wing Light	Grimes Mfg. Co., A1285-G-12
25	Left Wing Light	Grimes Mfg. Co., A1285-R-12
26	Tail Light	A-2064
27	Cockpit Light	Grimes Mfg. Co., Model J Spot, A-1425

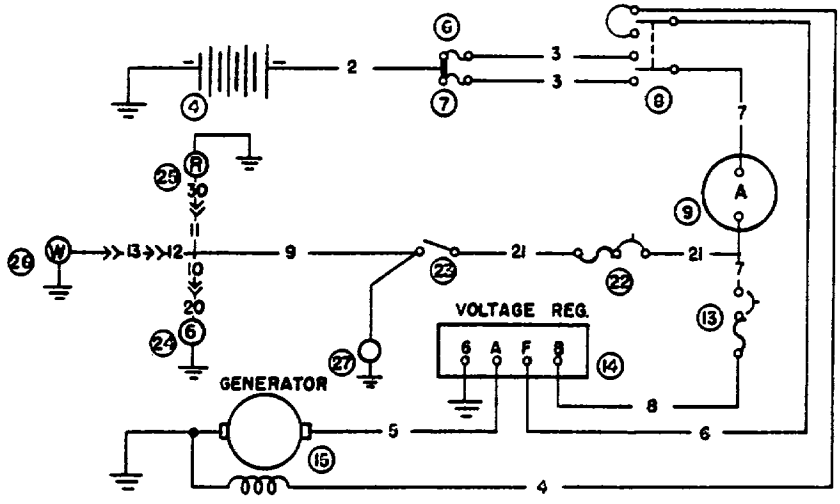


Figure 10-6. Navigation Light Circuit

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HEADQUARTERS,
DEPARTMENT OF THE ARMY
Washington 25, D. C., 1 May 1958

This manual (a reprint of an Air Force Technical Order) is approved for use by Army personnel.

By Order of Wilber M. Brucker, Secretary of the Army:

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HERBERT M. JONES,
Major General, United States Army,
The Adjutant General.