1st Lt Donald J. Drummond

T.O. NO. 1T-37A-2-1

HANDBOOK

MAINTENANCE INSTRUCTIONS

GENERAL AIRPLANE

USAF SERIES

T-37A

AIRCRAFT

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McCORMICK-ARMSTRONG. WICHITA. 1100. 7-9-56

28 FEBRUARY 1956
REVISED 28 MAY 1956

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Page No.	*Date of Latest Revision*
*vi	28 May 1956
* 2	28 May 1956
* 3	28 May 1956
* 4	28 May 1956
* 6	28 May 1956
* 7	28 May 1956
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*8A	28 May 1956
* 9	28 May 1956
*11	28 May 1956
*12	28 May 1956
*14	28 May 1956
*15	28 May 1956
*17	28 May 1956
*19	28 May 1956
*21	28 May 1956
*27	28 May 1956

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GENERAL AIRPLANE

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INTRODUCTION

The T-37A Sectionalized Maintenance Handbook has been prepared to meet the need of the line system mechanic or maintenance specialist. Each book is designed to contain all the information necessary to fully understand any functional system or component.

The information on each system is divided into five basic subsections which are:

1. DESCRIPTION AND OPERATION. This subsection gives maintenance instructions for specific models of equipment in a specific series of aircraft, and also discussion of the complete system to facilitate understanding of the system or component.

2. OPERATIONAL CHECK-OUT. Operational check-out gives a complete step-by-step operational check to determine that the system or equipment meets the minimum operational standard.

3. TROUBLE SHOOTING. A trouble shooting guide is included to provide a procedure for identifying malfunctions, isolating the malfunction to a particular component, accessory, assembly or subassembly, and the remedy of such malfunctions.

4. SERVICING. The servicing discussion gives information for filling, cleaning, draining and lubrication of the particular system or component.

5. MAINTENANCE. This gives step-by-step procedure for removal, installation and adjustment of all systems or components.

HOW TO FIND INFORMATION

1. Consult the Table of Contents in the front of the book.

2. Turn to the page number of the desired section and consult the Table of Contents of that section. To further help in finding information the section number and paragraph numbers are carried in the upper outer corner of each page.

3. If you are looking for one specific item, consult the alphabetical index in the back of each book.

4. For supplementary information on the T-37A airplane, consult the following publications:

T.O. No. 1T-37A-1	Flight Handbook
T.O. No. 1T-37A-3	Structural Repair Instructions
T.O. No. 1T-37A-4	Illustrated Parts Breakdown
T.O. No. 1T-37A-5	Basic Weight Check List
T.O. No. 1T-37A-6	Inspection Requirements

The following is a complete list of the T-37A sectionalized maintenance handbooks.

T.O.NO. IT-37A-2-1 General Airplane

SECTION I	GENERAL INFORMATION
SECTION II	HANDLING, SERVICING, LUBRICATION
SECTION III	AIRFRAME GROUP OPERATING SYSTEMS
SECTION IV	HYDRAULIC OPERATING SYSTEMS
SECTION V	POWER PLANT
SECTION VI	FUEL SYSTEM
SECTION VII	INSTRUMENTS
SECTION VIII	ELECTRICAL POWER SUPPLY AND DISTRIBUTUON
SECTION IX	RADIO, COMMUNICATIONS AND ELECTRONICS SYSTEMS
SECTION X	ARMAMENT AND ARMAMENT SYSTEMS (NOT APPLICABLE)

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SECTION I	GROUND HANDLING
SECTION II	SERVICING
SECTION III	LUBRICATION
SECTION IV	AIRFRAME GROUP MAINTENANCE

T.O. NO. IT-37A-2-3 Hydraulically Operated Systems and Utility Systems

SECTION I	HYDRAULICALLY OPERATED SYSTEMS
SECTION II	UTILITY SYSTEMS

T.O. NO. 1T-37A-2-4 Flight Control Systems

SECTION I PRIMARY FLIGHT CONTROL SYSTEMS
SECTION II SECONDARY FLIGHT CONTROL SYSTEMS

T.O. NO. 1T-37A-2-5 Power Plant, Fuel System and Oil System

SECTION I POWER PLANT
SECTION II FUEL SYSTEM
SECTION III OIL SYSTEM

T.O. NO. 1T-37A-2-6 Instruments and Radio, Communication and Navigation Equipment

SECTION I INSTRUMENTS
SECTION II RADIO, COMMUNICATION AND NAVIGATION EQUIPMENT

T.O. NO. 1T-37A-2-7 Electrical System

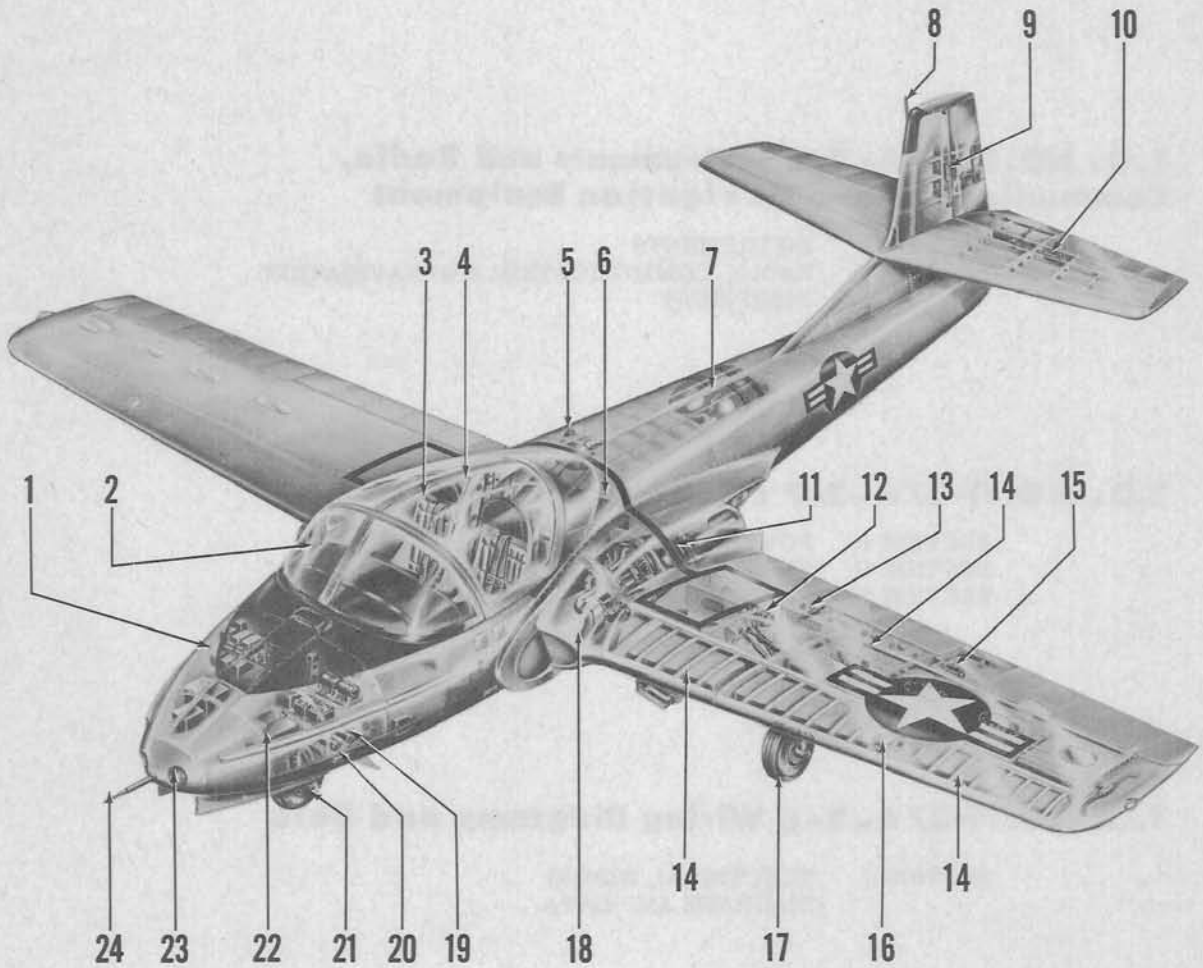
SECTION I POWER LOADING DATA
SECTION II ELECTRICAL POWER SUPPLY
SECTION III LIGHTING

T.O. NO. 1T-37A-2-8 Wiring Diagrams and Data

SECTION I ELECTRICAL WIRING DIAGRAMS AND DATA

INTRODUCTION

The General Airplane Handbook is designed to give maintenance personnel a general but factual overall description of the aircraft. This description has been kept to a familiarization level, and no specific maintenance instructions have been given. Technical phraseology has been strictly avoided, except where no other wording would clearly convey the intended meaning. Illustrations have been used freely to supplement the text.



1. Radio equipment
2. Instrument panel
3. Ejection seats
4. Navigation antenna
5. Hydraulic reservoir
6. Fuselage fuel cell
7. Oxygen bottles
8. Communication antenna
9. Rudder trim tab actuator
10. Elevator trim tab actuator
11. Engine
12. Landing light
13. Flap actuating cylinder
14. Wing fuel cells
15. Aileron trim tab motor
16. Fuel filler
17. Main landing gear
18. Engine oil tank
19. Electrical equipment
20. External power receptacle
21. Nose gear
22. Battery
23. Passing and taxi lights
24. Pitot tube

Figure 1-1. Interior Arrangement

SECTION I
GENERAL INFORMATION

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1-6.	WALKWAYS	2

1-1. GENERAL DESCRIPTION. The T-37A airplane, manufactured by the Cessna Aircraft Company, is an all metal, low wing jet trainer with a two place side-by-side seating arrangement. The airplane is equipped with conventional dual controls, ejection seats, jettisonable canopy, two jet engines, and is designed to teach primary phase students the maneuvers and techniques required of a military pilot.

1-2. GENERAL ARRANGEMENT. Figure 1-1 shows the general arrangement of the airplane. The right side of the nose section houses the UHF and VHF radio equipment to which access is provided by a large access door. The left hand compartment of the nose section contains the battery and other electrical equipment, with the external power receptacle located below the large access door on the left side of the nose section. Two ejection seats are located side-by-side in the cockpit with a control stick and a set of rudder pedals mounted in front of each seat. An electrically operated, jettisonable canopy covers the cockpit with the actuator located between the seats. Fuel is contained in thirteen fuel cells; six cells are located in each wing and one in the fuselage center section. The engines are located on each side of the fuselage, between the sides of the fuselage and the wings.

1-3. AIRCRAFT DIMENSIONS. Aircraft in level flight position unless otherwise stated.

GENERAL

Span	33.83 ft
Length	29.28 ft
Height	9.36 ft
Design Gross Weight	6100 lbs
Maximum Alternate Gross Weight	6150 lbs

WINGS

Type	Low
Airfoil Section	NACA 2418 at ℄ NACA 2412 at Sta. 190
Chord at root (Wing station 45.75)	73.084 in.
Chord at tip (Wing station 190)	53.970 in.
Dihedral	3°
Sweepback at station (22.5%c)	0
Aspect ratio	6

STABILIZER

Span	13.96 ft
Maximum chord	54.23 in.
Incidence	1°
Dihedral	0

FUSELAGE

Width (maximum) (Including nacelles)	7 ft 6 in.
Height (maximum)	54.20 in.
Length	29.28 ft

AREAS

Wings (less ailerons)	172.6 sq ft
Wings (with flaps extended)	172.6 sq ft
Ailerons (total)	11.3 sq ft
Flaps (total)	15.10 sq ft
Stabilizer (including elevators)	46.57 sq ft
Elevators (two) (Including tabs)	10.67 sq ft
Elevator trim tabs (total)	0.556 sq ft
Fin	10.23 sq ft
Rudder (including tab)	5.86 sq ft
Rudder trim tab (total)	0.38 sq ft

1-4. STATIONS. A station diagram is given in Figure 1-3 to assist in locating equipment when a written description is inadequate or impractical.

1-5. ACCESS AND INSPECTION PROVISIONS. Figure 1-4 shows the access and provisions, along with the items to which they provide access. Each removable panel is numbered with the corresponding number stenciled adjacent to the panel on the surrounding skin. The panels are numbered in this manner to aid in locating and installing the panel in its proper location. The number of the panel is used throughout the Sectionalized Maintenance Handbook to identify the panels.

1-6. WALKWAYS. Refer to figure 1-5 for No Step Diagram.

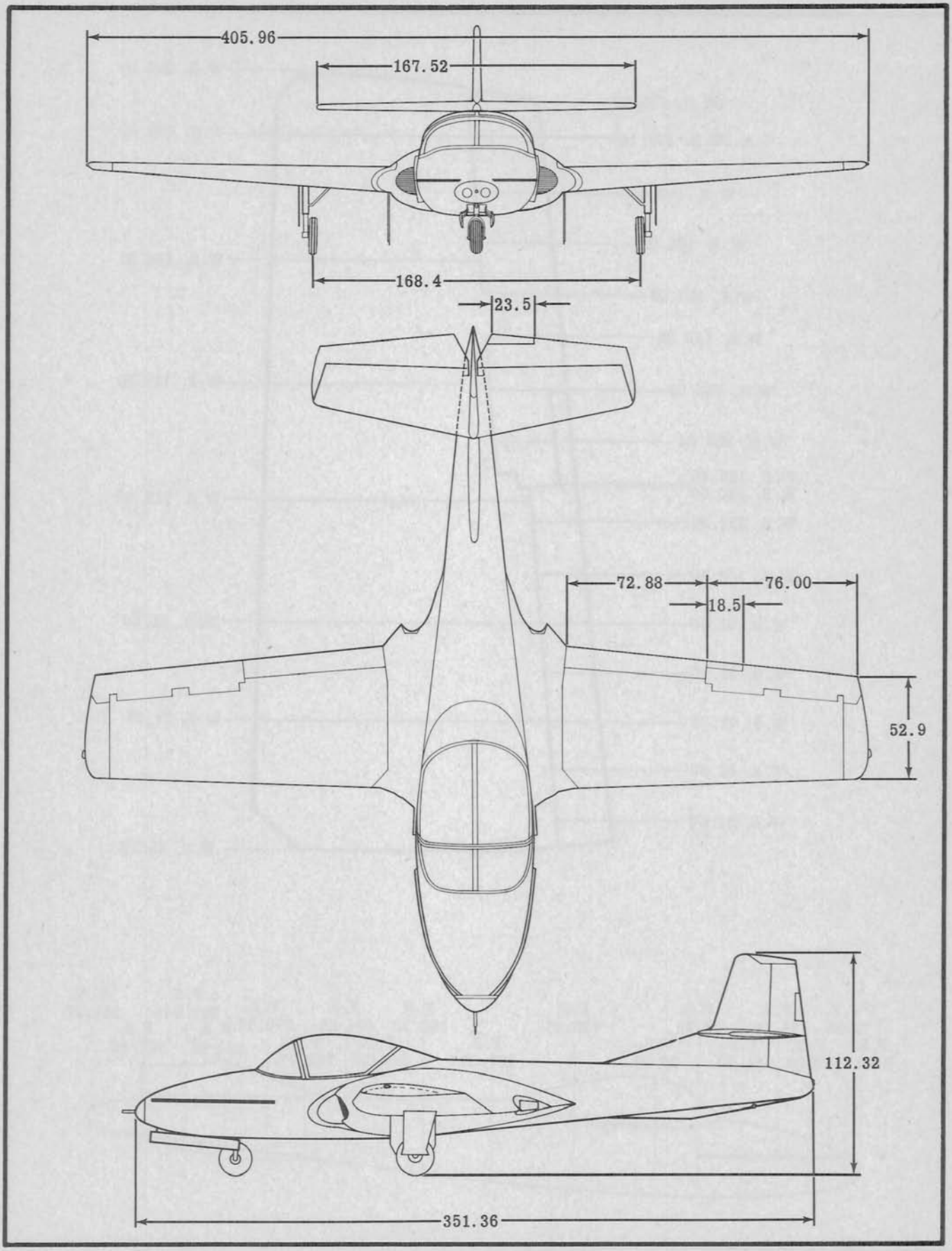


Figure 1-2. Aircraft Dimensions

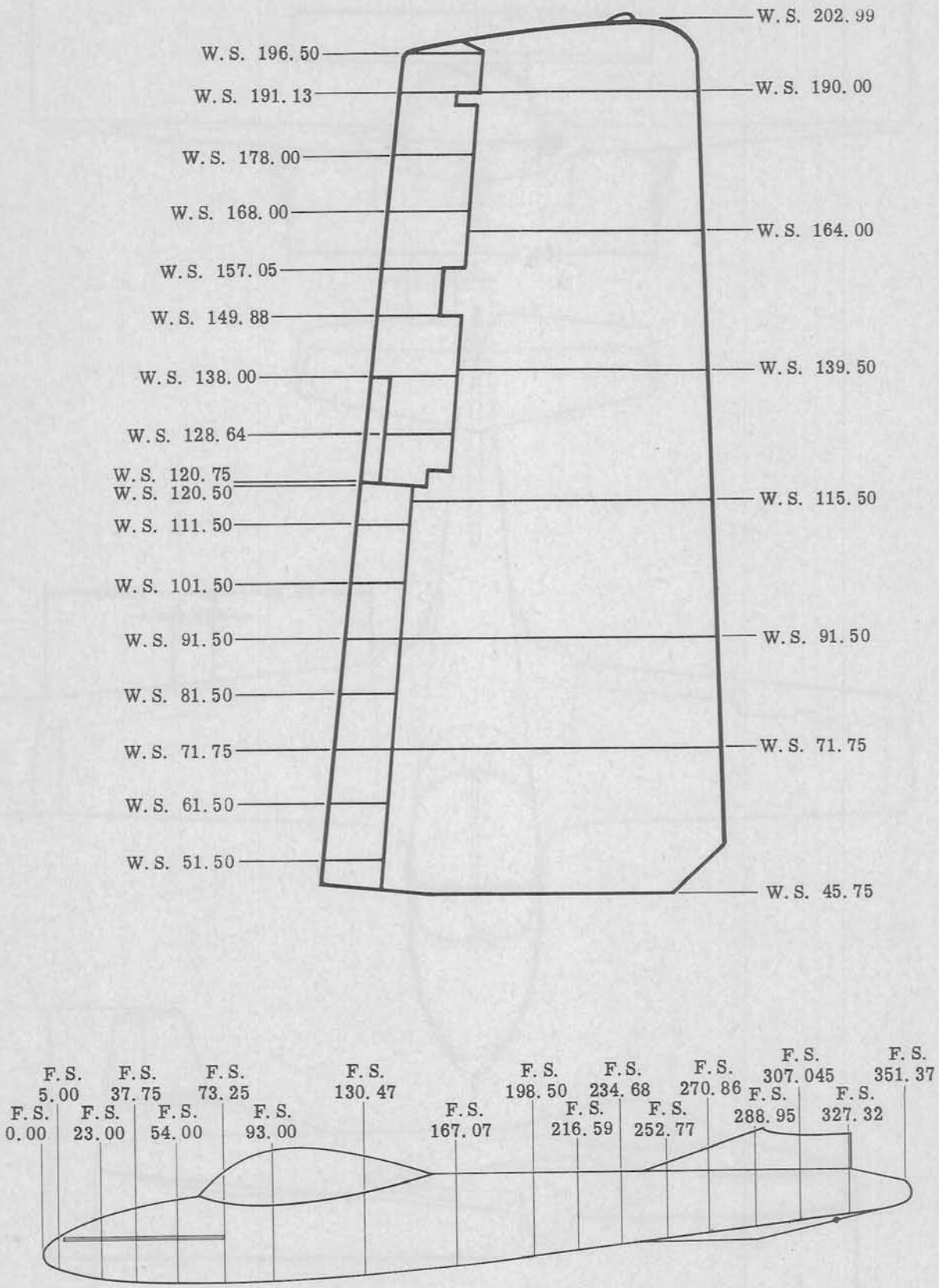


Figure 1-3. Station Diagram (Sheet 1 of 2)

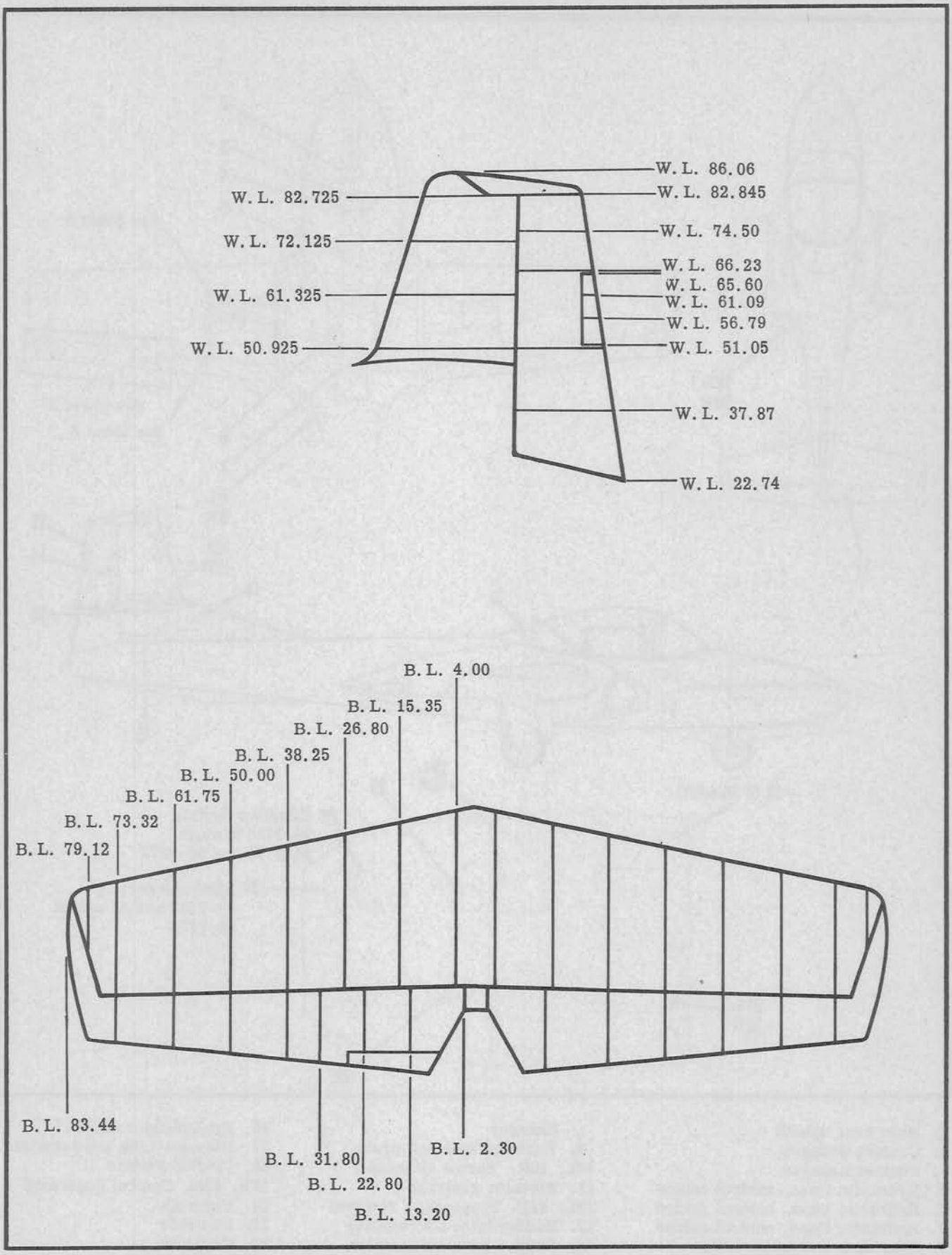
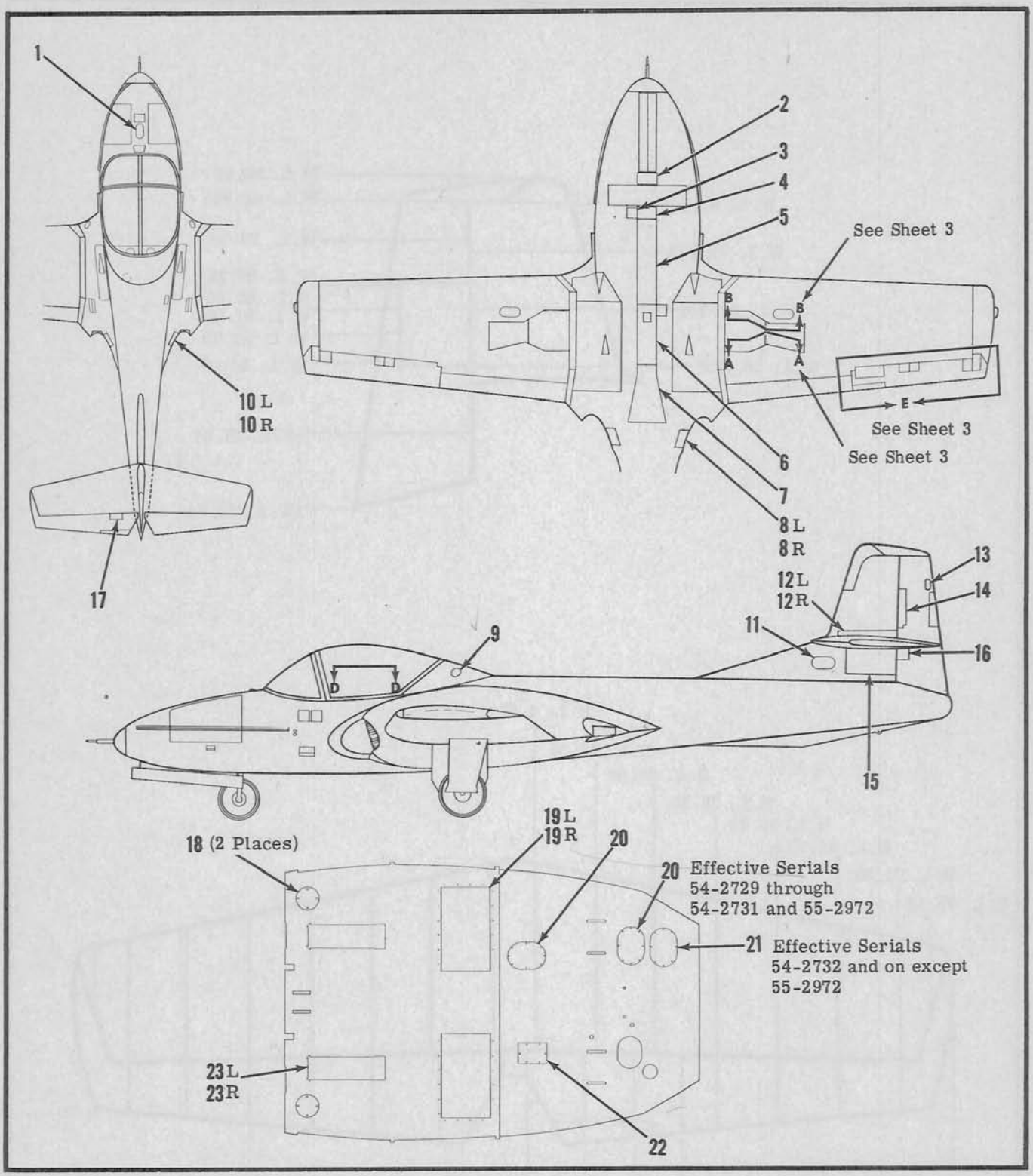


Figure 1-3. Station Diagram (Sheet 2 of 2)



1. Nose gear uplock
2. Control linkages
3. Control linkages
4. Hydraulic lines, control cables
5. Hydraulic lines, control cables
6. Hydraulic lines, control cables
7. Rear spar hydraulic units

8L, 8R. Thrust attenuator linkages

9. Fuselage fuel cell probe

10L, 10R. Thrust attenuator

11. Elevator controls

12L, 12R. Empennage removal

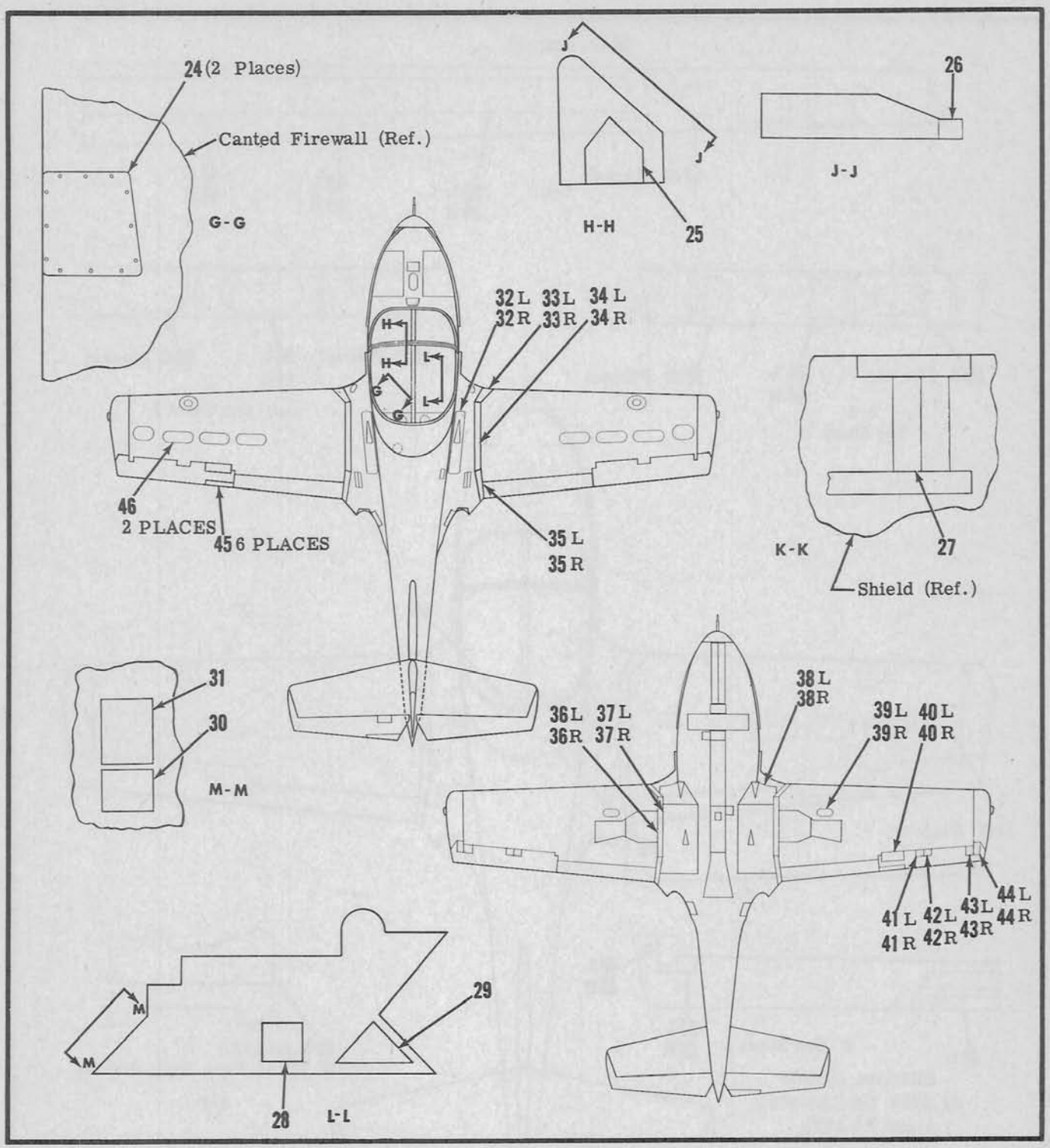
13. Rudder trim tab removal
14. Rudder trim tab actuator
15. Empennage removal
16. Empennage removal
17. Elevator trim tab actuator
18. Control pulleys

19L, 19R. Control quadrants

20. Controls
21. Controls
22. Controls

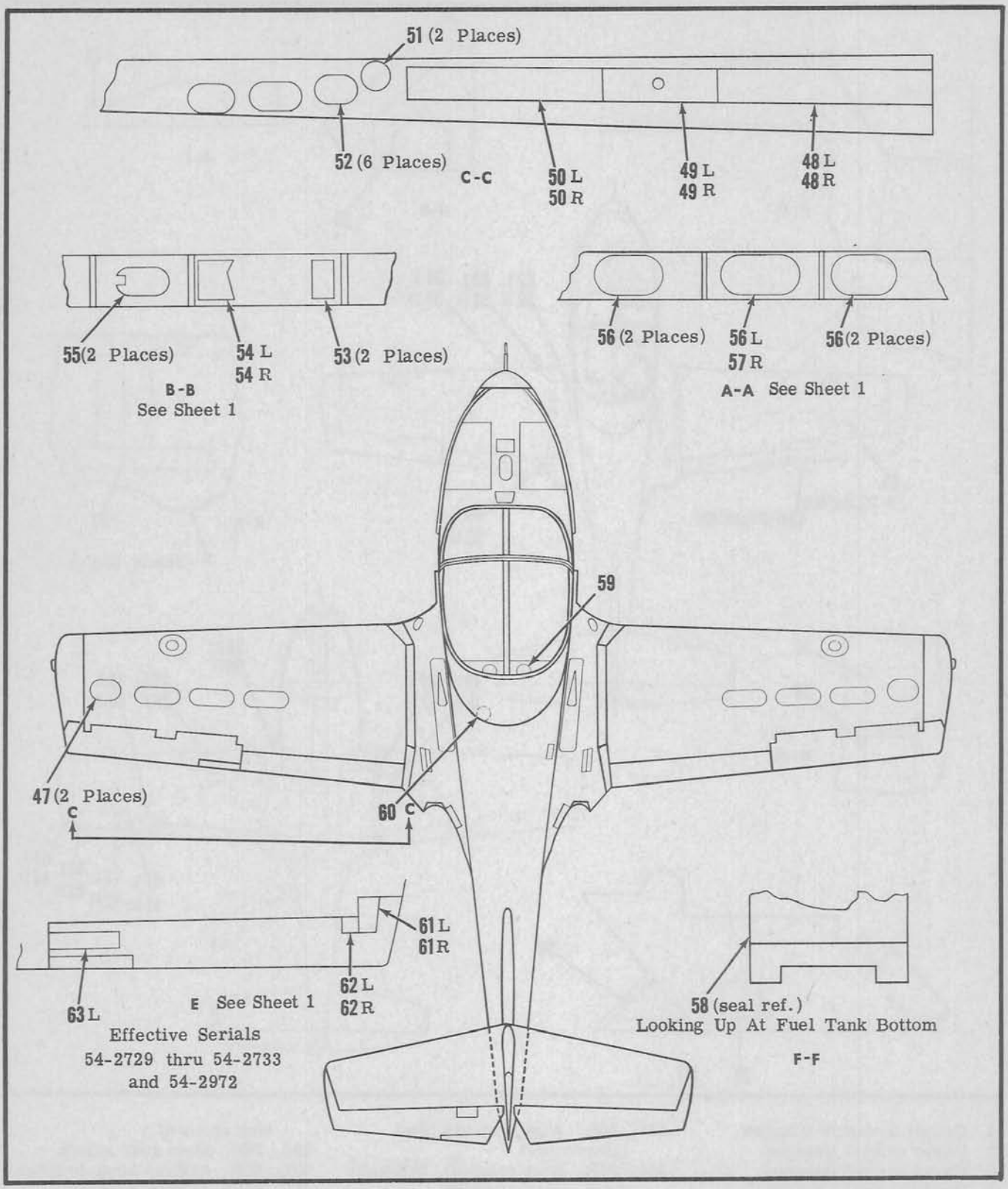
23L, 23R. Speed brake cylinder

Figure 1-4. Access and Inspection Provisions (Sheet 1 of 4)



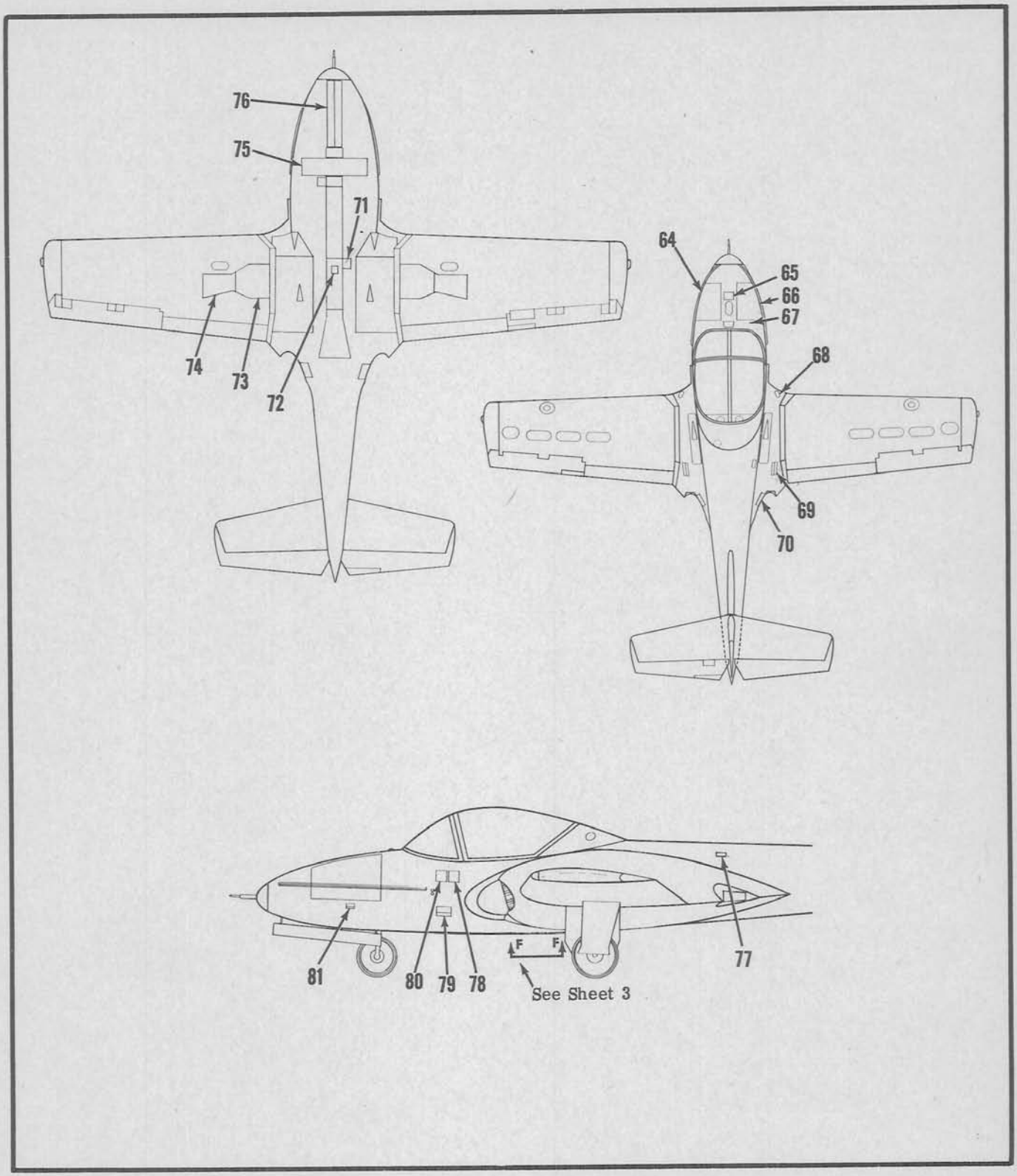
24. Canopy downlock linkages
25. Power control linkages
26. Power control linkages
27. Power control linkages
28. Power control linkages
29. Power control linkages
30. Power control linkages
31. Power control linkages
32L, 32R. Engine hoist attachment
33L, 33R. Wing removal, fuel interconnect
34L, 34R. Wing removal, hydraulic lines, aileron cables
35L, 35R. Wing removal, flap lines, flap removal
36L, 36R. Wing removal, hydraulic lines, aileron cables
37L, 37R. Engine removal
38L, 38R. Engine removal, oil tank removal
39L, 39R. Main gear uplock
40L, 40R. Aileron hinge bracket
41L, 41R. Aileron quadrant
42L, 42R. Aileron quadrant
43L, 43R. Aileron hinge bracket
44L, 44R. Aileron balance weights
45. Aileron trim tab actuator
46. Wing fuel cells removal

Figure 1-4. Access and Inspection Provisions (Sheet 2 of 4)



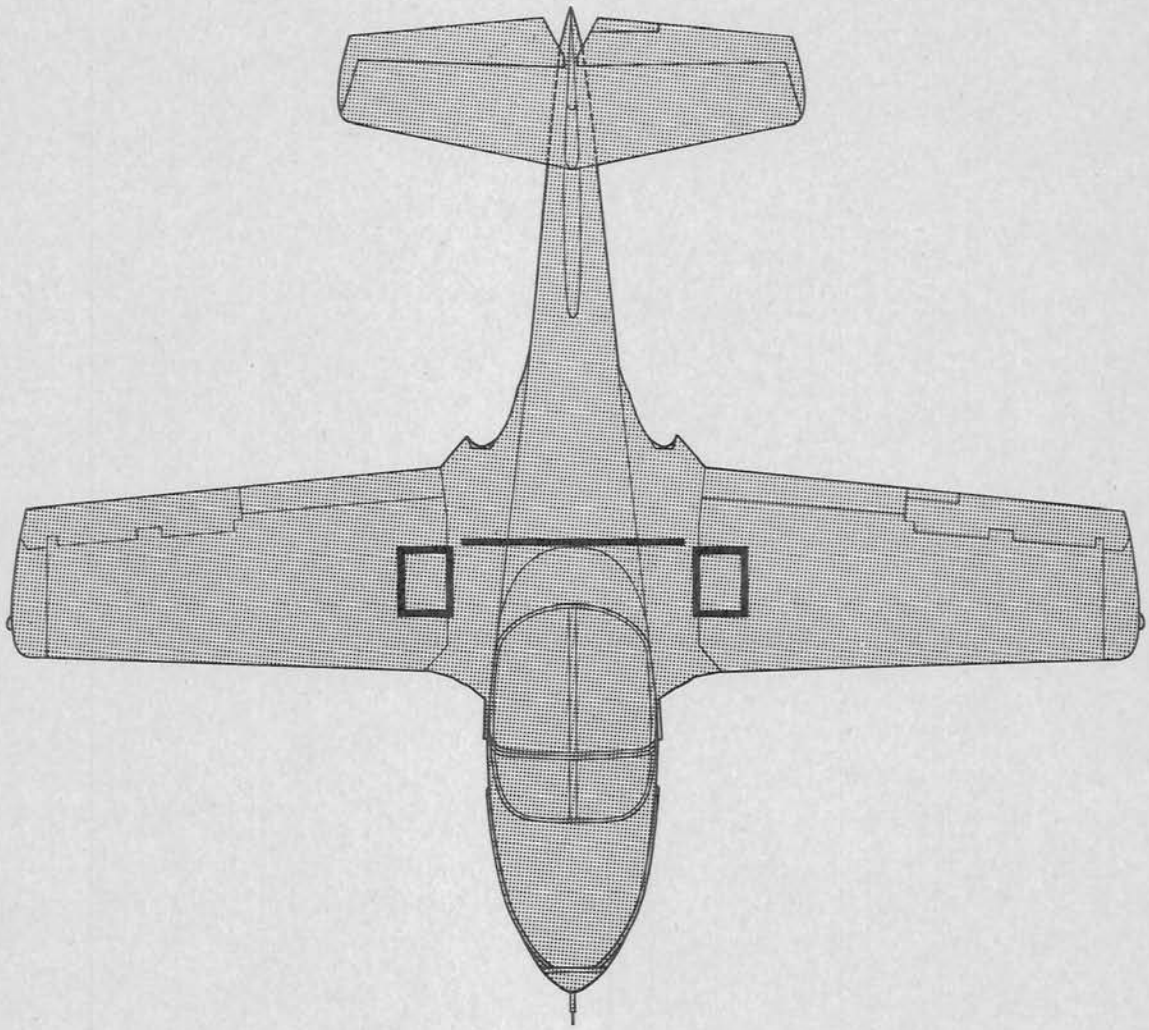
47. Wing fuel cell removal
48L, 48R. Flap lines, aileron cables
49L, 49R. Flap lines, aileron cables
50L, 50R. Flap lines, aileron cables
51. Aileron cables
52. Aileron cables
53. Main landing gear linkages
54L, 54R. Main landing gear linkages
55. Main landing gear linkages
56L, 56R. Main gear linkages
57R. Main landing gear linkages
58. Fuel cell removal
59. Fuselage fuel cell vent
60. Fuel probe
61L, 61R. Aileron removal
62L, 62R. Aileron removal
63. Aileron trim tab actuator

Figure 1-4. Access and Inspection Provisions (Sheet 3 of 4)



64. Battery, inverters, voltage regulators, etc.
65. Nose gear downlock
66. Radio
67. Brake reservoir
68. Oil tank filler
69. Fire extinguisher door
70. Hydraulic reservoir
71. Fuel drain
72. Defueling valve
73. Main gear inboard door
74. Main gear outboard door
75. Speed brake
76. Nose gear doors
77. Oxygen filler valve
78. Manual declutch handle
79. Step
80. Canopy external jettison handle
81. External power receptacle

Figure 1-4. Access and Inspection Provisions (Sheet 4 of 4)



Key

No Step Area

Figure 1-5. No Step Diagram

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SECTION II

HANDLING, SERVICING, LUBRICATION

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2-1. GROUND HANDLING. For a complete discussion of ground handling and the use of ground handling equipment refer to T.O. No. 1T-37A-2-2, Ground Handling, Servicing, and Airframe Maintenance Handbook.

2-2. TOWING PROVISIONS. The axle retaining nuts on the nose gear provide points for attaching a tow bar. Pins on the tow bar are inserted into these nuts and the tow bar is locked in place. Rings which are an integral part of each main gear trunnion are provided for attach-tow ropes or cables.

CAUTION

When towing the airplane, the nose gear must not be turned beyond the black strip limit marking across the nose gear doors. Turning the gear farther than this may result in damage to the airplane.

CAUTION

When towing the airplane with cables or ropes the cockpit must be occupied so the brakes can be applied to keep the airplane from advancing upon the towing vehicle.

2-3. PARKING.

2-4. PARKING BRAKES. A parking brake handle is located on the instrument panel and is mounted below the shock panel and to the left of the switch panel. The parking brakes are engaged by applying toe pressure to either set of rudder pedals and pulling out on the parking brake handle. The parking brakes are released by applying toe pressure to either set of rudder pedals.

2-5. GUST LOCK. A gust lock is mounted below the instrument panel in front of the student pilot's seat. The lock rotates up and is attached to the control stick. When the gust lock is installed all primary control surfaces and the throttle are locked. It is impossible for the pilot to take-off with the gust lock properly installed because the throttle cannot be advanced.

2-6. ANCHORING AND MOORING. Mooring provisions are provided at four different places on the airplane. These places are: (1) a removable combination jack pad and mooring ring, which may be attached to the underside of the fuselage, aft of the speed brake, (2) rings on the trunnion of each main gear, and (3) the tail bumper.

2-7. JACKING PROVISIONS. There are seven points on the airplane for the placement of jacks to lift the airplane. These points are located at the following places: the underside of each main gear axle fitting; the underside of each wing, aft of the wheel well; the underside of the fuselage, aft of the speedbrake; and at the end of each rear spar link. All jack pads except the main gear axle fitting are removable.

2-8. HOISTING PROVISIONS. The airplane is hoisted by using a sling which fits around the nose section, and links which attach to the fuselage rear spar. Provisions are also made on the wing to attach a sling to lift the wing.

CAUTION

To keep the airplane or wing from becoming unbalanced when it is hoisted no additional load should be placed upon it at any point.

2-9. LEVELING PROVISIONS. For longitudinal leveling, brackets are mounted in the nose wheel well on the left hand web and are identified by a small plate reading LEVEL HERE. Provisions for transverse leveling are located on the fuselage rear spar aft of the seats, and are also identified by a small plate reading LEVEL HERE.

2-10. GROUND HANDLING DOLLIES. The only special ground handling dolly for this airplane is an engine dolly. The engine is lowered from the airplane to the dolly by the engine hoist and then secured to the dolly.

2-11. PROTECTIVE COVERS AND AIR PLUGS. Protective covers are provided for the wings, empennage, canopy and windshield, and the pitot tube and nose cap. These covers should be used to prevent the accumulation of dirt, frost or ice and to prevent damage to the skin or plexiglas. Plugs are provided for insertion into the engine air intake and exhaust openings.

2-12. GROUND SAFETY LOCKS AND PINS. Ground safety downlocks are provided for each main gear and the nose gear. These locks are used to prevent inadvertant retraction of the landing gears while the airplane is on the ground. Safety pins are provided for the ejection seat, hand grips, seat and canopy initiators to prevent accidental firing while the airplane is on the ground. There is also a safety pin and streamer assembly for insertion in to the speedbrake shut-off valve. This pin should always be inserted when maintenance work is being performed in or around the speedbrake to prevent accidental closing of the speed brake.

WARNING

All ground safety locks and pins must be removed before the airplane is flown.

2-13. SERVICING. Complete and detailed service ininstructions are given in T.O. No. 1T-37A-2-2, Ground Handling, Servicing, and Airframe Maintenance. These instructions give the system or component to be serviced along with fluid capacities, type of fluid, expansion volume, and required air pressure.

2-14. LUBRICATION REQUIREMENTS. Complete lubrication requirements are listed in T.O. No. 1T-37A-2-2, Ground Handling, Servicing, and Airframe Maintenance. The lubrication diagram gives the item to be lubricated, type of lubricant and interval of application.

SECTION III

AIRFRAME GROUP OPERATING SYSTEMS

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3-1. CANOPY EJECTION SYSTEM. The electrically operated canopy opens and closes by rotating about two hinge points at the rear of the canopy hinge arms. The canopy may be opened or closed from the outside by pressing the appropriate switch on the left side of the fuselage. The canopy is opened or closed from inside the cockpit by actuating a toggle switch mounted below the instructor's control quadrant. A de-clutch handle is provided on the left side of the airplane to open the canopy manually. Pulling the handle de-clutches the canopy actuator and the canopy may be lifted manually. In case of an emergency the canopy may be jettisoned, either in flight or on the ground. In flight, the canopy may be jettisoned by lifting the jettison hand grips of either seat. This fires the initiators, which result in the unlocking and jettisoning of the canopy. Also, the canopy may be jettisoned in flight by pulling the initiator handle located on the left side of the cockpit. On the ground, external jettisoning of the canopy is accomplished by pulling the handle on the left side of the fuselage. On the ground internal jettisoning of the canopy is accomplished by pulling the initiator handle located on the left side of the cockpit.

3-2. SEAT EJECTION SYSTEM. Catapulting the seats from the airplane is initiated by squeezing the seat ejection trigger in the jettison hand grip on the right side of each seat. This action fires the seat catapult initiator located in the bottom of the seat which in turn fires the seat catapult. The seat catapult is mounted on the back of the seat and, when fired, guides the seat up the seat rails and clear of the airplane. A few seconds after the seat leaves the airplane the seat belt initiator fires, unlocking the seat belt letting the seat fall free from the occupant.

3-3. MAIN LANDING GEARS. The main landing gears are located, one in each wing, and are suspended from bearing supports attached to the wing structure. The main gears are hydraulically retracted and extended and are controlled by either of two wheel shaped control handles on the instrument panel. Position of the gears in either the up or down position is given by landing gear position indicators located on the upper left hand side of the instrument panel. Retraction of the gears is up and inboard into the wing wheel well. When the gears are fully retracted they are enclosed by two main gear doors which fit flush with the bottom skin of the wing. The gears are held in the uplocked position by a hydraulically operated uplock which engages the inboard door. A pneumatic system is tied in to the gear hydraulic system for emergency extension of the gear, in case of hydraulic power failure. The main gear shock struts are air-oil type mounted on 20 x 4.4 Type VII wheel assemblies. Refer to T.O. No. 1T-37A-2-3 for maintenance of the landing gears.

344. MAIN GEAR WHEELS AND BRAKES. Each main gear incorporates a 20 x 4.4 Type VII wheel assembly which includes multi-disc self-adjusting brakes.

3-5. NOSE GEAR. The nose gear is mounted in the nose wheel well and is suspended from bearing supports attached to the wheel well webs. The nose gear is hydraulically operated and retracts forward and up into the wheel well where it is held by the nose gear uplock. The gear operates in conjunction with the main gears and has the same emergency extension system. In the retracted position the gear is enclosed by two nose gear doors, which are linked to the nose gear side brace, and open and close as a result of the extension or retraction of the gear. The nose gear shock strut is an air-oil type.

3-6. NOSE GEAR WHEEL. The nose gear incorporates a 600 x 6 Type III wheel and low pressure tire.

3-7. NOSE GEAR STEERING. Nose gear steering is hydraulically operated and is incorporated to provide ease of turning and reduce wear on the brakes during ground operation. The power steering switch is located on the hand grip of each control stick and must be pushed before rudder pedal action is effective in steering the airplane. The gear is steerable through 50 degrees to the left or right of center position. This facilitates turning in a relatively small radius. Movement of either

left or right pedal of either set of rudder pedals will turn the airplane in the respective direction. After power steering has been selected it may be cut out by depressing the power steering switch again. Refer to T.O. No. 1T-37A-2-3 for further information.

3-8. FLIGHT CONTROL SYSTEMS. Refer to T.O. No. 1T-37A-2-4 for a detailed discussion of the flight control systems.

3-9. PRIMARY FLIGHT CONTROL SYSTEMS. The primary flight control systems are those systems which control direction of flight. These include the aileron, elevator, and rudder control systems. All primary flight control surfaces can be operated from either the student's or instructor's position.

3-10. AILERON CONTROL SYSTEM. The ailerons are mounted at the outboard trailing edge of each wing and are controlled by side-to-side movement of either control stick. A conventional cable system operates the ailerons, with the cables routed through pulleys and fairleads to the aileron quadrant mounted on the aft spar of each wing. Full aileron travel is 15° (+1°, -0°) up and down from neutral.

3-11. ELEVATOR CONTROL SYSTEM. The elevators are mounted to the aft spar of the horizontal stabilizer and are controlled by fore or aft movement of either control stick. The elevators are linked to a conventional cable system which is routed over pulleys through the fuselage to the elevator rear quadrant. A push-pull rod connects the quadrant to the elevator horns. The elevators may be deflected 26° (+1°, -0°) up from neutral or 15° (+1°, -0°) down from neutral.

3-12. RUDDER CONTROL SYSTEM. The rudder is hinged to the aft spar of the vertical stabilizer and will deflect through 25° ±30' to the left or right of neutral. Cables are routed from tne rudder pedal bellcrank through the fuselage and are attached to the rudder torque tube bellcrank. The rudder pedal bellcranks are interconnected, making operation of the rudder possible from either set of rudder pedals.

3-13. SECONDARY FLIGHT CONTROL SYSTEM. The secondary flight controls are all electrically operated and consist of the aileron, elevator and rudder trim tab systems. Switches for the aileron and rudder trim tabs are located on the hand grip of each control stick. The rudder trim tab switch is mounted below the student's power quadrant.

3-14. AILERON TRIM TAB CONTROL SYSTEM. The aileron trim tab is electrically actuated and controlled by a switch mounted on each control stick. The actuator is mounted to the leading edge of the aileron spar and is connected to the trim tab by a push-pull rod. The aileron tab will deflect 20° (±1°, -0°) up or down from neutral.

3-15. ELEVATOR TRIM TAB CONTROL SYSTEM. An electrically operated trim tab comprises the inboard trailing edge of the left elevator. The tab actuator is attached to the front spar of the left elevator. A flexible shaft is routed from the actuator to a screwjack which attaches to the tab. Elevator tab movement is 8° ±1° up from neutral and 10° ±1° down from neutral.

3-16. RUDDER TRIM TAB CONTROL SYSTEM. The rudder trim tab is electrically actuated and is attached to the trailing edge of the rudder. The tab is controlled by a switch mounted below the student's power control quadrant. The trim tab actuator is mounted in the leading edge of the rudder, and is connected to the tab by a push-pull rod. The rudder trim tab will deflect 20 ±1° to the left or right of neutral.

3-17. DRAG AND LIFT DEVICES The drag and lift devices are those controllable surfaces whose movement will increase the lift of the airplane or decrease its speed during flight. These surfaces include the flaps which are mounted inboard of each aileron on the trailing edge of the wing and the speedbrake which is located on the underside of the fuselage aft of the nose gear doors and the thrust attenuators.

3-18. FLAPS. The wing flaps are mounted inboard of each aileron and form a continuation of the wing trailing edge. The flaps are hydraulically operated and are controlled from either control quadrant by flap control handles. The flap actuating cylinder is mounted in the wing wheel well and attaches to a bracket extending from the leading edge of the flap. The flap pivots from two hinge brackets extending from the underside of the wing. Total flap deflection is 40 degrees down.

3-19. SPEED BRAKE. The speed brake is used to decrease the speed of the airplane during flight and is located on the underside of the fuselage, aft of the nose gear doors. A speedbrake switch is located on the right engine throttle of each power quadrant. The instructor's switch incorporates an override feature which prevents the student's switch from being effective until the instructor's switch is in the SOLO position. The speedbrake is hydraulically operated by two actuating cylinders attached to the speedbrake and the airplane structure. A manual shut-off valve is provided to cut-off hydraulic power to the actuating cylinders while maintenance work is being performed on the speedbrake.

3-20. THRUST ATTENUATOR. A thrust attenuator is located on each nacelle aft fairing and are incorporated to reduce effective thrust of the engines. The thrust attenuators permit the pilot to increase his angle of approach and still maintain a good flying speed power setting for go around in case go around is necessary. The thrust attenuators are hydraulically operated and from the retracted position extend out into the exhaust stream. See T.O. No. 1T-37A-2-3 for detailed information of the thrust attenuator system.

3-20A. STALL WARNING SPOILER. Two stall warning spoilers are mounted, one on the top side of each nacelle and serve to warn the pilot when he is approaching a stall condition. The spoilers are hydraulically operated and are actuated by the flap position transmitter arm when the flaps are extended beyond 28°. Each spoiler hinges up and forward from the top of the nacelle. With the spoilers extended, the air flow over the nacelles is disturbed, which in turn causes a slight turbulence of air around the empennage causing a slight buffeting effect. The pilot can feel this buffeting effect and know he is approaching a stall condition.

3-21. POWER CONTROL SYSTEM. The power controls are mounted on control quadrants, located one in the center and one on the left side of the cockpit. The power controls of each quadrant are interconnected making it possible to operate the engines from either quadrant. The power controls are connected to the engines by push tubes and torque tubes which are routed on top of the floorboard and out to each engine. A knurled friction knob is incorporated on the student's power quadrant, and is turned clockwise to increase throttle friction. Refer to T.O. No. 1T-37A-2-5 for a detailed duscussion of the power controls.

3-22. LIGHTING.

3-23. EXTERIOR LIGHTING. The exterior lighting consists of a light in each wing tip, top and bottom fuselage position lights, two lights in the stinger, the landing, taxi and passing lights. There is also a light on each main gear inboard door and the nose gear left door to provide external indication that the gears are down and locked. The retractable landing light is located in the left main gear wheel well. The taxi light and passing light are mounted in the nose section and emit light through windows in the nose cap. A flasher unit is incorporated in the navigation lights system causing them to blink on and off while in use. Refer to T.O. No. 1T-37A-2-7, Electrical System.

3-24. INTERIOR LIGHTS. The interior lights consist of the primary, secondary, and cockpit utility lights. The primary lights, light each instrument individually, the switch panel, heater panel, and radio control panel. The primary lights are controlled by a rheostat located forward of the instructor's power quadrant, on the quadrant support. The secondary lights are mounted beneath the glare shield and provide a soft red illumination for the entire instrument panel. The secondary lights are also controlled by a rheostat mounted forward of the instructor's power quadrant on the quadrant support. The cockpit utility lights are mounted on each side of the cockpit and may be directed to any portion of the cockpit desired. The utility lights incorporate a red lens which may be controlled by a switch mounted on the light. Refer to T.O. No. 1T-37A-2-7.

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SECTION IV
HYDRAULIC SYSTEM AND UTILITY SYSTEMS

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4-1. HYDRAULIC SYSTEM. The primary components of the hydraulic system are the hydraulic reservoir, accumulator, and two engine driven pumps. The hydraulic reservoir supplies hydraulic fluid to the pumps which pressurize the system to 1500 psi. The accumulator is incorporated to provide an emergency source of power in case of system pressure failure, and also acts as a cushion during normal operation of the hydraulic system. Also included in the system are the necessary filters, relief valves and pressure regulator. The hydraulic pressure gage is mounted on the instrument panel and is protected from pressure surges which might cause damage to the gage by a snubber. The hydraulic system provides operating power for the landing gear retraction system, wing flaps, speedbrake, stall warning spoiler and engine inlet screen. Refer to T.O. No. 1T-37A-2-3.

4-2. HEATING AND VENTILATING SYSTEM. The temperature of the cockpit air is controlled by control handles mounted on the instrument panel. These controls are two lever type handles mounted on the heating control panel and a "tee" handle located above the heating control panel. Warm bleed air is picked up from each engine compressor and delivered to the cockpit and to the defrost tubes through a duct system. The amount of warm air entering the cockpit or defrost tubes is dependent upon the setting of the "tee" handle and control levers. Air for defrosting the windshield and canopy is automatically mixed with cabin air before it enters the spray type defrost tubes. Check valves are incorporated in the bleed air system to insure a continuous supply of warm air with only one engine in operation. Outside air is picked up by the air scoop, located in front of the windshield, and delivered to the cockpit air outlets. Two of these outlets are swivel type wall ventilators located one on each side of the cockpit, and the other is located under the glare shield. The wall ventilators may be turned to direct air to any portion of the cockpit. For detailed maintenance instruction refer to T.O. No. 1T-37A-2-3.

4-3. OXYGEN SYSTEM. The low pressure oxygen system incorporates two oxygen cylinders and two Type D-2 oxygen regulators. The oxygen cylinders are mounted in the aft section of the fuselage. The oxygen filler valve is accessible through a small door located on the left hand side of the fuselage aft section. The Type D-2 oxygen regulators are located on each side of the instrument panel and incorporates an oxygen flow and oxygen pressure indicator. The Type D-2 regulators are demand type and supply the correct amount of oxygen at all times, automatically compensating for changes in altitude. For specific maintenance instructions and detailed discussions of the system components refer to T.O. No. 1T-37A-2-2 and T.O. No. 1T-37A-2-3.

4-4. FIRE DETECTION AND OVERHEAT SYSTEM. The fire detection and overheat system gives the pilot visual indication of fire or excessive temperatures in the engine nacelles. The system is divided into four major circuits with each circuit incorporating a sensing element which is attached to the airplane structure. Detector cables located forward of the engine fireseal are referred to as fire elements and are rated at 282°C (540°F) for 50 feet of cable. Detector cables located aft of the engine fireseal are referred to as overheat elements and are rated at 282°C (540°F) for 50 feet of cable. The fuel shut off tee handles located on the instrument panel each contain a warning light which glows red when the fire elements are heated and flashes on and off when the overheat elements are heated. Fire and overheat test switches are included in the system to provide a quick check of cable continuity. The fire test switch is located left of the fuel shut off handles and the overheat test switch is located to the right of the fuel shut off handle. For detail maintenance instructions refer to T.O. No. 1T-37A-2-3.

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5-1. ENGINE INSTALLATION. An engine is installed on each side of the airplane in nacelles located between the fuselage and the root rib of the wing. Access to the engine is provided by a large access door on the bottom of each engine nacelle. An access door on the top of each nacelle must be removed for the attachment of engine hoist fittings for removal or installation of the engine. Fire seals surround the engine in the nacelle area. The top portion of these seals are a permanent part of the airplane structure while the lower portion of the seals are removable and must be taken out before the engine can be removed. The tailpipe is attached to the aft part of the engine by a clamp. This clamp must be removed from the engine and the tailpipe slid aft as far as possible, to allow clearance for the engine as it is being removed or installed. Refer to T.O. No. 1T-37A-2-5, for engine maintenance, removal, and installation.

5-2. ENGINE STARTER - IGNITION SYSTEM. There are two starter-ignition systems, one for each engine. Each system consists of two ignitors, a starter generator, an ignition unit and start and ignition switches. Energizing the starter brings the engine up to a starting speed at which time the ignitors are fired by a standard jet ignition unit. Ignition is used for starting only and not to sustain combustion. The engine will normally be started using an external power source, but in an emergency the 24 volt battery may be used. For a detailed discussion of the starter-ignition system refer to T.O. No. 1T-37A-2-5.

5-3. ENGINE OIL SYSTEM. There are two completely independent oil systems, one for each engine. Oil is supplied to each engine from tanks located in the forward portion of the engine nacelles. Access to the tanks is provided by an access panel located on the underside and near the leading edge of the nacelle. Access to the filler neck is provided by a door on the top side of the nacelle, and is identified by the words ENGINE OIL CAP, CAPACITY 1.5 U.S. GAL., SPEC. MIL-G-7808. The oil tanks will supply oil to the engines for an indefinite period of inverted flight. Refer to T.O. No. 1T-37A-2-5, Power Plant, Fuel System and Oil System, for detailed duscussion and maintenance.

5-4. ENGINE NACELLE. Engine nacelles are located on each side of the fuselage and form a streamlined covering for the engine, air inlet duct, and tailpipe. An air boundary layer fence extends forward of each engine along the sides of the fuselage. An air inlet screen is mounted at the air inlet of each engine and operates in conjunction with the retraction or extension of the landing gears. When the gears are extended the screen covers the air inlet and when the gears are retracted the screen opens and retracts into the air boundary fence. The purpose of the air inlet screen is to prevent foreign matter from entering the engine during ground operation. Two large access doors on the bottom of the nacelle provide access for engine and oil tank removal. An engine hoist access door and a fire extinguisher door are located on the top surface of each nacelle. A stall warning spoiler is also mounted on the top surface of each nacelle. Refer to T.O. No. 1T-37A-2-5 and T.O. No. 1T-37A-2-3 for further information.

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6-1. FUEL CONTROL. The fuel control unit mounted on each engine supplies the proper amount of fuel needed through all ranges of the power control settings. The unit is designed to meter the fuel and to automatically make the necessary fuel adjustments resulting from sudden changes in altitude, power control settings, tailpipe temperatures and fuel pump failure. Basically, the unit consists of three engine driven pumps, a main fuel circuit containing an acceleration and governor system, a starting fuel circuit and a tailpipe temperature and compressor surge sensing circuit. The multiple fuel pump circuit serves as a safety factor to assure adequate fuel supply to the engines in the event of a fuel pump failure, and to maintain engine operation normally to altitudes of 6000 feet or less without assistance from the airplane fuel boost pump. The acceleration and governing circuit allows the pilot to make rapid power setting changes without danger of overloading the engines or causing possible flame-out. This circuit meters the fuel in proportion to power control settings in sufficient quantity to maintain constant rpm. The tailpipe sensing unit is an integral part of the governing circuit and functions to prevent excessive tailpipe temperatures by indirectly controlling the fuel through the governor. Refer to T.O. No. 1T-37A-2-5 for maintenance of the fuel control system.

6-2. FUEL TANKS. Six tanks are located in each wing and one in the fuselage making a total of thirteen tanks which carry the airplane fuel supply. Fuel from the wing tanks is delivered to the fuselage tank by a proportional pump. A fuel reservoir and boost pump is located in the fuselage tank to supply fuel to the engines. The reservoir will supply fuel for a duration of thrity seconds inverted flight. The fuel system must be serviced by using both fuel filler assemblies located one in each outboard leading edge assembly. Access to the wing fuel tanks is provided by access plates on the top surface of each wing, and by removing the wing leading edges. Access to the fuselage fuel tank is provided by removing the center tunnel door. For detailed duscussion and maintenance of the fuel cells refer to T.O. No. 1T-37A-2-5.

6-3. FUEL VENT SYSTEM. The wing fuel tanks are vented to vent tubes at the wing tips. The fuselage fuel tank is vented by a tube running from the top of the tank, aft through the tailcone, and exiting under the horizontal stabilizer.

6-4. FUEL QUANTITY INDICATING SYSTEM. The fuel quantity indicator is mounted on the shock panel and indicates the total pounds of usable fuel remaining in the fuel system. The fuel quantity indicator selector switch is provided so that a reading may be obtained from either left wing tanks, right wing tanks or fuselage tank. The fuel quantity indicating system is an electrically operated A-C system and incorporates a fuel low warning light that glows red when the total remaining fuel reaches 500 pounds or less. For a detailed discussion of the fuel quantity indicating system refer to T.O. No. 1T-37A-2-6.

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7-1. GENERAL. All instruments are located on the instrument panel mounted in the cockpit. The combination of instruments provided will enable the student to receive both day and night training instructions. Instruments have been provided so that a constant check may be made on the operation of each engine plus adequate warning indicators and navigational aids.

7-2. FLIGHT INSTRUMENTS. The flight instruments are located on the shock panel in front of the student pilot and consist of the airspeed indicator, directional gyro, turn and slip indicator, attitude gyro, rate-of-climb indicator, and accelerometer. For maintenance of the flight instruments refer to T.O. No. 1T-37A-2-6.

7-3. AIRSPEED INDICATOR. The airspeed indicator is operated by the pitot-static system, and indicates the speed of the airplane in relation to the air in which it is traveling. The airspeed indicator is calibrated in knots from zero to 650. The yellow radial indicates the maximum allowable speed with flaps or landing gear extended, the Mach pointer is set at 0.7 and the maximum allowable airspeed indicator is set at 430 knots.

7-4. DIRECTIONAL GYRO. The directional gyro is powered by the A-C electrical system and gives a visual indication of the rate of turn of the airplane, in degrees, with respect to a pre-determined reference. The indicator has a single pointer and is calibrated from zero to 360°.

7-5. ATTITUDE GYRO. The attitude gyro is also powered by the A-C electrical system, and gives visual indication of the attitude of the airplane in relation to the earth's horizon.

7-6. TURN AND SLIP INDICATOR. The turn and slip indicator is comprised of an electrically driven gyro turn indicator and a fluid dampened inclinometer. The gyro indicator registers direction and degree of turns, and the inclinometer indicates the lateral attitude of the airplane.

7-7. ALTIMETER. The altimeter is operated by the pitot-static system and indicates the altitude of the airplane above sea level. The altimeter has two pointers, one indicates the altitude from zero to 1000. The number of revolutions is transferred to a small rotating disc on the face of the instrument which gives the altitude in thousands of feet above sea level.

7-8. RATE-OF-CLIMB INDICATOR. The rate-of-climb indicator is operated by the static system and indicates the rate-of-climb or descent of the airplane in feet per minute. The instrument has a single pointer and two adjoining scales calibrated from zero to 6000.

7-9. ACCELEROMETER. The accelerometer measures positive or negative acceleration in terms of "G" units. These units represent a measure of force created by gravity or inertia. The instrument is marked with a design gross weight red radial at +6.67G and a maximum gross weight red radial at -2.67G.

7-10. ENGINE INSTRUMENTS. The engine instruments are mounted on the shock panel and consist of the fuel flow indicator, fuel quantity indicator, exhaust temperature indicators, tachometer, and loadmeters. For removal, installation and maintenance of the engine instruments refer to T.O. No. 1T-37A-2-6.

7-11. FUEL QUANTITY INDICATOR. The fuel quantity indicator is operated by the A-C electrical system and will, by use of the fuel quantity selector switch, indicate the total pounds of fuel remaining in the left wing tanks, the right wing tanks or the fuselage fuel tank.

7-12. FUEL FLOW INDICATORS. The fuel flow indicators are electrically operated A-C instruments and indicate the number of pounds of fuel consumed per hour by each engine.

7-13. EXHAUST TEMPERATURE INDICATORS. The exhaust temperature indicators indicate the temperature of the exhaust gasses of the engines. Thermocouples mounted in the tailpipe energize the indicators. The exhaust temperature indicators are calibrated in degrees centigrade from zero to 1000° and are marked with a red radial at 510 degrees for a minimum temperature for flight, a green arc at 510-573 degrees centigrade for continuous operation and a red radial at 683 degrees centrigrade for maximum temperature.

7-14. TACHOMETERS. The tachometers are operated by the tachometer generator mounted on each engine and are independent of the airplane electrical system.

The tachometers indicate the percent of maximum engine rpm and are calibrated from 0 to 100 percent rpm. The instrument has a maximum take off red radial at 100% rpm and a continuous operation green arc at 84-92% rpm.

7-15. LOADMETERS. Two loadmeters are mounted on the shock panel and indicate the percent of load being drawn from each generator.

7-16. POSITION, TEMPERATURE AND PRESSURE INDICATING INSTRUMENTS. These instruments include the landing gear, elevator trim tab, flap position indicators, and canopy downlock indicators; the hydraulic pressure and oil pressure indicators. Refer to T.O. No. 1T-37A-2-6 for maintenance instructions.

7-17. LANDING GEAR POSITION INDICATOR. The three landing gear position indicators are mounted in the upper left hand corner of the shock panel and give visual indication when the nose and main gears are down and locked or up and locked.

7-18. ELEVATOR TRIM TAB INDICATOR. The elevator trim tab indicator is located near the top of the shock panel and gives a visual indication when the trim tab is in the neutral position.

7-19. ENGINE ICE WARNING INDICATOR. The engine ice warning probe is incorporated to give visual indication when icing conditions exist within the engine air intake duct.

7-20. FLAP POSITION INDICATOR. The flap position indicator is located on the left side of the shock panel and gives the percent of flap deflection from full up to full down. The flap position indicator receives its operating power from the flap position transmitter which is linked directly to the flaps by a mechanical linkage.

7-21. CANOPY DOWNLOCK INDICATOR. The canopy downlock indicator is provided to give a warning to the pilot when the canopy is in the unlocked position.

7-22. HYDRAULIC PRESSURE GAGE. The hydraulic pressure gage is calibrated from 0 to 4000 psi and is mounted on the shock panel. The normal operating green arc is located between 1250-1500 psi and the maximum red radial is located at 1750 psi. The hydraulic pressure gage is protected, by a snubber, from sudden pressure surges which might cause damage to the instrument.

7-23. OIL PRESSURE GAGE. The direct reading oil pressure gage is mounted on the shock panel and is calibrated from zero to 200 psi. Minimum pressure for flight red radial is located at 15 psi, the continuous operation green arc is located between 15-45 psi and a maximum pressure red radial is located at 55 psi.

7-24. OXYGEN PRESSURE AND OXYGEN FLOW INDICATORS. The oxygen pressure and oxygen flow indicators are combined into one unit and are part of each oxygen demand regulator. The upper half of the instrument indicates the number of psi of oxygen in the system. The lower half of the instrument is the oxygen flow indicator. Indication of oxygen flow is given by the blinking of the flow indicator.

7-25. PITOT-STATIC SYSTEM. The pitot-static system provides a means of operation for the altimeter, rate-of-climb indicator and airspeed indicator. The pitot head is mounted in the nose section of the airplane and is electrically heated to prevent the accumulation of ice. Static ports are located on each side of the fuselage, with lines running inboard to the instruments. Refer to T.O. No. 1T-37A-2-6 for maintenance.

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8-1. A-C POWER SUPPLY. The A-C power supply system consists of a main inverter, spare inverter, transformer and inverter selector switch. Both the main and spare inverter are 115 volt, 400 cycle, three phase alternators operating on an input voltage of 27.5 volts d-c with a rated output of 100 volt amps. Consult T. O. No. 1T-37A-2-7, Electrical System for a detailed discussion of the A-C power supply.

8-2. A-C POWER DISTRIBUTION. The A-C power system supplies power for operating the gyros, fuel quantity indicating system and fuel flow indicating system. The transformer steps the alternator output voltage down for operation of the fuel flow indicating system. Refer to T.O. No. 1T-37A-2-7, Electrical System, for a detailed discussion of the A-C power distribution.

8-3. D-C POWER SUPPLY. The D-C electrical system is supplied by two starter-generators supplemented by a storage battery. An external power receptacle is provided for ground operation and starting. Indication of current drawn on the generators is provided by two loadmeters mounted on the instrument panel and circuit breakers protect the various systems from excessive current flow. Refer to T.O. No. 1T-37A-2-7.

8-4. D-C POWER DISTRIBUTION. D-C power is distributed by the bus bar which is connected, by relays, to the three power sources. For detailed information, on the D-C power distribution refer to T.O. No. 1T-37A-2-7, Electrical System.

8-5. EXTERNAL POWER. An external power receptacle is located on the left side of the nose section, for connection of an external power source. To avoid excessive drain on the battery the external power source should be used for starting and ground operational check out. Refer to T.O. No. 1T-37A-2-7, Electrical System.

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9-1. COMMUNICATION EQUIPMENT. The communication and associated electrical equipment provide a means of communication between the instructor and student through the use of the "Hot-Mike" or "Normal" interphone system, and provides air-to-air and air-to-ground communication. All equipment is protected by circuit breakers located on the circuit breaker panel in front of the instructor. Communication is provided by a Type F-14 "Hot-Mike" interphone system and an ARC Type 12 UHF-VHF communication system. Refer to T.O. No. 1T-37A-2-6 for maintenance of communication equipment.

9-2. INTERPHONE SYSTEM. Communication between the instructor and student is provided by the interphone system which can be operated with or without the use of microphone switches. Two way simultaneous speech communication is provided by a "Hot-Mike" switch located on the instrument panel. Placing the "Hot-Mike" switch to the ON position permits either the instructor or student to speak without the use of microphone switches, or either the student or instructor can participate in single voice conversation by using side tone through the transmitter and depressing the microphone switch on either right engine throttle.

9-3. ARC TYPE 12 UHF-VHF COMMUNICATION SYSTEM. The UHF-VHF system provides two-way radio telephone communication between aircraft-to-aircraft or aircraft-to-ground stations. The system is comprised of a VHF R-19 receiver which provides reception in the tuning range of 118-148 mc; a T-11B transmitter which permits VHF transmission in any 2 mc band from 116-132 mc; and a T-13A transmitter which operates in any 2 mc band from 132-148 mc. The R-19 receiver employs a "whistle-through" tuning feature which indicates that the receiver is tuned to the same frequency as the transmitter. Two TV-10 transverters are installed to provide UHF reception. Each transverter is a combination crystal-controlled UHF transmitter and a receiver converter to convert incoming high frequency signals to the low frequency signals. The converted signal is fed into the R-19 VHF receiver which is tunable from 118-148 mc.

9-4. VOR NAVIGATION. The ARC Type-15D VHF navigational equipment is located in the right side of the nose section and is supplied power directly from the D-C bus. The navigation antenna is mounted on the center retaining strip of the canopy. The ARC Type-15D navigation system includes an R-13B receiver, B-13 converter, E-14 rack, course selector and cross pointer. The Type R-13B receiver provides reception of communication and navigation signals in amplitude-modulated frequency range of 108-135 mc on the following facilities:

1. VHF Omnidirectional radio range (VOR).
2. VHF Visual-aural airways radio range (VAR).
3. VHF 90-150 cps runway localizers (LOC).
4. VHF voice reception simultaneously with navigation facilities.

9-5. MARKER BEACON RECEIVER TYPE R-20. The ARC Type R-20 marker beacon receiver is designed for visual and aural presentation of signals from the 75 mc marker beacons modulated with either voice or 400, 1300 or 3000 cycle tones. The receiver is mounted in the right hand compartment of the nose section, with a flush type antenna mounted on the underside of the nose section. Refer to T.O. No. 1T-37A-2-6 for maintenance of marker beacon.

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T.O. NO. 1T-37A-2-2

HANDBOOK

MAINTENANCE INSTRUCTIONS

GROUND HANDLING, SERVICING AND AIRFRAME MAINTENANCE

USAF SERIES

T-37A

AIRCRAFT

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PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE

McCORMICK-ARMSTRONG, WICHITA, 1277, 1-23-57

31 AUGUST 1956

REVISED 30 NOVEMBER 1956

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Page No.	*Date of Latest Revision*
* 1	30 November 1956
* 2	30 November 1956
* 3	30 November 1956
* 4	30 November 1956
* 4A	30 November 1956
* 4B	30 November 1956
* 4C	30 November 1956
* 5	30 November 1956
* 6	30 November 1956
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*20	30 November 1956
*21	30 November 1956
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*35	30 November 1956
*47	30 November 1956
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*52	30 November 1956
*57	30 November 1956
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GROUND HANDLING, SERVICING, AND AIRFRAME GROUP MAINTENANCE

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INTRODUCTION

This handbook is one of a series of sectionalized maintenance handbooks on the T-37A aircraft and contains instructions for line maintenance personnel to accomplish ground handling, servicing, lubrication and airframe group maintenance. Section I, Ground Handling, contains instructions for towing, mooring, hoisting, leveling, jacking along with the use of ground handling equipment. Section II, Servicing, gives complete information for servicing the airplane along with fluid capacities, expansion volumes and air pressures required. Section III, Lubrication, lists the items of equipment to be lubricated plus the type of lubricant and interval of application. Section, IV, Airframe Group Maintenance, provides specific instructions for maintenance of the windshield, canopy, seats, nose cap, stinger, vertical and horizontal stabilizers, throttle, brake and steering control systems. The instructions provided in this handbook are supplemented by illustrations to aid in locating various items of equipment and to show removal and installation procedures. The following is a list of the other handbooks of T.O. No. 1T-37A-2 sectionalized maintenance handbook.

T.O. No. 1T-37A-2-1	General Airplane
T.O. No. 1T-37A-2-3	Hydraulically Operated Systems and Utility Systems
T.O. No. 1T-37A-2-4	Flight Control Systems
T.O. No. 1T-37A-2-5	Power Plant, Fuel System and Oil System
T.O. No. 1T-37A-2-6	Instruments, Radio, Communication and Navigation Equipment
T.O. No. 1T-37A-2-7	Electrical System
T.O. No. 1T-37A-2-8	Wiring Diagrams and Data

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GROUND HANDLING

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1-1. TOWING.

1-1A. GENERAL. The airplane may be towed either forward or backward. A tow bar, ropes, or both may be used as necessary. The tow bar is mechanically attached to the nose gear. Attachment points for the tow ropes are forged pintle rings on the forward and aft sides of the main gear shock struts.

Note

All warnings, cautions, and notes described in the following paragraphs should be observed carefully to prevent damage to aircraft.

1-1B. TOWING ON HARD SURFACES OR RUNWAYS. (See figure 1-1.)

CAUTION

Be sure the nose gear torque link lock pin has been removed and all ground safety lock pins have been installed before any towing procedures are initiated.

On smooth surfaces or runways, the airplane may be towed by tow bar, ropes, or both. Before attaching tow bar or ropes, switch off all electrical power and disconnect the battery. Tow bar part number 4080200 has been issued and can be used but tow bar part number 4080410 is a later model and is preferred.

a. Tow bar part number 4080200 is attached as follows:

1. Insert axle pins (8) into nose wheel axle (5).
2. Lock tow bar tubes in position with spreader bar (6) and lock pin (7).
3. Check tow bar axle pins for secure attachment with nose gear axle.

b. Tow bar part number 4080410 is attached as follows:

1. Insert axle pins (8) into nose wheel axle (5).
2. Lock tow bar tube (12) by relieving spring in lever (11) and pull lever toward the tow bar pintle ring. Release the spring-in lever (11) to engage ratchet (10) then pull tight.
3. Check tow bar axle pins for secure attachment with nose wheel axle.

Tow ropes may be tied securely, with a good slip knot, to the forward main gear pintle rings and the towing vehicle, if necessary.

Note

A single wheel, tractor type towing vehicle or equivalent is sufficient for towing this airplane. Gross weight does not fluctuate enough to warrant use of a larger vehicle.

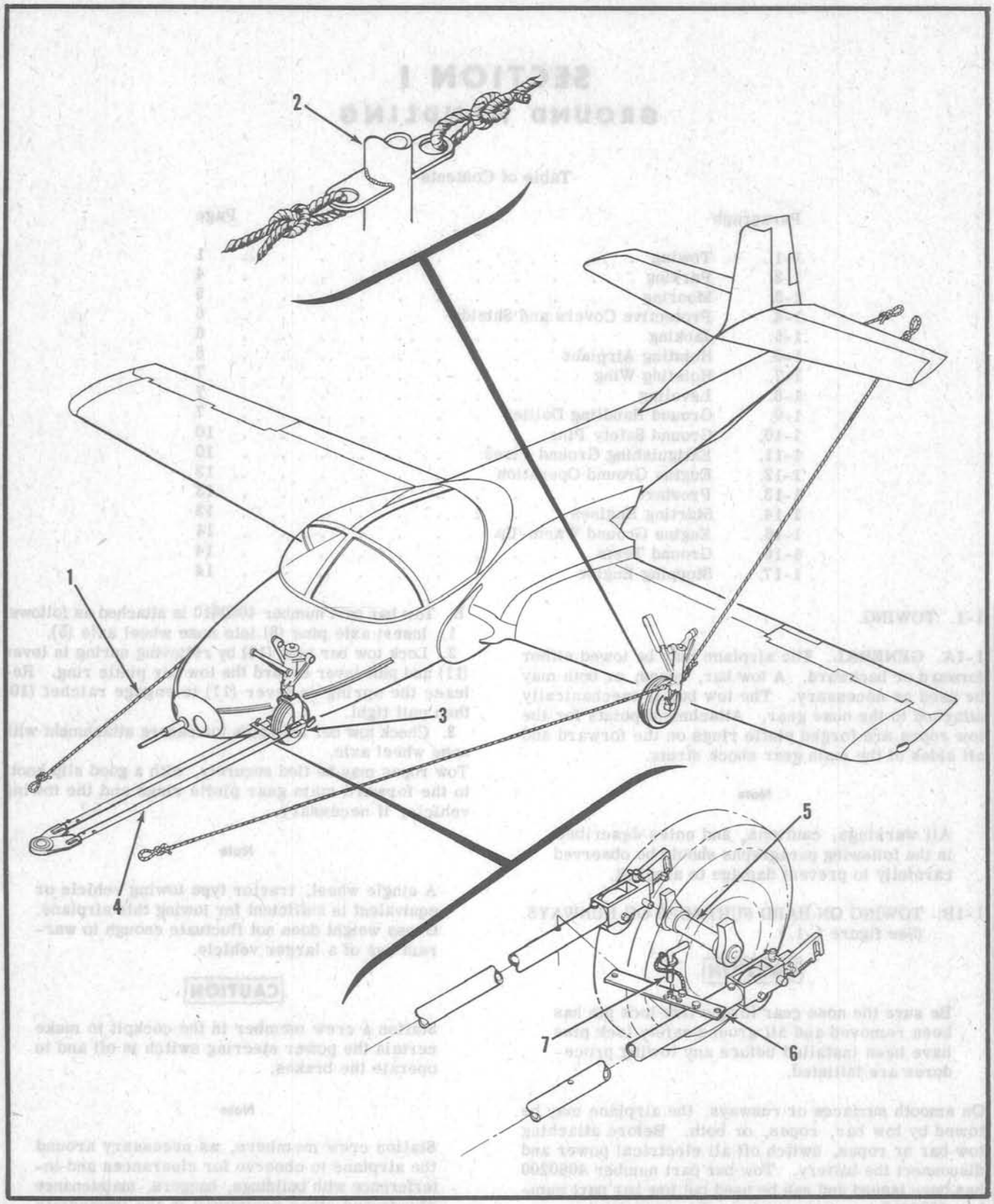
CAUTION

Station a crew member in the cockpit to make certain the power steering switch is off and to operate the brakes.

Note

Station crew members, as necessary around the airplane to observe for clearances and interference with buildings, hangers, maintenance stands and other equipment in the immediate area.

After attaching the towing vehicle, as specified, move the airplane forward slowly and cautiously. If it becomes necessary to turn the airplane, be sure the towing vehicle and the airplane are moving straight ahead



1. Tow ropes
2. Main gear trunnion
3. Nose gear
4. Tow bar
5. Nose gear axle
6. Spreader bar
7. Locking pin
8. Axle pins
9. Tie rod
10. Ratchet
11. Lever
12. Arm

Figure 1-1. Towing (Sheet 1 of 2)

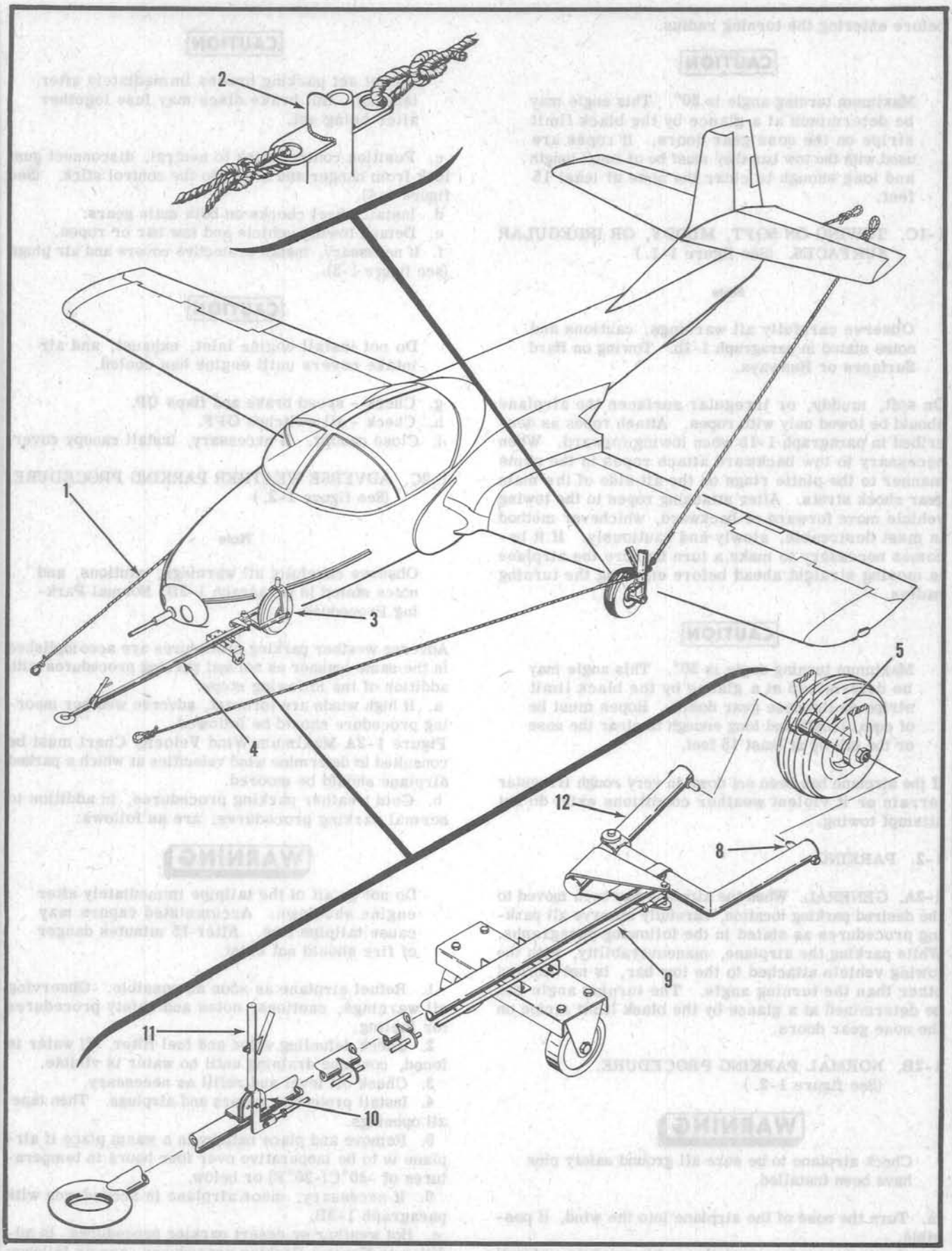


Figure 1-1. Towing (Sheet 2 of 2)

before entering the turning radius.

CAUTION

Maximum turning angle is 50°. This angle may be determined at a glance by the black limit stripe on the nose gear doors. If ropes are used with the tow bar they must be of equal length and long enough to clear the nose at least 15 feet.

1-1C. TOWING ON SOFT, MUDDY, OR IRREGULAR SURFACES. (See figure 1-1.)

Note

Observe carefully all warnings, cautions and notes stated in paragraph 1-1b. Towing on Hard Surfaces or Runways.

On soft, muddy, or irregular surfaces the airplane should be towed only with ropes. Attach ropes as described in paragraph 1-1b when towing forward. When necessary to tow backward attach ropes in the same manner to the pintle rings on the aft side of the main gear shock struts. After attaching ropes to the towing vehicle move forward or backward, whichever method is most desireable, slowly and cautiously. If it becomes necessary to make a turn be sure the airplane is moving straight ahead before entering the turning radius.

CAUTION

Maximum turning angle is 50°. This angle may be determined at a glance by the black limit stripe on the nose gear doors. Ropes must be of equal length and long enough to clear the nose or the tail by at least 15 feet.

If the airplane has been set down in very rough irregular terrain or if violent weather conditions exist do not attempt towing.

1-2. PARKING.

1-2A. GENERAL. When the airplane has been moved to the desired parking location, carefully observe all parking procedures as stated in the following paragraphs. While parking the airplane, maneuverability, with the towing vehicle attached to the tow bar, is not limited other than the turning angle. The turning angle can be determined at a glance by the black limit stripe on the nose gear doors.

1-2B. NORMAL PARKING PROCEDURE. (See figure 1-2.)

WARNING

Check airplane to be sure all ground safety pins have been installed.

a. Turn the nose of the airplane into the wind, if possible.
b. Apply toe pressure to the rudder pedals and pull parking brake handle, to set parking brakes.

CAUTION

Do not set parking brakes immediately after landing. Hot brake discs may fuse together after being set.

c. Position control stick to neutral, disconnect gust lock from hanger and attach to the control stick. (See figure 1-4).
d. Install wheel chocks on both main gears.
e. Detach towing vehicle and tow bar or ropes.
f. If necessary, install protective covers and air plugs (see figure 1-3).

CAUTION

Do not install engine inlet, exhaust, and air intake covers until engine has cooled.

g. Check - speed brake and flaps UP.
h. Check - all switches OFF.
i. Close canopy. If necessary, install canopy cover.

1-2C. ADVERSE WEATHER PARKING PROCEDURE. (See figure 1-2.)

Note

Observe carefully all warnings, cautions, and notes stated in paragraph 1-2B, Normal Parking Procedure.

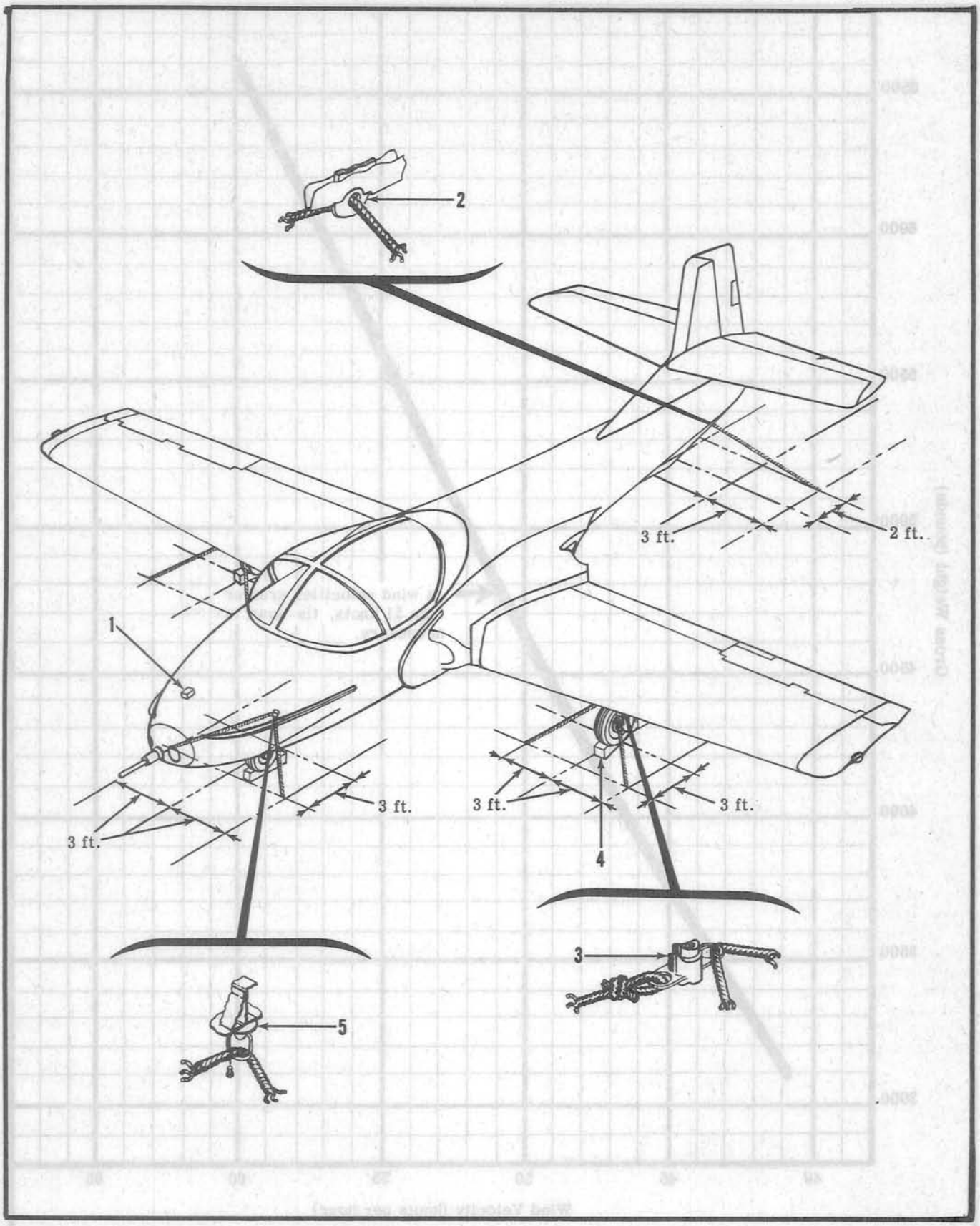
Adverse weather parking procedures are accomplished in the same manner as normal parking procedures with addition of the following steps:
a. If high winds are forecast, adverse weather mooring procedure should be followed.
Figure 1-2A Maximum Wind Velocity Chart must be consulted to determine wind velocities at which a parked airplane should be moored.
b. Cold weather parking procedures, in addition to normal parking procedures, are as follows:

WARNING

Do not go aft of the tailpipe immediately after engine shutdown. Accumulated vapors may cause tailpipe fire. After 15 minutes danger of fire should not exist.

1. Refuel airplane as soon as possible. Observing all warnings, cautions, notes and safety procedures for fueling.
2. Check defueling valve and fuel filter. If water is found, continue draining until no water is visible.
3. Check oil level and refill as necessary.
4. Install protective covers and airplugs. Then tape all openings.
5. Remove and place battery in a warm place if airplane is to be inoperative over four hours in temperatures of -30°C(-20°F) or below.
6. If necessary, moor airplane in accordance with paragraph 1-3B.

c. Hot weather or desert parking procedures, in addition to Normal Parking procedures, are as follows:
1. Refuel the airplane with extreme caution. Ob-



1. Jack pad stowage box
2. Tailcone bumper
3. Main gear shock strut
4. Wheel chocks
5. Jack pad

Figure 1-2. Mooring

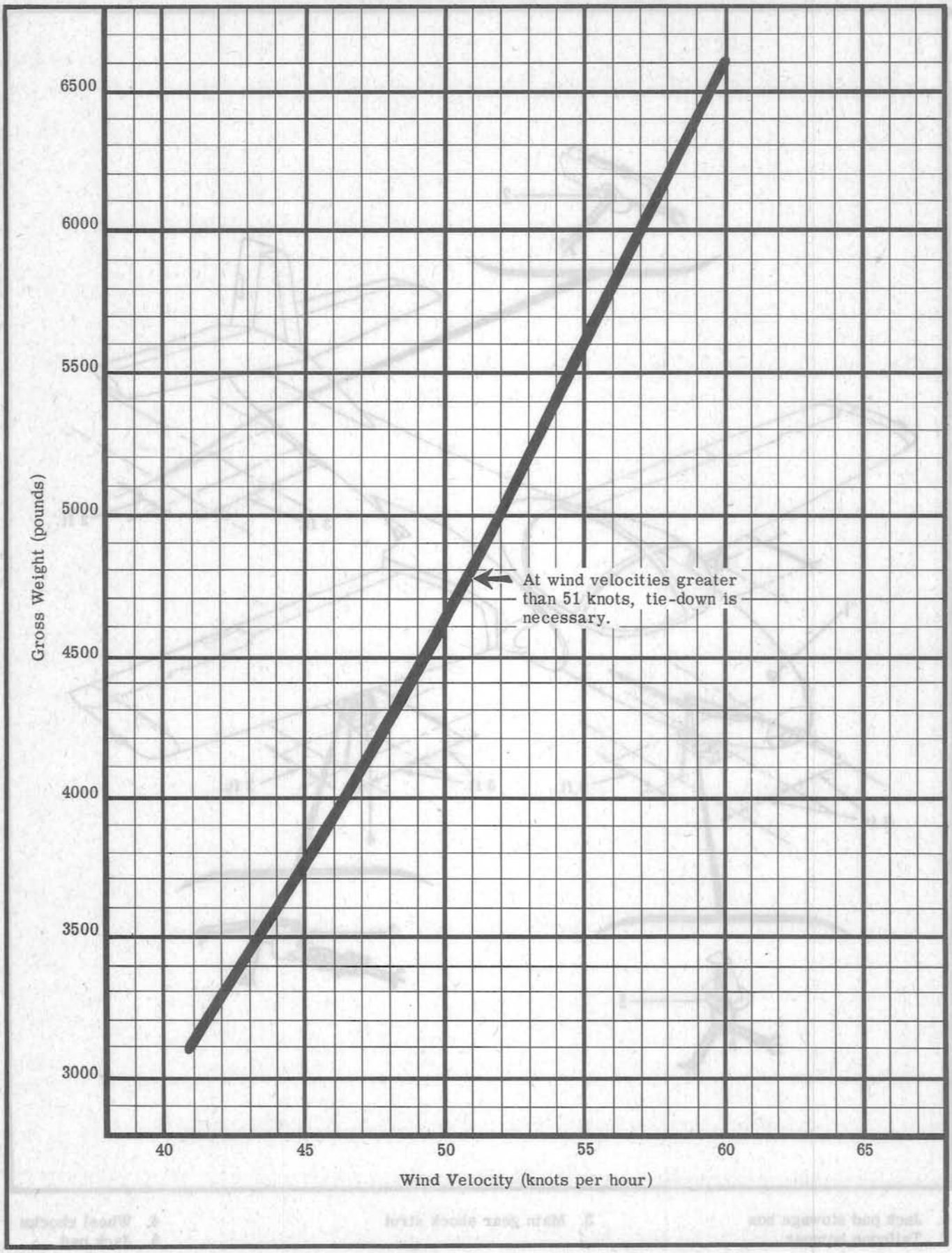
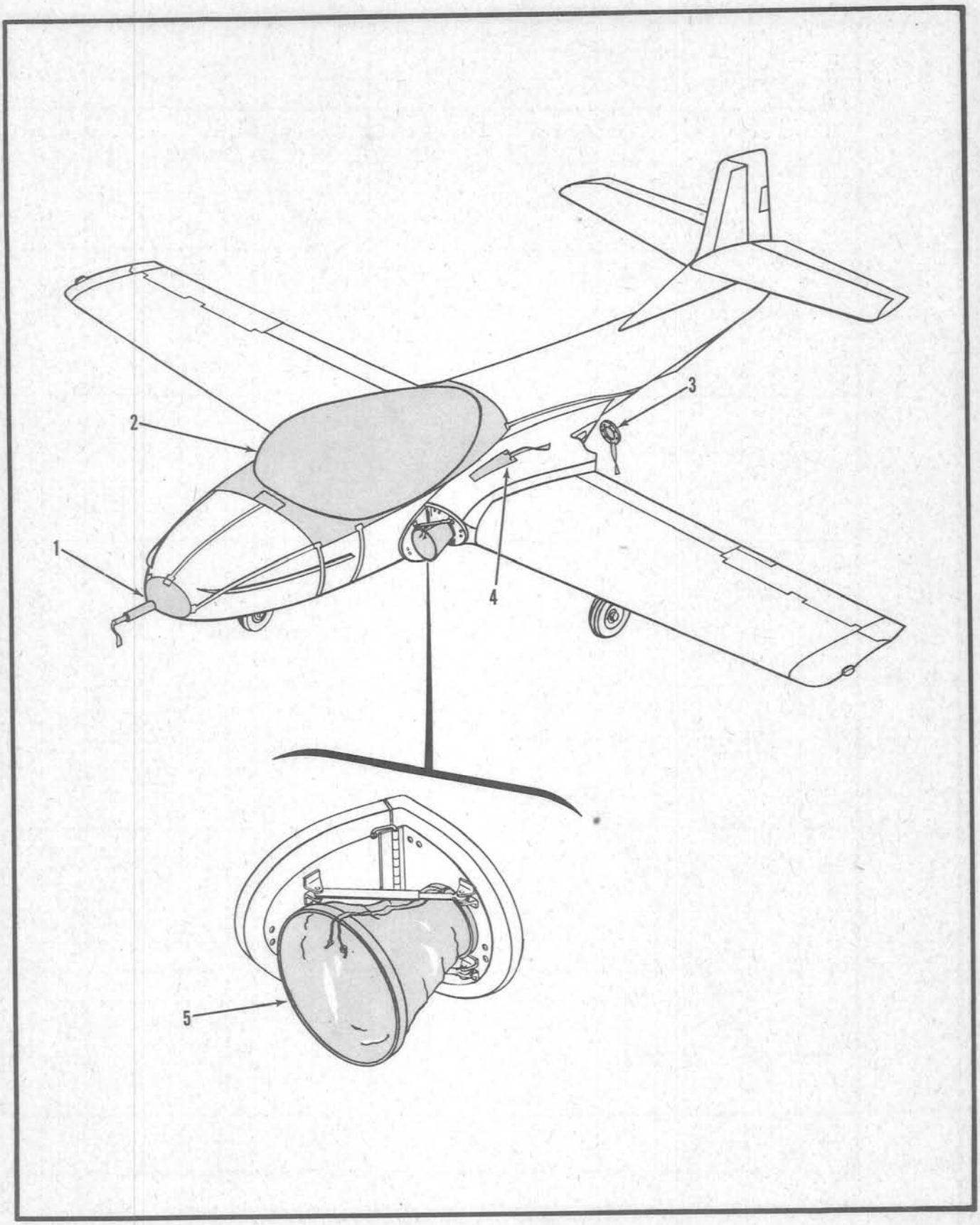


Figure 1-2A. Maximum Wind Velocity Chart



1. Nose and pitot tube cover
2. Canopy and windshield
3. Engine exhaust cover
4. Cooling air intake shield
5. Engine air intake shield

Figure 1-3. Protective Covers

serve all warnings, cautions, notes, and safety procedures for fueling. Extreme care must be taken with fuel when temperatures are 50°C(120°F) or more, particularly avoiding the danger of sparks. There is an unusual amount of static electricity in dry climates and a rapid vaporization of fuel at high temperatures. Therefore, extreme precautions must be taken to assure that the airplane fueling nozzle and the fuel truck are properly grounded. Do not overservice fuel cells, allow for expansion.

2. Check oil level immediately after engine shut down and refill as necessary.

3. Check tire pressures in accordance with Section II.

4. When sand or dust is blowing, protective covers and shields should be installed and all openings taped. The canopy should not be left closed when temperatures exceed 38°C(100°F). When temperatures are above 50°C(120°F) the canopy must be cracked open and the cockpit shaded from the direct rays of the sun.

5. Wipe shock struts clean of dust and sand before moving airplane.

d. Moor airplane, if necessary, in accordance with paragraph 1-3B.

1-3. MOORING.

1-3A. NORMAL MOORING PROCEDURE. (See figure 1-2.)

If the airplane is to be parked for an indefinite period of time, it should be moored. Airplane mooring provisions are located on the nose, tailcone, and each main gear. The jack pads double as mooring rings; remove one from the stowage box and install aft of the speed brake with the same bolts that secured stowage. The forged pintle rings on the main gear struts serve as mooring rings for the wings. The mooring eye in the ventral fin on the tailcone is the attachment point for the tail. If parking ramp space is not available, park the airplane on open ground and anchor with standard mooring kits. After parking (see paragraph 1-2B) proceed with mooring as follows:

a. Park airplane approximately wing span distance from other aircraft with the nose mooring point about four feet aft of the ground anchor.

b. Install wheel chocks, fore and aft, on all landing gears.

c. Install nose tie down ring.

d. Secure tie-down to ground anchor, slip through nose tie down ring, pull tight to prevent movement of nose gear strut, and secure to ground anchor. Make tie-down from 3/16 inch aircraft cable or chains that will sustain 1500 pounds pull-test. Secure cable with wire rope clips or chains with aircraft steel bolts. If cable or chain is not available 3/4 inch Manila rope may be used. However, rope is least desirable because of shrinkage when wet. Secure mooring ropes with a square or bowline knot. Do not use slip knots.

e. Secure main gear and tail moorings in same manner as in step d.

f. Install protective covers and shields if not already done and tape all openings.

g. Disconnect the battery.

CAUTION

All mooring tie-downs should be tight and secure; however, do not tighten them so that strain is placed on the airplane structure or other mooring points.

1-3B. MOORING FOR HIGH WINDS. (See figure 1-3.)

CAUTION

High-velocity surface winds can cause structural damage. Therefore, if at all possible, the airplane should be evacuated to a safe-weather area if a tornado, hurricane, or wind above 90 knots is expected. However, if airplanes are subjected to these conditions, they should be throughly inspected for structural damage.

The secure installation of the proper size wheel chocks is most important in proper mooring the airplane for high-velocity winds. Therefore, use wheel chocks at least four inches high that are suitable for this type aircraft. For ice or snow, use metal, collapsible, ice-grip chocks. Another important factor is the gross weight of the airplane. Figure 1-2A gives the various gross weights vs. wind velocities at which the airplane should be moored. To use this graph effectively it is necessary to know the gross weight of each airplane so that it can be determined which airplanes should be tied down dirst. Mooring the airplane for high winds procedures, in addition to Normal Mooring Procedures, are as follows:

a. Head airplane into the direction of the strongest forecasted wind or gusts.

b. Deflate nose gear strut. (See section II).

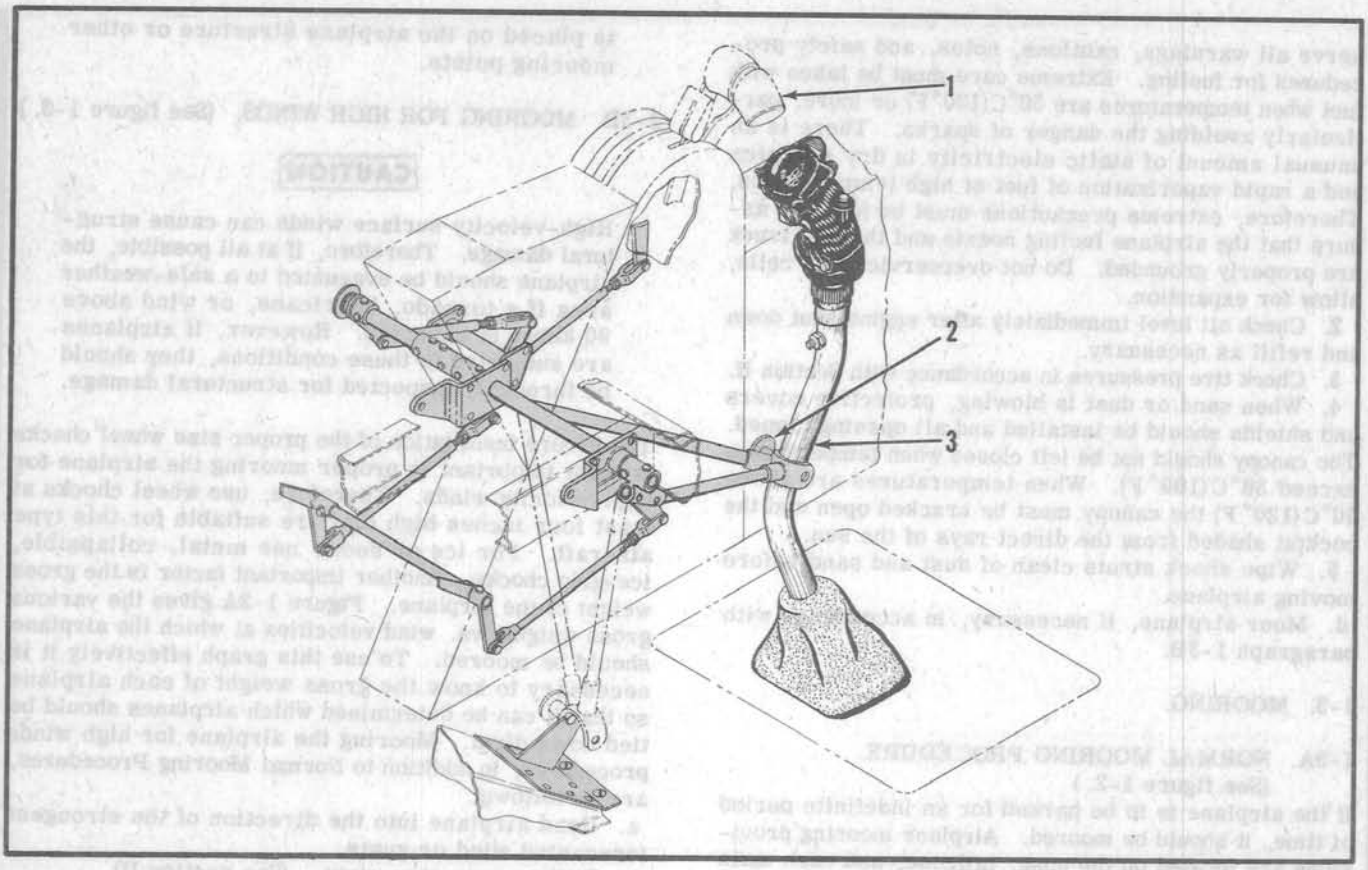
c. If time permits, fill all fuel cells to capacity.

d. Secure wheel chocks by nailing wood cleats, on both sides of each wheel, from fore to aft. If ice grip chocks are used, secure fore and aft, on both sides, with rope.

e. Secure all maintenance stands and loose equipment.

Note

After high winds, check airplane for structural damage and cycle all control surfaces through their complete range of travel. Inflate nose gear strut and connect battery.



1. Center power controls
2. Release disc
3. Students control stick

Figure 1-4. Gust Lock Installation

1-4. PROTECTIVE COVERS AND SHIELDS. (See figure 1-4.) Two protective covers and six shields are provided and should be installed as shown whenever the airplane is moored. The nose and pitot tube cover assembly is stowed with the loose equipment kit in the airplane and, with the canopy cover and the shield should be installed whenever the airplane is parked.

1-5. JACKING. (See figure 1-5.)

CAUTION

Do not attempt to jack the airplane at any point other than those which are discribed in this paragraph.

The airplane has seven jack points: one on each wing rear spar aft of each main gear, one aft of the speed brake, one on the lower end of each main gear shock strut, and one on each side of the rear spar carry thru. Three identical jack pads (3) are stowed in a jack pad stowage box (1) in the upper right hand nose compartment.

a. Install jack pads (3) with the bolts (4) which held them in their stowed position.

b. Place jacks (5), (6), and (7) solid and level.

c. Release brakes, remove wheel chocks, and extend all jacks simultaneously.

d. Set locking devices on jacks to prevent accidental lowering of plane.

Note

As an added safety precaution the airplane should be supported at the tailcone bumper if all three wheels are to be jacked simultaneously.

Note

On removing jacks (5), (6) and (7), replace jack pads (3) in stowage box (1) and secure with bolts (4).

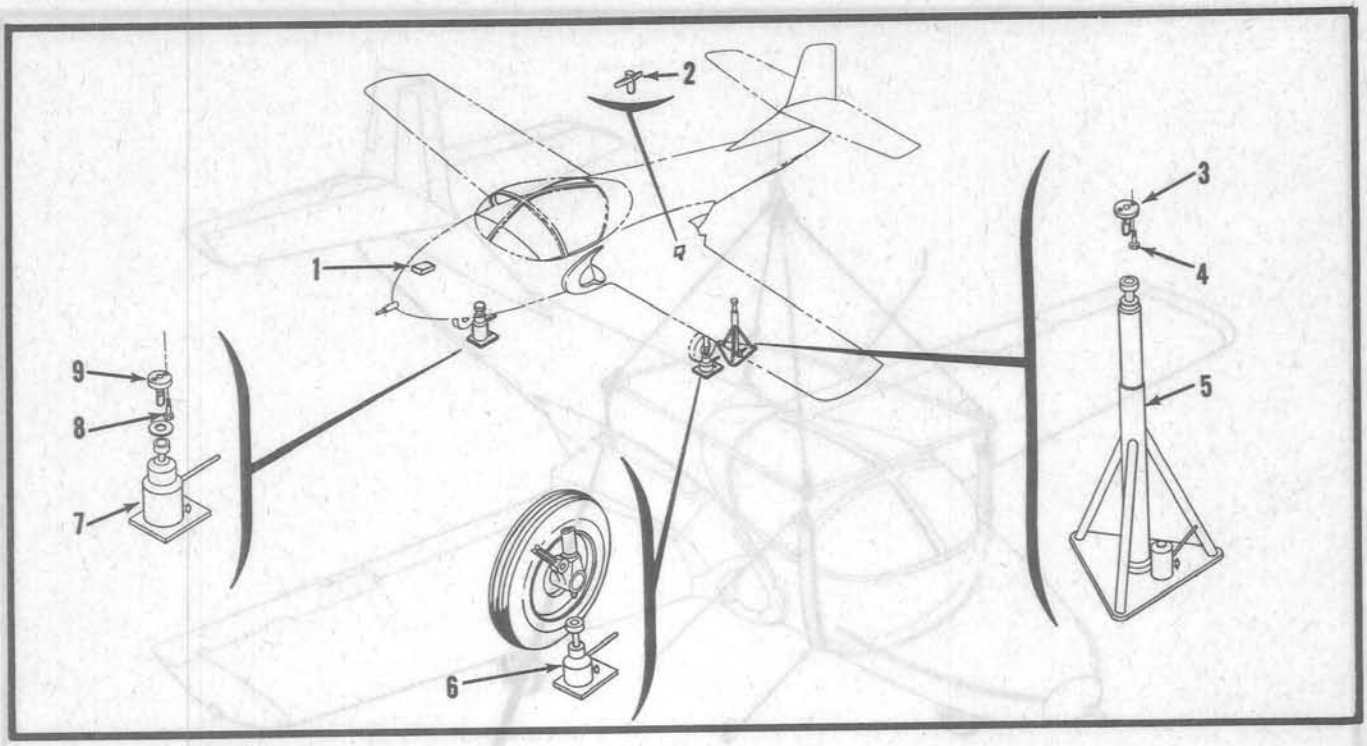
1-6. HOISTING AIRPLANE. Hoist the airplane in accordance with figure 1-6, and check the following carefully.

a. Check hoist sling assembly (1) for frayed or deteriorated belt (5) or cables, loose bolts or fittings.

b. Check belt and airplane belly for cleanliness.

c. Make sure the belt is not twisted or kinked and that the safety hooks (4) attaching the belt to the spreader bar are closed and locked.

d. Make sure that the belt and cables between the airplane and the spreader bars are vertical when hoisting the airplane.



1. Jack pad stowage box
2. Rear spar carry thru jack pad
3. Jack pad
4. Bolt
5. Hydraulic jack, wing, Type B-5
6. Hydraulic jack, main gear, Type A-2
7. Hydraulic jack, nose gear, Type A-3
8. Bolt
9. Jack pad

Figure 1-5. Jacking

CAUTION

To keep the airplane from becoming unbalanced after it has been hoisted, no additional load should be placed upon it at any point.

1-7. HOISTING WING. (See figure 1-7.)

a. Remove the wing to nacelle gap covers 33L, 34L, 35L and 35.

b. Attach fitting (1) and (6) to wing root rib with bolts (2).

c. Attach fittings (3) and (4) with bolt (5).

d. Attach hoist cable to hoist.

e. Remove wing in accordance with paragraph 4-59.

CAUTION

To keep wing from becoming unbalanced no additional weight should be placed upon it at any point.

1-8. LEVELING. (See figure 1-8.) Leveling provisions on the airplane consist of leveling lugs (2), on the front spar carry thru (3) for lateral leveling. On airplane serials 54-2729 thru 54-2738 and 55-2972, leveling brackets (1) are attached to the left nose wheel well web (4) for longitudinal leveling. Airplanes serials 54-2739 and on except 55-2972 have leveling lugs (2) on the top of the tailcone for longitudinal leveling.

a. Jack airplane.

b. Level longitudinally by placing a spirit level on the nose wheel well leveling brackets (1) or on the tailcone leveling lugs (2) and adjusting the nose jack.

c. Level laterally by placing a spirit level on the front spar carry thru leveling bolts (2) and adjusting the wing jacks.

d. Repeat steps b and c until airplane is both longitudinally and laterally level.

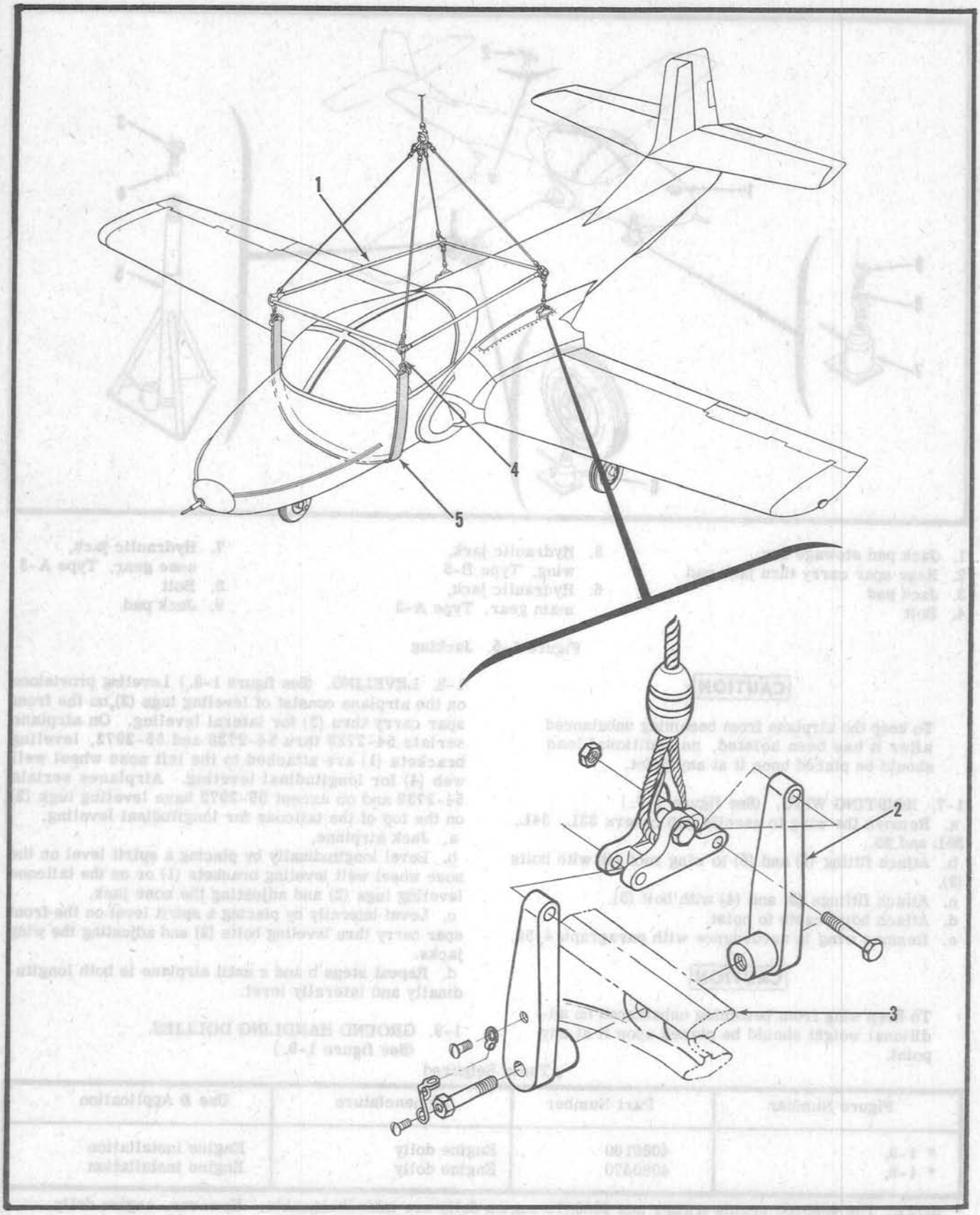
1-9. GROUND HANDLING DOLLIES. (See figure 1-9.)

Tools Required

Figure Number	Part Number	Nomenclature	Use & Application
* 1-9.	4080100	Engine dolly	Engine installation
* 1-9.	4080470	Engine dolly	Engine installation

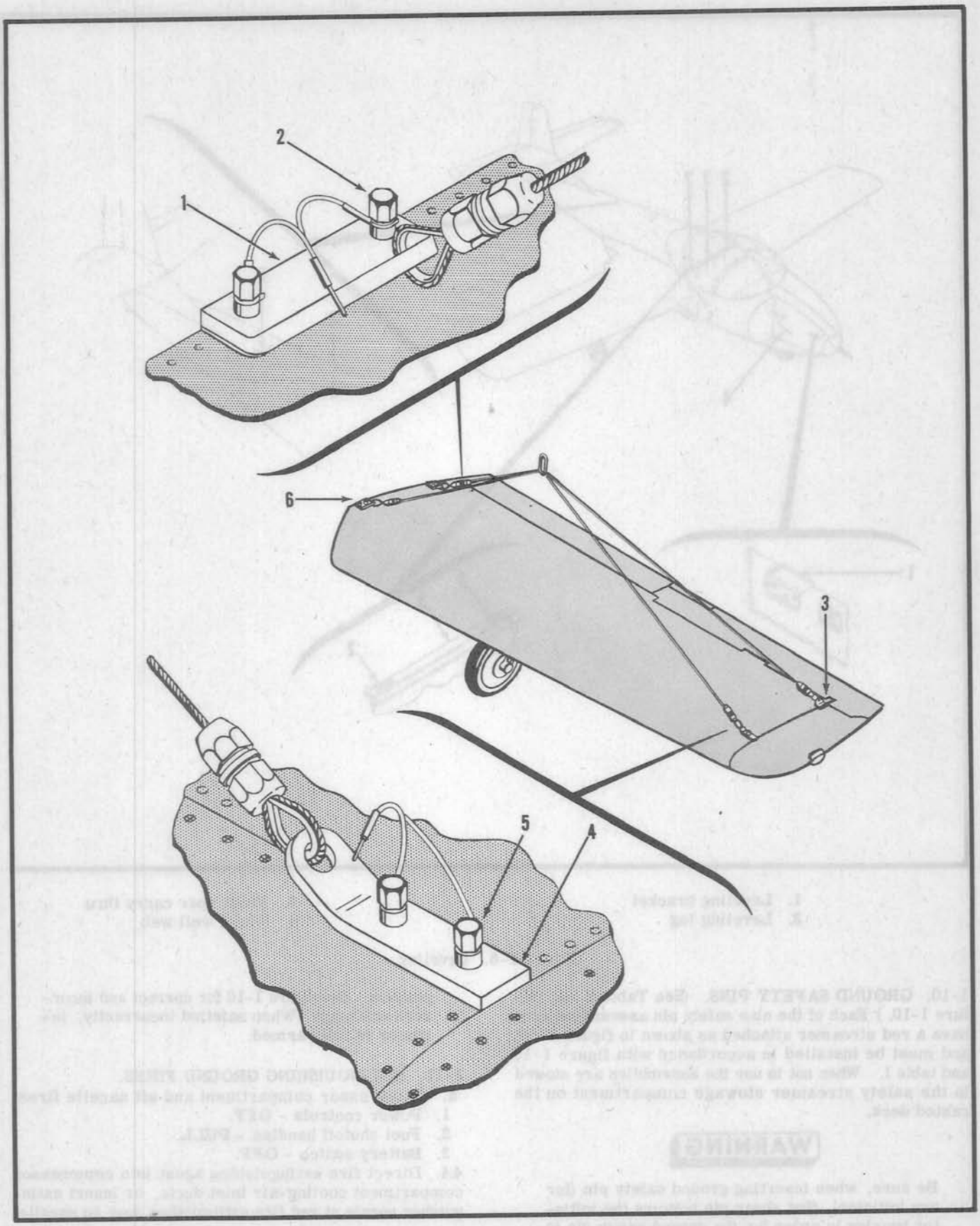
* NOTE: The 4080100 engine trailer and 4080470 engine dolly are interchangeable. However, engine dolly 4080470 is preferable and should be used in lieu of engine trailer 4080100.

Two dollies are provided. The 4080100 engine trailer can be used as a roadable trailer and as an installation dolly. The 4080470 engine dolly is used as an installation dolly only. The trailer and the dolly are both equipped with two forward engine mounts and one rear engine mount assembly.



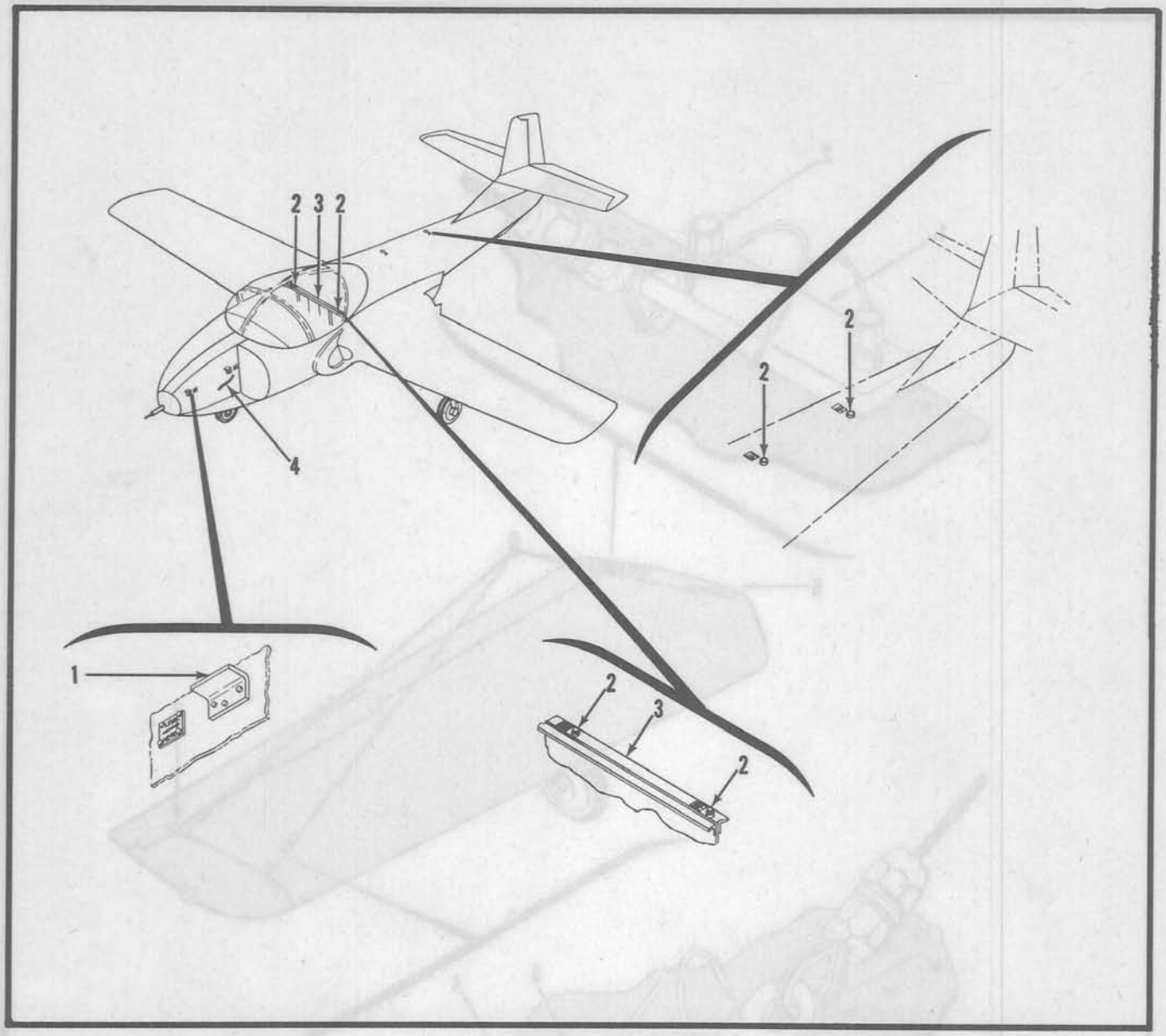
1. Hoist sling assembly
2. Link
3. Rear spar carry thru
4. Safety hook
5. Belt

Figure 1-6. Hoisting Airplane



1. Fitting
2. Bolt
3. Fitting
4. Fitting
5. Bolt
6. Fitting

Figure 1-7. Hoisting Wing



1. Leveling bracket
2. Leveling lug
3. Front spar carry thru
4. Wheel well web

Figure 1-8. Leveling

1-10. GROUND SAFETY PINS. (See Table I and figfure 1-10.) Each of the nine safety pin assemblies must have a red streamer attached as shown in figure 1-10, and must be installed in accordance with figure 1-10 and table I. When not in use the assemblies are stowed in the safety streamer stowage compartment on the canted deck.

WARNING

Be sure, when inserting ground safety pin (for any initiator), that shear pin bottoms the initiator housing in order for the ground safety pin to fit in the (annular) groove in the shear pin and not behind the shoulder of the shear pin. With the ground safety pin inserted behind the shoulder of the shear pin, the initiator is in the armed position. See figure 1-10 for correct and incorrect safetying. When safetied incorrectly, initiator is fully armed.

1-11. EXTINGUISHING GROUND FIRES.

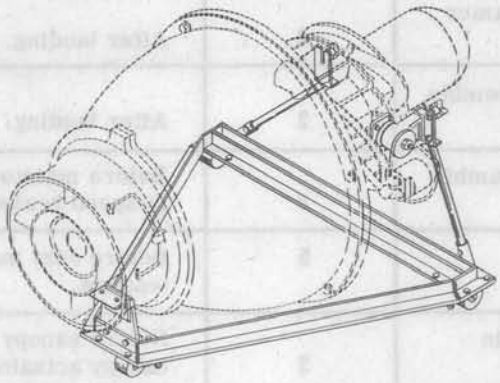
a. Compressor compartment and aft nacelle fires.

1. Power controls - OFF.
2. Fuel shutoff handles - PULL.
3. Battery switch - OFF.

4.4. Direct fire extinguishing agent into compressor compartment cooling-air inlet ducts, or insert extinguisher nozzle at red fire extinguisher door on nacelle.

CAUTION

Direct extinguishing agent into engine intake only if compressor case has failed. In an aft nacelle



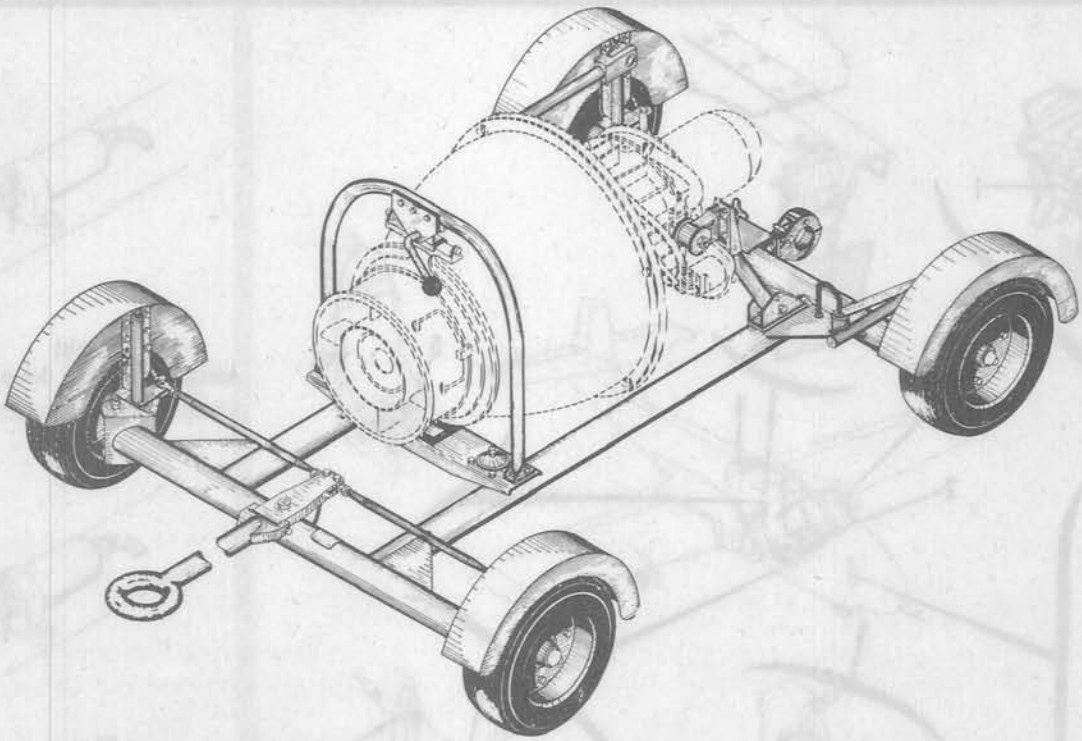


Figure 1-9. Ground Handling Dollies

ITEM	Figure 1-8, Index No.	INSTALL	REMOVE
Nose landing gear safety pin assembly (1)	9	After landing.	Before flight.
Main landing gear safety pin assembly (2)	1	After landing.	Before flight.
Canopy ejection safety pin assembly (1)	7	After landing.	Before flight.
Ground safety pin with warning streamer assembly (1)	6	After landing.	Before flight.
Ground safety pin with streamer assembly (1)	2	After landing.	Before flight.
Speed brake downlock safety pin assembly (1)	8	Before maintenance in speed brake well.	After completion of maintenance.
Seat maintenance pin assembly (1)	5	Before seat maintenance.	After completion of maintenance.
Canopy actuator firing head safety pin assembly (1)	3	Before canopy and canopy actuator remover maintenance.	After completion of maintenance.
Ground safety pins stowage compartment	4		

Table I. Ground Safety Pins

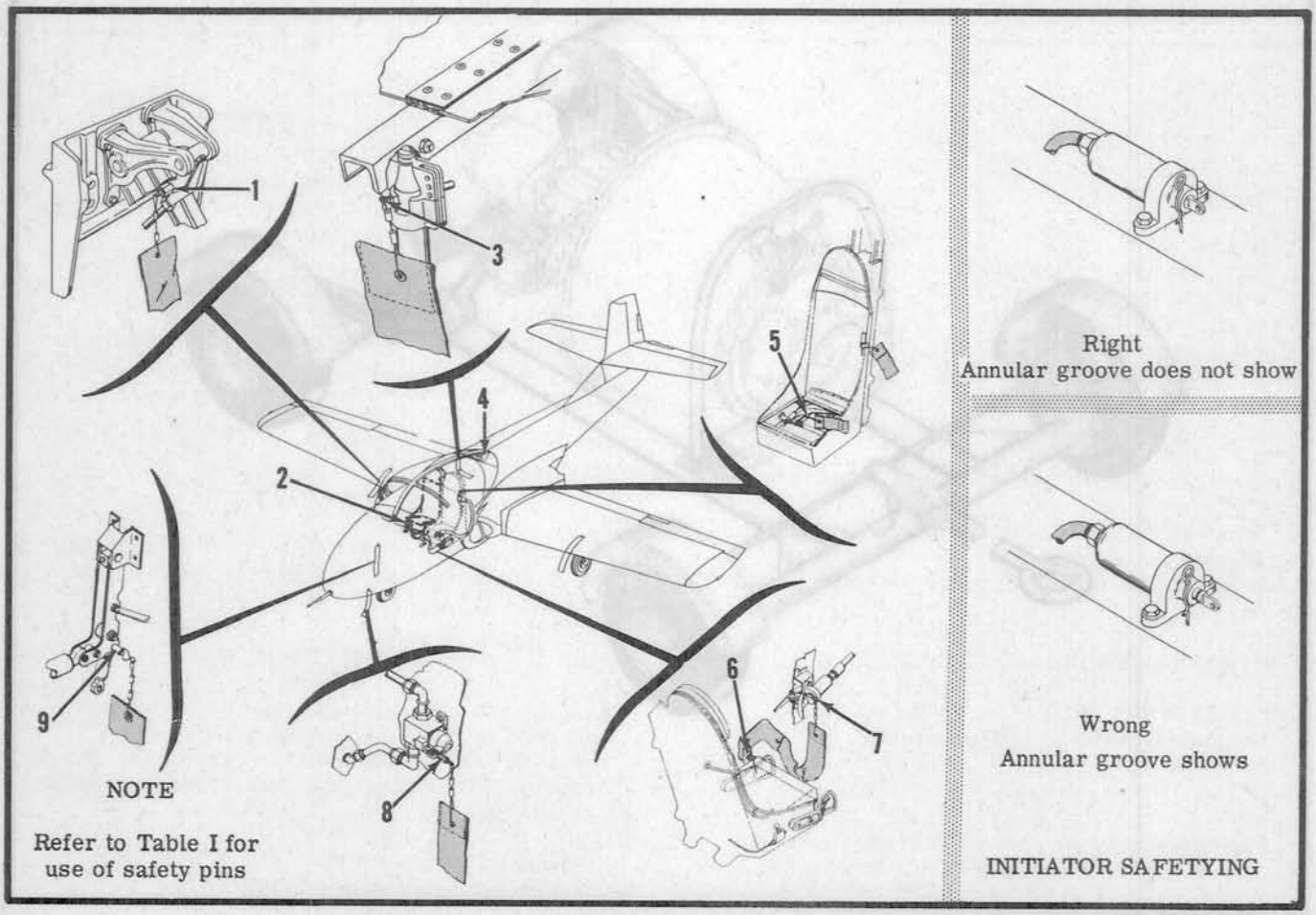


Figure 1-10. Ground Safety Pins

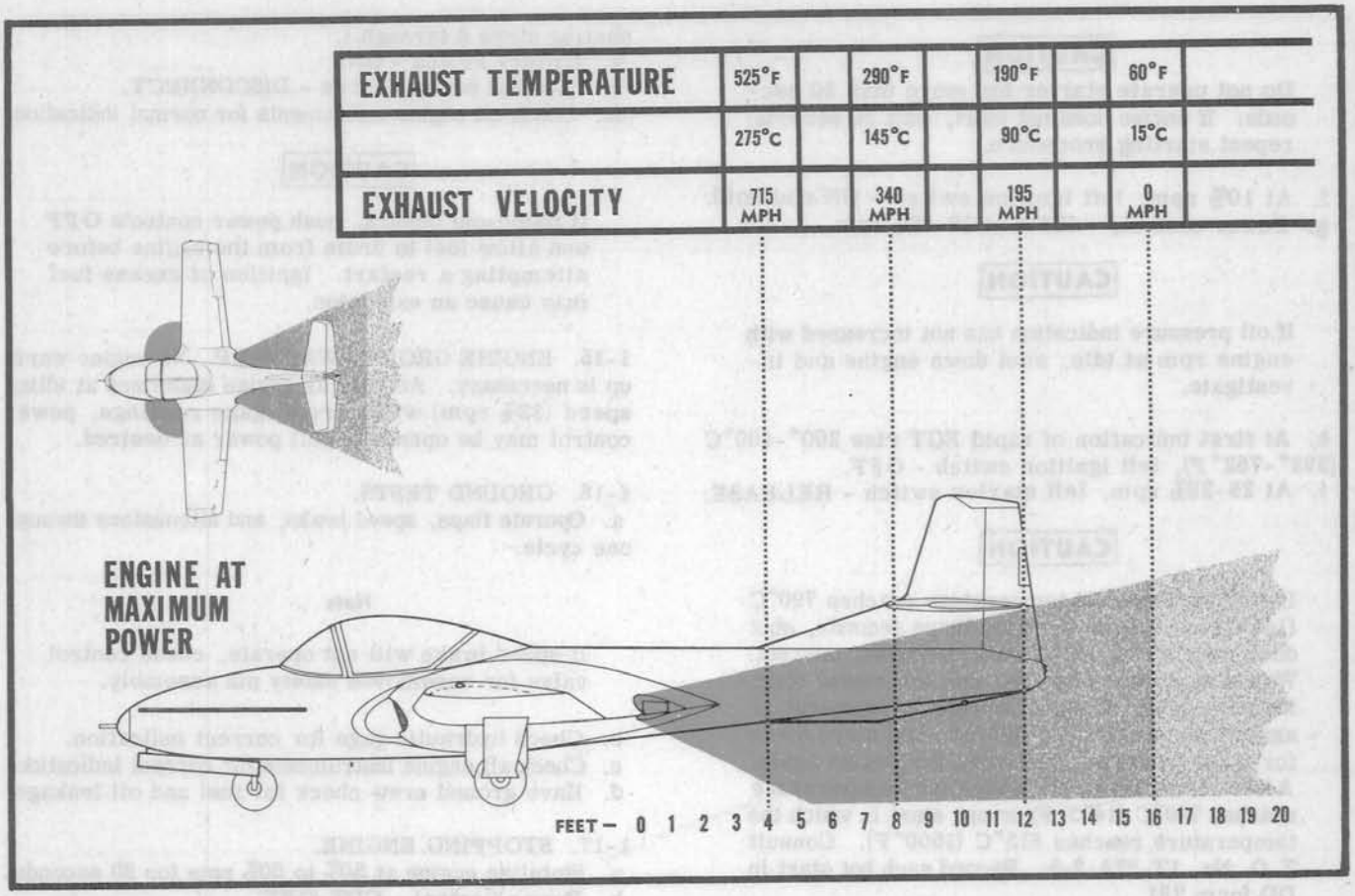


Figure 1-11. Danger Areas

fire, direct CO_2 stream over, not on, engine. if cold CO_2 strikes hot turbine shroud, engine damage may result.

b. Tailpipe fire.
1. External power - connected.
2. Power control - closed.
3. Starter switch - ON.
4. Allow engine to motor until fire is blown out. Keep starter operating time to minimum.

c. Postfire procedure: if highly corrosive dry chemical agent was used, it must be completely removed from airplane as follows:
1. Blow off extinguishing agent with compressed air and wipe clean with cloth.
2. Wash all affected structure with water.
3. If agent has penetrated engine or accessories, affected items must be thoroughly cleaned or removed for overhaul.

1-12. ENGINE GROUND OPERATION.

1-13. PRESTART.

a. Set parking brake and chock wheels.

Note

Face airplane into wind, if possible, since a tailwind may increase the tailpipe temperatures.

b. Move gust lock to stowed position. (See figure 1-2.)

CAUTION

Remove any objects on the ground, around or under the airplane that may be sucked into the engine or dangerously blown about.

WARNING

Check that danger area (figure 1-11.) is clear of personnel, buildings, etc. before starting engines.

1-14. STARTING ENGINES.

Note

Procedure is for left engine and, using right engine controls, is the same for the right engine.

a. Connect external power source.

Note

In case external power is not abailable, use battery. Otherwise, leave battery switch OFF at this time.

b. Power controls - OFF.
c. Fuel boost pump switch - ON.
d. Left fuel shutoff switch - PUSH-ON.
e. Left starter switch - hold at GND

CAUTION

Do not operate starter for more than 20 seconds. If engine does not start, wait 30 seconds; repeat starting procedure.

f. At 10% rpm, left ignition switch - ON and hold.
g. Power controls - IDLE at 10-15% rpm.

CAUTION

If oil pressure indication has not increased with engine rpm at idle, shut down engine and investigate.

h. At first indication of rapid EGT rise 200°-400°C (392°-752°F), left ignition switch - OFF.
i. At 25-28% rpm, left starter switch - RELEASE.

CAUTION

If indicated exhaust temperature reaches 790°C (1453°F) and stays there for three seconds, shut down the engine. If the cause is known, correct. Wait a mimimum of 30 seconds and repeat starting procedure. If indicated exhaust temperature again reaches 790°C (1453°F), and stays there for three seconds, shut down the engine again. After three starts in which the temperature reaches 790°C (1453°F) or one start in which the temperature reaches 815°C (1500°F). Consult T.O. No. 1T-37A-2-5. Record each hot start in DD form 781.

j. Use right engine controls to start right engine, repeating steps d through i.
k. Battery switch - ON.
l. External power source - DISCONNECT.
m. Check all engine instruments for normal indication.

CAUTION

If flame-out occurs, push power controls OFF and allow fuel to drain from the engine before attempting a restart. Ignition of excess fuel may cause an explosion.

1-15. ENGINE GROUND WARM-UP. No engine warm up is necessary. As soon as engine stabilizes at idling speed (33% rpm) with normal gage readings, power control may be opened to full power as desired.

1-16. GROUND TESTS.
a. Operate flaps, speed brake, and attenuators through one cycle.

Note

If speed brake will not operate, check control valve for unremoved safety pin assembly.

b. Check hydraulic gage for correct indication.
c. Check all engine instruments for correct indication.
d. Have ground crew check for fuel and oil leakage.

1-17. STOPPING ENGINE.
a. Stabilize engine at 50% to 60% rpm for 60 seconds.
b. Power Control - CUT-OFF.
c. All switches - OFF.

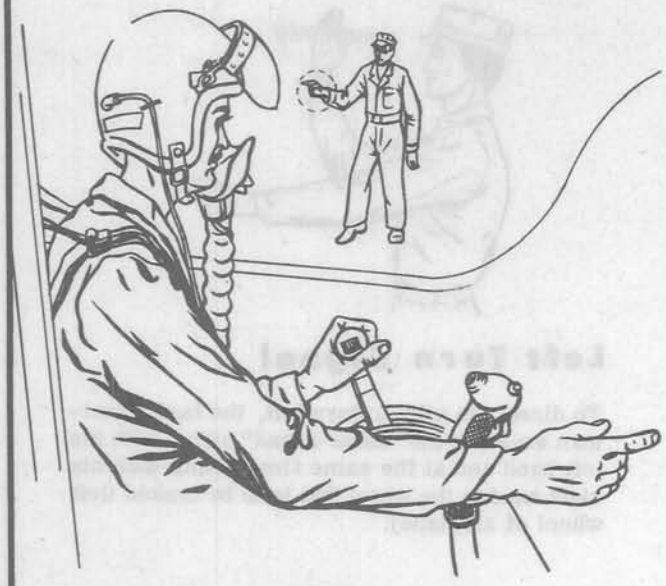
Position Of Signalman

The taxi signalman, when directing movement of the airplane, at all times assumes and maintains a position from which the eyes of the pilot are visible. The position is on a line extending forward from the left wing tip (with an additional man at the right wing tip when required), except when assumption of this position is rendered inadvisable by special conditions of the parking area.

The Flagman, Follow-Me-Jeep, And Taxi Signalman

When required by the volume or nature of traffic, a flagman or "follow-me" jeep is stationed on the landing field at a position far enough from the parking area to be clearly visible to the pilot of an approaching airplane. By use of a distinguishing black and white checked flag, the flagman directs the pilot to the taxi signalman or "follow-me" jeep who leads the pilot along a desired taxi path to the signalman. The signalman indicates that he is ready to assume guidance of the airplane by extending both arms perpendicularly at full lenght above his head, palms facing each other.

Figure 1-12. Ground Handling Hand Signals (Sheet 1 of 4)



Start Engine Signal

Before starting the engine, the pilot ensures that brakes are applied. He then indicates to the taxi signalman verbally, "Ready to start engine". The taxi signalman responds by rotating his hand before him in a clockwise circling motion if all is clear.

Pull Chocks Signal

The pilot ensures that the brakes are on, and then signals for the chock removal by an outward sweeping motion of his fist, with the thumb extended and pointing outward. The taxi signalman acknowledges the signal with a sweep of his fists away from each other at hip level, with the thumbs extended and pointing outward.

Pull-Power-Cart-Plug Signal

Pilot signals for removal of power cart plug by motion of withdrawing two fingers of right hand from cupped left hand.

All-Clear-To-Taxi Signal

The "all-clear-to-taxi" signal is initiated by the pilot to indicate his desire to begin taxiing and is made by touching the tip of the index finger with the tip of the thumb with the remaining fingers extended. The taxi signalman will respond with a similar gesture if all is clear to taxi.

Figure 1-12. Ground Handling Hand Signals (Sheet 2 of 4)

Come Ahead Signal

The taxi signalman directs the pilot to taxi forward by raising both hands before him to eye level, with elbows flexed and palms turned toward face, and executing beckoning motions. The rapidity of the hand motions indicate the speed desired of the airplane.

Right Turn Signal

To direct the pilot to turn right, the taxi signalman executes the "come-ahead" signal with his right hand and at the same time points with his left hand to the wheel that is to be braked (right wheel of airplane).

Stop Signal

To direct the pilot to stop, the taxi signalman raises both hands before him to eye level, elbows flexed and palms turned toward the airplane in a "policeman's stop".

Left Turn Signal

To direct the pilot to turn left, the taxi signalman executes the "come-ahead" signal with his left hand and at the same time points with his right hand to the wheel that is to be braked (left wheel of airplane).

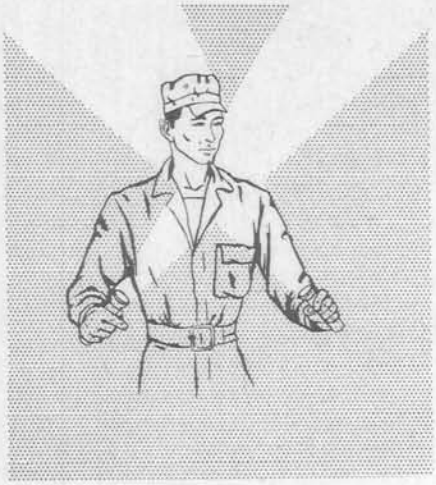
Cut Engine Signal

To direct the pilot to cut the engine, the taxi signalman draws the extended forefinger of one hand across his neck in a "throat-cutting" motion.

Insert Chocks Signal

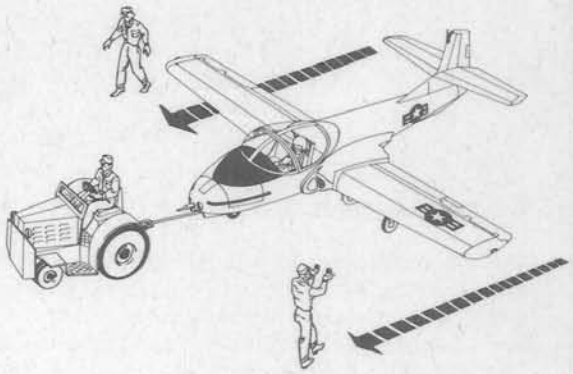
To direct the insertion of chocks, the taxi signalman sweeps his fist together at hip level with thumbs extended and pointing inward.

Figure 1-12. Ground Handling Hand Signals (Sheet 3 of 4)



Night Operations

When field illumination permits, the taxi signalman, during hours of darkness, stations himself in a lighted area and executes the foregoing signals as prescribed. In the absence of a suitably lighted area, the foregoing signals are executed by employing suitable illuminated wands (or flashlights if the wands are not available), one to be held in each hand of the signalman. Signals used when employing wands or flashlights are identical with the foregoing except that the "emergency-stop" signal is made by crossing wands or beams of the flashlight before the face of the signalman. Care must be exercised throughout to avoid flashing light in the eyes of the pilot.



Towing

To direct the towing of an airplane, the taxi signalman assumes the same position as prescribed for directing taxiing, keeping the eyes of the pilot and the driver of the towing vehicle at all times visible. When necessary, an additional crewman is stationed at the right wing tip. This crewman must be visible to the taxi signalman to whom he will direct all necessary signals.

Figure 1-12. Ground Handling Hand Signals (Sheet 4 of 4)

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SECTION II
SERVICING

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2-1. SERVICING OXYGEN SYSTEM.

2-2. FILLING OXYGEN SYSTEM. (See figure 2-1.)

WARNING

Before filling system be sure area around filler valve is clean and free from grease or oil. Fire or explosion may occur when oxygen under pres- comes in contact with grease or oil.

CAUTION

Never fill oxygen system from a storage cylinder without an approved drier and pressure reducing regulator installed on the recharger. Pressure from the recharger must be reduced to the airplane system's normal operating pressure of 425 PSI.

WARNING

Never loosen or disconnect oxygen lines with system pressurized.

a. Open the oxygen filler access door located in the left side of the tailcone.
b. Remove filler valve plug by turning handle one-eighth turn.
c. Turn supply tank regulator handle clockwise until handle turns freely.
d. Open supply tank valves slowly.
e. Turn regulator adjusting screw handle clockwise until delivery pressure gage indicates 150 PSI.
f. Open charging valve on supply hose end to blow out any dirt that may have accumulated in the adapters and close charging valve.
g. Lock adapter into filler valve. Check for security.
h. Open charging valve and allow pressure gage to stabilize; gradually increase pressure until pressure gage in airplane indicates 425 PSI. Then shut off charging valve and remove adapter.
i. Reinstall dust cap on filler and close access door.

Note

As the oxygen cylinders are being filled they will tend to become heated. After filling, cooling of the cylinders will reduce system pressure. This does not necessarily indicate a leak in the system.

2-3. EXHAUSTING OXYGEN SYSTEM.

WARNING

Before exhausting oxygen system carefully check all lines to be sure they are free from any oil, grease, hydraulic fluid or dirt. If necessary, lines should be cleaned with an approved soap without an oil base. When handling oxygen be sure hands and clothing are free from oil or grease. Fire or explosion may occur when a slight trace of grease or oil comes in contact with oxygen under pressure.

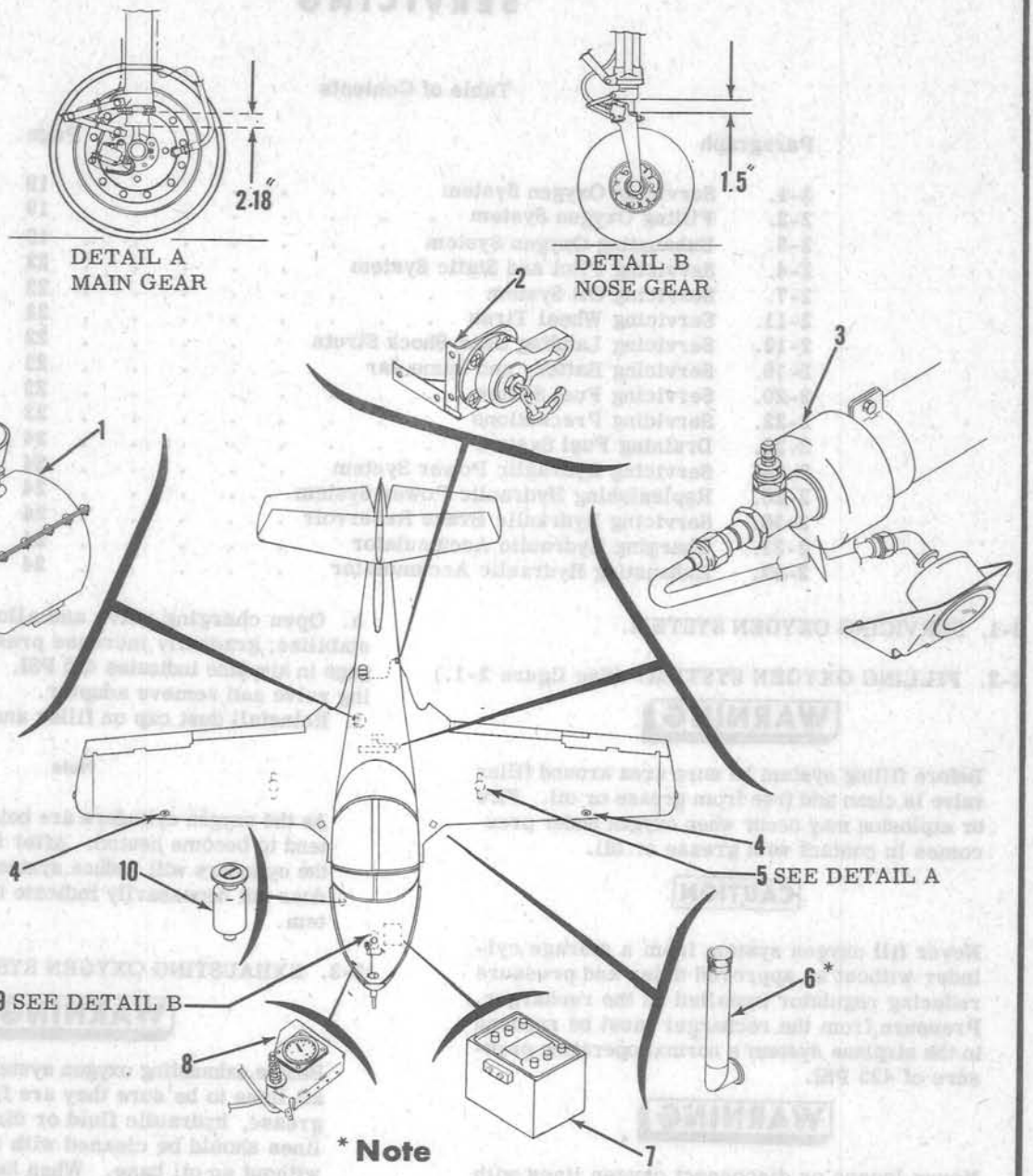
CAUTION

While exhausting oxygen system, be sure airplane is in a well ventilated area with airplane canopy open.

a. Discahrge pressure by turning regulator shut-off valve "ON" and emergency toggle switch "ON" (positioned to either left or right) until zero PSI is indicated on regualtor.

Fill with hydraulic fluid specification Mil-0-5606. Inflate to dimension shown. Inflate tire to 110 psi

Fill with hydraulic fluid specification Mil-0-5606. Inflate to dimension shown. Inflate tire to 25(+0, -2) PSI



1. Hydraulic reservoir
2. Oxygen filler valve
3. Hydraulic accumulator
4. Wing fuel filler
5. Main gear
6. Oil tank
7. Battery
8. Landing gear emergency release system
9. Nose gear
10. Brake reservoir

Figure 2-1. Servicing Diagram (Sheet 1 of 2)

HYDRAULIC FLUID

	Servicing points per airplane	Specification	Total (Gallons)		Usable (Gallons)		Expansion space (Gallons)		Pressure required
			U.S.	IMP.	U.S.	IMP.	U.S.	IMP.	
Hydraulic reservoir	1	MIL-O-5606	1.08	.91	.86	.72	.135	.113	
Main gear shock strut	2	MIL-O-5606	See detail A						
Nose gear shock strut	1	MIL-O-5606	See detail B						
Brake reservoir	1	MIL-O-5606	4.85 cu. in.		3.24 cu. in.		1.61 cu. in.		

FUEL AND OIL

	Servicing points per airplane	Specification	Total (Gallons)		Usable (Gallons)		Expansion space (Gallons)	
			U.S.	IMP.	U.S.	IMP.	U.S.	IMP.
FUEL	2	MIL-L-5642 Grade JP-4	317	263.96	309	257.30	31	25.8
OIL	2 See NOTE sheet 1	MIL-L-7808	4.76	3.98	2.32	1.94	1.26	1.05

AIR

Servicing points per airplane	Servicing points per airplane	Pressure required
Nose gear tire	1	25^{+0}_{-2}PSI
Main gear tire	2	110 psi
Hydraulic accumulator	1	600 ± 5psi
Landing gear emergency release	1	2000±250psi

OXYGEN

OXYGEN (one filler point)
Specification AN-O-1
fill to 425 psi

Figure 2-1. Servicing Diagram (Sheet 2 of 2)

2-4. SERVICING PITOT AND STATIC SYSTEM. (See figure 2-2.)

2-5. CLEANING PITOT AND STATIC LINES.

CAUTION

Be sure to disconnect all lines at the instruments before blowing out lines; otherwise instruments will be damaged.

a. Disconnect all instruments and remove all drain plugs (3), test fitting caps (4), or static ports (5) on line to be cleaned.
b. Cap instrument connection openings.
c. Connect a source of dry high pressure air to the instrument end of the line to be cleaned and blow out toward pitot tube (1) or static ports (5).
d. Replace and reconnect caps (4), plugs (3), static port fittings (5), and instruments at completion of cleaning.

2-6. DRAINING PITOT AND STATIC SYSTEM.
a. Remove drain plug (3) and allow lines to drain.

CAUTION

Be sure to replace drain plug (3) after draining lines. Make sure it fits properly. Turn clockwise as far as it will go with normal torque.

Note

Wipe off moisture or water in area surrounding drain plug (3) after replacing plug.

2-7. SERVICING OIL SYSTEM. (See figure 2-1.)

2-8. GENERAL. An oil tank of 2.5 U. S. gallons capacity is located outboard of the air intake in each left and right nacelle leading edge. Each tank should be filled to capacity immediately after each flight. A bayonet (dip stick) type oil gage is attached to the filler cap. A venting drain is located at the top of each tank and a scupper drain drains spilled oil from the scupper. A drain valve is located on the bottom of the tank.

2-9. FILLING OIL TANK.
a. Remove tank filler cap, located in the scupper. The cap is reached through the oil filler access door in each upper left and right nacelle surface.

CAUTION

After filling tank, check oil level with bayonet type oil gage in filler cap. Be sure to turn locking screw in top of cap clockwise until flush with top of cap. This locks the oil cap in its proper position.

2-10. DRAINING OIL TANK.
a. Open drain valve on bottom of tank, to full open position.

CAUTION

After tank is drained, be sure drain valve is turned to the full closed position and then wipe off excess oil at bottom of tank in area surrounding drain valve.

2-11. SERVICING WHEEL TIRES. (See figure 2-1.)
a. Nose Gear Wheel Tire - Infalte to 25(+0, -2)PSI.
b. Main Gear Wheel Tire - Inflate to 110 PSI.
c. A standard air hose extension is adequate for servicing the landing gear tires.

2-12. SERVICING LANDING GEAR SHOCK STRUTS. (See figure 2-1.)

2-13. DEFLATING LANDING GEAR SHOCK STRUTS.

WARNING

Release air in strut before removing air valve or serious injury may result.

a. Remove valve cap.
b. Check 5/8 inch swivel nut for tightness. Turn clockwise with wrench.
c. Check air pressure by depressing valve core with Schrader Tool No. 3263.

CAUTION

Do not use match stick type tool. If no air pressure is present, remove core from stem with Schrader Tool No. 3263.

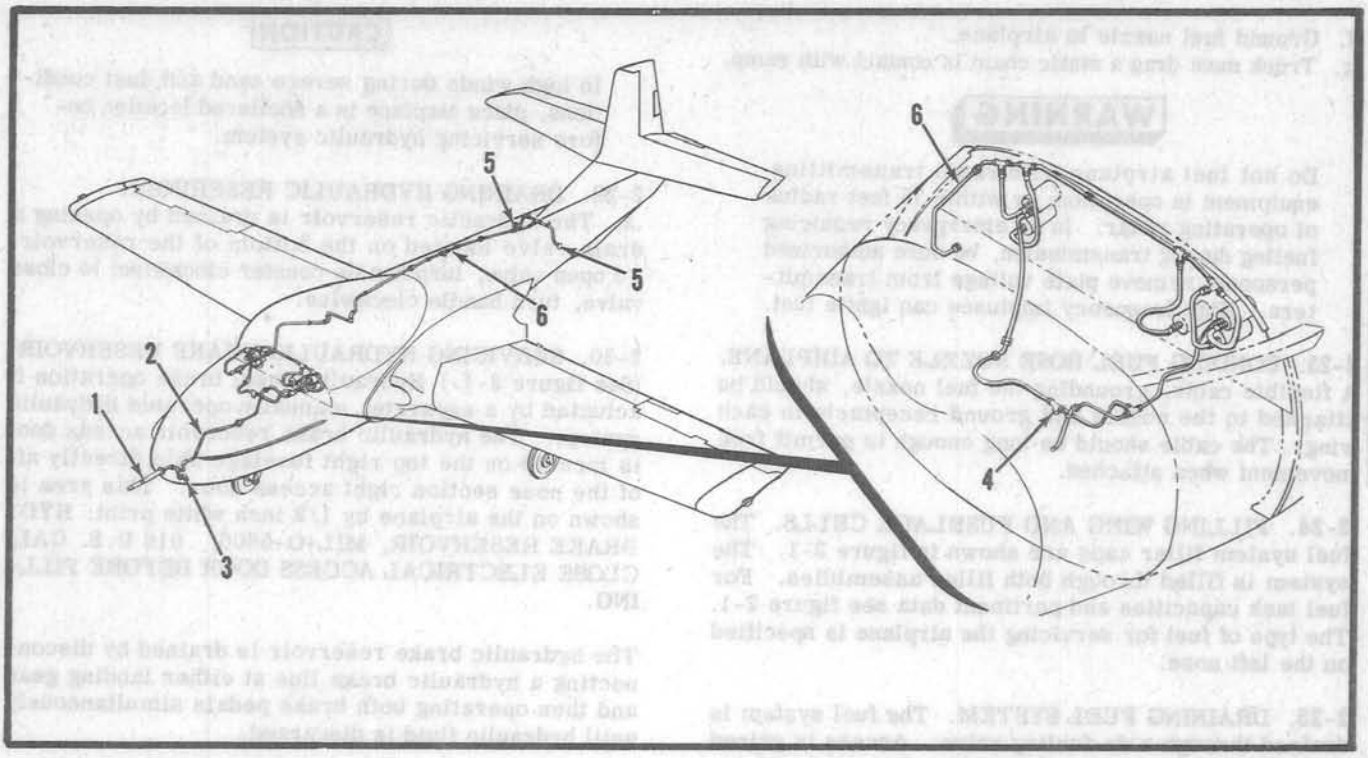
d. Loosen 5/8 inch hex swivel nut to a maximum of 1-1/2 counter clockwise turns and allow air to exhaust itself.

2-14. CHECKING FLUID LEVEL OF LANDING GEAR SHOCK STRUTS.
a. Remove air valve assembly by turning 3/4 inch hex nut counter clockwise.
b. Fill strut with hydraulic fluid specification MIL-O-5606 (red color) to level of filler hole with strut in fully compressed position and airplane in normal ground attitude.
c. Replace complete air valve assembly and tighten 3/4 inch hex nut to 100-110 inch pounds and the 5/8 inch hex nut to 50-70 inch pounds.
d. Lock wire valve assembly, using holes provided in 3/4 inch hex nut.

2-15. INFLATING LANDING GEAR SHOCK STRUT. (See figure 2-1.)
a. Remove valve cap.
b. Attach air filling chuck to valve core housing.
c. Loosen 5/8 inch hex nut to a maximum of 1-1/2 counterclockwise turns.
d. Roll ariplane forward for a few feet.
e. Inflate the struts untill the following dimensions are reached.

1. Nose gear shock strut distance between the outer cylinder and the upper surface of nose forks is 1.50 inches.
2. Main gear strut distance between the outer cylinder add flange is 2.18 inches.

f. Tighten 5/8 inch hex swivel nut to 50-70 inch pounds.
g. Remove air filling chuck.



1. Pitot tube
2. Pitot line
3. Drain plug
4. Test fitting cap
5. Static port
6. Static line

Figure 2-2. Servicing Pitot and Static System

h. Check for leaks.
i. Replace and tighten air valve cap to extreme finger tightness.

2-16. SERVICING BATTERY AND SUMP JAR.

2-17. GENERAL. The shielded storage battery (24 volt, 36 ampere-hour, die cast metal) is located in the left side of the fuselage nose section. It is reached through the nose access door and operates the electrical system when the generator system is not in operation, and when no external power source is available. A grounded, metal covered housing completely shields the battery and its terminal connections and prevents radio interference. Air is ducted through the battery to carry off fumes and excess acid. The fumes and liquid are carried through an overflow tube to the battery jar which is located below the battery.

2-18. SERVICING BATTERY. The battery is serviced only with distilled water or battery electrolyte. If the electrolyte level can be seen and specific gravity readings can be taken with a hydrometer, add no water. When adding water, do not fill higher than 3/8 inch above the baffle plate as too much water will cause the electrolyte to leak out the vents when the airplane is in flight.

CAUTION

Do not over-fill battery as this will cause boiling and excessive corrosion of the battery.

2-19. SERVICING BATTERY SUMP JAR. The two felt pads in the bottom of the battery jar must be kept moist. Saturate pads with a solution of one tablespoon sodium bicarbonate and one cup of water to provide a prolonged moist condition. Resaturate pads if they become dry.

2-20. SERVICING FUEL SYSTEM.

2-21. GENERAL. The fuel system uses thirteen interconnected bladder type fuel cells to provide single fuel cell operation. Gravity flow of fuel from twelve wing cells (six in each wing) releases fuel to the fuselage fuel cell from where a fuel boost pump supplies fuel to both engines. The fuselage cell is installed between the fuselage front and rear spars and inboard and outboard cells are attached in the leading edge of each wing. The remaining four wing cells are located between the front and rear wing spars and outboard of each main landing gear assembly.

2-22. SERVICING PRECAUTIONS. The following precautions must be observed when the fuel system is being serviced.
a. Service fuel system in the open air.
b. NO SMOKING within 50 feet of airplane or fuel truck.
c. Fuel truck must drag a static chain in contact with ramp.
d. SWITCH OFF all electrical power on the airplane. The electrical systems switches won't kill you, but a spark from any source during fueling will. Be sure all electrical switches are OFF and all external power sources are disconnected from the airplane when fuel cells and oil tanks are being serviced. If you are on the airplane, don't depend on the man servicing the fuel cells - look for yourself.
e. Ground fuel truck to airplane.

f. Ground fuel nozzle to airplane.
g. Truck must drag a static chain in contact with ramp.

WARNING

Do not fuel airplane with radio transmitting equipment in operation; or within 75 feet radius of operating radar. In an emergency requiring fueling during transmission, be sure authorized personnel remove plate voltage from transmitters. High frequency impluses can ignite fuel.

2-23. BONDING FUEL HOSE NOZZLE TO AIRPLANE. A flexible cable, grounding the fuel nozzle, should be attached to the nozzle and ground receptacle in each wing. The cable should be long enough to permit free movement when attached.

2-24. FILLING WING AND FUSELAGE CELLS. The fuel system filler caps are shown in figure 2-1. The system is filled through both filler assemblies. For fuel tank capacities and pertinent data see figure 2-1. The type of fuel for servicing the airplane is specified on the left nose.

2-25. DRAINING FUEL SYSTEM. The fuel system is drained through a de-fueling valve. Access is gained through the de-fueling valve access door which is located on the center tunnel door 6. The de-fueling valve has two positions: (1) drain and (2) bleed. Turn valve clockwise to drain; turn counter clockwise to bleed.

2-26. SERVICING HYDRAULIC POWER SYSTEM. (See figure 2-1.)

2-27. GENERAL. The hydraulic system fluid supply is contained in a hydraulic reservoir. The system is pressurized by two engine-driven pumps to actuate the landing gear, intake screens, flaps, thrust attenuators, speed brake, spoilers and nose gear power steering. The hydraulic reservoir is filled through an access door located in the top rear fuselage about three feet aft of the rear edge of the canopy. This area is shown on the airplane by 1/2 inch black print: HYD RESERVOIR FILLER. A mesh wire screen, mounted inside the reservoir below the filler cap, filters hydraulic fluid as the reservoir is being filled. A vent line provides an air filter and ventilation for the reservoir and leads overboard. An overflow line from the scupper to the drain line discharges excessive fluid overboard. A plexiglass sight gage on the top of the reservoir provides a visual check of the fluid level The hydraulic accumulator is mounted above the fuel cell forward of the fuselage rear spar bulkhead. The accumulator is charged to 600 ±5 PSI air pressure.

2-28. REPLENISHING HYDRAULIC POWER SYSTEM. The hydraulic reservoir filler is located on the left side of the fuselage aft of the canopy parting line and is identified by the words HYD RESERVOIR FILLER. Use only hydraulic fluid specification MIL-O-5606.

Note

Landing gear should be down, flaps, thrust attenuator and speed brake closed before servicing the hydraulic reservoir.

CAUTION

In high winds during severe sand and dust conditions, place airplane in a sheltered location before servicing hydraulic system.

2-29. DRAINING HYDRAULIC RESERVOIR.
a. The hydraulic reservoir is drained by opening a drain valve located on the bottom of the reservoir. To open valve, turn hnadle counter clockwise; to close valve, turn handle clockwise.

2-30. SERVICING HYDRAULIC BRAKE RESERVOIR. (See figure 2-1.) Hydraulic wheel brake operation is actuated by a separate, manually operated hydraulic system. The hydraulic brake reservoir access door is located on the top right fuselage skin directly aft of the nose section right access door. This area is shown on the airplane by 1/2 inch white print: HYD. BRAKE RESERVOIR, MIL-O-5606, .016 U.S. GAL. CLOSE ELECTRICAL ACCESS DOOR BEFORE FILLING.

The hydraulic brake reservoir is drained by disconnecting a hydraulic brake line at either landing gear and then operating both brake pedals simultaneously until hydraulic fluid is discarged.

CAUTION

During draining of the brake reservoir do not allow low hydraulic fluid to drain on wheel or brake.

CAUTION

After draining hydraulic fluid be sure and cap all openings to prevent foreign matter from entering system.

2-31. CHARGING HYDRAULIC ACCUMULATOR.
a. Make sure hydraulic system is replenished with hydraulic fluid specification MIL-O-5606.
b. Remove valve cap and attach air filling chuck to valve core housing.
c. Loosen 5/8 hex nut a maximum of one and one-half turns.
d. Inflate accumulator until accumulator gage indicates 600 ±5 PSI.
e. Tighten 5/8 hex nut to 50-70 inch pounds torque, and remove air filling chuck. Replace valve cap and tighten to extreme finger tightness.

2-32. EXHAUSTING HYDRAULIC ACCUMULATOR.
a. Discharge hydraulic pressure by operating flaps or speed brake until hydraulic pressure gage reads zero.
b. Remove valve cap and depress valve core until accumulator pressure gage reads zero.

CAUTION

Do not use match stick type tool. If no air pressure is present remove core from stem.

c. Loosen 5/8 inch hex swivel nut to a maximum of 1-1/2 counter-clockwise turns and allow air to exhaust itself.

SECTION III
LUBRICATION

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3-1. LUBRICATION. Lubrication of the airplane has been set up to be accomplished at regularly scheduled inspection periods. The lubrication diagram gives the type of lubricant, method and interval of application and indicates parts to be lubircated other than those lubricated by each engine oil system.

SPECIAL SERVICE NOTES

FITTINGS - Clean all fittings before lubricating. Lubricate through fittings until new grease appears at the part being lubricated.

PIANO TYPE HINGES - Lubricate all piano type hinges with oil general purpose Specification No. MIL-L-7870 every 100 hours. Wipe off excess oil.

FLEXIBLE RADIO CONTROL CABLES - Lubricate Radio Control Cables on Assembly with grease-low-temperature Specification No. MIL-G-3278.

OILITE BEARINGS - Lubricate all oilite bearings with oil general purpose, Specification No. MIL-O-7870 on assembly.

CONTROL SYSTEM BEARINGS - Lubricate all control pulley bearings with grease low temperature on assembly.

ENGINE OIL RESERVOIR - Check oil immediately after each flight and add oil if necessary.

Lubrication points marked * must be lubricated on opposite side of aircraft.

WARNING

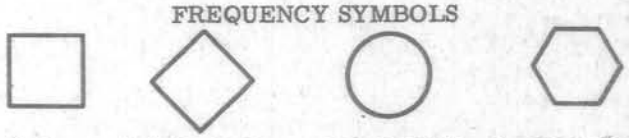
Do not use oil or grease on any part of the oxygen system as an explosion or fire may result when oil or grease comes in contact with oxygen.

Note 1: Heat oil to 60°C (140°F) and submerge bearing in oil for a period of 15 minutes. Wipe off excess oil.

TABLE OF LUBRICANTS

Identification Letter	Basic Specification	Type of Lubricant
GSG	MIL-G-7118	Grease-Aircraft Gear and Actuator Screw
OGP	MIL-L-7870	Oil-General Purpose
OHA	MIL-O-5606	OIL-Hydraulic Aircraft Petroleum Base
CSP	MIL-C-5544	Compound Anti Seize Graphite Petroleum
	MIL-L-7808	Lubricating Oil, Gas Turbine, Aircratf
GLT	MIL-G-3278	Grease-Low Temperature
GH	MIL-L-3545	Grease-High-Temperature

FREQUENCY SYMBOLS

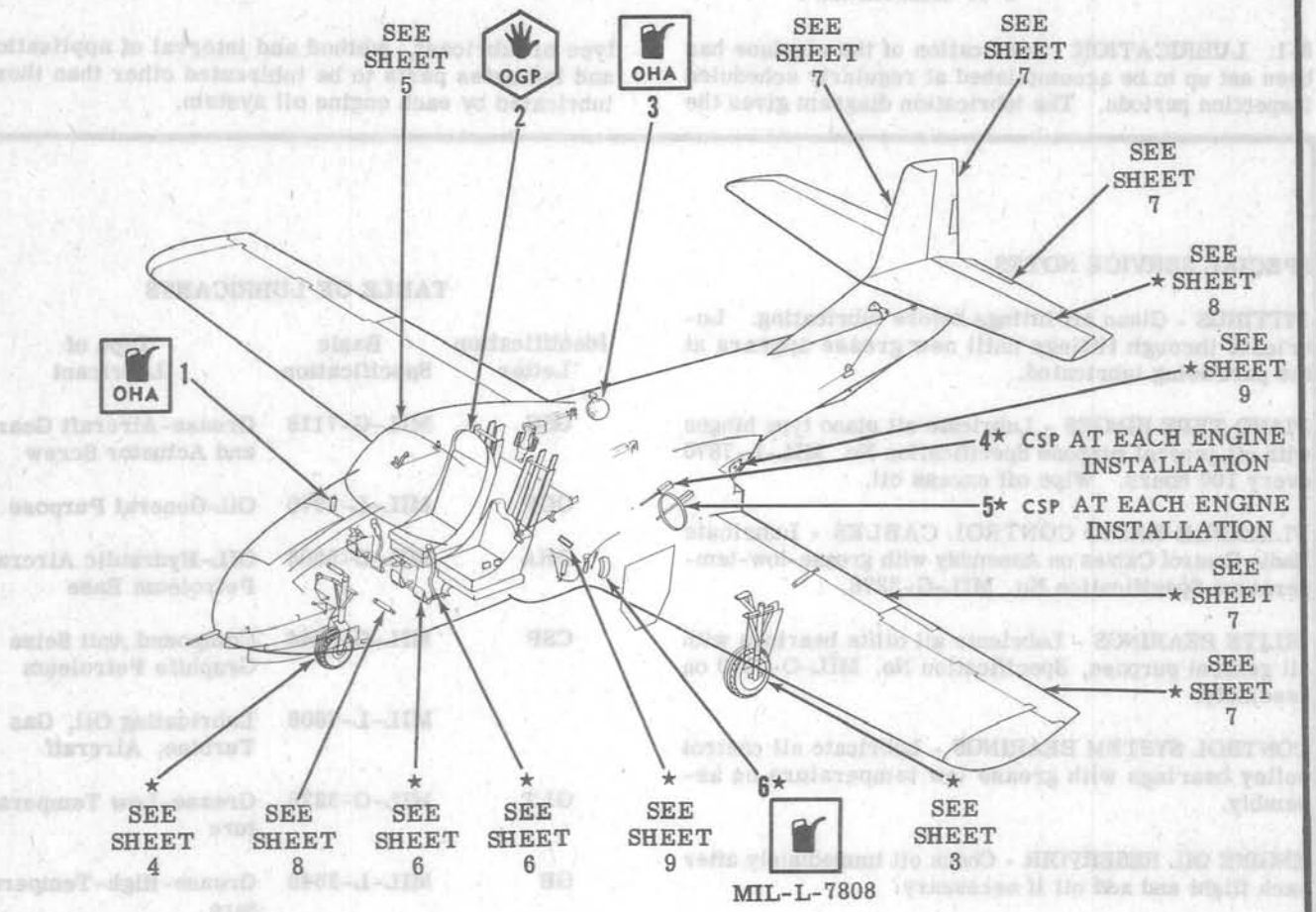


Daily 1st Periodic 2nd Perodic On assembly

APPLICATION SYMBOLS

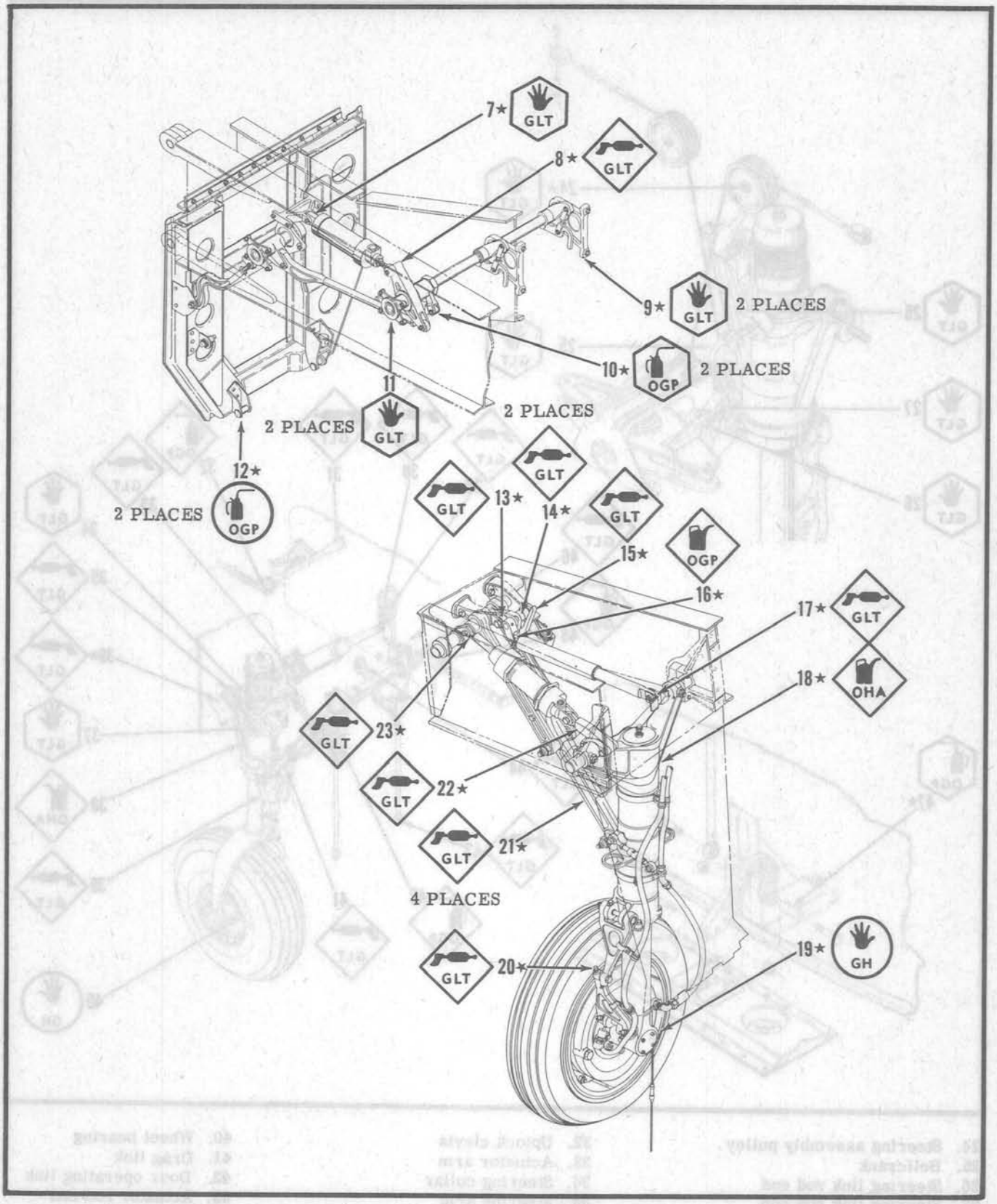
Oil Can Zerk Filler Can Hand

Figure 3-1. Lubrication Diagram (Sheet 1 of 5)



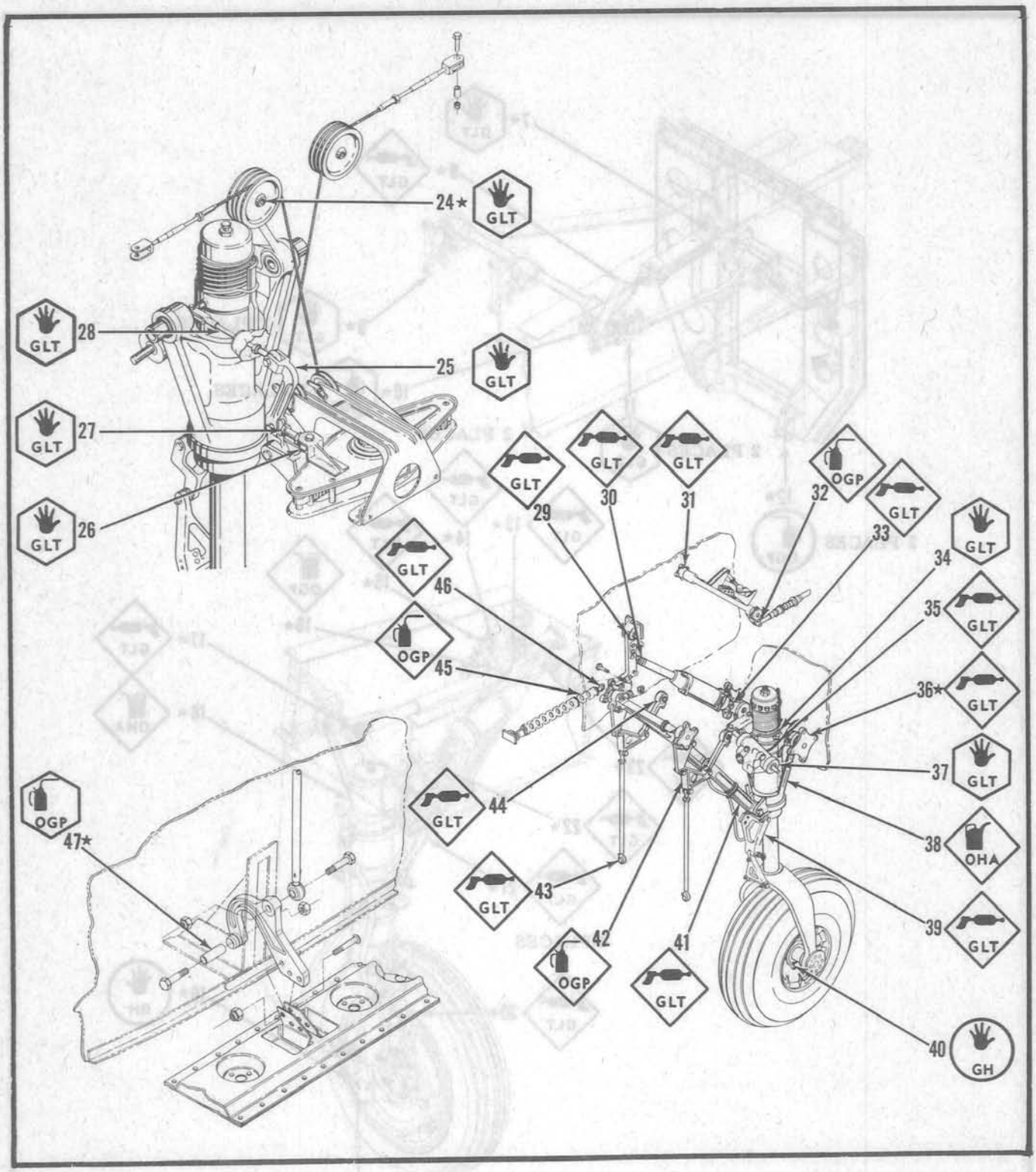
1. Brake reservoir
2. Ejection seat rollers
3. Hydraulic reservoir
4. Engine rear mount rollers
5. Tailpipe clamp
6. Oil reservoir
7. Cylinder assembly fixed end
8. Cylinder assembly rod end
9. Torque tube support fitting
10. Uplock bungee
11. Torque tube end fitting
12. Uplock roller

Figure 3-1. Lubrication Diagram (Sheet 2 of 9)



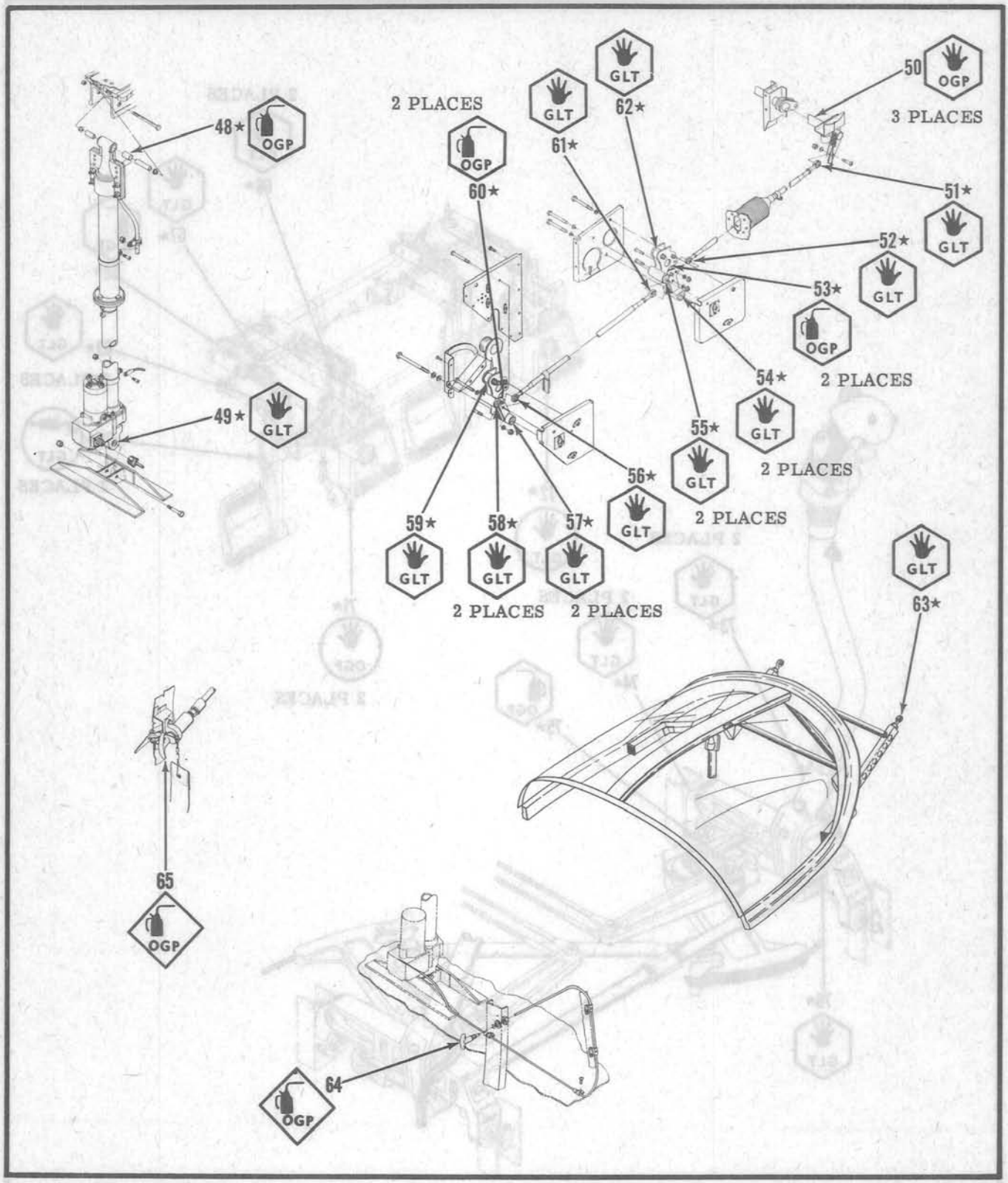
13. Downlock link
14. Downlock arm
15. Downlock assembly
16. Downlock bungee end
17. Downlock bungee rod end
18. Shock strut
19. Wheel bearing
20. Torque links
21. Side strut
22. Actuator arm
23. Cylinder rod end

Figure 3-1. Lubrication Diagram (Sheet 3 of 9)



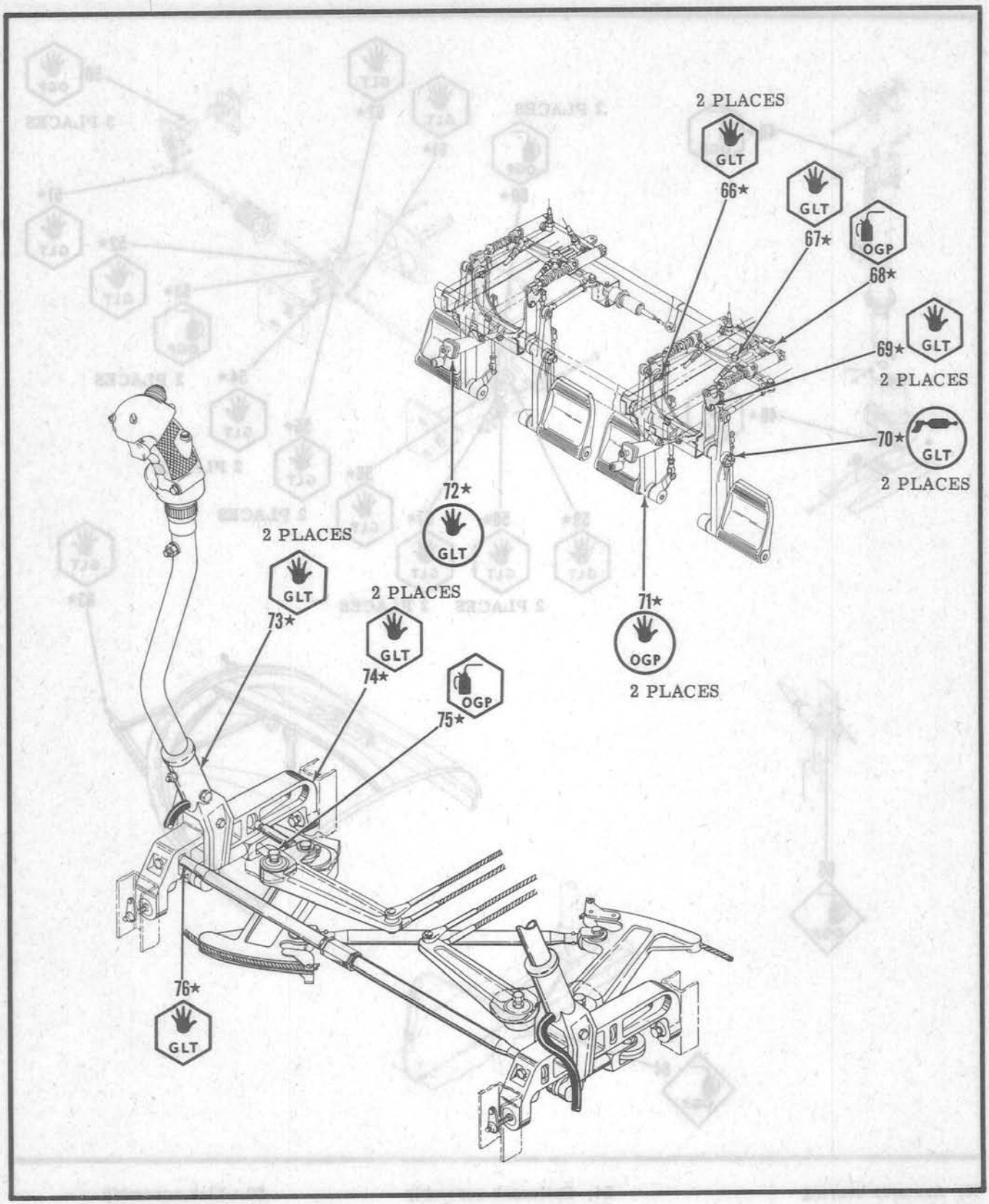
24. Steering assembly pulley
25. Bellcrank
26. Steering link rod end
27. Steering link rod end
28. Rod assembly
29. Downlock
30. Cylinder rod end
31. Uplock
32. Uplock clevis
33. Actuator arm
34. Steering collar
35. Steering arm
36. Retracting axis
37. Steering dampener
38. Shock strut
39. Torque links
40. Wheel bearing
41. Drag link
42. Door operating link
43. Actuator rod end
44. Pivot arm
45. Downlock bungee
46. Bungee rod end
47. Nose gear door hinges

Figure 3-1. Lubrication Diagram (Sheet 4 of 9)



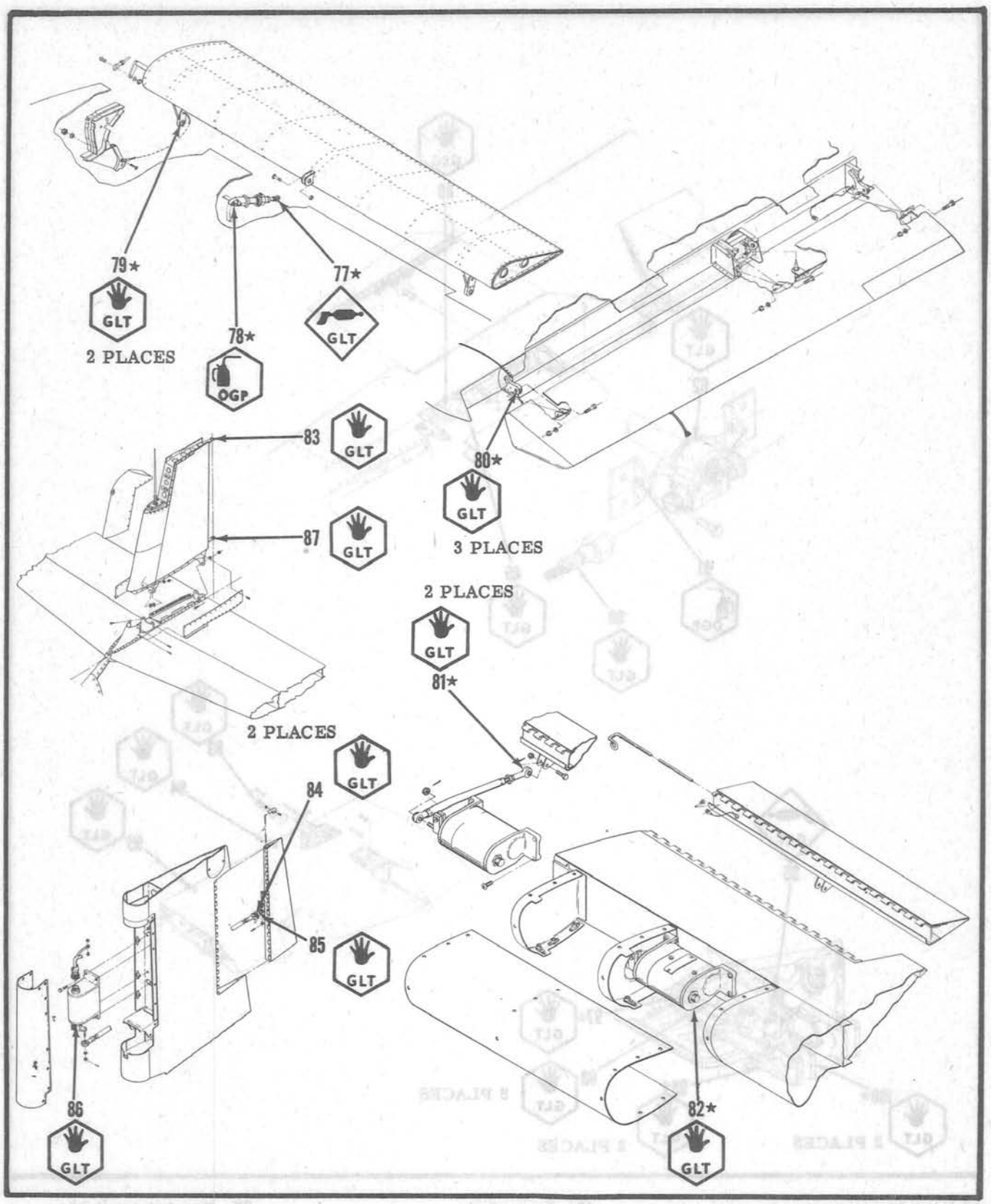
48. Actuator bearing
49. Needle bearing
50. Torque tube
51. Linkage assembly
52. Linkage assembly
53. Link assembly
54. Bellcrank assembly
55. Latch assembly
56. Linkage assembly
57. Bellcrank assembly
58. Latch assembly
59. Latch assembly
60. Link assembly
61. Linkage assembly
62. Latch assembly
63. Canopy hinge rod end
64. Manual declutch control
65. External initiator handle

Figure 3-1. Lubrication Diagram (Sheet 5 of 9)



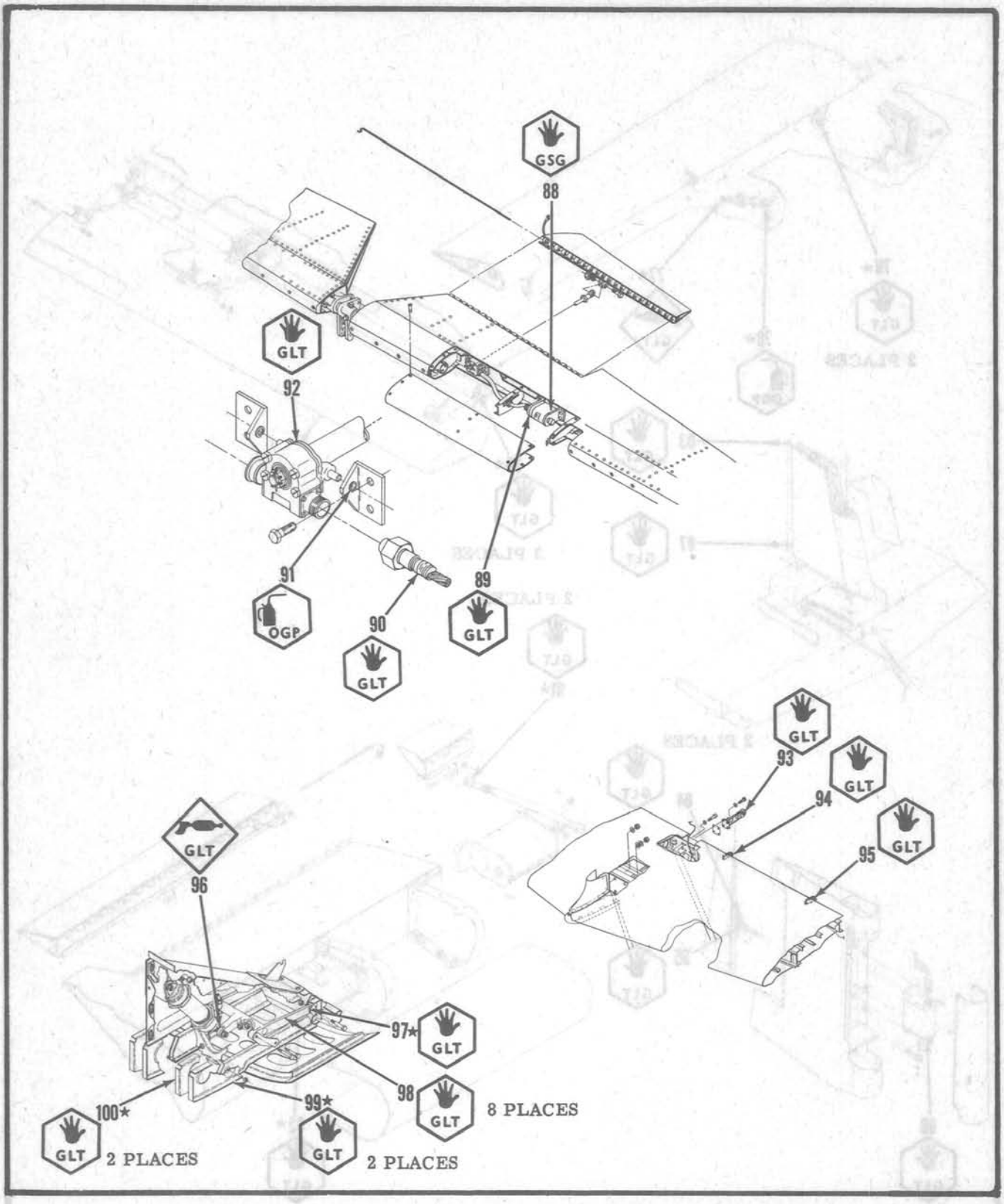
66. Bellcrank assembly
67. Bellcrank assembly
68. Bellcrank assembly
69. Hanger assembly
70. Arm assembly
71. Arm assembly
72. Screw jack
73. Control stick
74. Yoke assembly
75. Aileron bellcrank
76. Push rod

Figure 3-1. Lubrication Diagram (Sheet 6 of 9)



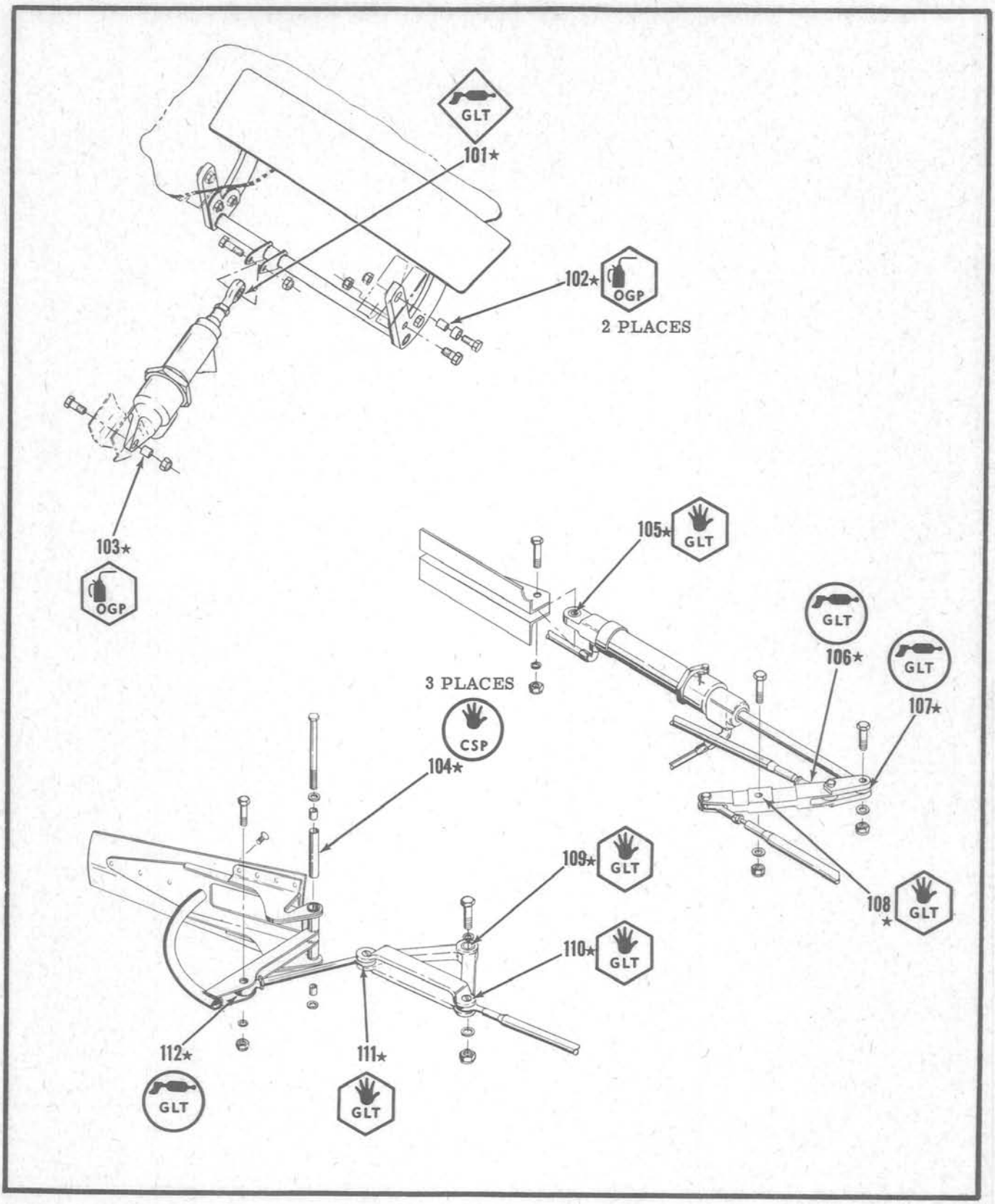
77. Actuator rod end
78. Flap actuator
79. Bearings
80. Aileron hinges
81. Actuator rod end
82. Trim tab actuator
83. Upper hinge
84. Tab actautor rod end
85. Bracket assembly
86. Tab actuator
87. Lower hinge

Figure 3-1. Lubrication Diagram (Sheet 7 of 9)



88. Actuator gears
89. Actuator bearing
90. Flex shaft
91. Screw jack support
92. Screw jack
93. Bracket assembly
94. Plate assembly
95. Plate assembly
96. Cylinder rod end
97. Bracket assembly
98. Actuating assembly
99. Outboard hinge support
100. Inboard hinge support

Figure 3-1. Lubrication Diagram (Sheet 8 of 9)



101. Cylinder rod end
102. Hinge
103. Cylinder fixed end
104. Hinge
105. Cylinder fixed end
106. Linkage assembly
107. Cylinder rod end
108. Bellcrank assembly
109. Bellcrank assembly
110. Linkage assembly
111. Drag link rod end
112. Drag link rod end

Figure 3-1. Lubrication Diagram (Sheet 9 of 9)

SECTION IV

AIRFRAME GROUP MAINTENANCE

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4-1. FUSELAGE.

4-2. GENERAL DESCRIPTION. The fuselage is a semi-monocoque structure built principally of aluminum alloy with certain structures built of stell sheet and steel forgings. While built as a single structural unit, the fuselage is considered to be divided into a nose section, center section, and aft section. Behind plastic windows in the metal nose cap are mounted the passing light and the taxi light. The rest of the nose compartment contains the shelves and brackets for mounting electronic equipment, the battery, inverters, other electrical equipment and the oxygen bottles. The pitot tube protrudes through the nose cap. A wheel well in the center of the nose compartment houses the nose gear. The center section comprises the two engine nacelles, the fuselage fuel cell area and the cockpit. The engine nacelles are streamlined housings containing the necessary openings and provisions for installing and servicing the two jet engines. The fuselage fuel cell lies between the front and rear spar carry through structures to which the wings attach. The cockpit contains the instrument panel, controls, and ejection seats and is covered by a jettisonable canopy. The aft section mounts the empennage and houses the empennage control cables and electrical leads. The fuselage has been generously provided with access doors and panels to facilitate maintenance of the airplane without the necessity of disassembling the structure.

4-3. WINDSHIELD.

4-4. GENERAL. The windshield is a transparent acrylic plastic panel divided into symmetrical halves by a vertical divider in the supporting structure. The panel halves are reinforced at the edges by acrylic impregnated orlon cloth strips and magnesium rods. The panels are held in place by retaining strips secured by flush head screws and sealed with Minnesota Mining Co. EC801 with non-crazing accelerator, sealer. The supporting structure of aluminum alloy is jig located on the fuselage and permanently bolted in place.

4-5. REMOVAL OF WINDSHIELD. (See figure 4-1.)

a. Remove screws (7) and retaining strips (6), (14) and (20).

b. Remove top spacers (4), (9) and (17).

c. Gently press the panel halves (1) and (12) out of their seats.

CAUTION

Handle the windshield panels with care to avoid scratching or maring the transparent surface.

4-6. INSTALLATION OF WINDSHIELD. (See figure 4-1.)

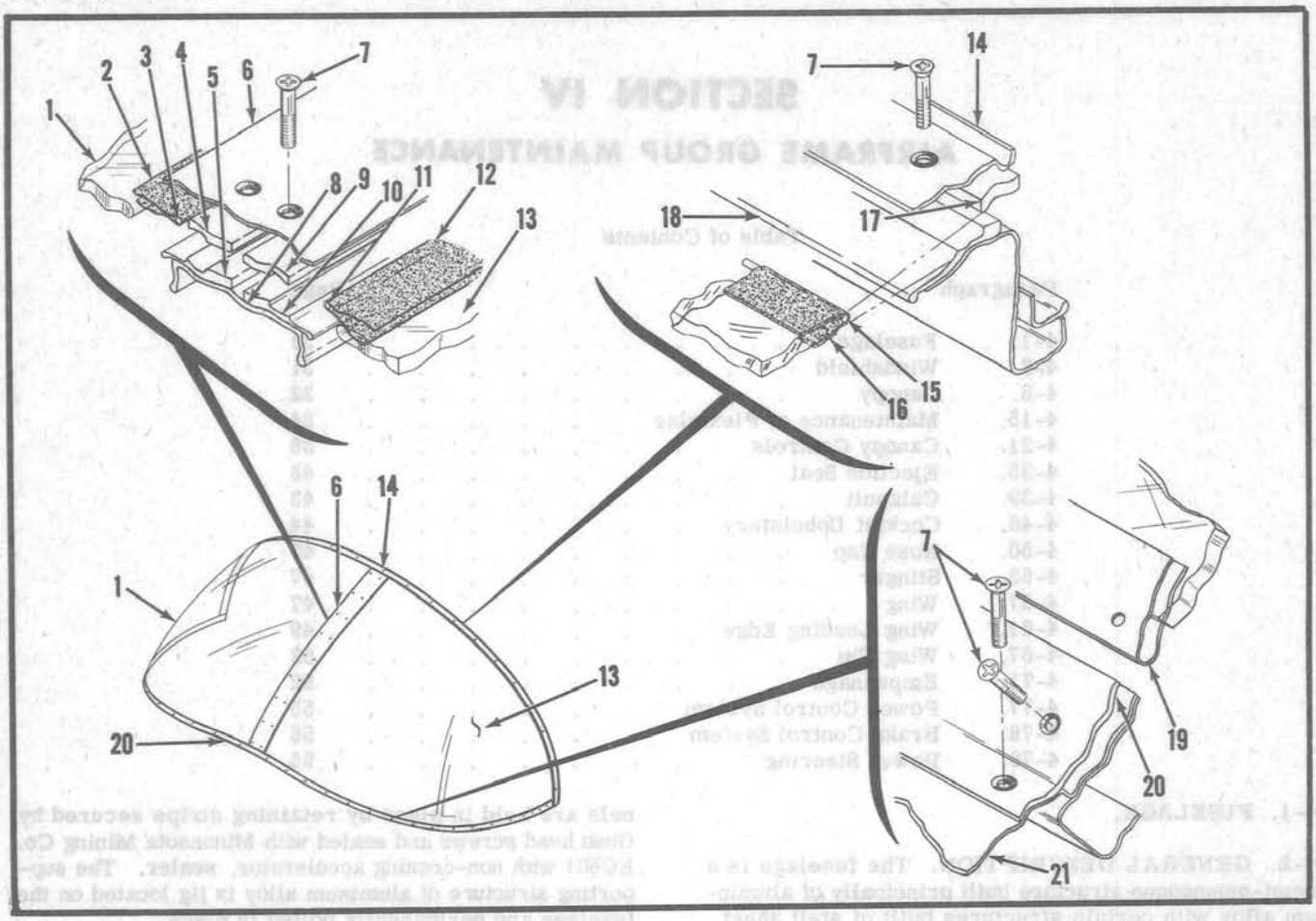
a. Clean all traces of old sealant from the windshield.

b. Apply a new bead of sealant, Minnesota Mining Co. EC801 with non-crazing accelerator, along the outer edge of the frame, spars, and retainer strips.

CAUTION

Directions with EC801 sealant state, EC1240 sealant accelerator should be used. However, EC1240 accelerator is a general purpose accelerator which will craze plexiglas and must not be used. EC1216 accelerator is non-crazing and should be used with EC801 sealant on all plexiglas.

c. Press the plexiglas panel halves, (1) and (13), into position.



1. Right plexiglas panel
2. Orlong edge, right side
3. Magnesium rod, right side
4. Right upper spacer
5. Right bottom spacer
6. Center retainer
7. Retaining screw
8. Center channel
9. Left upper spacer
10. Left bottom spacer
11. Magnesium rod, left side
12. Orlong edge, left side
13. Left plexiglas panel
14. Top retainer
15. Magnesium rod, top
16. Orlong edge, top
17. Top upper spacer
18. Bottom upper spacer
19. Mounting clip
20. Bottom retainer
21. Fuselage

Figure 4-1. Windshield Installation

d. Install top spacers (4), (9) and (17).
e. Install retainer strips (6), (14) and (20) with screws (7).

Note

The orlon reinforcing edges contain magnesium rods (3), (11) and (15) along the top and inner edges of the panels. This rod provides a beaded section which meshes with the corresponding grooves in the top and bottom spacers. This provides continuous support along the top and inner edge of the panels.

4-7. MAINTENANCE OF WINDSHIELD. Refer to paragraph 4-15 for general maintenance of windshield plexiglas.

4-8. CANOPY.

4-9. GENERAL DESCRIPTION. The canopy consists of two, formed, transparent, acrylic plastic panels mounted in an aluminum alloy frame. A steel arm assembly attaches the canopy to the airplane and provides the hinging action necessary for opening and closing. A canopy not-locked warning light is provided to indicate an insecurely locked canopy. Controls are provided to open and close the canopy electrically or manually and to jettison it in an emergency.

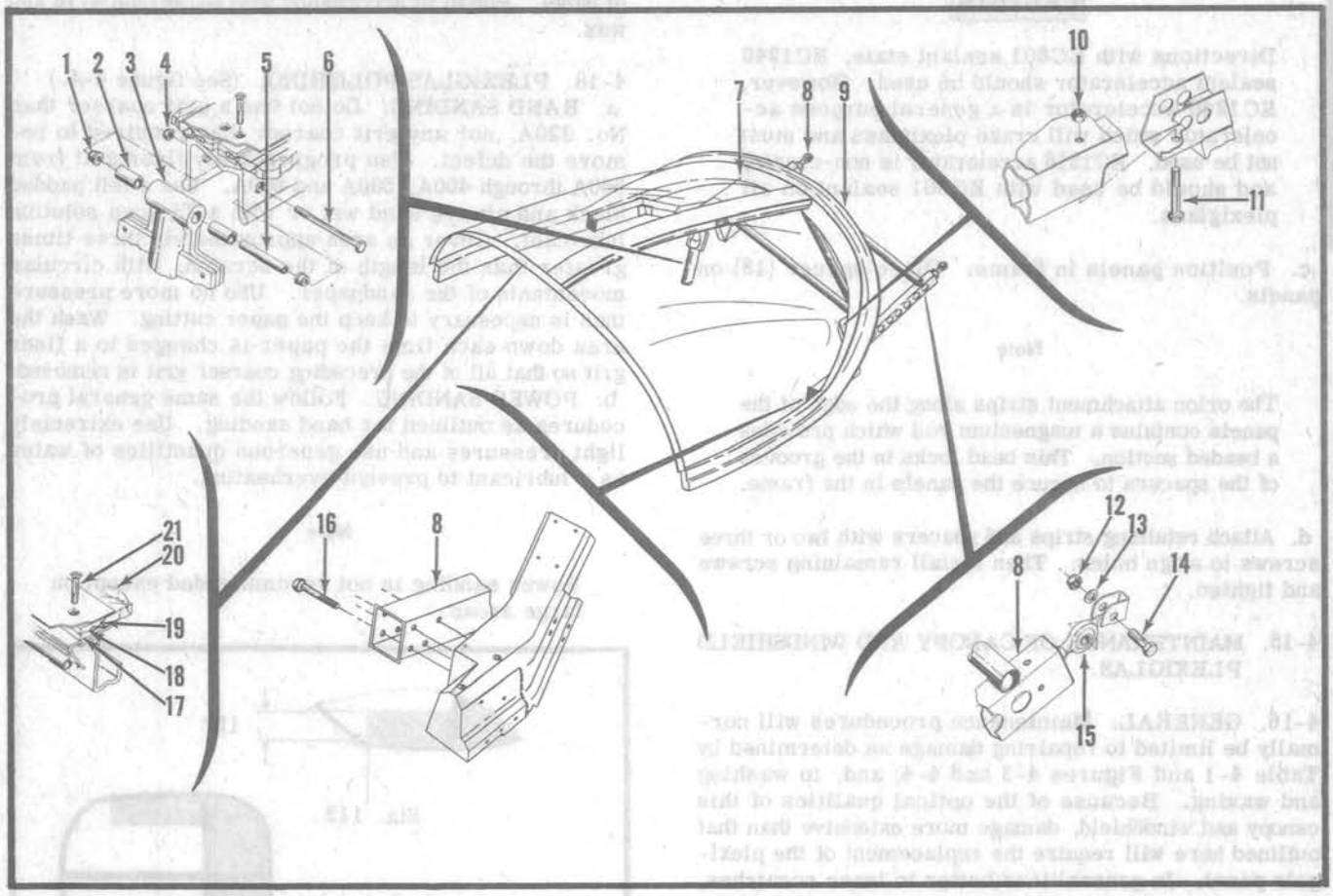
4-10. OPERATION OF CANOPY. The canopy is operated by an electro-mechanical linear actuator which is controlled by switches located inside and outside of the cockpit. Provisions are made to permit manual operation of the canopy in the event of power failures and to jettison the canopy in cases of emergency.

4-11. REMOVAL OF CANOPY. (See figure 4-2.)

WARNING

Install safety pins in seat leg guard handgrips to prevent accidential firing of the canopy remover during maintenance operations in cockpit.

a. Remove nut (4), bushing (1), bearings (2), bushings (5) and bolt (6) attaching canopy actuator to center channel on canopy.
b. Disconnect antenna lead at junction base of the two antennas.
c. Remove screws holding two antenna lead clamps to canopy top channel.
d. Remove nut (10), bolt (11) and washer, attaching



1. Bushing
2. Bearing
3. Remover
4. Nut
5. Bushing
6. Bolt
7. Antenna
8. Hinge arms
9. Canopy
10. Nut
11. Bolt
12. Nut
13. Washer
14. Bolt
15. Rod end
16. Bolt
17. Spacer
18. Top spacer
19. Retainer
20. Plexiglas
21. Screw

Figure 4-2. Canopy Installation

canopy to hinge arms.
e. Lift canopy from airplane.

Note

The canopy hinge arms may now be removed by disconnecting the thruster from the canopy arms, and removing the nuts, washers, and bolts attaching it to the fuselage structure.

4-12. INSTALLATION OF CANOPY. (See figure 4-2.)

CAUTION

Avoid scarring or scratching the plexiglas parts, as such damage is difficult to repair.

a. Position canopy in place over cockpit.
b. Attach canopy to hinge arms with bolt (11), washer and nut (10). Torque to 50-70 inch-pounds.
c. Attach canopy actuator to canopy top channel with bearings (2), bushing (5), bushings (1), bolt (6) and secure with nut (4). Torque to 50-70 inch-pounds.
d. Attach antenna lead clamps to canopy top channel and connect lead to antenna base.

4-13. REMOVAL OF CANOPY PLEXIGLAS. (See figure 4-2.)
a. Detach antenna from canopy.
b. Remove screws (20) and retaining strips (18) from canopy.
c. Remove top spacer (17).
d. Press plexiglas panels from canopy frame.

4-14. INSTALLATION OF CANOPY PLEXIGLAS. (See figure 4-2.)

a. Remove all traces of sealer from canopy frame.
b. Apply new sealer, Minnesota Mining Co. EC801 with non-crazing accelerator to spacers.

CAUTION

Directions with EC801 sealant state, EC1240 sealant accelerator should be used. However, EC1240 accelerator is a general purpose accelerator which will craze plexiglass and must not be used. EC1216 accelerator is non-crazing and should be used with EC801 sealant on all plexiglass.

c. Position panels in frame. Place spacer (18) on panels.

Note

The orlon attachment strips along the edge of the panels contains a magnesium rod which provides a beaded section. This bead locks in the grooves of the spacers to secure the panels in the frame.

d. Attach retaining strips and spacers with two or three screws to align holes. Then install remaining screws and tighten.

4-15. MAINTENANCE OF CANOPY AND WINDSHIELD PLEXIGLAS.

4-16. GENERAL. Maintenance procedures will normally be limited to repairing damage as determined by Table 4-1 and Figures 4-3 and 4-4; and, to washing and waxing. Because of the optical qualities of this canopy and windshield, damage more extensive than that outlined here will require the replacement of the plexigals panel. In general it is better to leave scratches, dents, spalls and other damage alone rather than to try to repair them. Attempts to repair such damage, even if skillfully done, will usually result only in increasing the area of opitcal distortion. Plexiglas panels in the canopy and windshield are replaced with a maximum of ease and for this reason replacement of the damaged part is recommended. For instances in which no replacement parts are immediately available, instructions for temporarily repairing fractures and holes are given.

4-17. TEMPORARY PLEXIGLAS REPAIRS. (See figure 4-3.

a. A serviceable repair of holes or severe surface damage can be made by removing damaged area by cutting a circular hole and beveling edges inward approximately 60°. Cut a plug from material approximately 1/16 inch thick and bevel edges to match hole.
b. Heat plug until soft and pliable and press into hole firmly enough to take the exact shape of the hole.
c. Allow the plug to cool and remove.
d. Cover both sides of the plug with masking tape and trim flush with edge of plug.
e. Soak plug in Specification MIL-C-3116 cement until the edges are soft. Methylene cloride stock R51-M-950-10 may be used in an emergency; however maintenance personnel will avoid breathing methylene chloride vapors which are toxic. A satisfactory cement can be made of 60 parts of methylene chloride to 40 parts methyl methacrylate monomer by volume.
f. Press plug into hole and allow it to set under pressure. Approximately 24 to 36 hours will be required before the plug can be sanded and polished.
g. Remove tape and sand plug down flush with surface of panel. Polish in accordance with paragraph 4-18 and wax.

4-18. PLEXIGLAS POLISHING. (See figure 4-4.)

a. HAND SANDING. Do not use a grit coarser than No. 320A, nor any grit coarser than required to remove the defect. Use progressively finer grit from 360A through 400A, 500A and 600A. Use a felt padded block and always sand wet or with a 2% soap solution lubricant. Cover an area approximately three times greater than the length of the scratch, with circular movements of the sandpaper. Use no more pressure than is necessary to keep the paper cutting. Wash the area down each time the paper is changed to a finer grit so that all of the preceding coarser grit is removed.
b. POWER SANDING. Follow the same general procedures as outlined for hand sanding. Use extremely light pressures and use generous quantities of water as a lubricant to prevent overheating.

Note

Power sanding is not recommended except on large areas.

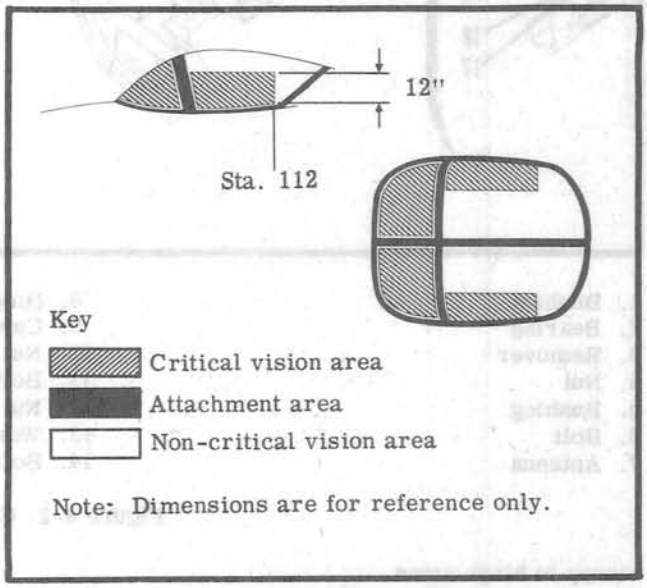


Figure 4-3. Critical Vision Areas

c. Carefully wash the part to be buffed so that coarse grit will not be transferred to the buffing wheel. Use a surface speed of 2000 feet per minute (1400 RPM for 6 inch wheel) and use light pressure. The buffing wheel can quickly overheat the plastic panel and leave marks known as "buff burns" which will necessitate replacement of the panel. Use Specification MIL-C-5547 polish.
d. Dry with a clean, damp chamois skin.

Note

Soft cloths may be used to dry the plexiglas only if care is taken to not rub the plexiglas after it is dry, as this will scratch plexiglas.

Table 4-1

Defect	Critical Vision Area		Non-Critical Vision Area	
	Repairable	Permissible	Repairable	Permissible
Nicks, Dents, Spalls, Conchoidal Fractures	None	length - .250 inch max. width - .125 inch max. depth - .020 inch max. frequency - 2 per area max.	length - .250 inch max. width - .100 inch max. depth - 3/4 face sheet thickness max. frequency - 2 per sq. ft. of area max.	length - .125 inch max. width .016 inch max. depth - .040 inch max. frequency - 1 per sq. ft. of area max.
Scratches	None	length - 5.0 inch max. total depth - .01 inch max. frequency - 1 per area Hairline scratches (depth of .001 or less) are acceptable in any amount and area as long as they do not cause vision blur or create undesirable glare.	None	length - 24 inch max. width - .02 inch max. depth - 01 inch max. frequency - total length of scratches 3 times longest dimension of area maximum
Cracks	None	None	None	None
Discoloration	None	May extend 1/2 inch from the entire edge area of the plastic enclosure.	None	May extend 1/2 inch from the entire edge area of the plastic enclosure.

e. Oil and grease may be removed by rubbing spot with cloth dampened with Specification No. TT-N-95 alipatic naptha or other solvents approved in technical orders for use on acrylic plastic.

CAUTION

The following materials will damage plexiglas by craxing or softening: gasoline, alcohol, benzene, hexane, kerosene, JP4, xylene, acetone, carbon tetrachloride, fire extinguishing agent. de-icing fluids, lacquer thinners or window cleaning sprays.

4-19. WASHING PLEXIGLAS.

a. Remove all loose dust and dirt with compressed air.

b. Wash plexiglas with soap and water free of grit and other abrasive matter. Use a sponge or cloth, only to get soapy water to the surface to be washed. Use a bare hand to rub the surface being washed so that grit and abrasive particles can be detected and removed before they can damage the surfaces.

4-20. WAXING PLEXIGLAS.

a. Apply a thin coat of suitable wax, to the cleaned and dried plexiglas surface. The wax should contain no chemicals detrimental to acrylic plastic nor any abrasive additives.

b. Apply and rub the wax sparingly. Excessively rubbing will scrach the plexiglas and charge it with static electricity which will attract dust.

c. Waxes suggested for use are Duco No. 7, Johnson's Paste Wax No. 109, Simoniz Wax or equally suitable commerical products.

CAUTION

In handling plexiglas panels, wear clean white cotton gloves, whenever practical, to prevent marking the panels.

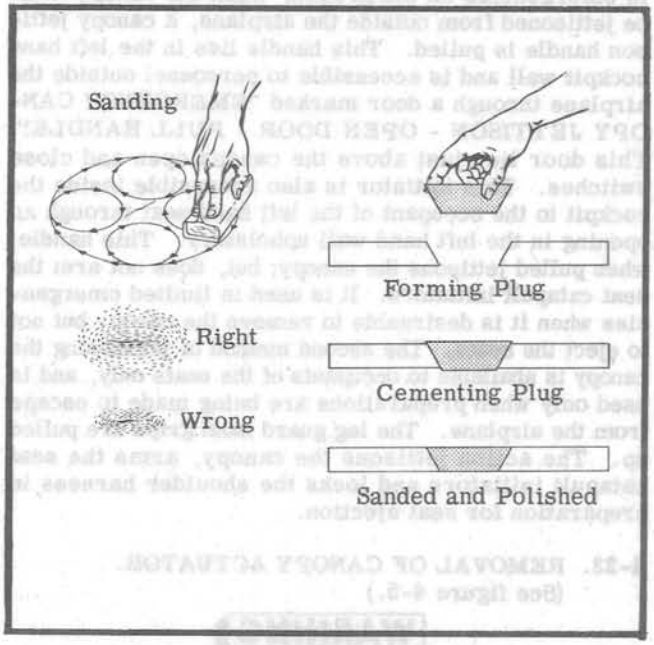


Figure 4-4. Temporary Repair of Plexiglas

4-21. CANOPY CONTROLS.

4-22. DESCRIPTION. The canopy actuator is controlled from inside the cockpit by a three position toggle switch located on the back of the center power control quadrant. The canopy is controlled from outside the airplane by two push button switches mounted flush with the left hand cockpit skin. These two switches are labeled "CANOPY SWITCH - OPEN - CLOSE". When the battery is dead and an auxiliary power unit is supplying power, it is necessary to close a switch labeled "APU TO CANOPY" located on the circuit breaker panel in the left hand nose compartment, to energize the canopy actuation circuits. In the event the battery is dead and no auxiliary power unit is available the canopy can be raised or lowered manually. This is accomplished by declutching the actuator and lifting or lowering the canopy as required. The declutching tee handle lies behind an access door located just above the outside canopy control switch. The handle can be reached from the interior of the airplane through a zippered opening in the cockpit upholstery. This handle must be held open all the while the canopy is being lifted or let down. Releasing the handle stops the canopy in the position it is in at the moment.

The declutching handle should never be pulled while the canopy is open and unsupported. To do so will let the canopy slam shut with possible damage to the airplane or injury to personnel.

In all cases in which the canopy is being opened, it must be unlocked. This is accomplished from within the airplane by pulling back on the canopy locking handle. From outside the airplane, personnel must reach through the zippered opening in the declutching handle compartment, into the cockpit, and push the locking handle back Two methods of jettisoning the canopy are provided. In emergencies on the ground, when the canopy must be jettisoned from outside the airplane, a canopy jettison handle is pulled. This handle lies in the left hand cockpit wall and is accessible to personnel outside the airplane through a door marked "EMERGENCY CANOPY JETTISON - OPEN DOOR - PULL HANDLE". This door lies just above the canopy open and close switches. This initiator is also accessible inside the cockpit to the occupant of the left hand seat through an opening in the left hand wall upholstery. This handle, when pulled jettisons the canopy; but, does not arm the seat catapult initiators. It is used in limited emergencies when it is desireable to remove the canopy but not to eject the seats. The second method of jettisoning the canopy is abailable to occupants of the seats only, and is used only when preparations are being made to escape from the airplane. The leg guard hand grips are pulled up. The action jettisons the canopy, arms the seat catapult initiators and locks the shoulder harness in preparation for seat ejection.

4-23. REMOVAL OF CANOPY ACTUATOR. (See figure 4-5.)

WARNING

Install safety pin in seat leg guard to prevent accidental firing of canopy remover initiator.

a. Open canopy and support to prevent its falling shut.
b. Disconnect initiator hose at the canopy remover.
c. Disconnect electrical connection (11).
d. Disconnect manual declutch control.
e. Disconnect safety cable (10).

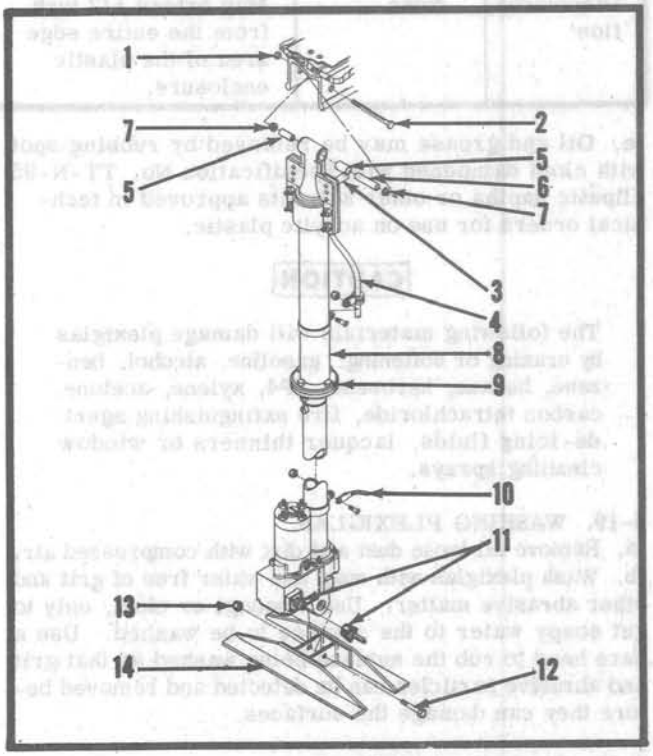
WARNING

Do not remove exactor (3) unless safety pin is installed. The canopy remover, bolted to the top of the actuator, contains an explosive charge, and must be handled with extreme caution. Do not drop it or place it where objects can fall on it.

f. Remove nut (13) and bolt (12) from the bottom of the actuator.
g. Remove nut (1), bushings (7), bearings (5), bushing (6) and bolt (2) from hinge assembly at the top of the canopy remover.
h. Lift canopy actuator out of airplane.

4-24. INSTALLATION OF CANOPY ACTUATOR. (See figure 4-5.)

a. Place actuator in position and install nut (13) and bolt (12) at the floorboard bracket.
b. Install bolt (2), bearings (5), bushings (6) and (7) and nut (1) in hinge assembly at top of actuator.



1. Nut
2. Bolt
3. Exactor
4. Initiator hose
5. Bearings
6. Bushing
7. Bushing
8. Remover
9. Height adjustment
10. Safety cable
11. Electrical connector
12. Bolt
13. Nut
14. Floor support

Figure 4-5. Canopy Actuator

Note

Bushings are installed with shoulders between hinge assembly and canopy channel flanges. Install from inside the channel.

WARNING

The canopy remover, bolted to the top of the actuator, contains an explosive charge. It must be handled with extreme caution. Do not drop or place it where objects can fall on it.

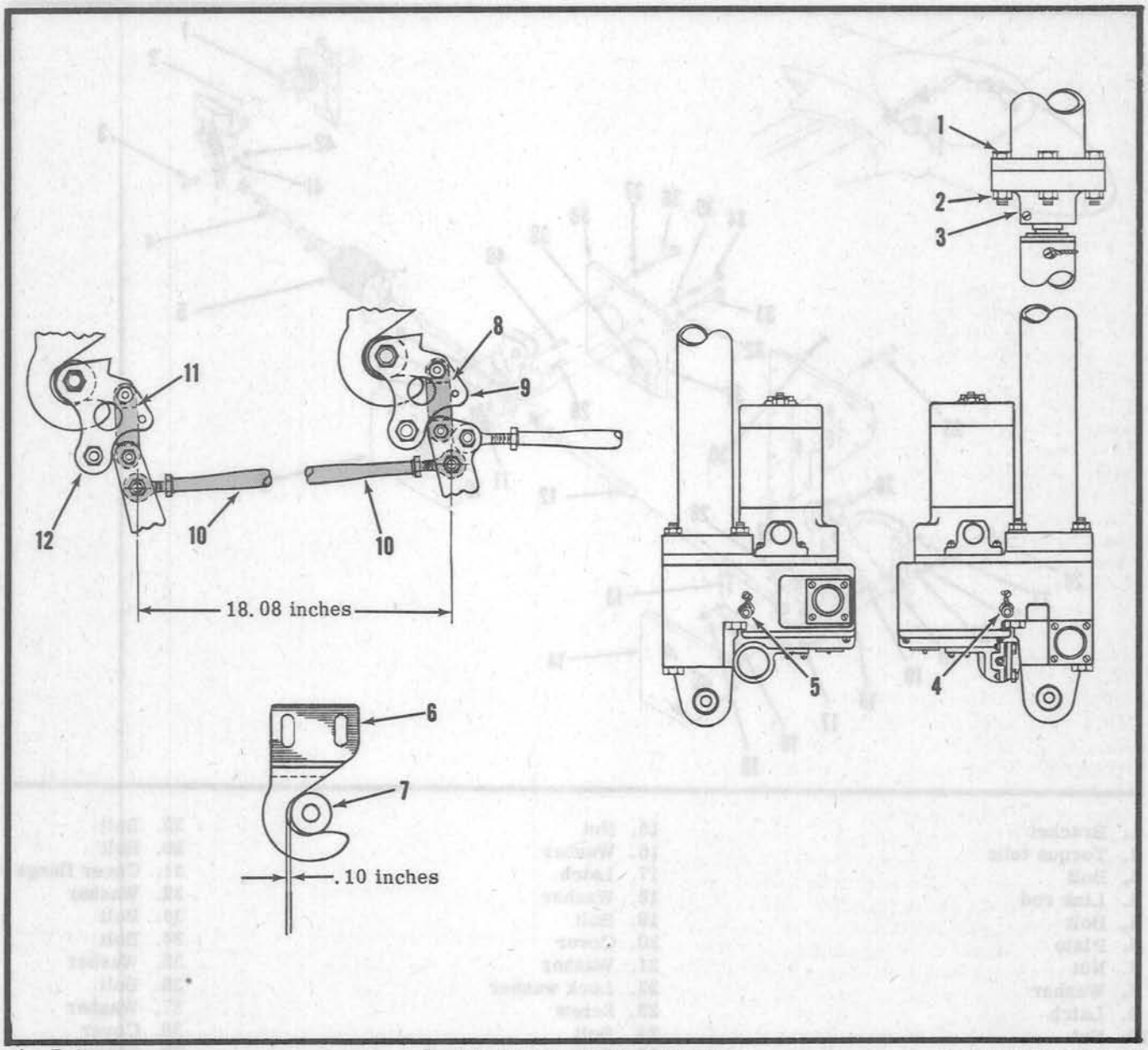
c. Connect safety cable (10).
d. Connect electrical head (11).
e. Connect initiator hose (4).
f. Connect manual declutch control.
g. Remove canopy support.

4-25. ADJUSTMENT OF CANOPY ACTUATOR. (See figure 4-6.)

Note

Adjustment of the canopy actuator should be made after it has been actuated electrically and not manually.

a. Close canopy electrically with paper strips installed per paragraph 4-30.

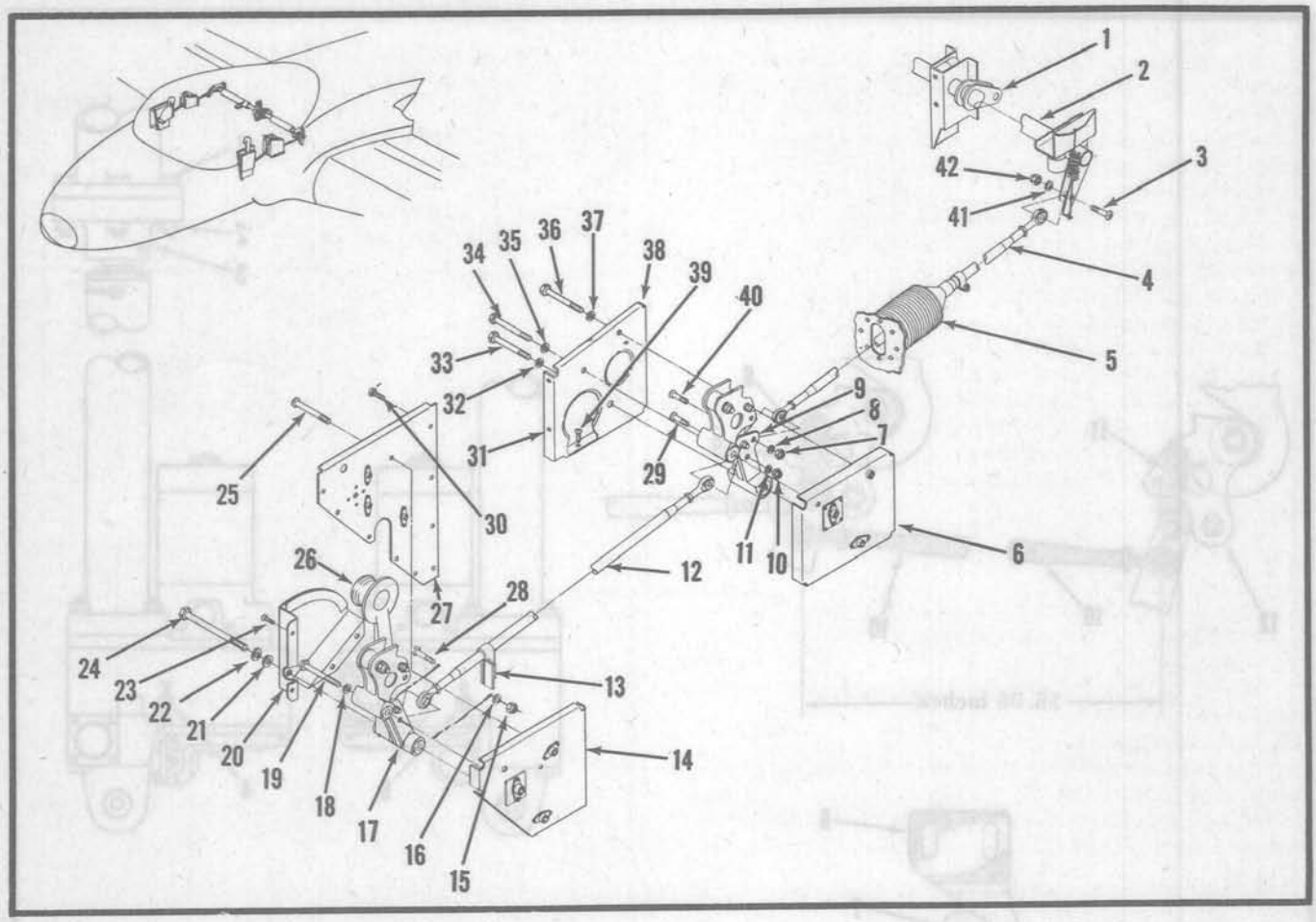


1. Bolt
2. Nut
3. Jack end fitting
4. Adjustment screw-extend
5. Adjustment screw-retract
6. Canopy hook
7. Downlock roller
8. Link
9. Latch assembly
10. Linkage tube
11. Link
12. Latch assembly

Figure 4-6. Canopy Components Adjustment

b. Remove nuts (2) and bolts (1). Turn fitting (3) to tighten. Tighten fitting (3) until paper strips break when pulled against seal pressure.
c. Install bolts (1) and nuts (2).
d. Raise Canopy electrically, adjust up travel by adjusting up limit travel switch by turning screw (4).
e. Lower canopy electrically, adjust down travel by adjusting down limit travel switch with screw (5).

4-26. REMOVAL OF CANOPY DOWNLOCKS.
(See figure 4-7.)
a. Remove bolt (24), lock washer (22), and washer.
b. Remove bolt (25).
c. Remove bolt (19) and washer (18).
d. Remove screws (23) and remove cover (20) from assembly.
e. Remove bolt (30) holding plate (27).
f. Remove bolt (28), washer (16) and nut (15) attaching link rod to latch assembly.
g. Lift operating handle and latch assembly (17) out of the fuselage wall.
h. Remove bolt (34) and washer (35).
i. Remove bolt (33) and washer (32).
j. Remove bolt (36) and washer (37).
k. Remove screws (39) from flange of cover (38) and remove cover.
l. Remove bolt (40), washer (8) and nut (7).
m. Remove bolt (29), washer (11) and nut (10).
n. Remove link rod (12),and (4).
o. Remove latch assembly (9).



1. Bracket
2. Torque tube
3. Bolt
4. Link rod
5. Bolt
6. Plate
7. Nut
8. Washer
9. Latch
10. Nut
11. Washer
12. Link rod
13. Trip
14. Plate
15. Nut
16. Washer
17. Latch
18. Washer
19. Bolt
20. Cover
21. Washer
22. Lock washer
23. Screw
24. Bolt
25. Bolt
26. Handle
27. Plate
28. Bolt
29. Bolt
30. Bolt
31. Cover flange
32. Washer
33. Bolt
34. Bolt
35. Washer
*36. Bolt
37. Washer
38. Cover
39. Screw
40. Bolt
41. Washer
42. Nut

Figure 4-7. Canopy Downlock Installation

Note

The link rod (12) is provided with a trip assembly (13) which engages, but is not attached to the canopy unlocked warning light microswitch. Care should be used in removing the link rod to avoid damaging the microswitch.

4-27. INSTALLATION OF CANOPY DOWNLOCKS. (See figure 4-7.)

a. Install link rod (12) with trip assembly (13) to the front and pointing down so as to engage the microswitch lever.
b. Attach latch assembly (9) to link rod (12) with bolt (29), washer (11) and nut (10).
c. Attach link rod (12) to latch assembly (9) with bolt (40), washer (8) and nut (7).
d. Place bolts (33), (34), and (36) with respective washers (32), (35), and (37) through holes in cover plate (38).
e. Align bolts with corresponding holes in latch assembly (9) and nut plates in fuselage wall bracket (6).
f. Tighten bolts.
g. Install screws (39) in flange of cover.
h. Attach link rod (4) to latch assembly with bolt (40), washer (8) and nut (7).
i. Insert bolt (19) with washer (18) and bolt (25) through mating holes in plate (27).
j. Align bolts with holes in handle-latch assembly (17) and nutplate holes in back of fuselage wall recess.
k. Tighten bolts in nutplates.
l. Insert bolts (30) attaching plate (27) to cockpit wall.
m. Attach cover (20) with screw (23).
n. Insert bolt (24) with lock washers (22) and washer (21) and tighten.

4-28. ADJUSTMENT OF CANOPY DOWNLOCKS. (See figure 4-6.)

a. The only adjustment possible on the canopy downlocks is for synchronous movement of the latch assemblies.
b. Insert rig pins in holes in latch assemblies as indicated in figure 4-6.
c. Disconnect rod (10).
d. Loosen nuts and twin rod ends until proper length is obtained (approximately 18.08 inches).
e. Install rod (10). With rod properly adjusted and installed links (9) and (11) should be in contact with the rig pins.

4-29. ADJUSTMENT OF CANOPY DOWNLOCK HOOKS. (See figure 4-6.)

Note

All adjustments should be made with canopy electrically operated and not manually operated.

a. The canopy downlock hooks may be moved up or down in serations as required to properly engage the canopy latches. To move the hooks, loosen the attaching nuts and move hook up or down to give dimension as indicated in figure 4-6. After adjustment is complete, tighten nuts.

4-30. ADJUSTMENT OF CANOPY SEALS.

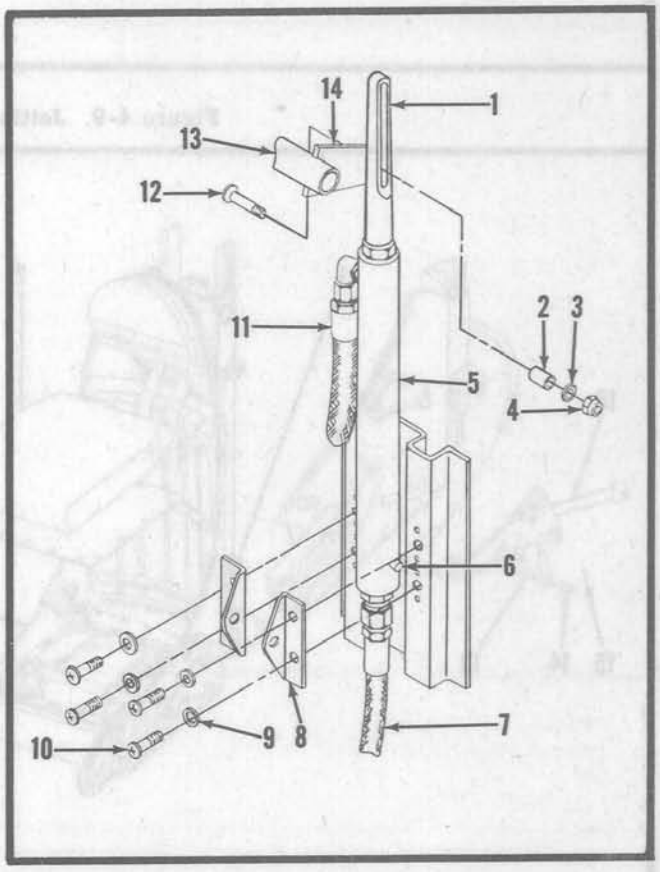
a. Insert strips of bond paper one inch wide beneath canopy sealing strips.
b. Run canopy down with actuator.
c. Pull on strips of paper. If paper breaks, the seals are sealing properly. If paper slips out, adjust actuator length, in accordance with paragraph 4-25.

4-31. REMOVAL OF THRUSTER. (See figure 4-8.)

a. Insert safety pins in seat leg guards.
b. Remove bolt (12), washer (3), spacer (2) and nut (4) attaching thruster to canopy downlock torque tube arm.
c. Disconnect initiator nose (7) at thruster.
d. Disconnect exactor nose (11) at thruster.
e. Remove two screws (10), and washers (9) to free one side (8) of the thruster support.
f. Lift thruster out.

4-32. INSTALLATION OF THRUSTER. (See figure 4-8.)

a. Fasten thruster guide (1) to torque tube arm (14) with bolt (12), washer (3), spacer (2) and nut (4).
b. Place thruster trunnions (6) in thruster support (8) and install two screws (10) and washers (9).
c. Attach initiator hose (7).
d. Attach exactor hose (11).



1. Guide
2. Spacer
3. Washer
4. Nut
5. Thruster
6. Trunnion
7. Initiator hose
8. Support
9. Washer
10. Screw
11. Exactor hose
12. Bolt
13. Torque tube
14. Arm

Figure 4-8. Thruster Installation

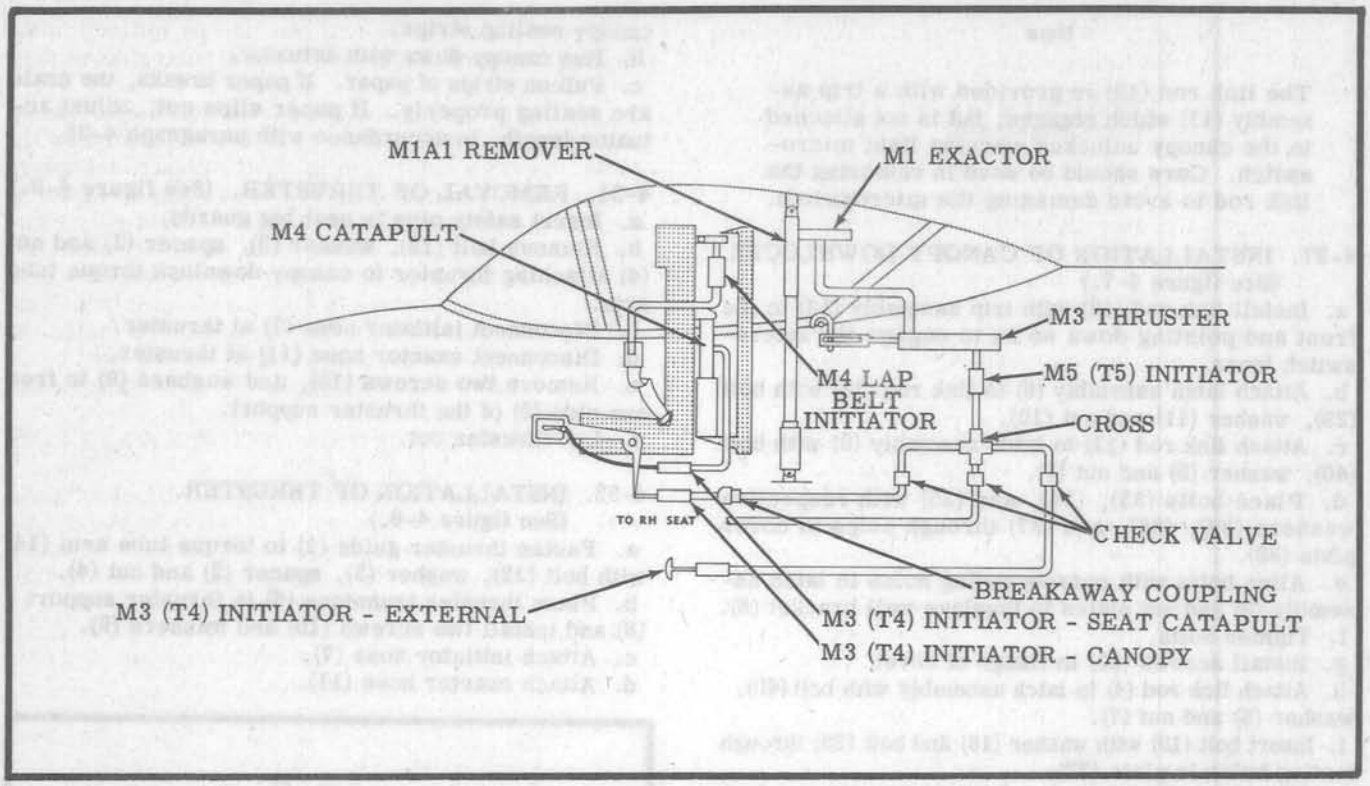
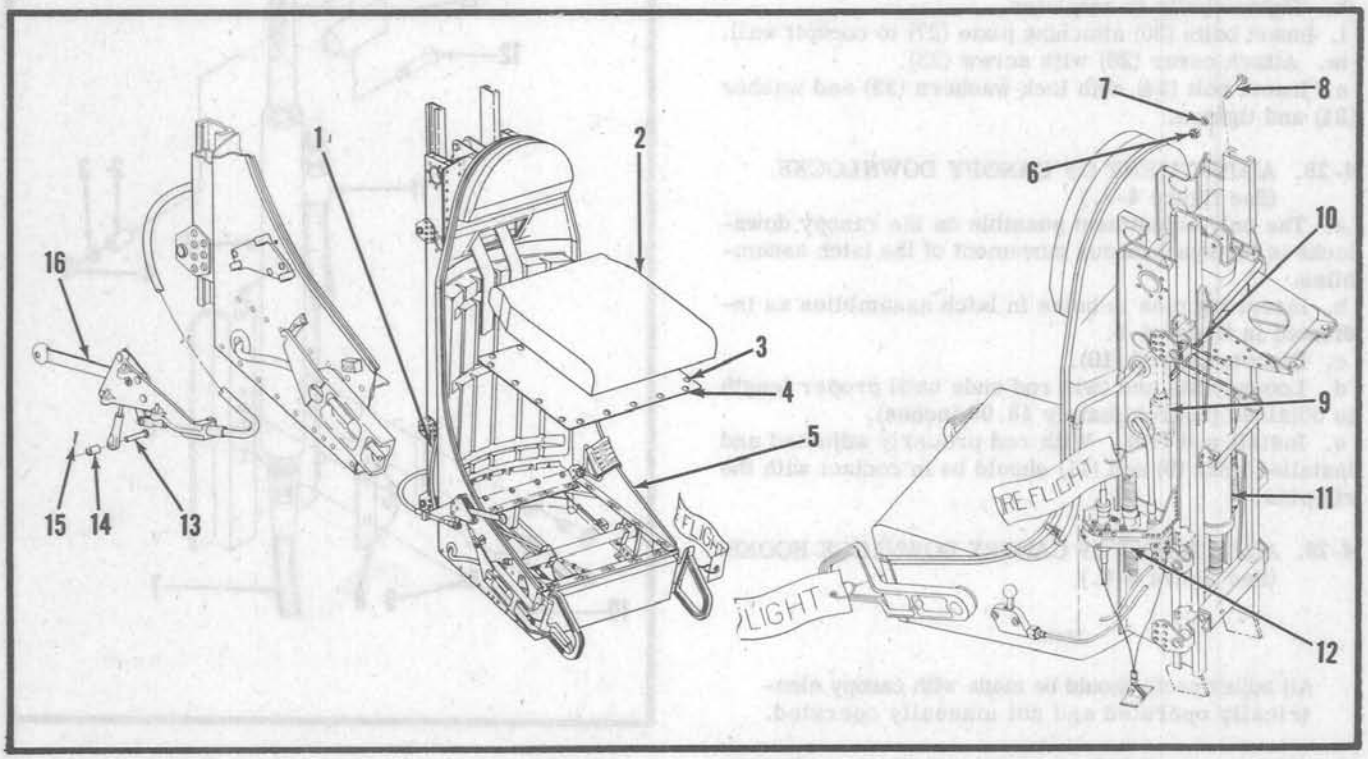


Figure 4-9. Jettison System Schematic



1. Catapult initiator hose
2. Seat cushion
3. Fastener
4. Seat pan
5. Seat
6. Nut
7. Washer
8. Bolt
9. Lap belt initiator
10. Initiator trigger
11. Catapult
12. Oxygen, electrical and ballistics breakaway
13. Pin
14. Spacer
15. Cotter pin
16. Seat adjustment control

Figure 4-10. Ejection Seat Installation

4-33. DISARMING OR SAFETYING JETTISON SYSTEM. (See figure 4-11.)

WARNING

Before removal of the airplane into a hanger or before maintenance work is to be performed, it is imperative that all initiators and the canopy remover be properly disarmed or safetied. Accidental firing of the initiators could cause serious injury or death to personnel. Also, any time any hose to any initiator is disconnected, it must be plugged to prevent dirt and moisture from collecting in the system.

There are eleven explosive devices in the airplane: an M1A1 canopy remover, two M4 seat catapults, two M4 safety belt, delay type initiators, five M3 initiators used to fire the canopy remover and seat catapults, and one M5 booster initiator used to increase gas pressure for unlocking the canopy and firing the canopy remover. Safety pins and streamers are provided for all except the catapults and the M5 booster initiator which should have their gas ports plugged whenever they are removed from the airplane. Whenever the airplane is on the ground, perform the following:

a. Insert safety pin in canopy remover and attach free end of streamer to canopy.

b. Insert safety pin in external canopy jettison initiator, making sure that initiator pin annular groove does not show.

c. Perform the applicable portion of the following:

1. When no maintenance is to be performed on the seats, insert a safety pin in each outboard leg guard of each seat; attach student seat safety pin streamer to streamer of external canopy jettison initiator safety pin.

2. When any maintenance is to be performed on a seat, insert the leg guard safety pin, remove the seat cushion, loosen fasteners and remove the seat pan, and insert safety pins in the two initiators inside the seat and in the safety belt initiator on the seat back. Make sure that initiator pin annular grooves do not show.

4-34. REMOVING JETTISON SYSTEM SAFETY PINS. (See figure 4-11.)

a. When seat maintenance is completely finished, make sure that leg guard safety pin is securely in place; then remove safety pins from the three initiators, and install the seat pan and the seat cushion. Stow the safety pins and streamer in the safety streamer stowage box.

b. When preflight maintenance is finished, remove canopy remover safety pin, unfasten streamer, and stow in safety streamer stowage box.

c. The pilot, not the maintenance personnel, removes the external canopy jettison initiator safety pin and the leg guard safety pins.

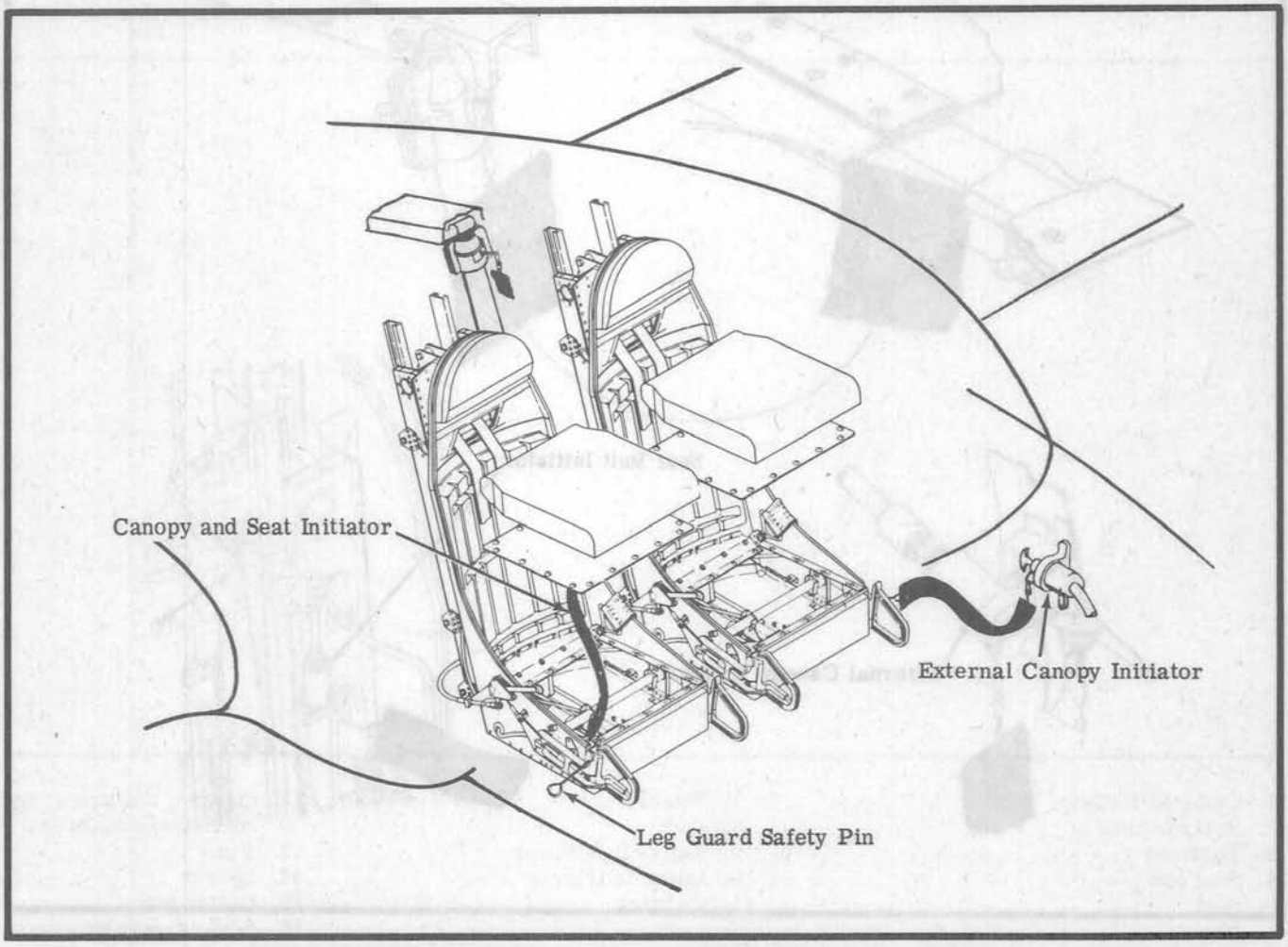


Figure 4-11. Disarming or Safetying Jettison System.
(Sheet 1 of 2)

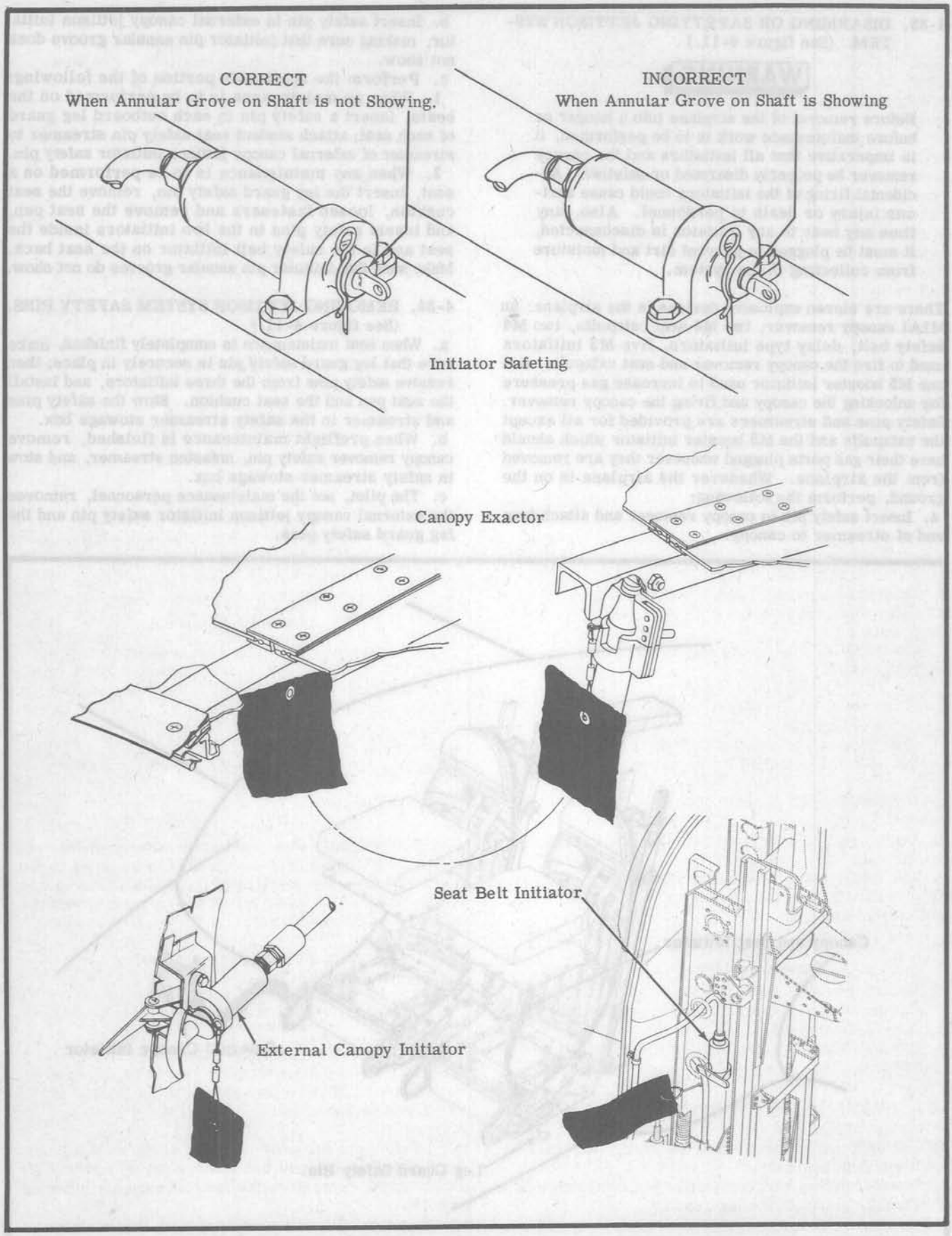


Figure 4-11. Disarming or Safetying Jettison System
(Sheet 2 of 2)

4-35. EJECTION SEAT.

4-36. GENERAL. The pilot's and co-pilot's seats are identical in construction and operation. Each seat is equipped with a lap belt and shoulder harness tensioned by an inertia reel. A vertical adjustment control handle and an inertia reel control handle are provided for each seat. The emergency escape system is controlled by handgrips at the end of the two leg guards provided for each seat. The safety belt buckle is normally opened manually, however, when the seat is ejected it is opened automatically. The seat may be adjusted for height by moving the seat adjustment handle forward, lifting the seat up or pushing it down to the desired height and then pulling the adjustment handle back to the locked position. The inertia reel is locked or unlocked by the control handle located on the left hand side of the seat. To eject the seat, the leg guards are seized by the hand grips and pulled up. This action jettisons the canopy, locks the inertia reel and positions the catapult initiator trigger in the right hand grip. Squeezing this trigger fires the catapult and ejects the seat. The lap belt opens automatically after the seat leaves the airplane.

4-37. REMOVAL OF SEAT. (See figure 4-10.)

a. Remove canopy in accordance with paragraph 4-11.
b. Disconnect the oxygen, electrical and ballistics breakaway connectors by pulling down on the lower half of the breakaway coupling bracket (12) until it snaps off.
c. Remove seat cushion (5).
d. Loosen fasteners (3) and remove seat pan (4).
e. Disconnect catapult initiator hose (1) at the top of the catapult
f. Install safety pins in the catapult remover and lap belt initiators.

Note

The three safety pins for initiators located on the seat are attached to the same streamer.

g. Remove nut (6), washer (7) and bolt (8) attaching catapult.
h. Detach seat adjustment control by removing cotter pin (15), pin (13), and spacer (14).
i. Lift seat upward. Move lap belt initiator trigger (10) to allow the initiator to pass unobstructed as the seat moves out of the rails.

WARNING

The M-4 seat catapult contains an explosive charge and must be handled with exterme care. Do not allow the catapult to strike the seat or the airplane while the seat or the catapult is being handled.

4-38. INSTALLATION OF EJECTION SEAT. (See figure 4-10.)

a. Lift seat into position, align rollers in rail tracks, and lower seat into place.
b. Install spacer, pin, and cotter pin attaching seat adjustment control to the leg guard.

Note

To securely seat the adjustment lever bracket in the three mounting pins (23) it is necessary to lift the leg guard one to two inches while the pin is placed in the connecting link. Pressing leg guard back into place pre-loads the lever bracket and seats it securely.

c. Install nut and bolt securing catapult to indexing arm.
d. Install canopy in accordance with paragraph 4-12.

Note

The danger of accidentally firing the ballistics system is greatest while the bulky canopy is being installed. The initiators in the seat should be left safetied and their hoses left disconnected until the canopy is secured.

e. Remove safety pins from initiators in the bottom of the seat.

WARNING

Leave lap belt initiator safetied as long as possible.

f. Connect the seat catapult initiator hose.
g. Install seat pan and secure with fasteners.
h. Snap lower half of breakaway connector mounting bracket (12) in place.

WARNING

The canopy remover is now connected to its initiator. Extreme caution should be used to avoid raising leg guards accidentally as this will now jettison the canopy.

i. Install seat cushion.
j. Remove safety pin from the lap belt initiator.

4-39. CATAPULT.

4-40. GENERAL. Each seat is fitted with an M4 catapult. The lower end of the catapult is attached to the seat rail assembly which is permanentaly attached to the airplane. The upper end of the catapult is attached to the ejectable structure of the seat.

4-41. REMOVAL OF SEAT CATAPULT. (See figure 4-12.)

WARNING

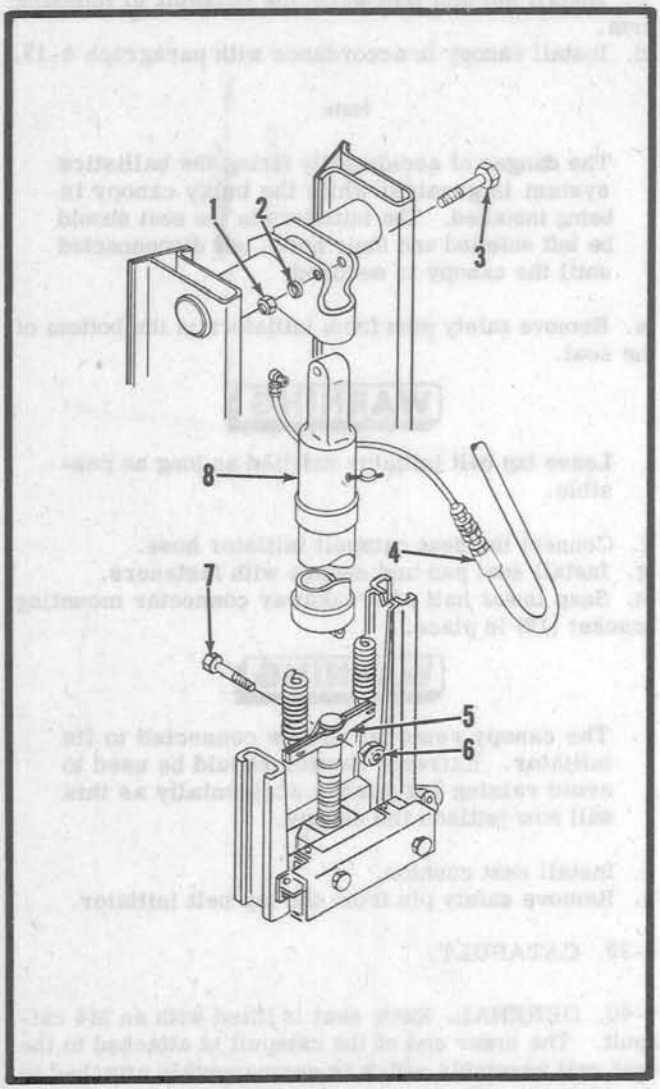
The M-4 catapult must be handled as live ammunition. Do not attempt to repair or adjust a catapult. If it is considered to be faulty, it should be replaced.

a. Disconnect initiator hose (4) at the catapult (8).
b. Support the catapult and remove nut (6) and bolt (7) attaching the catapult to the seat adjustment indexing arm (5).
c. Remove seat in accordance with instructions of paragraph 4-37.
d. Remove bolt (3), washer (2) and nut (1) attaching catapult to seat (9).

e. Remove catapult.

WARNING

Do not allow catapult to fall or drop against seat structure when attaching bolts are removed.



1. Nut
2. Washer
3. Bolt
4. Initiator hose
5. Indexing arm
6. Nut
7. Bolt
8. Catapult

Figure 4-12. Seat Catapult Installation

4-42. INSTALLATION OF CATAPULT. (See figure 4-12.)

a. Install bolt (3), washer (2) and nut (1) to attach catapult to seat.

b. Install bolt (7) and nut (6) to attach catupult to indexing arm (5).

c. Install seat in accordance with paragraph 4-36.

d. Attach initiator hose (5).

4-43. CANOPY, CATAPULT AND SEAT BELT INITIATORS.

4-42. REMOVAL OF CANOPY, CATAPULT AND SEAT BELT INITIATORS. (See figure 4-13.)

WARNING

Install safety pin in seat leg guard handgrip during all maintenance procedure on or around the ejection seats.

a. Remove seat cushion and pan (19).

b. Insert safety pins in canopy, catapult and seat belt initiators.

c. Disconnect hoses at the initiators (13).

d. Remove cotter pin (1), washer (2), and pin (3) from canopy remover initiator trigger linkage.

e. Remove the two bolts (26) and washers (27) securing the canopy remover initiator to the seat.

f. Repeat steps c to e for the seat catapult initiator.

g. To remove the lap belt initiator, remove seat in accordance with instructions in paragraph 4-42.

h. Remove lap belt hose (20).

i. Remove cotter pin (15), pin (14) attaching initiator to trigger lever (18).

j. Support the initiator and remove the two bolts (16) and washers (17) attaching it to the seat.

4-45. INSTALLATION OF CANOPY, CATAPULT AND SEAT BELT INITIATORS. (See figure 4-13.)

a. Reverse removal procedure.

4-46. COCKPIT UPHOLSTERY.

4-47. GENERAL. The cockpit upholstery consists of two floorcoard panels, two cockpit wall panels on each side and the stick fume boots.

4-48. REMOVAL OF UPHOLSTERY. (See figrue 4-12.)

a. Unsnap and remove First Aid Kit (2) from right hand cockpit wall.

b. Unsnap fasteners around the outer edges of the right hand upholstery panels.

c. Lift out the rear panel (3).

d. Lift out the front panel.

e. Unsnap fasteners around the outer edges of the left hand upholstery panels.

f. Lift out the rear panel (7).

g. Lift out the front panel (8).

h. Remove the five screws holding the bottom flange of the fume boots (5).

i. Unbutton the three snap fasteners (6) at the back of each boot.

j. Loosen clamp (4) fastening top of fume boot to stick (14).

k. Lift boots over sticks and remove from airplane.

l. Remove screws (13) and scuff plates (10) and (12) from floor mat.

m. Remove screws (14) and washers (13) fastening floor mats to floor.

n. Lift floor mats (9) and (10) out of airplane.

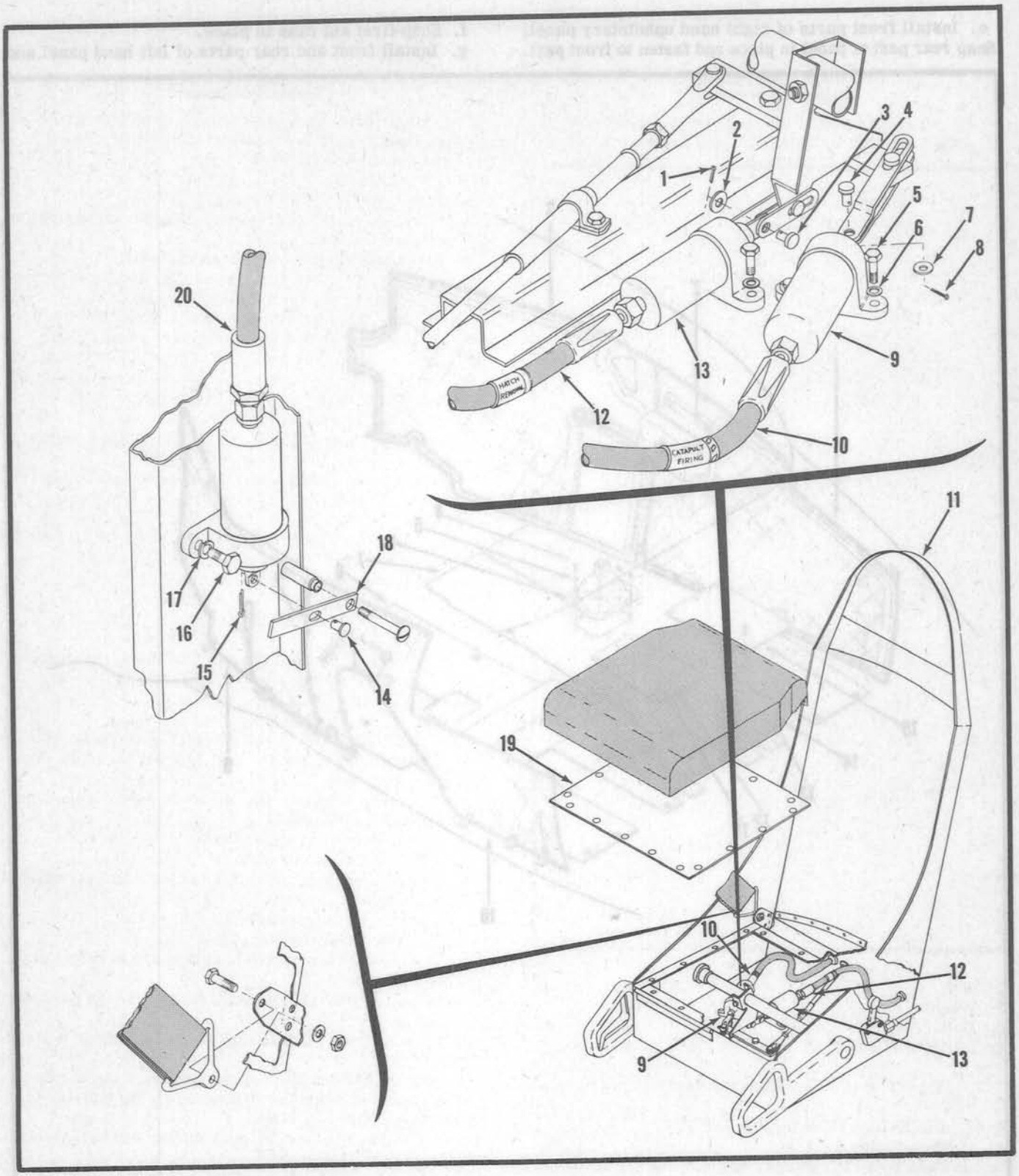
4-49. INSTALLATION OF UPHOLSTERY. (See fiureg 4-14.)

a. Install floor mats and fasten with screws and washers.

b. Install scuff plates and fasten with screws.

c. Install fume boots around sticks.

d. Tighten clamp and fasten snap fasteners. Install screws fastening boot to floorboards.



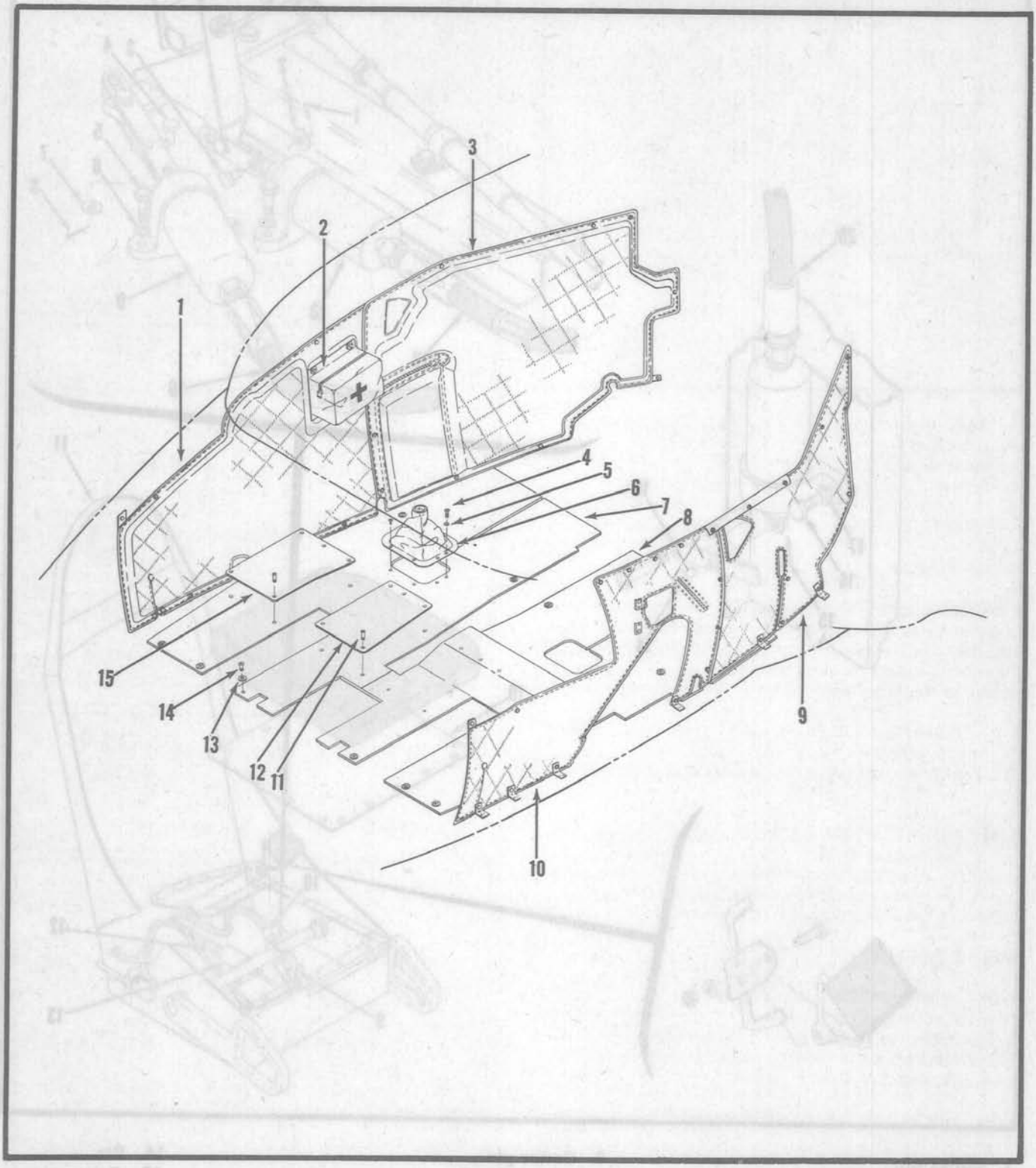
1. Cotter pin
2. Washer
3. Pin
4. Pin
5. Bolt
6. Washer
7. Washer
8. Cotter pin
9. Initiator
10. Catapult hose
11. Seat
12. Remover hose
13. Remover initiator
14. Pin
15. Cotter pin
16. Bolt
17. Washer
18. Trigger
19. Seat pan
20. Lap belt hose

Figure 4-13. Initiator Installation

e. Install front parts of right hand upholstery panel. Snap rear part of panel in place and fasten to front part.

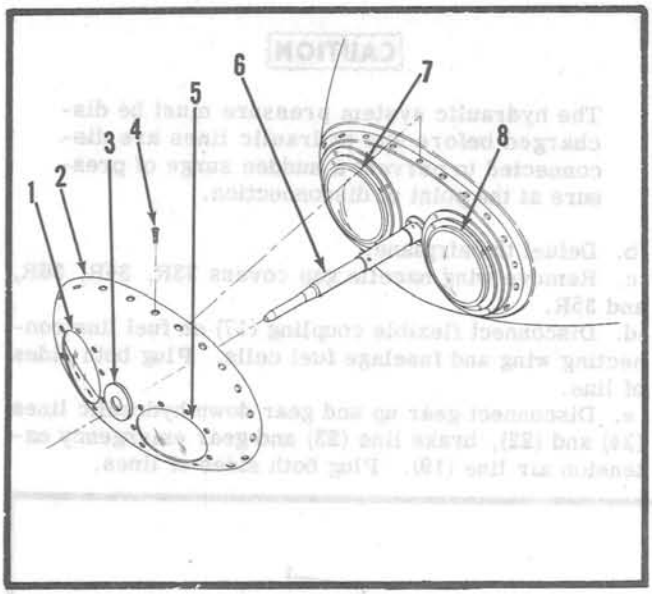
f. Snap first aid case in place.

g. Install front and rear parts of left hand panel and



1. Front panel
2. First aid kit
3. Rear panel
4. Screw
5. Washer
6. Fume boot
7. Floor mat
8. Floor mat
9. Rear panel
10. Front panel
11. Screw
12. Scuff plate
13. Washer
14. Screw
15. Scuff plate

Figure 4-14. Upholstery Installation



1. Taxi light window
2. Nose cap
3. Pitot tube seal
4. Screw
5. Passing light window
6. Pitot tube
7. Taxi light
8. Passing light

Figure 4-15. Nose Cap Installation

fasten together.

4-50. NOSE CAP. The nose cap is a fairing at the nose of the airplane and is provided with two windows for the taxi light and the passing light. A grommet is provided for sealing around the pitot tube which sticks through the center of the nose cap.

4-51. REMOVAL OF NOSE CAP. (See figure 4-15.)
a. Remove screws (4).
b. Pull nose cap (2) straight out until it clears the pitot tube (6).

4-52. INSTALLATION OF NOSE CAP. (See figure 4-15.)
a. Slide nose cap into position over the pitot tube.
b. Align holes and start a few random screws.
c. Start remaining screws and tighten.

4-53. STINGER.

4-54. DESCRIPTION. The stinger is a fairing at the rear extremity of the fuselage. This fairing covers and protects the rudder bellcrank and elevator horns. The stinger also provides a mounting for a yellow and a white navigation light.

4-55. REMOVAL OF STINGER. (See figure 4-16.)
a. Remove screws (5).
b. Pull stinger (4) straight out. Support stinger and disconnect electrical lead (6).

4-56. INSTALLATION OF STINGER. (See figure 4-16.)
a. Move the stinger into position and connect navigation light electrical lead.
b. Push stinger on fuselage mountnig flange (2) and align holes.

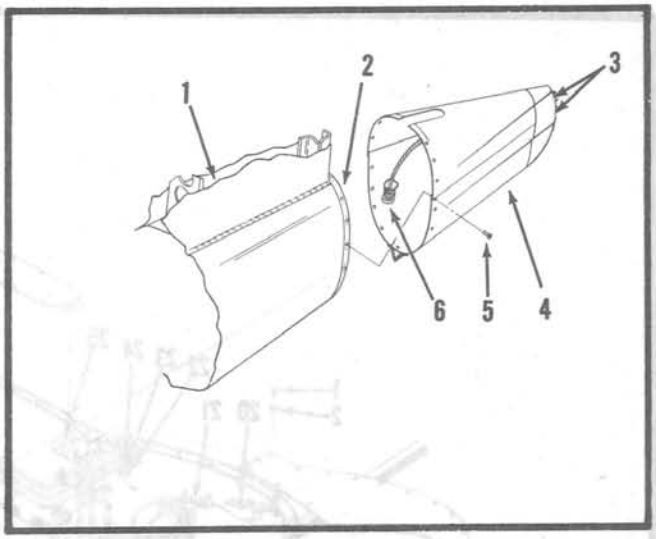
CAUTION

Do not use drift pins to align holes as this will damage dimples in the stinger skin and damage threads on the nutplates.

c. Install screws and tighten.

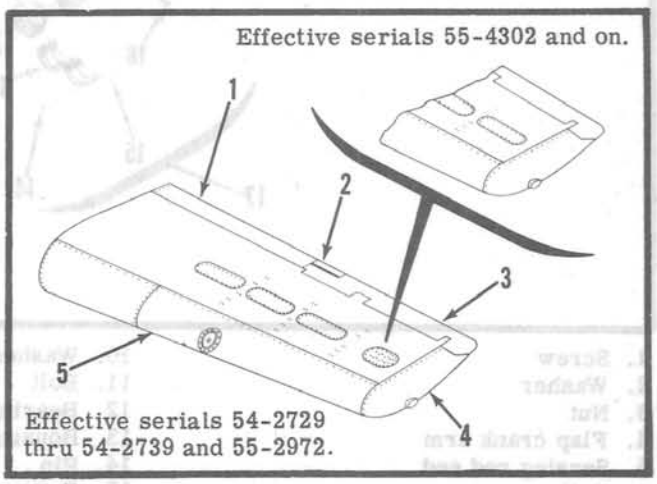
4-57. WING.

4-58. GENERAL. The wings are full cantilever, stressed skin, aluminum alloy structures which bolt, at the wing spar roots, to the front and rear spar carry through structures of the fuselage. Each wing consists of a main structure assembly to which are attached the tip, leading edge, aileron, and flap assemblies. Provisions are made in each wing to accomodate six fuel cells,



1. Dorsal fin
2. Fuselage
3. Lights
4. Stinger
5. Screw
6. Electrical lead

Figure 4-16. Stinger Installation



1. Flap
2. Aileron trim tab
3. Aileron
4. Tip
5. Leading edge

Figure 4-17. Wing Assembly

one retractable main landing gear, one retractable landing light, wing tip navigation lights, flap actuating system components, aileron control system components, and related plumbing, wiring and control cables.

4-59. REMOVAL OF WING. (See figure 4-18.)

a. Discharge the hydraulic system pressure by operating the flaps or the speed brake until the system pressure reads "zero".

Note

If, for any reason, it is not advisable to operate the flaps or speed brake, the accumulator pressure may be discharged by releasing the air charge through the air charging valve on the accumulator.

CAUTION

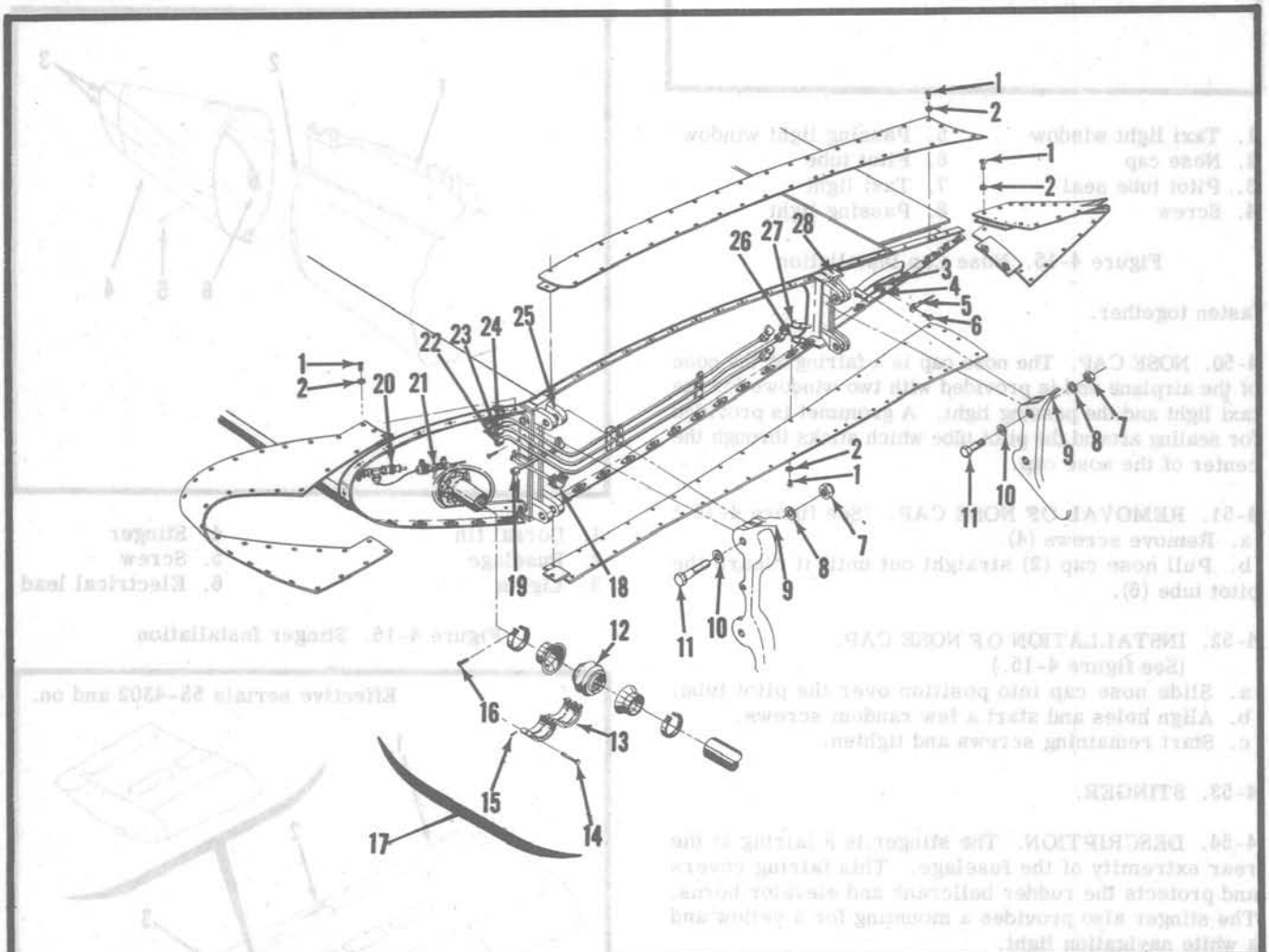
The hydraulic system pressure must be discharged before any hydraulic lines are disconnected to pervent a sudden surge of pressure at the point of disconnection.

b. Defuel the airplane.

c. Remove wing nacelle gap covers 33R, 34R, 36R, and 35R.

d. Disconnect flexible coupling (17) on fuel line connecting wing and fuselage fuel cells. Plug both sides of line.

e. Disconnect gear up and gear down hydraulic lines (24) and (22), brake line (23) and gear emergency extension air line (19). Plug both sides of lines.



1. Screw
2. Washer
3. Nut
4. Flap crank arm
5. Sensing rod end
6. Bolt
7. Nut
8. Washer
9. Carry through fitting
10. Washer
11. Bolt
12. Bearing
13. Housing
14. Pin
15. Cotter pin
16. Screw
17. Flexible coupling
18. Electrical connector
19. Emergency air line
20. Fuel probe tee
21. Fuel probe connector
22. Gear down line
23. Brake line
24. Gear up line
25. Wing Attach fitting
26. Flap down line
27. Flap up line
28. Rear spar fitting

Figure 4-18. Wing Installation

Note

It is unnecessary to relieve pressure in the gear emergency extension air bottle as the air line at the wing root is not under pressure unless the gear emergency extension handle has been operated.

f. Disconnect flap up and flap down hydraulic lines (27) and (26). Plug both sides of lines.

CAUTION

It is necessary to plug all lines to prevent entry of foreign matter into the systems.

g. Disconnect flap position sensing linkage by removing bolt (6) and nut (3) attaching rod end (5) to flap crank arm (4).
h. Disconnect the aileron cables at the turnbuckles. Coil them neatly and tie or tape the coils to the structure to keep the cables out of the way.
i. Disconnect main electrical wire bundle at electrical connector (18).
j. Disconnect the two fuel quantity gage probe (20) and (21).

Note

If wing sling is to be used refer to paragraph 1-7, for attachment.

k. While supporting wing, remove nuts (7), washers (8) and (10), and bolts (11) at each spar root fitting.

CAUTION

Recheck to see that all plumbing, control, and electrical connections are free and clear of surrounding structure.

l. The wing is now detached and may be removed from the airplane.

4-60. INSTALLATION OF WING. (See figure 4-17.)
a. Move wing into position; mate wing front and rear spar fittings to corresponding fuselage fittings and align the bolt holes.

CAUTION

Do not use drift pins or similar tools to align the holes. Such treatment will damage the parts. This can result in later structural failures.

b. Place a washer on each bolt and insert it in the proper spar fitting hole.

WARNING

All flight loads are concentrated on the eight bolts attaching the wings to the fuselage. Only the original bolts or exact replacements stressed to carry these loads shall be used to attach the wings. Use of wrong bolts can result in the loss of a wing in flight.

c. Place a washer and a nut on each bolt.
d. Torque nuts on the front spar fitting to 660-780 inch-pounds.
e. Torque nuts on the aft spar fitting to 480-600 inch-pounds.

CAUTION

Avoid scarring, nicking, or scratching the wing attachment forgings while replacing the wings and torquing nuts and connections. Round out and polish all nicks and scratches.

f. Connect the aileron control cables.

Note

All bolts shall be inserted from front to rear in the airplane, in all cases where the structure permits.

g. Connect electrical connector (18) and fuel quantity gaging system probe leads (20) and (21).
h. Attach flap position sensing rod end (5) to flap crank arm (4).
i. Attach flap (26) and (27), landing gear (22) and (24) and brake (23) hydraulic lines.
j. Attach landing gear emergency extension line (19).
k. Check the hydraulic system reservoir and replenish the fluid as necessary.
l. Charge the hydraulic accumulator with 600 psi air pressure.
m. Operate the complete hydraulic system to eliminate air from the lines. Refill the reservoir as required.
n. Replenish the brake reservoir as required and bleed the system. Refer to T.O. No. 1T-37A-2-5.

Note

If wing sling was used, remove sling.

o. Install wing-to-nacelle gap fairing 33R, 34R, 36R, and 35R.

4-61. WING LEADING EDGE.

4-62. DESCRIPTION. The wing leading edge is a stress-skin structure consisting of an inner and outer skin separated by hat section ribs. It is divided into an inboard and an outboard section. Both sections attach to the spar caps and the wing nose ribs with flush head screws. The leading edges contain fuel cells, with related plumbing and fuel quantity sensing electrical leads. The fuel filler assemblies and fuel nozzle grounding receptacles are located in each wing outboard leading edge.

4-63. REMOVAL OF WING INBOARD LEADING EDGE. (See figure 4-19.)
a. Defuel the airplane.
b. Remove leading edge wing-to-nacelle gap fairing 33.
c. Disconnect fuel line flexible coupling (7).
d. Remove screw (15) holding main electrical bundle clamp (6).
e. Remove screws (13) holding fuel quantity gaging system wire tee connector clamps.
f. Remove clamp (11), disconnect fuel quantity probe wiring at quick disconnect fittings (10).

g. Remove nuts (9), washers (7) and (5), and bolts (4) attaching top and bottom of canted rib flange to main spar fitting.

h. Remove screws (14) holding canted rib flange.

i. Remove screws (16) holding leading edge to spar (17) and leading edge rib.

j. Move leading edge straight out from wing until it is free and clear.

4-64. INSTALLATION OF WING INBOARD LEADING EDGE. (See firure 4-19.)

a. Move tip into position and guide fuel cell interconnects into proper holes.

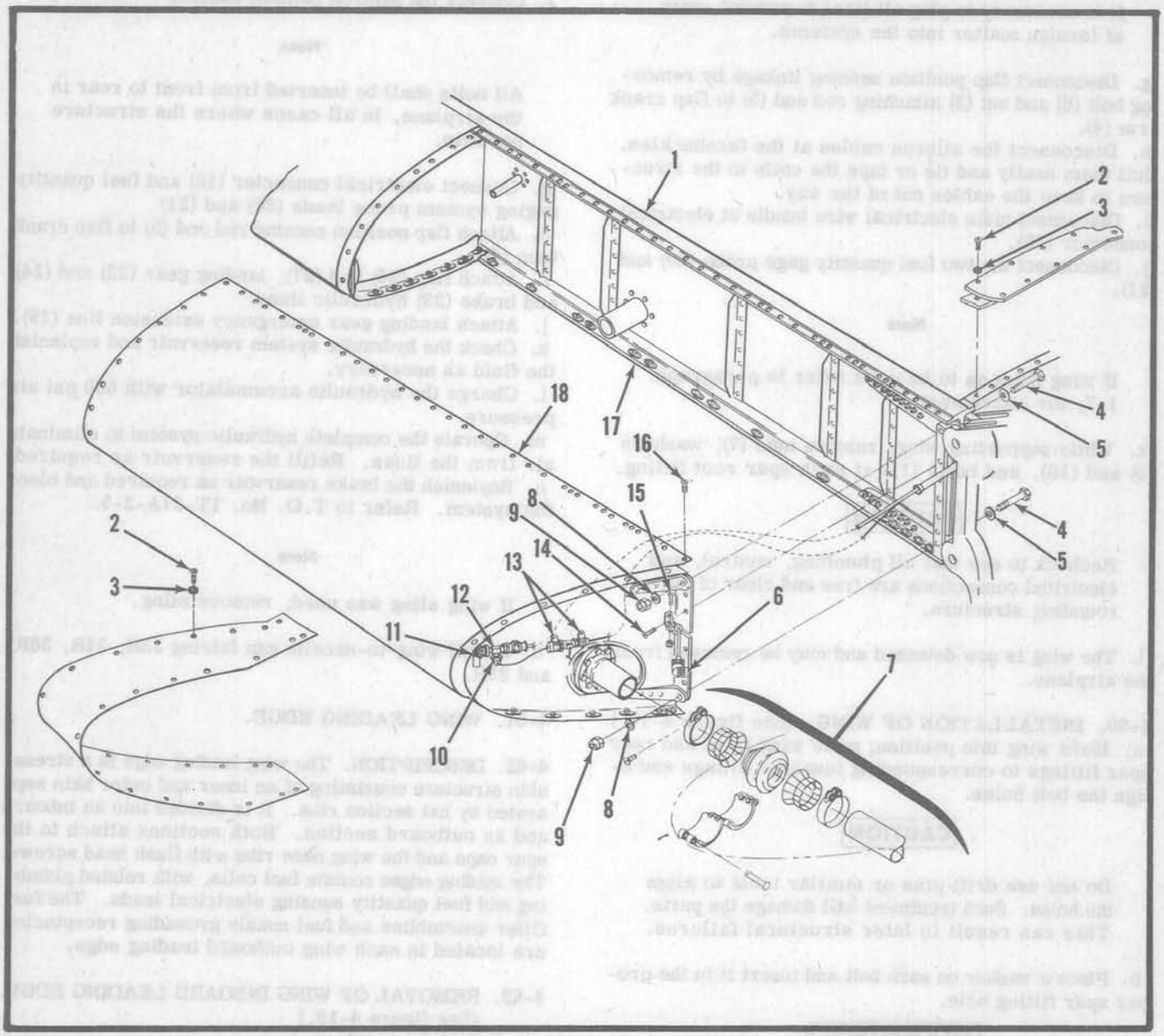
CAUTION

Insure that all "O" rings are in position when mating fuel system interconnects to prevent improper venting and fuel leakage in the wing.

b. Align holes and insert all bolts and screws.

Note

Do not tighten any screw or bolt until holes have been aligned and all screws and bolts started.



1. Wing
2. Screw
3. Washer
4. Bolt
5. Washer
6. Electrical connector
7. Flexible coupling
8. Washer
9. Nut
10. Fuel probe terminal
11. Clamp
12. Fuel probe tee
13. Clamp screw
14. Screw
15. Screw
16. Screw
17. Spar flange
18. Leading edge

Figure 4-19. Wing Inboard Leading Edge Installation

CAUTION

Do not use punches or drift pins to align screw holes as such treatment will stretch the holes out of shape and will damage nut plates.

c. Tighten all screws and bolts.
d. Connect fuel line flexible coupling (7).
e. Connect fuel quantity gaging probe lead (12), install clamp (11) and fuel probe (10).
f. Attach tee connector clamp with screws (13).
g. Attach main electrical bundle clamp with screw (15).

4-65. REMOVAL OF WING OUTBOARD LEADING EDGE. (See figure 4-20.)

a. Defuel airplane.
b. Remove wing access cover 46 and closure bars (3) to interspar fuel cell No. 4.
c. Remove cotter pin retaining check valve (4) on interconnect.
d. Loosen worm clamp (5).
e. Remove screws (7) attaching leading edge to spar caps, and wing tip rib and rib at wing station 91.50.
f. Move wing leading edge straight our from wing until all fuel interconnects are disengaged.

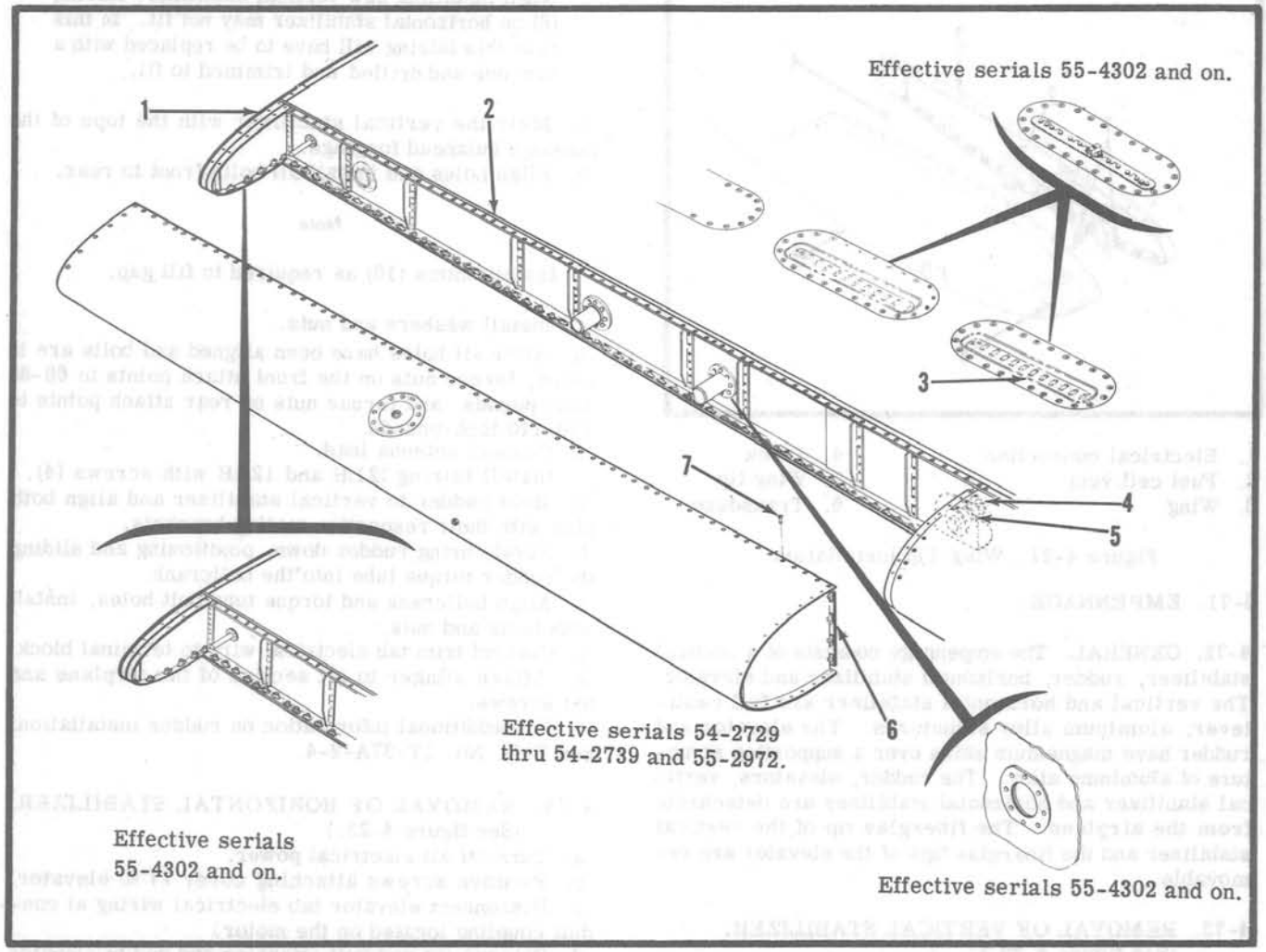
4-66. INSTALLATION OF OUTBOARD LEADING EDGE. (See figure 4-20.)

a. Move leading edge assembly into position and guide fuel cell interconnects into place.

CAUTION

Insure that all "O" rings are in position when mating fuel system interconnects to prevent improper venting and fuel leakage within the wing.

b. Align screw holes and install attaching screws (7).
c. Tighten worm clamp (5).
d. Install check valve (4) and cotter pin.
e. Install closure bars in interspar fuel cell No. 4 and install wing access cover 46.



1. Wing
2. Spar flange
3. Cell closure bar
4. Interconnect check valve
5. Worm clamp
6. Leading edge
7. Screw

Figure 4-20. Wing Outboard Leading Edge Installation

4-67. WING TIP.

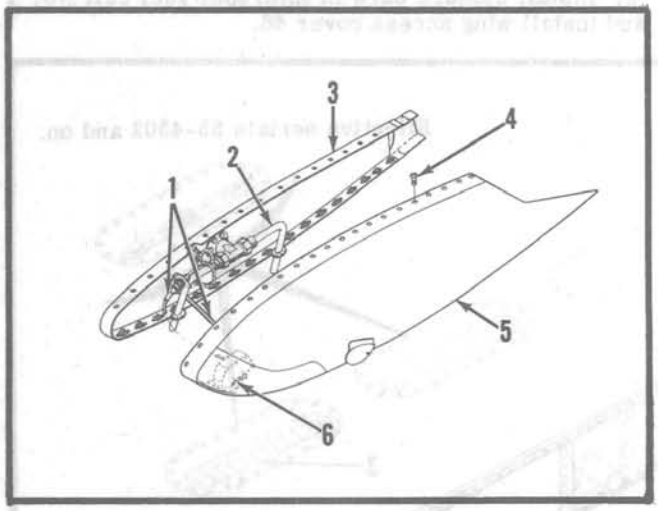
4-68. DESCRIPTION. The wing tips are plastics structures attached to the outboard wing with screws. Each tip conceals a fuel system vent tube and houses a navagation light. In left tip is the spoiler system transducer.

4-69. REMOVAL OF WING TIP. (See figure 4-21.)

a. Support the tip and remove attaching screws (3).
b. Free tip from fuel cell vent tubes (4).
c. Move tip out to give access to navigation light electrical and transducer leads, then disconnect leads.
d. Tip is now completely detached and may be removed from the airplane.

4-70. INSTALLATION OF WING TIP. (See figure 4-21.)

a. Support tip and hold close to wing while electrical wiring is connected.
b. Position vent tubes.
c. Align screw holes and install screws.



1. Electrical connection
2. Fuel cell vent
3. Wing
4. Screw
5. Wing tip
6. Transducer

Figure 4-21. Wing Tip Installation

4-71. EMPENNAGE.

4-72. GENERAL. The empennage consists of a vertical stabilizer, rudder, horizontal stabilizer and elevator. The vertical and horizontal stabilizer are full cantilever, aluminum alloy structures. The elevator and rudder have magnesium skins over a supporting structure of aluminum alloy. The rudder, elevators, vertical stabilizer and horizontal stabilizer are detachable from the airplane. The fiberglas tip of the vertical stabilizer and the fiberglas tips of the elevator are removable.

4-73. REMOVAL OF VERTICAL STABILIZER. (See figure 4-22.)

a. Turn off all electrical power.
b. Remove screws attaching stinger to aft section of airplane.
c. Disconnect trim tab electrical wiring at block located just inside of the aft section.
d. Remove bolts and nuts attaching rudder to bellcrank.
e. Lift rudder torque tube high enough from bellcrank to allow hinge pins to separate from the vertical stabilizer hinge pin brackets.
f. For additional instructions on removing rudder, see T.O. No. 1T-37A-2-4.
g. Remove screws (4) and fairings 12 LH and 12 RH.
h. Disconnect antenna lead.
i. Remove screws (7) from fairing (8).
j. Remove nuts (2), washers (3), and bolts (6) attaching vertical stabilizer rear spar to fuselage bulkhead forging.
k. Remove nuts (12), washers (11), shims (10) and bolts (9) attaching vertical stabilizer front spar to fuselage bulkhead forging.
l. Lift the vertical stabilizer up and to the rear to free it from the airplane.

4-74. INSTALLATION OF VERTICAL STABILIZER. (See figure 4-22.)

Note

When installing new vertical stabilizer, fairing (8) on horizontal stabilizer may not fit. In this case this fairing will have to be replaced with a new one and drilled and trimmed to fit.

a. Mate the vertical stabilizer with the tops of the fuselage bulkhead forgings.
b. Align holes and install all bolts front to rear.

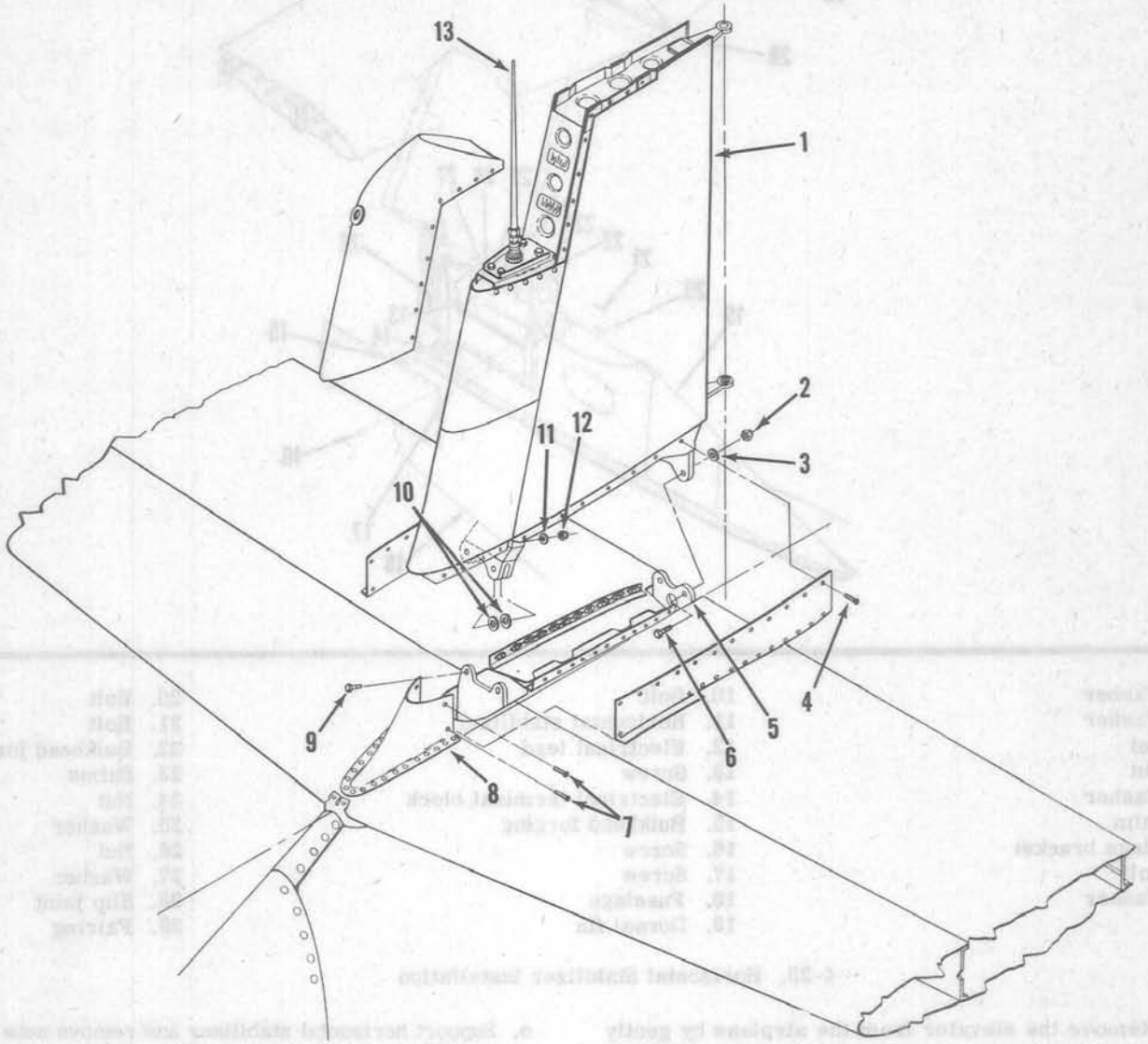
Note

Install shims (10) as required to fill gap.

c. Install washers and nuts.
d. After all holes have been aligned and bolts are in place, torque nuts on the front attach points to 60-85 inch-pounds, and torque nuts on rear attach points to 100-140 inch-pounds.
e. Connect antenna lead.
f. Install fairing 12LH and 12RH with screws (4).
g. Hold rudder to vertical stabilizer and align both pins with their respective mating brackets.
h. Slowly bring rudder down, positioning and sliding the rudder torque tube into the bellcrank.
i. Align bellcrank and torque tube bolt holes, install with bolts and nuts.
j. Connect trim tab electrical wire to terminal block.
k. Attach stinger to aft section of the airplane and set screws.
l. For additional information on rudder installation, see T.O. No. 1T-37A-2-4.

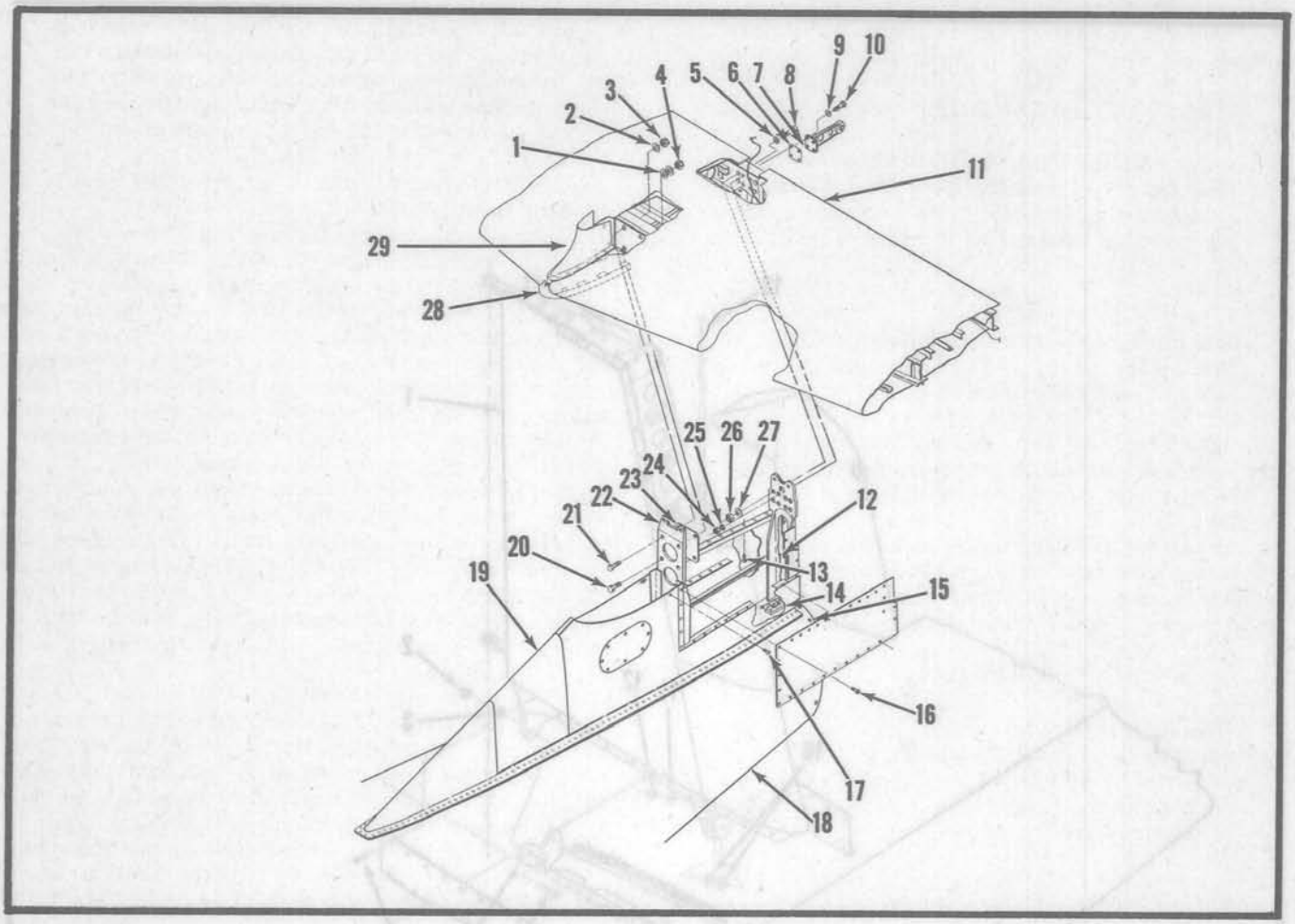
4-75. REMOVAL OF HORIZONTAL STABILIZER. (See figure 4-23.)

a. Turn off all electrical power.
b. Remove screws attaching cover 17 to elevator.
c. Disconnect elevator tab electrical wiring at conduit coupling located on the motor.
d. Remove nut and bolt attaching rod end to elevator horn.
e. Remove nuts and bolts attaching bracket and hinge to elevator horns.
f. Support elevators and remove remaining nuts, spacers, and bolts which hold the two elevator horns together.



1. Vertical Stabilizer
2. Nut
3. Washer
4. Screw
5. Bulkhead forging
6. Bolt
7. Screw
8. Fairing
9. Bolt
10. Shims
11. Washer
12. Nut
13. Antenna

Figure 4-22. Vertical Stabilizer Installation



1. Washer
2. Washer
3. Nut
4. Nut
5. Washer
6. Shim
7. Hinge bracket
8. Bolt
9. Washer
10. Bolt
11. Horizontal stabilizer
12. Electrical lead
13. Screw
14. Electrical terminal block
15. Bulkhead forging
16. Screw
17. Screw
18. Fuselage
19. Dorsal fin
20. Bolt
21. Bolt
22. Bulkhead forging
23. Shims
24. Nut
25. Washer
26. Nut
27. Washer
28. Slip joint
29. Fairing

4-23. Horizontal Stabilizer Installation

g. Remove the elevator from the airplane by gently sliding each half outboard until the hinge pins are free of the hinge brackets.

h. For further details on elevator removal, see T.O. No. 1T-37A-2-4.

i. Remove the elevator in accordance with T.O. No. 1T-37A-2-4.

j. Remove dorsal access cover 15 below left hand side of stabilizer.

k. Remove screws (12) below the right side of the horizontal stabilizer.

l. Detach electrical lead (12) at dorsal terminal block (14).

m. Remove screws on each side of horizontal stabilizer slip joint (28).

n. Detach elevator bracket assembly (7) by removing attaching bolts (10), washers (9) and (25), shims (6) and nuts (24).

o. Support horizontal stabilizer and remove nuts (26), washers (5) and (27) and bolts (8) attaching rear spar to the fuselage bulkhead forging.

p. Remove nuts (3) and (4), washers (1) and (2), shims (23) and bolts (20) and (21), attaching front spar to bulkhead forging.

q. The horizontal stabilizer is now free of the airplane and may be lifted out.

4-76. INSTALLATION OF HORIZONTAL STABILIZER. (See figure 4-23.)

Note

When installing new horizontal stabilizer, fairing (29) may not fit vertical stabilizer. In this case the fairing must be replaced with a new one and drilled and trimmed to fit.

a. Move the stabilizer into position and lower into place.

CAUTION

Guide stabilizer into position from beneath to insure that slip joint (28) goes into place inside dorsal fin structure (19) without cutting or damaging skin around dorsal fin opening.

Note

Bolts in the rear spar attach fitting must be installed from rear to front to provide wrench clearnaces for the nuts.

b. Insert bolts (8) and washers (5) in attach holes in the rear fuselage bulkhead forging and horizontal stabilizer rear spar. Install washers (27) and set nuts (26) finger tight.

c. Install the elevator bracket assembly (7) with shims (6) between the bracket and the elevator spar. Install bolts (10), washers (9) through spar and fuselage bulkhead forging. Install washers (25) and nuts (24).

CAUTION

Replace exactly the same thickness of shims which has been removed, when installing shimmed parts. Failure to shim properly will create distortions which can cause the eventual failure of the structure.

d. Install shims (23), bolts (20), washers (1) and (2) and nuts (3) and (4) in the front spar-to-fuselage bulkhead forging attach points.

e. Torque nuts on horizontal stabilizer front spar attachment bolts (3) and (4), to 290-410 inch-pounds.

f. Torque nuts (26) on horizontal stabilizer rear spar attaching bolts (8) to 480-690 inch-pounds.

g. Torque nuts (24) on elevator bracket assembly attaching bolts (10) to 50-70 inch-pounds.

h. Install screws (13) in fairing under the right hand side of the horizontal stabilizer.

i. Attach the horizontal stabilizer electrical lead (12) to terminal block (14).

j. Install dorsal access cover (15) and secure with screw (16).

k. Install screws (17) in the horizontal stabilizer slip joint (28).

l. Position elevators to horizontal stabilizer and slide inboard so that pins mate properly with hinge bracket.

m. Support elevators and install bolt, spacer and nut, joining them at the center.

n. Fasten hinge and bracket to the elevator horn with nuts and bolts.

o. Connect electrical wire to actuator motor.

p. Attach access panel 17 to elevator.

Note

Nut and bolt torque values cannot be accurately determined on old installations where the nut has had a chance to set and "freeze" on the bolt or stud. When the maintenance procedure requires checking nut and bolt torques only, the procedure is to slack off on the nuts in question and re-torque to the correct values given.

q. See T.O. No. 1T-37A-2-4 for further details on elevator installation.

4-77. POWER CONTROL SYSTEM. The power control system consists of two power control quadrants, each mounting a power control lever for each engine. One quadrant is located against the left hand fuselage wall and the other is mounted in the center of the cockpit between the seats. The quadrants are linked together to provide control of the engines from either quadrant. Through a system of levers, push-pull tubes and a proprietary, flexible push-pull control system, motion applied to the power control levers on the quadrants is transmitted to the engine fuel control unit which meters fuel to the engine. The fuel control unit meters fuel in accordance with the engine's need, compensating for the altitude, airspeed, compression ratio of the engine and ambient air temperature, Service instructions for the power control system are found in T.O. No. 1T-37A-2-5.

4-78. BRAKE CONTROL SYSTEM. The brakes are controlled by toe pressure on the rudder pedals. This toe pressure is communicated via linkages to a master cylinder on each of the four rudder pedals. The right or left main wheel brake is controlled respectively by the right or left rudder pedal of each set of rudder pedals. The master cylinders are fed by a reservoir opening on the top right hand side of the fuselage just aft of the right nose access door. The parking brake is controlled by a handle located on the left end of the switch panel. The parking brakes are set by applying toe pressure to both rudder pedals and pulling out on the parking brake handle. The parking brake is released by depressing brake pedals. Refer to T.O. No. 1T-37A-2-3 for service and maintenance instructions.

4-79. POWER STEERING. The power steering system consists of a hydraulic cylinder and valve assembly which drives the nose gear. The cylinder and valve assembly is controlled by a mechanical system linked to the rudder pedals. Hydrualic power is drawn from the main hydraulic system. A selector switch on either control stick grip cuts the system in or out as required at any time the airplane is on the ground. The system automatically cuts out and returns the nose wheel to the center position when the airplane leaves the ground. Suitable controls have been provided for power on and power off conditions and for fail safe operation. The system provides smooth handling of the airplane in all conditions from the low speed high rate of turns required in taxiing and parking to the high speed low rate of turns required in landing and take-off conditions. The system permits wheel castering necessary for towing and ground handling operations. For deatils on maintenance and repair of the power steering system see T.O. No. 1T-37A-2-3.

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T.O. NO. 1T-37A-2-3

HANDBOOK

MAINTENANCE INSTRUCTIONS

HYDRAULICALLY OPERATED SYSTEMS AND UTILITY SYSTEMS

USAF SERIES

T-37A

AIRCRAFT

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PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE

McCORMICK-ARMSTRONG, WICHITA, 1100, 8-6-56

31 MARCH 1956

REVISED 30 JUNE 1956

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*34	30 June 1956
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*36	30 June 1956
*37	30 June 1956
*38	30 June 1956
*38A	30 June 1956
*39	30 June 1956
*41	30 June 1956
*42	30 June 1956
*43	30 June 1956
*45	30 June 1956
*46	30 June 1956
*47	30 June 1956
*49	30 June 1956
*51	30 June 1956
*53	30 June 1956
*57	30 June 1956
*58	30 June 1956
*58A	30 June 1956

* The asterisk indicates pages revised, added or deleted by the current revision.

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HYDRAULICALLY OPERATED SYSTEMS AND UTILITY SYSTEMS

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INTRODUCTION

This handbook is one of a series of handbooks of T.O. No. 1T-37A-2 sectionalized maintenance handbook. The information given covers operational check out, removal, installation and adjustments of the hydraulically operated systems and the utility systems for use by line maintenance personnel. Illustrations, schematic diagrams and operational diagrams have been used throughout the handbook to supplement the text. The following is a list of other handbooks of the T.O. No. 1T-37A-2 sectionalized maintenance handbook.

T.O. No. 1T-37A-2-1	General Airplane
T.O. No. 1T-37A-2-2	Ground Handling, Servicing and Airframe Group Maintenance
T.O. No. 1T-37A-2-4	Flight Control Systems
T.O. No. 1T-37A-2-5	Power Plant, Fuel System and Oil System
T.O. No. 1T-37A-2-6	Instruments, Radio, Communication and Navigation Equipment
T.O. No. 1T-37A-2-7	Electrical System
T.O. No. 1T-37A-2-8	Wiring Diagrams and Data

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SECTION I
HYDRAULICALLY OPERATED SYSTEMS

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1-1. HYDRAULIC SYSTEM.

1-2. GENERAL DESCRIPTION. The hydraulic power system supplies, on demand, 1500 PSI operational power for the hydraulically operated components of the aircraft. The primary units incorporated in this system are the hydraulic reservoir, accumulator and two engine driven pumps. The system is protected by a filter, pressure regulator and relief valve.

1-3. OPERATION. The hydraulic reservoir supplies hydraulic fluid to the engine driven pumps which pressurize the system. A constant 1500 PSI pump output is maintained by the pressure regulator and the pressure relief valve protects the system in case of regulator failure. The accumulator holds reserve fluid under pressure for ground operation or pump failure, and provides a cushioning effect during normal operation. The system supplies hydraulic pressure for the operation of the fuel control shutoff valves, spoilers, speedbrake, thrust attenuators, landing gear, intake screens, power steering system, and flaps. A hydraulic fuse

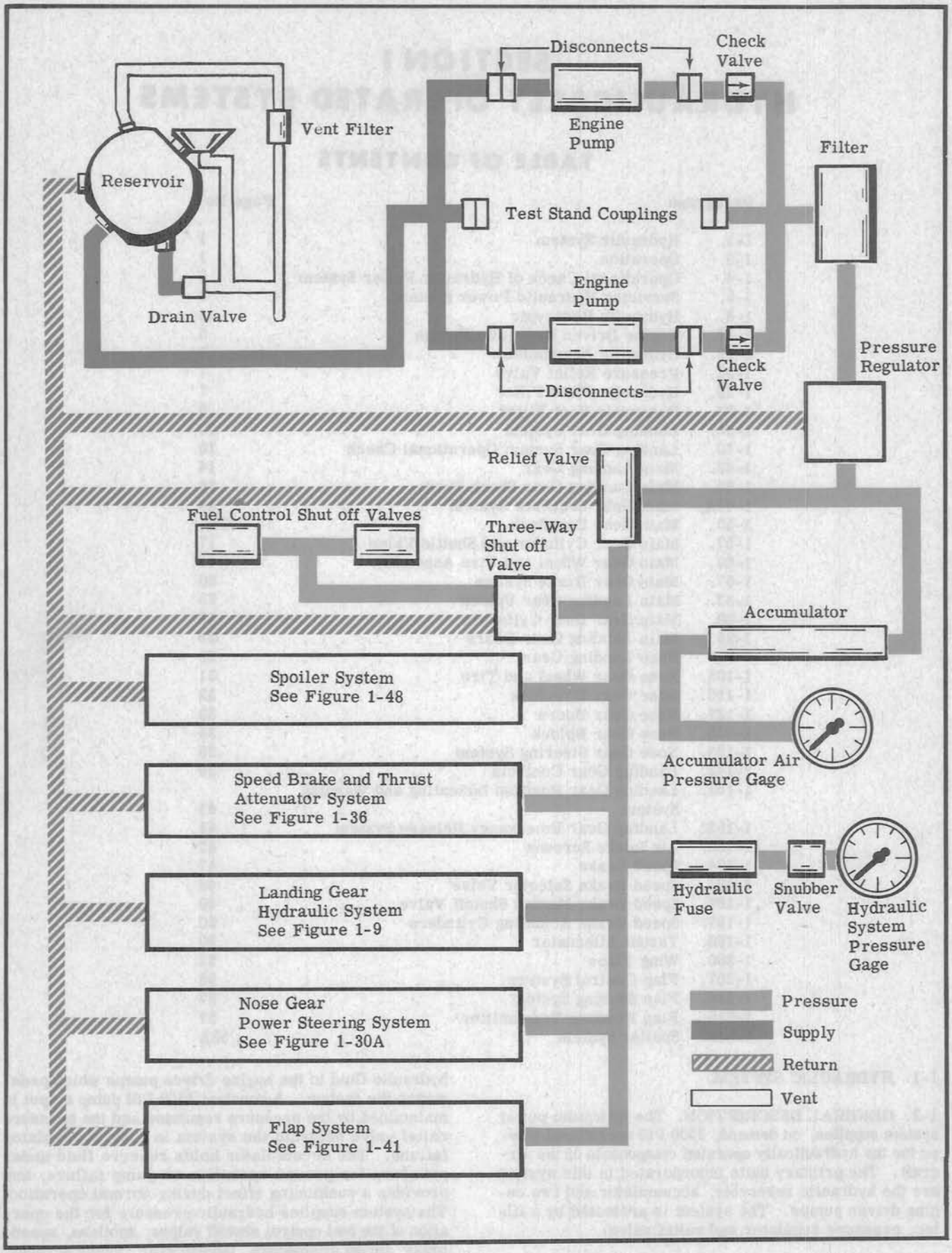


Figure 1-1. Hydraulic System Schematic

prevents excessive fluid loss through a leaking pressure indicator.

1-4. OPERATIONAL CHECK OF HYDRAULIC POWER SYSTEM.

Note

To check fuel control shutoff valves at least one engine must be operating. The rest of the system may be checked with a hydraulic test stand. (See figure 1-1.)

a. Check hydraulic reservoir and accumulator for servicing. Check flap area and speed brake area for obstructions or improper adjustment.
b. To check for proper operation of hydraulic power system, connect DC power and pressurize hydraulic system using either the engine driven pumps or a hudraulic auxiliary power unit.
c. During check out of the hydraulically operated systems, the entire system must be operated for at least 10 minutes to insure filtration of all hydraulic fluid. After each operation, system pressure should return to 1500 ±250 PSI.

1-5. SERVICING HYDRAULIC POWER SYSTEM.

a. Operate flaps or speed brake until hydraulic pressure gage reads zero. Remove door 7 and read accumulator pressure gage. If reading is below 575 PSI, charge accumulator to 600 ±25 PSI.
b. With landing gear down, flaps and speed brake up, and spoilers and attenuators retracted, open reservoir access door and check reservoir gage tube fluid level:
1. With hydraulic system pressure at zero, level mark number one indicates full and mark number three indicates fluid level low.
2. With the hydraulic system pressurized, level mark number two indicates full and mark number four indicates fluid level low. If fluid level is low, refill with hydraulic fluid MIL-O-5606.
c. To drain reservoir, remove door 7, place a two-gallon container under the drain tube, and open drain valve. To drain system lines, disconnect them at several low points.

1-6. HYDRAULIC GROUND TEST STAND PROVISIONS. (See figure 1-2.) Test stand couplings are located aft of the rear spar carry thru above door 7. Hand, gasoline, or electrically powered test stands may be used. To use test stand:
a. Remove door 7.
b. Remove coupling caps and connect test stand lines to couplings.
c. Follow instructions on hydraulic ground test data plate mounted behind the couplings on the firewall.

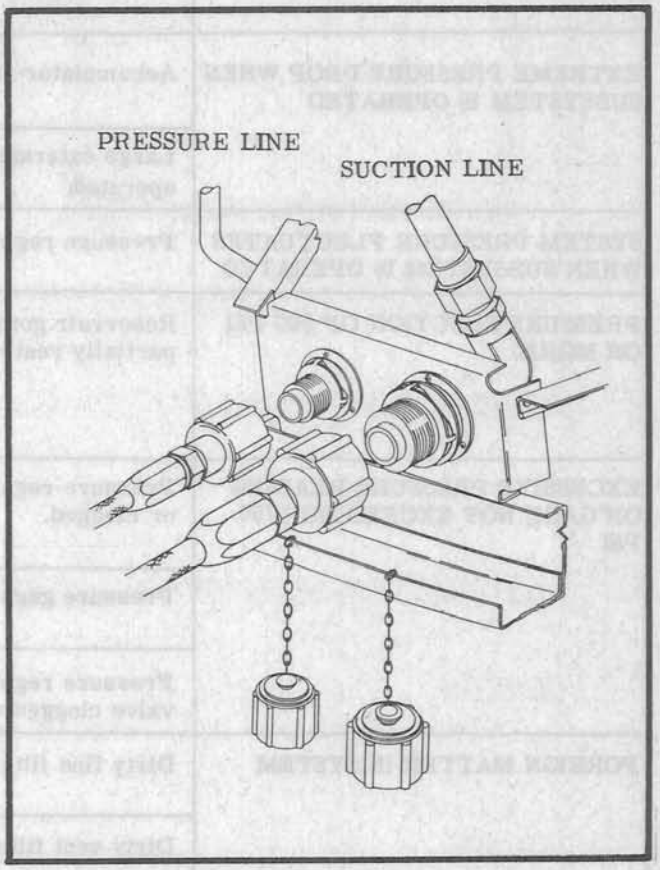


Figure 1-2. Hydraulic Auxiliary Power Unit Connection

1-7. TROUBLE SHOOTING HYDRAULIC SYSTEM.

TROUBLE	PROBABLE CAUSE	REMEDY
NO HYDRAULIC PRESSURE INDICATION WITH SYSTEM OPERATING	Reservoir empty.	Fill reservoir to proper level.
	Pressure gage defective or hydraulic fuse closed.	Test instrument and reset fuse.
	Defective pressure regulator.	Replace pressure regulator.
	Defective relief valve.	Replace relief valve.
	Hydraulic pumps inoperative or quick disconnect fitting loose or defective.	Tighten quick disconnects and operate pump to check for pressure. If trouble still exists, remove and replace pumps.
SYSTEM PRESSURE LOW, NO EXTERNAL LEAKAGE EVIDENT, STEADY INDICATION	Defective engine driven hydraulic pump.	Disconnect pumps one at a time and operate system. If either pump is defective remove and replace.

TROUBLE	PROBABLE CAUSE	REMEDY
	Pressure relief valve out of adjustment.	Replace pressure relief valve.
	Defective pressure regulator.	Remove and replace pressure regulator.
	Slow internal leak in subsystem, probably a selector valve.	Operate subsystem to determine which one is leaking. Cap off selector valve suspected of leaking and pressurize system.
EXTREME PRESSURE DROP WHEN SUBSYSTEM IS OPERATED	Accumulator not fully charged.	Charge accumulation and check for air leakage at accumulator.
	Large external leak in subsystem operated.	Check for external leakage.
SYSTEM PRESSURE FLUCTUATES WHEN SUBSYSTEM IS OPERATED	Pressure regulator defective.	Remove and replace regulator.
PRESSURE FLUCTION OF 500 PSI OR MORE.	Reservoir going empty or outlet partially restructed.	Service reservoir. If trouble still exists, open line at pump inlet and check for fluid flow. If fluid does not run out rapidly, remove and clean reservoir.
EXCESSIVE PRESSURE READING ON GAGE NOT EXCEEDING 1750 PSI	Pressure regulator stick, closed or clogged.	Flush regulator and test. If trouble still exists remove and replace regulator.
	Pressure gage defective.	Test gage, if found defective remove and replace.
	Pressure regulator and relief valve clogged or stuck closed.	Remove and replace pressure regulator and relief valve.
FOREIGN MATTER IN SYSTEM	Dirty line filter.	Remove filter element and replace with clean element.
	Dirty vent filter.	Remove filter element and replace with clean element.

1-8. HYDRAULIC RESERVOIR. The hydraulic reservoir probides a reserve supply of fluid for operation of the hydraulic system and also acts as a cooling tank during extended operation. The tank is sphere shaped with a funnel filler neck which is positioned beneath the reservoir filler access door on the right side of the fuselage. The hydraulic pump intake and return lines are connected to fittings which are installed in bosses on the reservoir. The intake fitting is connected to a pendulous intake hose which is inserted into the tank, this corrugated hose is weighted on the end so that fluid will be picked up from the lowest point in the reservoir no matter what the attitude of the aircraft. Reservoir vent and drain fittings are installed in threaded bosses provided in the reservoir, the drain fitting includes a drain valve which will drain the reservoir completely when opened. A wire mesh screen is mounted inside the reservoir below the filler cap to strain the hydraulic fluid during filling of the reservoir. An indication of the amount of reserve fluid left in the tank is provided by a sight gage. The sight gage consists of a glass tube held in place by two nuts installed on elbow fittings on the reservoir.

1-9. REMOVAL OF HYDRAULIC RESERVOIR. (See figure 1-3.)

CAUTION

Before disconnecting any hydraulic pressure line the hydraulic system should be discharged by operating the speed brake or flaps until the pressure gage reads zero. This will prevent a sudden surge of fluid from emerging when a line is disconnected.

a. Remove door 7.
b. Drain fluid from reservoir in accordance with paragraph 1-5.
c. Disconnect and plug all lines from reservoir.
d. Remove attaching screws from support angles.
e. Remove reservoir with brackets and support angles from airplane.

1-10. DISASSEMBLY AND MAINTENANCE OF HYDRAULIC RESERVOIR. (See figure 1-3.)

a. Remove the filler cap and the "O" ring. Inspect

for deterioration and replace if necessary.

b. Remove retainer ring and lift strainer from reservoir.

c. Inspect strainer for rips or tears and blow out any sediment with compressed air.

d. Remove pendulous intake fitting from reservoir and inspect hose for deterioration.

e. Remove sight tube gage by disconnecting nuts at each end.

f. Inspect tube for cracks and check level markings for clarity. If tube is cracked or markings are indistinct replace with new tube.

g. Inspect all fittings for damaged threads, replace as required.

h. Inspect reservoir for cracks or dents.

i. Wash all parts in kerosene.

CAUTION

Do not use aromatic fuels such as JP-4 to clean hydraulic system parts. These fuels will cause excessive swelling and rapid deterioration of the rubber parts of this system.

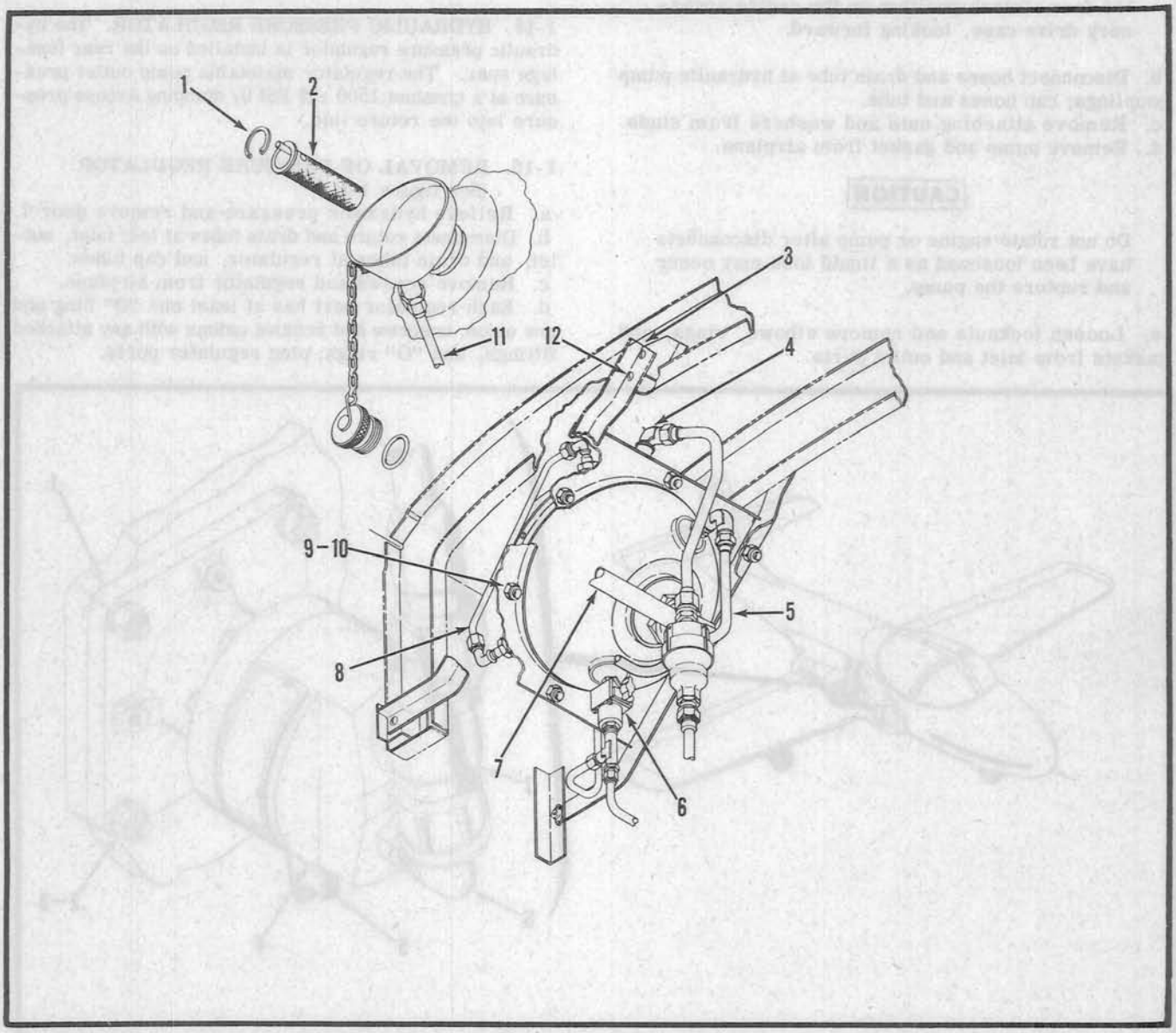
1-11. ASSEMBLY AND INSTALLATION OF HYDRAULIC RESERVOIR. (See figure 1-3.)

a. Install strainer, retainer ring, "O" ring, and filler cap.

b. Install sight gage tube.

c. Screw reservoir support angles to bulkhead.

d. Connect vent line, supply line, scupper drain line, drain valve, and return line to reservoir.



1. Retainer ring
2. Strainer
3. Support angle
4. Vent line
5. Return line
6. Drain Valve
7. Supply line
8. Sight gage tube
9. Screw
10. Nut
11. Overflow drain tube
12. Screw

Figure 1-3. Hydraulic Reservoir Installation

1-12. ENGINE DRIVEN HYDRAULIC PUMPS. The hydraulic pumps are located on the accessory drive section of each engine and supply a constant flow of fluid, under pressure, to the hydraulic system. The pumps are variable displacement, piston type, with flow ratings of 1.40 GPM and 1500 PSI at 3750 RPM. Quick disconnect couplings are provided in the outlet and inlet lines of the pumps for ease of removal.

1-13. REMOVAL OF HYDRAULIC PUMPS. (See figure 1-4.)

a. Relieve hydraulic pressure and remove door 38.

Note

The hydraulic pump mounting pad is located at the four o'clock position on the engine accessory drive case, looking forward.

b. Disconnect hoses and drain tube at hydraulic pump couplings; cap hoses and tube.
c. Remove attaching nuts and washers from studs.
d. Remove pump and gasket from airplane.

CAUTION

Do not rotate engine or pump after disconnects have been loosened as a liquid lock may occur and rupture the pump.

e. Loosen locknuts and remove elbows, rings, and gaskets from inlet and outlet ports.
f. Remove nipple and gasket from drain port.
g. Plug ports.

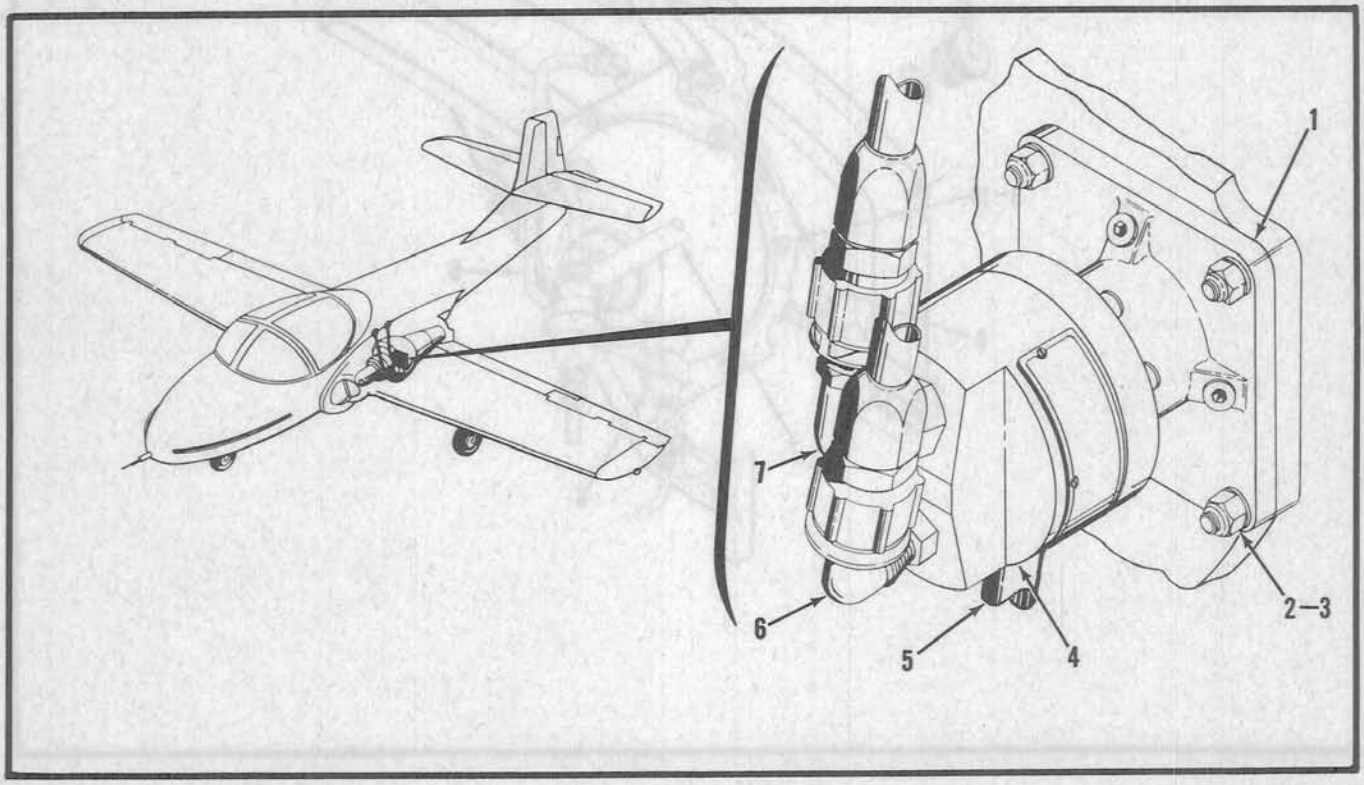
1-14. INSTALLATION OF HYDRAULIC PUMPS. (See figure 1-4.)

a. Unplug ports; check for damage or foreign matter.
b. Install in outlet and inlet ports; gaskets, rings, unions with locknuts, gaskets, elbows, rings, gaskets, nuts, and coupling halves. Make sure the larger coupling half is installed on the inlet port.
c. Install gasket and nipple in drain port.
d. Place gasket and pump on mounting pad; if splines do not align, rotate engine turbine slightly by hand. Secure with washers and nuts; torque to 50-70 IN. LB.
e. Install inlet, outlet, and drain lines.
f. Install door 38.

1-15. HYDRAULIC PRESSURE REGULATOR. The hydraulic pressure regulator is installed on the rear fuselage spar. The regulator maintains pump outlet pressure at a constant 1500 ±25 PSI by dumping excess pressure into the return line.

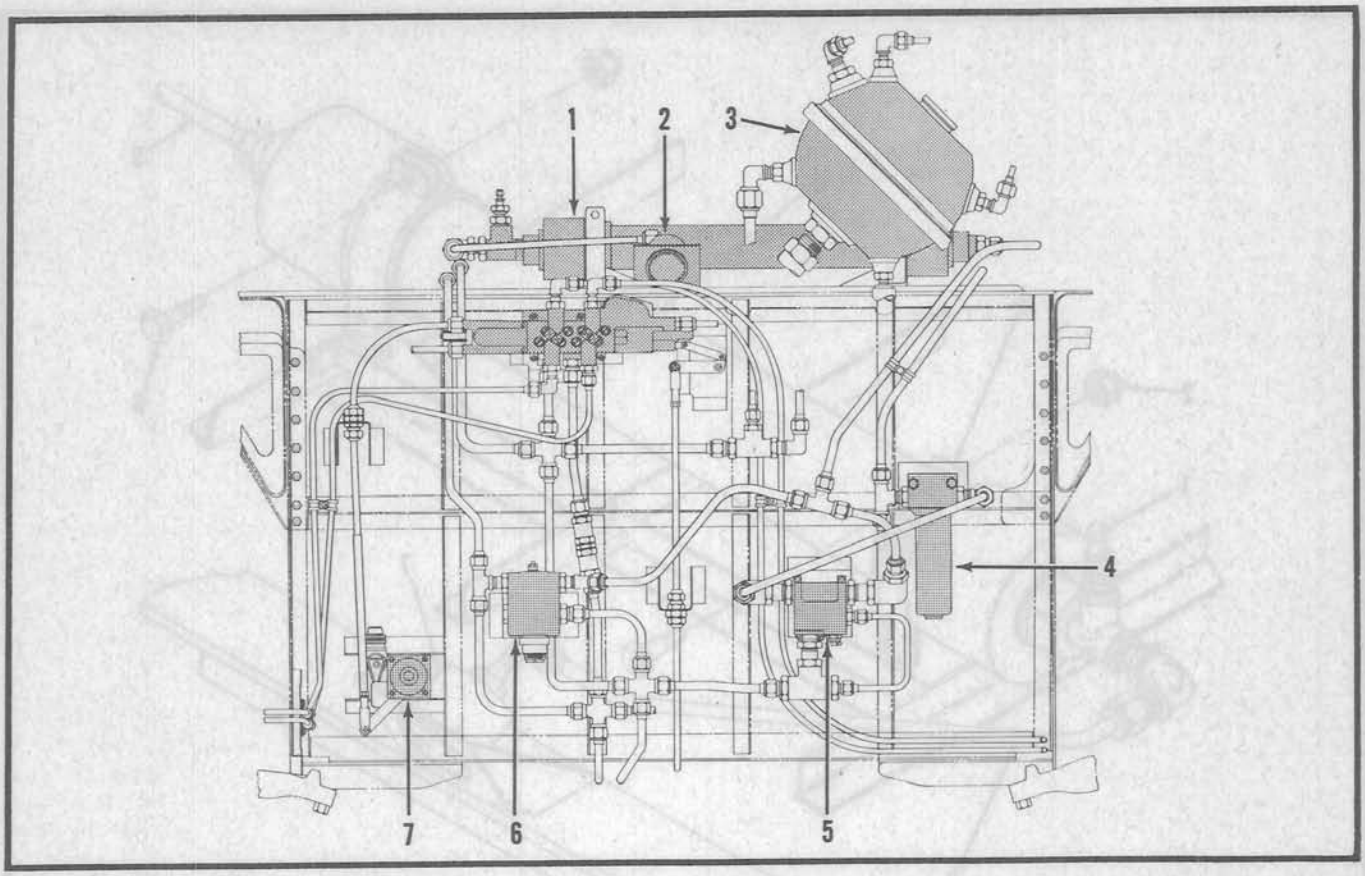
1-16. REMOVAL OF PRESSURE REGULATOR. (See figure 1-5.)

a. Relieve hydraulic pressure and remove door 7.
b. Disconnect return and drain tubes at tee; inlet, outlet, and drain tubes at regulator, and cap tubes.
c. Remove screws and regulator from airplane.
d. Each regulator port has at least one "O" ring and one union: unscrew and remove unions with any attached fittings, and "O" rings; plug regulator ports.



1. Gasket
2. Nut
3. Washer
4. Pump
5. Drain
6. Outlet
7. Inlet

Figure 1-4. Hydraulic Pump Installation



1. Hydraulic accumulator
2. Hydraulic accumulator gage
3. Hydraulic reservoir
4. Fluid filter
5. Pressure regulator
6. Relief valve
7. Flap position transmitter
8. Flap synchronizing valve

Figure 1-5. Rear Spar Hydraulic Units Installation

1-17. INSTALLATION OF PRESSURE REGULATOR. (See figure 1-5.)

a. Unplug regulator ports; install "O" rings; install unions with any attached fittings in the proper ports of the regulator.
b. Attach regulator to bracket with screws.
c. Uncap all tubes.
d. Connect return and drain tubes at tee; connect inlet, outlet, and drain tubes at regulator.
e. Perform operational check of hydraulic system in accordance with paragraph 1-4.

1-18. (Deleted)

1-19. HYDRAULIC ACCUMULATOR. The accumulator is located forward of the fuselage rear spar bulkhead above the fuselage fuel cell. The accumulator is a pneumatic piston type with a fluid capacity of 60 CU IN., and is charged with 600 PSI air pressure. When the hydraulic pumps build up pressure the piston is forced toward the air inlet port, further compressing the air in the chamber. When a unit in the system is actuated and system pressure drops, the accumulator piston forces a volume of fluid into the system until all reserve fluid has been expelled. This supplies a cushion and reserve at all times. There is an accumulator pressure gage connected to the air filler valve which indicates the pressure in the air chamber of the accumulator at all times.

1-20. REMOVAL OF HYDRAULIC ACCUMULATOR. (See figure 1-6.)

WARNING

Never loosen or disconnect any lines at accumulator before relieving hydraulic pressure and air pressure.

a. Relieve hydraulic pressure and remove door 7.
b. Remove air valve cap; turn 5/8 inch nut counterclockwise to a maximum of 3/4 turn; wait until pressure gage indicates zero.

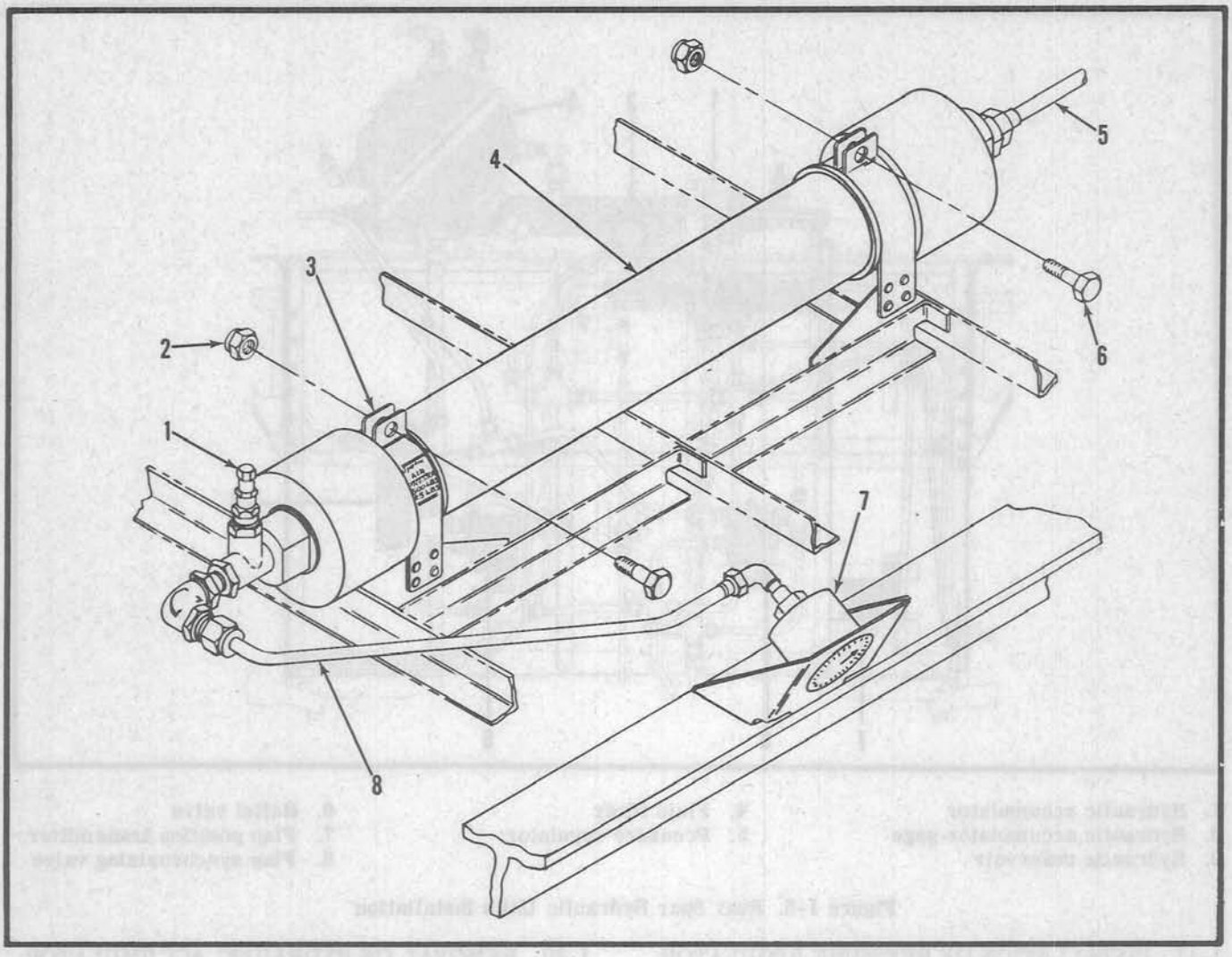
WARNING

Do not loosen 3/4 inch nut when accumulator has air pressure.

c. Disconnect gage tube and pressure tube at accumulator; cap tubes.
d. Remove nuts and bolts from accumulator brackets; remove accumulator with fittings from airplane.
e. Remove reducer and gasket from fluid port; remove bolt, body, valve, and gasket from air port; plug ports.

1-21. INSTALLATION OF HYDRAULIC ACCUMULATOR. (See figure 1-6.)

a. Unplug accumulator ports; install gasket and reducer



1. Air valve
2. Nut
3. Clamp
4. Accumulator
5. Pressure tube
6. Bolt
7. Pressure gage
8. Gage tube

Figure 1-6. Hydraulic Accumulator and Gage Installation

in fluid port; install gasket, body with air valve, and bolt in air port.

b. Place accumulator in brackets with air valve on the left and secure with nuts and bolts.

c. Uncap tubes and connect gage tube and pressure tube at accumulator.

d. With valve cap removed, 3/4 inch nut tightened to 100-110 inch-pounds, and 5/8 inch nut loosened to a maximem of 3/4 of a counterclockwise turn, charge accumulator to 600 ±5 PSI.

e. Tighten 5/8 inch nut to 50-70 inch-pounds, remove air chuck, replace and tighten valve cap to extreme finger tightness.

f. Perform operational check of hydraulic system in accordance with paragraph 1-4.

1-22. PRESSURE RELIEF VALVE. The pressure relief valve protects the system from extreme pressures due to pressure regulator failure. When pressure exceeds the 1750 PSI valve setting, a poppet is unseated to permit flow through the valve to the return line. Adjustment is not permitted. If the valve fails, replace it.

1-23. REMOVAL OF PRESSURE RELIEF VALVE. (See figure 1-5.)

a. Relieve hydraulic pressure and remove door 7.
b. Disconnect and cap tubes at valve fittings.
c. Remove screws, spacers and relief valve.
d. Remove fittings and gaskets from ports; plug ports.

1-24. INSTALLATION OF PRESSURE RELIEF VALVE. (See figure 1-5.)

a. Unplug ports and install gaskets and fittings.
b. Attach valve to bracket with screws and spcaers.
c. Uncap tubes and connect to valve fittings.
d. Perform operational check of hydraulic system in accordance with paragraph 1-5.

1-25. HYDRAULIC FLUID FILTER. The hydraulic fluid filter is mounted on the fuselage rear spar bulkhead near the right side, and filters all fluid from the pressure side of the pump. The hydraulic fluid filter

is a replaceable element, line type with a three GPM flow capacity. The filter incorporates a relief valve which is set to open at 50 ±5 PSI differential pressure in the event of the filter element becoming clogged with foreign matter. The replaceable filter element is constructed of specially treated cellulose, formed in vertical corrugations, bonded to an inlet bushing at the top, and sealed by a metal plate at the bottom. The inlet bushing fits over an inlet boss in the filter head which has a rubber seal around it to prevent leakage between the head and the element. The filter element case is externally threaded at the upper end with a smooth sealing surface at the top.

1-26. REMOVAL OF HYDRAULIC FLUID FILTER. (See figure 1-7.)

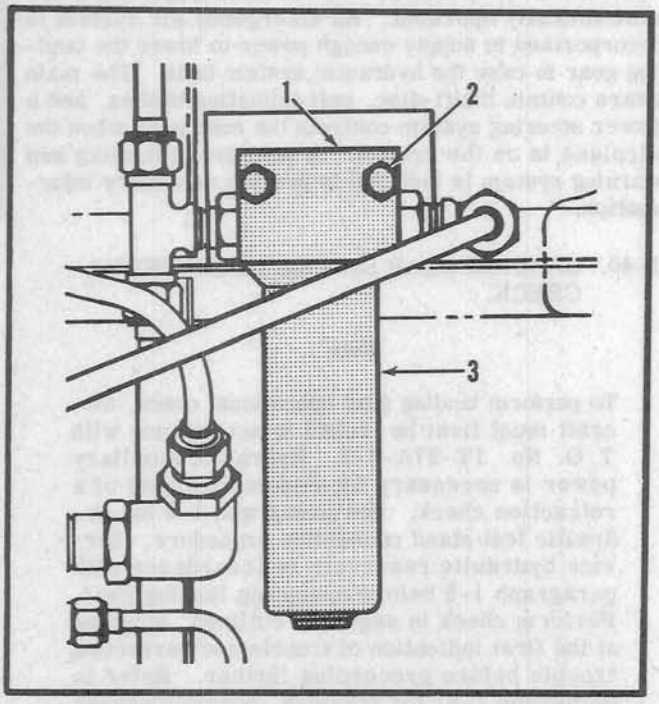
a. Relieve hydraulic pressure and remove door 7.
b. Disconnect pressure regulator supply tube at filter elbow; disconnect pressure tube and pressure quick disconnect tube at filter tee; cap tubes.
c. Remove bolts and filter from the airplane.
d. Remove tee, nut, gasket, and ring from filter inlet; plug ports.

1-27. REPLACEMENT OF FILTER UNIT. (See figure 1-7.)

a. Relieve hydraulic pressure and remove door 7.
b. Cut safety wire between head and case; unscrew case from head; and carefully pull filter element from head.
c. Push replacement element carefully into filler head; screw case into head until it bottoms.

CAUTION

Do not over-tighten filter case.



1. Head 2. Bolt 3. Case

Figure 1-7. Hydraulic Fluid Filter Installation

d. Safety wire case to head.
e. Install door 7.
f. Perform operational check in accordance with paragraph 1-4.

1-28. INSTALLATION OF HYDRAULIC FLUID FILTER. (See figure 1-7.)

a. Install ring, gasket, nut, and tee in filter inlet; install ring, gasket, nut, and elbow in filter outlet.
b. Install filter in airplane with bolts.
c. Uncap tubes; connect pressure quick disconnect tube and pressure tube at filter tee; connect pressure regulator supply tube at filter elbow.
d. Perform operational check in accordance with paragraph 1-4.

1-29. HYDRAULIC FUSE. A hydraulic fuse stops fluid flow to the hydraulic pressure gage after ten cubic inches of fluid have passed through it; however, when the fuse inlet pressure has fallen to 10 PSI, the fuse automatically resets. It is located beneath the cockpit floor at the aft end of the speed brake well.

1-30. REMOVAL OF HYDRAULIC FUSE.

a. Extend speed brake, close manual shutoff valve in nose gear well, and insert speed brake downlock safety pin assembly.
b. Relieve hydraulic pressure and remove door 4.
c. Disconnect gage tube and two pressure tubes; cap tubes.
d. Remove screw, nut, clamp, and fuse with fittings.
e. Remove fittings and gaskets and plug fuse ports.

1-31. MINTENANCE AND TESTING OF HYDRAULIC FUSE. No maintenance is permitted; no testing is necessary. If the fuse does not operate properly, it must be replaced.

1-32. INSTALLATION OF HYDRAULIC FUSE.

a. Unplug fuse ports and install fittings.

CAUTION

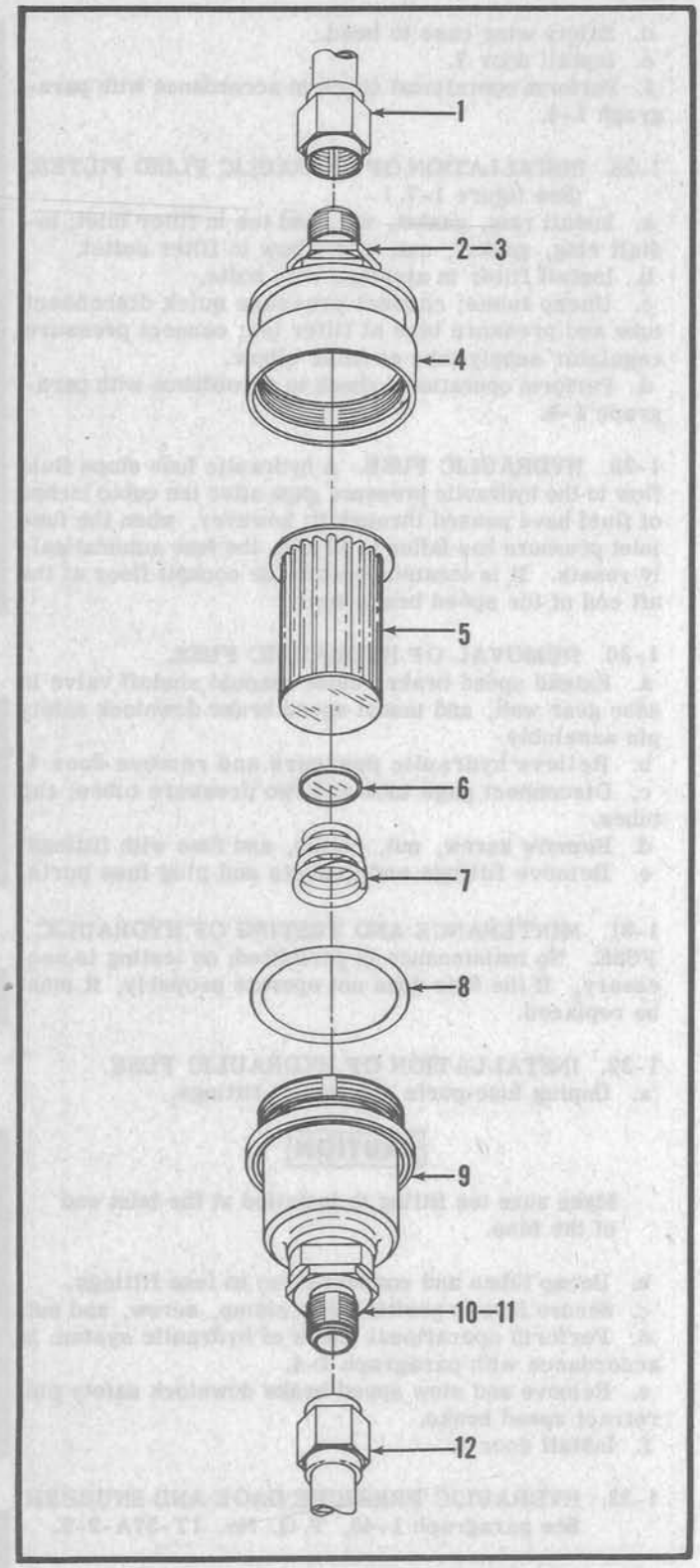
Make sure tee fitting is installed at the inlet end of the fuse.

b. Uncap tubes and connect them to fuse fittings.
c. Secure fuse in position with clamp, screw, and nut.
d. Perform operational check of hydraulic system in accordance with paragraph 1-4.
e. Remove and stow speed brake downlock safety pin, retract speed brake.
f. Install door 4.

1-33. HYDRAULIC PRESSURE GAGE AND SNUBBER. See paragraph 1-43, T. O. No. 1T-37A-2-6.

1-34. RESERVOIR VENT FILTER. The vent filter, clamped to the reservoir angle attachment bracket, prevents dirt and moisture from entering the reservoir through the vent line. It has an air flow capacity of three CFM. A replaceable filter element acts also as a relief valve and opens at 4 to 5 PSI differential pressure during air flow out of the reservoir.

1-35. REMOVAL OF RESERVOIR VENT FILTER. (See figure 1-8.)



1. Tube
2. Union
3. Gasket
4. Head
5. Filter element
6. Cap
7. Spring
8. "O" ring
9. Case
10. Gasket
11. Union
12. Tube

Figure 1-8. Hydraulic Reservoir Vent Filter

a. Remove door 7.
b. Disconnect and cap both bent tubes at filter.
c. Remove screw, nut, clamp, and filter from airplane.
d. Remove gaskets and unions from filter ports; plug ports.

1-36. MAINTENANCE OF RESERVOIR VENT FILTER. (See figure 1-8.)

a. Cut safety wire and unscrew head from case.
b. Exchange old filter element for new if dirty.
c. Screw head onto case, hand tight, and safety wire.

1-37. INSTALLATION OF RESERVOIR VENT FILTER. (See figure 1-8.)

a. Unplug filter ports and install gaskets and unions.
b. Uncap vent tubes and connect to filter.

Note

Make sure filter is installed right side up.

c. Secure filter in position with clamp, screw, and nut.
d. Install door 7.

1-38. LANDING GEAR SYSTEM.

1-39. GENERAL DESCRIPTION OF LANDING GEAR SYSTEM. The landing gear system is mechanically actuated, hydraulically operated, and electrically synchronized. Included in the system are tow air screens which are rigged to cover the engine air inlets whenever the landing gear is dwon. The three pneudraulic shock struts on which the wheels are mounted are held in the down or up position by mechanically actuated downlocks and uplocks. The outboard main gear doors are connected to the gears, the inboard main gear doors are hydraulically operated, and the nose gear doors are mechanically operated. An emergency air system is incorportaed to supply enough power to lower the landing gear in case the hydraulic system fails. The main gears contain multi-disc, self-adjusting brakes, and a power steering system controls the nose gear when the airplane is on the ground. A position indicating and warning system is included to provide necessary information.

1-40. LANDING GEAR SYSTEM OPERATIONAL CHECK.

Note

To perform landing gear operational check, aircraft must first be jacked in accordance with T. O. No. 1T-37A-2-2. Hydraulic auxiliary power is necessary for accomplishment of a retraction check. See paragraph 1-6 for hydraulic test stand connection procedure. Service hydraulic reservoir in accordance with paragraph 1-5 before operating landing gear. Perform check in sequence outlined, stopping at the first indication of trouble and correcting trouble before proceeding further. Refer to paragraph 1-41 for troubles, possible causes and remedies.

Two men will be required to perform a landing gear operational check. One man will operate the gear from

inside the cockpit and one man will visually observe landing gear operation from outside the cockpit.

CHECKING LANDING GEAR NORMAL OPERATION.

a. Outside of cockpit:

1. Connect electrical power, remove ground safety pins, and check wheel well area for obstructions.

b. Inside of cockpit:

1. Push gear indicator, gear warning, and gear handle circuit breakers in.
2. Turn battery switch "ON".
3. Obtain all clear from man outside cockpit.
4. Pull a gear control handle up. Gear position indicators should show diagonal red and yellow stripes until the gear is up and locked; then should show the word "UP". With the throttles at more than 65%, the warning horn should sound and the warning lights light until the gear is up and locked. With the throttles at less than 65%, the lights and horn should not go off until the gear is down and locked; however, the warning horn can be silenced by pushing either warning horn silencing switch on the switch panel.

c. Outside of cockpit:

1. Landing gears should unlock and retract into wheel wells. Doors should close as landing gears reach limit of up travel. All doors should fit flush with the wing skin with main gear inboard doors overlapping outboard doors. Landing gears should retract completely in eight seconds at 21°C (70°F). Air intake screens should open (rotate away from the engine air intake openings until they are flush with the fuselage).

d. Inside of cockpit:

1. When landing gears are fully retracted, obtain all clear from man outside and move instructor's gear control handle "DOWN".
2. Landing gear position indicators should show diagonal red stripes and red light in gear selector handle should light.
3. When gears reach the down and locked position the landing gear position indicators should show three gear symbols, and the red light in the gear selector handle should go out.

e. Outside of cockpit:

1. Observe gear, doors should open and gears should extend and lock within eight seconds at 21°C (70°F).
2. Check downlock for positive locking by pushing upward on side brace at hinge point.
3. Air intake screens should close.

CHECKING GEAR CONTROL HANDLE LOCK OVERRIDE SWITCH.

a. Outside of cockpit:

1. Connect hydraulic auxiliary power unit.
2. Remove quick disconnect from one of the landing gear safety switches.

b. Inside of cockpit:

1. Obtain all clear from man outside of cockpit.
2. Check each gear control handle for resistance to upward movement.
3. Press one of the override switches and raise the adjacent handle. Gear should retract and lock in the up position.

1-41. TROUBLE SHOOTING LANDING GEAR SYSTEM.

TROUBLE	PROBABLE CAUSE	REMEDY
LANDING GEAR WILL NOT RAISE OR LOWER NORMALLY	No hydraulic pressure.	Refer to hydraulic system trouble shooting, paragraph 1-7.
	Selector valve defective.	Replace valve.
	Loose linkages.	Check all linkages.
GEAR WILL NOT RETRACT	Ground safety pins installed.	Remove ground safety pins. .
	Selector valve defective.	Replace valve.
	Actuating cylinder defective.	Replace cylinder.
	Landing gear control linkages disconnected.	Connect linkages.
	No hydraulic pressure.	See paragraph 1-7.
MAIN GEAR WILL NOT RETRACT OR A SINGLE MAIN GEAR WILL RETRACT	Internal leakage in actuating cylinder.	Replace cylinder.
	Downlocks do not release.	Adjust downlocks or replace as required.
MAIN GEAR WILL NOT EXTEND ON NORMAL SYSTEM	Main gear uplock cylinder defective.	Replace cylinder.
LANDING GEAR FAILS TO LOCK DOWN ON NORMAL EXTENSION	Downlock out of adjustment or broken.	Adjust or replace as necessary.
	Actuating cylinder defective.	Replace cylinder.

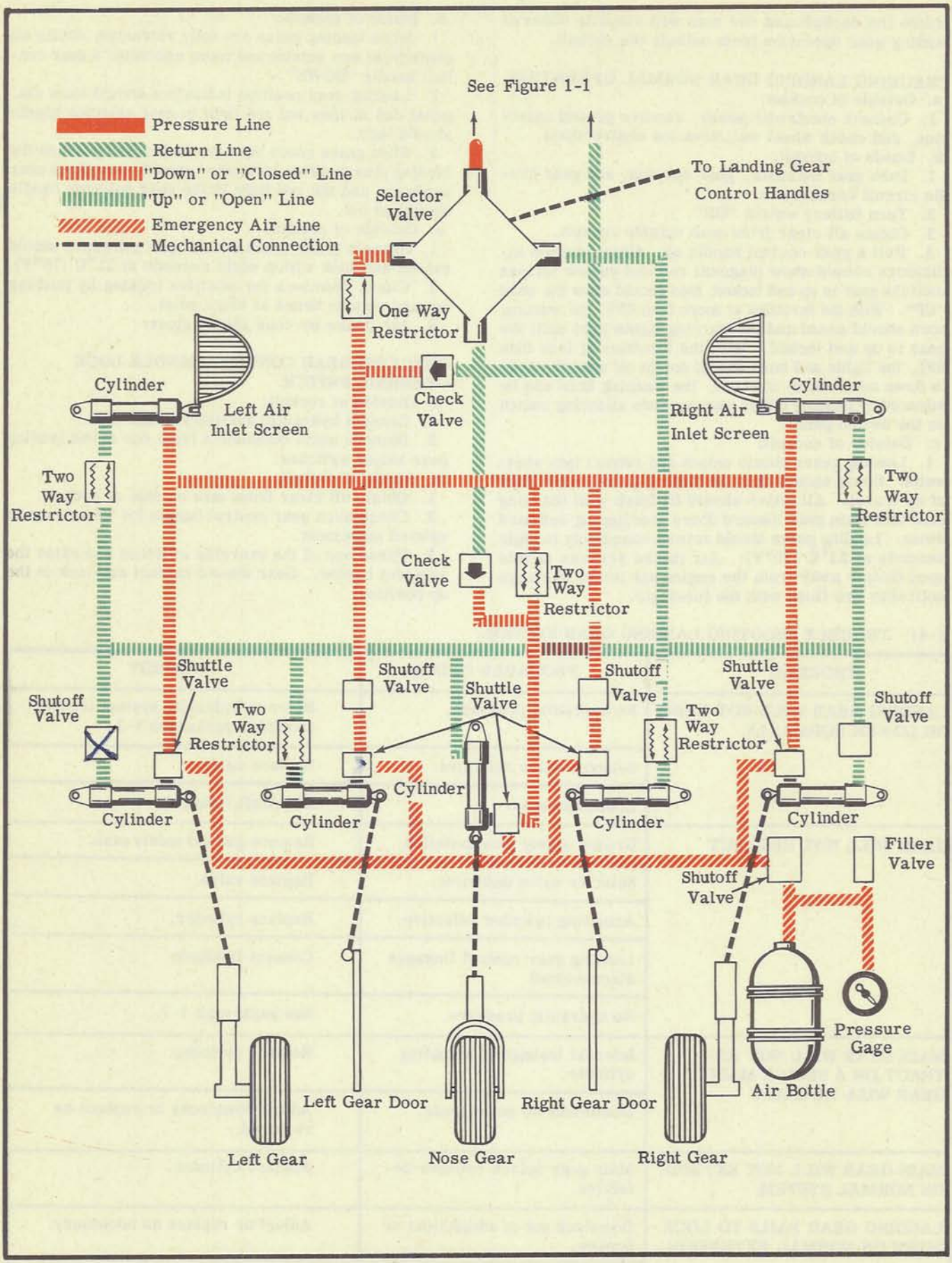


Figure 1-9. Landing Gear Hydraulic System Schematic

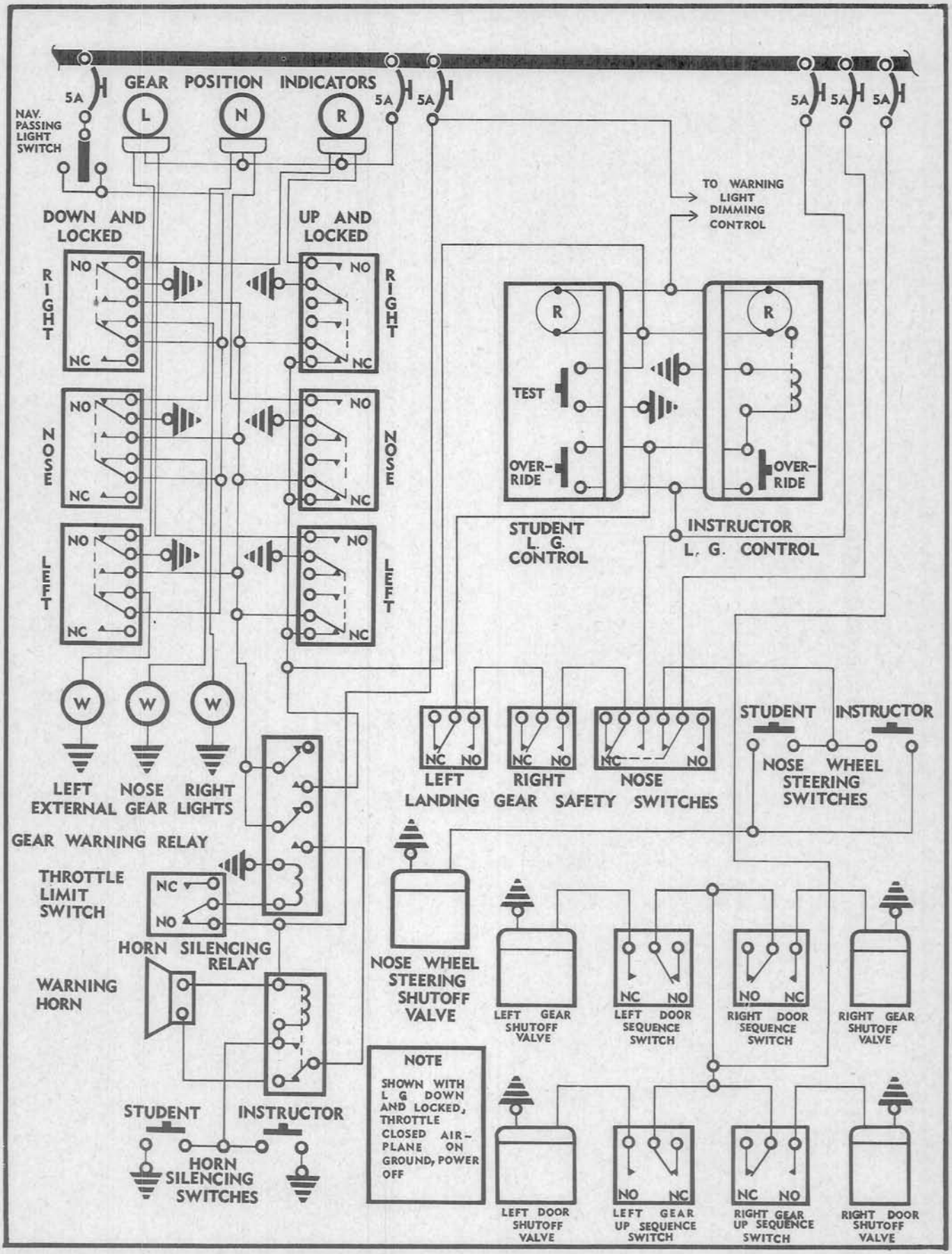


Figure 1-9A. Landing Gear Electrical Schematic

TROUBLE	PROBABLE CAUSE	REMEDY
	Foreign matter entangled in downlock.	Clean downlock.
LANDING GEAR WILL NOT EXTEND WHEN EMERGENCY RELEASE HANDLE IS PULLED	Air bottle not charged. Linkage disconnected.	Charge air bottle. Connect linkages.

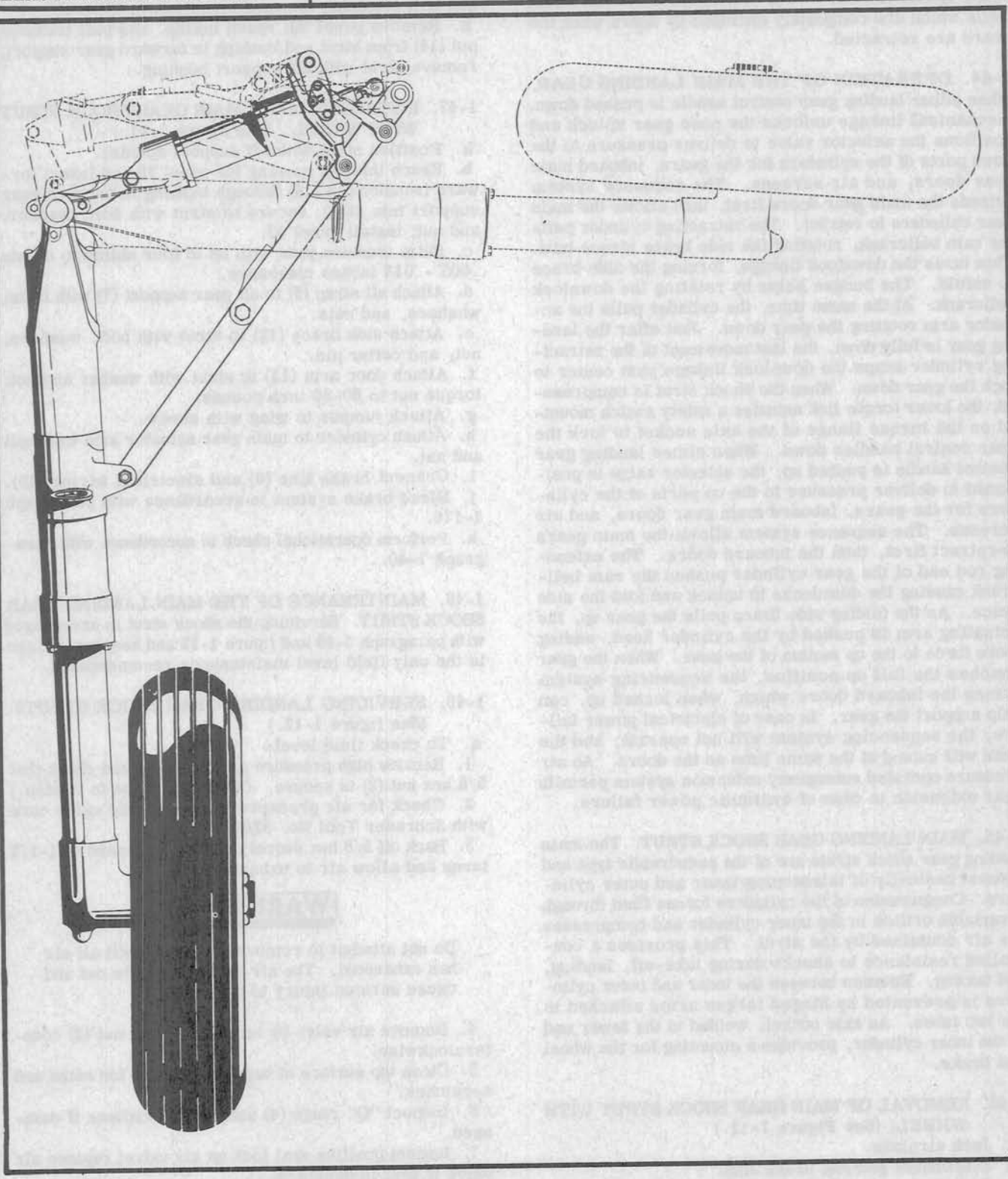


Figure 1-10. Main Landing Gear Retraction

1-42. MAIN LANDING GEAR.

1-43. GENERAL DESCRIPTION. Each main landing gear consists primarily of a pneudraulic shock strut on which is mounted a wheel, a brake, a torque arm assembly, a side brace assembly, and (on the left strut) a static ground wire assembly. The gears are mounted between the front and aft stub spars in the wings. They rotate up and inboard around trunnion pins into the wheel wells which are completely enclosed by doors when the gears are retracted.

1-44. OPERATION OF THE MAIN LANDING GEAR. When either landing gear control handle is pushed down, mechanical linkage unlocks the nose gear uplock and positions the selector valve to deliver pressure to the down ports of the cylinders for the gears, inboard main gear doors, and air screens. The sequence system extends the main gear doors first, then allows the main gear cylinders to retract. The retracting cylinder pulls the ram bellcrank, rotating the side brace torque tube. This turns the downlock linkage, forcing the side brace to unfold. The bungee helps by rotating the downlock bellcrank. At the same time, the cylinder pulls the actuator arm rotating the gear down. Just after the landing gear is fully down, the last movement of the retracting cylinder snaps the downlock linkage past center to lock the gear down. When the shock strut is compressed, the lower torque link actuates a safety switch mounted on the torque flange of the axle socket to lock the gear control handles down. When either landing gear control handle is pushed up, the selector valve is positioned to deliver pressure to the up ports of the cylinders for the gears, inboard main gear doors, and air screens. The sequence system allows the main gears to retract first, then the inboard doors. The extending rod end of the gear cylinder pushes the ram bellcrank causing the downlocks to unlock and fold the side brace. As the folding side brace pulls the gear up, the actuating arm is pushed by the cylinder head, adding more force to the up motion of the gear. When the gear reaches the full up position, the sequencing system raises the inboard doors which, when locked up, can help support the gear. In case of electrical power failure, the sequencing system will not operate, and the gear will extend at the same time as the doors. An air pressure operated emergency extension system permits gear extension in case of hydraulic power failure.

1-45. MAIN LANDING GEAR SHOCK STRUT. The main landing gear shock struts are of the pneudraulic type and consist basically of telescoping inner and outer cylinders. Compression of the cylinders forces fluid through a variable orifice in the inner cylinder and compresses the air contained by the strut. This provides a controlled resistance to shocks during take-off, landing, and taxiing. Rotation between the inner and outer cylinders is prevented by hinged torque arms attached to the two tubes. An axle socket, welded to the lower end of the inner cylinder, provides a mounting for the wheel and brake.

1-46. REMOVAL OF MAIN GEAR SHOCK STRUT WITH WHEEL. (See Figure 1-11.)

a. Jack airplane.
b. Disconnect and cap brake line.
c. Disconnect electrical wiring.
d. Remove nut and bolt attaching cylinder (18) to main gear actuating arm.
e. Remove screw attaching jumper to wing; remove nut and washer attaching door arm to strut.
f. Remove cotter pin, nut, washers, and bolt attaching side brace (12) to strut.
g. Support strut; remove nuts, washers, and bolts attaching aft strap (5) to aft support; remove nut, washer, and bolt attaching forward trunnion pin to strut.
h. Remove panel 39; reach inside, and pull trunnion pin (14) from strut and bushing in forward gear support; remove strut with aft support bushing.

1-47. INSTALLATION OF MAIN GEAR SHOCK STRUT WITH WHEEL. (See figure 1-11.)

a. Position strut with aft support bushing.
b. Reach through opening for panel 39 and insert forward trunnion pin (14) through bushing in forward gear support into strut; secure to strut with bolt, washer, and nut; install panel 39.
c. Shim trunnion pins with up to four shims to obtain .003 -.018 inches clearance.
d. Attach aft strap (5) to aft gear support (7) with bolts, washers, and nuts.
e. Attach side brace (12) to strut with bolt, washers, nut, and cotter pin.
f. Attach door arm (11) to strut with washer and nut; torque nut to 60-80 inch pounds.
g. Attach jumper to wing with screw.
h. Attach cylinder to main gear actuator arm with bolt and nut.
i. Connect brake line (9) and electrical wiring (10).
j. Bleed brake system in accordance with paragraph 1-176.
k. Perform operational check in accordance with paragraph 1-40.

1-48. MAINTENANCE OF THE MAIN LANDING GEAR SHOCK STRUT. Servicing the shock strut in accordance with paragraph 1-49 and figure 1-12 and keeping it clean is the only field level maintenance recommended.

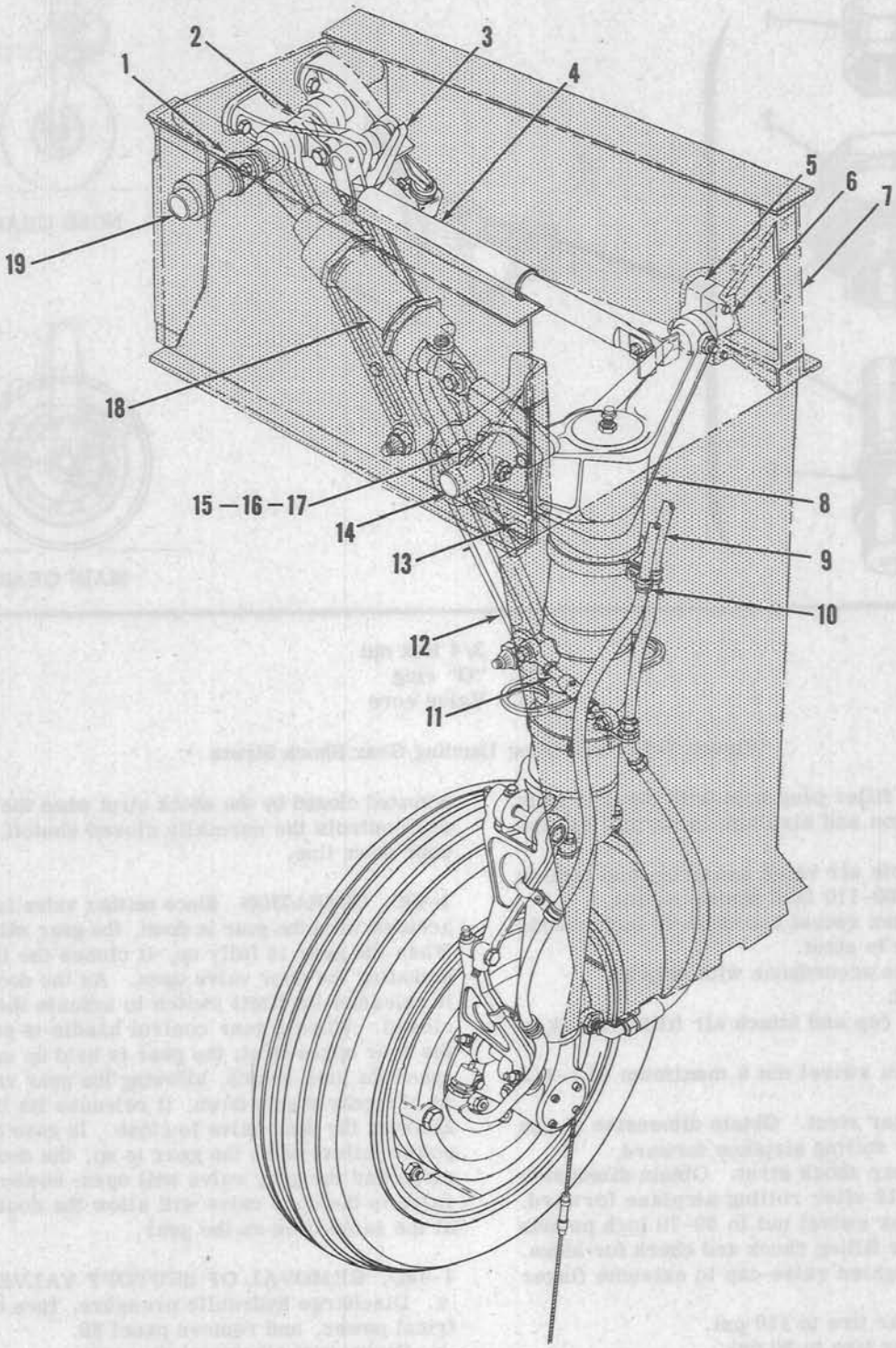
1-49. SERVICING LANDING GEAR SHOCK STRUTS. (See figure 1-12.)

a. To check fluid level:
1. Remove high pressure air valve cap and check that 5/8 hex nut (2) is secure. (Turn clockwise to tighten.)
2. Check for air pressure by depressing valve core with Schrader Tool No. 3263.
3. Back off 5/8 hex swivel nut (2) a maximum of 1-1/2 turns and allow air to exhaust itself.

WARNING

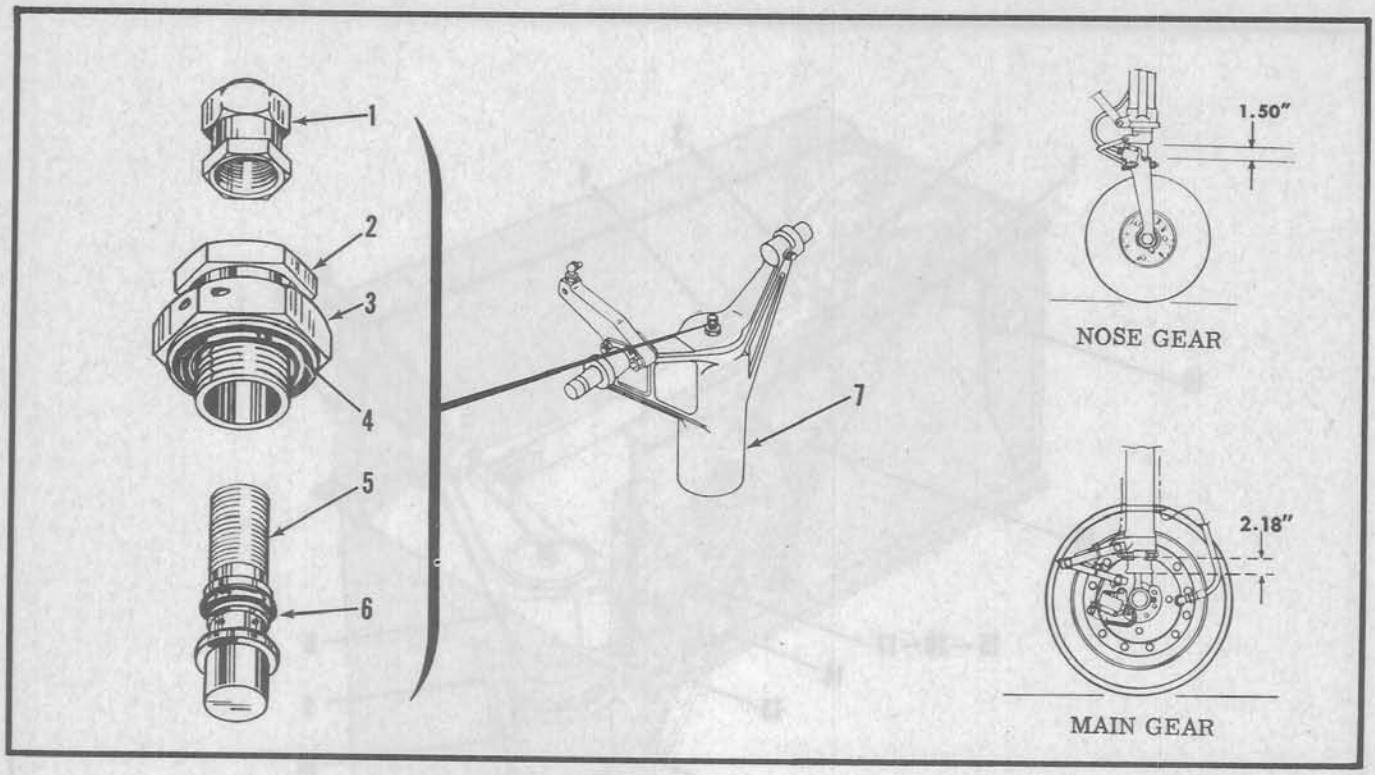
Do not attempt to remove air valve until all air has exhausted. The air valve may blow out and cause serious injury to personnel.

4. Remove air valve by turning 3/4 hex nut (3) counterclockwise.
5. Clean top surface of base and inspect for nicks and scratches.
6. Inspect "O" rings (4) and (6) and replace if damaged.
7. Inspect positive seat lock on air valve; replace air valve if seat is damaged.
8. Fill strut with hydraulic fluid specification MIL-



1. Bellcrank
2. Bellcrank
3. Downlock
4. Bungee
5. Aft strap
6. Trunnion pin
7. Support
8. Trunnion
9. Brake line
10. Electrical wiring
11. Outboard door arm
12. Side brace
13. Support
14. Trunnion pin
15. Bolt
16. Washer
17. Nut
18. Actuating cylinder
19. Torque tube

Figure 1-11. Main Landing Gear Installation



1. Valve cap
2. 5/8 Hex nut
3. 3/4 Hex nut
4. "O" ring
5. Valve core
6. "O" ring
7. Trunnion

Figure 1-12. Servicing Landing Gear Shock Struts

O-5606 to level of filler plug hole with strut in fully compressed position and airplane in normal ground attitude.

9. Install complete air valve assembly and tighten 3/4 hex nut (3) to 100-110 inch pounds torque.

10. Tighten 5/8 hex swivel nut to 50-70 inch pounds and lock wire valve to strut.

11. Inflate strut in accordance with step b.

b. To inflate strut:

1. Remove valve cap and attach air filling chuck to valve core housing.

2. Loosen 5/8 hex swivel nut a maximum of 1-1/2 turns.

3. Inflate main gear strut. Obtain dimension shown in figure 1-12 after rolling airplane forward.

4. Inflate nose gear shock strut. Obtain dimension shown in figure 1-12 after rolling airplane forward.

5. Tighten 5/8 hex swivel nut to 50-70 inch pounds torque. Remove air filling chuck and check for leaks.

6. Replace and tighten valve cap to extreme finger tightness.

c. Inflate main gear tire to 110 psi.

d. Inflate nose gear tire to 20 psi.

1-49A. MAIN GEAR SEQUENCE SYSTEM.

1-49B. DESCRIPTION. The main gear sequence system consists of two limit switches and two spring-loaded, electrically actuated, hydraulic shutoff valves for each main gear and inboard door. One switch is actuated open by the actuating rod (19, figure 1-23) when the door is down; and controls the normally open shutoff valve in the main gear up line. The other switch is actuated closed by the shock strut when the wheel is up, and controls the normally closed shutoff valve in the door down line.

1-49C. OPERATION. Since neither valve is electrically actuated when the gear is down, the gear will go up first. When the gear is fully up, it closes the limit switch, actuating the door valve open. As the door starts up, it releases its limit switch to actuate the gear valve closed. When a gear control handle is pushed down, the door opens first; the gear is held up until the door opens its limit switch, allowing the gear valve to open. As the gear starts down, it releases its limit switch, allowing the door valve to close. In case of electrical power failure when the gear is up, the door valve will close and the gear valve will open; however, a check valve in the door valve will allow the door to go down at the same time as the gear.

1-49D. REMOVAL OF SHUTOFF VALVE. (Typical)

a. Discharge hydraulic pressure, turn off all electrical power, and remove panel 39.

b. Disconnect electrical connector.

c. Disconnect and cap hydraulic lines and fittings.

d. Remove two screws, and remove shutoff valve.

1-49E. INSTALLATION OF SHUTOFF VALVE. (Typical)

a. Attach shutoff valve to bracket with two screws.

b. Uncap and connect lines and fittings.

c. Connect electrical connector.

d. Install panel 39 and perform operational check in accordance with paragraph 1-40.

1-49F. ADJUSTMENT OF SEQUENCE SWITCHES.

a. Adjust gear switch so that it is actuated as the gear reaches the UP position.

b. Adjust the door switch, in its bracket, so that it is actuated by the actuating rod (19[figure 1-23) as the door reaches the DOWN position.

1-50. MAIN GEAR DOWNLOCK. The downlock linkage for each main gear is attached to the main gear brace supports, the side brace torque tube, and the side brace assembly. As the gear goes down, the retracting cylinder pulls the ram bellcrank twisting the side brace torque tube. This unfolds the side brace assembly and the downlock linkage. The cylinder is not completely retracted until just after the landing gear is all the way down; and the last movement of the cylinder snaps the downlock linkage past center to lock the gear down. As the downlock goes past center, a bracket on the downlock bellcrank actuates a switch bracketed to the side of the wheel well, causing the position indicator for that wheel to indicate down.

1-51. REMOVAL OF MAIN GEAR DOWNLOCK. (See figure 1-13.)

a. Jack airplane in accordance with T.O. No. 1T-37A-2-2.

b. Discharge hydraulic pressure, release downlock, and raise gear by hand until main gear bungee safety pin holes are aligned; insert bungee safety pin.

WARNING

When bungee spring is compressed, it can cause serious injury if not properly safetied before removal.

c. Remove nut (13) and bolt (15) attaching bungee (14) to bellcrank (17).

d. Remove safety wire; remove bolt and shimming washers attaching downlock linkage (6) to pivot shaft (12). Pull shaft with bellcrank (17) from brace supports (2) and downlock linkage.

e. Remove nut (11), bolt (3), and spacer (7), attaching downlock link (4) to bellcrank (1).

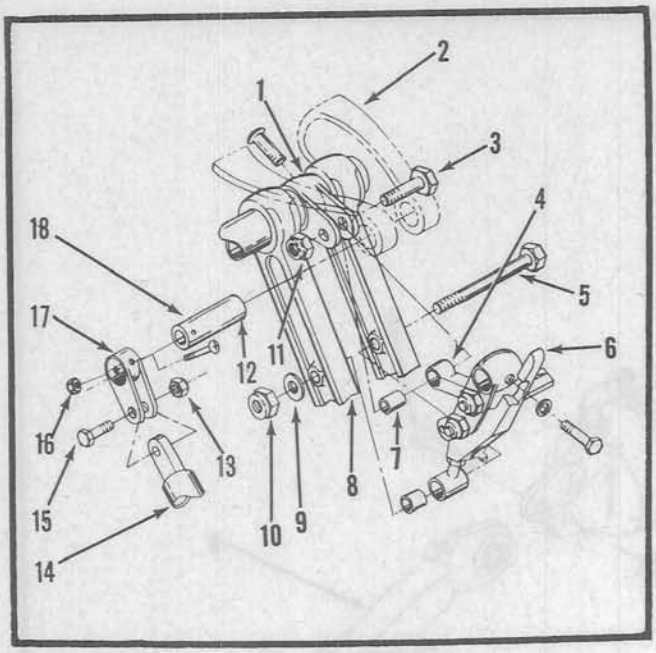
f. Remove nut (10), washer (9), bolt (5), and spacer to free downlock linkage from side brace assembly (8); remove downlock linkage from airplane.

1-52. INSTALLATION OF MAIN GEAR DOWNLOCK. (See figure 1-13.)

a. Attach downlock linkage (6) to side brace assembly (8) with spacer, bolt (5), washer (9), and nut (10).

b. Attach downlock link (4) to bellcrank (1) with spacer (7), bolt (3), and nut (11).

c. Insert pivot shaft (12) with bellcrank (17) through brace supports (2) and downlock linkage; perform steps a, d, e, f, g, and h of paragraph 1-53.



1. Bellcrank
2. Support
3. Bolt
4. Downlock link
5. Bolt
6. Downlock
7. Spacer
8. Side brace
9. Washer
10. Nut
11. Nut
12. Shaft
13. Nut
14. Bungee
15. Bolt
16. Nut
17. Bellcrank
18. Bolt

Figure 1-13. Main Gear Downlock Installation

1-53. ADJUSTMENT OF MAIN GEAR DOWNLOCK. (See figure 1-14.)

a. Remove nut and bolt securing hydraulic cylinder to ram bellcrank (17, figure 1-13.)

b. Release downlock; raise gear by hand until main gear bungee safety pin holes are aligned; insert safety pin.

WARNING

When bungee spring is compressed, it can cause serious injury if not properly safetied before removal.

c. Remove nut and bolt attaching bungee to bellcrank (17, figure 1-13.)

d. Adjust the downlock rod end until a pressure of approximately five pounds is necessary to push the downlock past center.

e. Shim bolt (part number 4041017-1) with washers until downlock will go over center by 0.12 inches, as shown in figure 1-14.

f. Attach bungee to bellcrank with bolt and nut; remove bungee safety pin.

g. Attach hydraulic cylinder to ram bellcrank with bolt and nut.

h. Perform operational check in accordance with paragraph 1-40.

i. If necessary, adjust main gear down and locked switch in its bracket so that it is actuated by the downlock actuator as the downlock snaps past center.

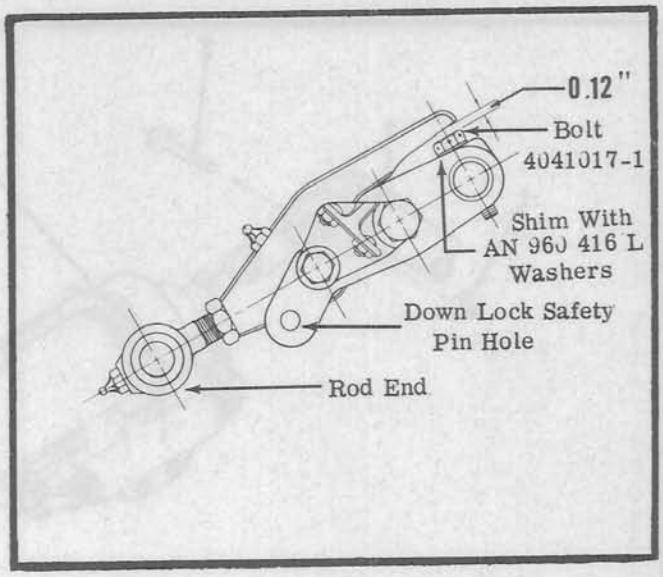


Figure 1-14. Main Gear Downlock Adjustment

1-54. MAIN GEAR SIDE BRACE. Each main gear side brace is bolted to the shock strut and held, at the other end, by the side brace torque tube. The main gear downlock is attached to the upper links of the brace.

1-55. REMOVAL OF MAIN GEAR SIDE BRACE. (See figure 1-11.)

a. Remove main gear downlock in accordance with paragraph 1-51.

b. Remove cotter pin, nut, washers, and bolt attaching lower link of side brace to shock strut.

c. Remove safety wire and remove bolts securing bellcranks (1) and (2) to side brace torque tube (19).

d. Remove panel 39 and pull side brace torque tube through stub spar, catching bellcranks (1) and (2) and side brace as tube is removed.

1-56. INSTALLATION OF MAIN GEAR SIDE BRACE. (See figure 1-11.)

a. Push side brace torque tube (19) through bushing in stub spar, bellcrank (1), forward main gear brace support, upper link of side brace, bellcrank (2), the other upper link of side brace, and seat in aft main gear brace support.

b. Attach bellcranks (1) and (2) to torque tube with bolts and safety wire bolts to bellcranks.

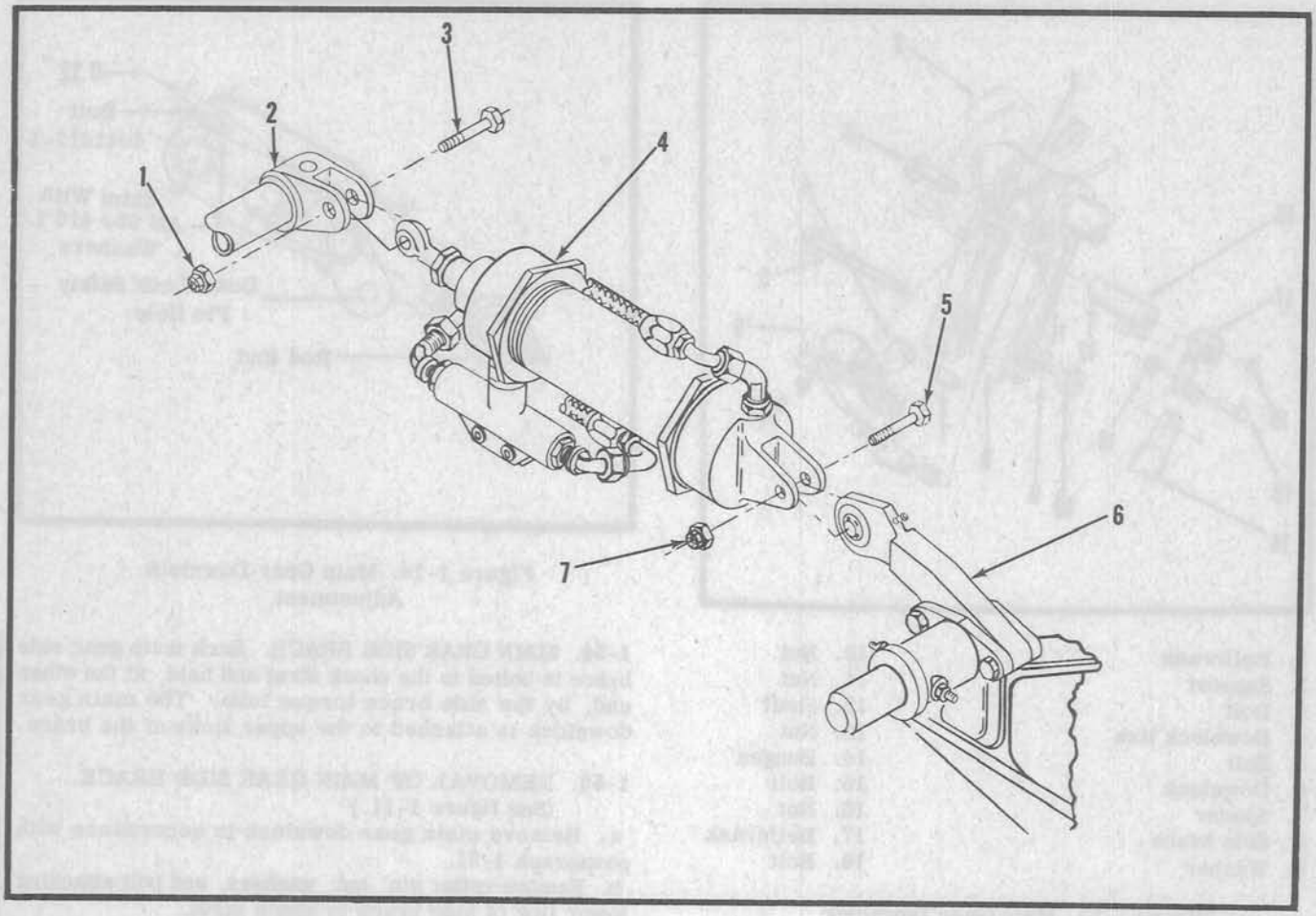
c. Attach lower link of side brace to shock strut with bolt, washers, nut, and cotter pin.

d. Install main gear downlock in accordance with paragraph 1-52.

1-57. MAIN GEAR CYLINDER AND SHUTTLE VALVE. The main gear cylinder retracts and extends the gear. The head is attached to the main gear actuator arm; the rod end is attached to the ram bellcrank. Power for gear retraction is furnished by the hydraulic system. A shuttle valve at the down port of the cylinder permits operation by the hydraulic system or by the emergency air system in moving the gear down.

1-58. REMOVAL OF MAIN GEAR CYLINDER AND SHUTTLE VALVE. (See figure 1-15.)

a. Discharge hydraulic power by operating flaps or



1. Nut
2. Ram bellcrank
3. Bolt
4. Cylinder
5. Bolt
6. Actuator arm
7. Nut

Figure 1-15. Main Gear Cylinder and Shuttle Valve

speedbrake until hydraulic pressure gage indicates zero.
b. Disconnect and plug hydraulic lines at cylinder.
c. Remove nut (1) and bolt (3) attaching cylinder rod end to bellcrank (2).
d. Remove nut (7) and bolt (5) attaching cylinder head to main gear actuator arm.

1-59. INSTALLATION OF MAIN GEAR CYLINDER AND SHUTTLE VALVE. (See figure 1-15.)
a. Attach cylinder head to main gear actuator arm with bolt (5) and nut (7).
b. Attach cylinder rod end to bellcrank (2) with bolt and nut.
c. Connect hydraulic lines to cylinder.
d. Perform operational check in accordance with paragraph 1-40.

1-60. MAIN GEAR WHEEL AND TIRE ASSEMBLY. The main gears are equipped with 20 x 4.4 Type VII wheel assemblies. The wheels are the split type and mounted on the axle at the lower end of the shock strut. The tire assemblies consist of a 20 x 4.4 casing, Type VII and tubes.

1-61. REMOVAL OF MAIN GEAR WHEEL. (See Figure 1-16.)
a. Jack airplane.
b. Remove cotter pin (15), nut (14), washer (13), and bearing retainer (12).
c. Slide wheel off axle.

CAUTION

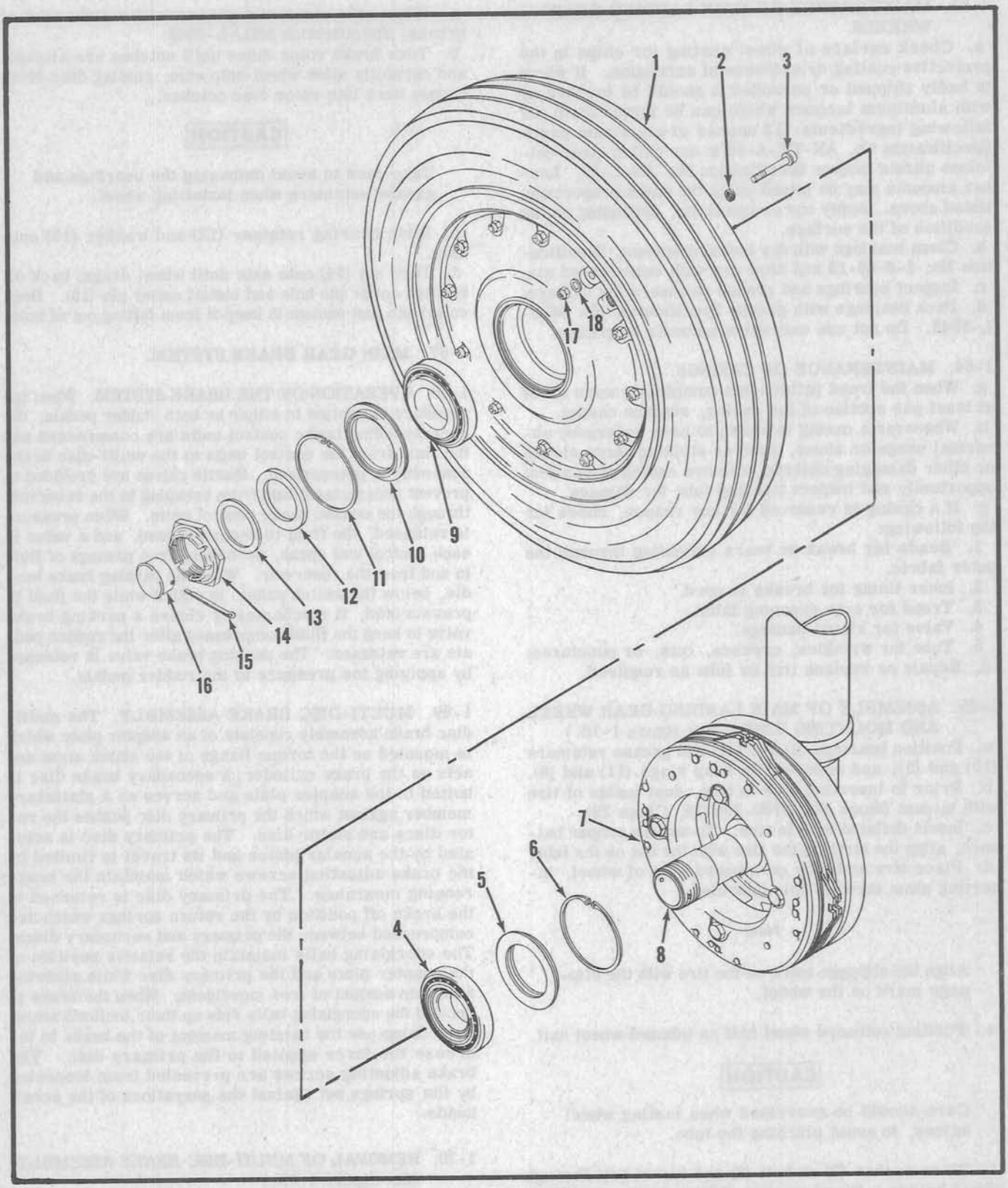
Take care to avoid damaging the bearings and grease retainers when removing wheel.

1-62. DISMOUNTING TIRE AND DISASSEMBLY OF MAIN GEAR WHEEL. (See figure 1-16.)
a. Completely deflate tire.

WARNING

Make sure tire is completely deflated before disassembling wheel. Serious injury can result due to sudden expansion of tire.

b. Break casing bead from both wheel rims.
c. Lay wheel down with nuts (17) on top.
d. Remove nuts, washers, (18) and (2), and bolts (3).
e. Separate wheel halves and remove tire and tube.
f. Remove snap rings (11) and (6), grease retainers (10) and (5), and bearings (9) and (4).



1. Wheel assembly
2. Washer
3. Bolt
4. Bearing
5. Grease retainer
6. Snap ring
7. Brake assembly
8. Axle
9. Bearing
10. Grease retainer
11. Snap ring
12. Bearing retainer
13. Washer
14. Nut
15. Cotter Pin
16. Striker
17. Nut
18. Washer

Figure 1-16. Main Landing Gear Wheel Installation

1-63. MAINTENANCE OF MAIN LANDING GEAR WHEELS.

a. Check surface of wheel casting for chips in the protective coating or evidence of corrosion. If wheel is badly chipped or corroded it should be touched up with aluminum lacquer which can be mixed from the following ingredients: 12 onuces of aluminum paste Specification No. AN-TT-A-46 to one gallon clear cellulose nitrate lacquer Specification No. AN-L-29. Lesser amounts may be mixed using the same proportions listed above. Apply one or two coats, depending on the condition of the surface.

b. Clean bearings with dry cleaning solvent, Specification No. 1-S-66-13 and blow dry with compressed air.

c. Inspect bearings and grease retainers for damage.

d. Pack bearings with grease Specification No. MIL-L-3545. Do not use excessive amounts of grease.

1-64. MAINTENANCE OF CASINGS.

a. When the tread pattern has completely worn off of at least one section of the casing, replace casing.

b. Whenever a casing is known to have undergone abnormal usage or abuse, such as striking large stones or other damaging objects, remove casing at earliest opportunity and inspect tire and tube for damage.

c. If a casing is removed for any reason, check for the following:

1. Beads for break or tears extending through the outer fabric.
2. Inner lining for breaks in cord.
3. Tread for cuts exposing fabic.
4. Valve for visual damage.
5. Tube for wrinkles, creases, cuts, or punctures.

d. Repair or replace tire or tube as required.

1-65. ASSEMBLY OF MAIN LANDING GEAR WHEEL AND MOUNTING TIRE. (See figure 1-16.)

a. Position bearings (9) and (4), and grease retainers (10) and (5), and secure with snap rings (11) and (6).

b. Prior to inserting tube in tire, dust inside of tire with talcum (Stock No. 6700-208716, Class 29).

c. Insert deflated tube in tire. To assure proper balance, align the strip on the tire with the dot on the tube.

d. Place tire and tube on inboard side of wheel, inserting stem through hole provided.

Note

Align the slippage mark on the tire with the slippage mark on the wheel.

e. Position outboard wheel half on inboard wheel half.

CAUTION

Care should be exercised when mating wheel halves, to avoid pinching the tube.

f. Place washer (2) on bolt (3) and insert bolt through wheel halves. Place washer (18) on bolt and install nut (17). Tighten nuts alternately and evenly. Torque to 15, then 20, and finally to 25 foot pounds torque.

g. Partially inflate tire; then deflate and check beads for proper seating. Inflate tire to 110 PSI.

1-66. INSTALLATION OF MAIN GEAR WHEEL. (See figure 1-16.)

a. Wipe axle clean and grease with a light coat of grease, Specification MIL-L-3545.

b. Turn brake rotor discs until notches are aligned, and carefully slide wheel onto exle, guiding disc drive torque bars into rotor disc notches.

CAUTION

Take care to avoid damaging the bearings and grease retainers when installing wheel.

c. Slide bearing retainer (12) and washer (13) onto axle.

d. Turn nut (14) onto axle until wheel drags; back off to align cotter pin hole and install cotter pin (15). Bend cotter pin just enough to keep it from falling out of hole.

1-67. MAIN GEAR BRAKE SYSTEM.

1-68. OPERATION OF THE BRAKE SYSTEM. When toe pressure is applied to either or both rudder pedals, the corresponding brake control units are compressed and the fluid from the control units to the multi-disc brake assembly is pressurized. Shuttle valves are provided to prevent pressurized fluid from escaping to the reservoir through the unused brake control units. When pressure is released, the fluid is decompressed, and a valve in each control unit opens, permitting free passage of fluid to and from the reservoir. When the parking brake handle, below the switch panel, is pulled while the fluid is pressurized, it mechanically closes a parking brake valve to keep the fluid compressed after the rudder pedals are released. The parking brake valve is released by applying toe pressure to the rudder pedals.

1-69. MULTI-DISC BRAKE ASSEMBLY. The multi-disc brake assembly consists of an adapter plate which is mounted on the torque flange of the shock strut and acts as the brake cylinder; a secondary brake disc is bolted to the adapter plate and serves as a stationary member against which the primary disc pushes the rotor discs and stator disc. The primary disc is actuated by the annular piston and its travel is limited by the brake adjusting screws which maintain the brake running clearance. The primary disc is returned to the brake off position by the return springs which are compressed between the primary and secondary discs. The energizing balls maintain the relative position of the adapter plate and the primary disc while allowing a certain amount of free movement. When the brake is applied the energizing balls ride up their inclined seats; in so doing use the twisting moment of the brake to increase the force applied to the primary disc. The brake adjusting screws are prevented from loosening by flat springs set against the serrations of the screw heads.

1-70. REMOVAL OF MULTI-DISC BRAKE ASSEMBLY. (See figure 1-19.)

a. Remove wheel in accordance with paragraph 1-61.

b. Disconnect and cap brake line and fitting (2).

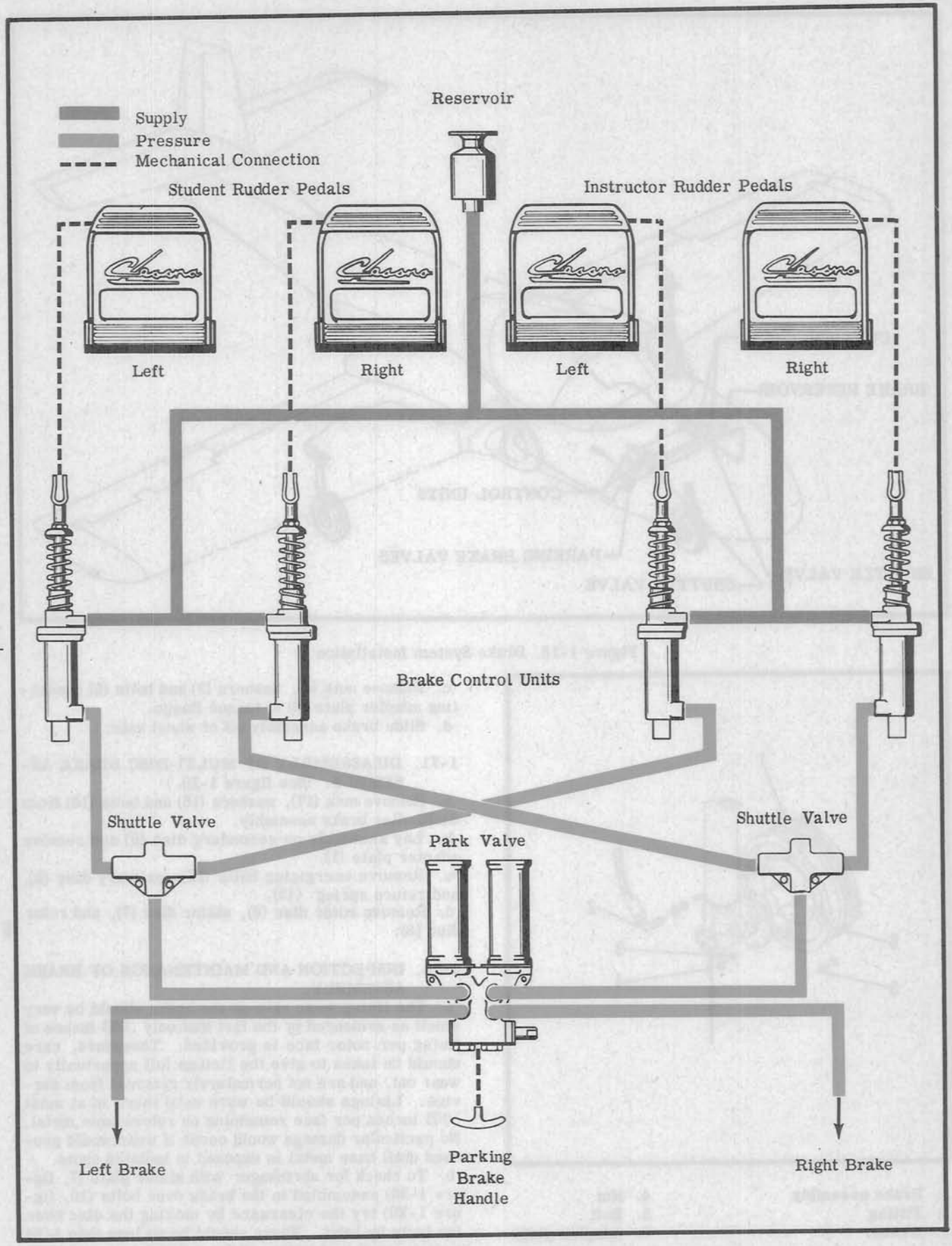


Figure 1-17. Brake System Schematic

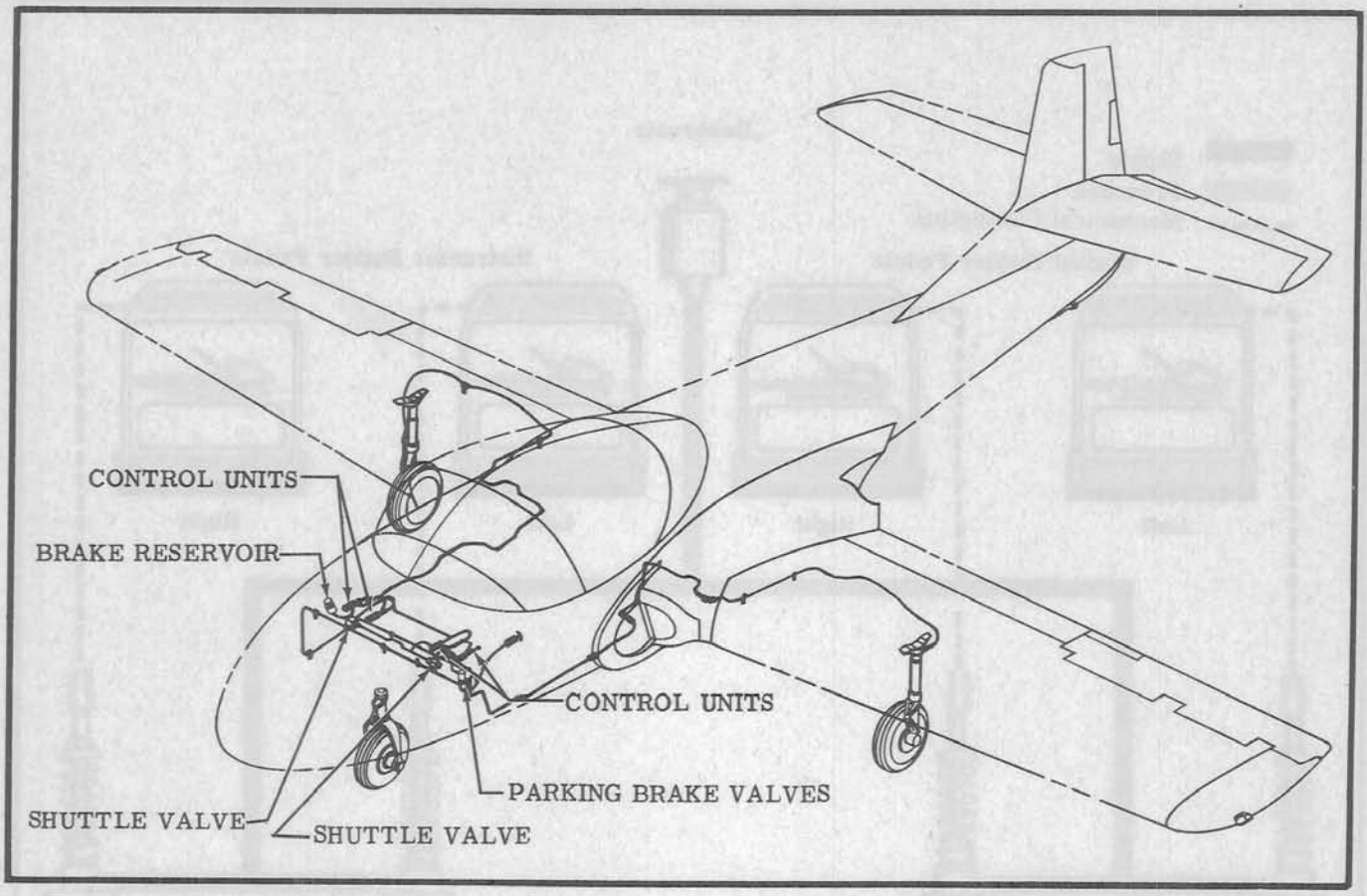
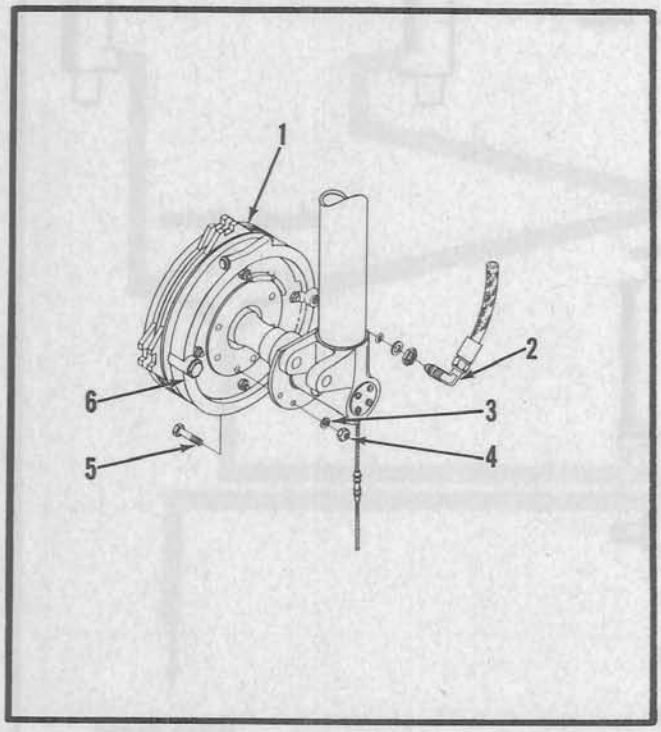


Figure 1-18. Brake System Installation



1. Brake assembly
2. Fitting
3. Washer
4. Nut
5. Bolt
6. Adapter plate

Figure 1-19. Brake Installation

c. Remove nuts (4), washers (3) and bolts (5) connecting adapter plate (6) to torque flange.
d. Slide brake assembly off of wheel axle.

1-71. DISASSEMBLY OF MULTI-DISC BRAKE ASSEMBLY. (See figure 1-20.)

a. Remove nuts (17), washers (16) and bolts (10) from multi-disc brake assembly.
b. Lay assembly on secondary disc (9) and remove adapter plate (1).
c. Remove energizing balls (12), primary disc (5), and return spring (11).
d. Remove rotor disc (6), stator disc (7), and rotor disc (8).

1-72. INSPECTION AND MAINTENANCE OF BRAKE ASSEMBLY.

a. The lining wear rate on the brake should be very small as evidenced by the fact that only .035 inches of lining per rotor face is provided. Therefore, care should be taken to give the linings full opportunity to wear out, and are not permaturely removed from service. Linings should be worn until there is at most .005 inches per face remaining on rotors base metal. No particular damage would occur if wear would proceed until base metal is exposed in isolated spots.
b. To check for shrinkage: with stator plate (7, figure 1-20) assembled in the brake over bolts (10, figure 1-20) try the clearance by moving the disc over the bolts by hand. There should be no less than 1/64 radial movement before disc removal is necessary.
c. Warpage will not affect brake performance unless

it has proceeded to the point where it has consumed brake running clearance. This could be as much as .035 inches.

d. If brake assembly has less than .010 inches running clearance the following points should be checked: (1) Adjusting screws for correct position; (2) There is no interference between piston and insulating ring; (3) The brake is fully released. This can be checked by shaking the brake assembly. A brake that is not fully released will have a distinct rattle from the loose energizing balls; (4) Casting warpage. If the brake has been subjected to excessive heat the castings could warp sufficiently to remove the running clearance.

e. If the brake fails to release, the following points should be checked; (1) Hydraulic groove and "O" ring for cleanliness; (2) Excessive shrinkage of stator; (3) Replace return springs; (4) Flat springs on adjustment screws which prevent overadjustment.

1-73. ASSEMBLY OF MULTI-DISC BRAKE. (See figure 1-20.)

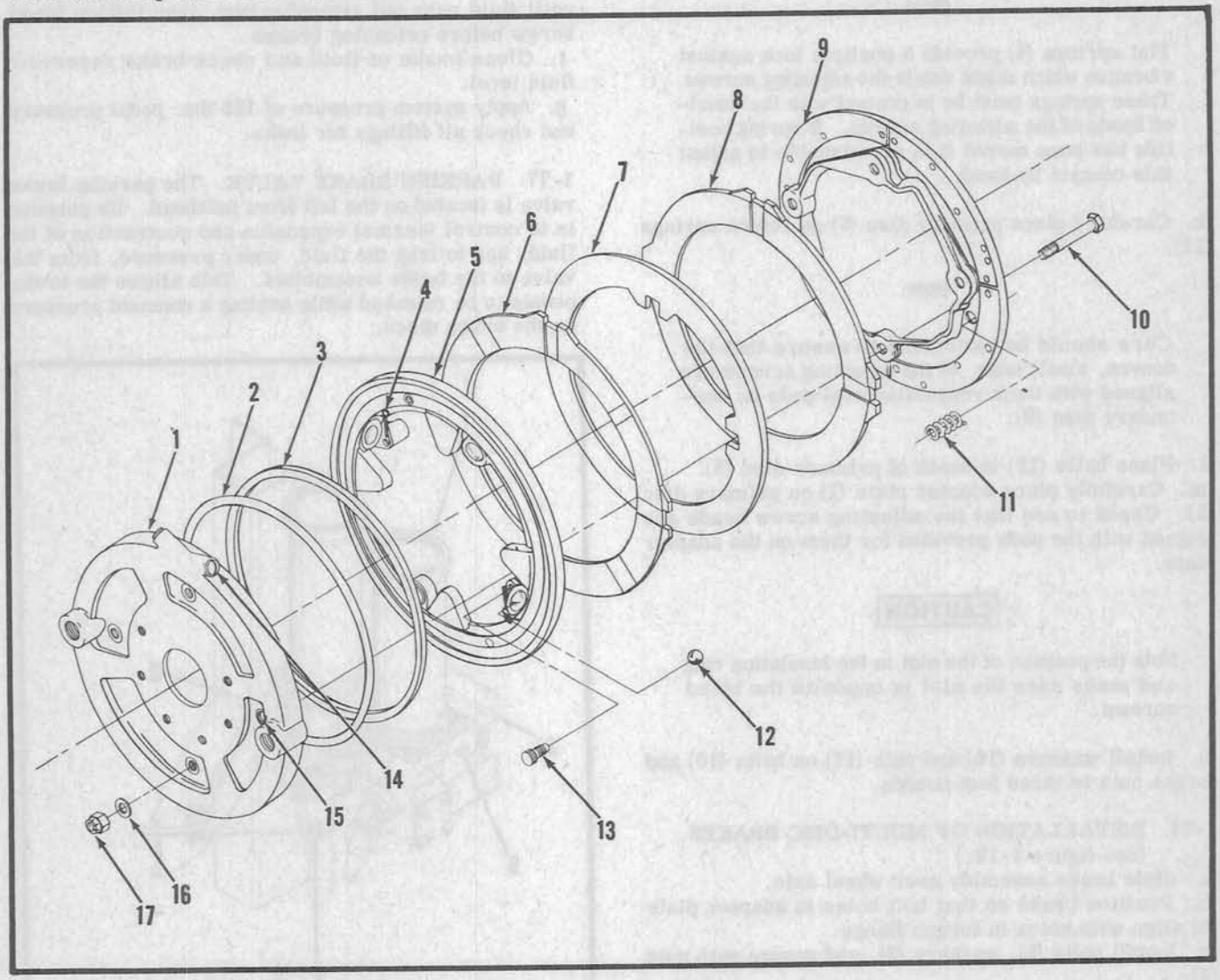
a. Lubricate piston groove in adapter plate (1) with hydraulic fluid Specification MIL-O-5606.

b. Lubricate "O" ring (2) with a light coat of grease conforming to Specification MIL-G-4343 and install "O" ring in groove by applying thumb pressure around its entire circumference.

CAUTION

Seat the "O" ring in the hydraulic groove with a soft blunt tool. Do not use any abrasive tool which might damage the adapter plate or "O" ring.

c. Apply a thin film of grease Specification MIL-G-4343 to the semi-circular groove in the face of the



1. Adapter plate
2. "O" ring
3. Piston
4. Flat spring
5. Primary disc
6. Rotor
7. Stator
8. Rotor
9. Secondary disc
10. Bolt
11. Return spring
12. Balls
13. Adjusting screw
14. Bleed screw
15. Inlet port
16. Washer
17. Nut

Figure 1-20. Assembly of Main Gear Brakes

piston (3) and wiped along the sides.

d. Install piston (3) in the hydraulic groove, with the concave face of the ring against "O" ring (2).

e. Place secondary disc (9) on a flat surface with the riveted facing turned up, then place rotor disc (8) on secondary disc facing.

f. Position stator disc (7) on rotor so that the four lug spaces line up with the four bolt holes.

g. Insert bolts (10) through secondary disc (9), from the back, and through the lugs in disc (7).

h. Place rotor (6) on top of stator (7).

i. Place return springs (11) in the spring seats of the secondary disc.

j. Grease adjusting screws with grease conforming to Specification MIL-G-9305. The screws should be rotated until the underside of the head is touching and then backed off two or three clicks of flat spring (4).

Note

Flat springs (4) provide a positive lock against vibration which might rotate the adjusting screws. These springs must be in contact with the knurled heads of the adjusting screws. If spring position has been moved it is permissable to adjust this contact by hand.

k. Carefully place primary disc (5) on return springs (11).

Note

Care should be exercised to assure that the convex, small ends, of the adjusting screws are aligned with their respective oval pads on secondary disc (9).

l. Place balls (12) in seats of primary disc (5).

m. Carefully place adapter plate (1) on primary disc (5). Check to see that the adjusting screw heads are aligned with the pads provided for them on the adapter plate.

CAUTION

Note the position of the slot in the insulating ring and make sure the slot is opposite the bleed screws.

n. Install washers (16) and nuts (17) on bolts (10) and torque nuts to three foot pounds.

1-74. INSTALLATION OF MULTI-DISC BRAKES. (See figure 1-19.)

a. Slide brake assembly over wheel axle.

b. Position brake so that bolt holes in adapter plate (6) align with holes in torque flange.

c. Install bolts (5), washers (3), and secure with nuts (4).

d. Connect brake line to brake fitting (2).

e. Install wheel in accordance with paragraph 1-66.

f. Bleed brake system in accordance with paragraph 1-76.

1-75. BREAKING IN NEW BRAKES. Upon replacing brake rotors, very little break-in is required. The pedal pressure will be somewhat higher until the linings are thoroughly broken in, but pedal pressure should still be within the required range. However, if it is felt that break-in is necessary, no more than five successive stops should be made from 30 mph ground speed without allowing the brakes to cool. Cooling time is approximately twenty minutes.

1-76. BLEEDING BRAKE SYSTEM.

a. Check all fittings for proper installation.

b. Remove bleed screws and replace with 1/4-20 thread screw and hose combination.

c. With the brake bleeder partially filled with hydraulic fluid Specification MIL-O-5606, force approximately one pint of fluid through the system from the control unit or until there are no more air bubbles apparent.

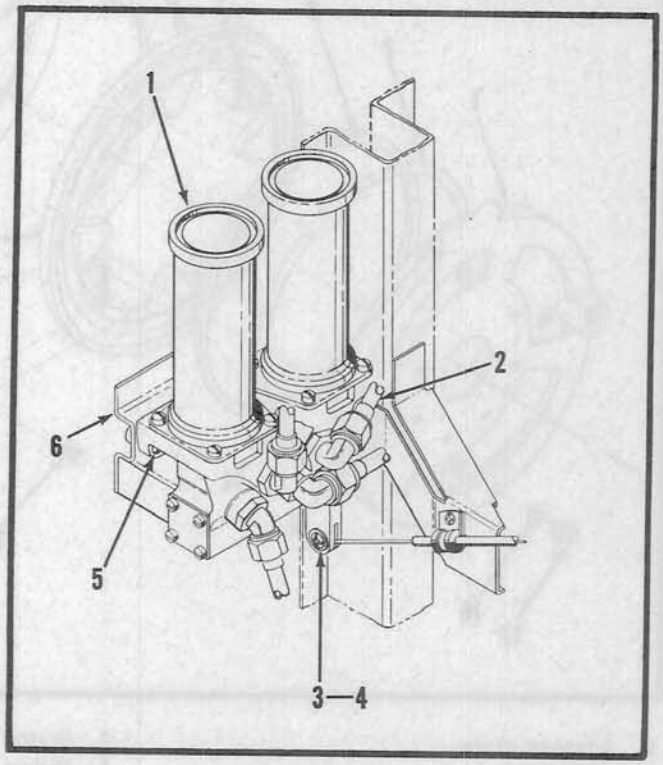
d. Remove bleed hose and fitting and replace with bleed screw.

e. Press on brake pedal with bleed screw slightly open until fluid runs out around screw, then tighten bleed screw before releasing brakes.

f. Clean brake of fluid and check brake reservoir fluid level.

g. Apply system pressure of 125 lbs. pedal pressure and check all fittings for leaks.

1-77. PARKING BRAKE VALVE. The parking brake valve is located on the left front bulkhead. Its purpose is to control thermal expansion and contraction of the fluid, and to trap the fluid, under pressure, from the valve to the brake assemblies. This allows the brake pedals to be released while holding a constant pressure on the brake discs.



1. Valve
2. Line
3. Screw
4. Nut
5. Screw
6. Bracket

Figure 1-21. Parking Brake Valve Installation

1-78. REMOVAL OF PARKING BRAKE VALVE. (See figure 1-21.)

a. Disconnect parking brake control linkage by removing screw and washer securing control valve arm to parking brake valve.
b. Disconnect and cap lines, fittings, and ports.
c. Remove three screws and parking brake valve.

1-79. INSTALLATION OF PARKING BRAKE VALVE. (See figure 1-21.)

a. Attach parking brake valve to mounting bracket with three screws.
b. Uncap and connect lines, fittings, and ports.
c. Connect parking brake control linkage by sliding parking brake control valve arm onto parking brake valve and secure with washer and screw.

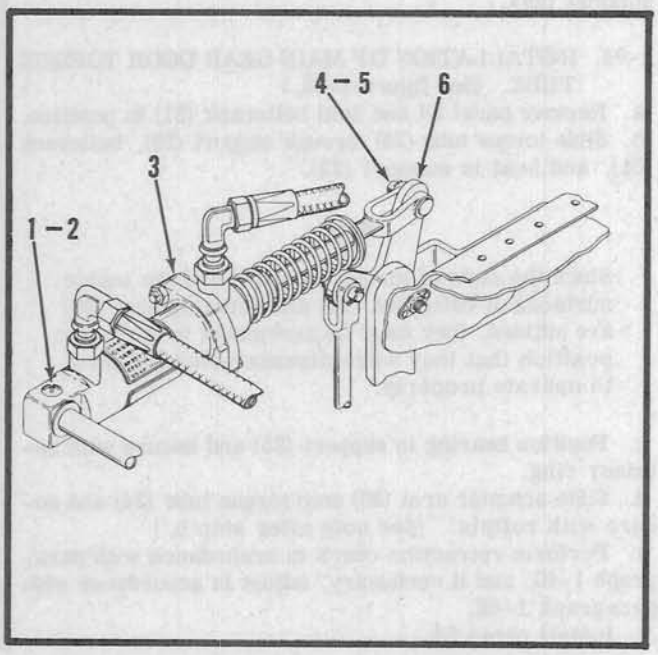
1-80. BRAKE CONTROL UNIT. A hydraulic brake control units attached to each of the four rudder pedals. Toe pressure applied on either of the left or right hand pedals initiates the flow of hydraulic fluid from the control unit to the wheel brake assembly on the corresponding main gear.

1-81. REMOVAL OF BRAKE CONTROL UNIT. (See figure 1-22.)

a. Disconnect hydraulic lines and cap them.
b. Remove cotter pin, pin, and disconnect clevis from bellcrank.
c. Remove screw and nut attaching control unit to pivot tube and remove unit from airplane.

1-82. INSTALLATION OF BRAKE CONTROL UNIT. (See figure 1-22.)

a. Attach control unit body to pivot rod with screw secure with nut.



1. Screw
2. Nut
3. Control unit
4. Pin
5. Cotter pin
6. Bellcrank

Figure 1-22. Brake Control Unit Installation

b. Attach clevis to bellcrank with pin and lock with cotter pin.
c. Connect hydraulic lines.
d. Recharge hydraulic brake system.

1-83. MAIN LANDING GEAR UPLOCK.

1-84. OPERATION OF MAIN LANDING GEAR UPLOCKS. The main gears and doors are locked in the up position by uplock assemblies located in the wheel wells. Two uplocks are attached to a torque tube which is operated through bellcranks by the main gear door cylinder. When either landing gear control handle is pulled up, the sequencing system retracts the main gear first, then extends the door cylinder, turning the uplock torque tube. This compresses a bungee, pushes an actuating rod assembly, and starts the uplocks moving down to engage the door rollers when the door is fully up. When the bungee moves past center, its compressed spring helps the cylinder to close the door. The actuating rod turns a torque tube which moves an arm and link to raise the door. When the door is fully closed, the arm and link will be slightly past center to help in locking the door up. As the uplocks complete their engaging of the door rollers, the aft lock actuates a switch mounted in the roller bracket, causing the position indicator for that wheel to indicate UP.

1-85. REMOVAL OF UPLOCK TORQUE TUBES. (See figure 1-23.)

a. Discharge hydraulic pressure by operating flaps or speed brake until hydraulic pressure gage reads zero.
b. Remove panel 56.
c. Remove nut, bolt, and spacer attaching bungee (16) to bellcrank (4).
d. Remove nut and bolt attaching actuating rod (19) to bellcrank (3).
e. Remove nut and bolt attaching hydraulic cylinder rod end to bellcrank (3).
f. Remove nuts and bolts attaching supports (6) and (9) to rib assembly and remove torque tube assembly.

1-86. DISASSEMBLY OF UPLOCK TORQUE TUBES. (See figure 1-23.)

a. Slide spacer (17) and bellcranks (3) and (4) off splined end of torque tube (7).
b. Turn nut (15) off torque tube.
c. Slide support (9) off torque tubes (7) and (11).
d. Remove four nuts, four bolts, and links (11) and (14).
e. Remove rollpins and key, and slide bellcrank (8) off torque tube (7), and uplock (10) off torque tube (12).
f. Remove rollpin and slide uplock (13) off torque tube (12).
g. Pull torque tube (12) from support (6); slide support (6) off torque tube (7).
h. Remove rollpin and key, and slide bellcrank (5) off torque tube (7).

1-87. ASSEMBLY AND INSTALLATION OF UPLOCK TORQUE TUBES. (See figure 1-23.)

a. Slide bellcrank (5) onto torque tube (7); insert key and secure with rollpin.
b. Slide support (6) onto torque tube (7).
c. Slide end of torque tube (12) through support (6).
d. Slide uplock (13) onto torque tube (12) and secure with rollpin.

e. Slide bellcrank (8) onto torque tube (7); insert key and secure with rollpin.
f. Slide uplock (10) onto torque tube (12) and secure with rollpin.
g. Attach links (11) and (14) to uplocks (10) and (13) and bellcranks (8) and (5) with four bolts and nuts.
h. Turn nut (15) as far as it will go onto torque tube (7).
i. Slide bellcranks (3) and (4) onto torque tube (7).

Note

Since bellcranks (3) and (4), and the end of torque tube (7) are splined, the index marks on these three parts must be aligned before the connecting linkage will operate correctly.

j. Insert the ends of torque tubes (12) and (7) into support (9).
k. Slide spacer (17) onto torque tube (7).
l. Position assembly in wheel well with the end of torque tube (7) inserted in support (18); attach supports (6) and (9) to rib assembly with bolts and nuts.
m. Attach hydraulic cylinder rod end to bellcrank (3) with bolt and nut.
n. Attach bungee (16) to bellcrank (4) with bolt, spacer, and nut.
o. Attach actuating rod (19) to bellcrank (3) with bolt and nut.
p. Tighten nut (15) against bellcrank (4) until there is no play in torque tube (7), and safety wire nut.
q. Adjust uplock in accordance with paragraph 1-88.

1-88. ADJUSTMENT OF MAIN GEAR UPLOCKS. The following parts are adjustable: the door retraction lower link (23, figure 1-23); the door actuator arm stop which is bracketed to the stub spar in the wheel well; the door actuator rod (19, figure 1-23); the door cylinder bellcrank stop which is bracket mounted to the front spar behind panel 55; the two door uplock link assemblies; the door cylinder rod end; and the door actuator rod stop. To adjust main gear uplocks, proceed as follows:
a. Jack the airplane.
b. Remove panel 55 and disconnect door actuator rod.
c. Adjust the door retraction lower link for a snug fit at the top of the retraction arc.
d. Adjust the door actuator arm stop to stop the door actuator arm just after it snaps past center. (Before the door starts to drop open again.) This is about 0.125 inches past center.
e. Connect door actuator rod, disconnect door cylinder, and adjust rod end for a snug fit when the two rod ends and the center of the torque tube (7, figure 1-23) are in a straight line, just before passing over center.
f. Adjust door cylinder bellcrank stop to stop bellcrank at 1/4 inch past center on retraction.
g. Adjust the two door uplock link assemblies to hold the uplocks firmly against the door rollers when the door is retracted.
h. Adjust uplock switch in aft roller bracket so it is actuated by the uplock as the door cylinder bellcrank moves past center.
i. With the door down, and the door cylinder fully closed, adjust the cylinder rod end to fit in the door cylinder bellcrank (3, figure 1-23) and connect them.
j. Adjust the door actuator rod stop so it doesn't quite touch the inboard bellcrank (21, figure 1-23) when the door is down.

1-89. MAIN GEAR DOOR CYLINDERS. The two door cylinders, one for each inboard door, are located between the front spars and the stub spars behind panels 54 and 55, accessible through the wheel wells.

1-90. REMOVAL OF MAIN GEAR DOOR CYLINDER. (See figure 1-23.)
a. Discharge hydraulic pressure by operating flaps or speed brake until hydraulic pressure gage reads zero; remove panels 54 and 55.
b. Disconnect and cap lines and ports.
c. Remove nut and bolt attaching cylinder rod end to bellcrank (3).
d. Remove nut, washers, and bolt attaching cylinder to bracket (26.)

1-91. INSTALLATION OF MAIN GEAR DOOR CYLINDER. (See figure 1-23.)
a. Attach cylinder to bracket (26) with bolt, two washers, and nut.
b. Attach cylinder rod end to bellcrank (3) with bolt and nut.
c. Uncap and connect lines and ports.
d. Perform retraction check in accordance with paragraph 1-40, and if necessary, adjust in accordance with paragraph 1-88.
e. Install panels 54 and 55.

1-92. MAIN GEAR DOOR TORQUE TUBE.

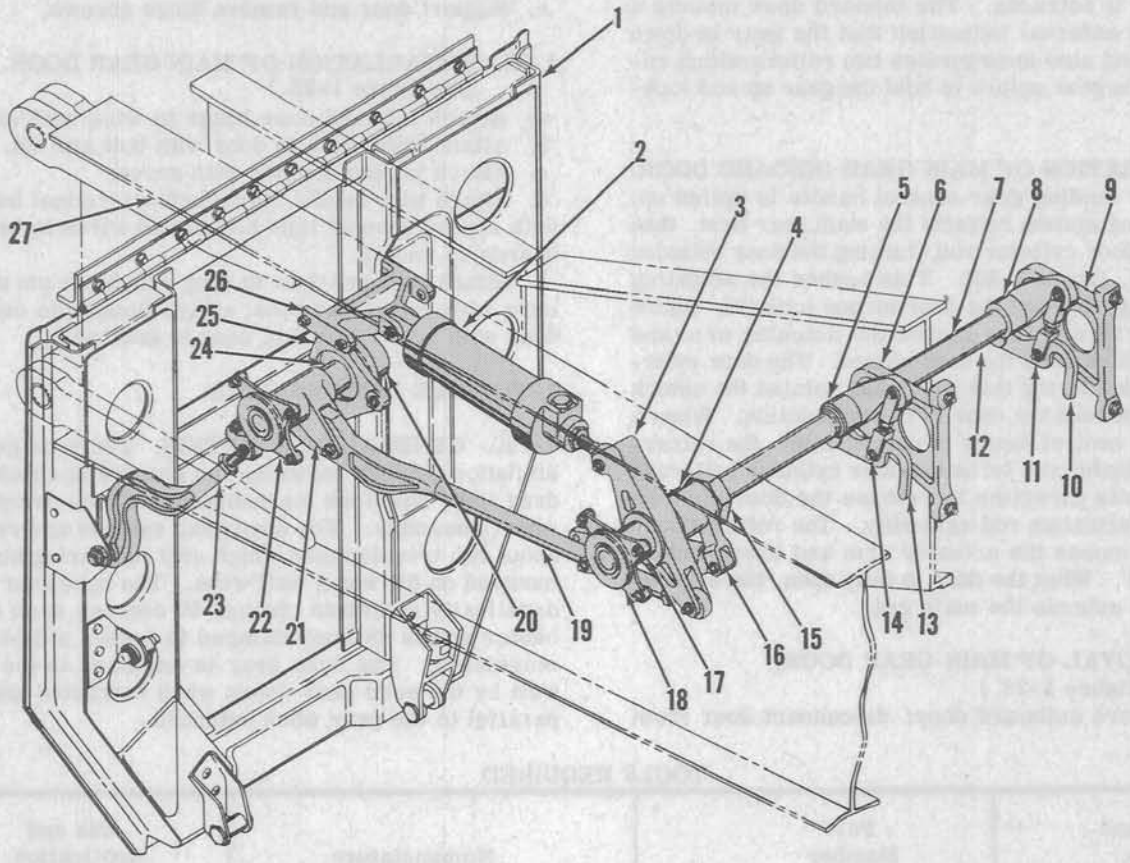
1-93. REMOVAL OF MAIN GEAR DOOR TORQUE TUBE. (See figure 1-23.)
a. Remove rollpin and slide actuator arm (20) off torque tube (24).
b. Remove retainer ring and bearing from support (25).
c. Pull torque tube (24) out from bellcrank (21) and support (25).

1-94. INSTALLATION OF MAIN GEAR DOOR TORQUE TUBE. (See figure 1-23.)
a. Remove panel 54 and hold bellcrank (21) in position.
b. Slide torque tube (24) through support (25), bellcrank (21), and seat in support (22).

Note

Since the ends of torque tube (24) and the inside surfaces of bellcrank (21) and actuator arm (20) are splined, they must be assembled in the same position that they were disassembled for them to operate properly.

c. Position bearing in support (25) and secure with retainer ring.
d. Slide actuator arm (20) onto torque tube (24) and secure with rollpin. (See note after step b.)
e. Perform retraction check in accordance with paragraph 1-40, and if necessary, adjust in accordance with paragraph 1-88.
f. Install panel 54.



1. Inboard door
2. Uplock cylinder
3. Bellcrank
4. Bellcrank
5. Bellcrank
6. Support
7. Torque tube
8. Bellcrank
9. Support
10. Uplock hook
11. Link
12. Torque tube
13. Uplock hook
14. Link
15. Nut
16. Bungee
17. Spacer
18. Support
19. Actuating rod
20. Actuator arm
21. Bellcrank
22. Support
23. Lower link
24. Torque tube
25. Support
26. Support
27. Wing front spar

Figure 1-23. Main Gear Uplock Installation

1-95. MAIN LANDING GEAR DOORS. The main landing gear doors are attached to the underside of the wings and enclose the gear in the wheel well when the gear is retracted. The doors hang parallel to the gears when in the extended position. The inboard door operates in conjunction with the main gear uplock while the outboard door is linked to the gear trunnion and is pulled up by the gear as it retracts. The inboard door mounts a light to give external indication that the gear is down and locked and also incorporates two rollers which engage the main gear uplock to hold the gear up and locked.

1-96. OPERATION OF MAIN GEAR INBOARD DOOR. When either landing gear control handle is upIled up, the sequencing system retracts the main gear first, then extends the door cylinder rod, turning the door cylinder bellcrank (3, figure 1-23). This pushes the actuating rod assembly, turning the door torque tube (24, figure 1-23). The torque tube moves the actuator arm and lower link which pulls the door closed. The door cylinder bellcrank, during this time, has rotated the uplock torque tube to lock the door in the up position. When a landing gear control handle is pushed down, the retracting door cylinder rod turns the door cylinder bellcrank in the opposite direction to release the door uplocks and pull the actuating rod assembly. The rotating door torque tube moves the actuator arm and lower link to open the door. When the door is fully open, the sequencing system extends the main gear.

1-97. REMOVAL OF MAIN GEAR DOOR.
(See figure 1-23.)

a. To remove outboard door: disconnect door from gear arm; remove screw and jumper; remove cotter pins and door hinge pin.
b. Disconnect light and switch wires at terminal boards 15 and 13; remove wire clamp below terminal board 13.
c. Remove screw to disconnect jumper on inboard door.
d. Remove nut and bolt to disconnect lower link at door.
e. Support door and remove hinge screws.

1-98. INSTALLATION OF MAIN GEAR DOOR.
(See figure 1-23.)

a. Attach inboard door hinge to wing with screws.
b. Attach lower link to door with bolt and nut.
c. Attach jumper to door with screw.
d. Attach wire bundle clamp below terminal board 13 with screw; connect light and switch wires to terminal boards 15 and 13.
e. Attach outboard door to wing with hinge pin and secure with two cotter pins; attach jumper to outboard door with screw; connect door to gear arm.

1-99. NOSE LANDING GEAR.

1-100. GENERAL DESCRIPTION. The nose gear installation consists basically of a pneudralic shock strut, drag link, downlock mechanism, shimmy damper and wheel assembly. The nose gear extends and retracts about two trunnion pins which seat in bearing supports mounted on the wheel well webs. The nose gear is hydraulically steerable through 50 degrees each side of center and is shimmy damped to lessen side-to-side movement. The nose gear is enclosed in the wheel well by the nose gear doors when retracted and hang parallel to the gear when extended.

TOOLS REQUIRED

Figure and Index No.	Part Number	Nomenclature	Use and Application
10, Figure 1-25	Cessna Part No. 4080640	Nose gear trunnion pin extractor	Removal of Nose Gear

1-101. NOSE GEAR SHOCK STRUT. The nose gear shock strut is of a pneudraulic type and consists basically of telescoping inner and outer cylinders. Cylinder movement forces fluid through a variable orifice in the inner cylinder and compresses the air contained in the strut. This provides a controlled resistance to shocks during take-off, landing, and taxiing. A yoke is attached to the lower end of the inner cylinder to provide a mounting for a wheel and tire assembly.

1-102. REMOVAL OF NOSE GEAR. (See figure 1-25.)

a. Jack airplane and remove panel 1.
b. Insert safety pin through nose gear bungee lightening holes.

WARNING

Serious damage or personnel injury can result from removing gear without adequately safetying gear bungee.

c. Disconnect electrical wiring to microswitch.
d. Disconnect and cap steering unit hydraulic lines and fittings.
e. Remove nut, washer, spacer, and bolt attaching push rod (5, figure 1-30) to the nose gear steering collar.
f. Remove cotter pin, nut, washer, and bolt attaching drag brace (17) to shock strut (15).
g. Remove nut and bolt attaching cylinder (4) to trunnion (14).
h. Remove nuts (12), washers (11), and bolts (6) attaching trunnion pins (9) to trunnion. This will disconnect the jumper (7) on the left side.
i. Twist gear until pin extractor (10) can be screwed into trunnion pin; pull pin from bearing support (5). Repeat on the other trunnion pin and remove gear.

1-103. INSTALLATION OF NOSE GEAR.
(See figure 1-25.)

a. Position gear in wheel well.
b. Align trunnion pin holes with socket holes and insert pins (9) through sockets, seating in supports (5).
c. If necessary, add shims between supports (5) and web to obtain .002 to .018 inches play between trunnion and supports.

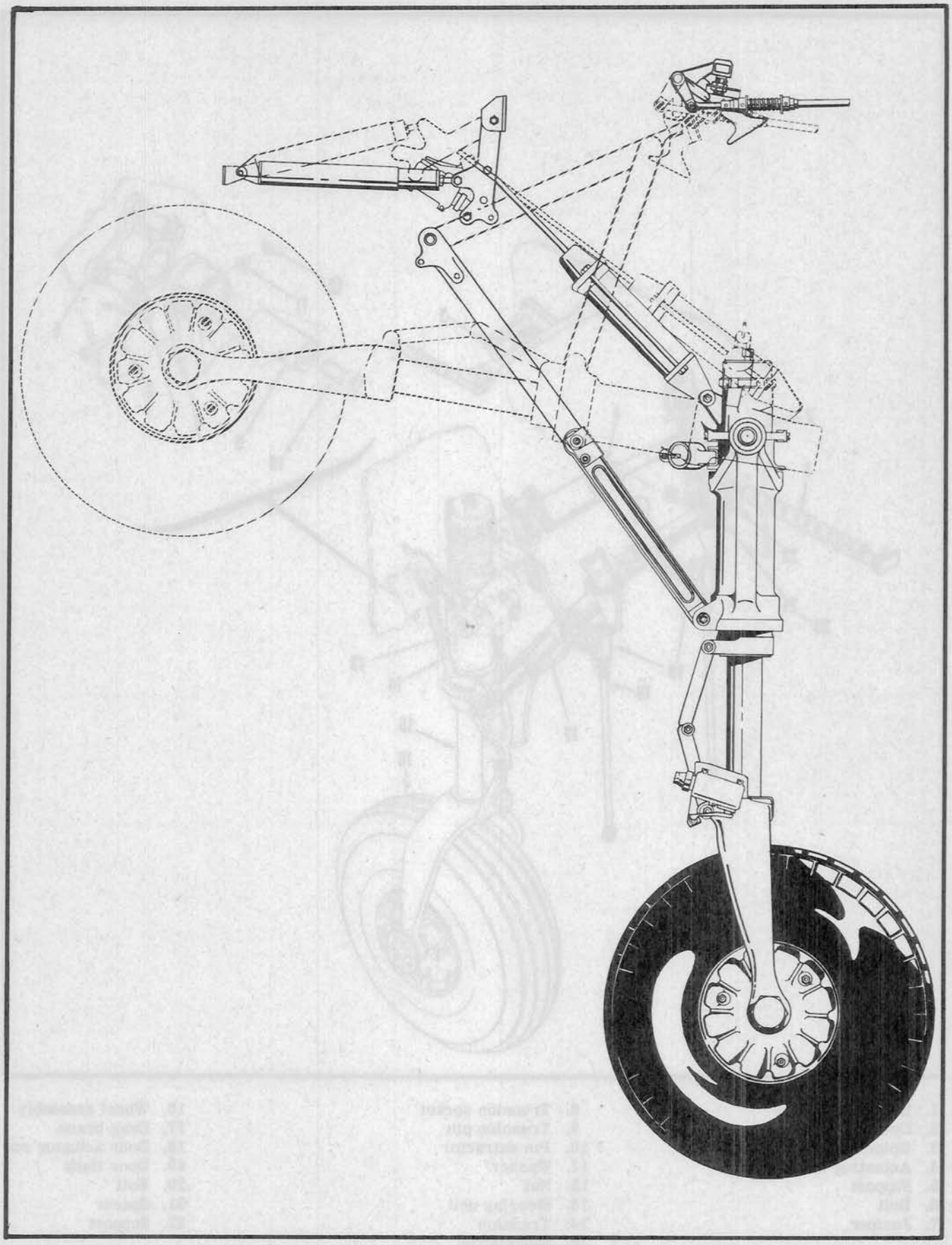
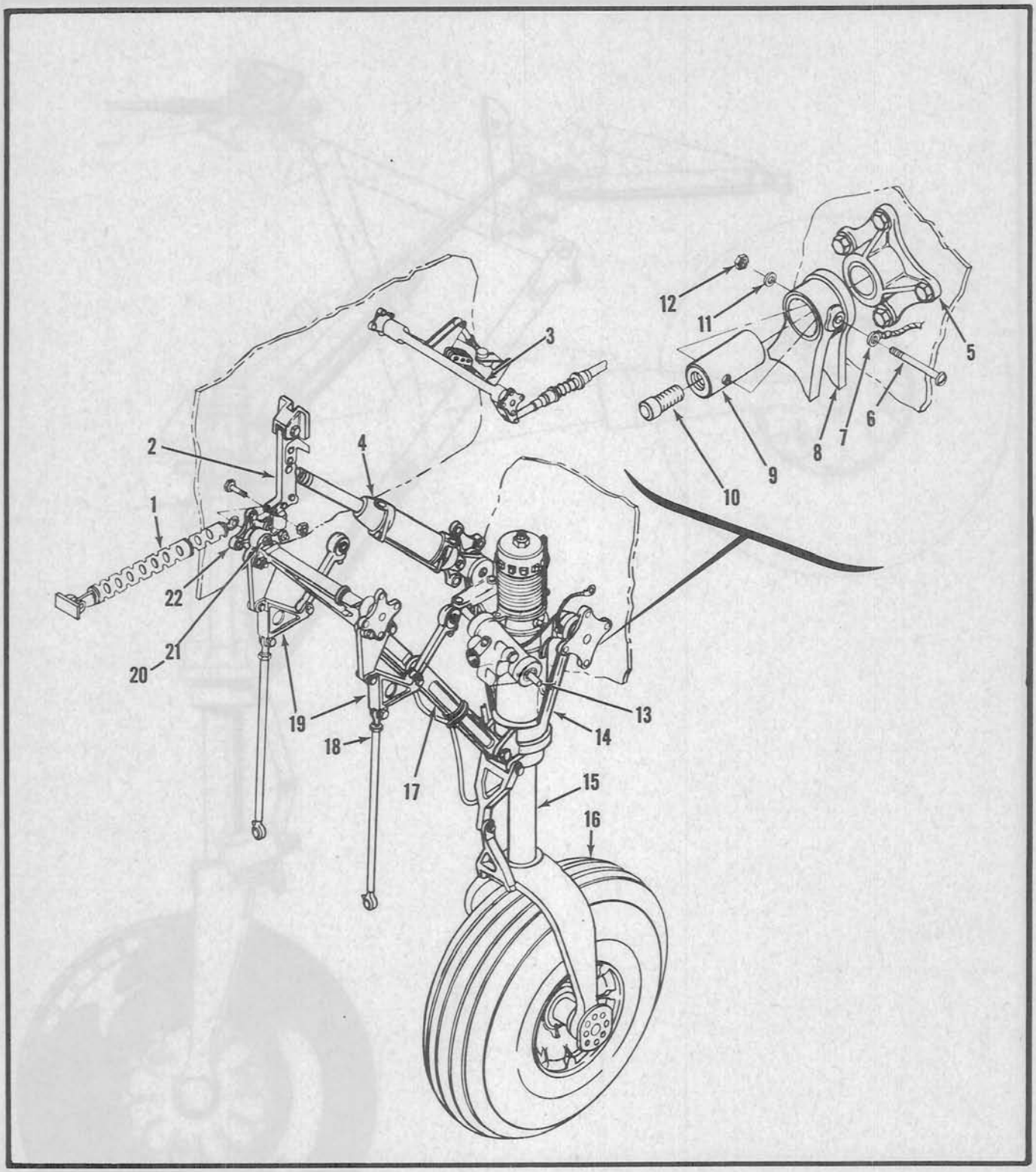


Figure 1-24. Nose Gear Retraction



1. Downlock bungee
2. Downlock arm
3. Uplock
4. Actuating cylinder
5. Support
6. Bolt
7. Jumper
8. Trunnion socket
9. Trunnion pin
10. Pin extractor
11. Washer
12. Nut
13. Steering unit
14. Trunnion
15. Shock strut
16. Wheel assembly
17. Drag brace
18. Door actuator rod
19. Door links
20. Bolt
21. Spacer
22. Support

Figure 1-25. Nose Gear Installation

d. Position jumper on left socket; attach trunnion sockets to pins with bolts (6), washers (11), and nuts (12).
e. Attach cylinder (4) to trunnion (14) with bolt and nut.
f. Attach drag brace (17) to shock strut (15) with bolt, washer, nut, and cotter pin.
g. Attach push rod (5, figure 1-30) to nose gear steering collar with bolt, spacer, washer, and nut.
h. Uncap and connect steering unit hydraulic lines and fittings.
i. Connect electrical wiring to microswitch.
j. Remove safety pin from nose gear bungee.
k. Perform operational check in accordance with paragraph 1-40.

1-104. MAINTENANCE OF NOSE GEAR SHOCK STRUT. Servicing the shock strut in accordance with paragraph 1-49, and figure 1-12, and keeping it clean is the only field maintenance recommended.

1-105. NOSE GEAR WHEEL AND TIRE.

1-106. GENERAL DESCRIPTION. A Type III, 600 X 6, low pressure tire and wheel assembly is mounted on the nose gear. The wheel is divided into two halves which are held together by six bolts, nuts, and washers. The wheel rotates on an exle which passes through the nose gear fork, spacers and wheel. The axle is secured by axle nuts which screw into the ends of the axle.

1-107. REMOVAL OF NOSE GEAR WHEEL AND DISMOUNTING TIRE. (See figure 1-26.)
a. Jack airplane.
b. Remove nuts and screws attaching axle nuts to nose gear fork.
c. Unscrew axle nuts from axle.
d. Pull axle from wheel assembly, releasing wheel and spacers.

CAUTION

Take care to avoid damage to grease retainers and bearings in wheel.

e. Deflate tire.

WARNING

Completely deflate tire before dismounting it: air pressure in tire can throw wheel halves with sufficient force to cause serious injury.

f. Break casing bead from both wheel halves.
g. Remove nuts, washers, and bolts attaching wheel halves and remove wheel halves from tire.

1-108. DISASSEMBLY OF NOSE GEAR WHEEL. Other than separating wheel halves, the only disassembly possible is the removal of the snap ring, grease retainer, and bearing assembly from each wheel half.

1-109. MAINTENANCE OF NOSE GEAR WHEEL AND TIRE. Refer to paragraphs 1-63 and 1-64 for maintenance of the nose gear wheel and tire.

1-110. ASSEMBLY OF NOSE GEAR WHEEL AND MOUNTING TIRE. (See figure 1-26.)
a. Insert bearings and grease retainers in wheel halves, and secure with snap rings.
b. Before inserting tube into tire, dust inside of tire with talcum (Stock No. 6700-208716, Class 29).
c. Insert deflated tube into tire. To assure proper balance, align the stripe on the tire with the dot on the tube.
d. Place tire with tube on wheel helf, inserting stem through hole provided.

Note

Align the slippage mark on the tire with the slippage mark on the wheel.

e. Place other wheel half on top.

CAUTION

Take care to avoid pinching tube when mating wheel halves.

f. Attach wheel halves with bolts, washers, and nuts. Tighten nuts alternately and evenly to 20-30 inch pounds torque.
g. Partially inflate tire; then deflate and check tire beads for proper seating. Then inflate tire to 20 ±2 PSI.

1-111. INSTALLATION OF NOSE GEAR WHEEL. (See figure 1-26.)
a. Wipe axle clean and grease with a light coat of grease, Specification MIL-L-3545.
b. Position wheel and spacers in fork and insert axle.

CAUTION

Take care to avoid damage to grease retainers and bearings in wheel.

c. Screw axle nuts evenly into axle until wheel drags; then back off to first hole and secure with screws and nuts.

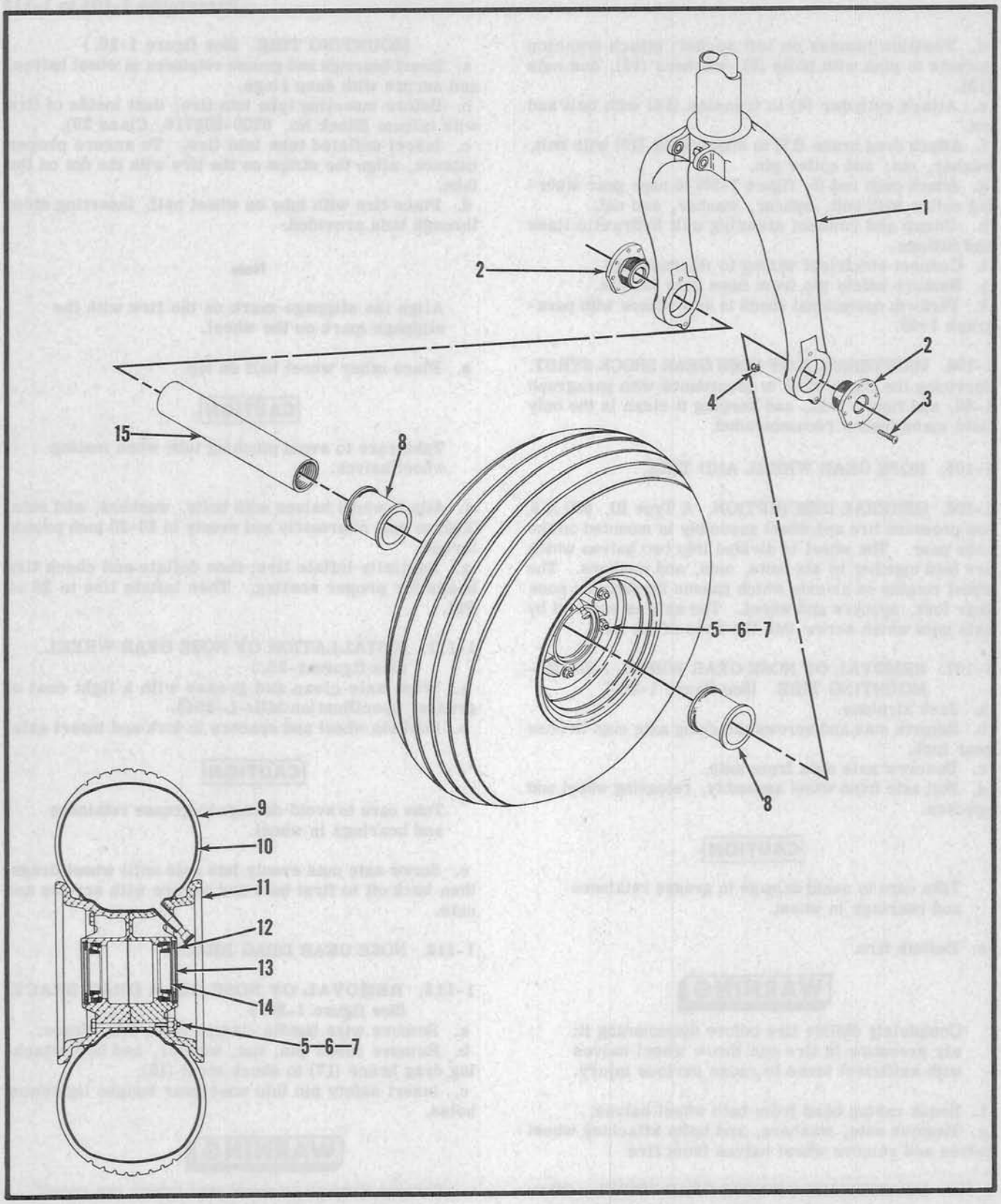
1-112. NOSE GEAR DRAG BRACE.

1-113. REMOVAL OF NOSE GEAR DRAG BRACE. (See figure 1-25.)
a. Remove wire bundle clamps from drag brace.
b. Remove cotter pin, nut, washer, and bolt attaching drag brace (17) to shock strut (15).
c. Insert safety pin into nose gear bungee lightening holes.

WARNING

Serious damage or personnel injury can result from disconnecting linkage before safetying bungee.

d. Remove nut and bolt attaching downlock arm (2) to drag brace.
e. Remove nuts, washers, and bolts attaching door links (19) to drag brace door operating fittings.
f. Remove bolts (20) and spacers (21) attaching drag brace to supports (22); and remove drag brace.



1. Fork
2. Axle nut
3. Screw
4. Nut
5. Bolt
6. Washer
7. Nut
8. Spacer
9. Tire
10. Tube
11. Wheel half
12. Snap ring
13. Grease retainer
14. Gearing
15. Axle

Figure 1-26. Nose Gear Wheel and Tire Installation

1-114. INSTALLATION OF DRAG BRACE. (See figure 1-25.)

a. Attach drag brace (17) to supports (22) with spacers (21) and bolts (20). If necessary add shims between supports and web to obtain .002 to .018 inch clearnace between drag brace and supports.

b. Attach door links (19) to drag brace door operating fittings with bolts, washers, and nuts.

c. Attach downlock arm (2) to drag brace with bolt and nut.

d. Attach drag brace to shock strut (15) with bolt, washer, nut, and cotter pin.

e. Attach wire bundle clamps to drag brace.

f. Remove nose gear bungee safety pin.

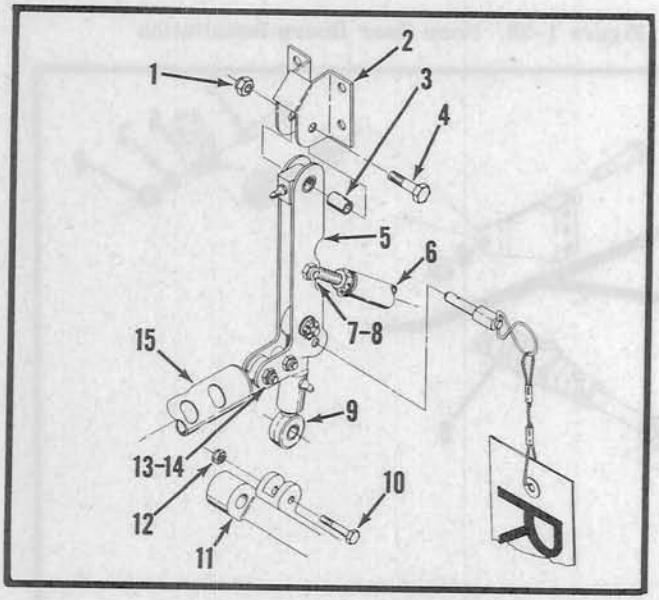
g. Perform operational check in accordance with paragraph 1-40.

1-115. NOSE GEAR DOWNLOCK.

1-116. GENERAL DESCRIPTION. The nose gear downlock is attached to the upper member of the drag brace, and the downlock bungee.

1-117. OPERATION OF NOSE GEAR DOWNLOCK. In extension, the downlock is moved over center by the actuating cylinder and the nose gear bungee, locking the drag brace in the down position. As the downlock moves over center, it actuates the down and locked switch which causes the position indicator for the nose gear to indicate down. During retraction, after the actuating cylinder unlocks the downlock, the linkage is such that the main retracting force from the actuating cylinder is exerted on the trunnion.

1-118. REMOVAL OF NOSE GEAR DOWNLOCK. (See figure 1-27.)



1. Nut
2. Support
3. Spacer
4. Bolt
5. Upper arm
6. Cylinder
7. Bolt
8. Nut
9. Lower arm
10. Bolt
11. Drag brace
12. Nut
13. Bolt
14. Nut
15. Bungee

Figure 1-27. Nose Gear Downlock Installation

Discharge all hydraulic pressure from system by operating speed brakes or flaps until hydraulic pressure gage reads zero.

WARNING

Serious damage or personnel injury can result if the nose gear bungee is not properly safetied before any linkage is disconnected.

a. Insert bungee safety pin through bungee lightening holes; remove nut (14) and bolt (13).

b. Disconnect nose gear actuating cylinder rod end (6) by removing nut (8) and bolt (7).

c. Unlock downlock; remove nut (1), spacer (3), and bolt (4) attaching downlock to support (2).

d. Remove nut (12) and bolt (10) attaching downlock to drag brace (11).

1-119. INSTALLATION OF NOSE GEAR DOWNLOCK. (See figure 1-27.)

a. Attach upper downlock arm (5) to support (2) with spacer (3), bolt (4), and nut (1).

b. Attach lower downlock arm (9) to drag brace (11) with bolt (10) and nut (12).

c. Attach cylinder rod end (6) to downlock with bolt (7) and nut (8).

d. Adjust downlock in accordance with paragraph 1-120.

1-120. ADJUSTMENT OF NOSE GEAR DOWNLOCK. (See figure 1-27.)

a. Safety bungee and remove nut (14) and bolt (13).

b. Disconnect lower end of downlock and adjust rod end until downlock just breaks over center. This can be checked by inserting bolt in downlock rod end and pulling downlock closed by hand.

c. Adjust actuating cylinder rod end (6) to fit when cylinder is fully retracted and downlock is locked.

d. Adjust down-and-locked switch so that plunger moves approximately .12 inches after contact with the actuator on the upper downlock arm.

e. Attach bungee (15) to downlock with bolt (13) and nut (14) and remove safety pin.

f. Perform operational check in accordance with paragraph 1-40.

1-121. NOSE GEAR DOORS.

1-122. GENERAL DESCRIPTION. The nose gear doors are constructed of formed aluminum with a pan riveted on the inside for strength. Each door rotates on three hinges which are attached to the fuselage structure. The center hinges are connected to the drag brace by actuator rods (18, figure 1-25) and door links (19, figure 1-25). The links are connected to the wheel web through pivots. This linkage operates the doors when the gear is extending or retracting. The right door mounts a light which can be turned on only when the nose wheel is down and locked, giving external indication that the wheel is down and locked.

1-123. REMOVAL OF NOSE GEAR DOORS AND HINGES. (See figure 1-28.)

a. Remove nut (1), washer (2) and bolt (5) attaching

rod (4) to hinge (3).
b. Disconnect wiring to light on right door.
c. Remove nuts (9) and screws (7) attaching hinges to door. This will disconnect the jumper from the front hinge bracket of each door. Doors are now completely disconnected from airplane.
d. To remove hinges: open nose section access doors and remove nuts (6), bolts (11), and spacers (10).

1-124. INSTALLATION OF NOSE GEAR DOORS AND HINGES. (See figure 1-28.)
a. Install hinges (3) by positioning them in the nose structure and inserting spacers (10) through hinges. Install bolts (11) and secure with nuts (6).
b. Position doors and jumpers, and attach hinges with screws (7) and nuts (9).
c. Attach actuator rods (4) to center hinges with bolts (5), washers (2), and secure with nuts (1).

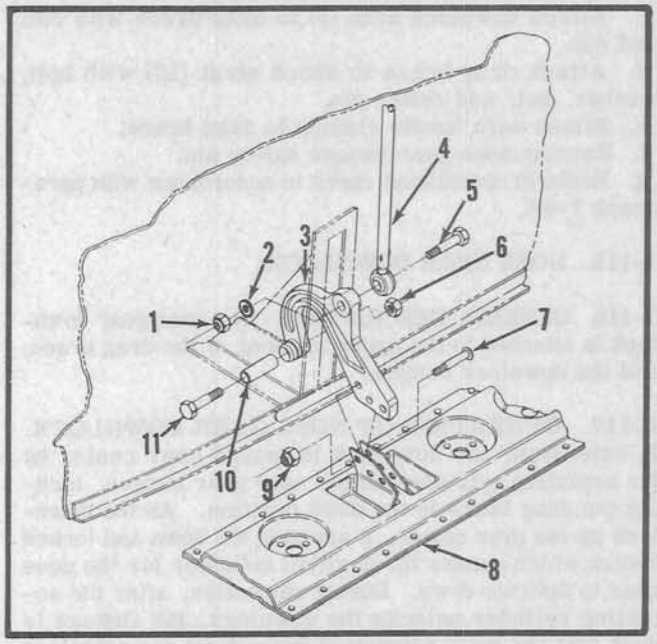
Note

If right hand door was removed, connect electrical wiring to light.

d. Cycle gear several times to insure proper operation of door. See paragraph 1-40.

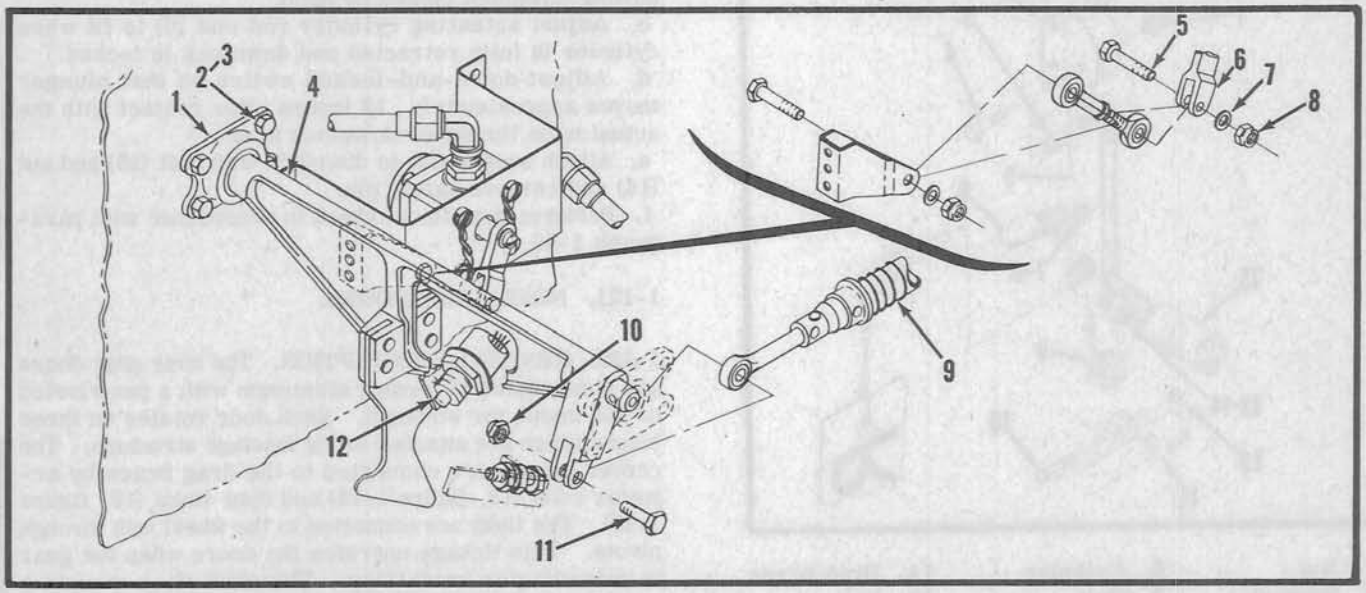
1-125. NOSE GEAR UPLOCK.

1-126. OPERATION OF NOSE GEAR UPLOCK. Positioning either gear control handle in the down position pushes the control linkage push rod forward. The push rod rotates the control torque tube bellcranks forward and up which, in turn, pulls the uplock bungee aft. As the bungee is pulled aft, it pulls aft on the nose gear uplock, releases the uplock from the gear and actuates the landing gear selector valve. When the gear control handles are positioned in the up position reverse action of the linkages occurs. The uplock is positioned to the down position ready to receive the uplock roller on the drag brace. As the gear retracts the uplock roller strikes the uplock pushing it aft. At this point the uplock bungee acts as a stationayr spring and pushes the uplock back over the roller to complete the uplock sequence.



1. Nut
2. Washer
3. Hinge
4. Arm
5. Bolt
6. Nut
7. Screw
8. Door
9. Nut
10. Spacer
11. Bolt

Figure 1-28. Nose Gear Doors Installation



1. Support
2. Bolt
3. Washer
4. Uplock assembly
5. Bolt
6. Selector valve bellcrank
7. Washer
8. Nut
9. Uplock bungee
10. Nut
11. Bolt
12. Switch

Figure 1-29. Nose Gear Uplock Installation

1-127. REMOVAL OF NOSE GEAR UPLOCK. (See figure 1-29.)

a. Remove nut (10) and bolt (11) attaching uplock bungee (9) to uplock (4).

b. Remove nut (8), washer (7), and bolt (5) attaching selector valve bellcrank (6) to uplock rod end.

c. Disconnect switch wiring, and remove wiring clamp from uplock.

d. Remove bolts (2) and washers (3) attaching supports (1) to wheel webs and remove uplock.

1-128. INSTALLATION OF NOSE GEAR UPLOCK. (See figure 1-29.)

a. Assemble bearings and supports (1) on uplock (4) and position in nose wheel well.

b. Attach supports to structure with bolts (2) and washers (3).

c. Attach wiring clamp to uplock and connect wiring to switch.

d. Attach uplock rod end to selector valve bellcrank (6) with bolt (5), washer (7), and nut (8).

e. Attach uplock bungee (9) to uplock with bolt (11) and nut (10).

f. Jack airplane, disconnect linkage from nose gear doors and cycle gear several times to make sure uplock is functioning properly.

1-129. ADJUSTMENT OF NOSE GEAR UPLOCK.

a. Adjust uplock bungee stop bolt to stop uplock, after the uplock roller on the side brace knee has cammed over the uplock hook and is touching the hook.

b. Adjust switch to be actuated just after uplock roller cams over the uplock hook.

c. Adjust uplock bungee rod end to provide adequate spring tension on the uplock.

d. Perform operational check in accordance with paragraph 1-40.

1-130. NOSE GEAR CYLINDER AND SHUTTLE VALVE. The cylinder retracts and extends the gear. The head is attached to the nose gear trunnion; the rod end is attached to the upper downlock arm. Power for gear retraction is furnished by the hydraulic system. A shuttle valve at the down port of the cylinder permits operation by the emergency air system in moving the gear down.

1-131. REMOVAL OF NOSE GEAR CYLINDER AND SHUTTLE VALVE. (See figure 1-25.)

a. Discharge hydraulic pressure; disconnect and plug lines and fittings at cylinder up port and both ports of shuttle valve.

b. Remove nut and bolt attaching cylinder rod end to downlock.

c. Remove nut and bolt attaching cylinder head to trunnion, and remove cylinder with shuttle valve.

1-132. INSTALLATION OF NOSE GEAR CYLINDER AND SHUTTLE VALVE. (See figure 1-25.)

a. Attach cylinder head to nose gear trunnion with bolt and nut.

b. Attach cylinder rod end to downlock with bolt and nut.

c. Uncap and connect lines and fittings at cylinder up port and at shuttle valve ports.

d. Perform operational check in accordance with paragraph 1-40.

1-133. NOSE GEAR STEERING SYSTEM. The nose gear steering system provides directional control of the airplane while on the ground. It is electrically and mechanically actuated and controlled, and hydraulically powered. Basically, it consists of two momentary contact, push button switches, one on each stick grip; a normally closed hydraulic shutoff valve in the nose wheel well; a steering unit on the nose gear; a pressure compensator in the nose wheel well; and a steering assembly on the floor of the cockpit. The switches are electrically connected to the shutoff valve which is hydraulically connected to the steering unit and the pressure compensator. The steering assembly is operated by the rudder pedals and is mechanically connected to the nose gear steering collar. Since the switches receive electrical power through the nose gear safety switch, the system is operable only when the weight of the airplane is on the wheels. See figures 1-9A and 1-30A.

1-134. OPERATION OF NOSE GEAR STEERING SYSTEM. Depressing either selector switch releases hydraulic pressure to the nose gear steering system. Then, as the rudder pedals are moved, cable action rotates the drum and cam-plate. The cam-plate, which rotates between the steering plate levers, pushes outboard against one of the levers. The lever pushed is dependent upon which rudder pedal was pushed. Since the bungee carries a greater load than that necessary to turn the steering plate, it will not compress, but will turn the steering plate instead. When the steering plate turns, it actuates a push rod to the pivot bellcrank which in turn actuates a push rod connected to the nose gear steering collar. Then, as the nose gear steering collar moves it actuates the steering unit spool valve. The movement of the spool valve meters pressure to the "steer right" or "steer left" side of the steering cylinder, thereby turning the gear. When the gear is retracted the steering plate is held in a fixed position. Rudder pedal action still actuates the drum and cam-plate. The cam pushes against one of the levers, but, because the steering plate is held fixed the bungee compresses and the plate does not move.

1-135. TROUBLE SHOOTING NOSE GEAR STEERING SYSTEM.

TROUBLE	PROBABLE CAUSE	REMEDY
NOSE GEAR WILL NOT STEER	Steering unit failed or disconnected; lack of hydraulic pressure	Replace or connect unit; service hydraulic system.
	Linkage failed or disconnected.	Connect or replace linkage.
	Failed switch.	Replace switch

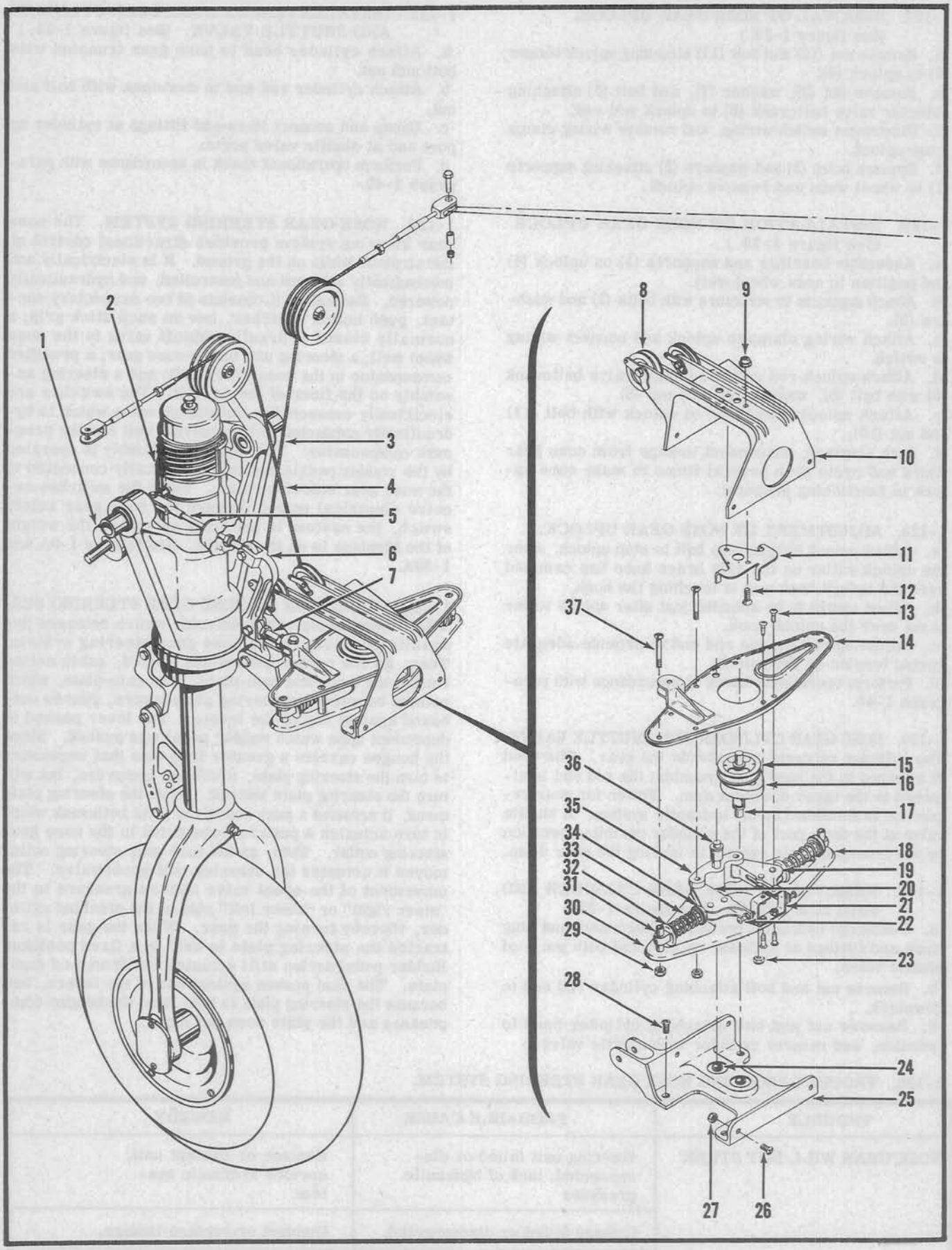
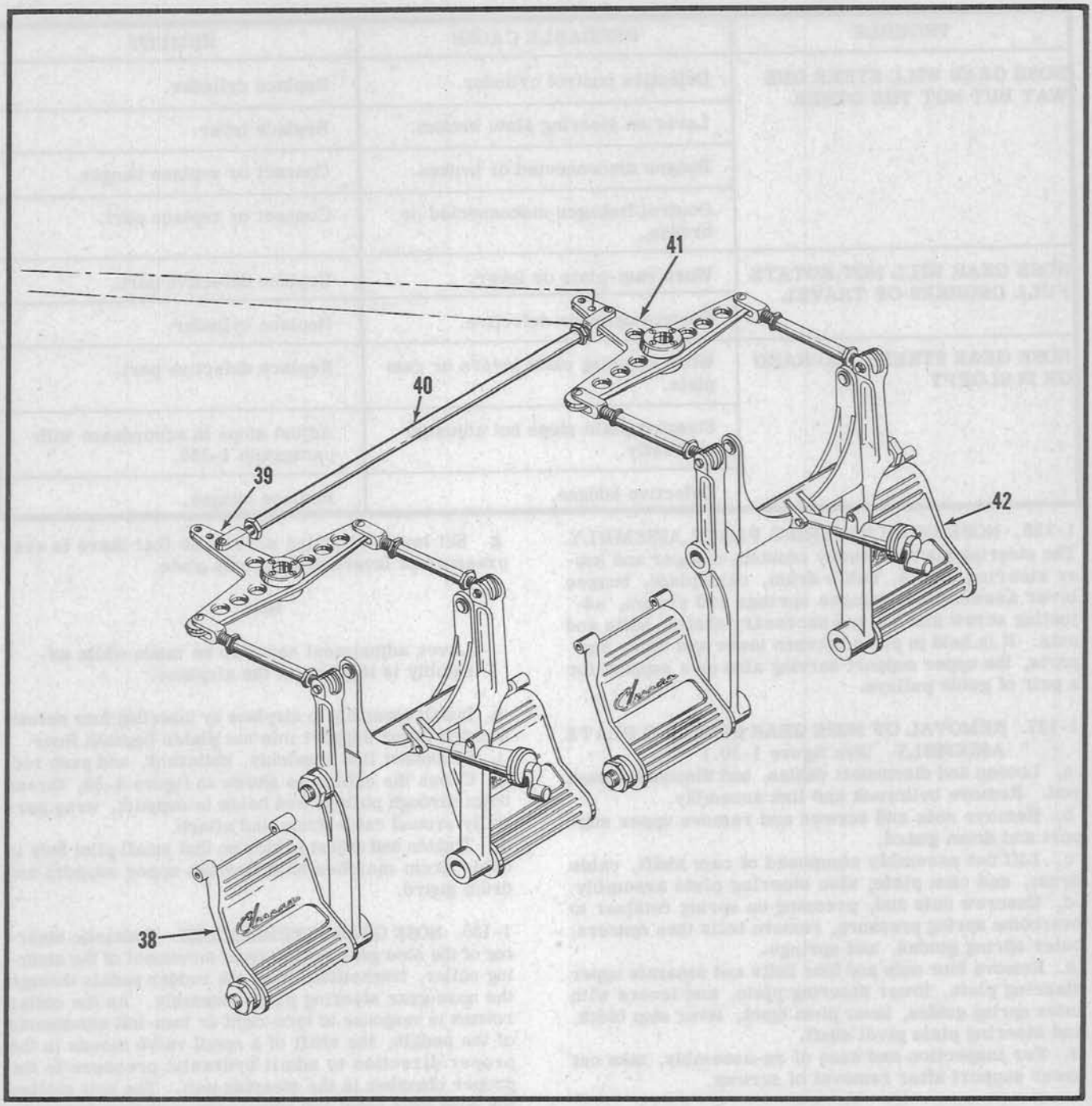


Figure 1-30. Nose Gear Steering Installation (Sheet 1 of 2)



1. Steering unit
2. Steering collar
3. Cable
4. Cable
5. Push rod
6. Bellcrank
7. Link assembly
8. Pulley
9. Nut
10. Support
11. Drum guard
12. Bolt
13. Screw
14. Upper steering plate
15. Cable drum
16. Cam plate
17. Cam shaft
18. Lower steering plate
19. Lever
20. Lever
21. Lever stop
22. Lever adjusting screw
23. Nut
24. Lower support bearing
25. Lower support
26. Screw
27. Nut
28. Screw
29. Nut
30. Lower steering plate
31. Spacer
32. Outer spring guide
33. Spring
34. Inner spring guide
35. Lever pivot block
36. Shaft
37. Bolt
38. Rudder pedal
39. Bellcrank
40. Tie rod
41. Bellcrank
42. Rudder pedal

Figure 1-30. Nose Gear Steering Installation (Sheet 2 of 2)

TROUBLE	PROBABLE CAUSE	REMEDY
NOSE GEAR WILL STEER ONE WAY BUT NOT THE OTHER	Defective control cylinder.	Replace cylinder.
	Lever on steering plate broken.	Replace lever.
	Bungee disconnected or broken.	Connect or replace bungee.
	Control linkages disconnected or broken.	Connect or replace part.
NOSE GEAR WILL NOT ROTATE FULL DEGREES OF TRAVEL	Worn cam-plate or lever.	Replace defective part.
	Control cylinder defective.	Replace cylinder.
NOSE GEAR STEERS TOO HARD OR IS SLOPPY	Worn steering plate levers or cam plate.	Replace defective part.
	Steering plate stops not adjusted correctly.	Adjust stops in accordance with paragraph 1-138.
	Defective bungee.	Replace bungee.

1-136. NOSE GEAR STEERING PLATE ASSEMBLY. The steering plate assembly consists of upper and lower steering plates, cable drum, cam-plate, bungee lever assemblies, bungee springs and guides, adjusting screw and nut and necessary shafts, bolts and nuts. It is held in place between lower and upper supports, the upper support serving also as a support for a pair of guide pulleys.

1-137. REMOVAL OF NOSE GEAR STEERING PLATE ASSEMBLY. (See figure 1-30.)

a. Loosen and disconnect cables, and disconnect push rod. Remove bellcrank and link assembly.

b. Remove nuts and screws and remove upper support and drum guard.

c. Lift out assembly composed of cam shaft, cable drum, and cam plate; also steering plate assembly.

d. Unscrew nuts and, pressing on spring retainer to overcome spring pressure, remove bolts then spacers, outer spring guides, and springs.

e. Remove four nuts and four bolts and separate upper steering plate, lower steering plate, and levers with inner spring guides, lever pivot block, lever stop block, and steering plate pivot shaft.

f. For inspection and ease of re-assembly, take out lower support after removal of screws.

1-138. INSTALLATION AND ADJUSTMENT OF NOSE WHEEL STEERING PLATE ASSEMBLY. (See figure 1-30.)

a. Assemble lower steering plate, lever pivot block, lever stop block, and levers wtth inner spring guides attached, and upper steering plate, by use of four bolts and nuts.

b. Place springs on outer spring guides, fit over inner spring guides, press into place, put spacers in and secure with two bolts and nuts.

c. Assemble cable drum, cam plate, and cam shaft.

d. Place steering plate pivot shaft into place assembly.

e. Assemble cam shaft and steering plate pivot shaft and attached parts into lower support bearings.

f. Fit upper support and attach drum guard over rest of plate assembly and fasten to lower support by four bolts and nuts.

g. Set lever adjusting screws so that there is even pressure of levers against cam plate.

Note

Lever adjustment can also be made while assembly is in place in the airplane.

h. Install assembly in airplane by inserting four screws through lower support into nut plates beneath floor.

i. Reconnect link assembly, bellcrank, and push rod.

j. Cross the cables as shown in figure 1-30, thread them through pulleys and holes in support, wrap partially around cable drum and attach.

k. Tighten and adjust cables so that small pilot hole in cable drum matches hole through upper support and drum guard.

1-139. NOSE GEAR STEERING UNIT. Hydraulic steering of the nose gear results from movement of the steering collar, transmitted from the rudder pedals through the nose gear steering plate assembly. As the collar rotates in response to turn-right or turn-left movements of the pedals, the shaft of a spool valve moves in the proper direction to admit hydraulic pressure to the proper chamber in the steering unit. The unit rotates the nose gear strut and wheel yoke in the corresponding direction. When the unit is not receiving pressure, an orifice permits slow passage of hydraulic fluid from one chamber to another to damp any shimmy tendencies of the nose wheel during taxiing.

1-140. REMOVAL OF NOSE GEAR STEERING UNIT. (See figure 1-30.)

a. Discharge all hydraulic pressure by operating the speedbrake or flaps until the hydraulic pressure gage indicates zero pressure.

b. Disconnect and plug all hydraulic hose connections at steering cylinder (1).

c. Remove cotter pins and shear pins, and remove cylinder from airplane.

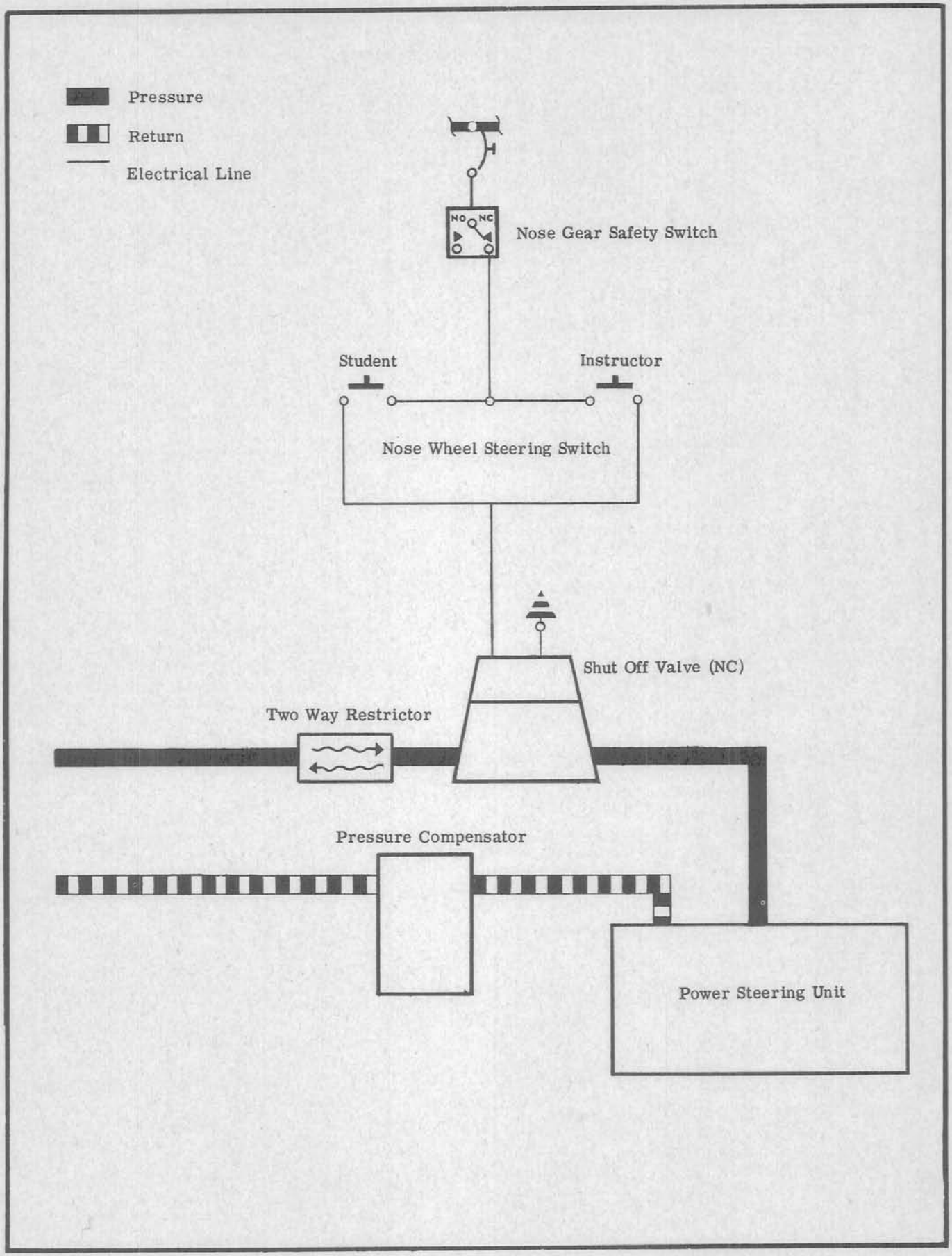


Figure 1- 30A. Nose Gear Steering Schematic

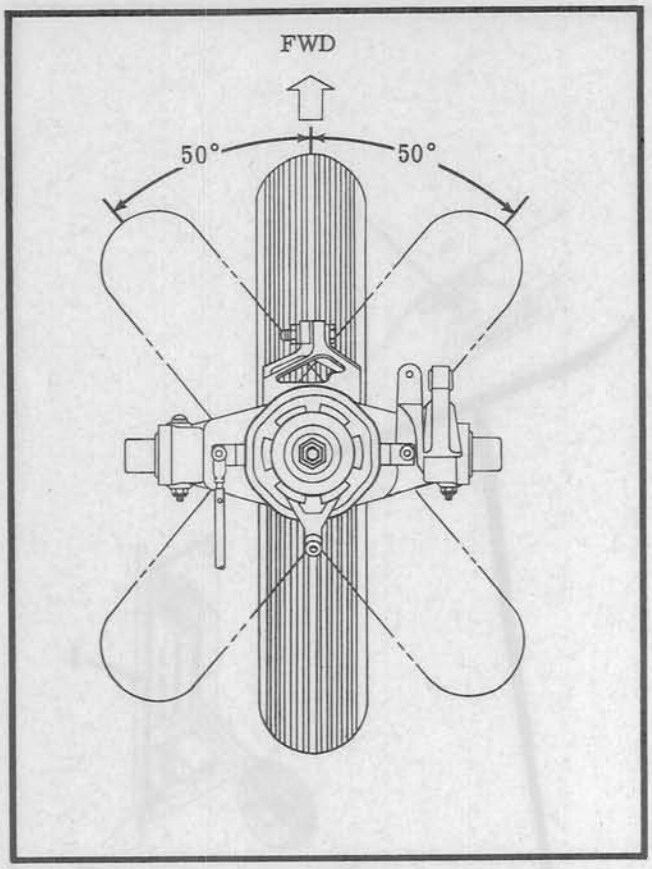


Figure 1-31. Nose Gear Steering Limits

1-141. INSTALLATION OF NOSE GEAR STEERING UNIT. (See figure 1-30.)

a. Attach cylinder assembly by inserting shear pins and securing with cotter pins.

b. Unplug and connect hydraulic hoses to connections on cylinder and valve.

c. Start hydraulic pump, bleed lines to eliminate air and actuate steering mechanism, checking for leaks and for correct operation.

1-142. LANDING GEAR CONTROLS.

1-143. GENERAL DESCRIPTION. The landing gears are hydraulically operated and are controlled by either of the two control handles mounted on the instrument panel. Each handle is connected to a common torque tube, by push rods, which enables the gears to be raised or lowered by using either handle. A bungee connects the landing gear torque tube to the nose gear uplock. The landing gear selector valve is actuated by movement of the nose gear uplock. The uplock is connected to the selector valve by a link, therefore, when the bungee moves the uplock, the selector valve is positioned to the corresponding position to allow gear extension or retraction.

1-144. LANDING GEAR CONTROL HANDLES. The landing gear control handles are mounted on the instrument panel and are connected to a common torque tube by push rods. The instructor's handle incorporates a solenoid lock which holds it in the down position as long as the gear safety limit switches are energized. This prevents inadvertent retraction of the gears while the airplane is on the ground, however, each gear incorporates an override switch which will allow on the ground retraction of the gears in an emergency. The knobs of both control handles are translucent plastic. Each contains a red lamp which lights whenever the gears are not down and locked and the throttle is set at less than 65%; or whenever the gears are in a position other than that indicated by control handle position.

1-145. OPERATION OF GEAR CONTROL HANDLES. During normal operation the handles will be in either the UP or DOWN position. No other position is possible because of a cam action which tends to force the handles to the extreme positions when they are moved slightly past center. When the handles are placed in the UP or DOWN position, the selector valve is positioned to allow hydraulic pressure to extend or retract the gears.

1-146. REMOVAL OF LANDING GEAR CONTROL. (See figure 1-32.)

a. Reach in behind instrument panel and disconnect electrical wiring at plug on handle.

b. Remove nut, bolt and washer attaching push pull rod to handle lever.

c. Remove nuts, washers, and screws attaching control to instrument panel.

d. Control can now be removed from the front of the instrument panel.

1-147. INSTALLATION OF LANDING GEAR CONTROL. (See figure 1-32.)

a. Position control in instrument panel and attach with screws, washers and nuts.

b. Connect push-pull tube to handle with bolt, washer and nut.

c. Connect electrical wiring to rear of control.

1-148. LANDING GEAR SELECTOR VALVE. The landing gear selector valve is attached to a bracket at the upper rear corner of the wheel well. It is a four way selector valve, rated at 2000 PSI, and controls the flow of fluid to and from the gear cylinders, inboard main gear door cylinders, and the air screen cylinders.

1-149. REMOVAL OF LANDING GEAR SELECTOR VALVE. (See figure 1-33.)

a. Discharge hydraulic pressure by operating flaps or speedbrake until hydraulic pressure gage reads zero.

b. Remove bolt (9), washer (7) and nut (6) which attaches rod end (8) to bellcrank (3).

c. Break safety and remove screw (5) and washer (4) which attaches bellcrank (3) to valve arm. Remove bellcrank (3) from valve arm.

d. Disconnect and plug hydraulic lines and fittings.

e. Remove screws (10) and remove valve from mounting bracket.

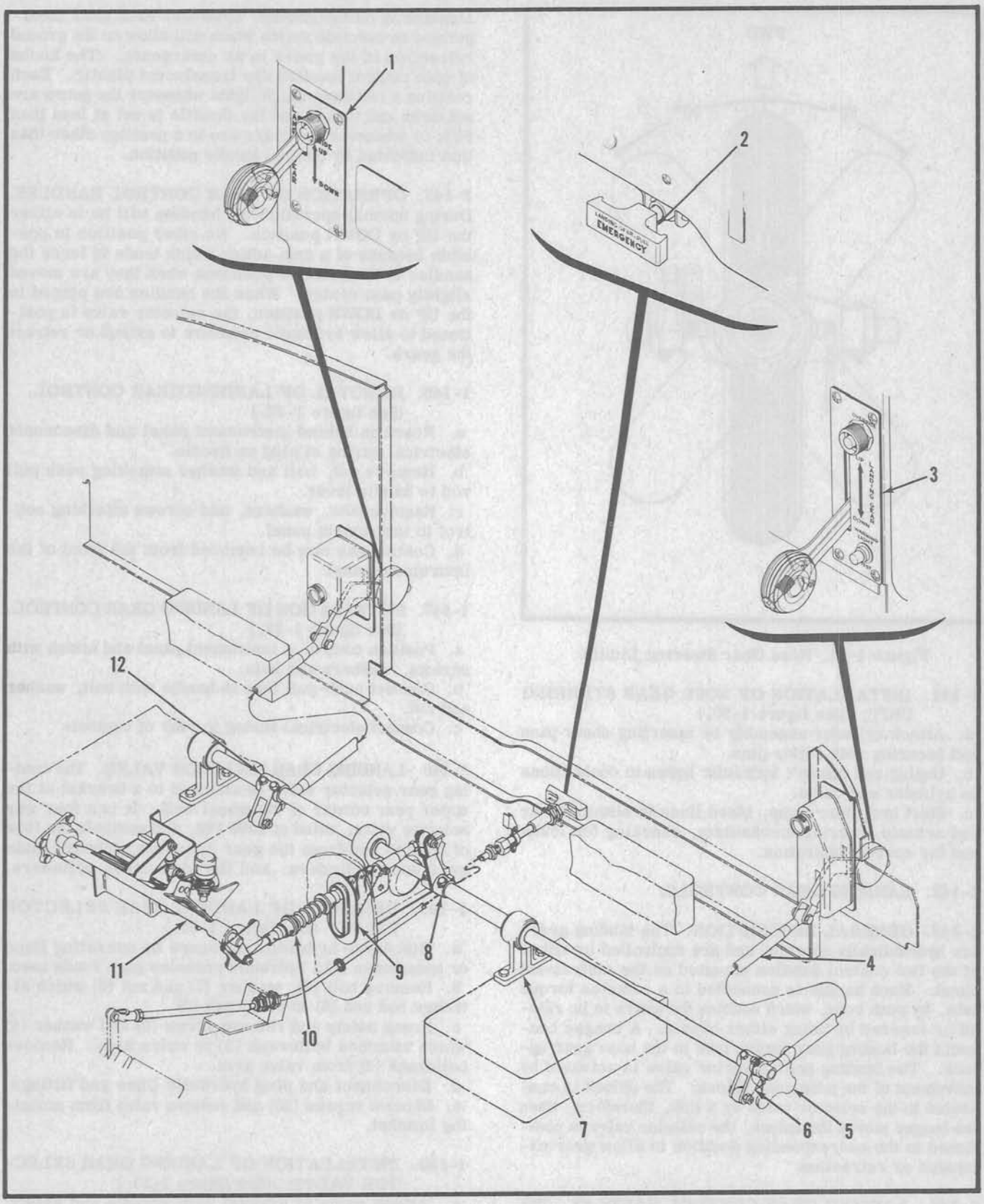
1-150. INSTALLATION OF LANDING GEAR SELECTOR VALVE. (See figure 1-33.)

a. Attach valve to bracket with screws and safety.

b. Uncap and connect hydraulic lines and fittings.

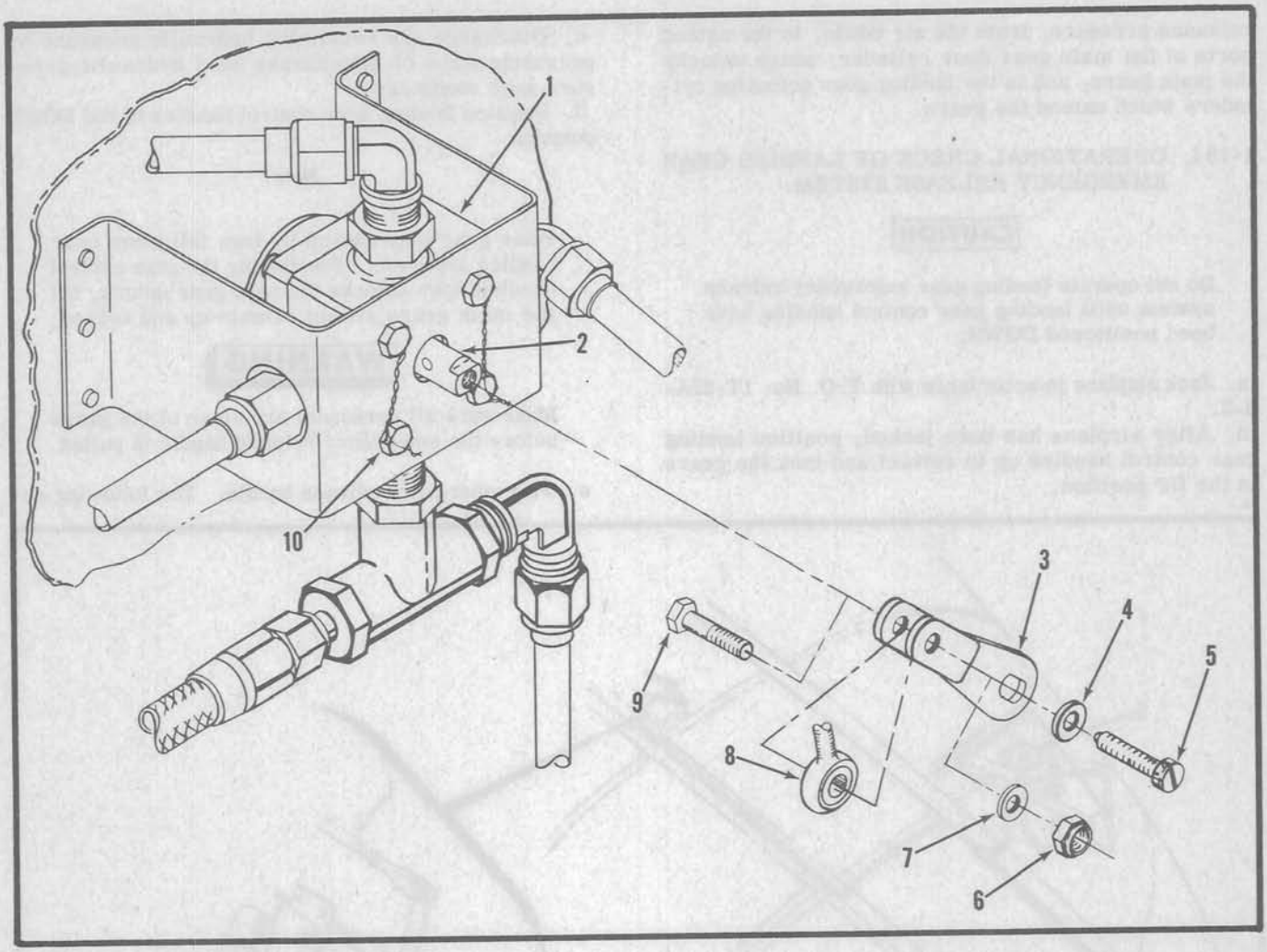
c. Attach bellcrank (3) to valve arm with washer (4) and screw (5). Safety screw to bellcrank.

d. Attach rod end (8) to bellcrank (3) with bolt (9), washer (7) and secure with nut (6).



1. Instructor's control
2. Emergency release
3. Student's control
4. Push rod
5. Bearing block
6. Bellcrank
7. Bearing block
8. Bellcrank
9. Boot
10. Uplock bungee
11. Uplock
12. Bellcrank

Figure 1-32. Landing Gear Controls Installation



1. Selector valve
2. Valve arm
3. Bellcrank
4. Washer
5. Screw
6. Nut
7. Washer
8. Rod end
9. Bolt
10. Screw

Figure 1-33. Landing Gear Selector Valve Installation

1-151. LANDING GEAR POSITION INDICATING AND WARNING SYSTEM. There are three landing gear position indicators located in the upper left corner of the instrument panel; each indicator represents one of the landing gears. The indicators consist of three round windows in which symbols appear that indicate landing gear position to the pilot. Each window displays a small gear and wheel when its corresponding gear is down and locked. The word "UP" appears in the windows when the corresponding gear is up and locked. Red and yellow diagonal stripes appear whenever the corresponding gear is neither down and locked, nor up and locked. The gear warning lights consists of two red lens and bulb assemblies which, when lit, cause the translucent gear control handles to glow red. The gear warning lights glow and the gear warning horn sounds when the throttles are retarded with the landing gear in any position except down and locked. The gear warning horn can be silenced by pressing either horn silence button. This breaks the circuit to the warning horn until the gear is cycled again or the throttle is advanced and retarded. Attached to each main landing gear inboard door and the nose gear right door is an external gear light which will light when the navigation and passing light switch is closed and its corresponding gear is down and locked. This is to give visual indication, that the gear is down and locked, to ground observers at night. The landing gear position indicating and warning system is controlled by limit switches on the uplocks and downlocks, and safety switches on the shock strut torque links.

1-152. LANDING GEAR EMERGENCY RELEASE SYSTEM. The landing gear emergency release system is provided as a means of extending the gears in case of hydraulic power failure. The system consists of an emergency release handle, air bottle and gage and tie in lines to the landing gear hydraulic system.

1-153. OPERATION OF LANDING GEAR EMERGENCY RELEASE SYSTEM. After the gear control handles have been positioned down, the nose gear is unlocked and the selector valve is positioned to allow pressure to the extend ports of the main gear uplock cylinder and the gear actuating cylinders. Then, when the emergency release handle is pulled the pneumatic valve

releases pressure, from the air bottle, to the extend ports of the main gear door cylinder, which unlocks the main gears, and to the landing gear actuating cylinders which extend the gears.

1-154. OPERATIONAL CHECK OF LANDING GEAR EMERGENCY RELEASE SYSTEM.

CAUTION

Do not operate landing gear emergency release system until landing gear control handles have been positioned DOWN.

a. Jack airplane in accordance with T.O. No. 1T-37A-2-2.

b. After airplane has been jacked, position landing gear control handles up to retract and lock the gears in the UP position.

c. Discharge any remaining hydraulic pressure by operating flaps or speedbrake until hydraulic pressure gage reads zero.

d. Position landing gear control handles to the DOWN position.

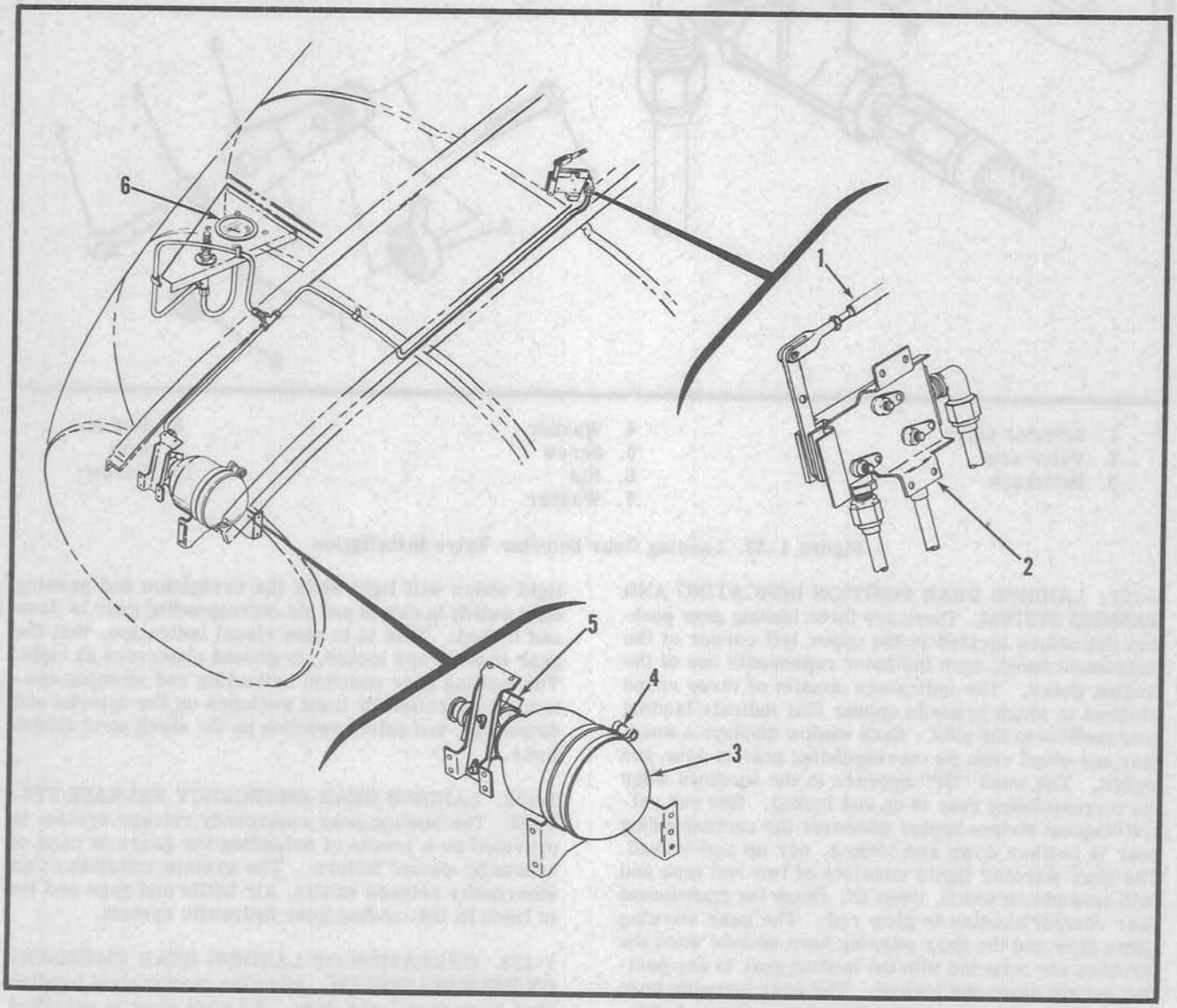
Note

Nose gear may extend by free fall when gear handles are down. Positioning the gear control handles down unlocks the nose gear uplock, but the main gears should remain up and locked.

WARNING

Make sure all personnel are clear of the gears before the emergency release handle is pulled.

e. Pull emergency release handle. The following re-



1. Control linkage
2. Pneumatic valve
3. Air bottle
4. Clamp
5. Clamp
6. Pressure gage

Figure 1-34. Landing Gear Emergency Release System

sults should occur:

1. Nose gear should lock in down position.
2. Main gear door cylinder should unlock the main gear and the main gears should extend to the down and locked position.
3. Landing gear position indicators should give correct position indication.

f. After operational check has been performed, the airplane should be let down from the jacks; hydraulic system recharged and emergency air bottle recharged.

1-155. LANDING GEAR EMERGENCY RELEASE AIR BOTTLE. The landing gear emergency release air bottle is attached by clamps to the front bulkhead in the nose gear wheel well. The bottle provides a source of power for extending the landing gears in case of hydraulic system failure and is charged to 2000 PSI.

1-156. REMOVAL OF EMERGENCY RELEASE AIR BOTTLE. (See figure 1-34.)

WARNING

The landing gear emergency release air bottle is charged to 2000 PSI. Therefore, to avoid possible injury to personnel, the air bottle pressure must be released before any item in the system is disconnected or removed.

a. Disconnect line connection at air bottle.
b. Disconnect clamps (4) and (5) and remove air bottle.

1-157. INSTALLATION OF EMERGENCY RELEASE AIR BOTTLE. (See figure 1-34.)

a. Position bottle (3) in clamps (4) and (5) and tighten clamps.
b. Connect air line to bottle.
c. Charge air. See paragraph 1-158.

1-158. SERVICING LANDING GEAR EMERGENCY RELEASE SYSTEM. The landing gear emergency air bottle filler valve and pressure gage are located in the right hand nose radio equipment section with access provided by the nose section right hand access door.

To fill the air bottle proceed as follows:

a. Remove filler valve cap and attach filler chuck.
b. Loosen 5/8 hex swivel nut a maximum of 1-1/2 turns.
c. Fill air bottle to 2000 ±5 psi.
d. Tighten 5/8 hex swivel nut to 50-70 inch pounds.

1-159. LANDING GEAR EMERGENCY RELEASE AIR BOTTLE PRESSURE GAGE. The emergency release air bottle pressure gage is mounted in the right hand nose radio equipment section. The gage is a direct reading type graduated from zero to 5000 PSI.

1-160. REMOVAL OF LANDING GEAR EMERGENCY RELEASE AIR BOTTLE AIR PRESSURE GAGE. (See figure 1-34.)

WARNING

Do not attempt to remove the pressure gage until all air is exhausted from the air bottle, or serious injury may occur as a result of suddenly releasing 2000 PSI air pressure.

a. Discharge air bottle pressure.
b. Disconnect line from back of gage.
c. Remove nuts and screws attaching gage to mounting bracket and remove gage from bracket.

1-161. INSTALLATION OF LANDING GEAR EMERGENCY RELEASE AIR BOTTLE PRESSURE GAGE. (See figure 1-34.)

a. Position gage in mounting bracket and attach with screws and nuts.
b. Connect pressure line to gage.
c. Recharge air bottle in accordance with paragraph 1-158.

1-162. PNEUMATIC VALVE. The landing gear emergency release pneumatic valve is located in the nose wheel well near the top of the left hand web. The pneumatic valve is connected to the emergency release handle and releases pressure to the landing gear hydraulic system, when the emergency release handle is pulled.

1-163. REMOVAL OF PNEUMATIC VALVE. (See figure 1-34.)

WARNING

Do not attempt to remove the pneumatic valve until all pressure has been exhausted from the air bottle; or serious injury may result due to the sudden release of 2000 PSI air pressure.

a. Discharge air bottle pressure.
b. Disconnect control linkage (1) from valve.
c. Disconnect air lines from valve.
d. Remove bolts attaching valve to mounting bracket and remove valve.

1-164. INSTALLATION OF PNEUMATIC VALVE. (See figure 1-34.)

a. Position valve in mounting bracket and attach with bolts.
b. Connect control linkage to valve.
c. Connect air lines to valve.
d. Recharge air bottle. See paragraph 1-158.

1-165. AIR INTAKE SCREENS.

1-166. ENGINE INLET DUCT SCREEN SYSTEM. The engine inlet duct screens are located in the air inlet of each engine nacelle, and retract into the boundary layer dam simultaneously with the retraction of the landing gear. There is an actuating cylinder attached to each screen which operates in parallel with the landing gear system. To prevent the inlet screens from slamming against the nacelle or the boundary layer pan, a two way restrictor is provided in the line to the extend port of each inlet screen actuating cylinder.

1-167. OPERATION OF AIR INTAKE SCREENS. The air intake screens operate in conjunction with the landing gear. When the landing gear selector is placed in the down position, fluid under pressure is routed to the retract port of the intake screen cylinder; the cylinders retract, closing the screens. The opposite position of the selector, routes fluid into the extend port of the cylinder, extending the cylinders and opening the screens allowing unobstructed airflow into the engines.

1-168. OPERATIONAL CHECK OF THE AIR INTAKE. SCREENS. Refer to paragraph 1-40.

1-169. TROUBLE SHOOTING THE AIR INTAKE SCREEN SYSTEM.

TROUBLE	PROBABLE CAUSE	REMEDY
SCREENS OPEN WHEN GEAR IS EXTENDED	Lines reversed at cylinder.	Reverse lines.
SCREENS OPERATE VERY SLOWLY	Restrictor adjusted incorrectly.	Refer to Note in paragraph 1-173.
LANDING GEAR OPERATES BUT SCREENS DO NOT	Restrictor incorrectly adjusted or clogged.	Refer to Note in paragraph 1-173. Remove restrictor and clean.
SCREENS DO NOT OPEN OR CLOSE FULLY	Cylinder clevis or rod end on bellcrank out of adjustment.	Refer to paragraph 1-173, step g.

1-170. REMOVAL OF AIR INTAKE SCREEN AND HINGE. (See figure 1-35.)

a. Remove lower front nacelle access door.
b. Remove nut (19), washer (18) and screw (17) attaching rod end (20) to actuating cylinder.
c. Remove cotter pin (28), washer (27) and pin (26) attaching bellcrank (21) to tube (25).
d. Remove cotter pin (16), nut (15), washer (14) and bolt (13) attaching tube (25) and jumper (22) to screen tube.
e. Remove tube (25) from screen.
f. Remove cotter pin (7), and washer (6) from pin (4).
g. Pull pin (4) half way out of the screen tube. This will allow the pin to be moved over to the long vertical slot, disengaging tube (3) from bearing (1).
h. Move pin (4) over and seat firmly in long vertical slot. Screen is now free from airplane and may be removed.
i. Remove pin (4) and tube (3) from screen.

1-171. INSTALLATION OF AIR INTAKE SCREEN AND HINGE. (See figure 1-35.)

a. Adjust bellcrank (21) and rod end (20) for two inch center to center length.
b. Adjust cylinder (12) for 8.50 overall length.
c. Align hole in tube (3) with longest slot in screen tube.
d. Loosely insert pin (4) through screen and tube (3) and let tube (3) bottom until pin (4) rests at the bottom of the longest slot.
e. Insert bearing (1) in structure.
f. Align tube (3) with bearing (1) and place washer (2) over tube (3).
g. Raise pin (4) up to horizontal slot, inserting tube (3) through bearing (1).
h. Move pin through horizontal slot and down into the short vertical slot.
i. Push pin (4) through tubes; install washer (6) and cotter pin (7).
j. Insert tube (25) through bearing (24). Place washer (23) on tube (25) and continue inserting tube into screen until holes are aligned.
k. Place jumper (22) on bolt (13) and insert bolt through tubes. Install washer (14), nut (15) and lock with cotter pin (16).
l. Position bellcrank (21) on tube (25); install pin (26), washer (27) and cotter pin (28).
m. Attach rod end (20) to actuating cylinder with screw (17), washer (18) and secure with nut (19).

1-172. REMOVAL OF INTAKE SCREEN ACTUATING CYLINDERS AND RESTRICTORS. (See figure 1-35.)

a. Remove lower forward engine access door.

CAUTION

Before disconnecting any hydraulic pressure line, the hydraulic system should be discharged by operating the speed brake or flaps until the pressure gage reads zero. This will prevent a sudden surge of fluid from emerging where a line is disconnected.

b. Disconnect lines from actuating cylinder and restrictor.
c. Remove screw from clamp holding restrictor.
d. Remove restrictor from aircraft.
e. Disconnect cylinder clevis from bellcrank rod end (20) by removing nut (19), washer (18) and screw (17).
f. Remove nut (11), washer (10), bolt (8) which attaches cylinder to firewall bracket. Remove spacers (9) from cylinder.
g. Remove cylinder from aircraft.

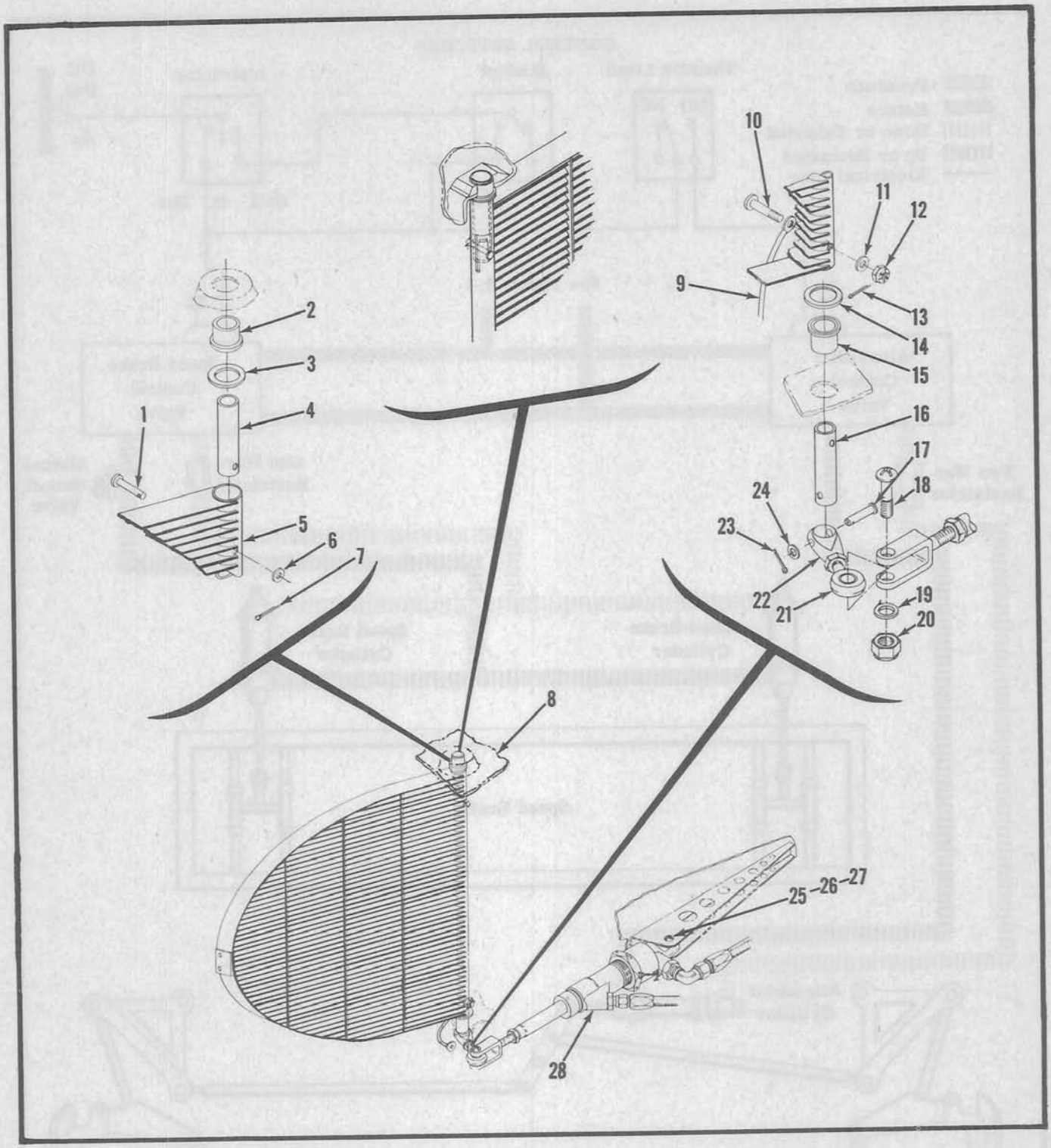
1-173. INSTALLATION OF INTAKE SCREEN ACTUATING CYLINDER AND RESTRICTOR. (See figure 1-35.)

a. Install spacer in cylinder head hole. Attach cylinder head to bracket with bolt (8), washer (10), secure with nut (11). Adjust cylinder for smooth operation at bracket and safety with cotter pin.
b. Attach clevis to bellcrank rod end (20) with screw and washer, and secure with nut.
c. Clamp restrictor to firewall.
d. Connect all hydraulic lines.
e. Perform landing gear retraction test.
f. Check for leaks and operation of screens. If screens rate of travel is to fast adjust restrictors.

Note

To adjust the restrictors loosen lock nut and turn screw clockwise to increase restriction and counter-clockwise to decrease restriction.

g. If screens do not fully open or close adjust bellcrank rod end and cylinder clevis for more travel by lengthening bellcrank rod end.



1. Pin
2. Bearing
3. Washer
4. Tube
5. Screen
6. Washer
7. Cotter pin
8. Structure
9. Jumper
10. Bolt
11. Washer
12. Nut
13. Cotter pin
14. Washer
15. Bearing
16. Tube
17. Pin
18. Screw
19. Washer
20. Nut
21. Rod end
22. Bellcrank
23. Cotter pin
24. Washer
25. Screw
26. Washer
27. Nut
28. Actuating Cylinder

Figure 1-35. Air Intake Screen Installation

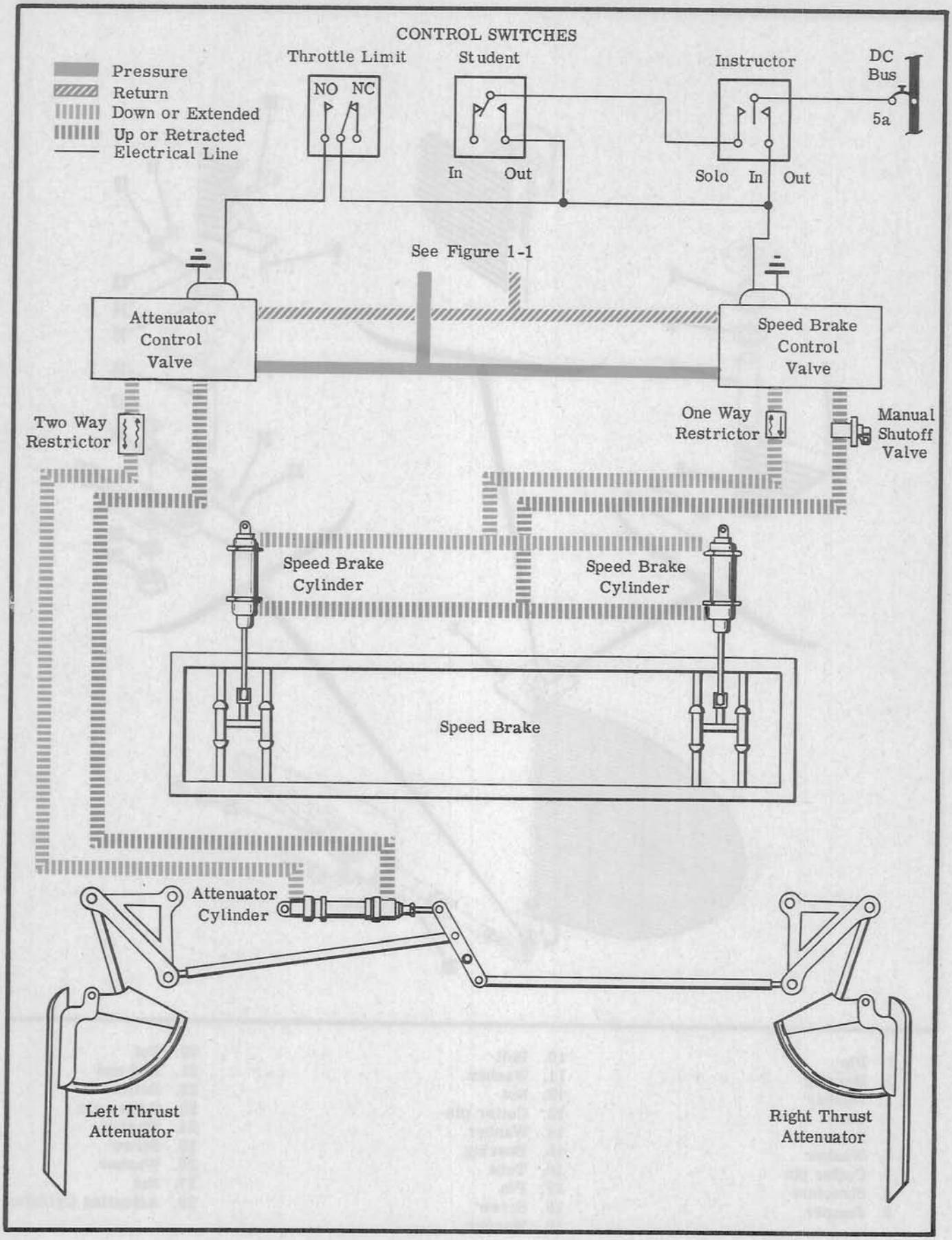


Figure 1-36. Speed Brake and Thrust Attenuator Hydraulic System Schematic

1-174. SPEED BRAKE.

1-175. GENERAL DESCRIPTION. The speed brake is a single structure located on the bottom of the fuselage just aft of the nose gear doors. When in the closed position, the brake fits flush with the bottom skin of the fuselage. Two actuating cylinders, operated by pressure supplied from the main hydraulic system, actuate the brake to the full open or closed position. No intermediate position is provided on this system. A speed brake switch is located on the knob of each right engine throttle. Either switch can be used to position the brake, however, the switch located on the instructor's right engine throttle includes a SOLO position which is not provided on the student pilot's switch. Both switches are connected to a solenoid which electrically positions the speed brake selector valve to the position indicated on the speed brake switch.

Note

To operate the speed brake from the student pilot's side, the instructor's switch must be in the SOLO position.

1-176. OPERATIONAL CHECK OF SPEED BRAKE. Two men will be required to perform an operational check of the brake system. With one man operating the cockpit control and one man observing the speed brake door.

Note

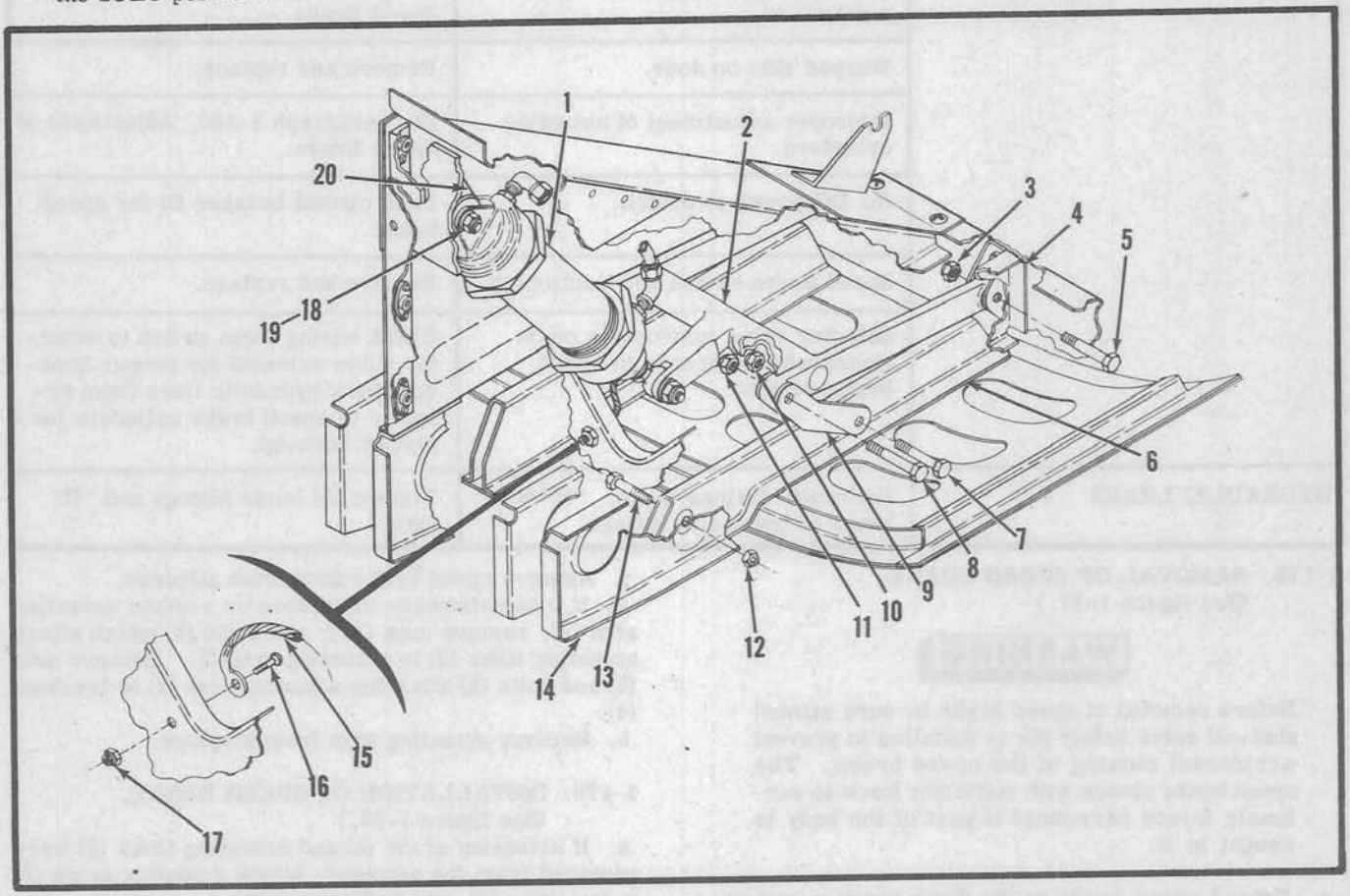
To operate the speed brake from student's side, the instructor's switch must be in the SOLO position.

a. Check hydraulic fluid level in reservoir.

WARNING

Stand clear of speed brake as it is being cycled, it closes with sufficient force to seriously injure personnel.

b. Outside of cockpit:
1. Connect DC power to airplane electrical system.
2. Connect hydraulic APU to airplane.
3. Remove ground safety pin from speed brake man-



1. Actuating cylinder
2. Actuator arm
3. Nut
4. Bracket
5. Bolt
6. Hinge support
7. Bolt
8. Bolt
9. Links
10. Nut
11. Nut
12. Nut
13. Bolt
14. Bracket
15. Jumper
16. Screw
17. Nut
18. Bolt
19. Nut
20. Bracket

Figure 1-37. Speed Brake Installation

ual shut off valve located in the nose wheel well.

4. Check the area for any obstructions which might cause damage to the speed brake door.

5. Assume position at speed brake station.

c. Inside the cockpit:

1. Before operating the speed brake, obtain "All-Clear" from a man outside the cockpit.

2. Check that circuit breaker for speed brake is IN.

3. Turn on battery switch.

4. Using speed brake switch located on the instructor's right throttle head, operate speed brake, stopping at the first indication of trouble or malfunction, and correct condition before continuing operations.

d. Outside the cockpit:

1. As speed brake cycles, check for proper travel to the OUT position and that door closes flush, in the IN position.

e. When operational check-out has been completed using the instructor's speed brake switch, return the switch to the SOLO position and perform a similar check-out using the speed brake switch located on the student pilot's right throttle head.

f. Whenever either speed brake switch is placed in the OUT position, the speed brake is extended out to its full travel: Placing either switch to the IN position retracts the brake flush with the fuselage forming a streamline surface. The SOLO position on the instructor's right throttle head is an override control permitting speed brake operation using the student pilot's control switch.

1-177. TROUBLE SHOOTING SPEED BRAKE.

TROUBLE	PROBABLE CAUSE	REMEDY
SPEED BRAKE DOES NOT CLOSE OR OPEN PROPERLY	Malfunctioning actuating cylinder or actuating cylinder leaking.	Remove and replace cylinder.
	Improper assembly of working mechanism.	See paragraph 1-179, Installation of Speed Brake.
	Warped skin on door.	Remove and replace.
	Improper adjustment of actuating cylinders.	See paragraph 1-180, Adjustment of Speed Brake.
	No DC power to switch.	Push circuit breaker IN for speed brake.
	Speed brake switch not functioning.	Remove and replace.
	Selector valve improperly positioned with reference to speed brake switch.	Check wiring from switch to selector valve solenoid for proper hook-up; check hydraulic lines from selector to speed brake cylinders for proper hook-up.
HYDRAULIC LEAKS	Hydraulic fittings loose. "B" nuts loose on hydraulic fittings.	Tighten all loose fittings and "B" nuts.

1-178. REMOVAL OF SPEED BRAKE.
(See figure 1-37.)

WARNING

Before removal of speed brake be sure manual shut-off valve safety pin is installed to prevent accidental closing of the speed brake. The speed brake closes with sufficient force to seriously injure personnel if part of the body is caught in it.

a. Extend speed brake to the down position and relieve any excess pressure by operating the flaps until hydraulic pressure gage reads zero.

b. Remove the nuts and bolts attaching cylinder rod ends to actuator arms (2).

c. Remove nuts (10) and bolts (7) which attach actuator arm links (9) to hinge supports (6).

d. Remove bonding jumpers (15).

e. Support the speed brake door, remove nuts (13) and bolts (12) which fasten hinge supports (6) to brackets.

f. Remove speed brake door from airplane.

g. If it is necessary to remove or replace actuating arm (2), remove nuts (11), and bolts (8) which attach actuating links (9) to actuating arm (2). Remove nuts (3) and bolts (5) attaching actuating arm (2) to brackets (4).

h. Remove actuating arm from airplane.

1-179. INSTALLATION OF SPEED BRAKE.
(See figure 1-37.)

a. If actuating arms (2) and actuating links (9) were removed from the airplane, attach actuating arms (2) to brackets (4) with bolts and nuts.

b. Attach actuating links (9) to actuating arms (2) with bolts (8) and nuts (11).

c. Support the speed brake door and attach to brackets (14) with bolts (12) and nuts (13).

d. Attach bonding jumpers.

e. Connect actuating arm links (9) to hinge supports (6) with bolts (7) and nuts (10).

f. Connect cylinder rod end to actuating arms (2) with bolts and nuts.

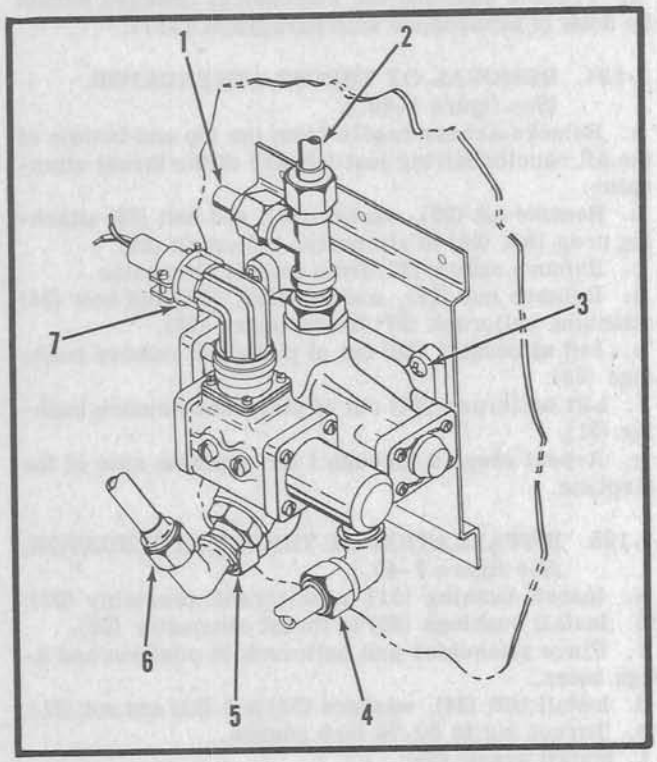
g. Charge hydraulic system and operate through one cycle. If necessary to adjust speed brake, follow procedure outlined in paragraph 1-180.

1-180. ADJUSTMENT OF SPEED BRAKE.

a. Close speed brake manual shut-off valve by installing safety pin with streamer.

b. The speed brake should close flush up against the bottom of the fuselage skin. If the speed brake closes too tight or does not close flush, check for proper assembly of linkages. Adjustments may be made by adjusting the actuating cylinders rod ends.

1-181. SPEED BRAKE SELECTOR VALVE. The speed brake selector valve, located on the rear bulkhead of the nose wheel well, is a four way solenoid operated valve, spring loaded in the speed brake up position. The position of the selector valve's piston is determined by the speed brake switches located on each right engine throttle knob. When there is no DC power the selector valve will return to the speed brake up position, raising the speed brake.



1. Return line
2. Return line
3. Screw
4. Speed brake up
5. Speed brake down
6. Return line
7. Electrical quick disconnect

Figure 1-38. Speed Brake Selector Valve Installation

1-182. REMOVAL OF SPEED BRAKE SELECTOR VALVE. (See figure 1-38.)

Note

Operate speed brake until hydraulic pressure gage indicates zero pressure and disconnect battery.

a. Disconnect and cap all lines.

b. Disconnect electrical leads at quick disconnect.

c. Remove mounting bolts at four points and remove selector valve from aircraft.

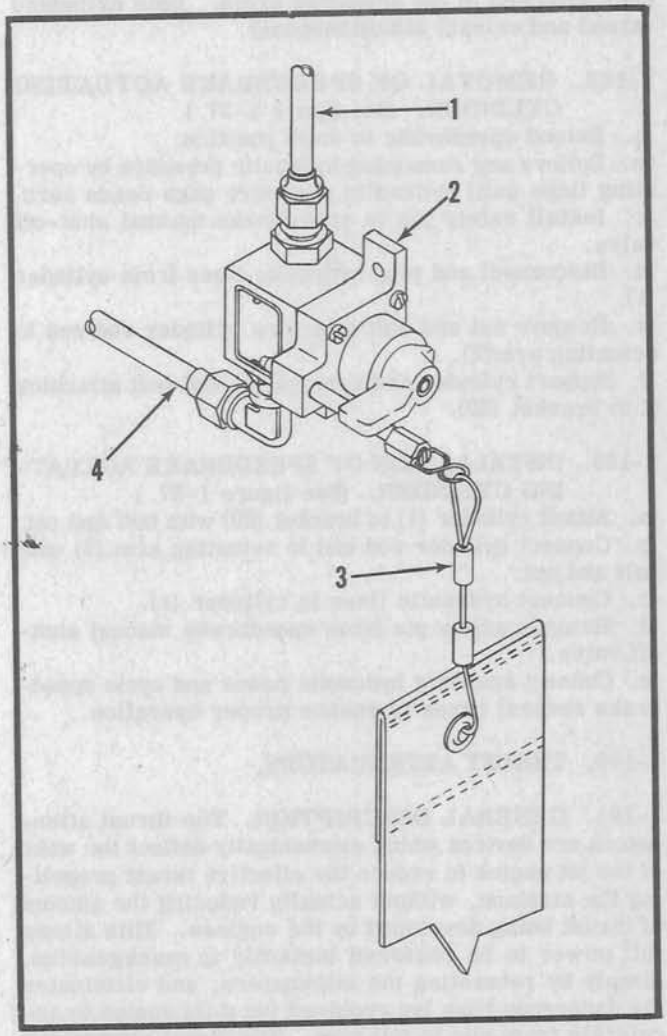
1-183. INSTALLATION OF SPEED BRAKE SELECTOR VALVE. (See figure 1-38.)

a. Position selector valve over mounting holes and install bolts.

b. Connect electrical wiring at quick disconnect.

c. Connect all speed brake selector valve lines and tighten.

1-184. SPEED BRAKE MANUAL SHUT-OFF VALVE. The speed brake manual shut-off valve, located on the lower rear corner of the left wheel well wall, is an ON-OFF valve, spring loaded to the ON position. It is held in the off position by a safety pin which must be installed while maintenance is being performed on the speed brake. The shut-off valve is incorporated in the speed brake up line as a safety measure to prevent accidental closing of the speed brake during maintenance operations.



1. Pressure line
2. Shut-off valve
3. Safety pin
4. Pressure line

Figure 1-39. Speed Brake Manual Shut-Off Valve Installation

1-185. REMOVAL OF SPEED BRAKE MANUAL SHUT-OFF VALVE. (See figure 1-39.)

a. Relieve pressure on hydraulic system by operating landing flaps until pressure gage indicates zero.
b. Remove hydraulic lines from manual ground shut-off valve and cap.
c. Remove screws attaching manual ground shut-off valve to bracket.

1-186. INSTALLATION OF SPEED BRAKE MANUAL SHUT-OFF VALVE. (See figure 1-39.)

a. Uncap hydraulic lines.
b. Position manual ground shut-off valve to bracket and secure in place with screws.
c. Connect hydraulic lines to manual ground shut-off valve.
d. Perform operational check of the system in accordance with paragraph 1-176.

1-187. SPEEDBRAKE ACTUATING CYLINDERS. There are two speedbrake actuating cylinders. Both cylinders are mounted in the speedbrake well and are attached to the fuselage structure at one end with the cylinder rod ends attached to the actuating arms. Both cylinders extend and retract simultaneously.

1-188. REMOVAL OF SPEEDBRAKE ACTUATING CYLINDER. (See figure 1-37.)

a. Extend speedbrake to down position.
b. Relieve any remaining hydraulic pressure by operating flaps until hydraulic pressure gage reads zero.
c. Install safety pin in speedbrake manual shut-off valve.
d. Disconnect and plug hydraulic lines from cylinder (1).
e. Remove nut and bolt attaching cylinder rod end to actuating arm(2).
f. Support cylinder and remove nut and bolt attaching it to bracket (20).

1-189. INSTALLATION OF SPEEDBRAKE ACTUATING CYLINDER. (See figure 1-37.)

a. Attach cylinder (1) to bracket (20) with bolt and nut.
b. Connect cylinder rod end to actuating arm (2) with bolt and nut.
c. Connect hydraulic lines to cylinder (1).
d. Remove safety pin from speedbrake manual shut-off valve.
e. Connect auxiliary hydraulic power and cycle speedbrake several times to ensure proper operation.

1-190. THRUST ATTENUATORS.

1-191. GENERAL DESCRIPTION. The thrust attenuators are devices which mechanically deflect the wake of the jet engine to reduce the effective thrust propelling the airplane, without actually reducing the amount of thrust being developed by the engines. This allows full power to be restored instantly in emergencies, simply by retracting the attenuators, and eliminates the dangerous time lag required for a jet engine to accelerate from idle to full rpm. The thrust attenuators are particularly useful in landing approaches when it is desireable to fly at reduced thrust but still maintain a good power setting.

1-192. OPERATION OF THRUST ATTENUATOR. The attenuators are actuated by a single hydraulic cylinder controlled by a solenoid valve energized by the speedbrake switch. A system of bellcranks and links transmits the motion from the cylinder to the thrust attenuators.

1-193. OPERATIONAL CHECK OF THRUST ATTENUATOR.

a. Attach hydraulic test stand leads.
b. Plug in electrical auxiliary power unit.
c. Slide speedbrake switch forward. The thrust attenuator behind each tail pipe should be fully extended. The speedbrake will also extend.
d. Slide speedbrake switch to the rear. The speedbrake and the thrust attenuator should return to the retracted position.
e. Failure of the attenuators to extend, or retract, indicates a malfunction in the solenoid valve circuit, in the attenuator hydraulic system, or in the mechanical linkage.
f. Trouble shooting the electrical system should be done in accordance with T.O. No. 1T-37A-2-7.
g. Trouble shooting the mechanical linkages should be done in accordance with paragraph 1-177.

1-194. REMOVAL OF THRUST ATTENUATOR. (See figure 1-40.)

a. Remove access panels from the top and bottom of the aft nacelle fairing just inboard of the thrust attenuator.
b. Remove nut (25), washer (26), and bolt (29) attaching drag link (24) to attenuator bellcrank (27).
c. Remove screw (30) from face of attenuator.
d. Remove nut (21), washer (22), (33) and bolt (34) attaching bellcrank (27) to attenuator (28).
e. Lift attenuator (28) out of place and remove bushings (23).
f. Lift bellcrank (27) out of place and remove bushing (31).
g. Repeat steps a through f for opposite side of the airplane.

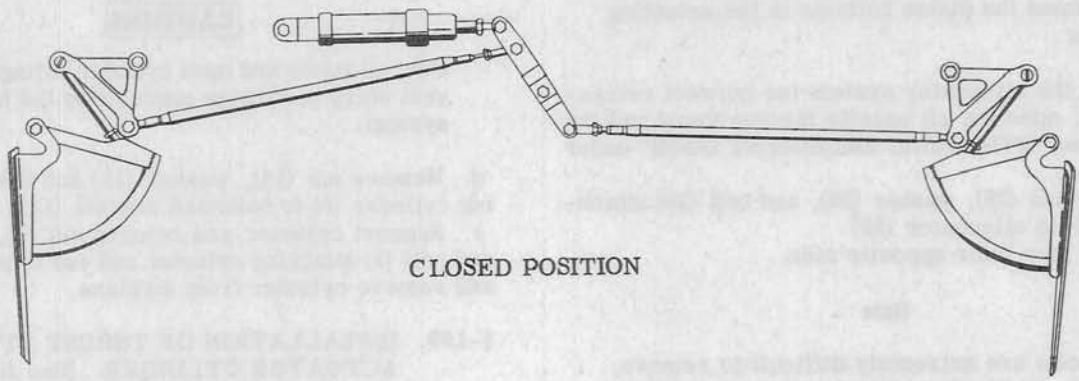
1-195. INSTALLATION OF THRUST ATTENUATOR. (See figure 1-40.)

a. Install bushing (31) in bellcrank assembly (27).
b. Install bushings (32) in thrust attenuator (28).
c. Place attenuator and bellcrank in position and align holes.
d. Install bolt (34), washers (33) and (22) and nut (21).
e. Torque nut to 50-70 inch pounds.
f. Install screw (30).
g. Install access covers on aft nacelle fairing.
h. Repeat steps a through g for opposite side of airplane.

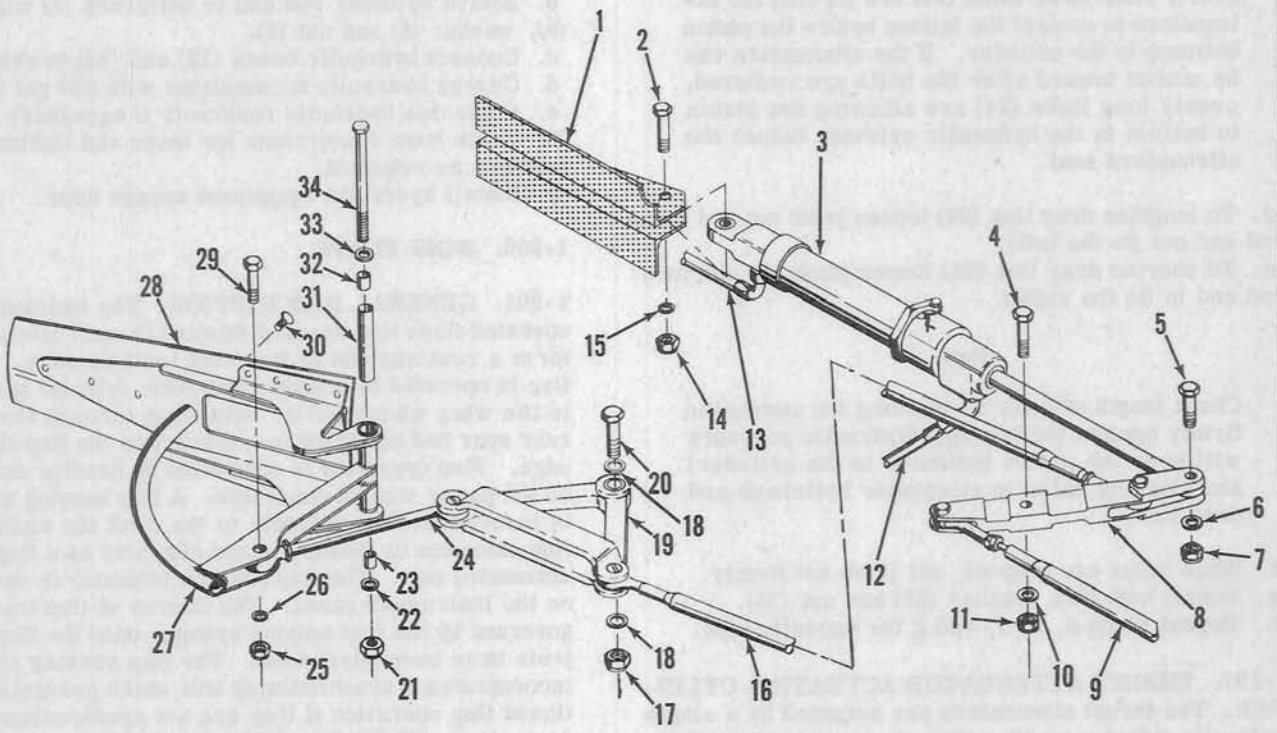
1-196. ADJUSTMENT OF THRUST ATTENUATOR.

Note

The thrust attenuators should not require adjustment during their normal service life. If excessive wear has occurred, no compensating adjustment is possible. Replacement of parts is the normal procedure for restoring correct travel tolerances. Replacement drag links are set at the factory for correct length. If this setting has been disturbed, a complete re-rig-



CLOSED POSITION



OPEN POSITION

1. Bracket
2. Bolt
3. Cylinder
4. Bolt
5. Bolt
6. Washer
7. Nut
8. Bellcrank
9. Linkage
10. Washer
11. Nut
12. Hydraulic line
13. Hydraulic line
14. Nut
15. Washer
16. Linkage
17. Nut
18. Washer
19. Bellcrank
20. Bolt
21. Nut
22. Washer
23. Bushing
24. Drag link
25. Nut
26. Washer
27. Bellcrank
28. Thrust attenuator
29. Bolt
30. Screw
31. Bushing
32. Bushing
33. Washer
34. Bolt

Figure 1-40. Thrust Attenuator Installation

ging of the linkage assembly will be required. The system should be rigged so that the attenuators are flush against the nacelle fairing at the moment the piston bottoms in the actuating cylinder.

a. To rig the attenuator system for correct retraction travel, open the aft nacelle fairing doors and the panel marked "HYDRAULIC EQUIPMENT DOOR" under the airplane.
b. Remove nut (25), washer (26), and bolt (29) attaching link (24) to attenuator (28).
c. Repeat step b for opposite side.

Note

If the bolts are extremely difficult to remove, or, if there is a perceptible movement of the bellcranks (19) when the last bolt is removed, overly short drag links (24) are forcing the attenuators to contact the fairing before the piston bottoms in the cylinder. If the attenuators can be moved inward after the bolts are removed, overly long links (24) are allowing the piston to bottom in the hydraulic cylinder before the attenuators seat.

d. To lengthen drag link (24) loosen jamb nut and turn rod end out (to the left).
e. To shorten drag link (24) loosen jamb nut and turn rod end in (to the right).

Note

Check length of links by pressing the attenuator firmly against the fairing, (hydraulic pressure will keep the piston bottomed in the cylinder) and aligning holes in attenuator bellcrank and drag link.

f. When holes are aligned, set jamb nut firmly.
g. Install bolt (29), washer (26) and nut (25).
h. Repeat steps d, e, f, and g for opposite side.

1-197. THRUST ATTENUATOR ACTUATING CYLINDER. The thrust attenuators are actuated by a single hydraulic cylinder working through an assembly of bellcranks and drag links which translate the four inch stroke of the cylinder into an attenuator angular movement of approximately 70°. Piston bottoming at both ends of the stroke provide the positive stops for the system.

1-198. REMOVAL OF THRUST ATTENUATOR ACTUATING CYLINDER. (See figure 1-40.)
a. Remove the hydraulic equipment access door from the bottom of the airplane.
b. Extend speedbrake. Discharge any remaining hydraulic pressure by operating flaps until hydraulic pressure gage reads zero.

CAUTION

Hydraulic pressure must be released before disconnecting a hydraulic system line to prevent a sudden burst of hydraulic fluid when the joint is broken.

c. Disconnect the hydraulic lines (12) and (13) and plug hoses and cylinder parts.

CAUTION

Plug all hoses and open cylinder fittings to prevent entry of foreign matter into the hydraulic system.

d. Remove nut (14), washer (15) and bolt (2) attaching cylinder (3) to bulkhead bracket (1).
e. Support cylinder and remove nut (7), washer (6) and bolt (5) attaching cylinder rod end to bellcrank (8), and remove cylinder from airplane.

1-199. INSTALLATION OF THRUST ATTENUATOR ACTUATOR CYLINDER. (See figure 1-40.)
a. Attach cylinder to bulkhead bracket (1) with bolt (2), washer (15) and nut (14).
b. Attach cylinder rod end to bellcrank (8) with bolt (5), washer (6) and nut (7).
c. Connect hydraulic hoses (12) and (13) to cylinder.
d. Charge hydraulic accumulator with 600 psi of air.
e. Replenish hydraulic reservoir if necessary.
f. Check hose connections for leaks and tighten connections as required.
g. Install hydraulic equipment access door.

1-200. WING FLAPS.

1-201. GENERAL DESCRIPTION. The hydraulically operated flaps are mounted inboard of each aileron and form a continuation of the wing trailing edge. Each flap is operated by a single hydraulic cylinder mounted in the wing wheel wells, extending through the wing rear spar and attaching to a bracket on the flap leading edge. Flap operation is controlled by handles mounted on the power control quadrants. A flap sensing system is incorporated to indicate to the pilot the amount of flap extension or retraction and also acts as a flap synchronizing unit. The flap position indicator is mounted on the instrument panel. The degree of flap travel is governed by the flap sensing system, once the flap controls have been positioned. The flap sensing system incorporates a synchronizing unit which prevents continued flap operation if they are not synchronized with each other. Total flap deflection is 40 degrees when in the full down position. The flap synchronizing unit is mounted on the fuselage rear spar bulkhead and access to it is provided by the rear tunnel door. Hydraulic lines are routed from the synchronizing unit to the flap cylinder mounted in the wing wheel well.

1-202. OPERATION OF FLAPS. Movement of either flap control handle actuates a linkage connected to the flap synchronizing valve. Actuation of the valve releases pressure to the flap up or flap down tubes which are routed from the synchronizing valve to the flap actuating cylinders. The cylinders extend or retract the flaps to the control handle setting. If, however, the flaps are extending or retracting at an uneven rate, the synchronizing valve will shut off pressure to the flap cylinder with the greatest amount of pressure, until the pressures are again equalized. The flap position transmitter is actuated by a cable to the synchronizing valve and electrically transmits the flap position to the flap position indicator.

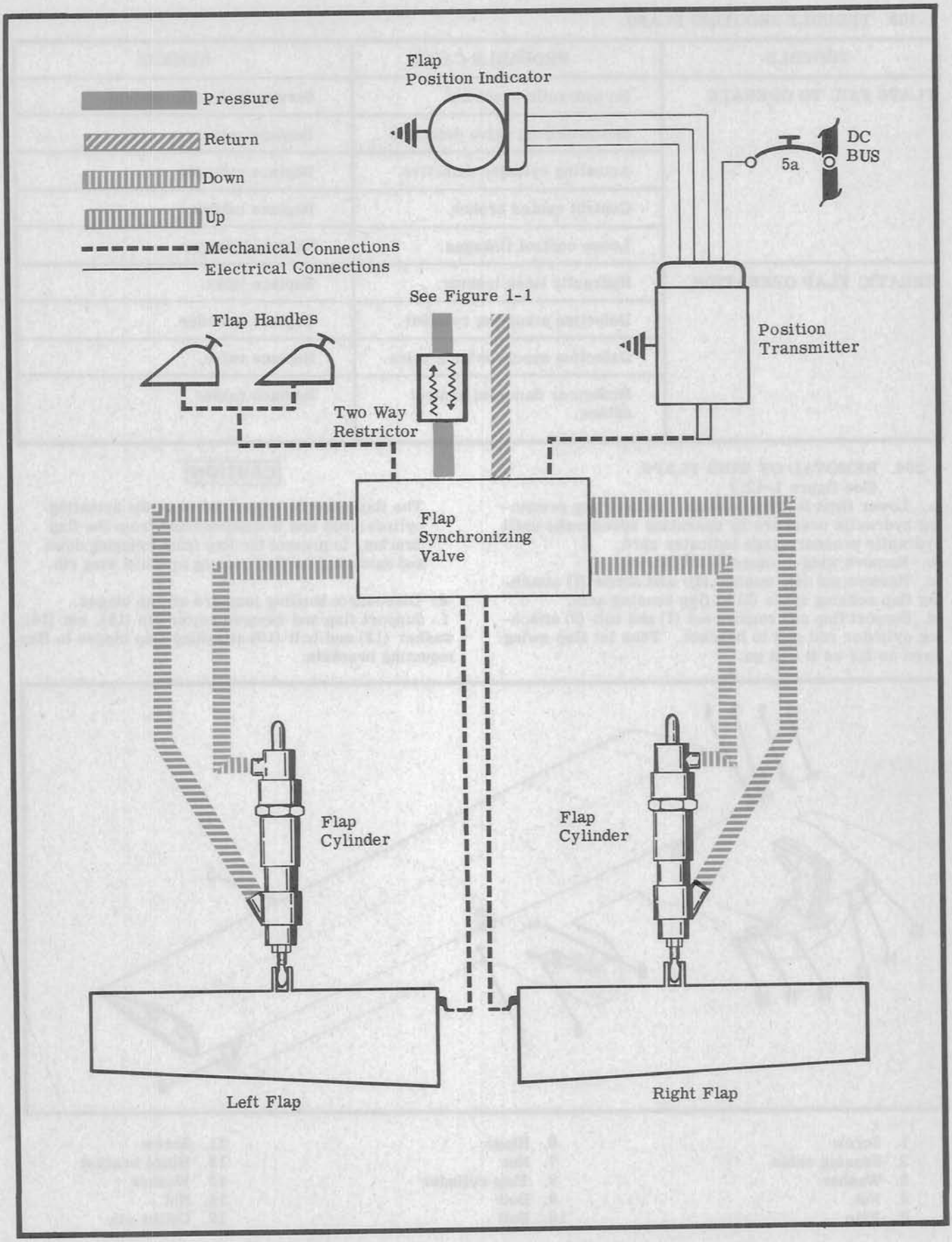


Figure 1-41. Flap Hydraulic System Schematic

1-203. TROUBLE SHOOTING FLAPS.

TROUBLE	PROBABLE CAUSE	REMEDY
FLAPS FAIL TO OPERATE	No hydraulic pressure.	Service hydraulic system.
	Synchronizing valve defective.	Replace valve.
	Actuating cylinder defective.	Replace cylinder.
	Control cables broken.	Replace cables.
	Loose control linkages.	Tighten linkages.
ERRATIC FLAP OPERATION	Hydraulic lines leaking.	Replace lines.
	Defective actuating cylinder.	Replace cylinder.
	Defective synchronizing valve.	Replace valve.
	Broken or damaged control cables.	Replace cables.

1-204. REMOVAL OF WING FLAPS.
(See figure 1-42.)

a. Lower flaps to down position. Relieve any remaining hydraulic pressure by operating speedbrake until hydraulic pressure gage indicates zero.

b. Remove wing-to-nacelle aft fairing.

c. Remove nut (4), washer (3), and screw (1) attaching flap sensing cable (2) to flap sensing arm.

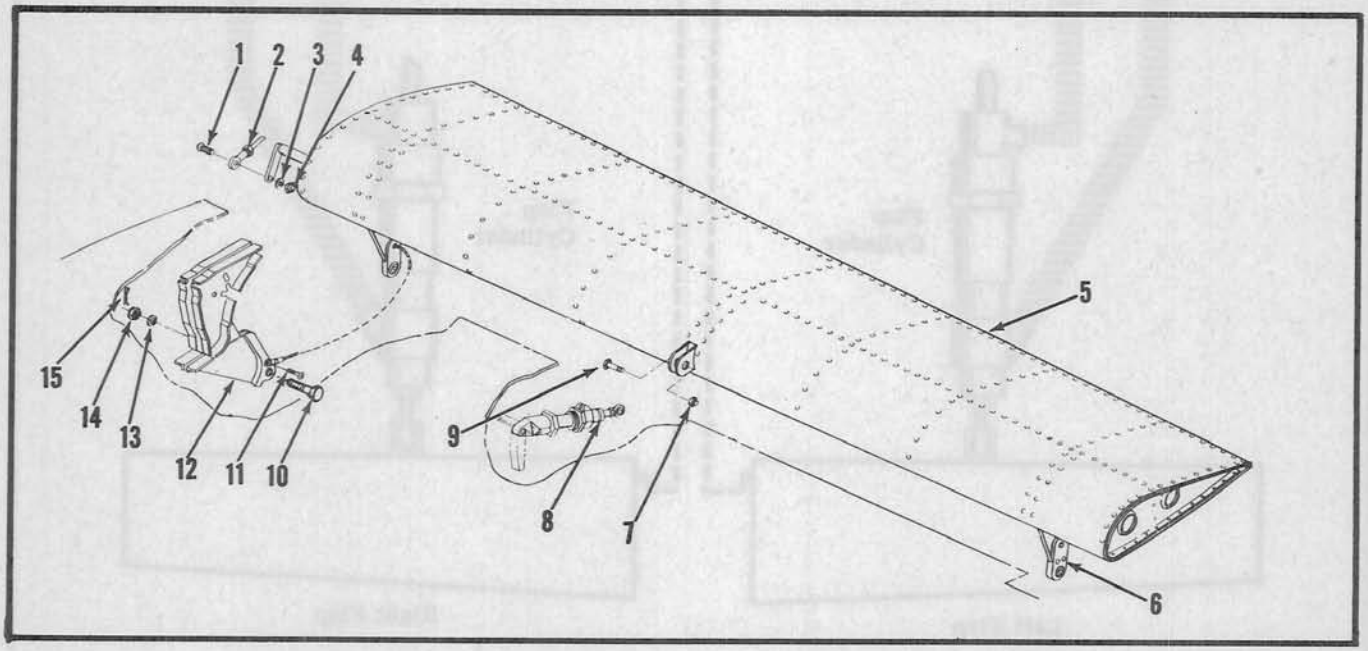
d. Support flap and remove nut (7) and bolt (9) attaching cylinder rod end to bracket. Then let flap swing down as far as it will go.

CAUTION

The flap must be supported when the actuating cylinder rod end is disconnected from the flap bracket, to prevent the flap from swinging down and damaging the flap sensing arm and wing rib.

e. Disconnect bonding jumpers at flap hinges.

f. Support flap and remove cotter pin (15), nut (14), washer (13) and bolt (10) attaching flap hinges to flap mounting brackets.



1. Screw
2. Sensing cable
3. Washer
4. Nut
5. Flap
6. Hinge
7. Nut
8. Flap cylinder
9. Bolt
10. Bolt
11. Screw
12. Hinge bracket
13. Washer
14. Nut
15. Cotter pin

Figure 1-42. Flap Installation

1-205. INSTALLATION OF WING FLAPS. (See figure 1-42.)

a. Mate flap hinges with hinge brackets.
b. Attach flap to hinge brackets with bolts (10), washers (13), nuts (14) and lock with cotter pin.
c. Attach bonding jumpers at hinges.
d. Raise flap up and attach hydraulic cylinder rod end to bracket with bolt (9) and secure with nut (7).
e. Attach flap sensing cable (2) to flap sensing arm with screw (1), washer (3) and nut (4).
f. Adjust flaps in accordance with paragraph 1-206.
g. Install wing-to-nacelle rear fairing.

1-206. ADJUSTMENT OF FLAPS.

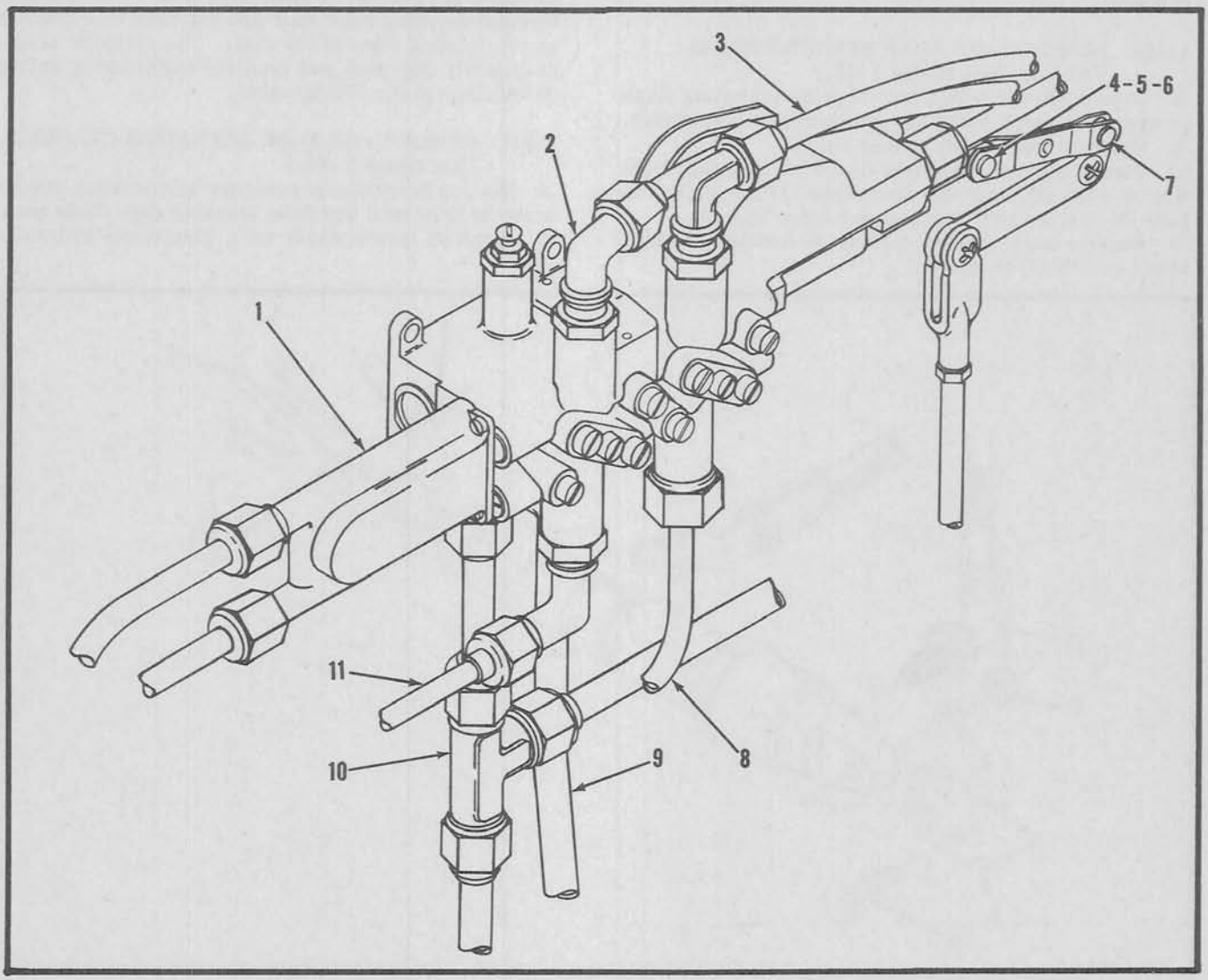
a. Remove safety wire and loosen flap cylinder locknut.
b. Screw rod end in or out of piston rod assembly until the flap is in configuration with the wing when in the up position.

Note

The distance between the mounting hole in the rod end, and the mounting hole in the head should be 8.44 inches with the cylinder in the closed position.

c. Tighten locknut and resafety to washer and attach to flap bracket with bolt and nut.
d. Connect auxiliary hydraulic power hand pumps to hydraulic system and cycle flaps several times to insure proper operation. Check flap position indicator during flap cycles.

1-207. FLAP CONTROL SYSTEM. The two flap control handles are mounted one on each power control quadrant, and are interconnected at a junction box making control of the flaps possible from either the student's or instructor's position. From the junction box



1. Synchronizing valve
2. Right flap down
3. Right flap up
4. Cotter pin
5. Washer
6. Pin
7. Link
8. Left flap up
9. Pressure line
10. Return line
11. Left flap down

Figure 1-43. Flap Synchronizing Valve Installation

a single cable is routed aft to the flap synchronizing valve on the rear spar bulkhead. Movement of either control handle will position the synchronizing valve to allow pressure to enter the extend or retract port of the flap actuating cylinder.

1-208. FLAP SYNCHRONIZING VALVE. The flap synchronizing valve is mounted on the rear spar bulkhead and is used as a selector valve and balancing unit. Operation of either flap control handle will position the valve to allow pressure to the extend or retract ports of the flap actuating cylinders. The valve acts as a synchronizing unit by action of the flap position transmitter cables which are routed from the flaps. As long as the flaps are extending or retracting equally, the unbalancing unit is in a neutral position, but when unequal movement of the flaps is transmitted by the transmitter cables, the unit becomes unbalanced and shuts off pressure to the most highly pressurized flap cylinder.

1-209. REMOVAL OF FLAP SYNCHRONIZING VALVE. (See figure 1-43.)

a. Discharge hydraulic pressure by operating flaps or speedbrake until hydraulic pressure gage reads zero.
b. Remove rear tunnel access door.
c. Disconnect and plug right flap down tube (2), right flap up tube (3), left flap down tube (11), left flap up tube (8), return tube (10) and pressure tube (9).
d. Remove cotter pin (4), washer (5) and pin (6) which attaches link (7) to valve.
e. Disconnect and remove cables from valve.
f. Support valve and remove screws attaching valve to mounting bracket.

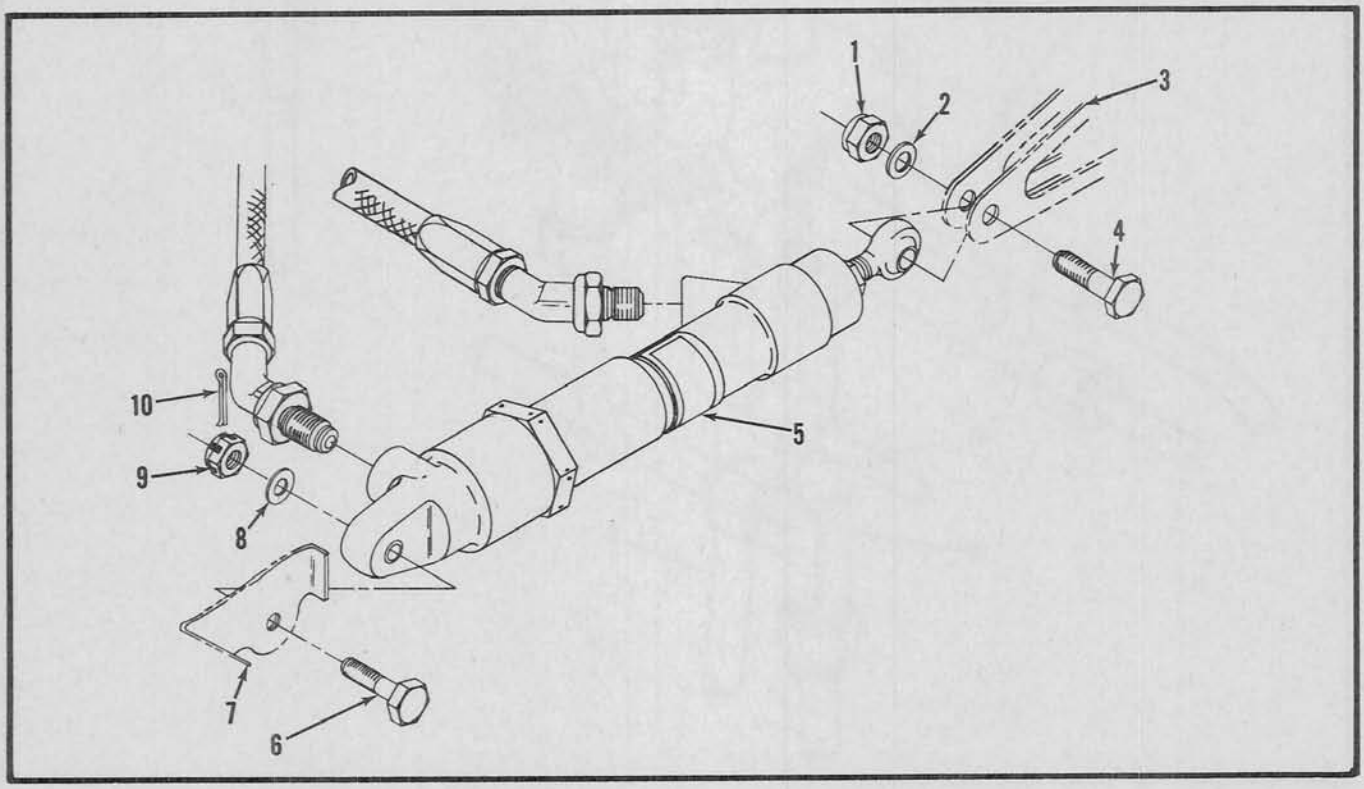
1-210. INSTALLATION OF FLAP SYNCHRONIZING VALVE. (See figure 1-43.)

a. Position valve on mounting bracket and attach with screws.
b. Attach link (7) to valve with pin (6), washer (5) and lock with cotter pin (4).
c. Connect return tube (10), pressure tube (9), left flap up tube (8), left flap down tube (11), right flap down tube (2) and right flap up tube (3).
d. Install cables.
e. Connect hydraulic auxiliary power unit and operate flaps several times to insure correct operation. Check flap position indicator for correct flap travel.

1-211. FLAP ACTUATING CYLINDER. A flap actuating cylinder is mounted in each wing wheel web; extends through the wing rear spar and attaches to a bracket on the leading edge of the flap. The cylinder is hydraulically operated and receives pressure by action of the flap synchronizing valve.

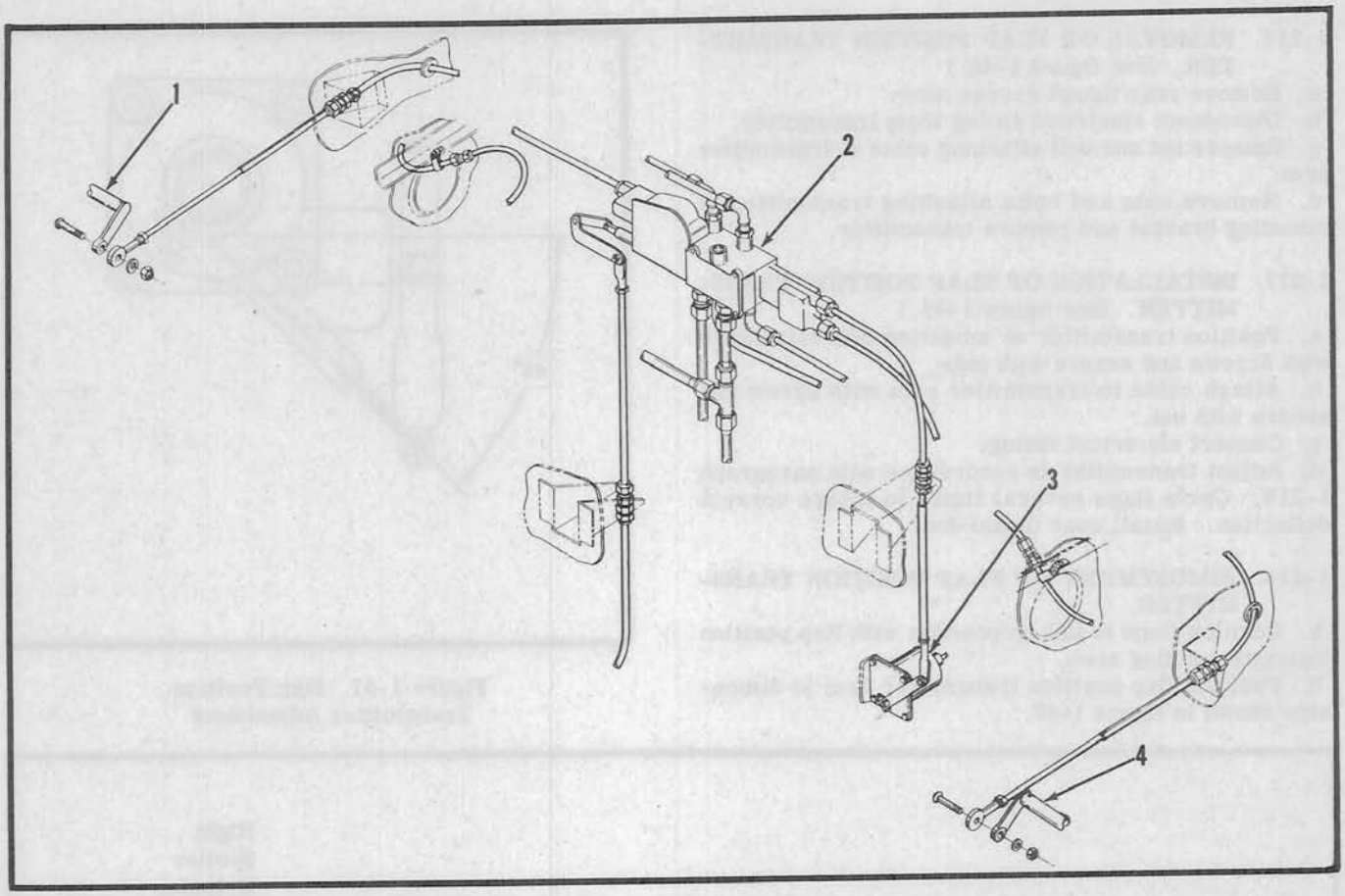
1-212. REMOVAL OF FLAP ACTUATING CYLINDER. (See figure 1-44.)

a. Discharge hydraulic pressure by operating speedbrake or flaps until hydraulic pressure gage reads zero.
b. Working inside wheel well, disconnect hydraulic lines.



1. Nut
2. Washer
3. Flap bracket
4. Bolt
5. Cylinder
6. Bolt
7. Wing bracket
8. Washer
9. Nut
10. Cotter pin

Figure 1-44. Flap Actuating Cylinder Installation



1. Right flap transmitter arm
2. Synchronizing valve
3. Flap position transmitter
4. Left flap transmitter arm

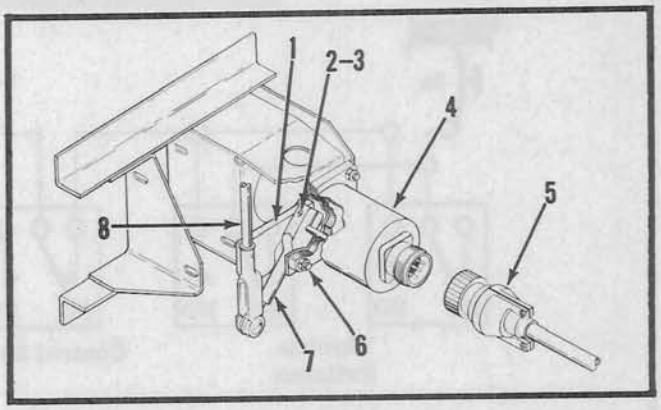
Figure 1-45. Flap Sensing Installation

c. Support flap and remove nut (1), washer (2), and bolt (4) attaching hydraulic cylinder rod end to flap bracket.
d. Remove nut (9), washer (8), and bolt (6) attaching hydraulic cylinder to mounting bracket in wing wheel web.

2-213. INSTALLATION OF FLAP ACTUATING CYLINDER. (See figure 1-44.)
a. Attach cylinder to mounting bracket in wing wheel well with bolt (6), washer (8), and secure with nut.
b. Attach cylinder rod end to flap bracket with bolt (4), washer (2) and secure with nut (1).
c. Connect cylinder hydraulic lines.
d. Connect hydraulic auxiliary power unit and cycle flap several times to insure correct operation.

1-214. FLAP SENSING SYSTEM. The flap sensing system is incorporated to give the pilot the amount of flap deflection. The flap position transmitter is mounted on the rear spar bulkhead and is connected to the flap synchronizing valve by a cable and electrically to the flap position indicator. The flap position transmitter is actuated by a cable routed from the flap synchronizing valve to the transmitter arm. This cable is moved when the flap sensing cables, routed from the flaps to the synchronizing valve, actuate the valve. This movement positions the transmitter to reflect the position of the flaps; the transmitter in turn transmits this position to the flap position indicator.

1-215. FLAP POSITION TRANSMITTER. The flap position transmitter is mounted to the fuselage rear spar bulkhead and is actuated by a cable routed from the flap synchronizing valve. The transmitter transmits to the flap position indicator the amount of flap deflection.



1. Actuating arm
2. Nut
3. Screw
4. Transmitter
5. Electrical fitting
6. Screw
7. Lever
8. Cable

Figure 1-46. Flap Position Transmitter

1-216. REMOVAL OF FLAP POSITION TRANSMITTER. (See figure 1-46.)

a. Remove rear tunnel access door.

b. Disconnect electrical fitting from transmitter.

c. Remove nut and bolt attaching cable to transmitter arm.

d. Remove nuts and bolts attaching transmitter to mounting bracket and remove transmitter.

1-217. INSTALLATION OF FLAP POSITION TRANSMITTER. (See figure 1-46.)

a. Position transmitter on mounting bracket; attach with screws and secure with nuts.

b. Attach cable to transmitter arm with screw and secure with nut.

c. Connect electrical fitting.

d. Adjust transmitter in accordance with paragraph 1-218. Cycle flaps several times to insure correct deflection. Install rear tunnel door.

1-218. ADJUSTMENT OF FLAP POSITION TRANSMITTER.

a. Position flaps to full up position with flap position indicator reading zero.

b. Position flap position transmitter arm to dimension shown in figure 1-47.

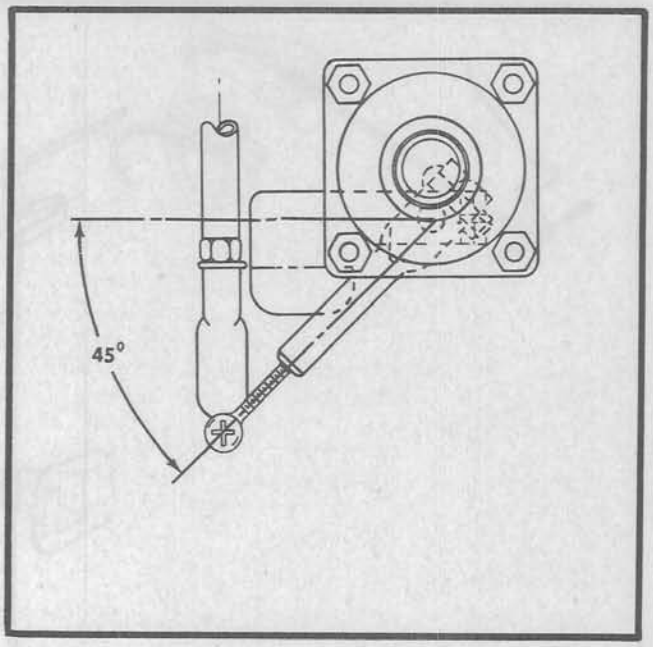


Figure 1-47. Flap Position Transmitter Adjustment

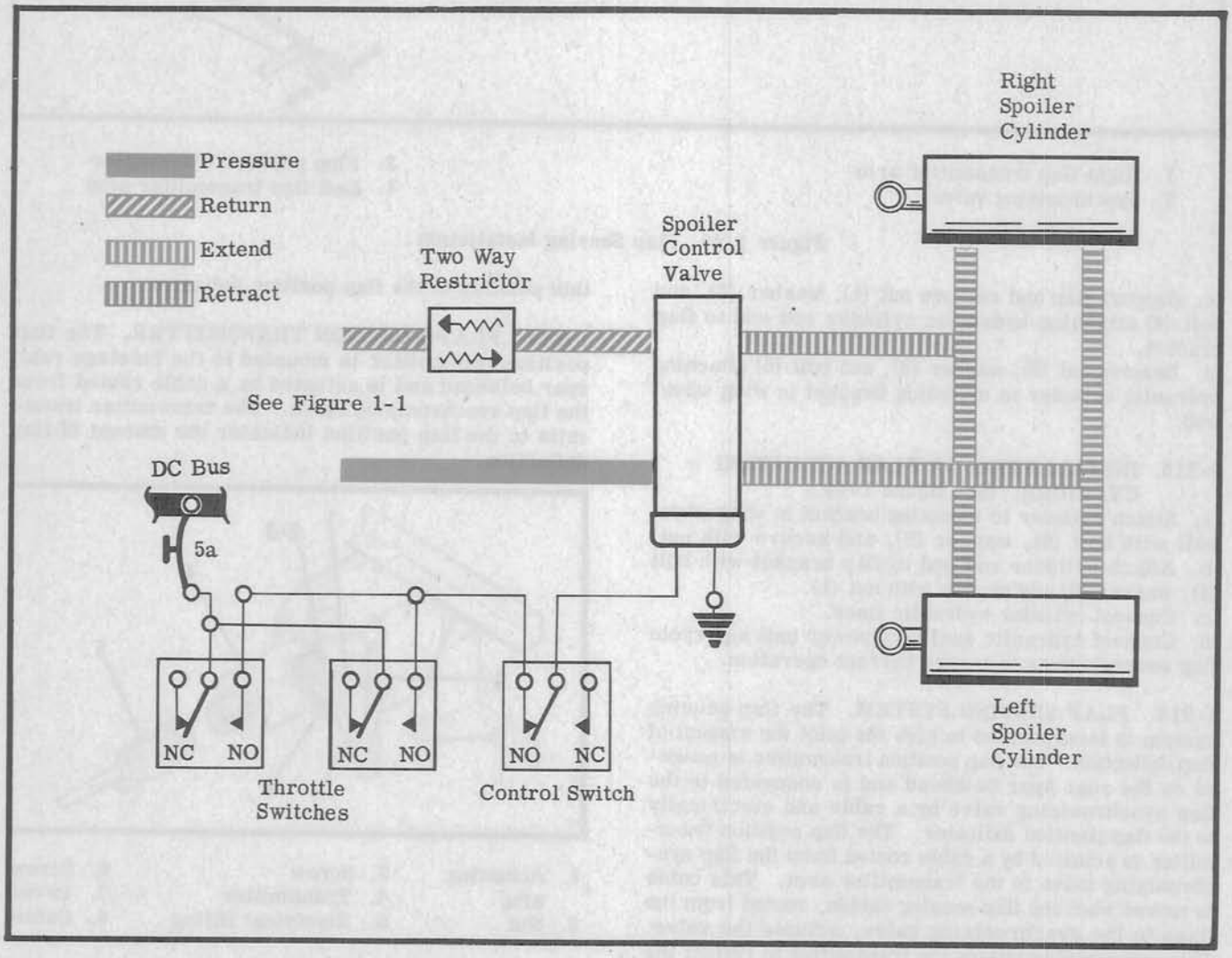


Figure 1-48. Spoiler Systems Schematic

1-219. SPOILER SYSTEM.

1-220. DESCRIPTION. The spoiler system includes three limit switches, one in each control quadrant and one on the rear spar carry thru assembly; a two way restrictor in the return line from the control valve; an electrically actuated control valve on the fuel tank top; and two hydraulic cylinders, one in each nacelle, for the spoilers.

1-221. OPERATION. When the throttles are set at less than 65% RPM, the throttle limit switches are closed; then, when the flaps have extended 28 degrees, an actuator arm on the flap position transmitter (see figure 1-46) closes the control switch on the rear spar, and the spoiler control valve is actuated to provide pressure to the extend ports of the cylinders, raising the spoilers, which are located on the nacelle. The spoilers are provided to warn the pilot when he is approaching a stall condition.

1-222. REMOVAL OF SPOILER CONTROL VALVE.
a. Discharge hydraulic pressure and remove door 7.
b. Disconnect electrical fitting.
c. Disconnect and cap hydraulic lines and fittings.
d. Remove four screws and valve.

1-223. INSTALLATION OF SPOILER CONTROL VALVE.
a. Attach valve to bracket with four screws.
b. Uncap and connect lines and fittings.
c. Connect electrical fitting.
d. Install door 7 and perform operational check in accordance with paragraph 1-4.

1-224. REMOVAL OF SPOILER CYLINDER.
a. Discharge hydraulic pressure and remove doors 32 and 38.
b. Disconnect and cap hydraulic lines and fittings.
c. Remove nut, spacer, and bolt attaching cylinder head to spoiler actuator bracket.
d. Remove nut and bolt attaching cylinder rod end to spoiler actuating tube and remove cylinder.

1-225. INSTALLATION OF SPOILER CYLINDER.
a. Attach cylinder rod end to spoiler actuating tube with bolt and nut.
b. Attach cylinder head to spoiler actuator bracket with bolt, spacer, and nut.
c. Uncap and connect lines and fittings.
d. Install doors 32 and 38; perform operational check in accordance with paragraph 1-4.

SECTION II
UTILITY SYSTEMS

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2-1. HEATING, VENTILATING AND DEFROST SYSTEM.

2-2. DESCRIPTION. Compressor bleed air, ranging in temperature from 121°C (350° F) to 233°C (450° F), is taken from the inboard side of the combustion section of each engine. This hot air is used for heating the cabin and defrosting the windshield and canopy. Cool outside air enters the system through an air scoop and screen located forward of the windshield in the center of the fuselage and is distributed to the three ventilation outlets from the plenum chamber. Cabin temperatures can be regulated for pilot comfort by positioning the control levers located near the center of the instrument panel.

2-3. OPERATION. The ventilation portion of the heating, ventilation and defrost system has three outlets, two of these are adjustable valves located just forward of each seat on opposite sides of the cockpit. These valves can be directed to any part of the pilot's body and are adjustable from fully open to completely closed. The remaining outlet exhaust through the center of the glare shield, and contains a valve which is actuated by the cold air control lever located on the heater panel. Hot air flows from the engine through tubing into the collector manifold at the rear of the cockpit. From the manifold the hot air flows through the hot air shut off valve to the "Y" fitting where it is divided into two ducts, one connected to the defrost diluter nozzel, and the other to the hot air tube which is welded to the bottom of the plenum chamber. The heating portion of the system consists of the hot air tube which includes a hot air control valve and two outlets which direct hot air to the floor of the cockpit. The hot air control valve is actuated by the hot air tee handle located above the heater panel. The remainder of the hot air flows through the defrost diluter nozzel picking up relatively cool cabin air through the venturi action of the diluter nozzel and the diluter. This diluted air leaves the defrost diluter through three tubes passing into the defrost distributor manifolds and sprays onto the windshield and canopy. The flow of hot air through the diluter nozzel is controlled by the defrost valve which is actuated by the hot air control tee handle.

2-4. OPERATIONAL CHECK OF HEATING, VENTILATING AND DEFROST SYSTEM. To operationally test the heating and defrost portions of the system both engines must be operated. For engine operation instructions refer to T.O. No. 1T-37A-2-5.

CAUTION

Do not operate defrost system for extended periods during ground run up. Excessive temperatures may warp and deteriorate the windshield and canopy.

a. Start engines and operate at 70% RPM.
b. Open hot air valve by pulling tee handle on instrument panel.

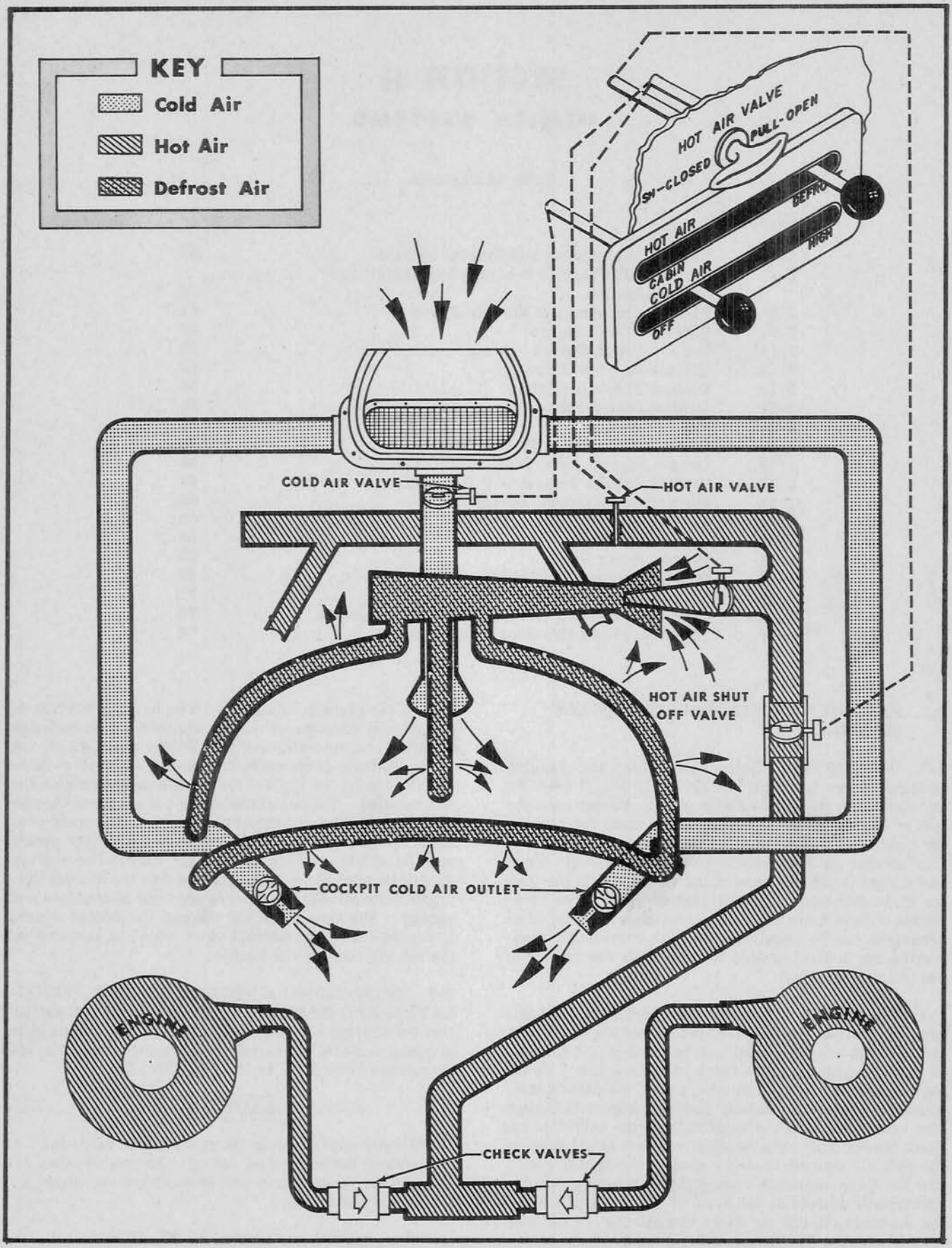


Figure 2-1. Heating and Ventilating System Schematic

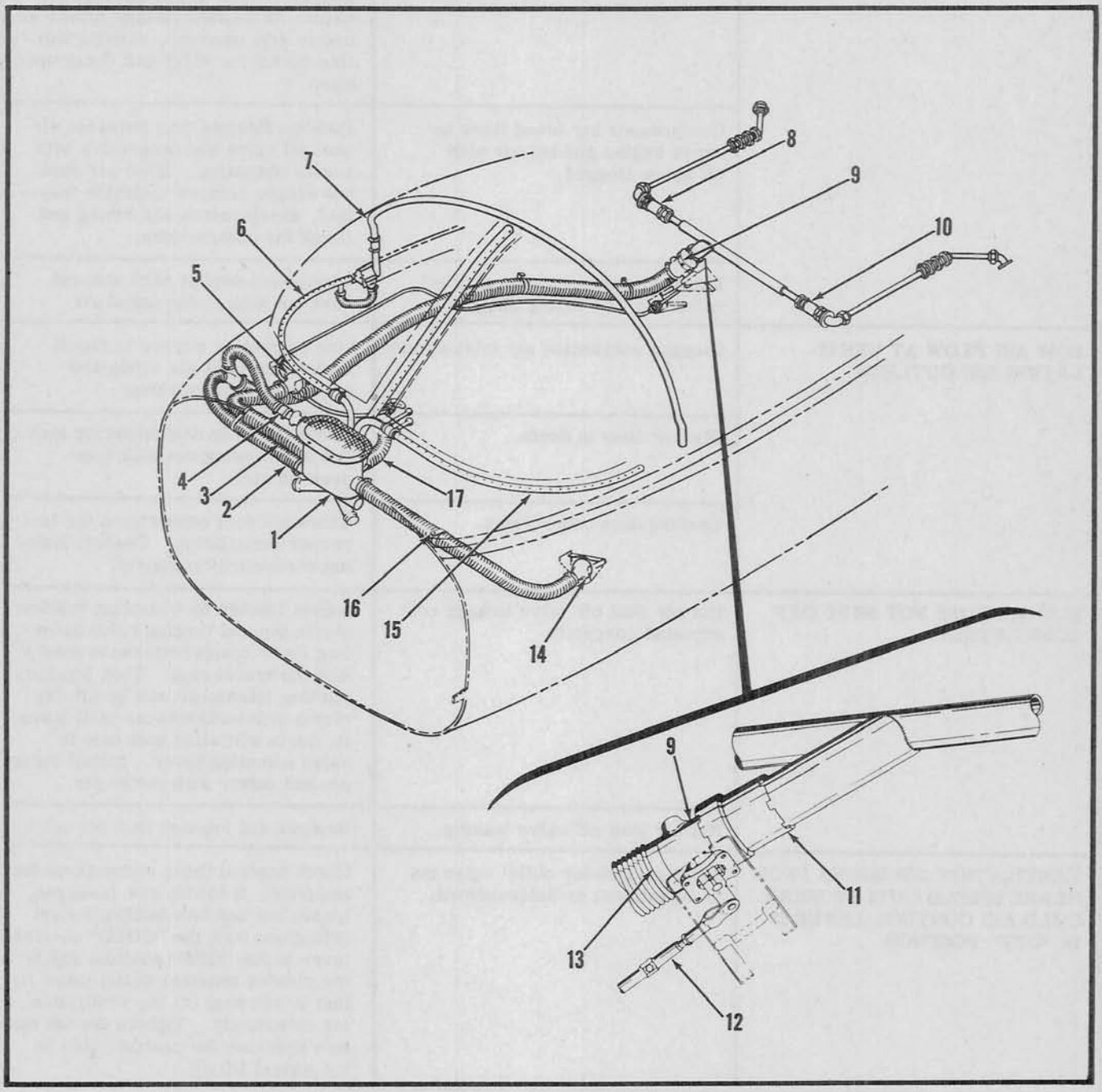
c. Move "HOT AIR" control lever to "CABIN" and place hand under hot air tube outlets. Hot air should exhaust from each outlet.

d. Move "HOT AIR" control valve to "DEFROST" and feel along defrost outlet tubes, hot air should spray onto windshield out of holes in defrost tubes which surround the windshield.

e. Check defrost and cabin heat valve operation by moving "HOT AIR" control lever to "CABIN" and then to "DEFROST" heated air should flow out of hot air outlet tubes only and then gradually shift to defrost outlet tubes only.

f. Close hot air shut off valve by pushing tee handle "HOT AIR VALVE" and check for valve leakage by placing hand over outlets in defrost tubes.

g. Perform normal engine shutdown.



1. Plenum chamber
2. Hot air inlet tube
3. Cold air outlet tube
4. Diluter nozzel
5. Cockpit cold air outlet
6. Windshield defrost tube
7. Canopy defrost tube
8. Hot air check valve
9. Hot air shut off valve
10. Hot air check valve
11. Coupling
12. Hot air control
13. Clamp
14. Cockpit cold air outlet
15. Windshield defrost tube
16. Cold air outlet tube
17. Cold air outlet tube

Figure 2-2. Heating and Ventilating System Installation

2-5. TROUBLE SHOOTING HEATING AND VENTILATING SYSTEM.

TROUBLE	PROBABLE CAUSE	TROUBLE
HOT AIR NOT AVAILABLE TO DEFROST OR CABIN HEAT PORTIONS OF THE SYSTEM	Hot air shut off valve stuck closed.	Check operation of teleflex linkage by alternately pushing and pulling hot air valve tee handle on instrument panel while checking for teleflex movement at hot air shut off valve. If teleflex linkage moves actuator arm on valve, remove flexible duct from valve and check operation.
	Compressor air bleed lines between engine and hot air shut off valve clogged.	Remove flexible duct from hot air shut off valve and open valve with engine operating. If hot air does not escape remove collector manifold, check valves and tubing and check for obstructions.
	Ducting between hot air shut off valve and "Y" fitting clogged.	Disconnect duct at each end and blow out with compressed air.
LOW AIR FLOW AT VENTILATION AIR OUTLETS	Clogged ventilation air inlet screen.	Use inspection mirror to check ventilation inlet air scoop and screen for obstructions.
	Obstructions in ducts.	Check ducts by disconnecting each end and blowing out with compressed air.
	Leaking duct connections.	Check all duct connections for improper installation. Connect leaking connections properly.
HOT AIR DOES NOT SHUT OFF COMPLETELY.	Hot air shut off valve linkage not adjusted correctly.	Adjust linkage by removing teleflex clevis pin and turning valve actuating lever counterclockwise until it hits the travel stop. Then lengthen teleflex telescopic unit by turning clevis counterclockwise until holes in clevis will align with hole in valve actuating lever. Install clevis pin and safety with cotter pin.
	Hot air shut off valve leaking.	Remove and replace shut off valve.
VENTILATION AIR ISSUES FROM GLARE SHIELD OUTLET WHEN COLD AIR CONTROL LEVER IS IN "OFF" POSITION	Plenum chamber outlet valve out of adjustment or disconnected.	Check control cable connections for security. If cables are insecure, loosen nut and bolt holding swivel fitting and with the "COLD" control lever in the "OFF" position adjust the plenum chamber outlet valve so that it will shut off the ventilation, air completely. Tighten the nut and bolt securing the control cable in the swivel fitting.
FUEL OR OIL FUMES IN THE COCKPIT WHEN THE HEATING OR DEFROST PORTIONS OF THE SYSTEM ARE IN OPERATION	Fuel or oil leak in the accessory gear case or in fuel or oil lines.	Pressure check engine. Tighten or replace leaking lines as required. Replace engine if condition continues to exist.

2-6. PLENUM CHAMBER AND HOT AIR TUBES. The plenum chamber is located inside the forward portion of the fuselage center section, directly below the ventilation air scoop. Three outlet tubes protrude from the lower part of the chamber, two of these tubes face outboard and are connected by ducts to the cold air

valves on each side of the cockpit. The center outlet tube contains a butterfly type throttle valve which controls air flow to the glare shield outlet. This valve is operated by positioning the cold air control lever on the instrument panel. Welded to the bottom of the plenum chamber is the hot air tube which receives hot bleed air from the engine compressors. At the inlet of the hot air tube is a butterfly type throttle valve, positioned by the "HOT AIR" control lever on the instrument panel, which regulates the flow of hot air into the tube. Two outlet tubes are welded to the bottom of the hot air tube and are positioned so as to exhaust hot air toward the cockpit floor in the direction of the rudder pedals. The closed end of the defrost diluter is secured to the plenum chamber by means of a support bracket.

2-7. REMOVAL OF PLENUM CHAMBER, HOT AIR TUBE AND DILUTER. (See figure 2-2.)

a. Loosen clamps securing ducts to outlet tubes and disconnect ducts from outlets.

b. Loosen clamp and disconnect hot air tube, inlet screen, defrost diluter and ventilation air scoop from aircraft.

2-8. INSTALLATION OF PLENUM CHAMBER, HOT AIR TUBE AND DILUTER. (See figure 2-2.)

a. Working behind the instrument panel, position the plenum chamber mounting flange beneath the mounting holes.

Note

Be sure inlet screen is positioned over the plenum chamber before chamber is positioned at mounting holes.

b. The man outside the cockpit can now position the ventilation air scoop over the mounting holes and install the mounting screws.

c. Connect control linkage to cabin heat valve, ventilation air control valve, and defrost valve.

d. Install attaching screw in clamp to secure flare end of diluter.

e. Connect hot air inlet duct to hot air tube and secure with clamp.

f. Connect ducts to outlet tubes and secure with clamps.

2-9. DEFROST DILUTER NOZZLE. The diluter nozzle is a convergent duct which accelerates hot air from the engine compressors in the bell shaped mouth of the defrost diluter. Due to the venturi action of the high velocity hot air passing from the diluter nozzle into the diluter, relatively cool cabin air is drawn into the diluter along with the compressor bleed air. This cools the hot compressor bleed air to a safe temperature for defrosting the plexiglas of the windshield or canopy. Incorporated in the diluter nozzle is a butterfly type defrost valve, which regulates the air flow through the diluter nozzle. This valve is connected by flexible linkage to the "HOT AIR" control lever located on the instrument panel. The diluter nozzle is held in place by a clamp which is secured to a bracket located beneath the windshield on the left side of the cockpit.

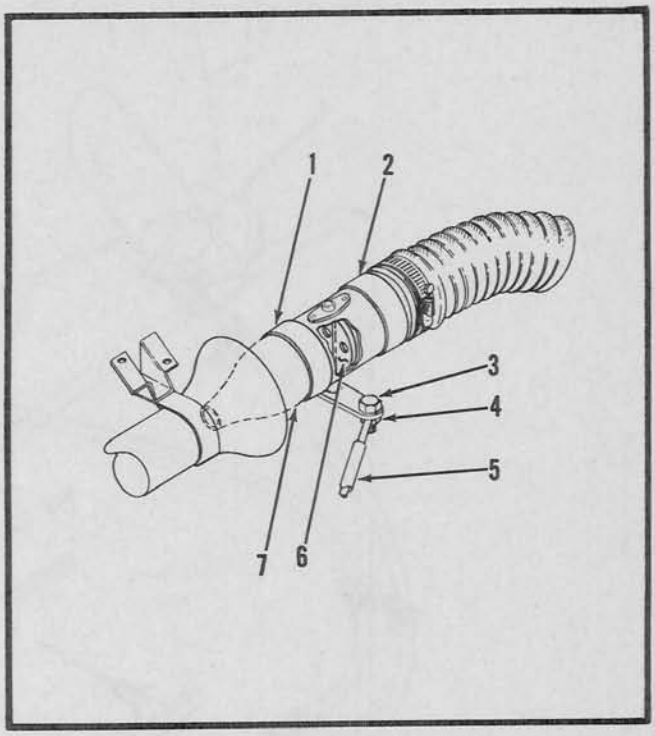
2-10. REMOVAL OF DILUTER NOZZLE. (See figure 2-3.)

a. Loosen duct clamp at diluter nozzle and disconnect duct.

b. Disconnect control linkage from defrost valve.

c. Remove screw from clamp attaching diluter nozzle to bracket.

d. Remove diluter nozzle from aircraft.



1. Clamp
2. Clamp
3. Bolt
4. Nut
5. Control
6. Valve
7. Diluter nozzle

Figure 2-3. Duluter Nozzle

2-11. INSTALLATION OF DILUTER NOZZLE. (See figure 2-3.)

a. Position diluter nozzle on bracket and clamp securely making certain that the nozzle is centered in the diluter mouth.

b. Connect control linkage to defrost valve.

c. Install duct on diluter nozzle and clamp.

2-12. HOT AIR CHECK VALVES. There is a hot air check valve connected to each flow limiter of the collector tube, which prevents the loss of compressor bleed air through the collector tube during single engine operation.

2-13. REMOVAL OF HOT AIR CHECK VALVES. (See figure 2-2.)

a. Disconnect hot air check valve at flow limiter.

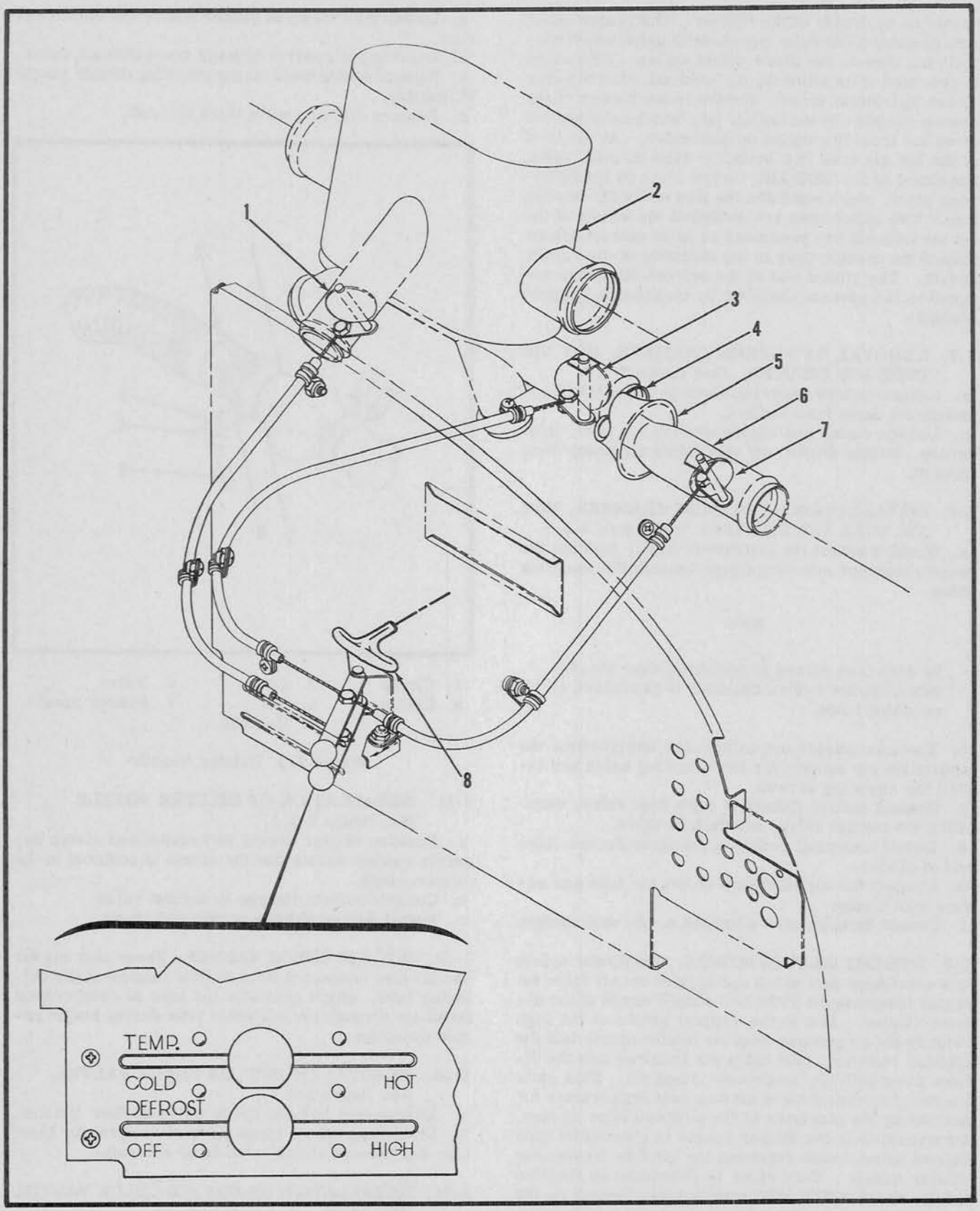
b. Disconnect hot air check valve at compressor bleed tube and remove check valve from aircraft.

2-14. INSTALLATION OF HOT AIR CHECK VALVES. (See figure 2-2.)

a. Connect hot air check valve to the flow limiter.

b. Connect hot air check valve to compressor bleed tube.

2-15. HOT AIR SHUT OFF VALVE. The shutoff valve



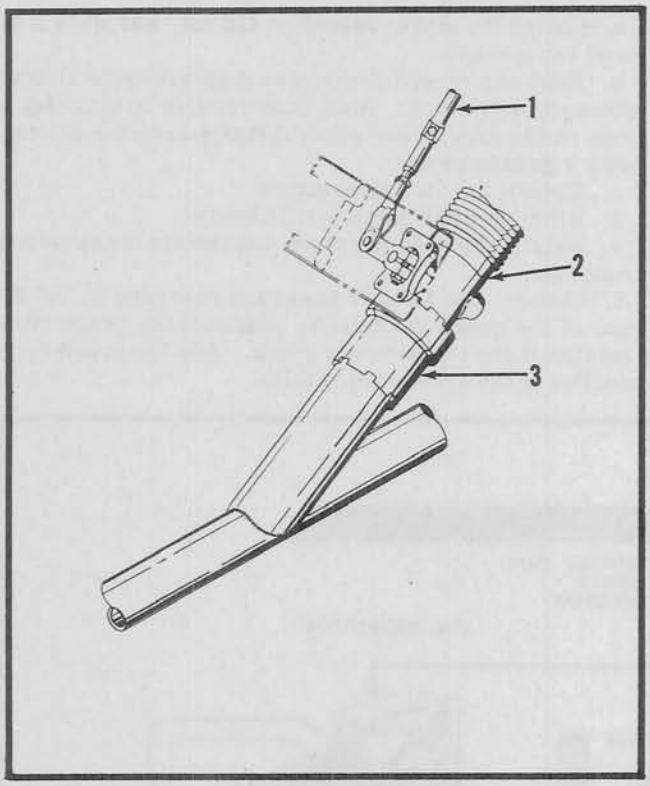
1. Cold air valve
2. Hot air valve
3. Defrost control valve
4. Hot air inlet
5. Cabin heat valve
6. Duluter nozzle
7. Defrost valve
8. Hot air control handle

Figure 2-4. Heating and Ventilating Controls Installation

provides a positive shut off of the compressor bleed air when the heating system is not in use. The valve is a butterfly type, controlled from the instrument panel by a push-pull tee handle. The shut off valve is located in the compressor bleed air manifold on the bulkhead directly behind the right ejection seat.

2-16. REMOVAL OF HOT AIR SHUT OFF VALVE. (See figure 2-5.)

a. Disconnect control linkage to shut off valve.
b. Remove bolts from hot air shut off valve bracket.
c. Loosen clamp and remove duct from shut off valve.
d. Using spanner wrench disconnect coupling at shut off valve and remove valve from aircraft.



1. Control
2. Clamp
3. Coupling

Figure 2-5. Hot Air Shut Off Valve

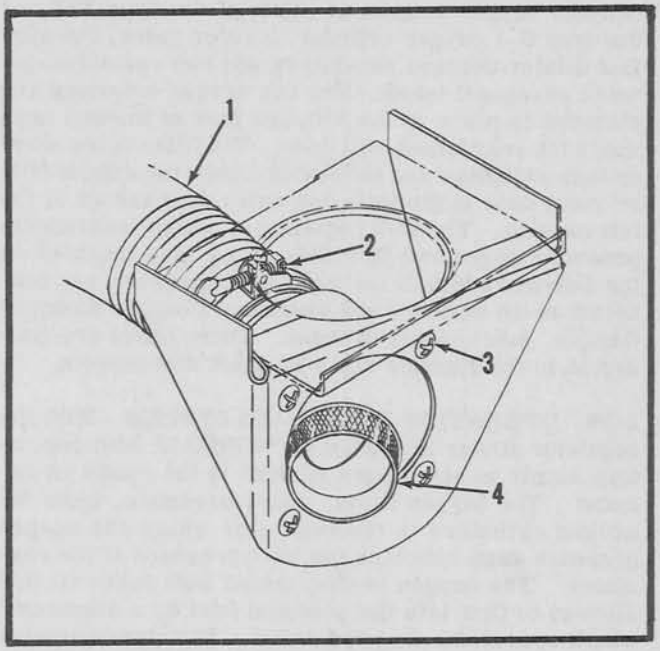
2-17. INSTALLATION OF HOT AIR SHUT OFF VALVE. (See figure 2-5.)

a. Position shut off valve in coupling and torque coupling.
b. Install bolts attaching shut off valve to bracket.
c. Install duct on shut off valve and clamp.
d. Connect control linkage to shut off valve arm.

2-18. COCKPIT COLD AIR OUTLETS. The cockpit air outlets are located on each side of the cockpit and provide a means of adjusting direction and velocity of the ventilation air entering the cockpit. They consist of a ball socket outlet tube with an adjustable valve incorporated to vary the outlet area. The outlets are located on the cockpit wall forward of each seat.

2-19. REMOVAL OF COCKPIT COLD AIR OUTLETS. (See figure 2-6.)

a. Loosen clamp on rear of outlet and remove duct.
b. Remove screws attaching outlet to bracket.
c. Remove sealing ring from front of outlet and remove outlet tube from valve and remove valve.



1. Hose
2. Clamp
3. Screw
4. Valve

Figure 2-6. Cockpit Cold Air Valve

2-20. INSTALLATION OF COCKPIT COLD AIR OUTLETS. (See figure 2-6.)

a. Position outlet tube in bracket from rear then fit sealing ring over tube and install screws.
b. Install duct on rear of outlet and clamp.

2-21. DEFROST OUTLET TUBES. The defrost outlet tubes consist of four aluminum alloy tubes one inch in diameter which are formed to follow the contour of the windshield and canopy frames. In these tubes are several equally spaced holes drilled so as to direct defrost air against the windshield when the tubes are clamped to the frames. Defrost air enters the three windshield defrost outlet tubes from the three diluter outlets. The right windshield defrost outlet tube also acts as a duct, it is connected to the canopy defrost outlet tube by a passageway through the windshield corner fitting into the canopy corner fitting when the canopy is closed.

2-22. REMOVAL OF DEFROST OUTLET TUBES. (See figure 2-2.)

a. Loosen hose clamps at each end of defrost outlet tubes so that tubes will slip out of hose flex-coupling when tubing clamps are unfastened.
b. Remove screws and nuts securing defrost outlet tubes to windshield and canopy frames.
c. Remove defrost outlet tubes from aircraft.

2-23. INSTALLATION OF DEFROST OUTLET TUBES. (See figure 2-2.)

a. Slip defrost outlet tube ends into hose flex-couplings and secure tubing clamps with screws and nuts.
b. Tighten hose clamps around hose flex couplings.

2-24. OXYGEN SYSTEM.

2-25. GENERAL DESCRIPTION. The low pressure, demand oxygen system consists of one type F-1 and one type G-1 oxygen cylinder, a filler valve, two type D-2 diluter demand regulators and two regulator-to-mask personnel tubes. The two oxygen cylinders are clamped in place in the forward part of the tail cone above the rear tunnel wall door. The filler valve serves both cylinders and is located inside the oxygen filler valve door in the tail cone wall above and aft of the left nacelle. The D-2 regulators, which incorporate pressure gages and flow indicators, are mounted on the outboard edges of the instrument panel and are connected to the student's and instructor's oxygen masks by flexible, fabric covered hoses. These hoses are connected to the ejection seats by quick disconnects.

2-26. OPERATION OF OXYGEN SYSTEM. With the regulator diluter levels set at "NORMAL" both regulators supply an air-oxygen mixture to the masks on demand. The oxygen flows, under pressure, from the oxygen cylinders to the regulator where the oxygen pressure gage indicates the inlet pressure at the regulator. The oxygen is then mixed with cabin air and allowed to flow into the personal lead by a diaphragm which operates a demand valve. The flow indicator gives visual indication that oxygen is flowing through the regulators.

2-27. OPERATIONAL CHECK OF OXYGEN SYSTEM.

2-28. OXYGEN SYSTEM LEAK TEST.

WARNING

When working with the oxygen system all clothing, lines, fittings, and working equipment must be free from grease, oil, water, or foreign matter. Fire or explosion may result when grease or oil comes in contact with oxygen under pressure. Water will cause corrosion and freezing of the oxygen equipment at low temperatures. Do not open valves near an open flame.

a. Charge the oxygen system to 425 psi, and allow it to cool for one hour.
b. Read and record the oxygen gage pressure at both demand regulators. Note each reading by drawing a line on the gage cover glass directly over the pointer with a grease pencil.
c. Record the air temperature.
d. Allow aircraft to sit for 24 hours.
e. Record the gage pressure and the air temperature readings.
f. Correct the 24 hour pressure recorded in "c" by use of the graph in Chart I. Subtract the graph correction if the temperature rises. Add the graph correction if the temperature falls.

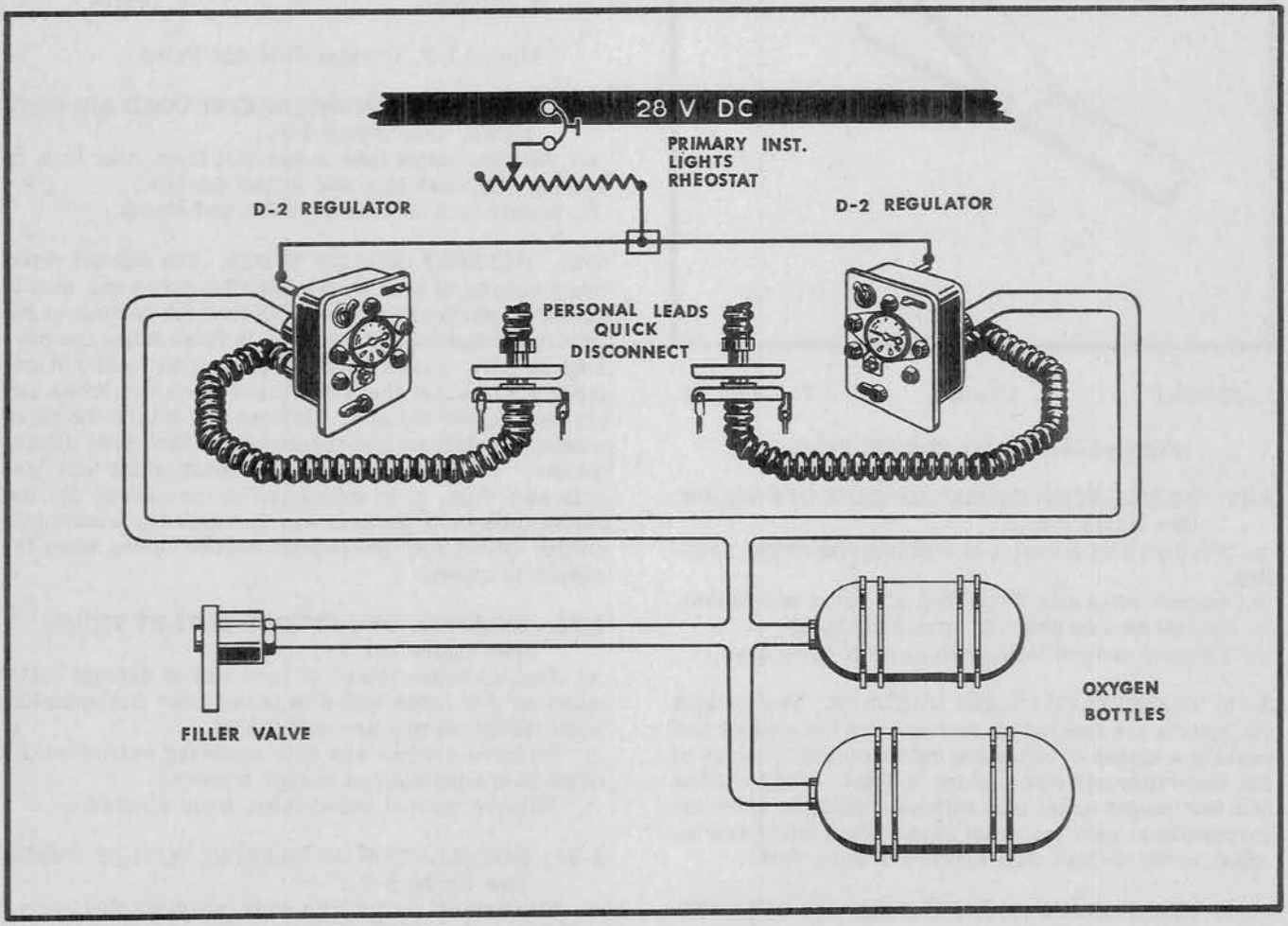


Figure 2-7. Oxygen System Schematic

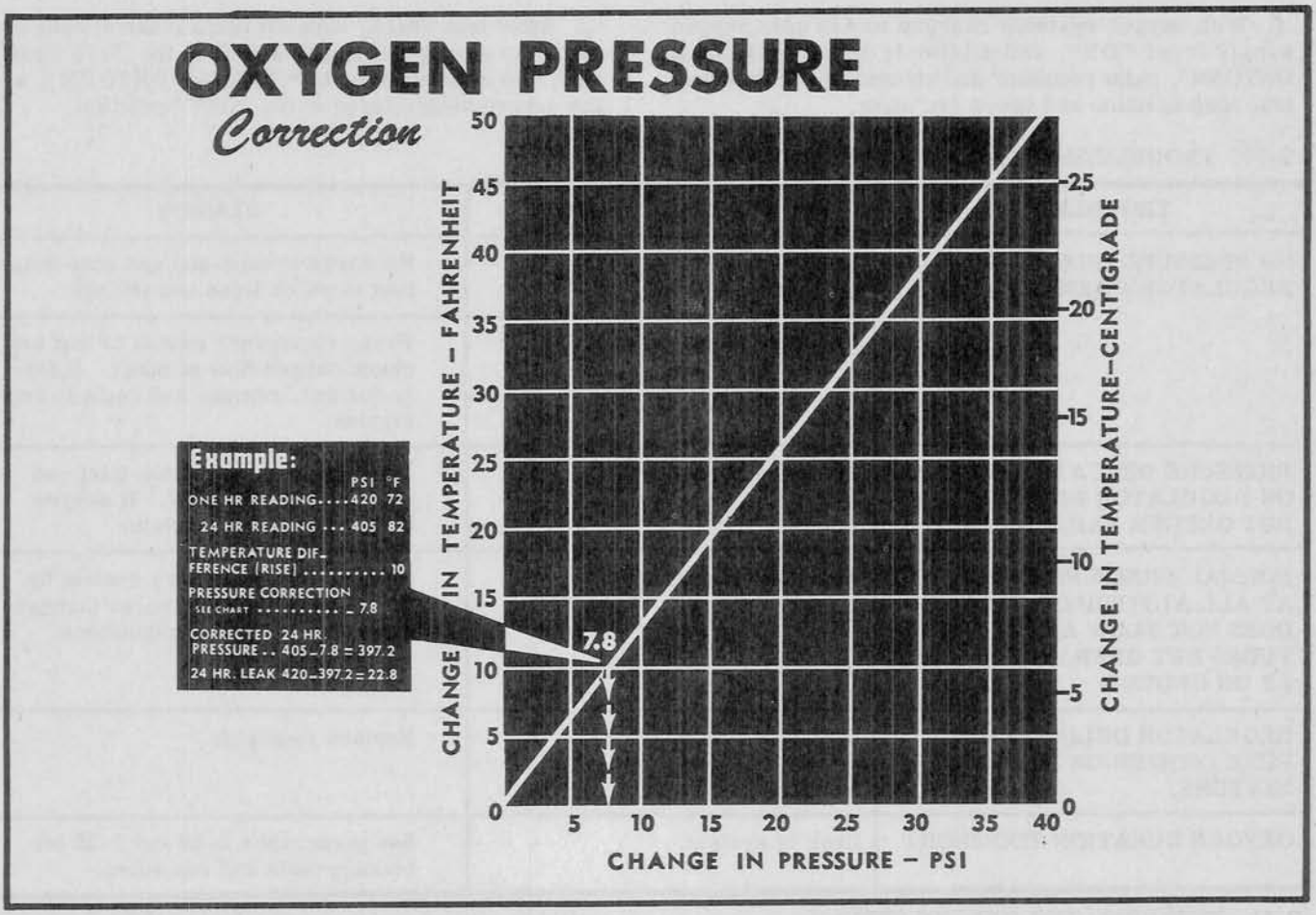


Figure 2-8. Oxygen Pressure Correction Chart

g. Subtract the corrected 24 hour oxygen pressure found in "f" from the one hour oxygen pressure recorded in "b".

h. If the 24-HOUR LEAK is greater than 25 psi, the aircraft should not be cleared for flights above 10,000 feet until the leak has been found and corrected, and the oxygen system recharged to 425 psi. If the 24-HOUR LEAK is within permissible limits, the system should be recharged to 425 psi.

i. If the leak test indicates leakage in the oxygen system paint all connections with a mild soap solution (castile preferred) and locate leaks. Wipe all parts clean and dry after locating leak.

WARNING

Do not use soap with a grease base as fire or explosion may result.

Note

Double flap fairing used on oxygen tubing is normally torqued to 100-125 inch-pounds on initial installation. When tightening a leaking connection, torque up to 200 inch-pounds is allowed. Increase torque in increments of 25 inch-pounds to permit further tightening if a leak should develop later.

2-29. TESTING OXYGEN SYSTEM D-2 REGULATORS.

a. Charge oxygen system to 425 psi.

b. Turn oxygen supply lever to "ON" and diluter lever to 100% OXYGEN, place the open end of the personal-lead against mouth and blow gently into hose. There should be a constant resistance to reverse air flow through to the personal-lead and regulator.

Note

If the resistance to blowing in the personal-lead is not constant check the personal-lead and the regulator for leaks.

c. Connect oxygen mask to personal-lead at quick-disconnect.

d. With cylinders fully charged, oxygen supply lever "ON", and diluter lever alternately at "NORMAL OXYGEN" and "100% OXYGEN", take several breaths in the mask.

e. Observe oxygen flow indicator, black and white segments should appear alternately in the slots of the flow indicator, with each breath, indicating a free flow of oxygen.

Note

If an uncomfortable amount of suction is required to obtain the flow of oxygen, the regulator is defective and must be replaced. Do not attempt any repair or adjustment of the regulator.

f. With oxygen systems charged to 425 psi, oxygen supply lever "ON", and diluter lever at "NORMAL OXYGEN", paint regulator and connections with a neutral soap solution and check for leaks.

g. After leak check, wipe all parts clean of soap and place the emergency toggle switch in the "OFF" position, the diluter lever to "NORMAL OXYGEN", and the oxygen supply lever in the "OFF" position.

2-30. TROUBLE SHOOTING OF OXYGEN SYSTEM.

TROUBLE	PROBABLE CAUSE	REMEDY
NO PRESSURE INDICATION ON REGULATOR PRESSURE GAGES	Leak in system has exhausted pressure.	Recharge system and use soap solution to check lines and fittings.
	Pressure gages defective.	Press emergency switch to test and check oxygen flow at mask. If flow is normal, remove and replace regulators.
PRESSURE INDICATION NORMAL ON REGULATOR PRESSURE GAGE BUT OXYGEN FAILS TO FLOW	Defective regulator.	Loosen line at regulator inlet and check for oxygen flow. If oxygen escapes replace regulator.
NORMAL PRESSURE INDICATIONS AT ALL ALTITUDES. OXYGEN DOES NOT FLOW AT HIGH ALTITUDES BUT OPERATES NORMALLY ON GROUND	Water in cylinders.	Remove regulators dry system by forcing dry air or nitrogen through cylinders. Replace regulators.
REGULATOR DELIVERS ONLY PURE OXYGEN OR IMPROPER MIXTURE.	Defective regulator.	Replace regulator.
OXYGEN DURATION TOO SHORT	Leak in system.	See paragraphs 2-28 and 2-29 for leakage tests and remedies.

2-31. SERVICING THE OXYGEN SYSTEM.

WARNING

Before filling system, carefully inspect area around filler valve for grease, oil or other flammable matter, as fire or explosion may result when oxygen under pressure comes in contact with oil or grease.

CAUTION

Never fill oxygen system from storage cylinder without a drier and pressure reducing regulator installed on the recharger. Pressure from the recharger must be reduced to the aircraft systems normal operating pressure.

Note

Recharging the cylinders generates heat. After filling, cooling of the cylinders will reduce cylinder pressure and does not necessarily indicate a leak in the system.

a. Open oxygen filler valve door located on the left side of the tail cone.
b. Remove filler valve plug by turning handle one-eighth turn.
c. Turn supply tank regulator handle clockwise until handle turns freely.
d. Open supply tank valves slowly.
e. Turn regulator adjusting screw handle clockwise until delivery pressure gage indicates 150 psi.
f. Open charging valve on supply hose end to blow out any dirt that may have accumulated in the adapter. Close charging valve.
g. Lock adapter into filler valve. Check for security.
h. Open charging valve and allow pressure gage to stabilize then gradually increase delivery pressure until pressure gage in aircraft oxygen regulator reads 425 psi. Then shut off charging valve and remove adapter.
i. Replace dust cap on filler and close filler door.

2-32. MAINTENANCE OF OXYGEN SYSTEM.

a. When oil or grease is found on oxygen equipment, tubing and fittings of the oxygen system they must be removed from the aircraft and replaced with serviceable equipment. Contaminated equipment must be returned to the depot.
b. When the oxygen system has been opened, for replacement of any part of the system, all lines and equipment must be plugged or capped to prevent entrance of moisture or foreign matter. If the system has been accidently left open, the system must be purged by filling with oxygen and emptying at least three times.

WARNING

In no case is it permissable to put cleaning solutions, or any other solution, or to use other gases except oxygen inside any part of the oxygen system while it is installed in the aircraft.

2-33. OXYGEN CYLINDERS. The oxygen is contained in two shatter-proof cylinders located in the tail cone

of the airplane. Access is provided by the aft tunnel door.

2-34. REMOVAL OF OXYGEN CYLINDER. (See figure 2-9.)

a. Discharge pressure by turning regulator shut-off valve "ON" and emergency toggle switch "ON" (position to right or left) until zero psi is indicated on the regulator.

b. Remove aft tunnel door. Make sure there is no grease, oil, water or foreign matter around cylinders and tubing connections.

Note

Provide ample light and assume a position that permits a good view and easy reaching of the oxygen cylinders and related equipment.

c. Disconnect tubing from cylinders. Plug each tube promptly to prevent foreign matter or moisture from entering the tube.

d. Loosen clamps holding cylinders in brackets and remove cylinders.

2-35. MAINTENANCE OF OXYGEN CYLINDERS.

a. Keep stored cylinders dry and protected from direct rays of the sun.

Note

Maintain a minimum of 50 psi of oxygen in cylinders at all times.

b. Do not attempt repair of faulty cylinder.

2-36. INSTALLATION OF OXYGEN CYLINDERS. (See figure 2-9.)

CAUTION

Oxygen cylinders are stored containing at least 50 psi. Exhaust pressure slowly before attempting to install a new cylinder.

a. Position cylinder in mounting brackets and secure with clamps.

b. Make sure there is no grease or oil, water, or foreign matter around cylinder and tubing connections.

c. Unplug and connect tubing to cylinders.

d. Charge oxygen system to 425 psi in accordance with paragraph 2-31.

WARNING

Never fill the oxygen system from storage cylinders without using a drier and pressure reducing regulator on the recharger, since the pressure from the recharger must be reduced to the safe working pressure of the airplane.

2-37. OXYGEN FILLER VALVE. A standard AN type oxygen filler valve is located near the oxygen cylinders just inside the oxygen filler valve door on the left side of the tailcone. A plug with a rubber washer is provided with, and fits into the filler valve to keep it clean when not in use.

2-38. REMOVAL OF OXYGEN FILLER VALVE. (See figure 2-9.)

a. Discharge pressure by turning regulator shut-off valve "ON", and emergency toggle switch "ON" (positioned to right or left) until zero psi is indicated on regulator.

b. Remove the aft tunnel door. Inspect filler valve and connections and remove any grease, oil, dirt or moisture that might be on them.

c. Remove the connections and plug the tube at once to prevent foreign matter and moisture from entering the tube.

d. With an assistant working outside, through the oxygen filler valve door, remove the attaching screws and nuts and remove the valve.

2-39. INSTALLATION OF OXYGEN FILLER VALVE. (See figure 2-9.)

a. Working inside the tail cone and with an assistant working through the oxygen filler valve door, attach filler valve to bracket with screws and nuts.

b. Make sure there is no grease or oil, water or foreign matter around filler valve and tubing connection.

c. Unplug tube connection and connect tube to filler valve.

d. Charge oxygen system to 425 psi in accordance with paragraph 2-31.

2-40. OXYGEN DEMAND REGULATOR. An oxygen demand regulator is mounted on each outboard edge of the instrument panel. The demand regulator is basically a diaphragm-operated flow valve which opens when the user inhales, and closes when he exhales. A combination pressure gage and flow indicator is mounted on the face of the regulator. The flow indicator shows alternate black and white segments in the slots with each breath of the user. The oxygen supply valve, operated by a lever on the bottom of the regulator face, can be turned "ON" and "OFF" to start or stop the flow of oxygen. A diluter lever on the upper right hand corner of the regulator face can be turned to "NORMAL OXYGEN" or "100% OXYGEN". A toggle switch above the oxygen supply valve lever provides for emergency operation or testing the mask. An oxygen system warning light switch on the upper left hand corner of the regulator face is non-operative.

2-41. OPERATION OF THE OXYGEN DEMAND REGULATOR. Each time the user inhales, the pressure is reduced enough to deflect a diaphragm which opens a demand valve to which it is attached. As the demand valve opens, oxygen flows to the mask. As inhalation stops and pressure returns to normal, a spring returns the diaphragm to its original position and the valve is closed. With the diluter lever in the "NORMAL OXYGEN" position, the demand regulator automatically supplies the required amount of oxygen compensating for change in altitude. With the diluter lever in "100% OXYGEN", the operation of the demand regulator remains the same, but the air inlet is closed and the user is supplied with 100% oxygen. Pushing the emergency toggle switch to the right or to the left deflects the diaphragm and permits flow of oxygen without inhalation. Pressing in on the toggle switch deflects the diaphragm farther and allows a greater flow of oxygen until released, when the switch is returned to a neutral position, the diaphragm is released and the continuous flow

of oxygen stops.

2-42. REMOVAL OF THE OXYGEN DEMAND REGULATORS. (See figure 2-9.)

a. Discharge pressure by turning regulator shut-off valve "ON", and emergency toggle switch "ON" (positioned to right or to left) until zero psi is indicated on pressure indicator.

b. Make sure there is no grease or oil, water, or foreign matter around demand regulator or connections.

c. Disconnect, remove, and plug aluminum tubing and regulator-to-mask hose. Also plug openings in demand regulator.

d. Unfasten dzus fasteners and remove demand regulator.

CAUTION

The oxygen demand regulator is a very delicate instrument and must be handled as such. Any oxygen demand regulator that does not operate properly must be replaced without attempting any adjustment or repair.

2-43. INSTALLATION OF OXYGEN DEMAND REGULATOR. (See figure 2-9.)

WARNING

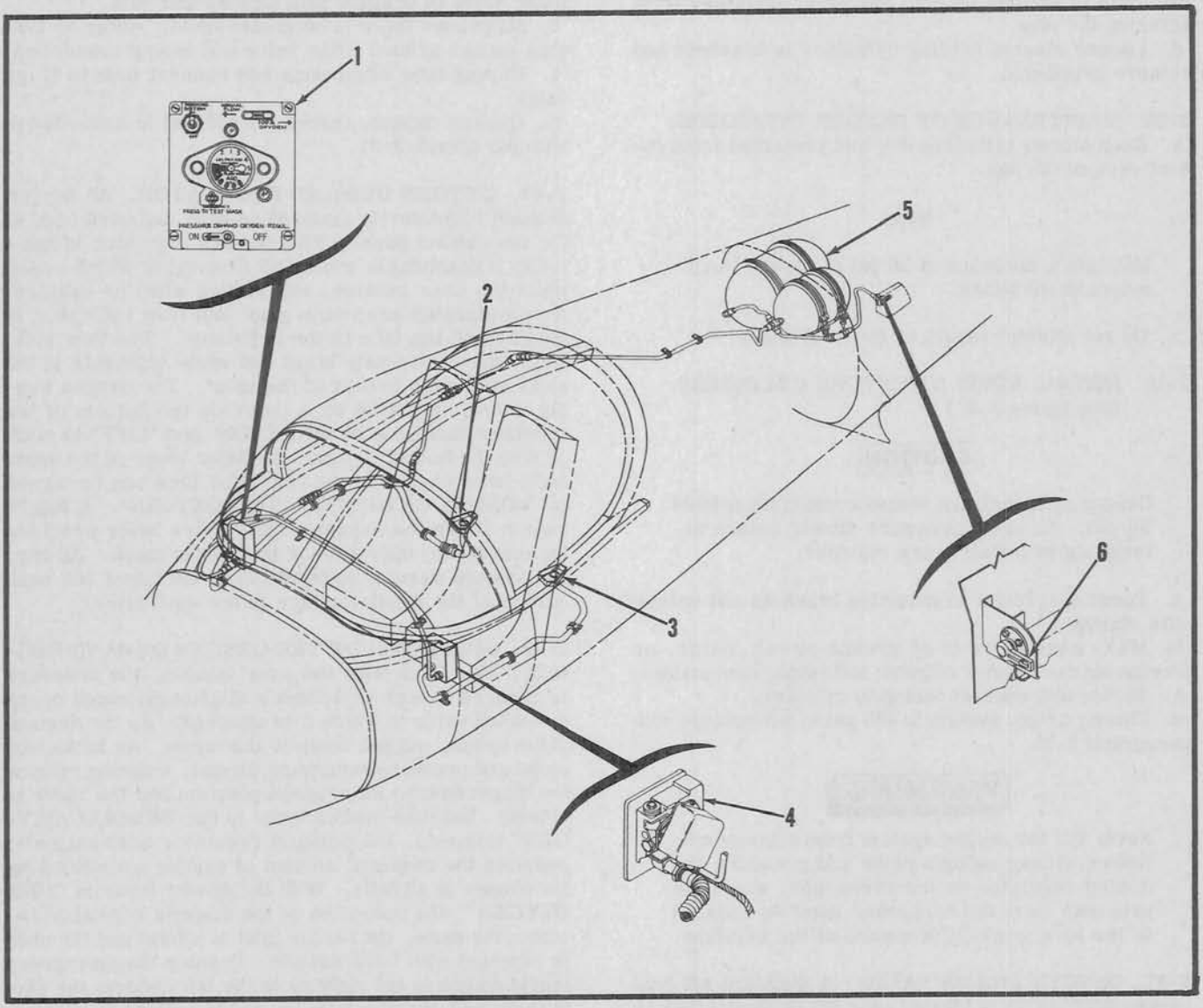
Be sure dust plugs are removed from regulator before oxygen lines are connected to it.

a. Attach demand regulator to bracket with dzus fasteners.

b. Make sure there is no grease or oil, water, or foreign matter around demand regulator or connections.

c. Unplug openings and connect demand regulator with tubing and regulator-to-mask hose.

d. Charge oxygen system to 425 psi in accordance with paragraph 2-31.



1. Instructor's demand regulator
2. Seat quick disconnect
3. Seat quick disconnect
4. Student's demand regulator
5. Oxygen cylinders
6. Filler valve

Figure 2-9. Oxygen System Installation

2-44. FIRE DETECTION AND OVERHEAT SYSTEM.

2-45. GENERAL DESCRIPTION. The fire detection and overheat system gives the pilot a visual indication of fire or excessive temperatures in the engine nacelles. The system is divided into four major circuits with each circuit incorporating a sensing element which is fastened to the various structural components with snap-on mounting brackets. These sensing elements consist of one or more detector cables connected in series by fire-proof connector unions, they pass through the nacelle firewall and connect to one of the four control units located in the left nose compartment. The detector cables located forward of the engine fireseal in each nacelle are referred to as the left or right fire elements and the detector cables located aft of the fireseal are referred to as the right or left overheat elements. There are two fuel shut off tee handles located on the instrument panel, each of which contains a warning light which glows red when the fire element of the system is heated and flashes off and on when the overheat element is heated. Overheat and fire test switches are included in the system to provide a quick check of cable continuity and operation of all other system components. The fire detect test switch is located to the left of the fuel shut off tee handles on the shock mounted instrument panel and the overheat test switch is located to the right.

2-46. OPERATION. The fire detect portion of the fire detection and overheat system uses a sensing element which is rated at 149°C (300°F) alarm temperature for 50 feet of cable while the overheat portion of the system uses a sensing element which is rated at 282°C (540°F) for 50 feet of cable. This difference in temperature response is due to the location of the sensing elements. The overheat elements being located in the high temperature area of the nacelle are subjected to higher temperatures normally than the fire detect elements. When an overheat condition occurs aft of the engine fireseal the semi-conductor compound in the sensing element looses its resistance, completing the circuit from the center wire of the cable to the ground outer tube. This unbalances one arm of a wheatstone bridge circuit incorporated in the control unit, actuating a sensitive control relay which in turn closes a slave relay completing the circuit to the warning light in the fuel shut off tee handle. A flasher unit incorporated in the overheat portion of the system distinguishes the overheat signal from the fire detect signal at the fuel shut off tee handle.

Note

A flashing red light in the right or left fuel shut off tee handle indicates an overheat condition aft of the engine fireseal in the respective engine nacelle. A steady red light in the right or left fuel shut off tee handle indicates a fire forward of the engine fireseal in the respective engine nacelle.

When the overheat condition is corrected or the fire is extinguished, the resistance of the semi-conductor compound stabilizes again at near-inifinity, turning off the alarm signal. The system is then automatically ready to repeat its operation. Two test switches located on either side of the fuel shut off tee handles, are provided to check continuity and operation of the components of either the overheat or fire detect portion of the system.

2-47. TROUBLE SHOOTING OF FIRE DETECTION AND OVERHEAT SYSTEM.

TROUBLE	PROBABLE CAUSE	REMEDY
RIGHT OR LEFT FUEL SHUT OFF TEE HANDLE FLASHES CONSTANTLY WITH NO HEAT APPLIED TO SENSING ELEMENT	Short in overheat portion of system.	Isolate each length of detector cable, in the right or left nacelle aft of the fireseal, separately. Test continuity between the outer tube and the center wire of each cable. Remove and replace any shorted or broken cables.
	Defective overheat test switch.	Replace test switch.
	Overheat control unit out of adjustment.	Replace control unit.
RIGHT OR LEFT FUEL SHUT OFF TEE HANDLE LIGHTS CONSTANTLY WHEN THERE IS HEAT APPLIED TO SENSING ELEMENT	Short in fire detect portion of system.	In the right or left engine nacelle as the case may be isolate each length of detector cable separately. Test continuity between the outer tube and the center wire of each cable. Remove and replace any shorted or broken cables.
	Defective fire detect test switch.	Replace test switch.
	Fire detect control unit out of adjustment.	Replace control unit.

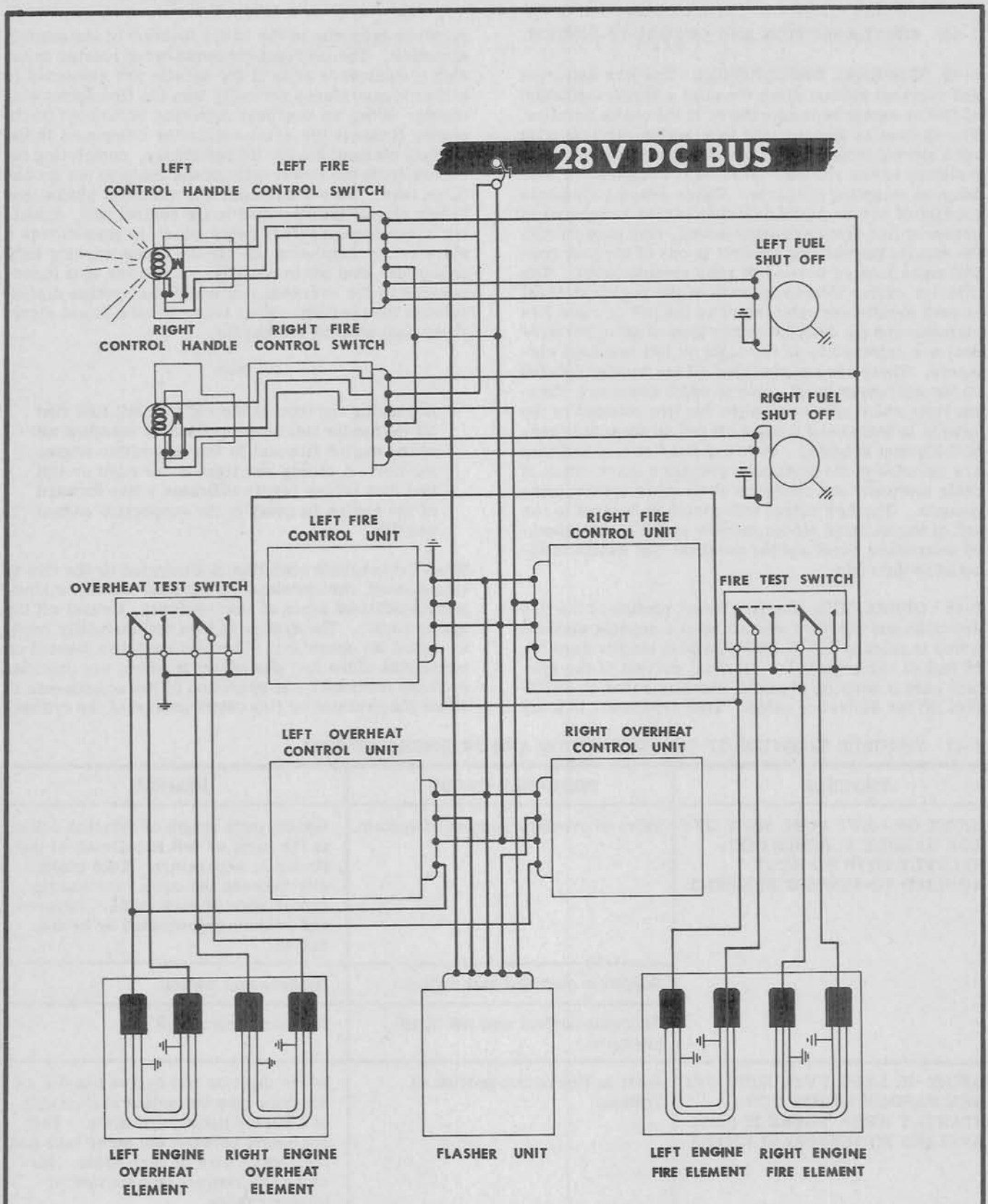
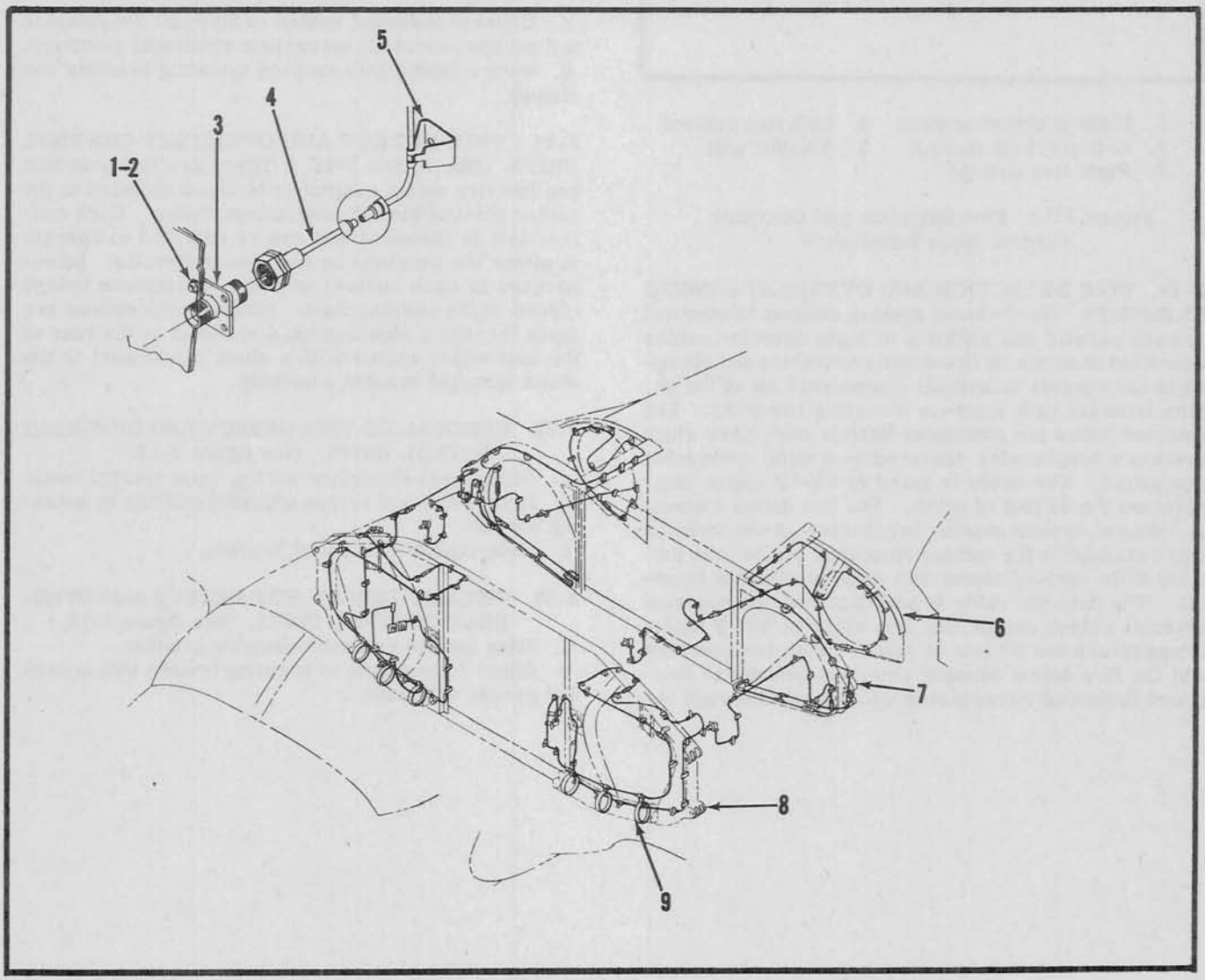


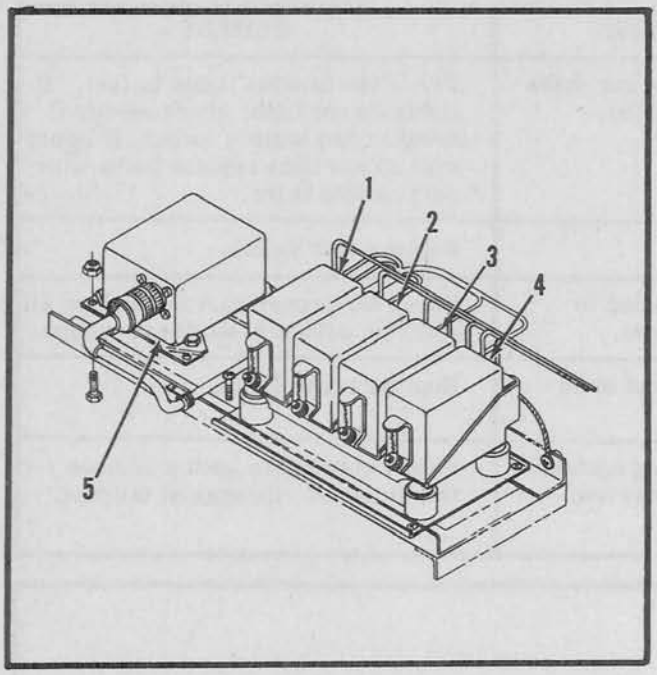
Figure 2-10. Fire Detection and Overheat System Schematic

TROUBLE	PROBABLE CAUSE	REMEDY
SYSTEM DOES NOT OPERATE WHEN EITHER TEST SWITCH IS ACTUATED	No DC power or burned out bulbs in fuel shut off tee handles.	Press tee handles lights to test. If lights do not light, check circuit breaker and battery switch. If lights still do not light replace bulbs with serviceable bulbs.
	Defective test switch.	Replace test switch.
OVERHEAT CIRCUIT GIVES FALSE ALARMS ON ENGINE START	Fire detect cable installed in overheat sensing element.	Check for proper part number on all detector cables in overheat system.
	Overheat control unit out of adjustment.	Replace control unit.
	Sensing element rubbing against engine tailpipe on turbine section.	Install element in such a manner that it cannot rub against tailpipe.



1. Screw
2. Nut
3. Connector
4. Cable
5. Mounting clamp
6. Bulkhead
7. Fuselage rear spar
8. Fuselage front spar
9. Fuel interconnect hose

Figure 2-11. Fire Detection and Overheat System Installation



1. Right overheat control
2. Left overheat control
3. Right fire control
4. Left fire control
5. Flasher unit

Figure 2-12. Fire Detection and Overheat Control Units Installation

2-48. FIRE DETECTION AND OVERHEAT SENSING ELEMENTS. The overheat sensing element is identical in each nacelle and consists of eight detector cables connected in series by fire-proof receptacles and clamped to the various structural components aft of the engine fireseal with snap-on mounting brackets. The detector cables are continuous flexible steel tubes which contain a single wire centered in a semi-conductor compound. The cable is rated at 300° F alarm temperature for 50 feet of cable. The fire detect element is identical in each nacelle and consists of one detector cable clamped to the various structural components forward of the engine fireseal with snap-on mounting brackets. The detector cable is identical with the overheat detector cables except that it is rated at 540° F alarm temperature for 50 feet of cable. Both the overheat and the fire detect sensing elements connect to fireproof bulkhead receptacles which pass through the nacelle firewall connecting to an electrical lead on the opposite side of the firewall.

2-49. REMOVAL OF FIRE DETECTION AND OVERHEAT SENSING ELEMENTS. (See figure 2-11.)
a. Disconnect sensing element at all receptacles.
b. Remove all clamps from detector cables.
c. Unsnap snap-on mounting brackets from detector cables and remove cables from aircraft.

2-50. INSTALLATION OF FIRE DETECTION AND OVERHEAT SENSING ELEMENTS. (See figure 2-11.)

CAUTION

Check part numbers carefully when installing detector cables. Installation of a fire detect cable aft of the engine fireseal will result in false alarms.

a. Connect detector cables to firewall receptacles and position correctly on various structural members.
b. Secure cables with snap-on mounting brackets and clamps.

2-51. FIRE DETECT AND OVERHEAT CONTROL UNITS. (See figure 2-12.) There are two overheat and two fire detect control units shock mounted to the center shelf of the left nose compartment. Each control unit is identical and can be adjusted to operate in either the overheat on fire detect circuits. Incorporated in each control unit is a wheatstone bridge circuit to the warning light. External connections are made through a single quick disconnect at the rear of the unit which mates with a quick disconnect in the shock mounted bracket assembly.

2-52. REMOVAL OF FIRE DETECT AND OVERHEAT CONTROL UNITS. (See figure 2-12.)
a. Disconnect electrical wiring from control units.
b. Remove nuts and screws attaching controls to mounting bracket.
c. Slide control unit out of bracket.

2-53. INSTALLATION OF FIRE DETECT AND OVERHEAT CONTROL UNITS. (See figure 1-12.)
a. Slide control unit into mounting bracket.
b. Attach control units to mounting bracket with screws and secure with nuts.

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T.O. NO. 1T-37A-2-4

HANDBOOK

MAINTENANCE INSTRUCTIONS

FLIGHT CONTROL SYSTEMS

USAF SERIES

T-37A

AIRCRAFT

THIS PUBLICATION REPLACES T.O. No. 1T-37A-2-4 DATED 28 FEBRUARY 1956

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE

30 NOVEMBER 1956

McCORMICK-ARMSTRONG, WICHITA, 1777, 1-23-57

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LIST OF EFFECTIVE PAGES

This publication consists of the following pages:

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i	**30 November 1956**
ii	**30 November 1956**
1-1 thru 1-22 .	**30 November 1956**
2-1 thru 2-16 .	**30 November 1956**
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FLIGHT CONTROL SYSTEMS

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INTRODUCTION

The maintenance technical order for the T-37A aircraft is divided into a series of separate handbooks. This handbook, T.O. No. 1T-37A-2-4, Flight Control Systems, contains instructions to be followed by line maintenance personnel in the maintenance and servicing of flight control systems of the aircraft. This includes information on operational checking, removal, installation, adjusting and rigging of the various systems and components. Illustrations are provided to supplement the text and to aid in the various maintenance procedures. Following is a list of the other handbooks in the T.O. No. 1T-37A-2 Maintenance Technical Order series:

T.O. No. 1T-37A-2-1	General Airplane
T.O. No. 1T-37A-2-2	Ground Handling, Servicing and Airframe Group Maintenance
T.O. No. 1T-37A-2-3	Hydraulically Operated Systems and Utility Systems
T.O. No. 1T-37A-2-5	Power Plant, Fuel System and Oil System
T.O. No. 1T-37A-2-6	Instruments, Radio, Communication and Navigation Equipment
T.O. No. 1T-37A-2-7	Electrical System
T.O. No. 1T-37A-2-8	Wiring Diagrams and Data

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PRIMARY FLIGHT CONTROL SYSTEMS

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1-1. PRIMARY FLIGHT CONTROL SYSTEMS.

1-2. GENERAL DESCRIPTION. The flight control system includes both primary and secondary control surfaces. The primary control surfaces consist of the ailerons, elevator and rudder and are operated from the cockpit by conventional dual control sticks and rudder pedals. Secondary control surfaces comprise a trim tab on one aileron, on the elevator and on the rudder. All trim tabs are electrically operated. Combined aileron and elevator trim tab switches are located on the top of each control stick hand grip. The rudder trim tab switch is located on the student's control quadrant.

1-3. CABLE TENSIOMETER. Reliable and accurate readings of cable tension require careful use of the tensiometer.

Note

The dial reading of a tensiometer may not be a true reading and a correction may be necessary. Therefore, observe any correction tables or tags that may be in the box or attached to instrument.

Control surfaces must be in the neutral position when the cable tension is being checked. In placing the instrument on the cable, the cable must be lying against the back of the instrument when pressure is applied, so that no extra pull is applied to the cable. When taking tensiometer readings where it is necessary to use the lock to hold the reading, do not snap the instrument off of the cable but remove it carefully while the reading is locked. Also, avoid pushing or pulling at the tensiometer or cable while a reading is being noted.

1-4. CABLE TENSION. Heat and cold have a direct effect on the tension of the cable system, so the following precautions should be observed:

a. Whenever possible, rigging should be done in a well shaded area such as a hangar.

b. Before rigging, allow the airplane to remain in a constant temperature area long enough to permit structure to adjust to atmospheric temperature.

c. Always rig as close to the center of tolerance as possible.

d. If the airplane must be rigged in the sun, position the airplane so that it will either face directly into or away from the sun.

1-5. SAFETYING CABLE TURNBUCKLES. Whenever turnbuckles have to be unsaftied to loosen or tighten the tension on the cables, resafety after tension has been corrected. After making turnbuckle adjustments check to see that approximately the same number of threads show from either end of the turnbuckle barrel and that no more than three threads on either terminal are showing.

1-6. AILERON SYSTEM.

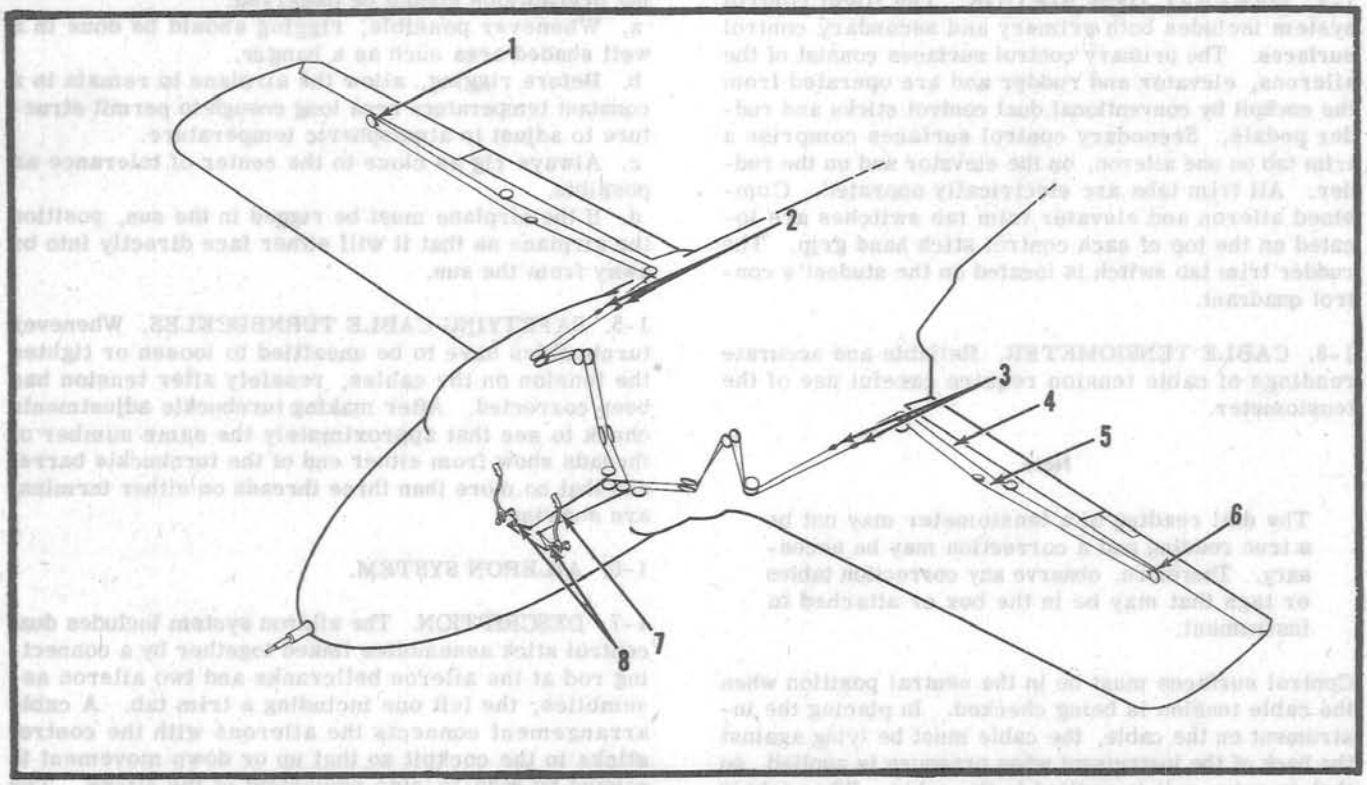
1-7. DESCRIPTION. The aileron system includes dual control stick assemblies linked together by a connecting rod at the aileron bellcranks and two aileron assemblies, the left one including a trim tab. A cable arrangement connects the ailerons with the control sticks in the cockpit so that up or down movement is caused by side-to-side movement of the sticks. The trim tab is electrically operated and is controlled from push buttons on the control stick grips.

1-8. FUNCTIONAL DESCRIPTION. The two control sticks are interlocked so that a force in any direction

on either stick will result in the same movement by both. Side-to-side stick movement results in up or down angular travel of the ailerons, the action being transmitted through bellcranks and cables to wing quadrants mounted on the wing rear spars. The aileron movement is produced by the action of these quadrants on the aileron actuating arms. The ailerons provide a means of rotating the airplane about its longitudinal axis. Both ailerons have a maximum angular travel of 15 degrees up or down from their neutral position. Each has three hinge brackets which mate with support brackets located on the trailing edges of the wings. The aileron trim tab, located on the left aileron, is controlled by either of two, four position momentary aileron and rudder trim tab switches, one switch being on the grip of each control stick.

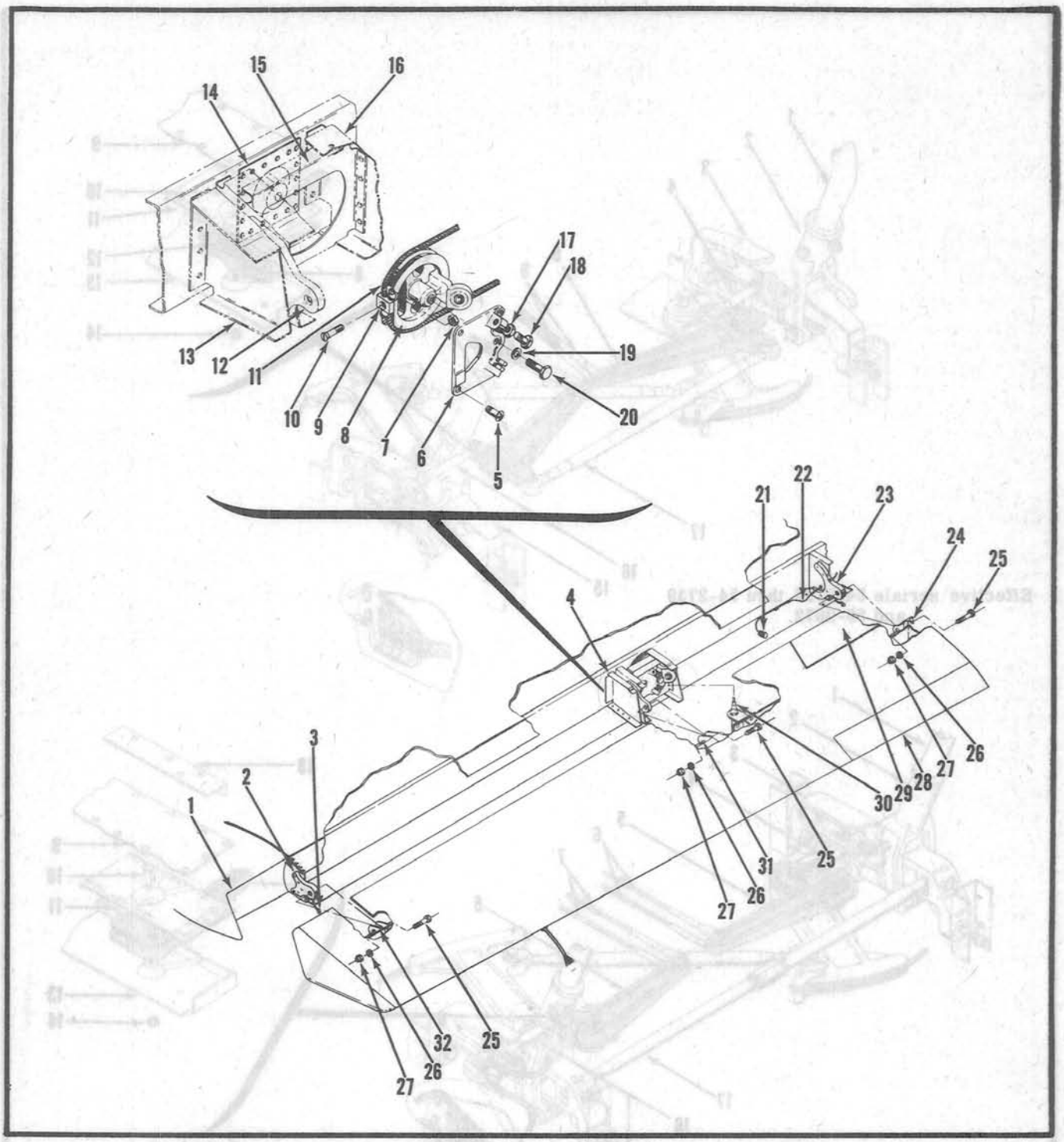
1-9. TROUBLE SHOOTING THE AILERON SYSTEM.

TROUBLE	PROBABLE CAUSE	REMEDY
AILERONS ARE NOT IN THE NEUTRAL STREAMILNE POSITION WHEN STICKS ARE IN NEUTRAL CENTER	Aileron cable system is not rigged properly.	Rig aileron cable system. See paragraph 1-18.
IMPROPER AILERON SURFACE TRAVEL	Aileron travel limit stops not adjusted properly.	Adjust travel limit stops. See paragraph 1-19.
STICK MOVEMENT NOT SMOOTH, OR EXCESSIVE STICK FORCES REQUIRED TO MOVE CONTROLS	Binding in cable system.	Check cable tension. Check all aileron pulleys, brackets, bellcranks, quadrants and cables for malfunction or mechanical defects.
INSUFFICIENT CLEARANCE AROUND AILERON	Improperly repaired aileron or wing.	Increase clearance by filing or grinding surrounding parts, not the aileron. See figure 1-6.
EXCESSIVE CLEARANCE AROUND AILERON	Damaged or improperly repaired aileron or wing.	Repair or replace aileron or wing. See figure 1-6.



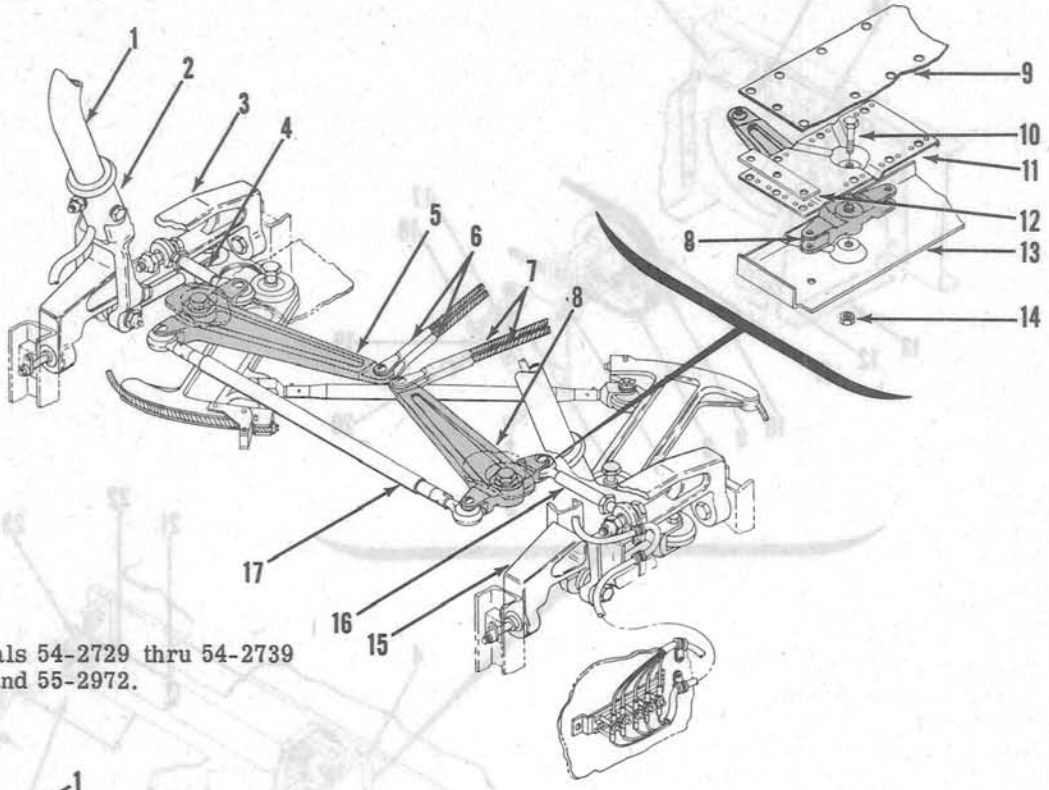
1. Wing quadrant
2. Turnbuckle
3. Turnbuckle
4. Aileron up cable
5. Aileron down cable
6. Wing quadrant
7. Control stick
8. Bellcrank

Figure 1-1. Aileron Control System

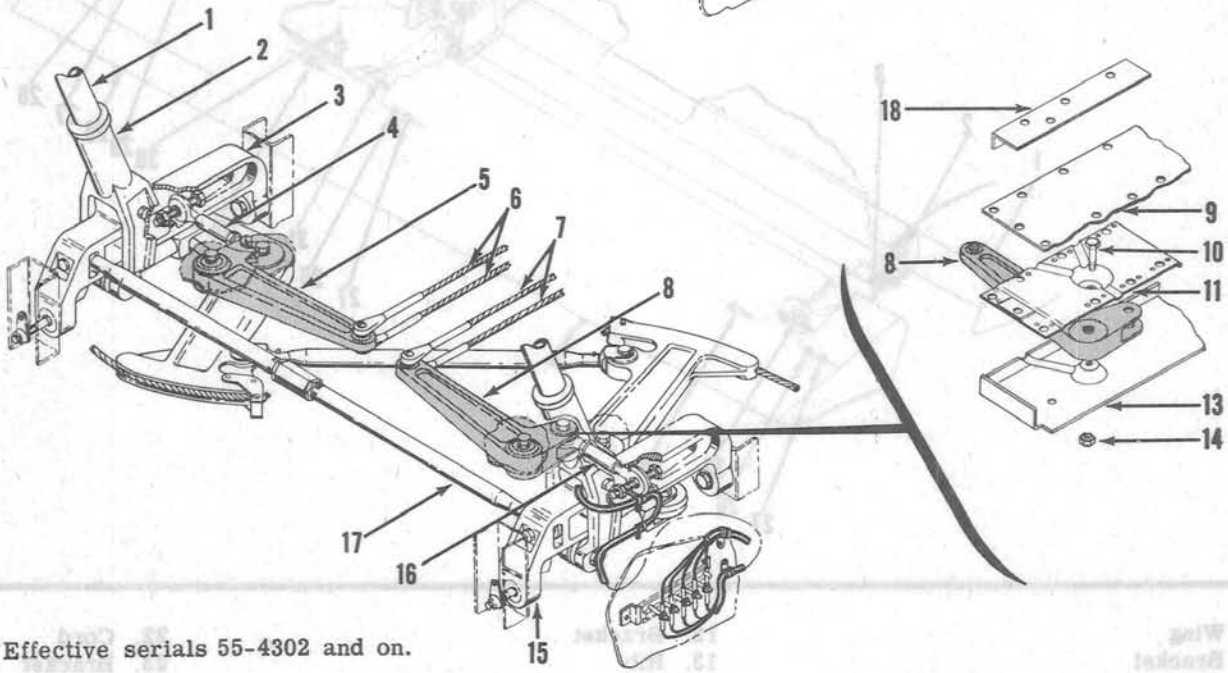


1. Wing
2. Bracket
3. Jumper
4. Rib
5. Screw
6. Bracket
7. Nut
8. Quadrant
9. Retainer
10. Bolt
11. Cable
12. Bracket
13. Rib
14. Bracket, forward
15. Bracket, aft
16. Rib
17. Nut
18. Bolt
19. Washer
20. Bolt
21. Connector
22. Cord
23. Bracket
24. Bracket
25. Bolt
26. Washer
27. Nut
28. Tab
29. Cover
30. Actuating arm
31. Bracket
32. Bracket

Figure 1-2. Aileron Installation



Effective serials 54-2729 thru 54-2739 and 55-2972.



Effective serials 55-4302 and on.

1. Control stick
2. Stick socket
3. Yoke
4. Push-pull rod
5. Aileron bellcrank
6. Aileron cable
7. Aileron cable
8. Aileron bellcrank
9. Cover
10. Bolt
11. Plate assembly
12. Filler
13. Lower plate
14. Nut
15. Yoke
16. Push-pull rod
17. Connecting rod
18. Angle

Figure 1-3. Aileron Bellcrank Installation

Table I. Settings and Range of Movement of Primary Flight Control Surfaces

Control Surfaces	Degree from Rigged Neutral	Inches	Reference Point	Tolerances	
				Degrees	Inches
Ailerons - up	15	2.92	T.E. at Inboard end	+1° -0°	0.19
Ailerons - down	15	2.92	T.E. at Inboard end	+1° -0°	0.19
Elevator - up	26	6.03	T.E. at Inboard end	+1° -0°	0.23
Elevator - down	15	3.50	T.E. at Inboard end	+1° -0°	0.23
Rudder - right	25	7.72	T.E. at Bottom end	+30' -30'	0.16
Rudder - left	25	7.72	T.E. at Bottom end	+30' -30'	0.16
Vertical stabilizer offset (measured from fuselage centerline) ------0°					

1-10. REMOVAL OF AILERONS. (See figure 1-2.)

a. Remove access doors marked No. 41 and No. 43.

Note

Step b applies only to the left aileron.

b. Deflect the aileron up and disconnect wiring connector (21) at actuator.

c. Remove nuts and screws which hold flexible jumpers to the aileron.

d. Remove nuts (27) and washers (26). Support aileron while bolts (25) which attach aileron hinge brackets (32), (31) and (24) to wing brackets (2), (12) and (23) are removed. Carefully move aileron down and aft from the wing.

1-11. INSTALLATION OF AILERONS. (See figure 1-2.)

a. Support aileron at both ends and bring the hinge brackets into place on the wing, making certain that the aileron actuating arm (30) is fitted properly into the wing quadrant arm (8).

b. Attach aileron temporarily with bolts (25) through the hinge brackets. Move aileron up and down and check for clearances. See paragraph 1-9, Trouble Shooting The Aileron System.

c. After correct tolerances are assured place washers (26) and nuts (27) on bolts at all the hinge brackets and tighten.

d. Attach jumpers to aileron with screws and secure with nuts.

Note

Step e applies only to the left aileron.

e. Deflect aileron up and connect electric wiring to actuator motor.

f. Close access doors No. 41 and No. 43 and fasten.

g. Operate aileron through its complete cycle, checking for full travel distance and freedom from interference.

1-12. REMOVAL OF AILERON BELLCRANK. (See figure 1-3.)

a. Remove wing-to-nacelle gap access cover No. 34.

b. Remove safety wires from aileron control cable turnbuckles and relieve tension on the cables.

c. Remove tunnel access doors No. 4 and No. 5.

d. Remove nuts and bolts attaching cables (6) and (7) to bellcranks (5) and (8).

Note

Tag cables before removing to facilitate reinstalling in proper locations.

e. In the cockpit, remove screws and retaining strip that hold fume boot to the floorboard cover plate.

f. Loosen clamps at tops of fume boot and slip boot up on control stick.

g. Remove screws from floorboard cover plate (9), marked No. 19, which surrounds the control stick and remove plate.

h. Remove nuts (14) and bolts (10) which hold aileron bellcrank (5) and (8) in place.

i. Remove screws which hold plate (11) in place.

j. Remove screws which hold angle (18) to tunnel wall cap.

k. On aircraft serial numbers 54-2729 through 54-2739 and 55-2792, remove nuts and bolts attaching connecting rod (17) to aileron bellcranks.

l. Remove angle (18), plate (11) and bellcranks from airplane.

1-13. INSTALLATION OF AILERON BELLCRANK. (See figures 1-3. and 1-4.)

a. Insert bellcranks into position through tunnel wall, fit plate (11) in place and loosely attach both to bottom plate (13) with bolt (10) and nut (14).

b. Fit angle (18) in place and attach tightly with screws inserted from inside the tunnel (on airplanes serials 55-4302 and on).

c. On airplanes serial numbers 54-2729 through 54-2739 and 55-2792, attach connecting rod (17) to bellcranks (5) and (8) with bolts and nuts.

d. Tighten screws which hold plate (11). Tighten nut (14).

e. Install cover plate (9) and attach with screws.

f. Lower the fume boot and attach by use of retainer ring and screws. Tighten clamp at top.

1-14. REMOVAL OF AILERON WING QUADRANT. (See figure 1-2.)

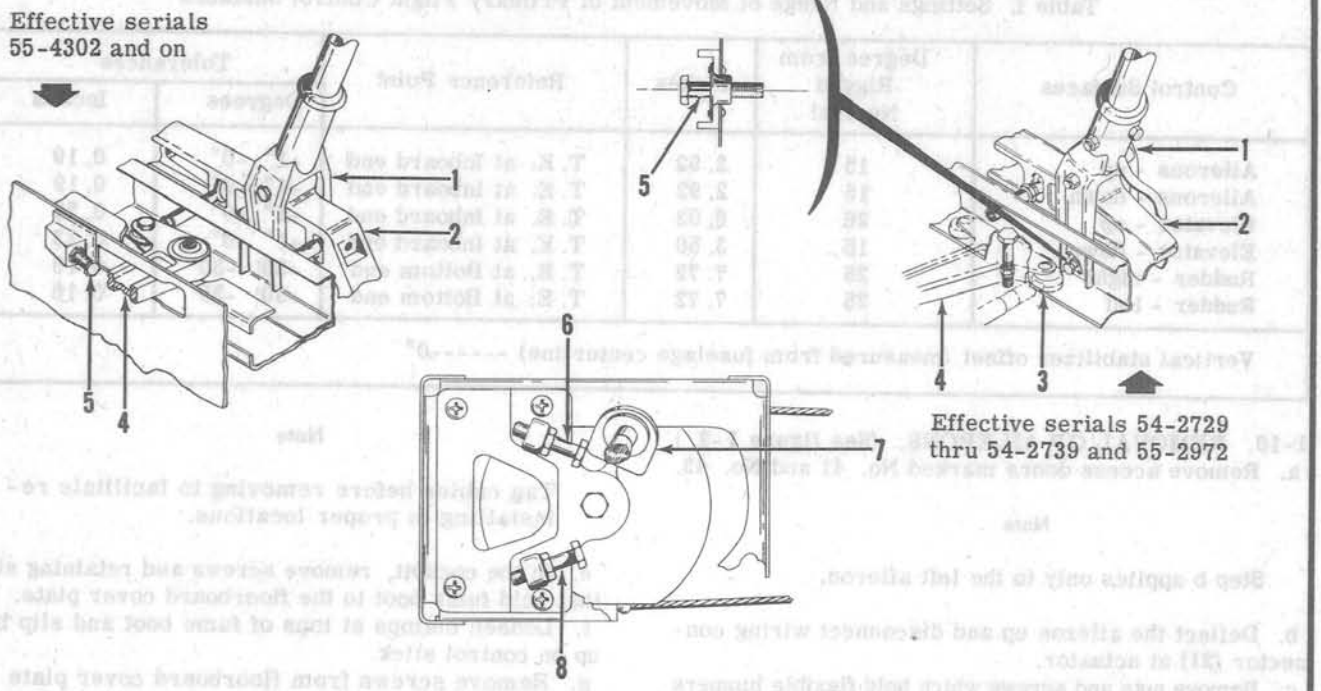
a. Remove aileron from wing in accordance with paragraph 1-10.

b. Remove wing gap cover No. 34.

c. Remove safety wires from control cable turnbuckles in wing gaps and relieve tension in cables.

d. Remove screws attaching bracket (6) to wing structure.

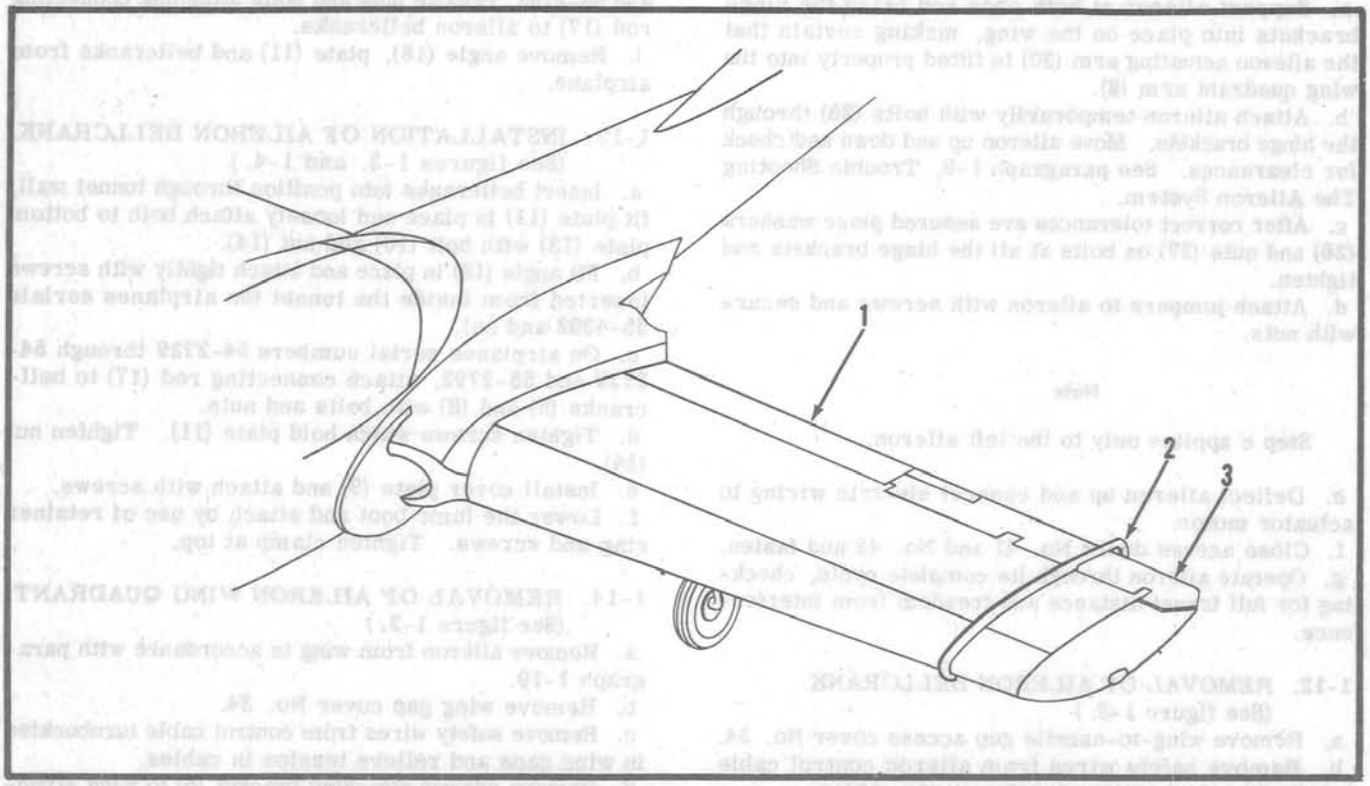
e. Remove bolt (20) and washer (19) attaching bracket (6) to quadrant (8) and support (14).



WING QUADRANT TRAVEL STOPS

1. Stick socket
2. Yoke
3. Connecting rod
4. Aileron bellcrank
5. Bellcrank travel stop
6. Wing quadrant travel stop
7. Quadrant
8. Wing quadrant travel stop

Figure 1-4. Aileron Travel Stops



1. Wing flap
2. Sickle gage
3. Aileron

Figure 1-5. Aileron Rigging

f. Remove nut and bolt attaching cable retainer (9) to quadrant and remove cables from quadrant.
g. Remove quadrant from airplane.

1-15. INSTALLATION OF AILERON WING QUADRANT. (See figure 1-2.)

a. Connect aileron control cables to quadrant (8) using cable retainer bolt (10) and nut (7).
b. Attach removable bracket (6) and quadrant (8) to support (14) with washer (19) and bolt (20).
c. Secure removable bracket (6) with screws (5).
d. Connect aileron control cables with turnbuckles, tension properly and apply safety wires.
e. Install aileron on wing in accordance with paragraph 1-11.
f. Operate aileron through several complete cycles and observe for freedom of movement, and that aileron travel to the full up and down position is complete and without structural interference.
g. Install cover No. 34.
h. Adjust aileron travel in accordance with paragraph 1-19.

1-16. REMOVAL OF AILERON WING QUADRANT SUPPORT. (See figure 1-2.)

a. Remove aileron (paragraph 1-10). Remove cover marked No. 34 and relax cable tension at turnbuckles.
b. Detach removable bracket (6) by removing screws (5), bolt (20) and washer (19).
c. Detach cables (11) from wing quadrant (8) by removing nut (7) and bolt (10) from cable retainer (9). Remove quadrant.
d. Using a drill and 1/8 inch drill bit, drill rivets holding aft support bracket (15) to ribs. Remove.
e. Drill out rivets holding forward aileron actuator support (14) assembly to the wing spar and remove from wing.

1-17. INSTALLATION OF AILERON WING QUADRANT SUPPORT. (See figure 1-2.)

a. Install forward aileron actuator support assembly (14) by riveting it in place on the rear wing spar web.
b. Attach aft bracket (15) by riveting it to ribs.
c. Attach cables (11) to quadrant (8) using retainer (9), bolt (10) and nut (7).
d. Fit quadrant in place, cover with removable bracket (6) and fasten both to support with washer (19) and bolt (20).
e. Fasten removable bracket (6) in place with screws (5).
f. Tighten cables and check for correct quadrant travel.
g. Install aileron and check operation.

1-18. ADJUSTMENT AND RIGGING OF AILERON CONTROLS.

1-19. ADJUSTMENT OF AILERON TRAVEL STOPS. (See figures 1-4 and 1-5.)

a. Lock control sticks in neutral position with gust lock. Ailerons should be in neutral position.
b. To attach aileron sickle gage, remove two screws at next rib inboard of wing tip rib, to match sickle gage clips. Fasten with screws so that gage is located just outboard at the rib and is perpendicular to aileron hinge line.
c. Omit the next steps (1 and 2) if sickle gage shows the aileron to be in the neutral position.
1. Adjust cable turnbuckles until aileron is in the neutral position.
2. When loosening or tightening turnbuckles refer to safetying instructions, paragraph 1-5.
d. Move aileron through a complete cycle noting limits of travel in both UP and DOWN positions.

Note

For correct travel from neutral to full UP and DOWN positions, see Table I "Setting and Range of Movement of Primary Control Surfaces".

e. If adjustment is required remove access doors No. 41 and No. 43. See figure 1-4. Increase stop clearance by loosening lock nuts and turning bolts (6) and (8) as required.

Note

Before adjusting the wing quadrant travel stops, increase the amount of clearance at the controls travel stops which limit the travel of the aileron bellcrank located beneath the cockpit floor. See figure 1-4.

Note

Step f with substeps 1 and 2, and steps g and h apply only to airplanes serial 54-2729 through 54-2739 and 55-2972.

f. To reach the beneath-cockpit aileron bellcrank travel stops:
1. Remove screws and fume boot retaining strip, loosen clamp around control stick and slide fume boot upward on the stick.
2. Remove screws from No. 19 and remove plate.
g. The threaded and slotted end of the control travel stop bolt will be seen outboard and forward of the yoke.
h. To increase stop clearance, loosen lock nut on bolt and, using a screwdriver in the bolt slot, turn the bolt counter-clockwise. To decrease clearance, or shorten the aileron travel, turn the bolt clockwise. Adjust until ailerons will travel to correct limits then set bolts for an additional 1/16 inch of clearance between bellcrank and stop bolt. Tighten lock nut.

Note

Step i applies only to aircraft serial numbers 55-4302 and on.

i. To reach the beneath-cockpit aileron bellcrank travel stops, remove tunnel door marked No. 5.
j. The stop bolt will be seen protruding from a lug attached to the tunnel wall just aft of the aileron bellcrank.
k. To increase clearance between stop bolt and aileron bellcrank or to increase aileron travel, loosen lock nut on the stop bolt and turn bolt clockwise. To decrease clearance or shorten the aileron travel, turn the bolt counter-clockwise. Adjust until aileron will travel to the correct limits then set the stop bolt to provide an additional 1/16 inch clearance between bolt head and bellcrank. Tighten lock nut against the bolt lug and re-check clearance.

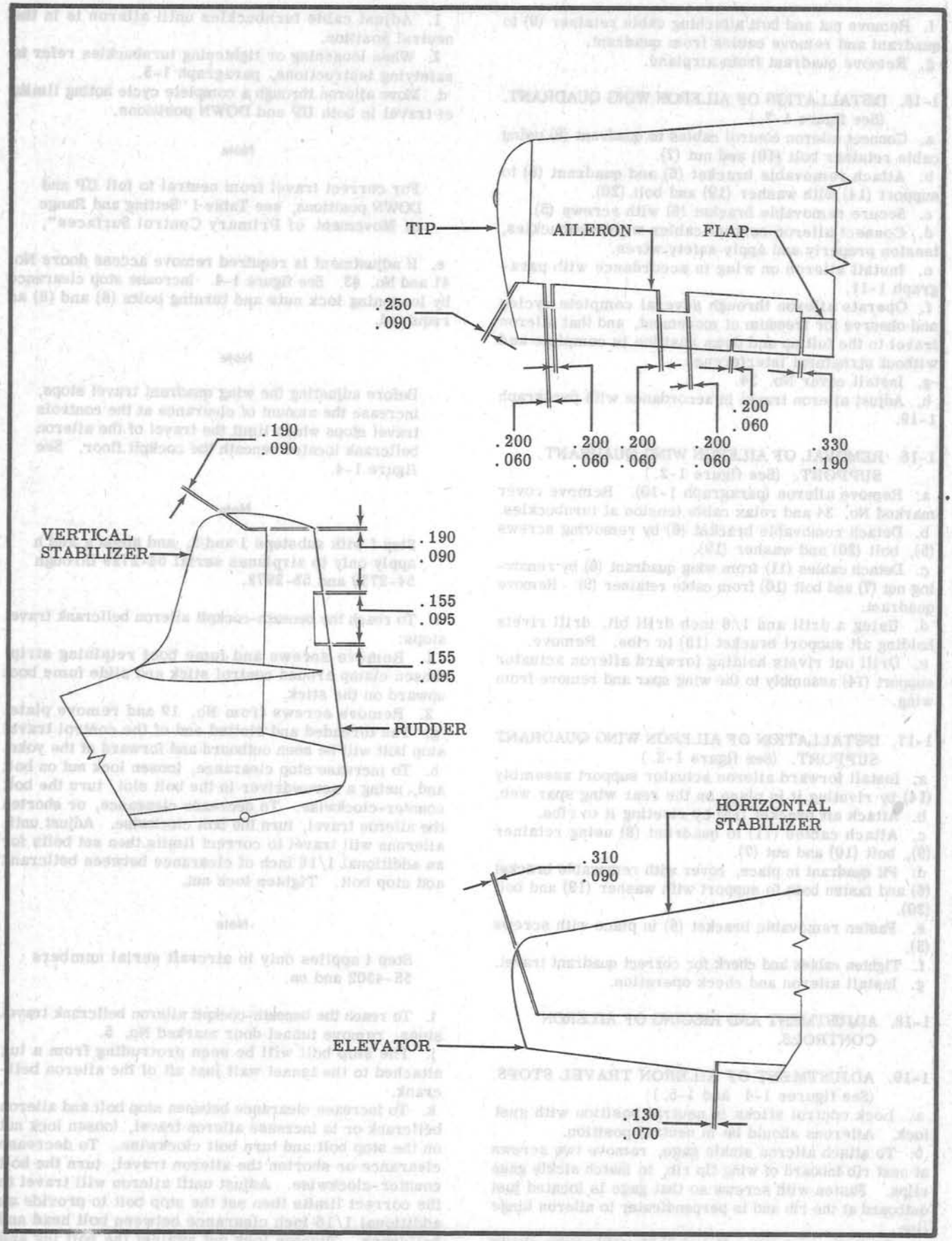


Figure 1-6. Primary Control Surface Clearances

Note

The following instructions apply to all aircraft.

l. Adjust wing quadrant travel stop bolts until both ailerons have the required travel. Lock the bolt settings with the lock nuts.

m. Perform an operational check of the aileron system by moving the control sticks from side to side, noting freedom of movement and limits of travel of the ailerons.

n. Re-install all parts and covers removed to accomplish the preceeding adjustments.

1-20. AILERON CABLES. Stranded, carbon steel cables 1/8 inch diameter and clad with aluminum sheathing between pulleys, connect the cockpit controls with the ailerons. The cables are routed through the lower forward section of the fuselage to the forward section of the nacelles. From there they pass aft along the wing gap, then outboard along the wing rear spar and attach to the wing aileron quadrants. Each cable is in two sections, the fuselage and wing sections meeting at turnbuckles in the wing gap area. The turnbuckles permit tension adjustment. Correct cable tension is 35 ±5 pounds at 24°C (75°F) for aileron cables.

1-21. REMOVAL OF AILERON CABLES. (See figure 1-1.)

a. Remove ailerons (see paragraph 1-10). Remove flaps.

b. Remove access doors No. 5, 33, 34, 35, 36, 48, 49, 50, 51 and 52.

c. Remove safety wires from turnbuckles and separate the cable sections from each other at the turnbuckles.

d. Remove retainer pins and blocks holding cables to quadrants.

e. Unbolt and remove pulleys at inboard end of wing rear spar.

f. Remove cables. Tag each cable to insure its return to original location.

1-22. INSTALLATION OF AILERON CABLES. (See figure 1-1.)

a. Thread cables through openings in structure and past all pulley locations.

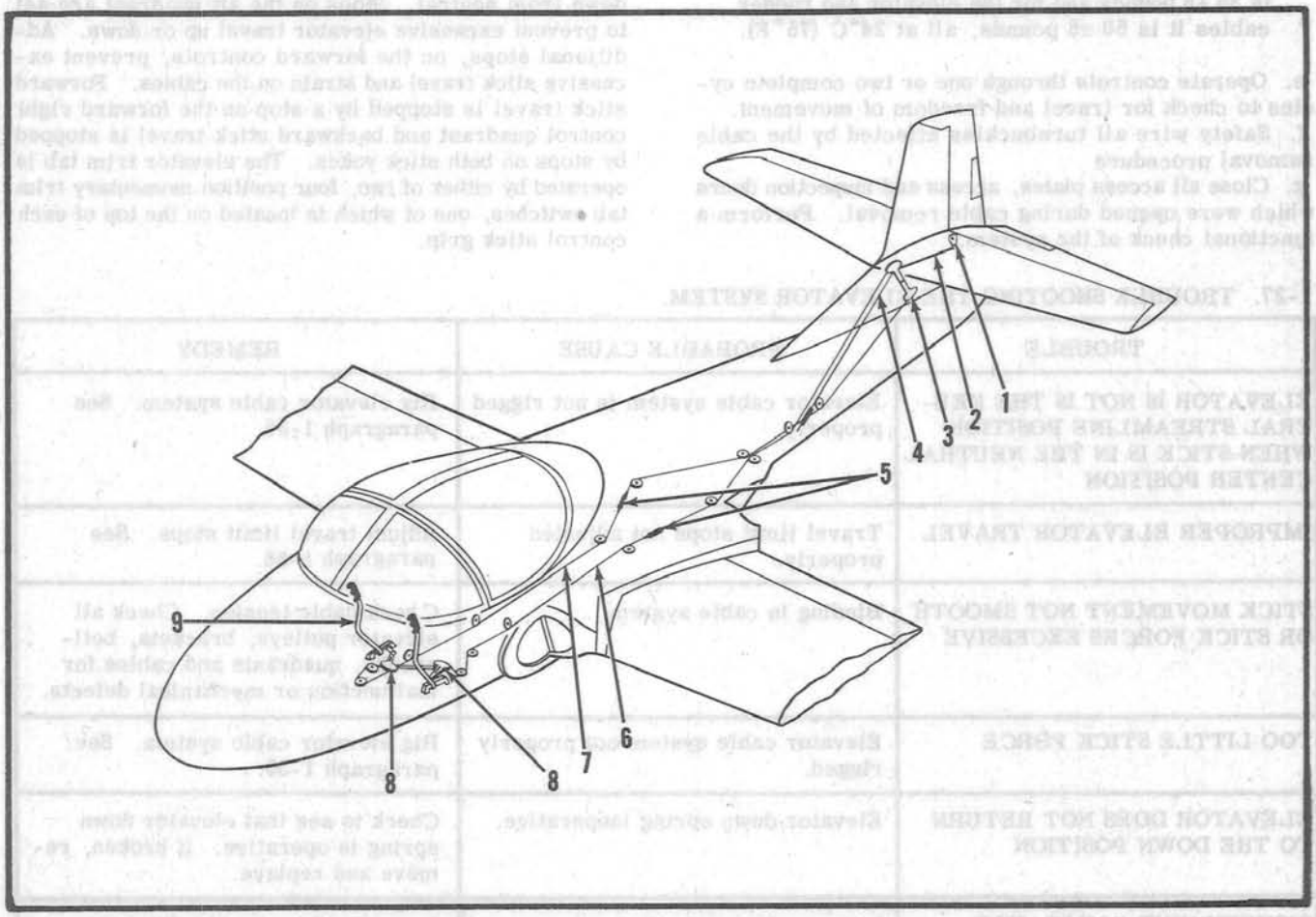
b. Bolt pulleys in place at inboard end of rear spar.

c. Attach cables to quadrants by use of pins and retainer blocks.

d. Attach cable sections at turnbuckles, adjust and check tension. Safety wire all turnbuckles.

e. Install all access doors and panels.

f. Install flaps and ailerons.



1. Horn
2. Push-pull rod
3. Elevator aft quadrant
4. Elevator down-spring cable
5. Turnbuckle
6. Elevator "up" cable
7. Elevator "down" cable
8. Elevator forward quadrant
9. Control stick

Figure 1-7. Elevator Control System

1-23. CABLE REMOVAL AND INSTALLATION.

(To Remove Cables)

a. Remove all necessary access plates, access and inspection doors.

b. Neutralize controls.

c. Remove safety wires from turnbuckles and separate cable sections at turnbuckles.

d. Remove guard pins from all pulley brackets which route the cables or section of cable being removed.

e. Remove cable or section of cable from airplane.

(To Install Cables)

a. String cable or section of cable through the routing pulleys and to the attaching points.

b. Connect cable terminal ends to quadrants or bellcranks and secure with proper bolts, nuts, retainers or pins.

c. Install all guard pins which were removed from pulley brackets.

d. Attach cable sections at turnbuckles, and rig for proper tension.

Note

Correct tension for the aileron control cables is 35 ±5 pounds and for the elevator and rudder cables it is 50 ±5 pounds, all at 24°C (75°F).

e. Operate controls through one or two complete cycles to check for travel and freedom of movement.

f. Safety wire all turnbuckles affected by the cable removal procedure

g. Close all access plates, access and inspection doors which were opened during cable removal. Perform a functional check of the system.

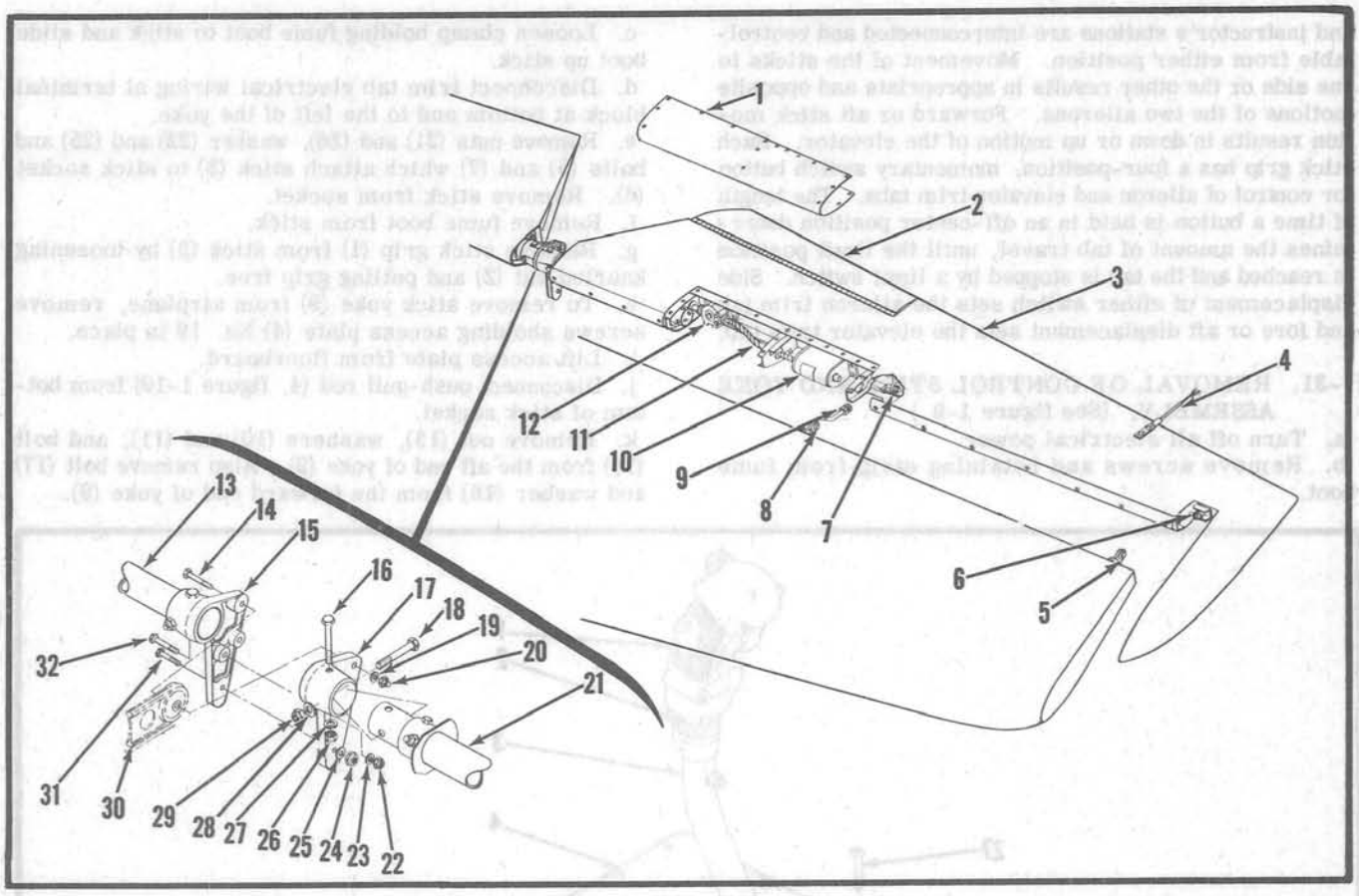
1-24. ELEVATOR SYSTEM.

1-25. DESCRIPTION. The elevator system includes dual control stick and control quadrant assemblies linked together by a connecting rod, a single cable system, left and right sections of the elevator and an electrically actuated trim tab on the left section of the elevator. Each elevator section has two hinge pins which mate with corresponding hinge brackets on the rear spar of the horizontal stabilizer. A bracket extending aft from the center of the horizontal stabilizer rear spar attaches to and supports elevator horns on both halves of the elevator. An electrically operated tab actuator is mounted on the front spar of the left section of the elevator and controls the tab through a flexible drive shaft and a screwjack.

1-26. FUNCTIONAL DESCRIPTION. Fore or aft motion of the interconnected control sticks will actuate the elevator control quadrants beneath the cockpit floor and they transmit the motion, through the cable system, to the aft elevator quadrant located in the empennage. Motion of the aft quadrant is transmitted through a push-pull rod to the elevator horns, rotating both halves of the elevator up or down about its hinge line. The maximum angular travel is 26 degrees up or 15 degrees down from neutral. Stops on the aft quadrant are set to prevent excessive elevator travel up or down. Additional stops, on the forward controls, prevent excessive stick travel and strain on the cables. Forward stick travel is stopped by a stop on the forward right control quadrant and backward stick travel is stopped by stops on both stick yokes. The elevator trim tab is operated by either of two, four position momentary trim tab switches, one of which is located on the top of each control stick grip.

1-27. TROUBLE SHOOTING THE ELEVATOR SYSTEM.

TROUBLE	PROBABLE CAUSE	REMEDY
ELEVATOR IS NOT IS THE NEUTRAL STREAMLINE POSITION WHEN STICK IS IN THE NEUTRAL CENTER POSITION	Elevator cable system is not rigged properly.	Rig elevator cable system. See paragraph 1-35.
IMPROPER ELEVATOR TRAVEL	Travel limit stops not adjusted properly.	Adjust travel limit stops. See paragraph 1-36.
STICK MOVEMENT NOT SMOOTH OR STICK FORCES EXCESSIVE	Binding in cable system.	Check cable tension. Check all elevator pulleys, brackets, bellcranks, quadrants and cables for malfunction or mechanical defects.
TOO LITTLE STICK FORCE	Elevator cable system not properly rigged.	Rig elevator cable system. See paragraph 1-35.
ELEVATOR DOES NOT RETURN TO THE DOWN POSITION	Elevator down spring inoperative.	Check to see that elevator down spring is operative. If broken, remove and replace.
INSUFFICIENT CLEARANCE AROUND ELEVATOR	Improperly repaired elevator or stabilizer.	Increase clearance by filing or grinding surrounding skin edges. See figure 1-6.
EXCESSIVE CLEARANCE AROUND ELEVATOR	Damaged or improperly repaired elevator or stabilizer.	Repair or replace aileron or wing. See figure 1-6.



1. Cover
2. Trim tab
3. Elevator
4. Static discharger
5. Bracket
6. Pin
7. Pin
8. Bracket
9. Coupling
10. Actuator
11. Flexible shaft
12. Screwjack
13. Torque tube
14. Bolt
15. Horn
16. Bolt
17. Horn
18. Bolt
19. Washer
20. Nut
21. Torque tube
22. Nut
23. Washer
24. Nut
25. Washer
26. Nut
27. Washer
28. Washer
29. Nut
30. Hinge
31. Bolt
32. Bolt

Figure 1-8. Elevator Installation

1-28. REMOVAL OF ELEVATOR. (See figure 1-8.)

a. Shut off all electric power.

Note

Steps b and c apply to left section only.

b. Remove actuator cover (1) marked No. 17.

c. Disconnect tab actuator electric wiring at conduit coupling (9).

d. Remove nut (24) and bolt (31) which attach push-pull rod end to elevator horns (15) and (17).

e. Remove nut (20), washer (19) and bolt (14) attaching elevator horns (15) and (17) to bracket (30).

f. Support elevator and remove remaining nuts and bolts which hold elevator horns together.

g. Remove sections of elevator from airplane by carefully moving each section outward until hinge pins (6) and (7) are free from hinge brackets.

h. To remove elevator horn, remove nuts (26) and (29), washers (27) and (28) and bolts (16) and (18); slide horn free of the torque tube. Repeat for opposite section.

1-29. INSTALLATION OF ELEVATOR. (See figure 1-8.)

a. If elevator horns were removed, slide them into place on the torque tubes and fasten with bolts (16) and (18), washers (27) and (28) and nuts (26) and (29).

b. Bring elevator sections into place and slip hinge pins (6) and (7) into bearings in stationary brackets (5) and (8) on horizontal stabilizer.

c. Install bolt (32), washer (23) and nut (22) loosely, to hold elevator sections together.

d. Connect elevator horns to hinge (30) with bolt (14), washer (19) and nut (20).

e. Attach push-pull rod to elevator horns using bolt (31), washer (25) and nut (24). Tighten all nuts.

Note

Steps f and g apply only to left section.

f. Connect tab actuator wiring at coupling (9).

g. Attach cover (1) marked No. 1.

1-30. CONTROL STICK. Control sticks at the student's

and instructor's stations are interconnected and controllable from either position. Movement of the sticks to one side or the other results in appropriate and opposite motions of the two ailerons. Forward or aft stick motion results in down or up motion of the elevator. Each stick grip has a four-position, momentary switch button for control of aileron and elevator trim tabs. The length of time a button is held in an off-center position determines the amount of tab travel, until the limit position is reached and the tab is stopped by a limit switch. Side displacement of either switch sets the aileron trim tab and fore or aft displacement sets the elevator trim tab.

1-31. REMOVAL OF CONTROL STICK AND YOKE ASSEMBLY. (See figure 1-9.)

a. Turn off all electrical power.

b. Remove screws and retaining strip from fume boot.

c. Loosen clamp holding fume boot to stick and slide boot up stick.

d. Disconnect trim tab electrical wiring at terminal block at bottom and to the left of the yoke.

e. Remove nuts (21) and (26), washer (22) and (25) and bolts (5) and (7) which attach stick (3) to stick socket (6). Remove stick from socket.

f. Remove fume boot from stick.

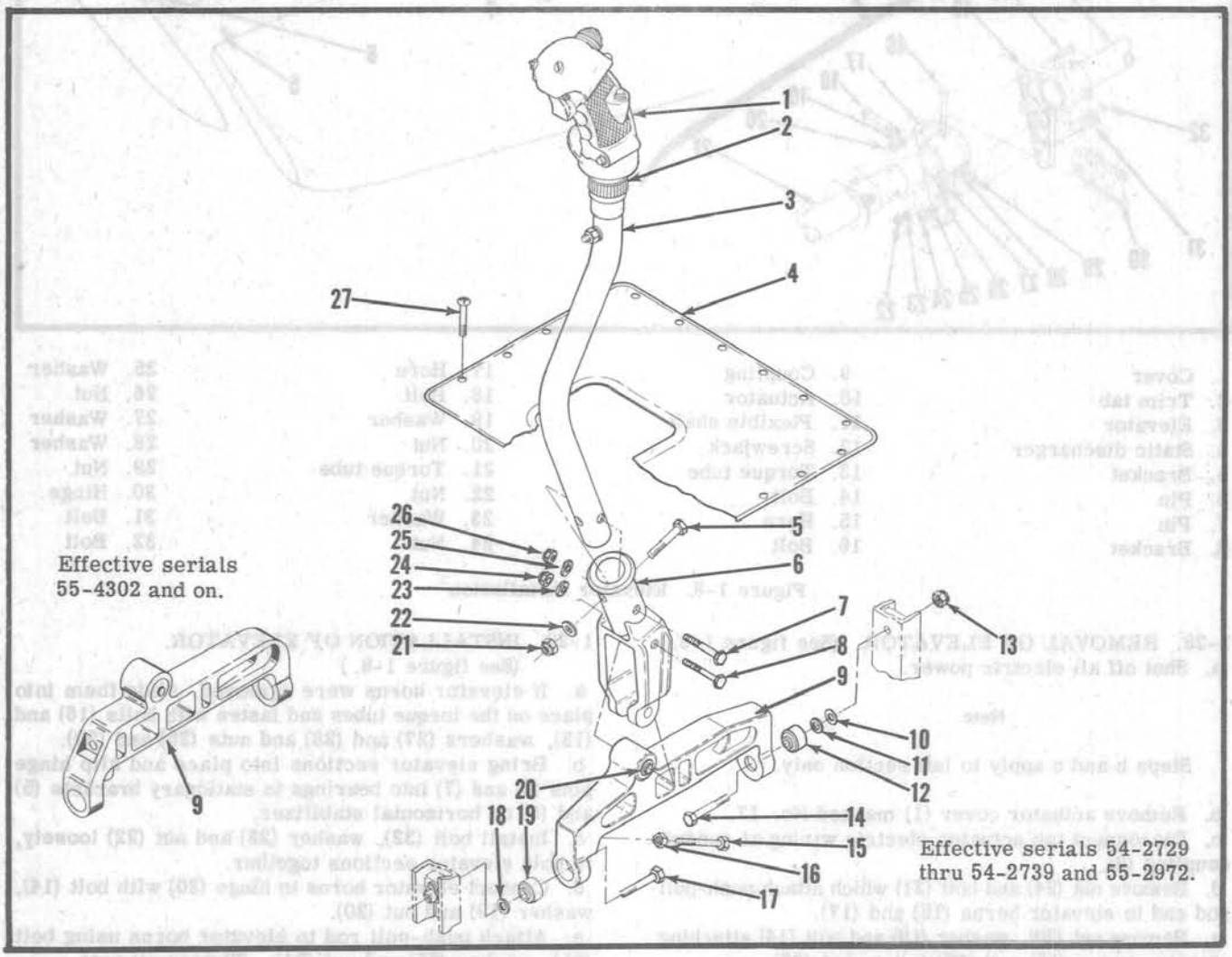
g. Remove stick grip (1) from stick (3) by loosening knurled nut (2) and pulling grip free.

h. To remove stick yoke (9) from airplane, remove screws sholding access plate (4) No. 19 in place.

i. Lift access plate from floorboard.

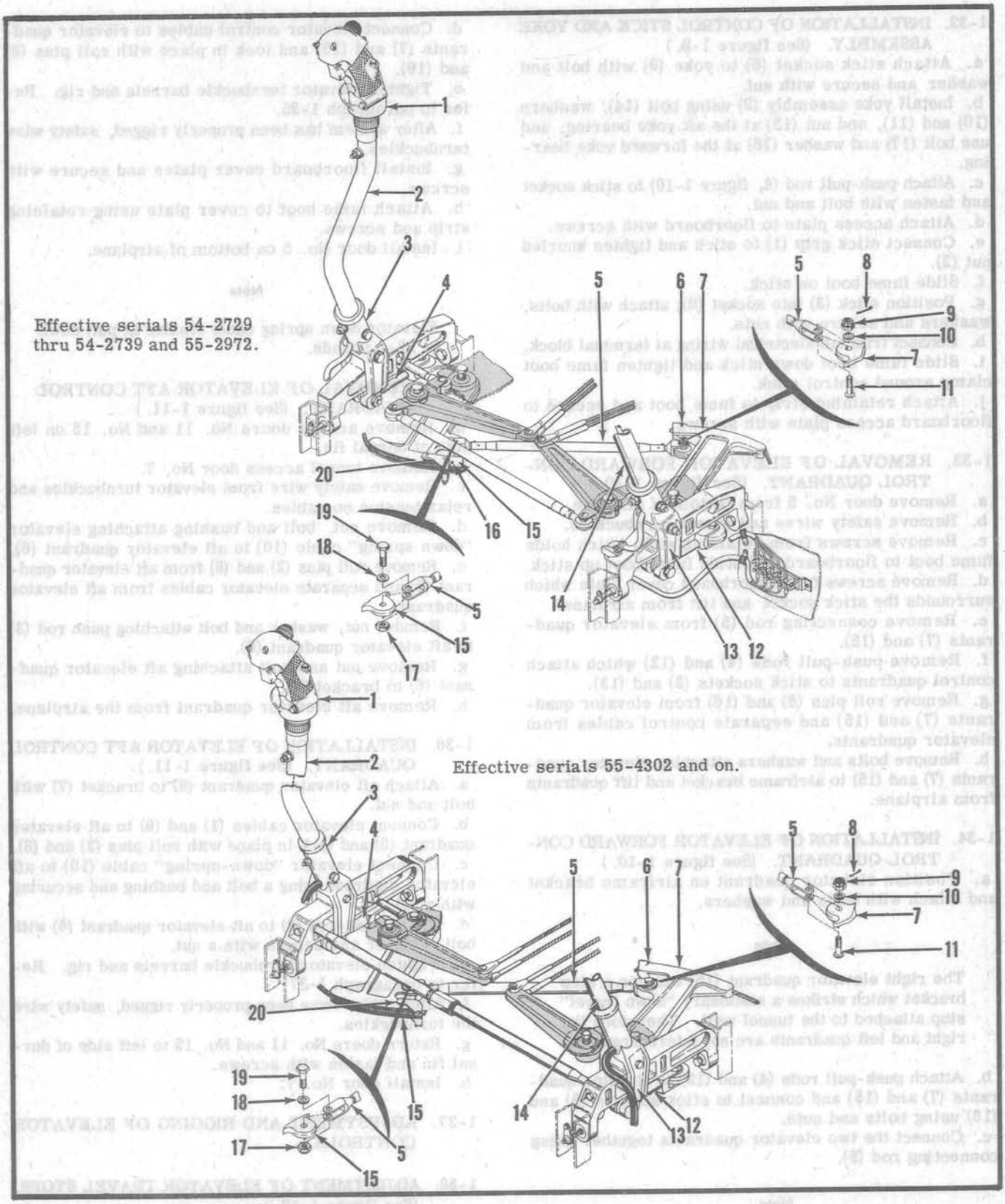
j. Disconnect push-pull rod (4, figure 1-10) from bottom of stick socket.

k. Remove nut (13), washers (10) and (11), and bolt (14) from the aft end of yoke (9). Also remove bolt (17) and washer (18) from the forward end of yoke (9).



1. Stick
2. Knurled nut
3. Control stick
4. Cover
5. Bolt
6. Stick socket
7. Bolt
8. Bolt
9. Yoke (two types shown)
10. Washer
11. Washer
12. Bearing
13. Nut
14. Bolt
15. Bolt
16. Nut
17. Bolt
18. Washer
19. Bearing
20. Bearing
21. Nut
22. Washer
23. Washer
24. Nut
25. Washer
26. Nut
27. Screw

Figure 1-9. Control Stick and Yoke Installation



1. Stick grip
2. Control stick
3. Stick socket
4. Push-pull rod
5. Connecting rod
6. Roll pin
7. Elevator quadrant
8. Cotter pin
9. Nut
10. Washer
11. Bolt
12. Push-pull rod
13. Stick socket
14. Control stick
15. Elevator quadrant
16. Roll pin
17. Nut
18. Washer
19. Bolt
20. Travel stop

Figure 1-10. Elevator Forward Quadrant Installation

1-32. INSTALLATION OF CONTROL STICK AND YOKE ASSEMBLY. (See figure 1-9.)

a. Attach stick socket (6) to yoke (9) with bolt and washer and secure with nut.

b. Install yoke assembly (9) using bolt (14), washers (10) and (11), and nut (13) at the aft yoke bearing, and use bolt (17) and washer (18) at the forward yoke bearing.

c. Attach push-pull rod (4, figure 1-10) to stick socket and fasten with bolt and nut.

d. Attach access plate to floorboard with screws.

e. Connect stick grip (1) to stick and tighten knurled nut (2).

f. Slide fume boot on stick.

g. Position stick (3) into socket (6); attach with bolts, washers and secure with nuts.

h. Connect trim tab electrical wiring at terminal block.

i. Slide fume boot down stick and tighten fume boot clamp around control stick.

j. Attach retaining strip to fume boot and secure to floorboard access plate with screws.

1-33. REMOVAL OF ELEVATOR FORWARD CONTROL QUADRANT. (See figure 1-10.)

a. Remove door No. 5 from bottom of airplane.

b. Remove safety wires and loosen turnbuckles.

c. Remove screws from retaining strip which holds fume boot to floorboard and slide fume boot up stick.

d. Remove screws from floorboard cover plate which surrounds the stick socket and lift from airplane.

e. Remove connecting rod (5) from elevator quadrants (7) and (15).

f. Remove push-pull rods (4) and (12) which attach control quadrants to stick sockets (3) and (13).

g. Remove roll pins (6) and (16) from elevator quadrants (7) and (15) and separate control cables from elevator quadrants.

h. Remove bolts and washers attaching elevator quadrants (7) and (15) to airframe bracket and lift quadrants from airplane.

1-34. INSTALLATION OF ELEVATOR FORWARD CONTROL QUADRANT. (See figure 1-10.)

a. Position elevator quadrant on airframe bracket and attach with bolts and washers.

Note

The right elevator quadrant (15) carries a stop bracket which strikes a stationary "down travel" stop attached to the tunnel wall. Therefore the right and left quadrants are not interchangeable.

b. Attach push-pull rods (4) and (12) to elevator quadrants (7) and (15) and connect to stick sockets (3) and (13) using bolts and nuts.

c. Connect the two elevator quadrants together using connecting rod (5).

Note

When attaching the connecting rod to the elevator quadrants be sure to insert the bolt head DOWN on the left quadrant and use a washer, nut and cotter key. Insert the bolt with the head UP on the right quadrant and use a washer and nut only.

d. Connect elevator control cables to elevator quadrants (7) and (15) and lock in place with roll pins (6) and (16).

e. Tighten elevator turnbuckle barrels and rig. Refer to paragraph 1-35.

f. After system has been properly rigged, safety wire turnbuckles.

g. Install floorboard cover plates and secure with screws.

h. Attach fume boot to cover plate using retaining strip and screws.

i. Install door No. 5 on bottom of airplane.

Note

Elevator down spring cable tension at pull down is 22±1 pounds.

1-35. REMOVAL OF ELEVATOR AFT CONTROL QUADRANT. (See figure 1-11.)

a. Remove access doors No. 11 and No. 15 on left side of dorsal fin.

b. Remove tunnel access door No. 7.

c. Remove safety wire from elevator turnbuckles and relax tension on cables.

d. Remove nut, bolt and bushing attaching elevator "down spring" cable (10) to aft elevator quadrant (6).

e. Remove roll pins (2) and (8) from aft elevator quadrant (6) and separate elevator cables from aft elevator quadrant.

f. Remove nut, washer and bolt attaching push rod (3) to aft elevator quadrant (6).

g. Remove nut and bolt attaching aft elevator quadrant (6) to bracket (7).

h. Remove aft elevator quadrant from the airplane.

1-36. INSTALLATION OF ELEVATOR AFT CONTROL QUADRANT. (See figure 1-11.)

a. Attach aft elevator quadrant (6) to bracket (7) with bolt and nut.

b. Connect elevator cables (1) and (9) to aft elevator quadrant (6) and lock in place with roll pins (2) and (8).

c. Connect elevator "down-spring" cable (10) to aft elevator quadrant using a bolt and bushing and securing with a nut.

d. Attach push-rod (3) to aft elevator quadrant (6) with bolt, washer and secure with a nut.

e. Tighten elevator turnbuckle barrels and rig. Refer to paragraph 1-37

f. After cables have been properly rigged, safety wire the turnbuckles.

g. Return doors No. 11 and No. 15 to left side of dorsal fin and fasten with screws.

h. Install door No. 7.

1-37. ADJUSTMENT AND RIGGING OF ELEVATOR CONTROLS.

1-38. ADJUSTMENT OF ELEVATOR TRAVEL STOPS. (See figure 1-12.)

a. Place elevator sickle gage on the horizontal stabilizer.

b. Operate elevator through its complete cycle, noting the gage reading when the elevator has reached its extended travel to the UP position and also the DOWN position. For instructions regarding setting of the elevator in streamlined position, see paragraph 1-39.

Note

For the correct number of degrees of elevator travel from neutral to the full UP or full DOWN position, refer to Table I "Settings and Range of Movement of Primary Flight Control Surfaces".

c. If the amount of travel is not within the specified limits of Table I, then adjust the travel stops until the gage indicates the correct travel.

Note

The "DOWN" travel stop is located on the right elevator quadrant ONLY. (See figure 1-12.) The "UP" travel stops are located on BOTH control stick yokes.

d. To gain access to the elevator travel stops:

1. Remove tunnel access door No. 7 from the bottom of the airplane.
2. Remove screws from fume boot retaining strip; loosen clamp around stick and slide fume boot up stick.
3. Remove screws attaching cover plate to floorboard.

e. Loosen lock nut at travel stop; screw travel stop bolt in or out to provide proper travel of elevator as indicated by the gage.

f. Tighten travel stop lock nut and follow the same procedure for the opposite travel stop.

g. Upon completion of travel stop adjustment:

1. Check elevator for proper travel.
2. After adjustment has been completed, install cover plate and secure to floorboard with screws.
3. Slide fume boot down stick, tighten clamp around stick and secure to floorboard cover plate using the retaining strip and screws.

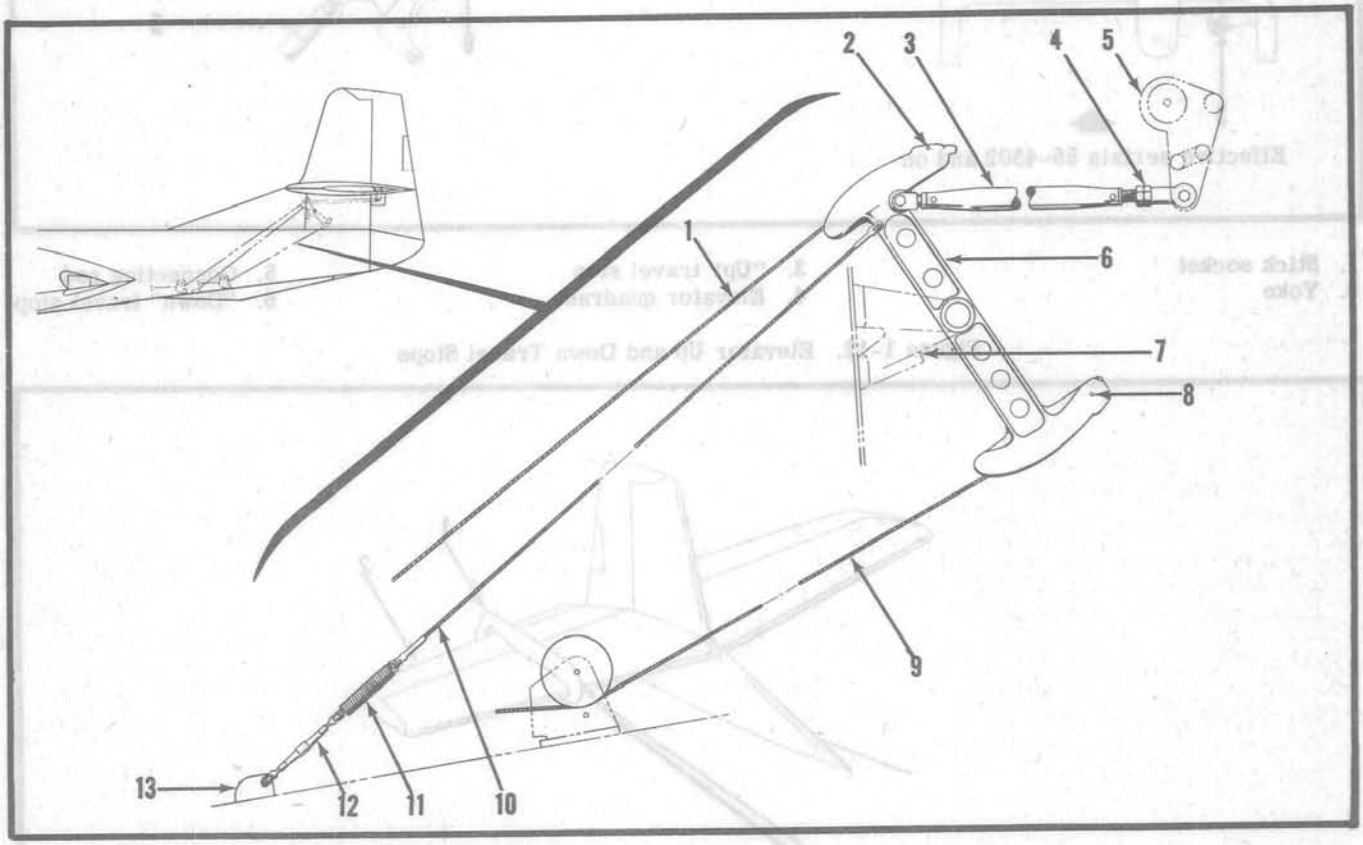
h. Perform an operational check of the elevator system by moving the control sticks fore and aft, noting freedom of movement and travel extent at the control surfaces.

i. Remove gage from stabilizer surface.

1-39. COORDINATING THE ELEVATOR WITH THE CONTROL STICKS.

a. Attach gust lock to control stick. If this does not streamline the elevator, proceed as follows:

1. Remove doors No. 15 and No. 16.
2. Remove nut, washer and bolt attaching push rod assembly to aft elevator quadrant.
3. Adjust push rod length by turning terminal end until the rod will hold elevator in streamlined position.
4. Attach push rod to elevator horn with bolt, washer and nut.
5. Install doors No. 15 and No. 16.



1. Elevator cable
2. Roll pin
3. Push rod
4. Nut
5. Elevator horn
6. Aft elevator quadrant
7. Bracket
8. Roll pin
9. Elevator cable
10. Elevator "down" spring cable
11. Spring
12. Turnbuckle
13. Bracket

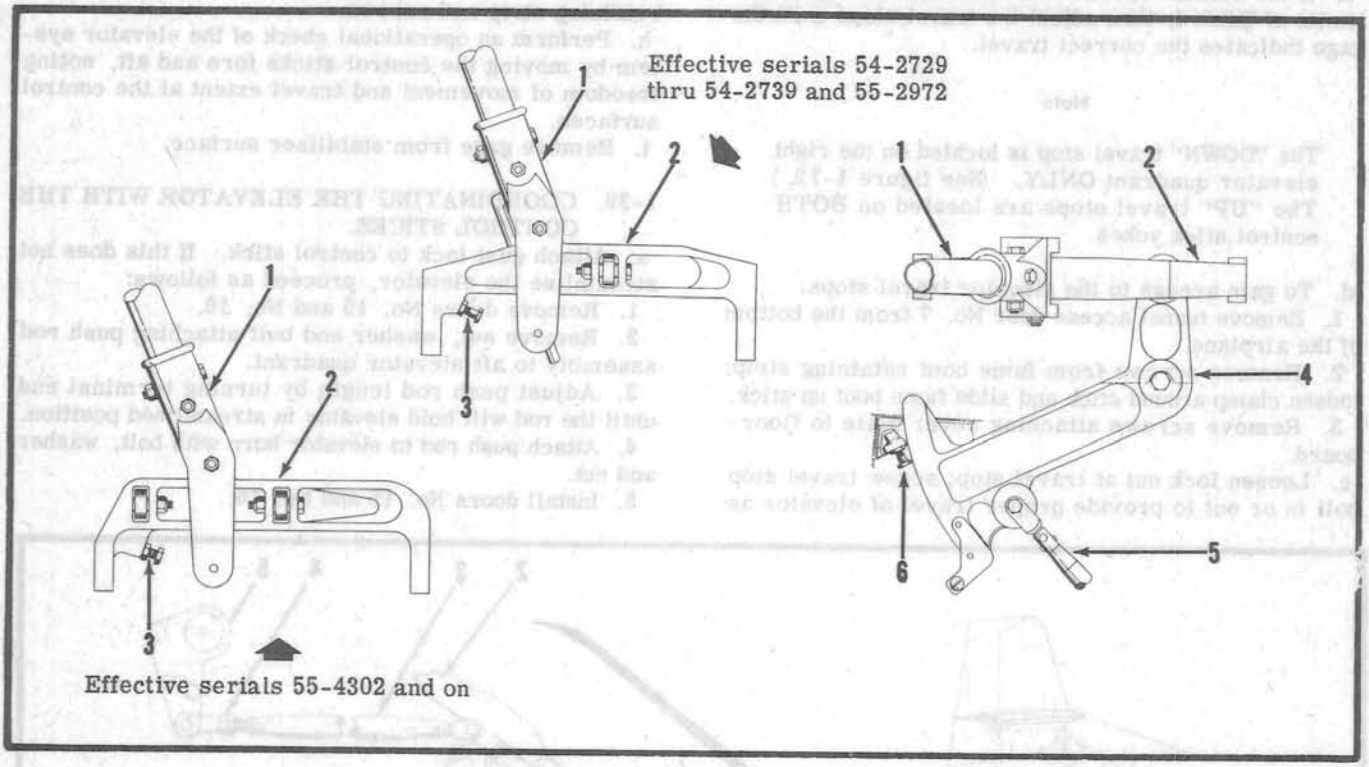
Figure 1-11. Elevator Aft Quadrant Installation

1-40. ELEVATOR CABLES. (See figure 1-7.)

Note

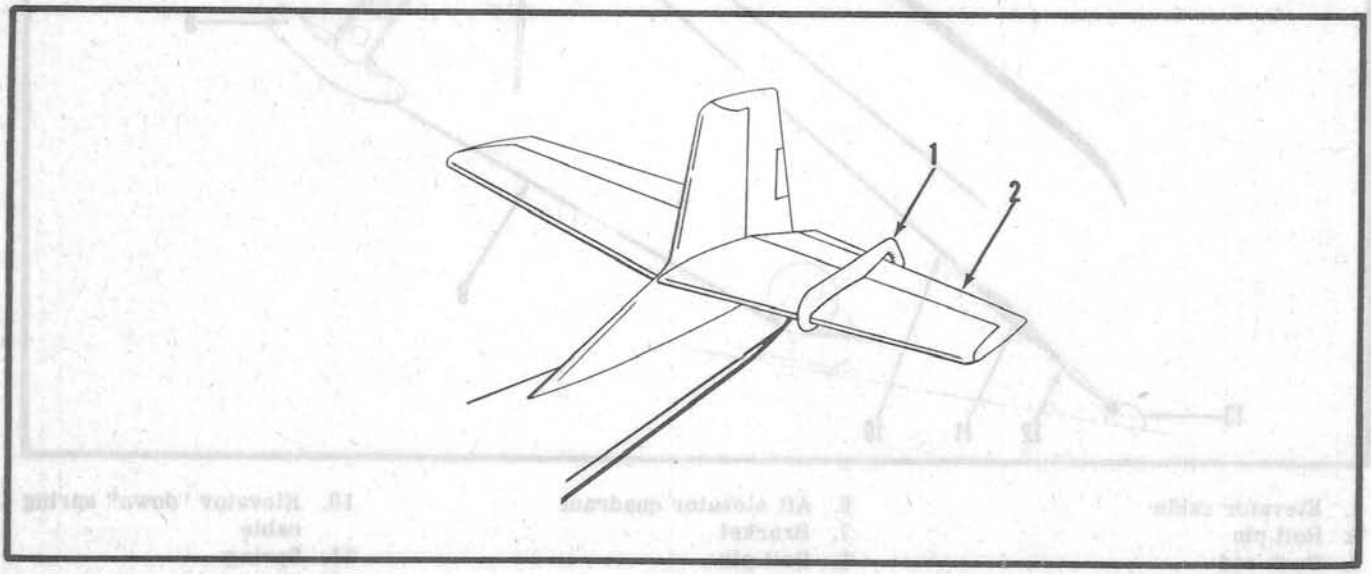
For cable removal and installation, refer to paragraph 1-23.

The 1/8 inch elevator cables are made of stranded carbon steel. They are attached to the forward elevator quadrants and are guided through the lower part of the fuselage and up to the aft elevator quadrant. Each cable can be divided by disconnecting the fore and aft sections at the turnbuckles just inside tunnel door No. 7. Roll pins are used to fasten cables to their respective seats on the quadrants and must be removed when removing cables. Cable tension is controlled by adjustment of the turnbuckles and a tension of 50±5 pounds must be maintained at a temperature of 20°C(75°F).



1. Stick socket
2. Yoke
3. "Up" travel stop
4. Elevator quadrant
5. Connecting rod
6. "Down" travel stop

Figure 1-12. Elevator Up and Down Travel Stops



1. Sickle gage
2. Elevator

Figure 1-13. Elevator Rigging

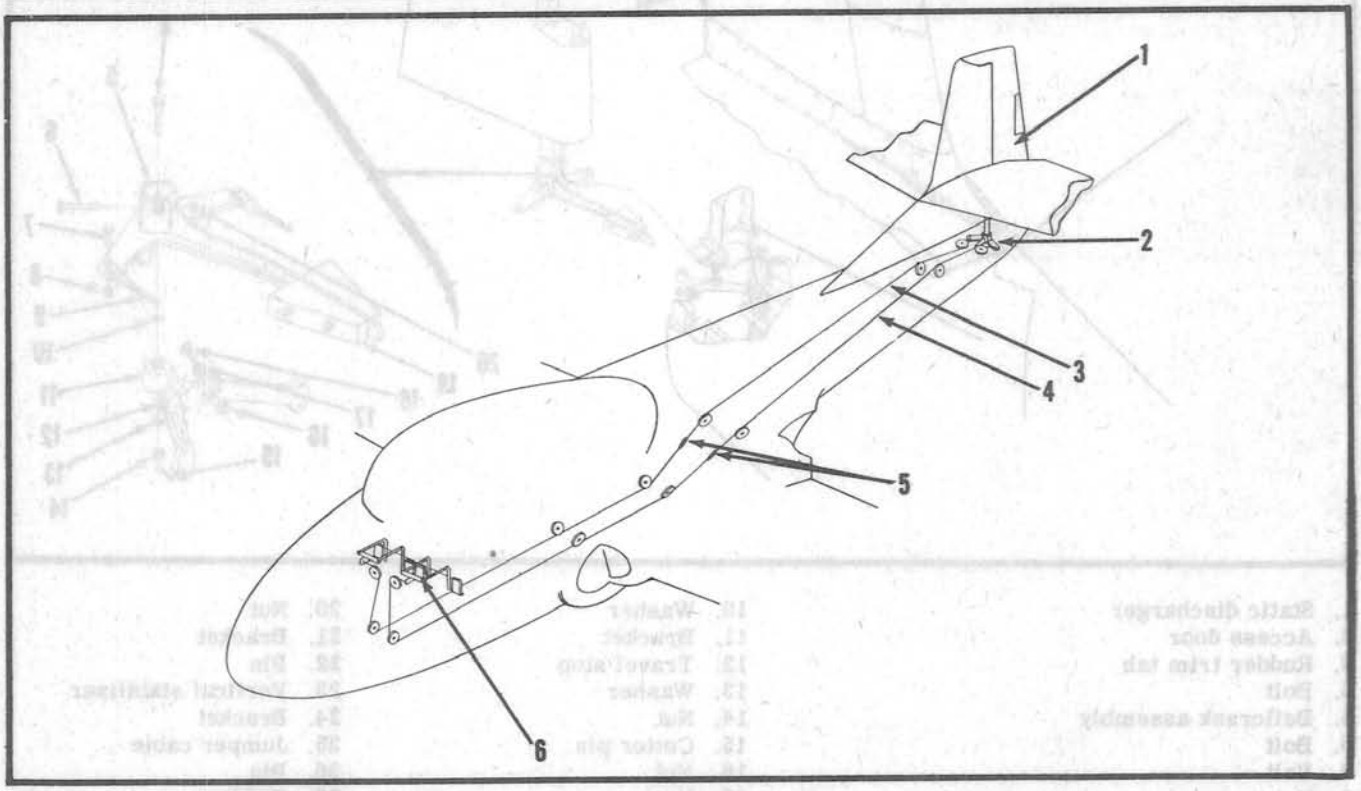
1-41. RUDDER SYSTEM.

1-42. DESCRIPTION. The rudder system consists of a dual set of control pedals, a single cable system and a rudder assembly. The rudder rotates to either side of the center streamlined position on two hinge pins. These hinge pins mate with two hinge pin brackets located on the aft spar of the vertical stabilizer (fin). The rudder assembly torque tube extends down from the bottom of the rudder and is attached by two bolts to a bellcrank and counter-weight assembly. This assembly and rudder are supported by a bracket fastened to the aft end of the aircraft tail cone. The rudder may be removed from the airplane by unbolting the torque tube and removing it from the bellcrank, without disturbing the cable adjustment. The rudder trim tab is controlled from the cockpit and is actuated by an electric actuator located in the rudder leading edge.

1-43. FUNCTIONAL DESCRIPTION. The rudder is deflected sideways by a corresponding movement of the interconnected rudder pedals at the student's and instructor's stations. The motion of the pedals is transmitted by a cable system to a bellcrank in the aft end of the tail cone. The action of the bellcrank on the rudder torque tube rotates the rudder.

1-44. TROUBLE SHOOTING THE RUDDER SYSTEM.

TROUBLE	PROBABLE CAUSE	REMEDY
IMPROPER SURFACE TRAVEL OR PEDAL MOVEMENT	Rudder bellcrank travel stops out of adjustment.	Adjust rudder bellcrank travel stops.
SLIGHT MOVEMENT ON RUDDER PEDALS DOES NOT MOVE RUDDER	Rudder improperly rigged.	Rig cable system. See paragraph 1-48.
RUDDER DISTORTED	Warped skin.	Remove and replace rudder. See paragraph 1-45.
INSUFFICIENT CLEARANCE AROUND RUDDER OR TAB	Improperly repaired rudder, tab or fin.	Increase clearance by filing or grinding skin edges. See figure 1-6.
EXCESSIVE CLEARANCE AROUND RUDDER OR TAB	Damaged or improperly repaired rudder, tab or fin.	Repair or replace faulty assembly. See figure 1-6.



1. Rudder
2. Bellcrank
3. Right rudder cable
4. Left rudder cable
5. Turnbuckle
6. Bellcrank

Figure 1-14. Rudder Control System

1-45. REMOVAL OF RUDDER. (See figure 1-15.)

a. Turn off all electrical power.

b. Remove screws attaching stinger to aft section of airplane.

c. Remove door No. 15. Disconnect rudder trim tab actuator wiring at terminal strip. Unwrap wiring ties.

d. Remove nuts and bolts attaching rudder torque tube (2) to bellcrank (5).

e. Lift rudder torque tube from bellcrank high enough to allow pins (22) and (26) to separate from the vertical stabilizer brackets.

f. To remove bellcrank (5) from the airplane, relieve tension on rudder cables by loosening either rudder cable turnbuckle.

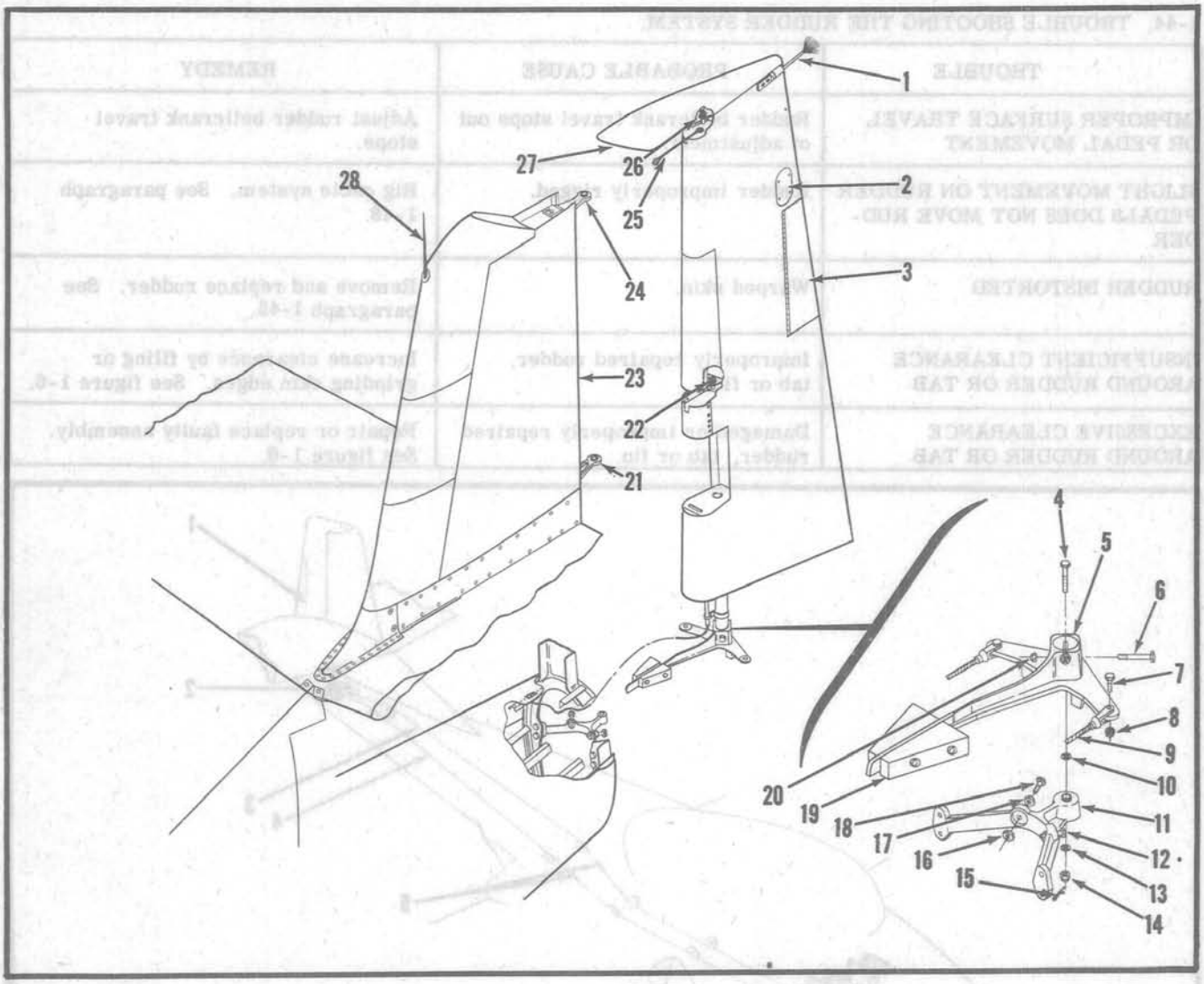
g. Remove cotter keys, nuts and bolts attaching rudder cable ends to bellcrank (5).

h. Remove cotter pin (15), nut (14), washers (13) and (10) and bolt (4) and remove bellcrank (5) from airplane.

1-46. INSTALLATION OF RUDDER. (See figure 1-15.)

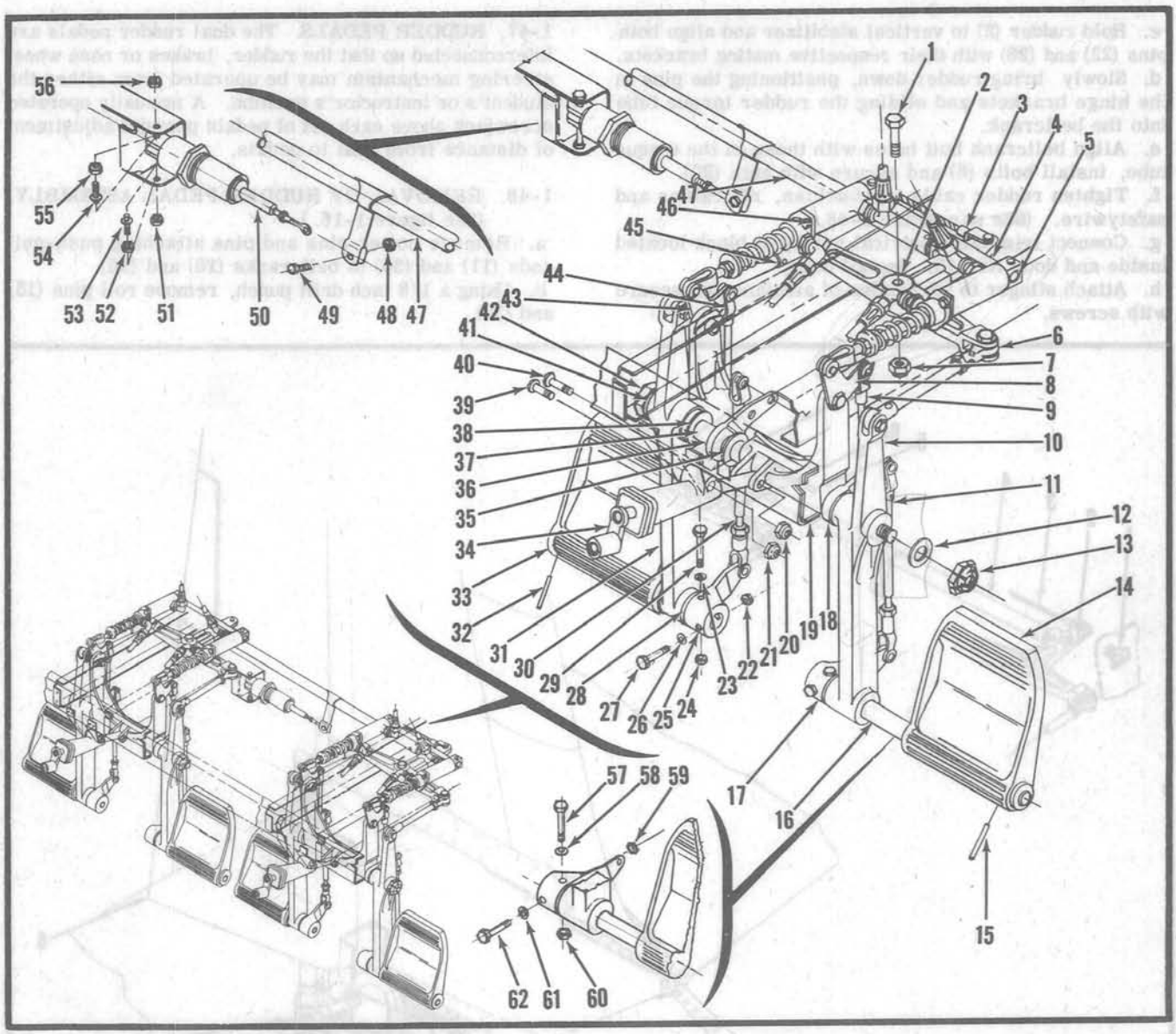
a. If bellcrank assembly was removed, reinstall with bolt (4), washers (10) and (13), nut (14), and cotter pin (15).

b. Attach rudder cable ends to bellcrank (5) with bolts (7), nuts (8) and cotter pins.



1. Static discharger
2. Access door
3. Rudder trim tab
4. Bolt
5. Bellcrank assembly
6. Bolt
7. Bolt
8. Nut
9. Rudder cable
10. Washer
11. Bracket
12. Travel stop
13. Washer
14. Nut
15. Cotter pin
16. Nut
17. Nut
18. Bolt
19. Balance weight
20. Nut
21. Bracket
22. Pin
23. Vertical stabilizer
24. Bracket
25. Jumper cable
26. Pin
27. Rudder
28. Communication antenna

Figure 1-15. Rudder Installation



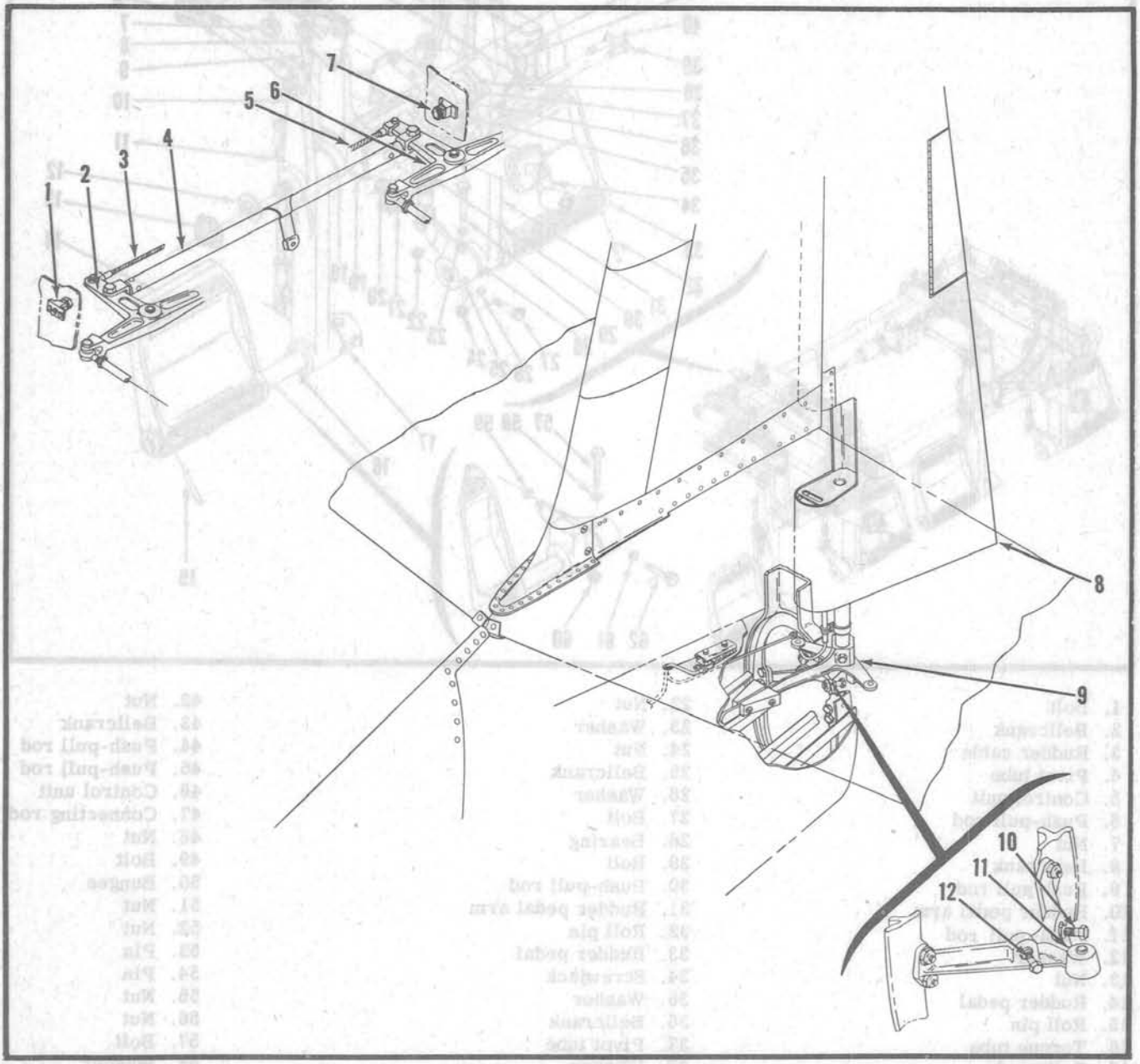
1. Bolt
2. Bellcrank
3. Rudder cable
4. Pivot tube
5. Control unit
6. Push-pull rod
7. Nut
8. Bellcrank
9. Push pull rod
10. Rudder pedal arm
11. Push- pull rod
12. Washer
13. Nut
14. Rudder pedal
15. Roll pin
16. Torque tube
17. Bellcrank
18. Bellcrank
19. Hanger
20. Nut
21. Nut
22. Nut
23. Washer
24. Nut
25. Bellcrank
26. Washer
27. Bolt
28. Bearing
29. Bolt
30. Push-pull rod
31. Rudder pedal arm
32. Roll pin
33. Rudder pedal
34. Screwjack
35. Washer
36. Bellcrank
37. Pivot tube
38. Washer
39. Clevis bolt
40. Clevis bolt
41. Washer
42. Nut
43. Bellcrank
44. Push-pull rod
45. Push-pull rod
46. Control unit
47. Connecting rod
48. Nut
49. Bolt
50. Bungee
51. Nut
52. Nut
53. Pin
54. Pin
55. Nut
56. Nut
57. Bolt
58. Washer
59. Nut
60. Nut
61. Washer
62. Bolt

Figure 1-16. Rudder Pedal Installation

c. Hold rudder (2) to vertical stabilizer and align both pins (22) and (26) with their respective mating brackets.
d. Slowly bring rudder down, positioning the pins in the hinge brackets and sliding the rudder torque tube into the bellcrank.
e. Align bellcrank bolt holes with those in the torque tube, install bolts (6) and secure with nuts (20).
f. Tighten rudder cable turnbuckles, rig cables and safetywire. (See paragraph 1-48.)
g. Connect trim tab electrical wiring at block located inside and door No. 15. Install door.
h. Attach stinger to aft section of airplane and secure with screws.

1-47. RUDDER PEDALS. The dual rudder pedals are interconnected so that the rudder, brakes or nose wheel steering mechanism may be operated from either the student's or instructor's position. A manually operated screwjack above each set of pedals permits adjustment of distance from seat to pedals.

1-48. REMOVAL OF RUDDER PEDAL ASSEMBLY. (See figure 1-16.)
a. Remove cotter pins and pins attaching push-pull rods (11) and (30) to bellcranks (18) and (36).
b. Using a 1/8 inch drift punch, remove roll pins (15) and (32).



1. Forward rudder travel stop
2. Bellcrank
3. Rudder cable
4. Connecting rod
5. Rudder cable
6. Bellcrank
7. Forward rudder travel stop
8. Rudder
9. Bellcrank
10. Aft rudder travel stop
11. Bracket
12. Aft rudder travel stop

Figure 1-17. Rudder Travel Stops

c. Remove nuts (22), (24), (59), and (60) and bolts (27), (29), (57), and (62) from bellcrank (17) and (25).
d. Separate rudder pedals (14) and (33), bellcranks (17) and (25) and torque tubes (16) from rudder pedal arms (10) and (31).
e. Remove push-pull rods (9) and (44) which connect bellcranks (8) and (43) to bellcranks (18) and (36).
f. Remove push-pull rods (6) which connect rudder pedal arms (10) and (31) to bellcrank (2).
g. Remove nuts and washers attaching rudder pedal arms (10) and (31) to hanger (19) and remove pedal arms from pivot tube.
h. Remove washers and bellcranks (18) and (36) from pivot tube (37).
i. To remove bellcrank (2) from the airplane, remove safety wire from the rudder cable turnbuckle, relax cable tension and remove nuts and bolts attaching cable terminal to bellcrank.
j. Remove nuts (51), (52), (55) and (56) and pins (53) and (54) attaching bungee (50) to support assembly. Remove nut (48) and bolt (49) attaching bungee (50) to connecting rod (47). Remove bungee from airplane.
k. Remove nut (7) and bolt (1) from bellcrank (2).
l. Remove bellcrank from airplane.

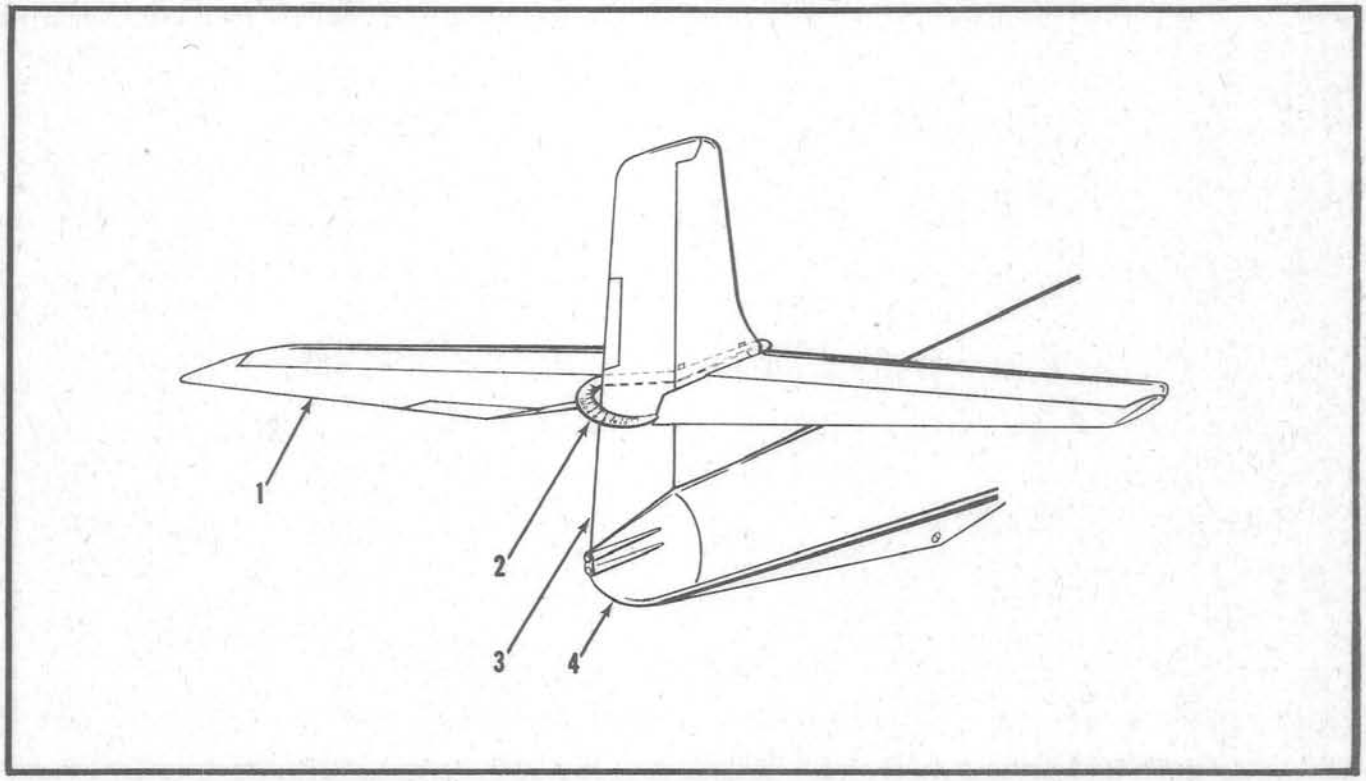
1-49. INSTALLATION OF RUDDER PEDAL ASSEMBLY. (See figure 1-16.)

a. If rudder bellcrank (2) was removed from airplane, install with bolt (1) and nut (7).
b. Replace nuts (51), (52), (55), and (56) and pins (53) and (54) attaching bungee (50) to support assembly. Replace nut (48) and bolt (49) attaching bungee to connecting rod (47).
c. Attach cable terminal (3) to bellcrank (2) with a bolt and nut.
d. With a washer placed on either side of bellcrank (18) and (36), slide bellcrank on pivot tube (37).
e. Attach rudder pedal arms (10) and (31) to hanger (19) and secure with washer and nuts.
f. Connect push-pull rods (6) and (45) to rudder pedal arms (10) and (31) and to bellcrank (2).
g. Attach push-pull rods (9) and (44) to bellcrank (8) and (43) and (18) and (36) with pins and secure with cotter pins.
h. Install torque tubes (16) on rudder pedal arms (10) and (31).
i. Replace nuts (22), (24), (59), and (60) and bolts (27), (29), (57), and (62) in bellcranks (17) and (25).
j. Slide rudder pedals on torque tubes (16) and lock in place with roll pins (15) and (32).
k. Attach push-pull rods (11) and (30) to bellcranks (18) and (36) with pins and secure with cotter pins.
l. Rig rudder cable system in accordance with paragraph 1-50.

1-50. ADJUSTMENT AND RIGGING OF RUDDER CONTROLS.

1-51. ADJUSTMENT OF RUDDER TRAVEL STOPS. (See figure 1-17.)

a. Remove stinger from aft end of tail cone.
b. Lock rudder controls in neutral position by fastening gust lock to control stick.
c. To use rudder sickle gage, remove proper screws from skin at bottom rib of vertical stabilizer (fin) and fasten clips of sickle gage with screws removed.



1. Elevator
2. Sickle gage
3. Rudder
4. Stinger

Figure 1-18. Rudder Rigging

d. If rudder is not streamlined with the vertical stabilizer as indicated by a zero reading on the sickle gage, adjust cable lengths at the turnbuckles, lengthening one span and shortening the other, until the rudder is streamlined.

e. Release gust lock and move rudder to full travel positions right and left.

Note

See Table I, Settings and Range of Movement of Primary Flight Control Surfaces, for correct angular travel from neutral to full RIGHT and LEFT positions.

f. If the amount of travel is not within the specified limits indicated in Table I, adjust the aft travel stops until they permit correct travel as indicated by the sickle gage.

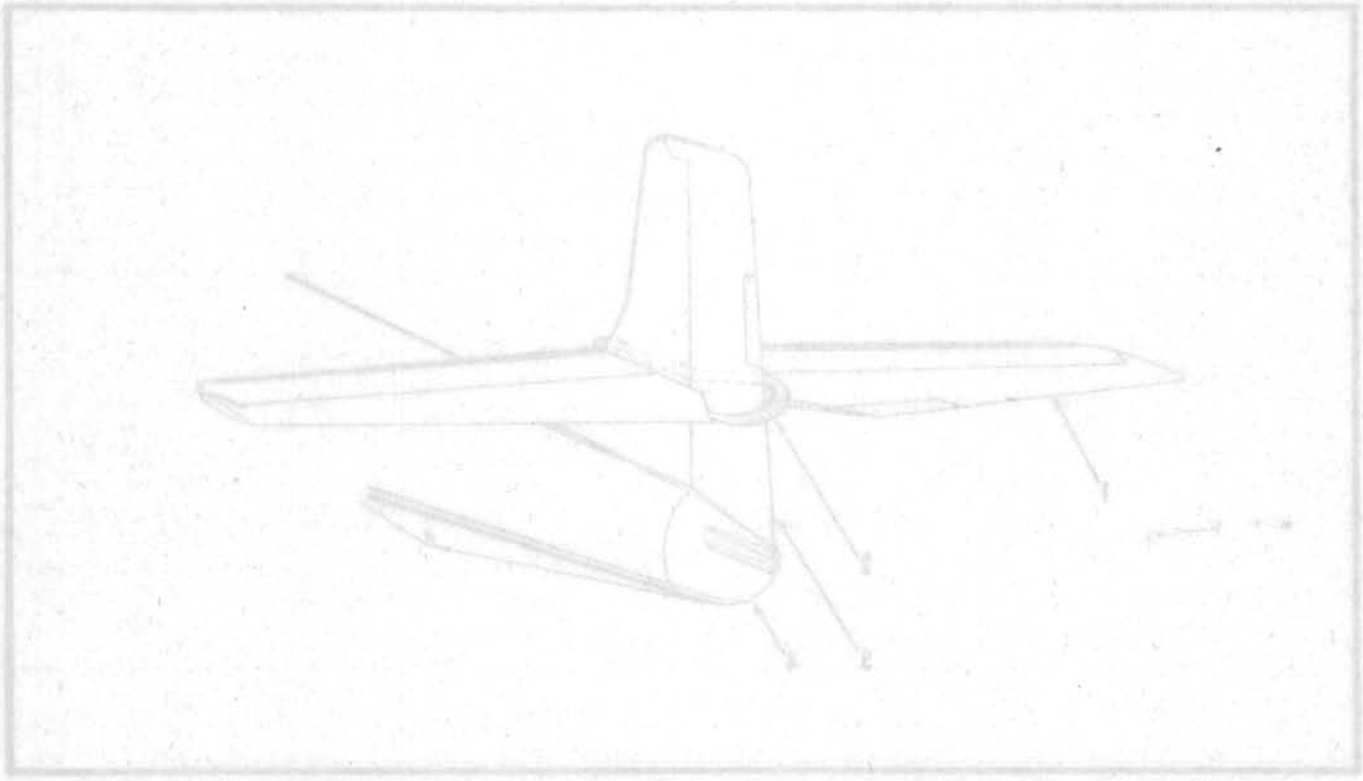
g. Adjust forward stops (see figure 1-17) to "bottom out" with aft stops then back off until a clearance of 1/16 inch is reached.

h. After stops are adjusted:

1. Check rudder for proper travel.
2. If adjustment is correct, remove sickle gage.

i. Make operational check of rudder system, using each set of pedals, checking freedom of movement and amount of travel. Install stinger.

1-52. RUDDER CABLES. (See figure 1-14.) The 1/8 inch stranded carbon steel rudder cables are routed from the forward bellcranks, through the tunnel area and tail cone to the rear rudder bellcrank. Each of the two cables can be divided into fore and aft sections at their respective turnbuckles which are accessible by removal of tunnel door No. 7. Tension adjustment is made at the turnbuckles. Correct rudder cable tension is 50±5 pounds at a temperature of 24°C(75°F).



SECTION II

SECONDARY FLIGHT CONTROL SYSTEMS

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2-1. SECONDARY FLIGHT CONTROL SYSTEMS.

2-2. DESCRIPTION. The secondary flight controls are magnesium constructed trim tabs that permit the pilot to trim the primary flight control surfaces at any time. This alleviates the necessity of constant pressure on the controls to maintain course and airplane stability. The trim tabs are linked mechanically with electrical actuators, installed forward of the hinge line, that serve as balance weights for their respective flight controls. There are three trim tabs, one in the left wing aileron, one in the left elevator, and one in the rudder. Each system is powered by the DC bus and protected by a 5 ampere circuit breaker.

TABLE II. Settings and Range of Movement of Secondary Flight Control Surfaces.

Control Surfaces	Travel		Reference Point	Tolerances	
	Degrees	Inches		Degrees	Inches
Aileron Trim - up	20	1.128	T. E. at Inboard end	+1° -1°	0.057
Aileron Trim - down	20	1.128	T. E. at Inboard end	+1° -1°	0.057
Elevator Trim - up	8	0.354	T. E. at Inboard end	+1° -1°	0.044
Elevator Trim - down	25	0.879	T. E. at Inboard end	+1° -1°	0.044
Rudder Trim - right	20	1.568	T. E. at Bottom of Tab	+1° -1°	0.079
Rudder Trim - left	20	1.564	T. E. at Bottom of Tab	+1° -1°	0.079

2-3. AILERON TRIM TAB SYSTEM.

2-4. DESCRIPTION. The aileron trim tab system includes a single trim tab hinged in the left wing aileron, a push-pull mechanical linkage between the tab and the actuator, a linear type, reversible, electric actuator, and a trim tab control switch mounted on top of the control stick grip. Operation of this system permits the pilot to trim the airplane longitudinally.

2-5. FUNCTIONAL DESCRIPTION. (See figure 2-2.) The trim tab switch, on top of the control stick, receives power from the DC bus. Closing the LH contact actuates the trim tab down-circuit, trimming the ailerons to drop the left wing. Closing the RH contact actuates the trim tab up-circuit, trimming the ailerons to drop the right wing. System actuation is continuous until the control switch is released. When relieved the switch automatically returns to the OFF position. The control switches are wired in parallel so that either will actuate both circuits. Trim tab travel from neutral to full up is 20° and from neutral to full down is 20°.

2-6. TROUBLE SHOOTING THE AILERON TRIM TAB SYSTEM.

TROUBLE	PROBABLE CAUSE	REMEDY
IMPROPER TAB TRAVEL	Tab not properly rigged.	Rig tab. See paragraph 2-12.
TRIM TAB DOES NOT ACTUATE	No power.	Check circuit breaker for IN.
	Defective control switch.	Check both stick grip aileron tab switches. If defective, remove.

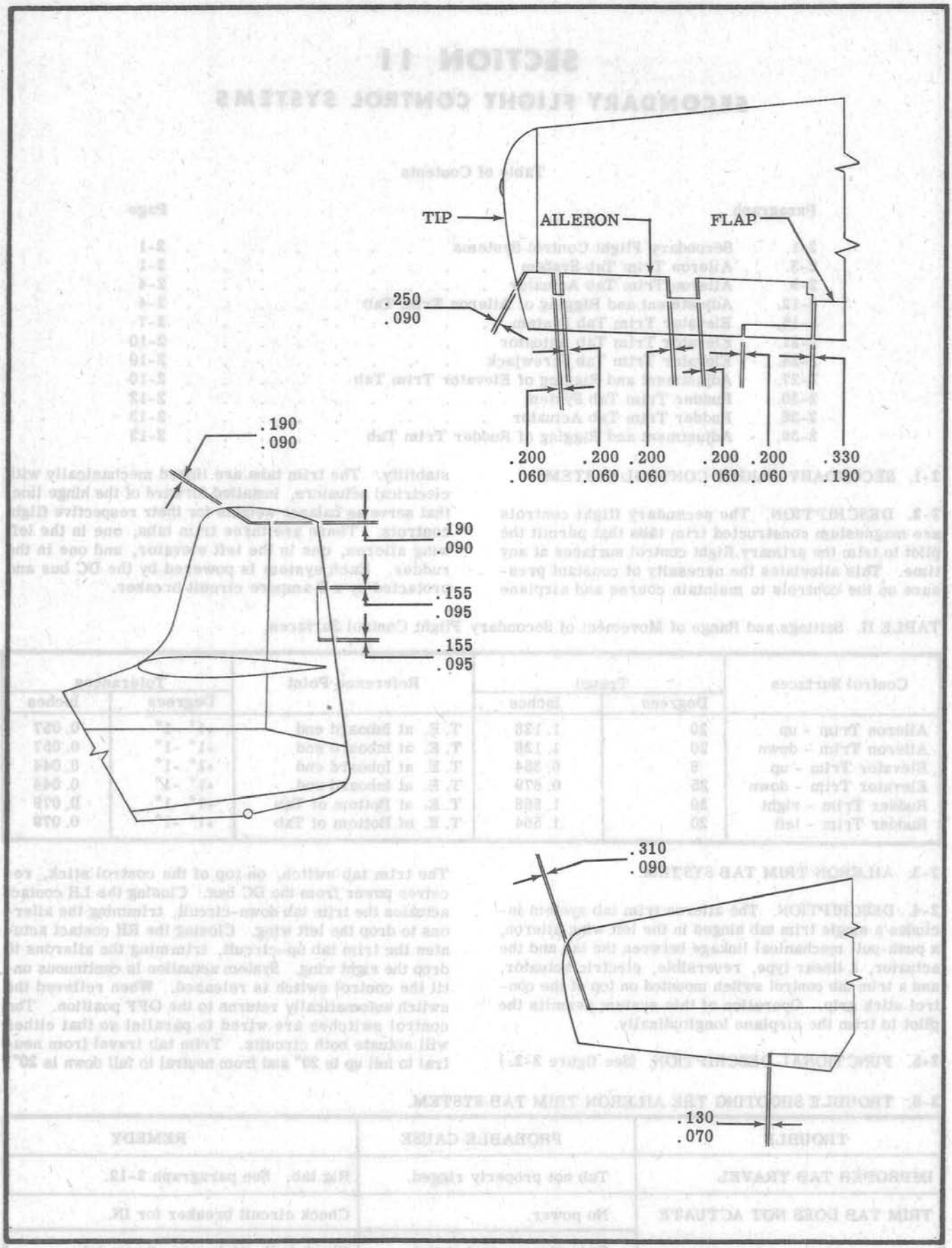
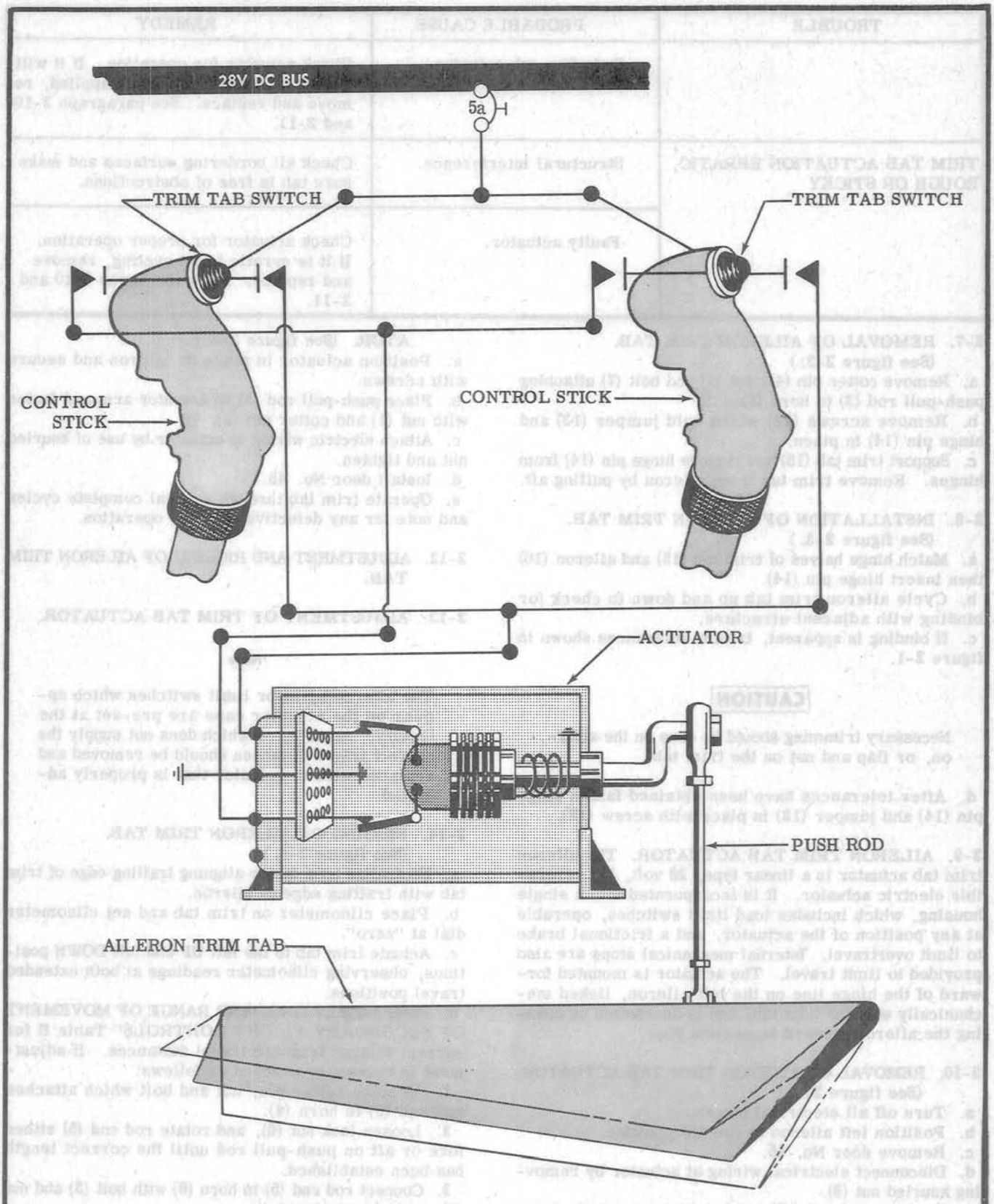


Figure 2-1. Secondary Control Surface Clearance Tolerances



NOTE: System Shown Electrical Power Off.

Figure 2-2. Aileron Trim Tab Electrical Schematic

TROUBLE	PROBABLE CAUSE	REMEDY
	Defective tab actuator.	Check actuator for operation. If it will not operate when current is applied, remove and replace. See paragraph 2-10 and 2-11.
TRIM TAB ACTUATION ERRATIC, ROUGH OR STICKY	Structural interference.	Check all bordering surfaces and make sure tab is free of obstructions.
	Faulty actuator.	Check actuator for proper operation. If it is erratic in its cycling, remove and replace. See paragraphs 2-10 and 2-11.

2-7. REMOVAL OF AILERON TRIM TAB. (See figure 2-3.)

a. Remove cotter pin (4), nut (5) and bolt (7) attaching push-pull rod (3) to horn (8).

b. Remove screws (12) which hold jumper (13) and hinge pin (14) in place.

c. Support trim tab (15) and remove hinge pin (14) from hinges. Remove trim tab from aileron by pulling aft.

2-8. INSTALLATION OF AILERON TRIM TAB. (See figure 2-3.)

a. Match hinge halves of trim tab (15) and aileron (16) then insert hinge pin (14).

b. Cycle aileron trim tab up and down to check for binding with adjacent structure.

c. If binding is apparent, trim to tolerances shown in figure 2-1.

CAUTION

Necessary trimming should be done on the aileron, or flap and not on the trim tab.

d. After tolerances have been obtained fasten hinge pin (14) and jumper (13) in place with screw (12).

2-9. AILERON TRIM TAB ACTUATOR. The aileron trim tab actuator is a linear type, 28 volt, DC reversible electric actuator. It is incorporated into a single housing, which includes load limit switches, operable at any position of the actuator, and a frictional brake to limit overtravel. Internal mechanical stops are also provided to limit travel. The actuator is mounted forward of the hinge line on the left aileron, linked mechanically with the trim tab, and is accessible by opening the aileron inboard inspection door.

2-10. REMOVAL OF AILERON TRIM TAB ACTUATOR. (See figure 2-3.)

a. Turn off all electrical power.

b. Position left aileron to full UP position.

c. Remove door No. 45.

d. Disconnect electrical wiring at actuator by removing knurled nut (8).

e. Remove cotter pin (2) and nut (1) from actuator arm and remove push-pull rod from actuator.

f. Remove screws (10) attaching actuator to aileron.

g. Remove actuator, letting the forward portion move down and out between the aileron and the wing.

2-11. INSTALLATION OF AILERON TRIM TAB ACTUATOR. (See figure 2-3.)

a. Position actuator in place on aileron and secure with screws.

b. Place push-pull rod (3) on actuator arm and fasten with nut (1) and cotter pin (2).

c. Attach electric wiring to actuator by use of knurled nut and tighten.

d. Install door No. 45.

e. Operate trim tab through several complete cycles and note for any defective actuator operation.

2-12. ADJUSTMENT AND RIGGING OF AILERON TRIM TAB.

2-13. ADJUSTMENT OF TRIM TAB ACTUATOR.

Note

The aileron actuator limit switches which appear on the actuator case are pre-set at the factory. An actuator which does not supply the correct travel distances should be removed and replaced with an actuator that is properly adjusted.

2-14. RIGGING OF AILERON TRIM TAB. (See figure 2-4.)

a. Neutralize trim tab by aligning trailing edge of trim tab with trailing edge of aileron.

b. Place clinometer on trim tab and set clinometer dial at "zero".

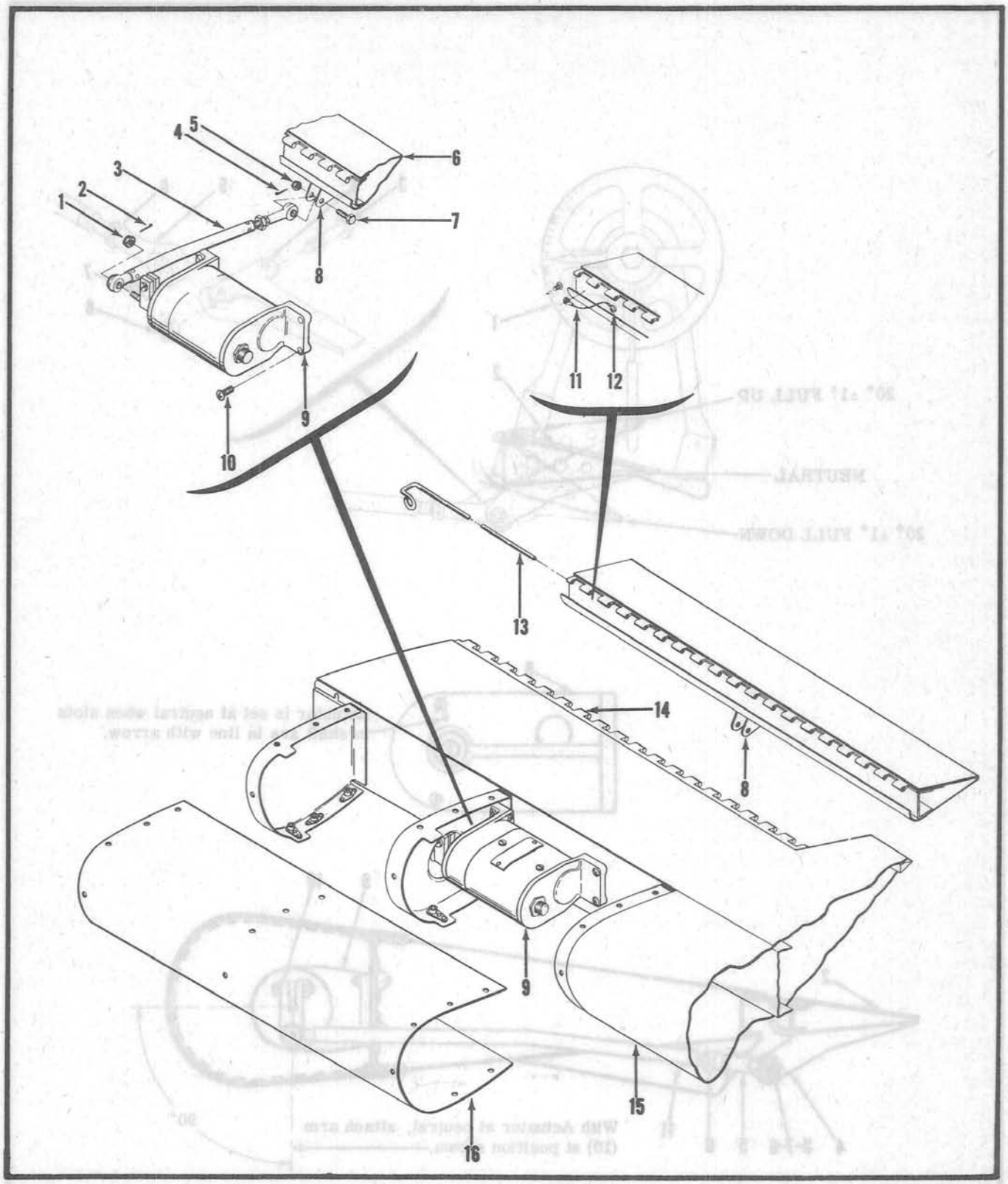
c. Actuate trim tab to the full UP and full DOWN positions, observing clinometer readings at both extended travel positions.

d. Refer to "SETTINGS AND RANGE OF MOVEMENT OF SECONDARY FLIGHT CONTROLS" Table II for correct aileron trim tab travel distances. If adjustment is necessary proceed as follows:

1. Remove cotter pin, nut and bolt which attaches rod end (5) to horn (4).
2. Loosen lock nut (6), and rotate rod end (5) either fore or aft on push-pull rod until the correct length has been established.
3. Connect rod end (5) to horn (6) with bolt (3) and nut (8), and repeat step "c".
4. Once the correct tab travel is reached install cotter pin (7) and tighten lock nut (6).

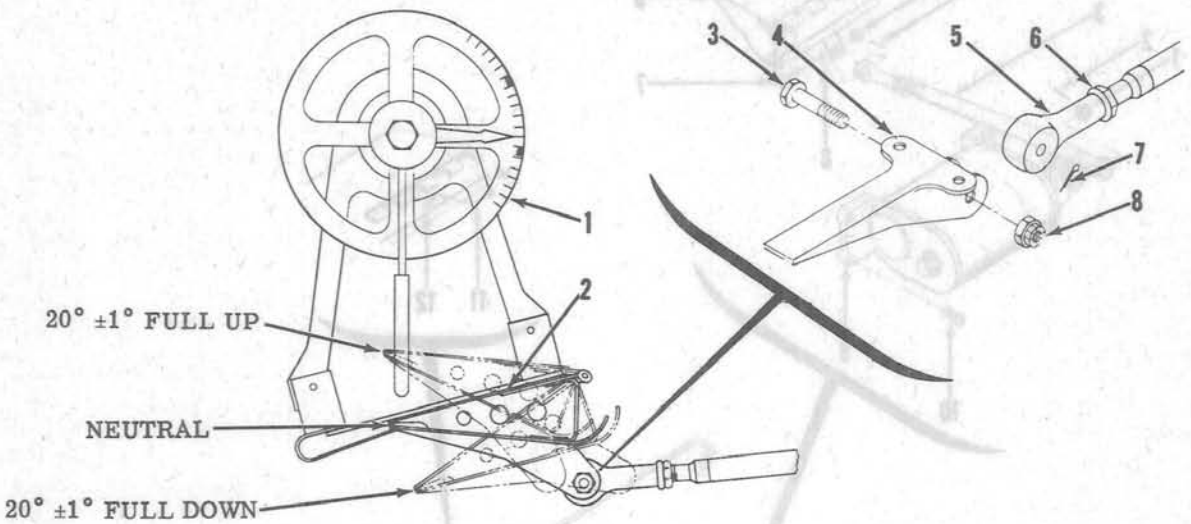
Note

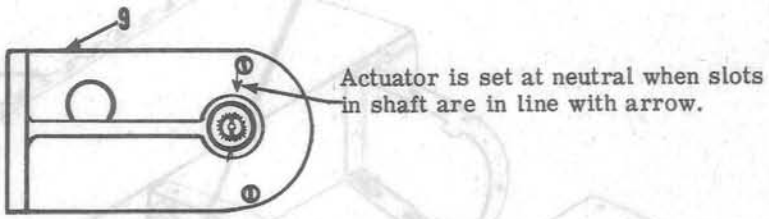
Check tab cycle for proper travel clearance.

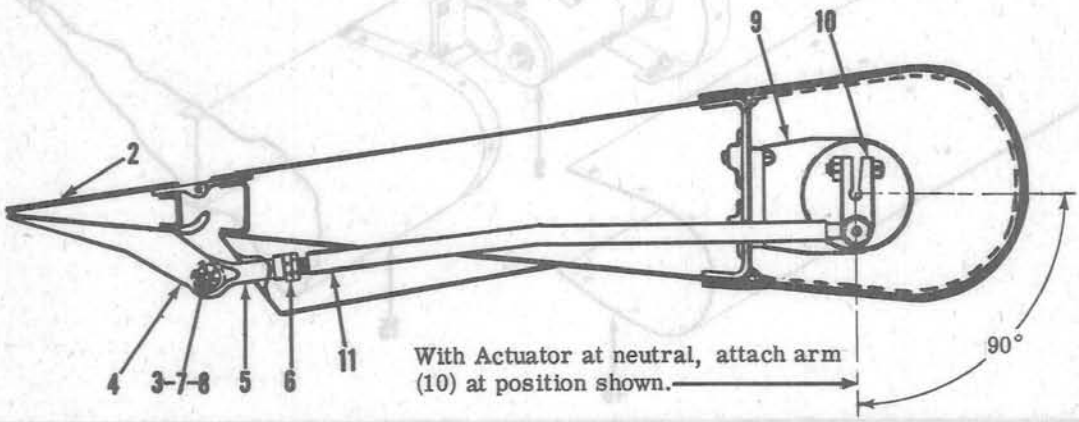


1. Nut
2. Cotter pin
3. Push-pull rod
4. Cotter pin
5. Nut
6. Trim tab
7. Bolt
8. Horn
9. Actuator
10. Screw
11. Jumper
12. Screw
13. Hinge pin
14. Hinge half
15. Aileron
16. Cover

Figure 2-3. Aileron Trim Tab Installation







1. Clinometer
2. Trim tab
3. Bolt
4. Horn
5. Rod end
6. Nut
7. Cotter pin
8. Nut
9. Actuator
10. Actuator arm
11. Push rod

Figure 2-4. Aileron Trim Tab Rigging

2-15. ELEVATOR TRIM TAB SYSTEM.

2-16. DESCRIPTION. The elevator trim tab system includes a single trim tab hinged in the left elevator, an actuating arm incorporated with a screwjack mounted in the left elevator, flexible drive shaft between the screwjack and the actuator, a linear type, DC reversible, electric actuator, and a trim tab control switch mounted on top of the control stick grip. Operation of this system permits the pilot to trim the airplane latterally.

2-17. FUNCTIONAL DESCRIPTION. (See figure 2-5.) The trim tab switch, on top of the control stick, receives power from the DC bus. By closing the up or forward contact the trim tab up-circuit is actuated, trimming the elevators to drop the nose. Closing the down or aft contact the trim tab down-circuit is actuated, trimming the elevators to drop the tail. The system actuation is continuous until the control switch is released. When directional pressure has been relieved the switch automatically returns to the OFF position. The control switches are wired in parallel so that either switch will actuate both circuits. The trim tab neutral position is indicated by a green light located directly above the directional gyro on the left shock panel in the cockpit. Trim tab travel from neutral to full up is 8° and from neutral to full down is 25° (See Table II).

2-18. TROUBLE SHOOTING THE ELEVATOR TRIM TAB SYSTEM.

TROUBLE	PROBABLE CAUSE	REMEDY
IMPROPER TRAVEL TO THE UP OR DOWN POSITION	Tabs not properly rigged.	Rig tabs. See paragraph 2-27.
TRIM TABS DO NOT ACTUATE UP OR DOWN	No power.	Check circuit breaker.
	Defective control switch.	Check both switches for operation. If either switch is inoperative remove hand grip and replace by loosening knurl nut and lifting from stick receptacle.
	Defective power unit.	Check power unit for operation, if it will not function when current is applied, remove and replace. See paragraphs 2-22 and 2-23.
	Defective screwjack.	Note A defective screwjack could cause the tab to be inoperative. Check screwjack. If defective remove and replace. See paragraph 2-25 and 2-26.
	Power unit brushes faulty.	Check power unit for proper operation. If it is erratic in its cycling remove and replace. See paragraphs 2-22 and 2-23.
	Tab ends binding on edges of elevator slot.	Remove tab in accordance with paragraph 2-19 and trim elevator.
TRIM TAB "NEUTRAL" LIGHT INOPERATIVE	Bulb burned out.	Check bulb for operation. If burned out, remove and replace.
	Indicator switch malfunctioning.	Check switch for operation. If faulty, remove and replace power unit. See paragraphs 2-22 and 2-23.
	Power unit malfunctioning.	Check power unit for proper operation. If operating improperly remove and replace in accordance with paragraphs 2-22 and 2-23.
TRIM TAB OVERTRAVEL	Defective limit switches in actuator.	Check actuator for proper operation. If faulty, remove and replace in accordance with paragraphs 2-22 and 2-23.

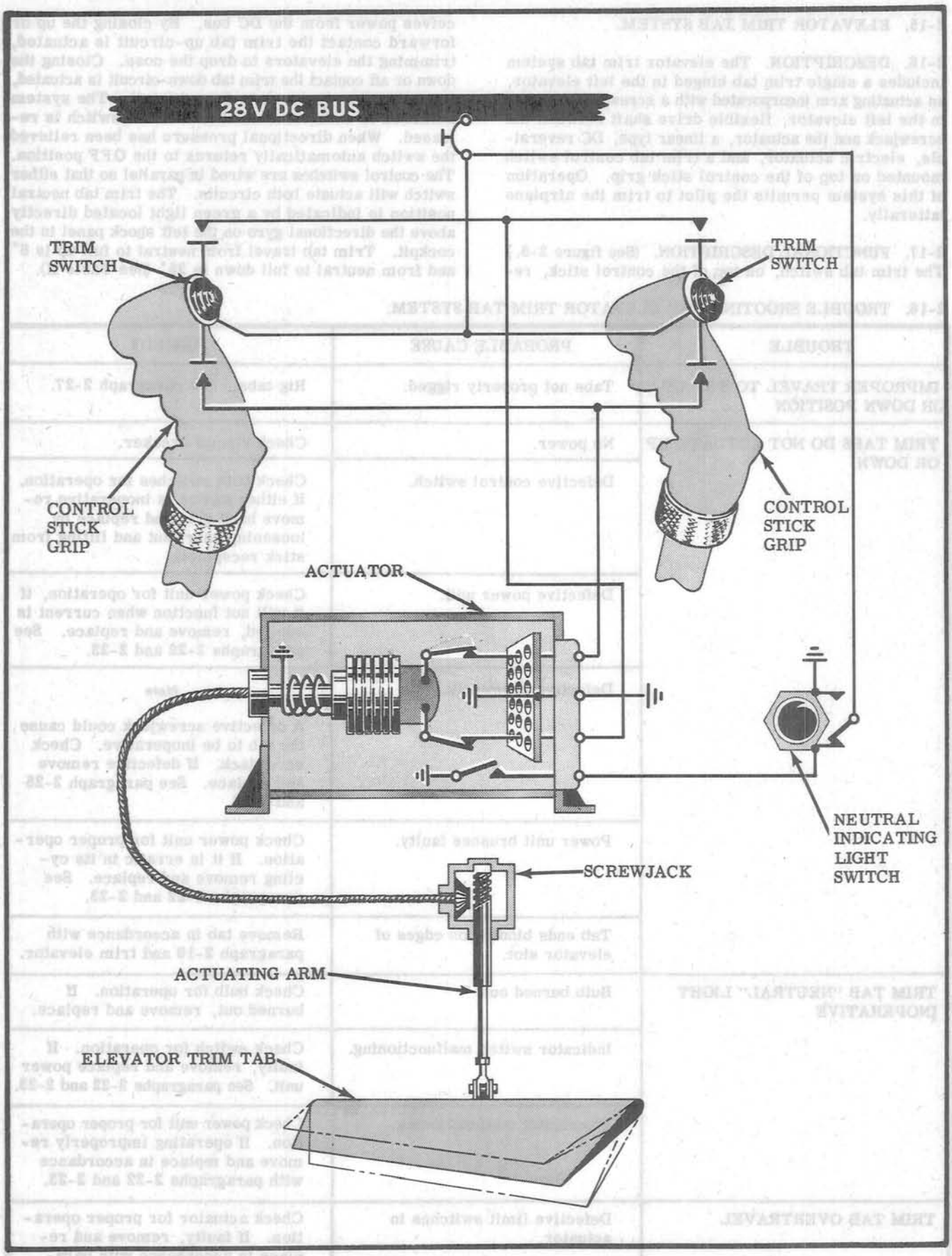
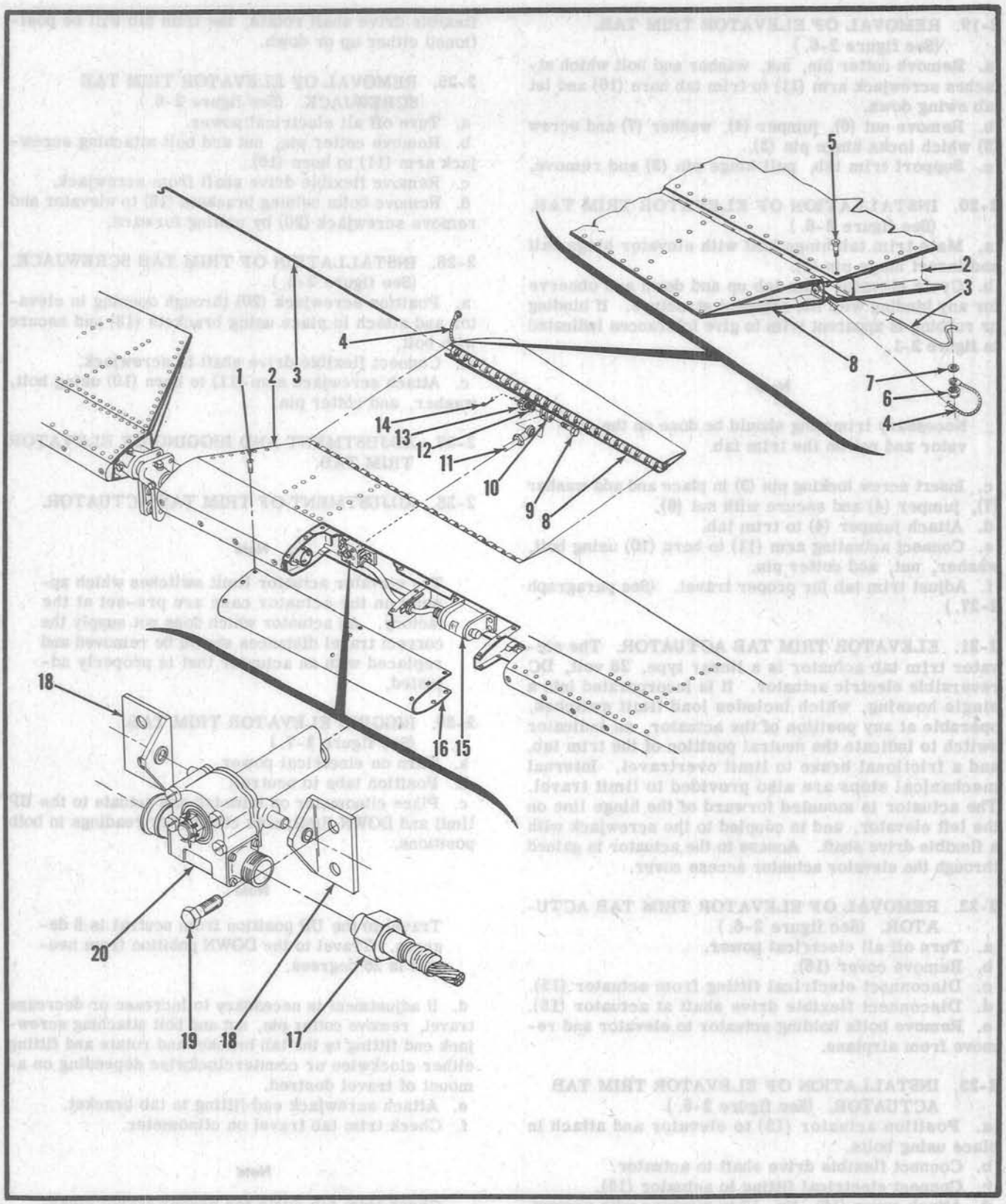


Figure 2-5. Elevator Trim Tab Electrical Schematic



1. Screw
2. Elevator
3. Pin
4. Jumper
5. Screw
6. Nut
7. Washer
8. Trim tab
9. Bolt
10. Horn
11. Screwjack arm
12. Washer
13. Nut
14. Cotter pin
15. Actuator
16. Cover
17. Nut
18. Bracket
19. Bolt
20. Screwjack

Figure 2-6. Elevator Trim Tab Installation

2-19. REMOVAL OF ELEVATOR TRIM TAB. (See figure 2-6.)

a. Remove cotter pin, nut, washer and bolt which attaches screwjack arm (11) to trim tab horn (10) and let tab swing down.

b. Remove nut (6), jumper (4), washer (7) and screw (5) which locks hinge pin (3).

c. Support trim tab, pull hinge pin (3) and remove.

2-20. INSTALLATION OF ELEVATOR TRIM TAB. (See figure 2-6.)

a. Mate trim tab hinge half with elevator hinge half and insert hinge pin (3).

b. Cycle elevator trim tab up and down and observe for any binding with the adjacent structure. If binding or rubbing is apparent trim to give tolerances indicated in figure 2-1.

Note

Necessary trimming should be done on the elevator and not on the trim tab.

c. Insert screw locking pin (3) in place and add washer (7), jumper (4) and secure with nut (6).

d. Attach jumper (4) to trim tab.

e. Connect actuating arm (11) to horn (10) using bolt, washer, nut, and cotter pin.

f. Adjust trim tab for proper travel. (See paragraph 2-27.)

2-21. ELEVATOR TRIM TAB ACTUATOR. The elevator trim tab actuator is a linear type, 28 volt, DC reversible electric actuator. It is incorporated into a single housing, which includes load limit switches, operable at any position of the actuator, an indicator switch to indicate the neutral position of the trim tab, and a frictional brake to limit overtravel. Internal mechanical stops are also provided to limit travel. The actuator is mounted forward of the hinge line on the left elevator, and is coupled to the screwjack with a flexible drive shaft. Access to the actuator is gained through the elevator actuator access cover.

2-22. REMOVAL OF ELEVATOR TRIM TAB ACTUATOR. (See figure 2-6.)

a. Turn off all electrical power.

b. Remove cover (16).

c. Disconnect electrical fitting from actuator (15).

d. Disconnect flexible drive shaft at actuator (15).

e. Remove bolts holding actuator to elevator and remove from airplane.

2-23. INSTALLATION OF ELEVATOR TRIM TAB ACTUATOR. (See figure 2-6.)

a. Position actuator (15) to elevator and attach in place using bolts.

b. Connect flexible drive shaft to actuator.

c. Connect electrical fitting to actuator (15).

d. Attach cover (16), No. 17 to elevator with screws.

2-24. ELEVATOR TRIM TAB SCREWJACK. The left elevator mounts a screwjack on its front spar which is used to transfer the rotary motion of the actuator and flexible drive shaft to a push pull motion. This push-pull motion is then directed to the trim tab by the screwjack arm. Thus, whenever the actuator and flexible drive shaft rotate, the trim tab will be positioned either up or down.

2-25. REMOVAL OF ELEVATOR TRIM TAB SCREWJACK. (See figure 2-6.)

a. Turn off all electrical power.

b. Remove cotter pin, nut and bolt attaching screwjack arm (11) to horn (10).

c. Remove flexible drive shaft from screwjack.

d. Remove bolts holding brackets (18) to elevator and remove screwjack (20) by pulling forward.

2-26. INSTALLATION OF TRIM TAB SCREWJACK. (See figure 2-6.)

a. Position screwjack (20) through opening in elevator and attach in place using brackets (18) and secure with bolt.

b. Connect flexible drive shaft to screwjack.

c. Attach screwjack arm (11) to horn (10) using bolt, washer, and cotter pin.

2-27. ADJUSTMENT AND RIGGING OF ELEVATOR TRIM TAB.

2-28. ADJUSTMENT OF TRIM TAB ACTUATOR.

Note

The elevator actuator limit switches which appear on the actuator case are pre-set at the factory. An actuator which does not supply the correct travel distances should be removed and replaced with an actuator that is properly adjusted.

2-29. RIGGING ELEVATOR TRIM TAB. (See figure 2-7.)

a. Turn on electrical power.

b. Position tabs to neutral.

c. Place clinometer on trim tab and actuate to the UP limit and DOWN limit; note clinometer readings in both positions.

Note

Travel to the UP position from neutral is 8 degrees. Travel to the DOWN position from neutral is 25 degrees.

d. If adjustment is necessary to increase or decrease travel, remove cotter pin, nut and bolt attaching screwjack end fitting to the tab bracket and rotate and fitting either clockwise or counterclockwise depending on amount of travel desired.

e. Attach screwjack end fitting to tab bracket.

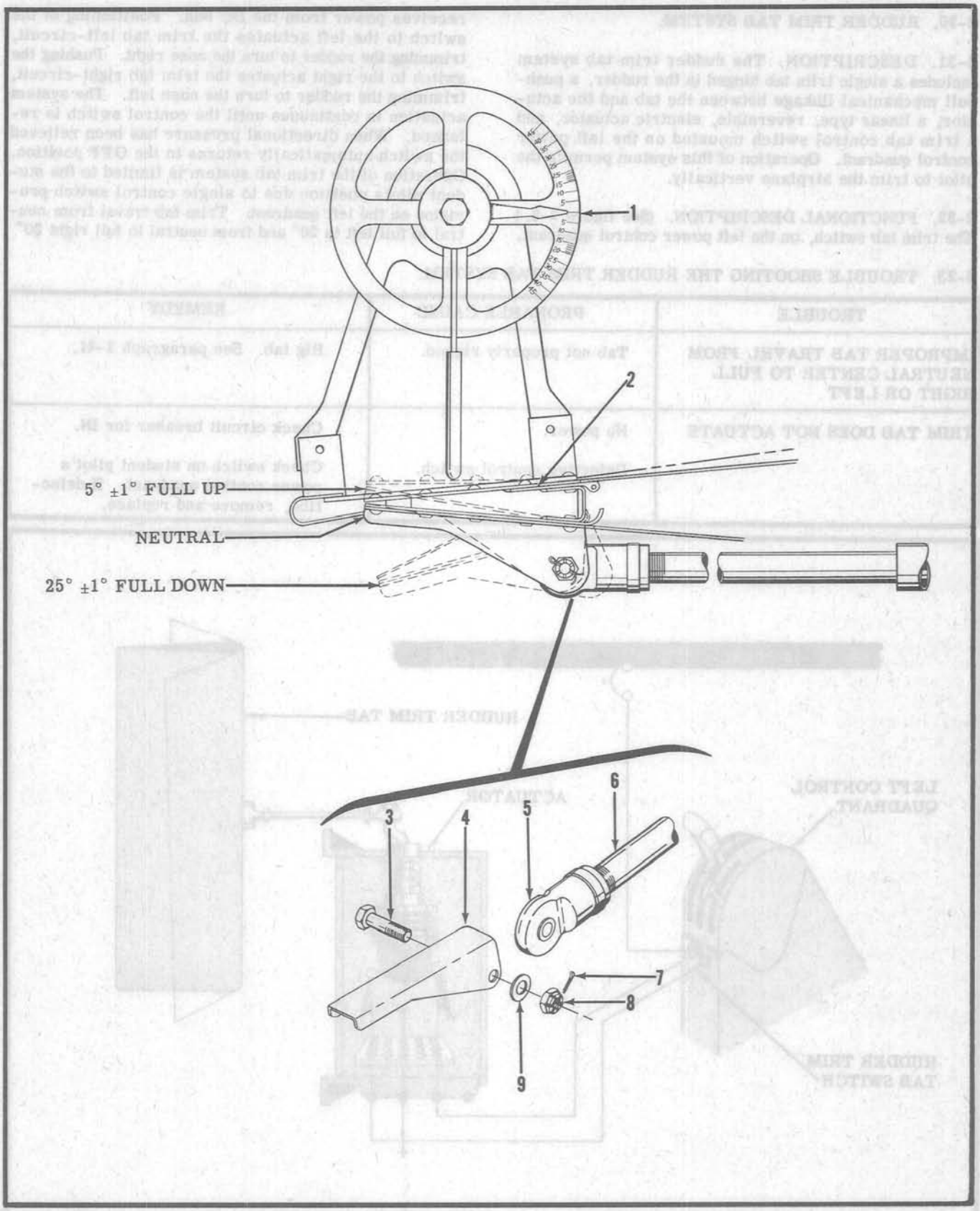
f. Check trim tab travel on clinometer.

Note

Check trim tab cycle for proper travel clearance. If binding is present trim edges of elevator slot in accordance with tolerances given in figure 2-1, and the procedure given in paragraph 2-20.

g. Tighten nut and install cotter pin.

h. Remove clinometer from trim tab.



1. Clinometer
2. Trim tab
3. Bolt
4. Horn
5. Screwjack end
6. Screwjack arm
7. Cotter pin
8. Nut
9. Washer

Figure 2-7. Elevator Trim Tab Rigging

2-30. RUDDER TRIM TAB SYSTEM.

2-31. DESCRIPTION. The rudder trim tab system includes a single trim tab hinged in the rudder, a push-pull mechanical linkage between the tab and the actuator, a linear type, reversible, electric actuator, and a trim tab control switch mounted on the left power control quadrant. Operation of this system permits the pilot to trim the airplane vertically.

2-32. FUNCTIONAL DESCRIPTION. (See figure 2-8.) The trim tab switch, on the left power control quadrant, receives power from the DC bus. Positioning of the switch to the left actuates the trim tab left-circuit, trimming the rudder to turn the nose right. Pushing the switch to the right actuates the trim tab right-circuit, trimming the rudder to turn the nose left. The system actuation is continuous until the control switch is released. When directional pressure has been relieved the switch automatically returns to the OFF position. Operation of the trim tab system is limited to the student pilots position due to single control switch provision on the left quadrant. Trim tab travel from neutral to full left is 20° and from neutral to full right 20°

2-23. TROUBLE SHOOTING THE RUDDER TRIM TAB SYSTEM.

TROUBLE	PROBABLE CAUSE	REMEDY
IMPROPER TAB TRAVEL FROM NEUTRAL CENTER TO FULL RIGHT OR LEFT	Tab not properly rigged.	Rig tab. See paragraph 2-41.
TRIM TAB DOES NOT ACTUATE	No power.	Check circuit breaker for IN.
	Defective control switch.	Check switch on student pilot's power control quadrant. If defectibe, remove and replace.

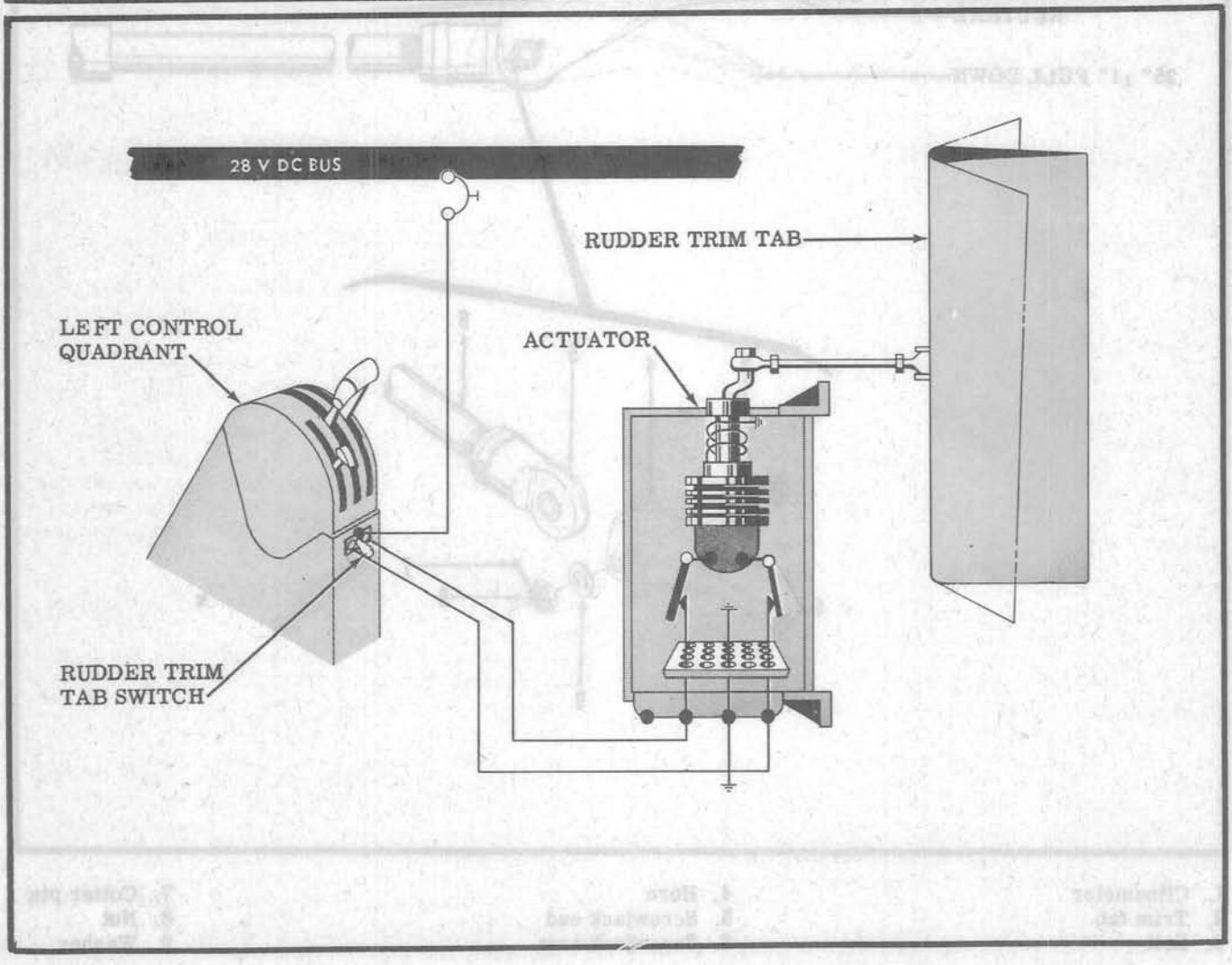


Figure 2-8. Rudder Trim Tab Electrical Schematic

TROUBLE	PROBABLE CAUSE	REMEDY
	Defective tab actuator.	Check actuator for operation if it will not operate when current is applied, remove and replace. See paragraph 2-37 and 2-38.
TRIM TAB ACTUATION ERRATIC, ROUGH AND STICKY	Structural interference.	Check all bordering surfaces and make sure tab is free of obstruction.
	Faulty actuator.	Check actuator for proper operation. If it is erratic in its cycling, remove and replace. See paragraph 2-37 and 2-38.

2-34. REMOVAL OF RUDDER TRIM TAB. (See figure 2-9.)

a. Turn off electrical power. Remove door No. 13.
b. Remove cotter pin, nut, washer, jumper, and bolt which attaches push-pull rod (9) to horn (8).
c. Remove nut (2), pin stop (3), and screw (4).
d. Pull out hinge pin (5). Remove trim tab.

2-35. INSTALLATION OF RUDDER TRIM TAB. (See figure 2-9.)

a. Fit trim tab (6) to rudder (1) by matching tab and rudder hinges.
b. Insert pin (5) thru door No. 13.
c. Cycle rudder trim tab left and right and observe for any binding with the adjacent structure. If binding or rubbing is apparent trim to give tolerances indicated in figure 2-1.

Note

Necessary trimming should be done on the rudder and not on the trim tab.

d. Secure pin (5) in place with pin stop (3), screw (2) and nut (4). Install door No. 13.
e. Connect push-pull rod (9) to horn (8) using bolt (7),

2-36. RUDDER TRIM TAB ACTUATOR. The rudder trim tab actuator is a linear type, 28 volt, DC reversible electric actuator. It is incorporated into a single housing, which includes load limit switches operable at any position of the actuator, and a frictional brake to limit overtravel. Internal mechanical stops are also provided to limit travel. The actuator is mounted forward of the hinge line of the rudder and is linked mechanically with the trim tab. It is accessible by removing the actuator access cover from the leading edge of the rudder.

2-37. REMOVAL OF RUDDER TRIM TAB ACTUATOR. (See figure 2-9.)

a. Turn off all electrical power.
b. Remove access cover 14.
c. Remove electrical connection from tab actuator (19).
d. Remove cotter pin (16), nut (15), and washer (17) attaching push rod (9) to actuator (19).
e. Remove bolts (23) attaching actuator to front spar, and remove actuator from rudder.

2-38. INSTALLATION OF RUDDER TRIM TAB ACTUATOR. (See figure 2-9.)

a. Position actuator (19) on rudder front spar and secure with bolts (23).
b. Connect push-pull rod (9) to actuator (19) with the washer (17), nut (15), and cotter pin (16).
c. Install electrical fitting (20) to actuator (19).
d. Install rudder trim tab cover 14 and secure with screws.

2-39. ADJUSTMENT AND RIGGING OF RUDDER TRIM TAB.

2-40. ADJUSTMENT OF TRIM TAB ACTUATOR.

Note

The rudder actuator is not adjustable. If the actuator does not supply the correct travel distance it should be removed and replaced with an actuator that is properly adjusted.

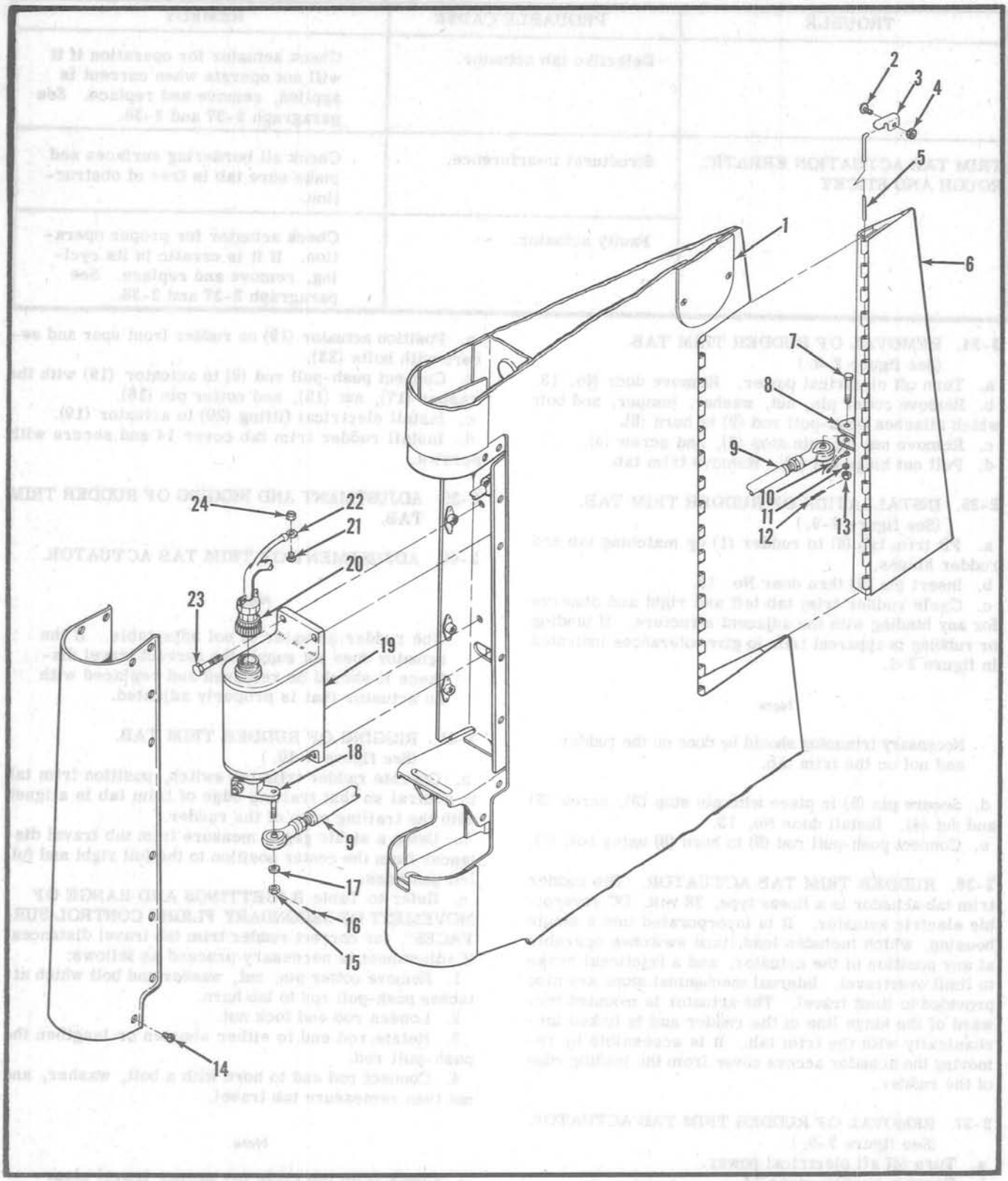
2-41. RIGGING OF RUDDER TRIM TAB. (See figure 2-10.)

a. Operate rudder trim tab switch, position trim tab to neutral so that trailing edge of trim tab is aligned with the trailing edge of the rudder.
b. Using a sickle gage, measure trim tab travel distances from the center position to the full right and full left positions.
c. Refer to Table II "SETTINGS AND RANGE OF MOVEMENT OF SECONDARY FLIGHT CONTROL SURFACES", for correct rudder trim tab travel distances. If adjustment is necessary proceed as follows:
1. Remove cotter pin, nut, washer and bolt which attaches push-pull rod to tab horn.
2. Loosen rod end lock nut.
3. Rotate rod end to either shorten or lengthen the push-pull rod.
4. Connect rod end to horn with a bolt, washer, and nut then remeasure tab travel.

Note

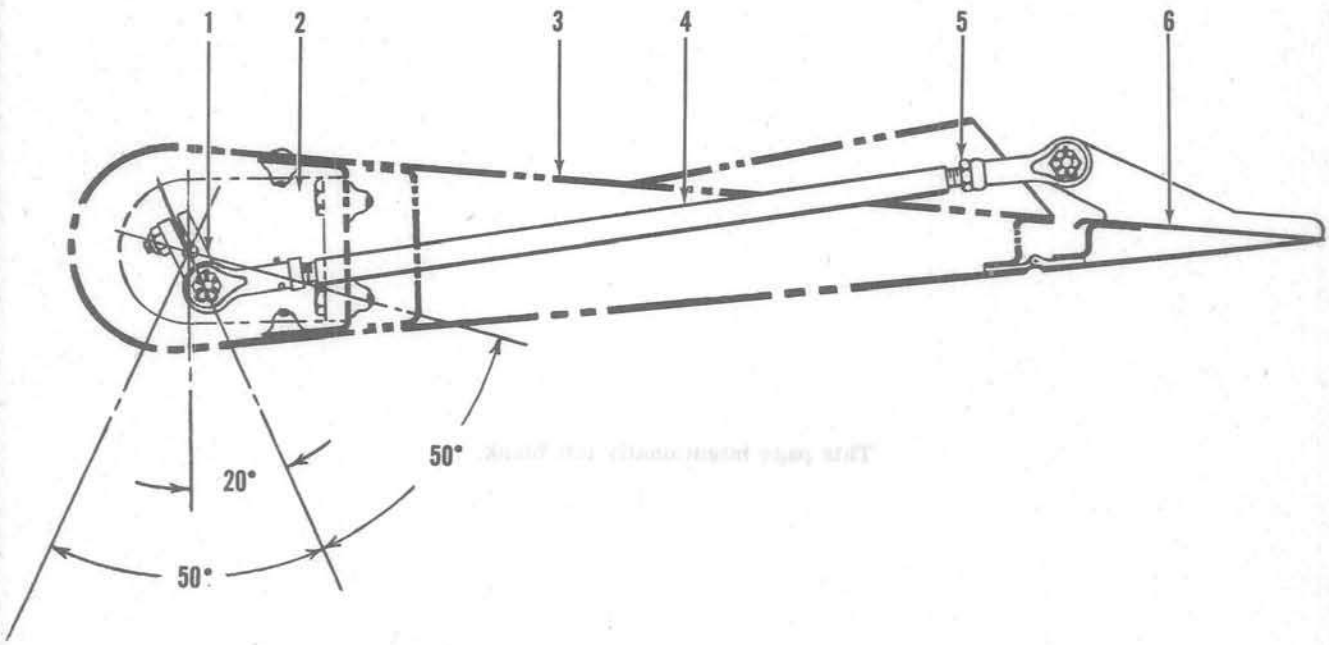
Check trim tab cycle for proper travel clearance. If binding is present trim edges of elevator slot in accordance with tolerances given in figure 2-1.

5. When the correct tab travel has been attained, tighten rod end lock nut.
6. Then tighten attaching nut and install cotter pin.
d. Remove sickle gage.



1. Access door
2. Screw
3. Pin stop
4. Nut
5. Hinge pin
6. Trim tab
7. Bolt
8. Horn
9. Push-pull rod
10. Jumper
11. Washer
12. Cotter pin
13. Nut
14. Screw
15. Nut
16. Cotter pin
17. Washer
18. Actuator arm
19. Actuator
20. Coupling
21. Screw
22. Ground wire
23. Bolt
24. Nut

Figure 2-9. Rudder Trim Tab Installation



NOTE: Prior to installing new actuator, arm (1) must be in position shown when tab is neutral.

1. Actuator arm
2. Actuator
3. Rudder
4. Push-pull rod
5. Nut
6. Trim tab

Figure 2-10. Rudder Trim Tab Rigging

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T.O. NO. 1T-37A-2-5

HANDBOOK

MAINTENANCE INSTRUCTIONS

POWER PLANT, FUEL SYSTEM AND OIL SYSTEM

USAF SERIES

T-37A

AIRCRAFT

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE

McCORMICK-ARMSTRONG, WICHITA, 1100, 5-14-56

31 MARCH 1956

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POWER PLANT, FUEL SYSTEM AND OIL SYSTEM

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INTRODUCTION

This handbook is one of a series of handbooks of the T.O. No. 1T-37A-2 sectionalized maintenance handbook. Information in this handbook covers operational check out, trouble shooting, removal, installation and adjustments of the power plant, fuel system and oil system to be accomplished by line maintenance personnel. Illustrations have been used throughout the handbook to supplement the text. The following is a list of the other handbooks of the T.O. No. 1T-37A-2 sectionalized maintenance handbook.

T.O. No. 1T-37A-2-1	General Airplane
T.O. No. 1T-37A-2-2	Ground Handling, Servicing and Airframe Group Maintenance
T.O. No. 1T-37A-2-3	Hydraulically Operated Systems and Utility Systems
T.O. No. 1T-37A-2-4	Flight Control Systems
T.O. No. 1T-37A-2-6	Instruments, Radio, Communication and Navigation Equipment
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POWER PLANT

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1-1. POWER PLANT.

1-2. GENERAL DESCRIPTION. The two engines which provide power for this aircraft are mounted in the engine nacelles. The basic right and left engines are identical, therefore, to avoid confusion only one engine is described. The J-69-T-9 turbo-jet engine consists of a single stage centrifugal compressor, a straight-through-flow annular combustion chamber, and a single stage axial-flow turbine which is mounted on a common shaft with the compressor. The turbine and the compressor housings are bolted together providing structural support for the compressor, turbine and shaft. Power is taken from the rotor shaft to drive the accessories which fan out across the base of the compressor housing. Included with the engine is the fuel system which schedules fuel flow, the oil system which lubricates the rotating parts, and the starting system which brings the rotor assembly up to starting speed and ignites the fuel-air mixture. Compressor air is bled from the engine for cabin heating and defrosting and the engine also drives the hydraulic pump and starter generator and tachometer generator which supply hydraulic and electrical power to the aircraft.

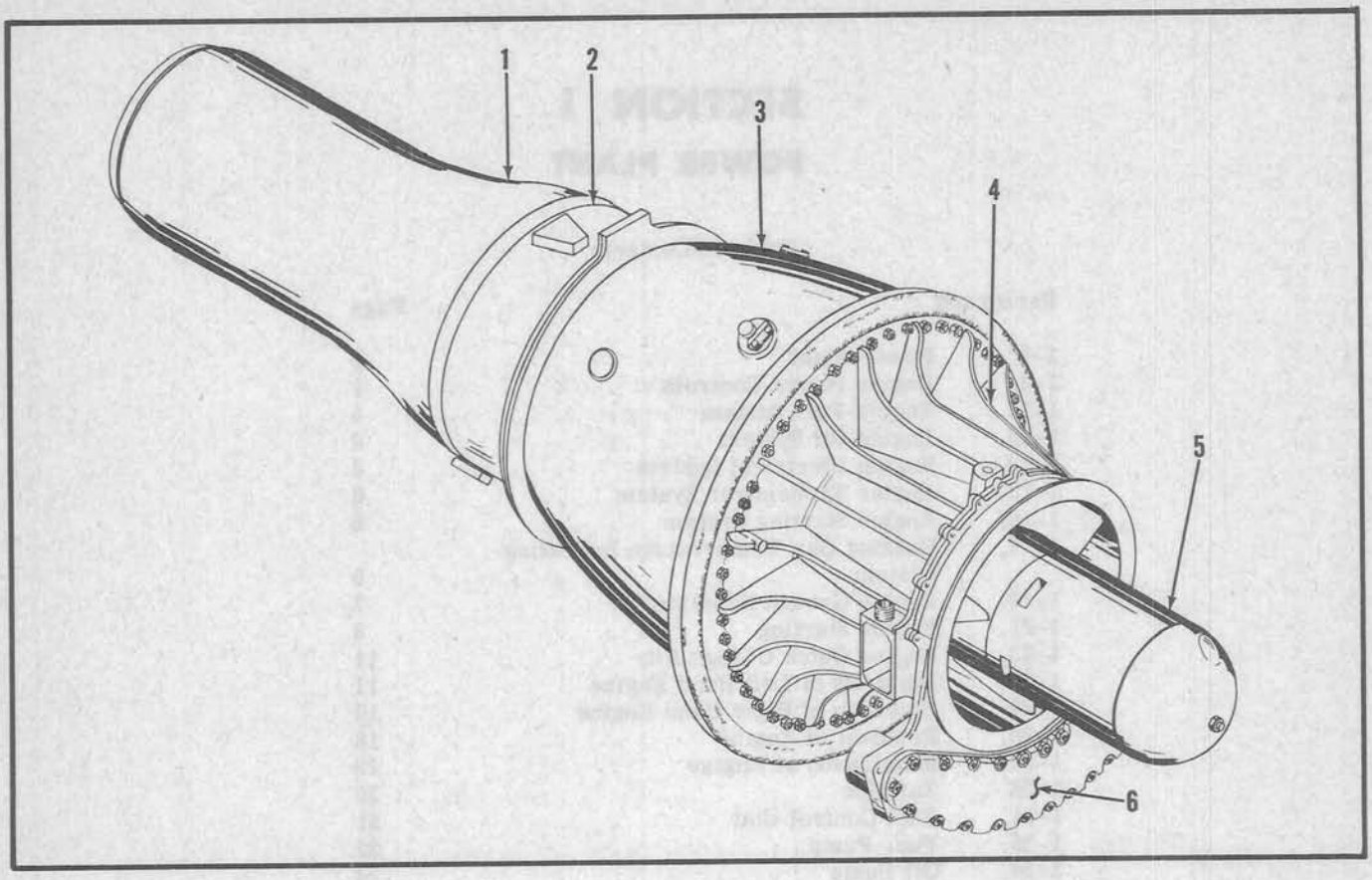
1-3. ENGINE POWER CONTROLS. There are two interconnected power control quadrants located in the cockpit, one for the student and one for the instructor. The student's quadrant is located against the left side of the cockpit and the instructor's quadrant is located in the center. Each quadrant consists of a right and left power control lever which actuates mechanical linkage to its respective engine fuel control unit. Idle stops are provided on the student's throttle quadrant which prevents inadvertent cut-off of either engine during deceleration. On the side of the student's power control quadrant is a friction adjustment knob which can be used to vary the resistance to control lever movement, preventing creepage of the power control levers.

1-4. REMOVAL OF POWER CONTROLS FORWARD TORQUE TUBES. (See figure 1-3.)

Note

Both torque tubes are removed in a similar manner.

a. Remove cotter pin (75), washer (74) and pin (68) which attaches push rod (67) to bellcrank (70).
b. Remove triangular shaped access plate on center power quadrant support.
c. Remove cotter pin (82), washer (83), and pin (85) which attaches push rod (84) to bellcrank (81).
d. Remove cotter pin (86), washer (87) and pin (78) which attaches push rod (88) to bellcrank (81).
e. Remove nut (72), washer (71) and pin (69).
f. Remove bellcrank (70) and spacer (73) from torque tube (76).
g. Remove nut (80), washer (79), and pin (77).



1. Tailpipe
2. Exhaust diffuser
3. Turbine housing
4. Compressor housing
5. Starter-generator
6. Accessory drive case

Figure 1-1. Power Plant

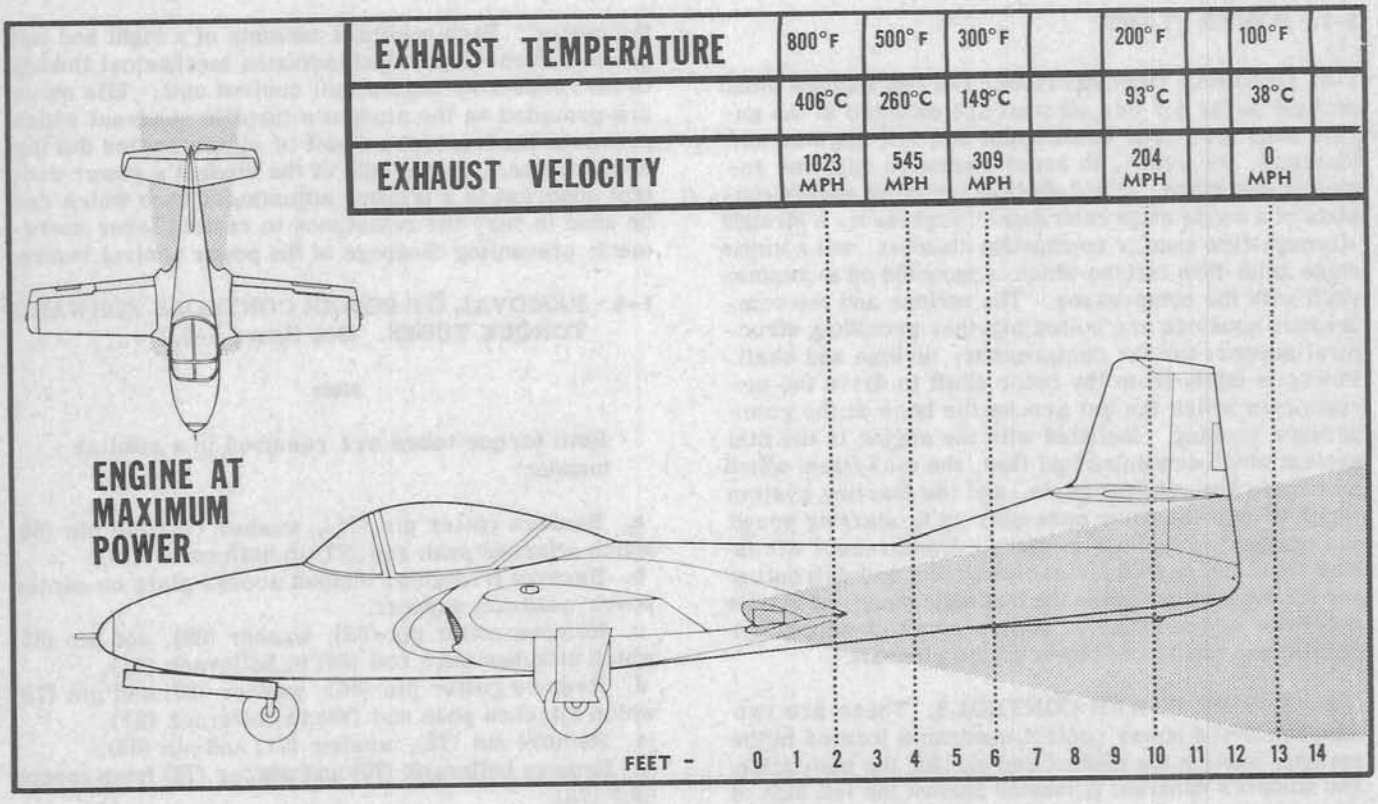


Figure 1-2. Danger Areas

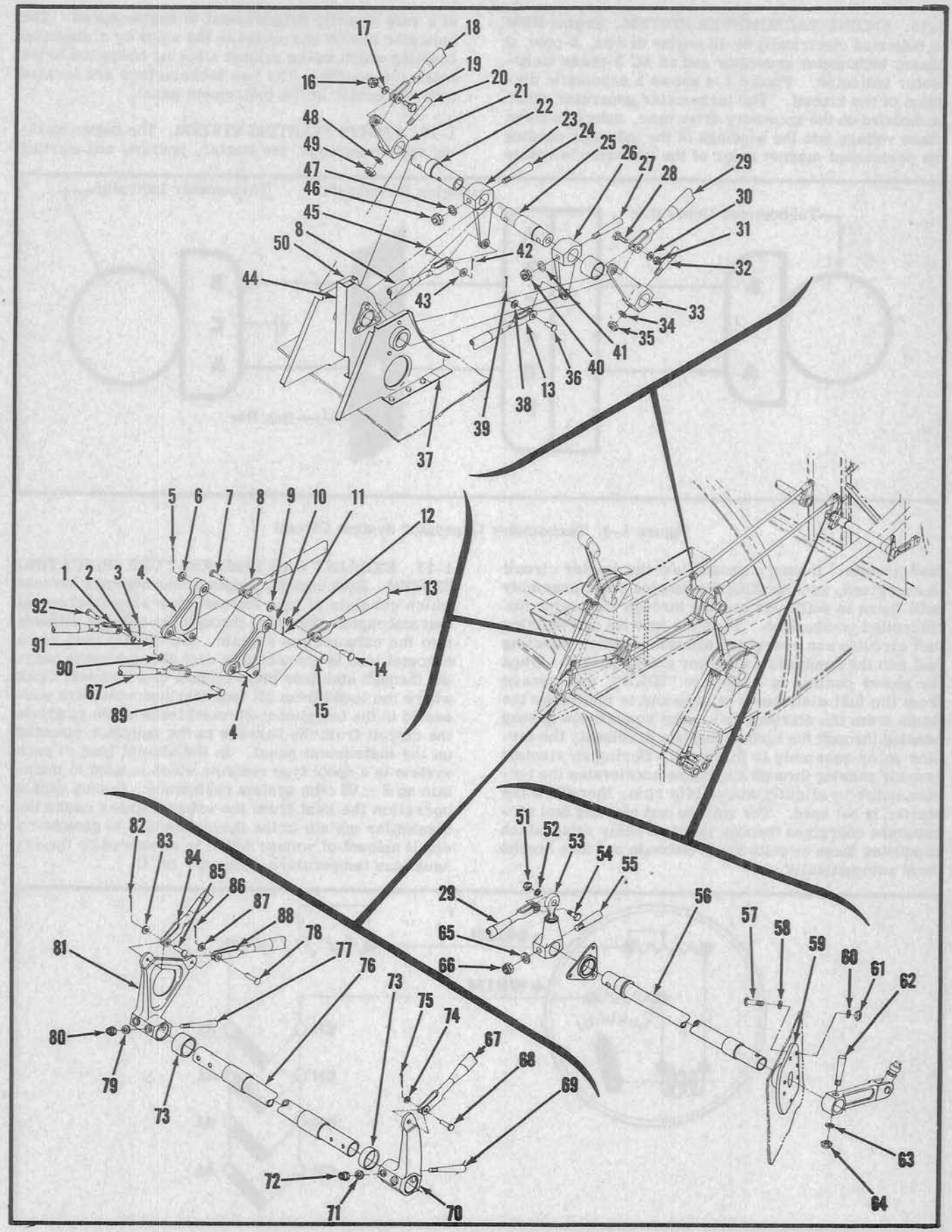


Figure 1-3. Power Controls Installation

1-15. ENGINE TACHOMETER SYSTEM. Engine RPM is indicated electrically by an engine driven, 2-pole, 3 phase, tachometer generator and an AC 3-phase tachometer indicator. Figure 1-4 shows a schematic diagram of the circuit. The tachometer generator which is mounted on the accessory drive case, induces a three phase voltage into the windings of the indicator causing the permanent magnet rotor of the indicator to rotate at a rate directly proportional to engine speed. The indicator needle is coupled to the rotor by a magnetic coupling which works against a spring connected to the indicator needle. The two tachometers are located near the center of the instrument panel.

1-16. ENGINE STARTING SYSTEM. The engine starting system includes, the starter, ignition, and starting

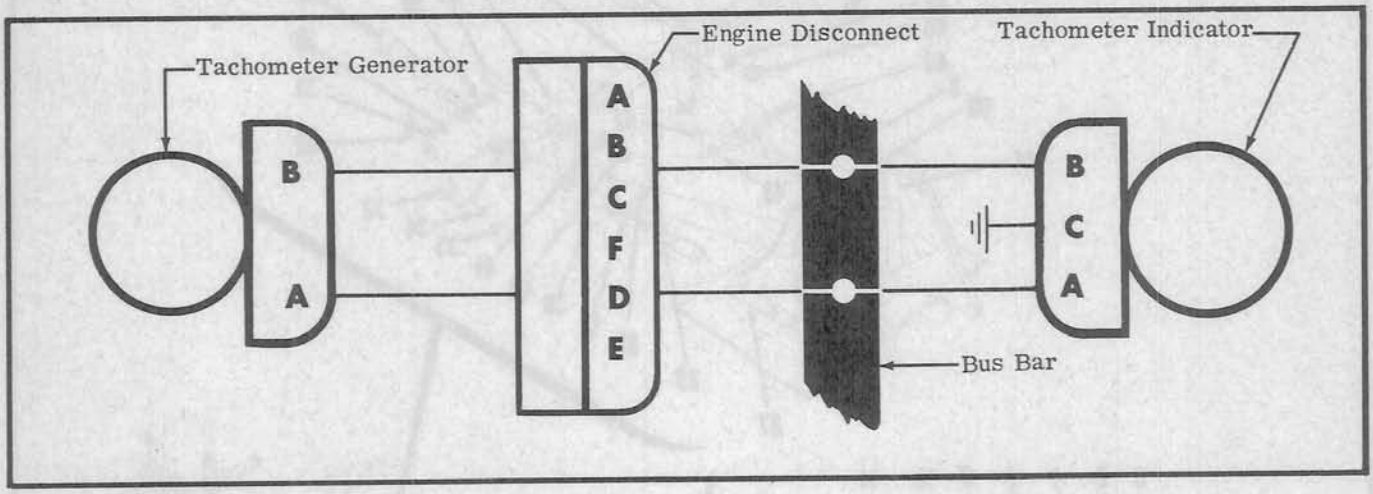


Figure 1-4. Tachometer Generator System Circuit

fuel circuits. During a ground test the starter circuit is energized, accelerating the turbine rotor assembly until there is sufficient airflow through the engine for controlled combustion. Then the ignition and starting fuel circuits are energized simultaneously, injecting fuel into the combustion chamber and igniting it. When the power control is opened to "IDLE", fuel sprays from the fuel distributor nozzle and is ignited by the flame from the starting fuel. The combustion gasses passing through the turbine buckets accelerate the turbine rotor assembly to dile rpm. During an airstart ram air passing through the engine accelerates the turbine rotor to slightly above idle rpm, therefore the starter is not used. The ignition and starting fuel circuits are energized through the time delay relay which completes these circuits for 30 seconds and then breaks them automatically.

1-17. EXHAUST GAS TEMPERATURE INDICATING SYSTEM. Each engine includes a thermocouple harness which consists of four bayonet type alumel-chromel thermocouples extending through the exhaust diffuser into the exhaust gas stream. An alumel lead and a chromel lead is connected to each thermocouple passing through stainless steel conduit to a terminal block where the leads from all four thermocouples are connected to the two alumel-chromel leads which complete the circuit from the harness to the indicator mounted on the instrument panel. In the alumel lead of each system is a spool type resistor which is used to maintain on 8 ±.05 ohm system resistance. During engine operation the heat from the exhaust gases cause the dissimilar metals in the thermocouples to generate a small amount of voltage which is measured by the exhaust gas temperature indicator in °C.

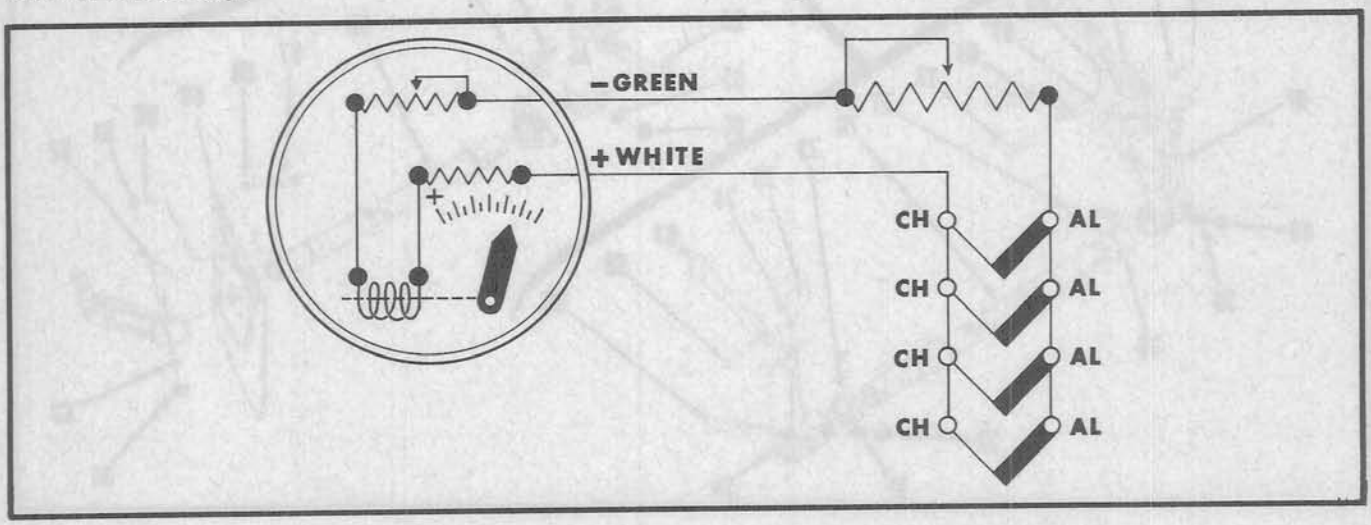


Figure 1-5. Exhaust Gas Temperature Indicating Circuit

h. Remove bellcrank (81), and spacer (73) from torque tube (76).
i. Remove torque tube by pulling it to the right side of the airplane until it is free from the bearings.

1-5. INSTALLATION OF POWER CONTROLS FORWARD TORQUE TUBES. (See figure 1-3.)

Note

Both torque tubes are installed in a similar manner.

a. Insert torque tube (76) through bearings.
b. Position spacer (73) and bellcrank (70) over torque tube (76).
c. Attach bellcrank (70) to torque tube (76) with pin (69), washer (71) and secure with nut (72).
d. Position spacer (73) and bellcrank (81) over torque tube (76).
e. Attach bellcrank (81) to torque tube (76) with pin (77), washer (79) and secure with nut (80).
f. Attach push rod (67) to bellcrank (70) with pin (68), washer (74) and lock with cotter pin (75).
g. Attach push rod (88) to bellcrank (81) with pin (78), washer (87) and cotter pin (86).
h. Attach push rod (84) to bellcrank (81) with pin (85), washer (83) and cotter pin (82).
i. Install access plate.

1-6. REMOVAL OF IDLER ASSEMBLY. (See figure 1-3.)
a. Remove access plate on center power quadrant support.
b. Remove cotter pin (3), washer (2) and pin (92) which attaches push rod (1) to idler (4).
c. Remove cotter pin (91), washer (90) and pin (89) which attaches push rod (67) to idler (4).
d. Remove cotter pin (10), washer (9) and pin (7) which attaches push rod (8) to idler (4).
e. Remove cotter pin (12), washer (11) and pin (14) which attaches push rod (13) to idler (4).
f. Remove cotter pin (5), washer (6) and pin (15) which attaches idlers (4) to mounting bracket.

1-7. INSTALLATION OF IDLER ASSEMBLY. (See figure 1-3.)
a. Attach idlers (4) to bracket with pin (15), washer (6) and cotter pin (5).
b. Attach push rod (13) to idler (4) with pin (14), washer (11) and cotter pin (12).
c. Attach push rod (8) to idler (4) with pin (7), washer (9) and cotter pin (10).
d. Attach push rod (67) to idler (4) with pin (89), washer (90) and cotter pin (91).
e. Attach push rod (1) to idler (4) with pin (92), washer (2) and cotter pin (3).
f. Install access plate.

1-8. REMOVAL OF POWER CONTROLS BELLCRANK ASSEMBLY. (See figure 1-3.)
a. Remove nut (31), washer (30) and bolt (28) which attaches push rod (29) to bellcrank (33).
b. Remove cotter pin (39), washer (38) and pin (36) which attaches push rod (13) to bellcrank (26).
c. Remove nut (16), washer (17) and bolt (19) which attaches push rod (18) to bellcrank (21).
d. Remove cotter pin (42), washer (43) and pin (45) which attaches push rod (8) to bellcrank (23).
e. Remove nut (35), washer (34), and pin (32) which attaches bellcrank (33) to torque tube (25).
f. Remove nut (40), washer (41) and pin (27) which attaches bellcrank (26) to torque tube (25).
g. Remove torque tube (25) and spacer from the mounting brackets.
h. Remove nut (49), washer (48) and pin (20) which attaches bellcrank (21) to torque tube (22).
i. Remove nut (46), washer (47) and pin (24) which attaches bellcrank (23) to torque tube (22).
j. Remove torque tube from brackets.

1-9. INSTALLATION OF POWER CONTROLS BELLCRANK ASSEMBLY. (See figure 1-3.)
a. Hold bellcrank (23) between brackets (44) and (50) and insert torque tube (22) through bracket (50), bellcrank (23) and seat in bracket (44).
b. Attach bellcrank (23) to torque tube (22) with pin (24), washer (47) and secure with nut (46).
c. Attach bellcrank (21) to torque tube (22) with pin (20), washer (48) and secure with nut (49).
d. Slip spacer on torque tube (25).
e. Hold bellcrank (26) between brackets and insert torque tube (25) through bracket (37), bellcrank (26) and seat in bracket (44).
f. Attach bellcrank (26) to torque tube (25) with pin (27), washer (41) and secure with nut (40).
g. Attach bellcrank (33) to torque tube (25) with pin (32), washer (34) and secure with nut (35).
h. Attach push rod (29) to bellcrank (33) with bolt (28), washer (30) and nut (31).
i. Attach push rod (13) to bellcrank (26) with pin (36), washer (38), and cotter pin (39).
j. Attach push rod (8) to bellcrank (23) with pin (45), washer (43) and cotter pin (42).
k. Attach push rod (18) to bellcrank (21) with bolt (19), washer (17) and nut (16).

1-10. REMOVAL OF POWER CONTROL AFT TORQUE TUBES. (See figure 1-3.)

Note

Both torque tubes are removed and installed in a similar manner.

a. Remove access doors on bottom of engine nacelle.
b. Disconnect power controls at quick disconnect.
c. Remove nut (51), washer (52) and bolt (54) which attaches push rod (29) to bellcrank (53).
d. Remove nut (66), washer (65) and pin (55) which attaches bellcrank (53) to torque tube (56).
e. Remove nut (64), washer (63) and pin (62) which attaches bellcrank to torque tube (56).
f. Pull torque tube inboard until it is free from firewall bearing.
g. Remove nuts (61), washers (60) and (58) and screw (57) and remove firewall bearing.
h. Pull torque tube (56) outboard until it is free.

1-11. INSTALLATION OF POWER CONTROLS AFT TORQUE TUBES. (See figure 1-3.)
a. Push torque tube (56) through hole in firewall and into bracket.
b. Attach bearing (59) to firewall.

c. Insert torque tube through bearing (59).
d. Attach bellcrank (53) to torque tube (56) with pin (55), washer (65) and nut (66).
e. Attach bellcrank (67) to torque tube (56) with pin (62), washer (63) and nut (64).
f. Connect power controls at quick disconnect.
g. Attach push rod (29) to bellcrank (53) with bolt (54), washer (52) and nut (51).
h. Install access doors, that were removed, on the nacelle.

1-12. ENGINE FUEL SYSTEM. The engine fuel system includes an engine driven fuel pump, a fuel control unit, two starting fuel nozzles, and a fuel distributor. The engine driven fuel pump, located at the five o'clock position of the accessory gear case, is a three element unit, with one centrifugal boost element feeding two parallel gear pump elements. There are three fluid ports on the pump, one supply inlet port, one by-pass inlet port and one pressure outlet port. The fuel control unit located at the eight o'clock position of the accessory gear case, provides three separate paths of fuel flow, one for starting fuel, one for emergency fuel, and one for main fuel, it also incorporates a dual element fuel filter and a by-pass valve which allows fuel to flow around the filter when it becomes clogged. The starting fuel nozzles extend through the turbine housing into the space between the annular combustion chamber and the turbine housing. They are bolted to bosses located on the upper portion of the turbine housing. The fuel distributor is a part of the turbine rotor assembly and is supplied with fuel through a passageway in the rotor shaft.

1-13. ENGINE OIL SYSTEM. Each engine has a separate, fully scavenged, dry sump oil system. All components of this systems are attached to the engines except the oil tanks and pressure gages. The oil tanks are mounted between the inlet duct and the skin covering of each nacelle and are connected to the engine by flexible hoses. The direct reading oil pressure gages are located on the shock mounted instrument panel near the center of the cockpit. The engine mounted components of the oil system include a multi-element oil pump, a micronic filter, a filter by-pass valve, an anti-leak valve, and a pressure relief valve.

1-14. ENGINE ELECTRICAL SYSTEM. The engine electrical system includes the starter-generator and its harness; the ignition coil, ignitor plugs and their leads and the starting fuel solenoid valve incorporated in the fuel control unit.

1. Push rod
2. Washer
3. Cotter pin
4. Idler
5. Cotter pin
6. Washer
7. Pin
8. Push rod
9. Washer
10. Cotter pin
11. Washer
12. Cotter pin
13. Push rod
14. Pin
15. Pin
16. Nut
17. Washer
18. Push rod
19. Bolt
20. Pin
21. Bellcrank
22. Torque tube
23. Bellcrank
24. Pin
25. Torque tube
26. Bellcrank
27. Pin
28. Bolt
29. Push rod
30. Washer
31. Nut
32. Pin
33. Bellcrank
34. Washer
35. Nut
36. Pin
37. Bracket
38. Washer
39. Cotter pin
40. Nut
41. Washer
42. Cotter pin
43. Washer
44. Bracket
45. Pin
46. Nut
47. Washer
48. Washer
49. Nut
50. Bracket
51. Nut
52. Washer
53. Bellcrank
54. Bolt
55. Pin
56. Torque tube
57. Screw
58. Washer
59. Bearing
60. Washer
61. Nut
62. Pin
63. Washer
64. Nut
65. Washer
66. Nut
67. Push rod
68. Pin
69. Pin
70. Bellcrank
71. Washer
72. Nut
73. Spacer
74. Washer
75. Cotter pin
76. Torque tube
77. Pin
78. Pin
79. Washer
80. Nut
81. Bellcrank
82. Cotter pin
83. Washer
84. Push rod
85. Pin
86. Cotter pin
87. Washer
88. Push rod
89. Pin
90. Washer
91. Cotter pin
92. Pin

Key to Figure 1-3. Power Controls Installation

1-18. ENGINE GROUND HANDLING. Figures 1-6 and 1-7 show engine ground handling equipment. The engine hoist is used for removal and installation of the engine and the engine trailer is used to move the engine about and as an installation dolly.

1-19. ATTACHING ENGINE HOIST TO ENGINE. (See figure 1-6.)

a. Remove engine nacelle upper access door.

b. Position yoke (4) on engine so that the mounting holes mate with the rear engine mount and the pad on the engine compressor housing.

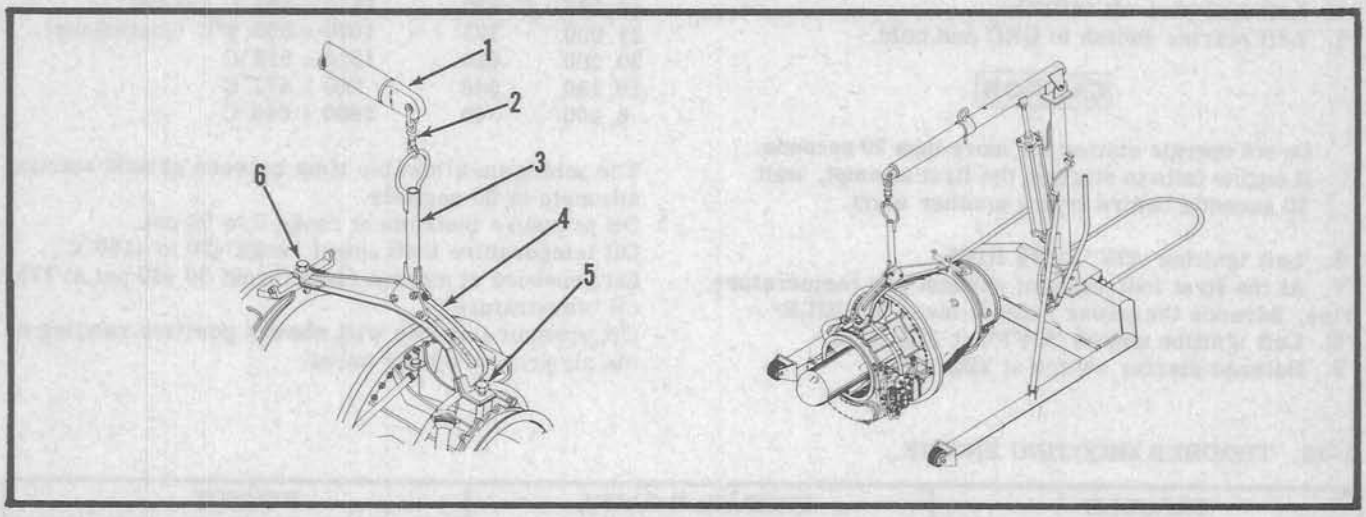
c. Attach yoke (4) to engine with bolts (5) and (6).

d. Engage strap (3) and safety hook (2) on hoist.

1-20. ATTACHING ENGINE TO ENGINE TRAILER. (See figure 1-7.)

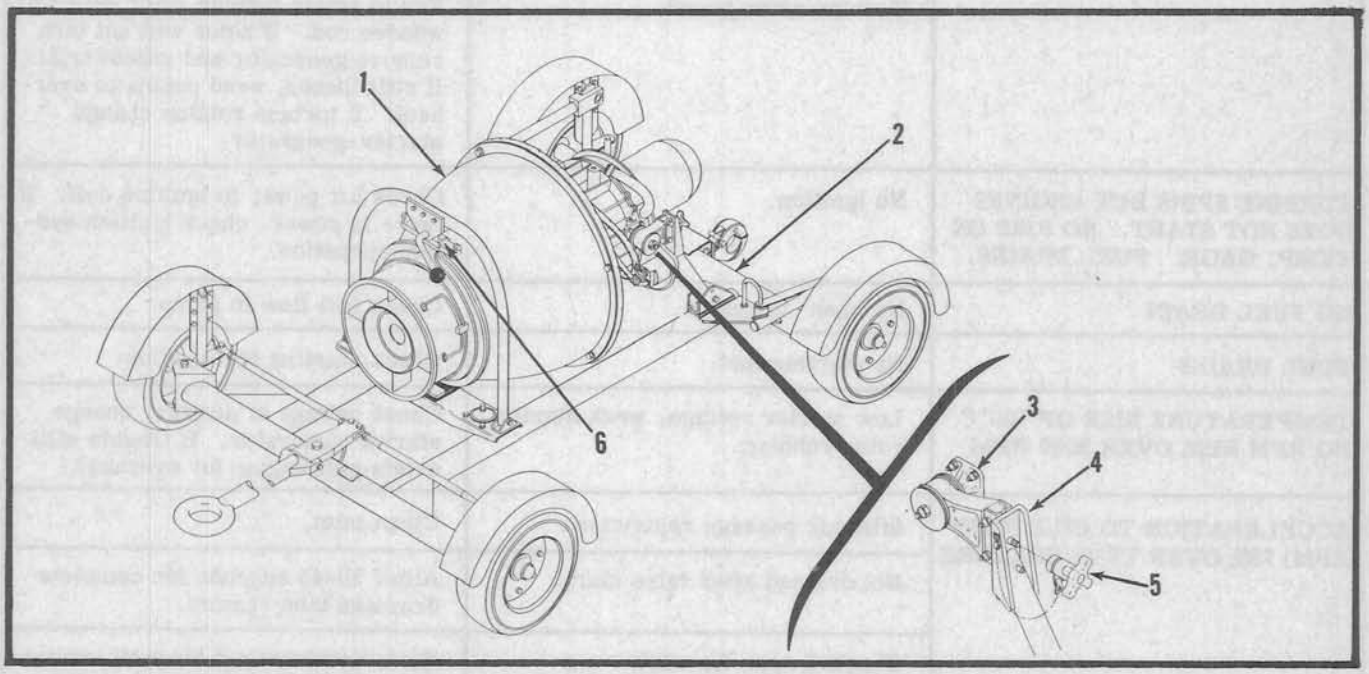
a. As engine is lowered from the nacelle, position it so that the rear of the engine rests between the hold down tubes, and the front engine mounting bolts are inserted into holes in supports (4).

b. After the engine is positioned in the trailer, secure it by attaching bolts with knobs (5). Also secure rear of engine by raising hold down tubes over the engine and turning handle until foot (6) is secure against engine.



1. Engine hoist
2. Hook
3. Strap
4. Yoke
5. Bolt
6. Bolt

Figure 1-6. Attaching Hoist to Engine



1. Engine
2. Engine trailer
3. Engine mount
4. Support
5. Knob
6. Foot

Figure 1-7. Attaching Engine to Engine Trailer

1-21. ENGINE STARTING.

Note

Engines should be operated with the aircraft facing into the wind if possible since a tail wind may increase exhaust gas temperature.

The engines may be started using auxiliary ground power or battery power. Starting procedure

1. Battery switch "ON".
2. Power controls "OFF".
3. Fuel boost pump "ON".
4. Left fuel shut-off "OPEN".
5. Left starter switch to GND and hold.

CAUTION

Do not operate starter for more than 20 seconds. If engine fails to start on the first attempt, wait 30 seconds before trying another start.

6. Left ignition "ON" at 9% RPM.
7. At the first indication of exhaust gas temperature rise, advance the power control lever to "IDLE".
8. Left ignition switch "OFF" at 12% RPM.
9. Release starter switch at 22% RPM.

CAUTION

At engine speeds of 6300 rpm or less, if the tailpipe temperature reaches 815°C (1500° F) the engine must be replaced. If the engine has more than three starts at temperatures exceeding 790°C (1453° F) perform a visual inspection of tip clearance. Tip tolerances are from .022 to .032. The three starts at 790° F (1453° F) need not be consecutive.

RPM	LB/TH	°F °C
22,700	920	1250 = 662°C (5 min.)
22,000	835	1175 = 662°C (30 min.)
21,000	725	1070 = 559.9°C (continuous)
20,300	650	1010 = 518°C
19,150	540	960 = 471°C
6,300	46	1000 = 640°C

The minimum allowable time between ground starting attempts is 30 seconds.
Oil pressure instrument range 0 to 60 psi.
Oil temperature instrument range -20 to +150°C.
Oil pressure at normal rated thrust 30 ±10 psi at 175° oil temperature.
Oil pressure at idle will show a positive reading on the oil pressure instrument.

1-22. TROUBLE SHOOTING ENGINE.

TROUBLE	PROBABLE CAUSE	REMEDY
STARTER DOES NOT SPIN ROTOR	Open or shorted circuit.	Check for power to starter terminals. If power is normal refer to next entry.
	Turbine rotor bound.	Try to rotate turbine rotor with soft wooden rod. If rotor will not turn remove generator and repeat trial. If still locked, send engine to overhaul. If turbine rotates change starter-generator.
TURBINE SPINS BUT ENGINES DOES NOT START. NO RISE ON TEMP. GAGE. FUEL DRAINS.	No ignition.	Check for power to ignition coil. If there is power, check ignition system operation.
NO FUEL DRAIN	No input to engine.	Check fuel flow to pump.
FUEL DRAINS	No starting fuel.	Check starting fuel system.
TEMPERATURE RISE OF 100°C NO RPM RISE OVER 2000 RPM	Low starter voltage, weak starter, rotor rubbing.	Check voltage at starter, change starter-generator. If trouble still exists pull engine for overhaul.
ACCELERATION TO IDLE (6300 RPM) 28% OVER TEMPERATURE	Inlet air passage restricted.	Clean inlet.
	Not drained after false start.	Allow 30-45 seconds for complete drainage then restart.
	Throttle open too early.	Hold throttle at cut off until temperature rises, then advance throttle.
	Starting fuel held on too long.	Attempt another start, if high temperature reoccurs, check starting fuel system.

TROUBLE	PROBABLE CAUSE	REMEDY
	Starting fuel nozzle top missing.	Replace defective nozzle after checking turbine for visible damage.
	Fuel control defective.	If none of the above, change fuel control.
ENGINE WILL NOT REACH 6300 RPM, 28% AT IDLE SETTING	Air lock or fuel control defective.	Cut throttle, switch to emergency and accelerate to 15000 RPM, switch back to main. Operate 1-2 minutes on main, shut down and attempt another start. If trouble reoccurs change fuel control.
IDLE SPEED HIGH OR LOW	Improperly adjusted.	Readjust linkage to 6300 RPM.
SPEED FLUCTUATES AT IDLE	Fuel input low or fuel control defective.	Accelerate engine to 15,000 RPM and switch to emergency, retard throttle to idle. If flutter continues on emergency, check fuel system and engine pump, if flutter stops on emergency change fuel control.
FLAME OUT WHEN STARTING FUEL IS SHUT OFF	Starting fuel shut off too soon or fuel control bad.	Stop engine, allow it to drain and restart. If trouble repeats change fuel control.
ACCELERATION FROM IDLE	Air block or internal damage.	Check inlet and tailpipe for block, improper "mice", check rotor for damage. If latter, pull engine for overhaul. If former, clear or fix installation.
	Fuel control bad.	If not above, try again. If repeated cut throttle to idle and switch to emergency. If trouble clears, change fuel control. If surge shows on emergency even with slow movement of throttle, pull engine for overhaul.
	Gauge or thermocouple bad.	If repeated on another try, check gauge with gauge of known accuracy. If not gauge, check thermocouples and harness for short or damage. (If clears on second try, no action is required.)
	Fuel control bad.	If none of above, change fuel control
	Fuel control bad.	Change fuel control.
SURGE OR RUMBLE	Air block or internal damage.	Check inlet and tailpipe for foreign matter, improper "mice" etc. Check rotor for damage.
	Fuel control defective.	Decelerate to idle and switch to emergency, accelerate on emergency if engine doesn't rumble on emergency change fuel control, if trouble continues to exist on emergency change engine.
OVERTEMPERATURE	Air block or internal damage.	Check inlet and tailpipe for restriction or improper mice, check rotor for damage.

TROUBLE	PROBABLE CAUSE	REMEDY
	Indicator or thermocouple defective.	Check indicator with one of known accuracy. Check thermocouples, harness and resistor for shorts damage or improper resistance.
	Fuel control defective.	If none of the above change fuel control.
SLOW ACCELERATION TAKES LONGER THAN 20 SECONDS TO ACCELERATE FROM IDLE TO 100% RPM (22,700 RPM)	Fuel control defective.	Change fuel control.
ENGINE DOES NOT REACH 100% RPM	Throttle not opening fully.	Adjust linkage.
	Air filter block or CDP line leakage.	Open air filter at fuel control unit port and clean or check for loose connections or cracked line to fuel control unit.
	Low pump pressure.	Check main fuel pressure.
	Maximum speed stop out of adjustment.	Adjust maximum speed turn counter clockwise to increase speed and counterclockwise to decrease.
	Fuel control defective.	If none of above change fuel control.
OVERSPEED	Maximum stop out of adjustment.	Turn stop screw clockwise to lower speed.
	Governor defective.	Change fuel control.
LOW TEMPERATURE AT 100% RPM	Tailpipe diameter too large	Replace with correct tailpipe. Check "mice".
	Main fuel pulsing.	Cut throttle to idle, switch to emergency and allow RPM to stabilize under manual control. If RPM stabilizes on emergency, fuel control is defective and must be changed. If RPM does not stabilize on emergency check tachometer, boost pressure, and fuel pump. This cannot be caused by the rotor assembly, do not change engine.
VIBRATION	Engine mounts.	Check mounts.
	Internal damage.	Change engine.
FLAME OUT ON DECELERATION	Defective fuel control.	Change fuel control.
ENGINE FAILS TO SHUT DOWN WHEN THROTTLE IS FULLY CLOSED	Linkage out of adjustment.	Adjust linkage.
	Cut off stop out of adjustment.	Disconnect control linkage, backout screw, pull down until it seats solidly then run screw in to touch lever and lock screw.
	Fuel control defective.	Change fuel control.
EXCESS OIL USAGE OVER 1.5 QTS. PER HR.	Leakage.	Check for external leakage.

TROUBLE	PROBABLE CAUSE	REMEDY
	Seals worn.	Change engine.
LOW OIL PRESSURE	Oil level low.	Check oil level.
	External leakage.	Check for external leakage.
	Bad instrument.	Test with instrument of known accuracy.
	Oil pressure relief valve stuck.	Pull relief valve clean and inspect.
	Oil pump worn.	Change oil pump.
	Engine worn.	If not corrected by above, change engine.
MAKES EXCESS OIL	Seal worn.	Change engine.

1-23. ENGINE QUICK CHANGE KITS. Quick engine change kits are provided so that an engine may be quickly and easily adapted for installation into the airplane. There is a difference between the left hand and right hand engine build-up, therefore particular attention should be given to the installation of lines and hoses.

1-24. BUILD-UP OF LEFT HAND ENGINE. (See figure 1-8.)

The left engine quick change kit contains the items necessary to ready the engine for installation into the airplane. These items consists of the hydraulic pump, tachometer generator and their attaching hardware and the necessary plumbing for the fuel, oil and hydraulic systems. Also included are the front and rear engine mounts, power control assembly and bleed air connections.

a. Place butt plate (38) over studs at outboard engine

1. Clamp
2. Bolt
3. Bolt
4. Connector
5. Gasket
6. Bolt
7. Washer
8. Power control mounting bracket
9. Screw
10. Nut
11. Clamp
12. Clamp
13. Bolt
14. Vent tube support bracket
15. Vent tube
16. Clamp
17. Nut
18. Union
19. Gasket
20. Washer
21. Nut
22. Check nut
23. Rod end
24. Fuel control lever
25. Bolt
26. Jumper
27. Gasket
28. Nut
29. Elbow
30. Fuel control drain tube
31. Gasket
32. Union
33. Oil pressure hose
34. Quick disconnect half
35. Front engine mount
36. Nut
37. Washer
38. Butt plate
39. Gasket
40. Nipple
41. Rear engine mount
42. Clamp
43. Screw
44. Washer
45. Nut
46. Clamp
47. Tachometer generator
48. Gasket
49. Washer
50. Nut
51. Quick disconnect half
52. Oil return hose
53. Elbow
54. Nut
55. Gasket
56. Gasket
57. Elbow
58. Fuel pump drain tube
59. Gasket
60. Nut
61. Nipple
62. Clamp
63. Gasket
64. Union
65. Fuel supply hose
66. Quick disconnect half
67. Quick disconnect half
68. Elbow
69. Nut
70. "O" ring
71. Gasket
72. Hydraulic pump drain tube
73. Nipple
74. Gasket
75. Gasket
76. Hydraulic pump
77. Washer
78. Nut
79. Gasket
80. "O" ring
81. Nut
82. Elbow
83. Quick disconnect half
84. Front engine mount
85. Washer
86. Power control mounting bracket
87. Nut
88. Cotter pin
89. Quick disconnect half
90. Check nut
91. Power control
92. Bolt
93. Washer
94. Washer
95. Nut

Key to Figure 1-8. Left Engine Quick Change Kit

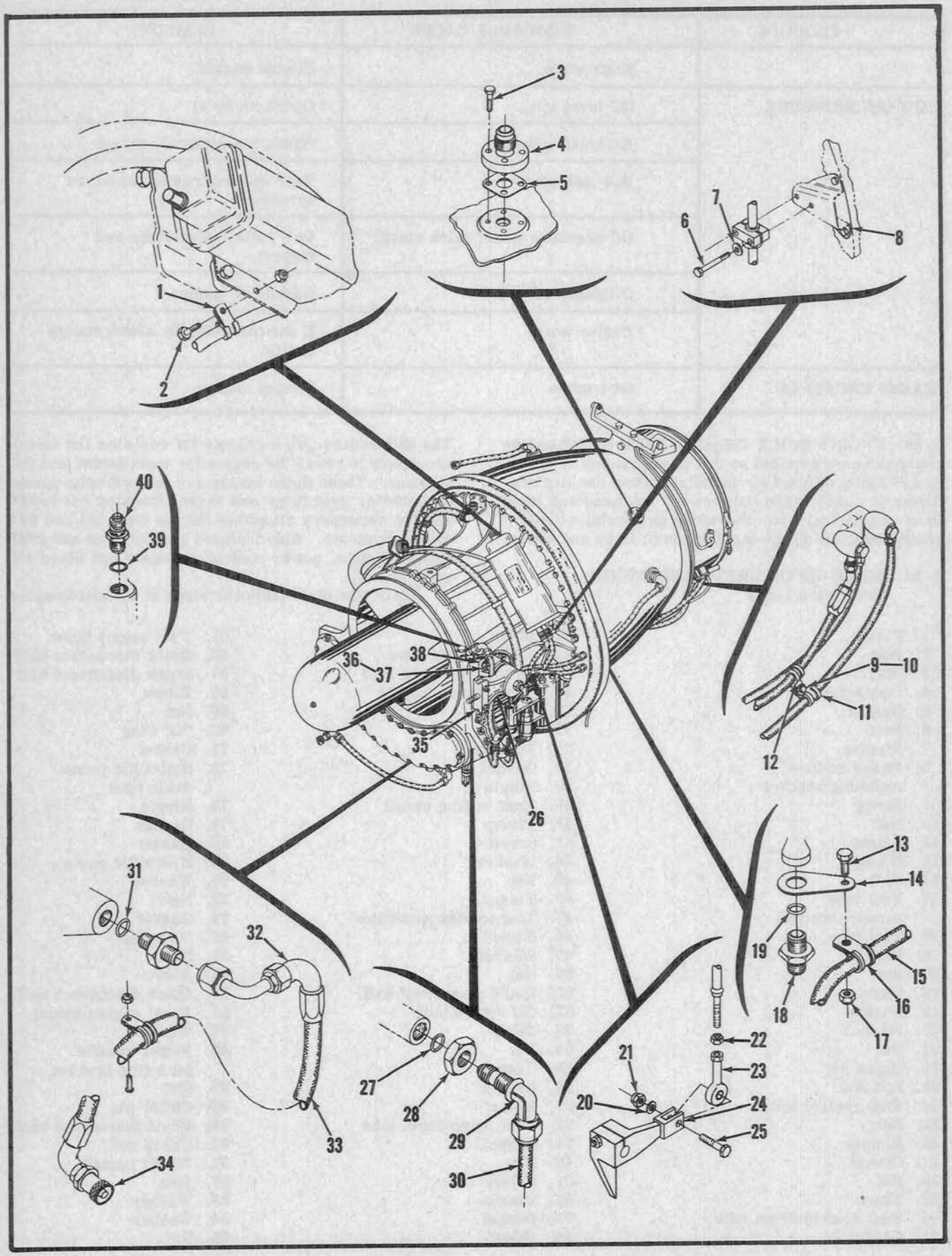


Figure 1-8. Left Engine Quick Change Kit (Sheet 1 of 2)

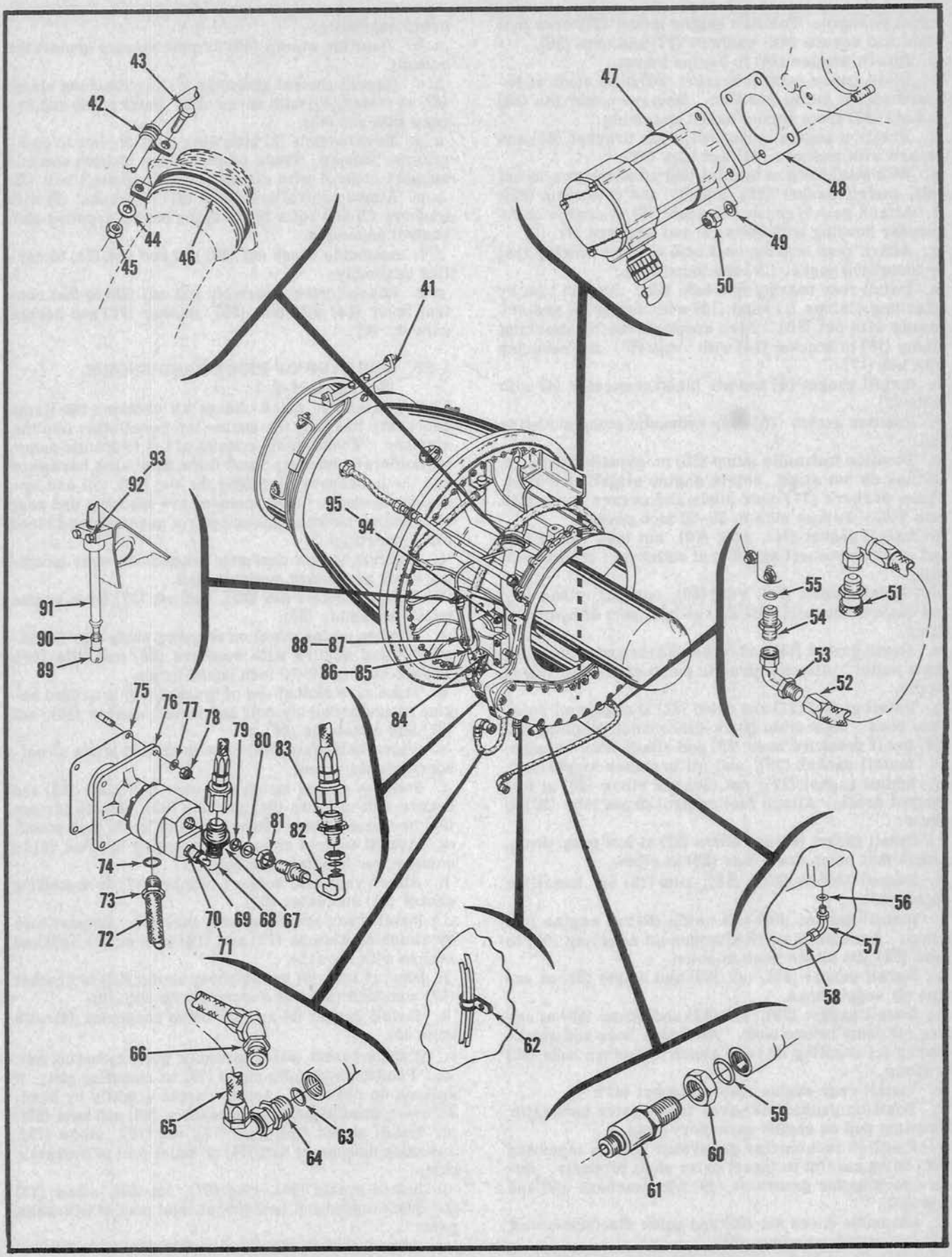


Figure 1-8. Left Engine Quick Change Kit (Sheet 2 of 2)

mount position. Position engine mount (35) over butt plate and secure with washers (37) and nuts (36).

b. Attach jumper (26) to engine mount.

c. Place power control bracket (86) over studs at inboard engine mount position. Remove cotter pin (88) and nut (87) from engine mount assembly.

d. Position engine mount (84) over bracket (86) and secure with washers (84) and nuts (95).

e. With slotted end of bracket (86) around engine mount bolt, install washer (85), nut (87) and cotter pin (88).

f. Attach power control bracket (8) to engine compressor housing with bolts (6) and washers (7).

g. Attach rear bearing vent tube support bracket (14) by installing gasket (19) and union (18).

h. Install rear bearing vent tube (15). Support tube by attaching clamps (11) and (12) with screw (9) and securing with nut (10). Also support tube by attaching clamp (16) to bracket (14) with bolt (13) and securing with nut (17).

i. Install gasket (5) and air bleed connector (4) with bolts (3).

j. Position gasket (75) over hydraulic pump mounting pad.

k. Position hydraulic pump (76) on mounting pad. If splines do not align, rotate engine slightly by hand. Place washers (77) over studs and secure pump with nuts (78). Torque nuts to 50-70 inch pounds.

l. Install gasket (71), ring (70), nut (69), elbow (68) and quick disconnect half (67) at outlet port of hydraulic pump.

m. Install gasket (79), ring (80), nut (81), elbow (82) and quick disconnect half (83) at inlet port of hydraulic pump.

n. Attach gasket (74) and nipple (73) to hydraulic pump drain outlet. Attach hydraulic pump drain tube (72) to nipple.

o. Install gasket (31) and union (32) at engine oil pressure boss. Assemble quick-disconnect coupling half (34) to oil pressure hose (33) and attach hose to union.

p. Install gasket (39), and oil breather nipple (40).

q. Install gasket (27), nut (28) and elbow (29) at fuel control drain. Attach fuel control drain tube (30) to elbow.

r. Install gasket (46) and elbow (57) at fuel pump drain. Attach fuel pump drain line (58) at elbow.

s. Support tubes (30), (58), and (72) by installing clamp (62).

t. Install gasket (63) and union (64) at engine fuel pump. Assemble quick-disconnect coupling (66) to hose (65) and attach hose to union.

u. Install gasket (59), nut (60) and nipple (61) at engine oil supply boss.

v. Install gasket (55), nut (54) and elbow (53) at engine oil pump return boss. Assemble hose and quick-disconnect coupling (51) and attach oil return hose (52) to elbow.

w. Install rear engine roller support (41).

x. Position gasket (48) over tachometer generator mounting pad on engine accessory case.

y. Position tachometer generator (47) on mounting pad, being careful to insert drive shaft properly. Secure tachometer generator (47) with washers (49) and nuts (50).

z. Assemble check nut (90) and quick disconnect half (89) to control assembly (91).

a.a. Attach control assembly (91) to bracket (86) with washers (93) and bolts (94). Use blocks provided with cable assembly.

a.b. Position clamp (46) around starter-generator conduit.

a.c. Support control assembly (91) by attaching clamp (42) to clamp (46) with screw (43), washer (44) and secure with nut (45).

a.d. Remove bolt (2) attaching ignition unit to compressor housing. Route control under ignition unit and support control with clamp (1) and reinstall bolt (2).

a.e. Attach control assembly (91) to bracket (8) with washers (7) and bolts (6) by using blocks supplied with control assembly.

a.f. Assemble check nut (22) and rod end (23) to control assembly.

a.g. Attach control assembly rod end (23) to fuel control lever (24) with bolt (25), washer (20) and secure with nut (21).

1-25. BUILD-UP OF RIGHT HAND ENGINE.

(See figure 1-9.)

The right engine quick change kit contains the items necessary to ready the engine for installation into the airplane. These items consist of the hydraulic pump, tachometer generator and their attaching hardware and the necessary plumbing for the fuel, oil and hydraulic systems. Also included are the front and rear spar engine mounts, power control assembly and bleed air connections.

a. Position control assembly bracket (30) over mounting studs at inboard engine mount.

b. Remove cotter pin (36), and nut (37) from engine mount assembly (39).

c. Position engine mount on mounting studs over bracket (30) and secure with washers (28) and nuts (29). Torque nuts to 50-70 inch pound torque.

d. Make sure slotted end of bracket (30) is around engine mount assembly bolt and install washer (38), nut (37) and cotter pin (36).

e. Place butt plate (92) over mounting studs at outboard engine mount.

f. Position engine mount (91) over butt plate (92) and secure with washers (94) and nuts (93). Attach jumper (90) to engine mount. Torque nuts to 50-70 inch pound.

g. Attach control assembly mounting bracket (8) to compressor housing with bolts (7).

h. Attach vent tube support bracket (17) by installing gasket (21) and union (20).

i. Install rear breathing vent tube (9). Support tube by attaching clamps (12) and (13) with screw (10) and secure with nut (11).

j. Support tube (9) by attaching clamp (18) to bracket (17) with bolt (16) and securing with nut (19).

k. Install gasket (5) and air bleed connector (4) with bolts (3).

l. Position basket (85) at hydraulic pump mounting pad.

m. Position hydraulic pump (79) on mounting pad. If splines do not align, rotate engine slightly by hand. Secure hydraulic pump with washers (84) and nuts (83).

n. Install gasket (78), ring (77), nut (76), elbow (75), and quick disconnect half (74) at outlet port of hydraulic pump.

o. Install gasket (86), ring (87), nut (88), elbow (73) and quick disconnect half (89) at inlet port of hydraulic pump.

p. Attach gasket (82), and nipple (84) to hydraulic pump drain outlet. Attach hydraulic pump drain tube (80) to nipple.

q. Attach gasket (49) and snubber (50) to engine oil pressure boss.

r. Assemble quick-disconnect (52) to oil pressure hose and attach hose (51) to snubber (50).

s. Install gasket (53) and oil breather nipple (54).

t. Install gasket (40), nut (41) and elbow (42) at fuel control drain. Attach fuel control drain tube (43) to elbow.

u. Install gasket (62) and elbow (63) at fuel pump drain outlet. Attach fuel pump drain tube (64) to elbow.

v. Support tubes (43), (64), and (80) by installing clamp (61).

w. Attach gasket (62) and union (70) to fuel pump. Assemble quick-disconnect (72) to hose (71) and attach hose to union.

x. Install gasket (66) and reducer (67) at engine oil supply boss.

y. Assemble quick-disconnect coupling half (65) to oil supply hose (68) and attach hose to reducer.

z. Install gasket (48), nut (47) and elbow (46) to engine oil pump.

a.a. Assemble quick-disconnect coupling (44) to oil return hose (45) and attach hose to elbow (46).

a.b. Install rear engine roller support (6).

a.c. Position gasket (57) over tachometer generator mounting pad on engine accessory case.

a.d. Position tachometer generator on mounting pad, being careful to insert drive shaft properly. Secure tachometer generator (58) with washers (60) and nuts (59).

a.e. Assemble quick-disconnect half (35) and check nut (34) to power control assembly (33).

a.f. Attach power control assembly (33) to bracket (30) with washers (31) and bolts (32). Use blocks supplied with control assembly.

a.g. Remove nut and washer attaching compressor case to accessory case. Place clamp (55) around control assembly and attach clamp to stud with nut (56) that was removed.

a.h. Remove bolt (2) attaching ignition unit to compressor housing. Route control assembly under ignition unit and support control with clamp (1) by reinstalling bolt (2).

a.i. Attach control assembly (33) to bracket (8) with washers (15) and bolts (14). Use blocks supplied with control assembly.

a.j. Assemble rod end (26) and check nut (25) on to control assembly. Attach rod end (26) to fuel control lever (22) with bolt (27), washer (23) and secure with nut (24).

1. Clamp
2. Bolt
3. Bolt
4. Air bleed connector
5. Gasket
6. Rear engine mount
7. Bolt
8. Power control mounting bracket
9. Vent tube
10. Screw
11. Nut
12. Clamp
13. Clamp
14. Bolt
15. Washer
16. Bolt
17. Vent tube support
18. Clamp
19. Nut
20. Union
21. Gasket
22. Fuel control lever
23. Washer
24. Nut
25. Check nut
26. Rod end
27. Bolt
28. Washer
29. Nut
30. Power control mounting bracket
31. Washer
32. Bolt
33. Power control
34. Check nut
35. Quick disconnect half
36. Cotter pin
37. Nut
38. Washer
39. Front engine mount
40. Gasket
41. Nut
42. Elbow
43. Fuel control drain tube
44. Quick disconnect half
45. Oil return hose
46. Elbow
47. Nut
48. Gasket
49. Gasket
50. Snubber
51. Oil pressure hose
52. Quick disconnect half
53. Gasket
54. Oil breather nipple
55. Clamp
56. Nut
57. Gasket
58. Tachometer generator
59. Nut
60. Washer
61. Clamp
62. Gasket
63. Elbow
64. Fuel pump drain tube
65. Quick disconnect half
66. Gasket
67. Reducer
68. Oil supply hose
69. Gasket
70. Union
71. Fuel pump hose
72. Quick disconnect half
73. Elbow
74. Quick disconnect half
75. Elbow
76. Nut
77. "O" ring
78. Gasket
79 Hydraulic pump
80. Hydraulic pump drain tube
81. Nipple
82. Gasket
83. Nut
84. Washer
85. Gasket
86. Gasket
87. "O" ring
88. Nut
89. Quick disconnect half
90. Jumper
91. Front engine mount
92. Butt plate
93. Nut
94. Washer

Key to Figure 1-9. Right Engine Quick Change Kit

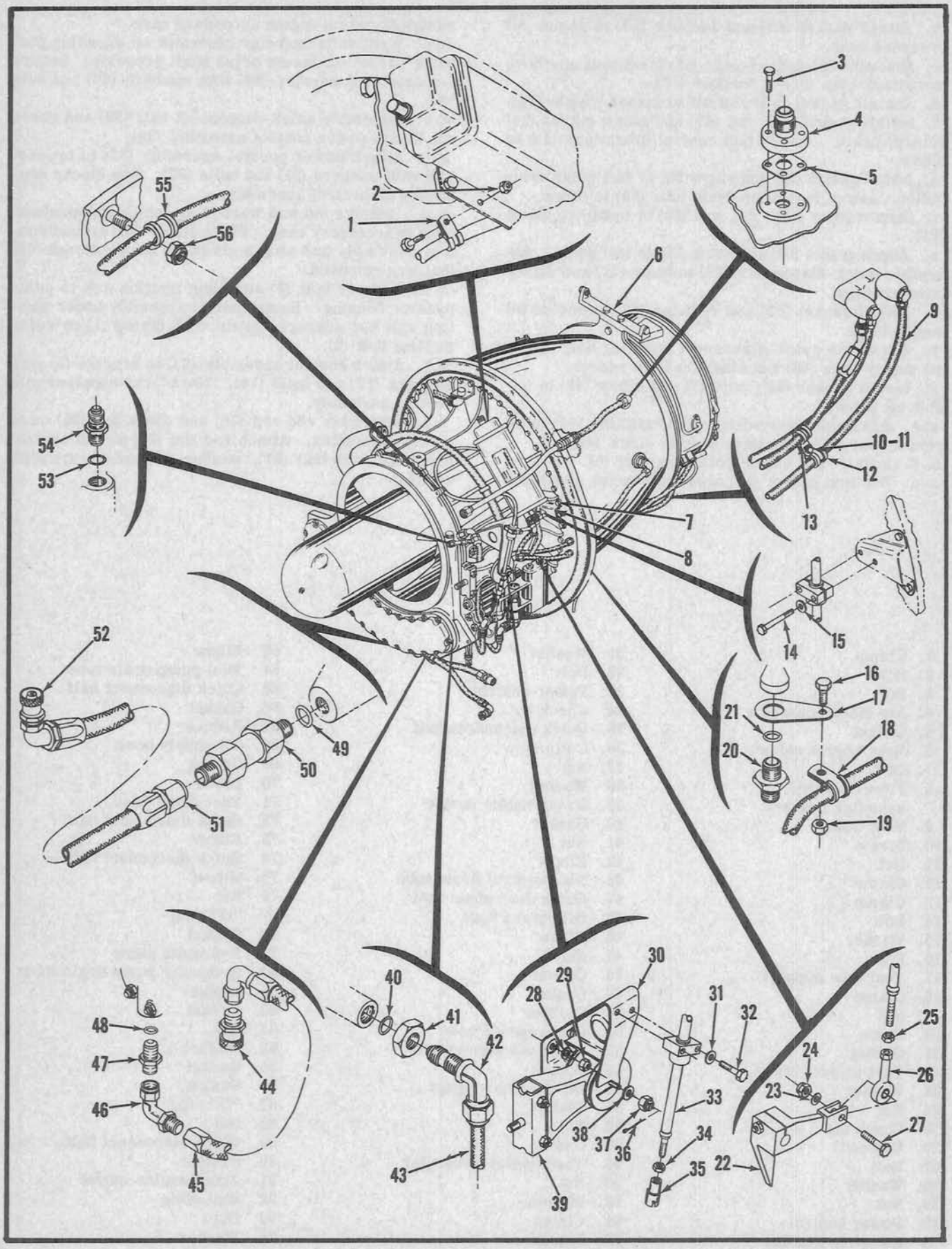


Figure 1-9. Right Engine Quick Change Kit (Sheet 1 of 2)

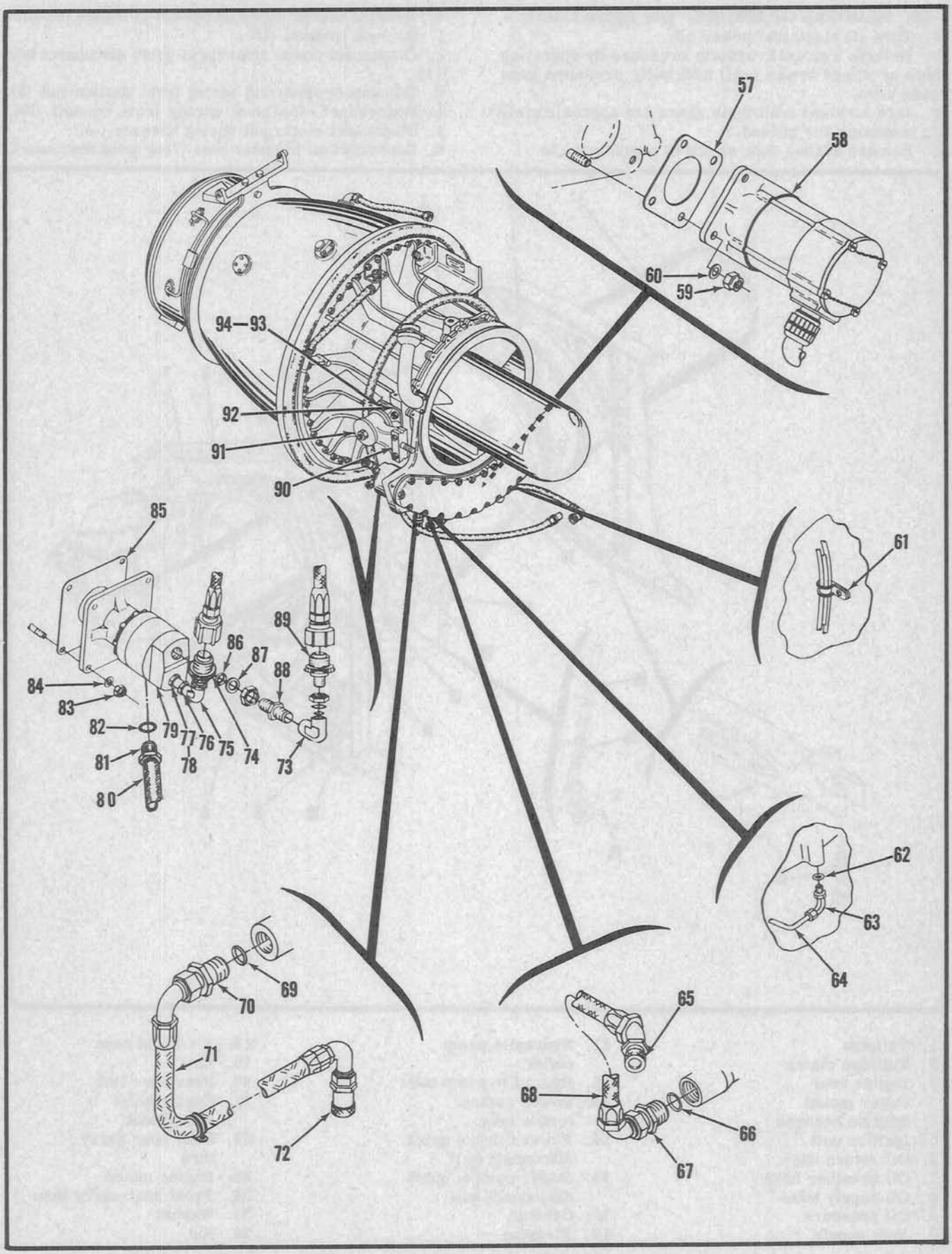


Figure 1-9. Right Engine Quick Change Kit (Sheet 2 of 2)

1-26. REMOVAL OF ENGINE. (See figure 1-10.)

a. Turn all electrical power off.

b. Relieve hydraulic system pressure by operating flaps or speed brake until hydraulic pressure gage reads zero.

c. Jack airplane until main gears are approximately six inches off the ground.

d. Remove access door on top of engine nacelle.

e. Remove access doors on bottom of engine nacelle.

f. Remove fireseal (16).

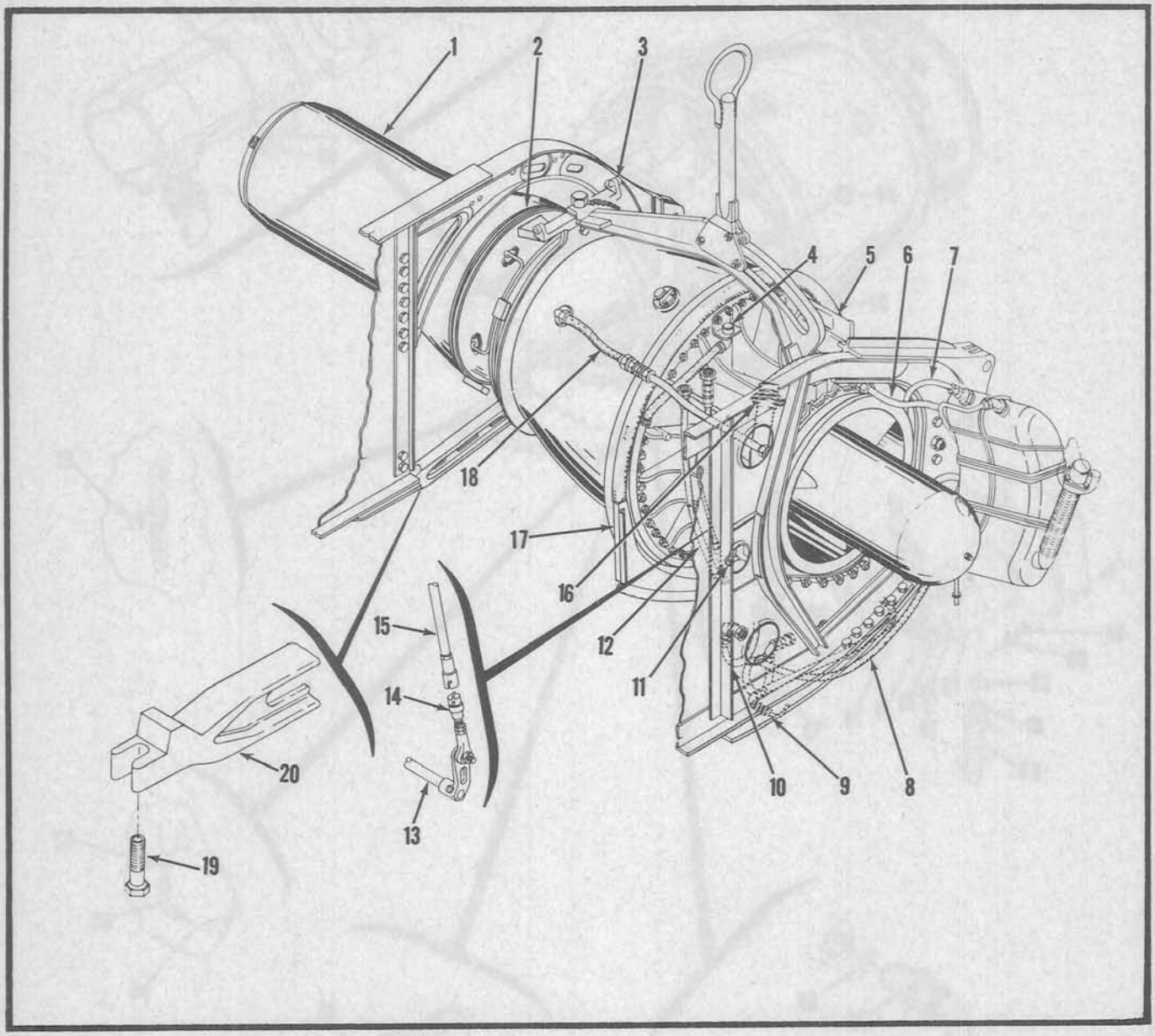
g. Disconnect power controls at quick disconnect bolt (15).

h. Disconnect electrical wiring from ignition unit (5).

i. Disconnect electrical wiring from conduit (16).

j. Disconnect electrical wiring harness (4).

k. Disconnect oil breather hose (7) at quick disconnect.



1. Tailpipe
2. Tailpipe clamp
3. Engine rear roller mount
4. Ignition harness
5. Ignition unit
6. Oil return hose
7. Oil breather hose
8. Oil supply hose
9. Oil pressure
10. Fuel supply
11. Hydraulic pump outlet
12. Hydraulic pump inlet
13. Power control torque tube
14. Power control quick disconnect half
15. Power control quick disconnect half
16. Conduit
17. Fireseal
18. Air bleed hose
19. Bolt
20. Rear spar link
21. Engine hoist attachment
22. Rear spar carry thru
23. Engine mount
24. Front spar carry thru
25. Washer
26. Nut

Figure 1-10. Engine Installation (Sheet 1 of 2)

l. Unscrew nut at engine and disconnect air bleed hose (18).
m. Disconnect oil return hose (6) at quick disconnect.
n. Disconnect oil supply line (8) from engine. Left engine only.
o. Disconnect oil supply line (8) at quick disconnect. right engine only.
p. Disconnect fuel supply line (10) at quick disconnect.
q. Disconnect hydraulic pump hoses at quick disconnects (11) and (12).
r. Disconnect engine thermocouple lead (22).
s. Remove bolt (19) and hinge rear spar link (20) down.
t. Remove tailpipe clamp (2) and slide tailpipe (1) aft as far as it will go.

CAUTION

Make final check to see that all lines, hoses, and electrical wiring are disconnected, so that they will not be torn loose or damaged as the engine is lowered from the nacelle.

u. Attach engine hoist to engine in accordance with paragraph 1-11.
v. Remove nuts (26) and washers (25) which attach engine mounts to front spar carry thru.
w. Position engine trailer under engine.
x. Slide engine aft until the front engine mounts are free from the front spar carry thru.
y. Continue to slide the engine aft until the rear engine mount rollers are free from the airplane structure and then lower engine to engine trailer.
z. Secure engine to engine trailer in accordance with paragraph 1-12.

1-27. INSTALLATION OF ENGINE. (See figure 1-10.)
a. Position engine under engine nacelle.
b. Attach engine hoist in accordance with paragraph 1-19.
c. Raise engine into nacelle and guide rear engine mount rollers (3) into slots in support.
d. Continue to raise engine and guide front engine mount bolts through front spar carry thru.

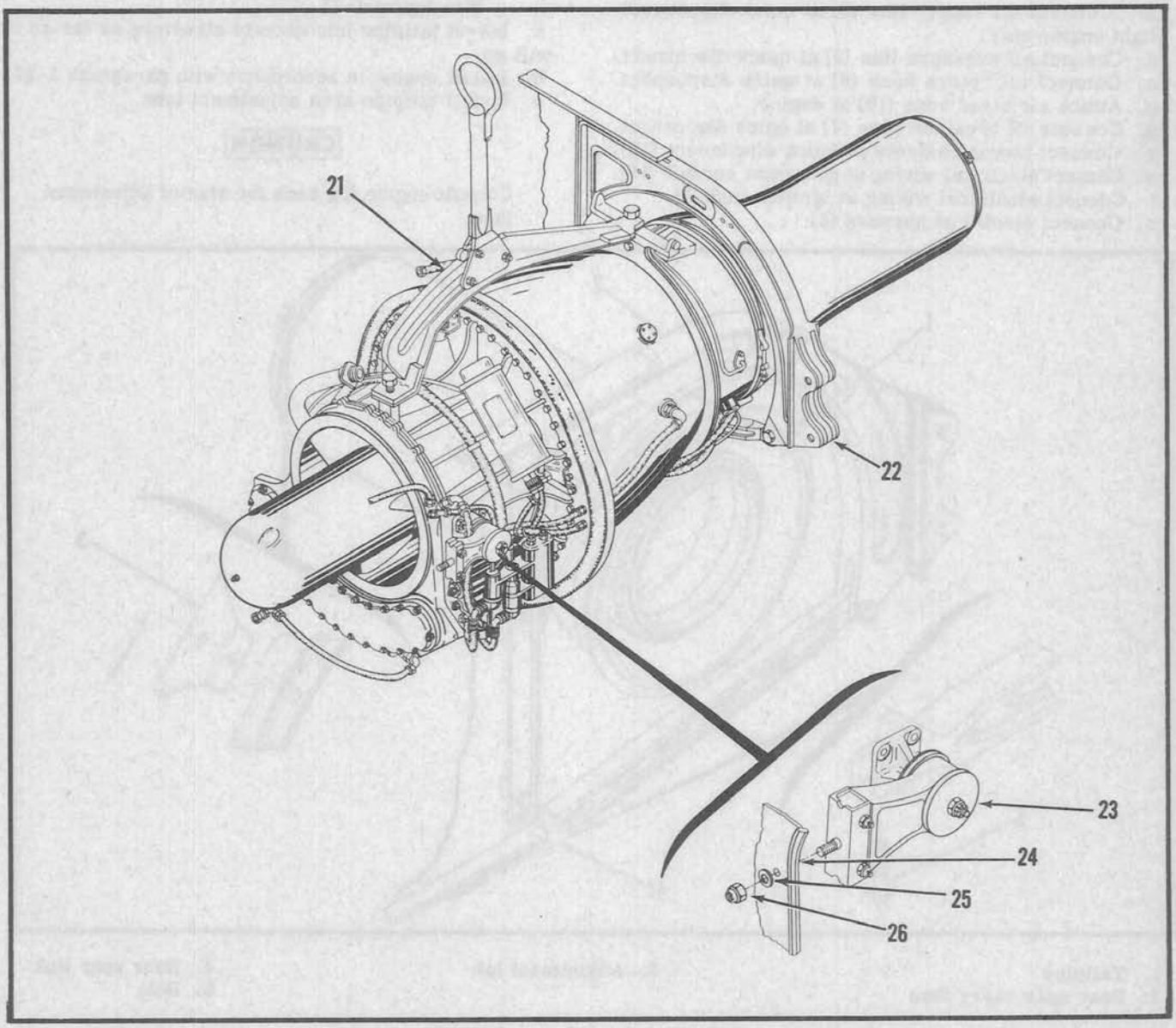


Figure 1-10. Engine Installation (Sheet 2 of 2)

Note

There are three pilot studs on the front of the engine. These studs must be inserted into three holes provided in the inlet duct to provide proper alignment of duct and engine.

e. Secure front engine mount bolt to front spar carry thru with washers (25) and nuts (26). Torque nuts to 165-195 inch pounds.
f. Mate tailpipe to exhaust diffuser assembly and install tailpipe clamp (2).
g. Hinge rear spar link (20) up to rear spar carry thru and install bolt (19). Torque bolt to 490 ±10 inch pounds and safety.
h. Remove engine hoist.
i. Connect engine thermocouple lead (22).
j. Connect hydraulic pump hoses at quick disconnects (11) and (12).
k. Connect fuel supply line (10) at quick disconnect.
l. Connect oil supply line (8) to engine. Left engine only.
m. Connect oil supply line (8) at quick disconnect. Right engine only.
n. Connect oil pressure line (9) at quick disconnect.
o. Connect oil return hose (6) at quick disconnect.
p. Attach air bleed hose (18) at engine.
q. Connect oil breather hose (7) at quick disconnect.
r. Connect power controls at quick disconnect (15).
s. Connect electrical wiring at generator conduit (16).
t. Connect electrical wiring at ignition unit (5).
u. Connect electrical harness (4).
v. Service oil tank. See T.O. No. 1T-37A-2-2.
w. Service hydraulic system in accordance with T.O. No. 1T-37A-2-2.
x. Service fuel system, if necessary, in accordance with T.O. No. 1T-37A-2-2.
y. Perform engine operational check-out in accordance with paragraph 1-21.
z. Install fireseal (17).
a.a. Install engine nacelle upper and bottom doors.
a.b. Let airplane down from jacks.

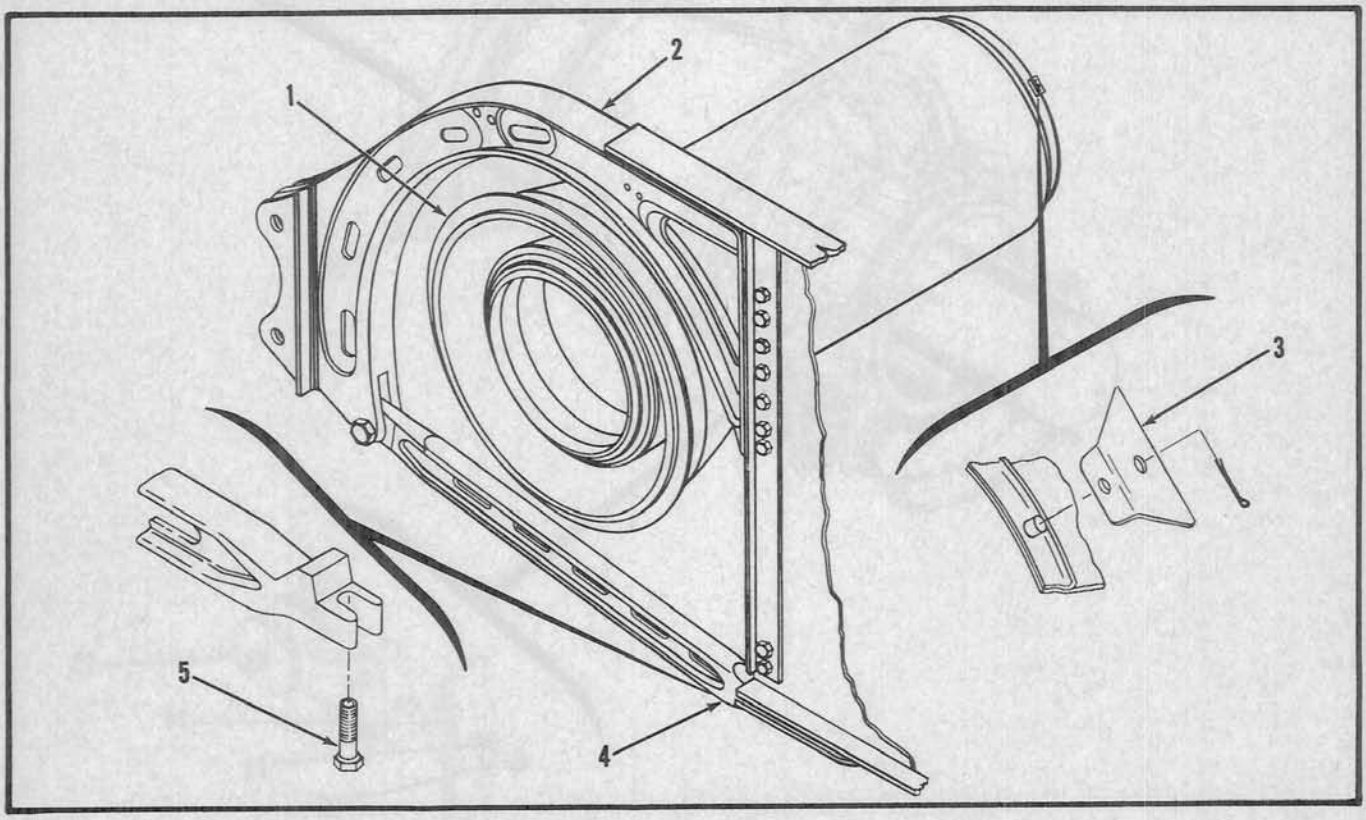
1-28. TAILPIPE. The tailpipe is constructed of stainless steel and is attached to the engine exhaust diffuser by a clamp. The aft end of the tailpipe extends into the ejector shroud.

1-29. REMOVAL OF TAILPIPE. (See figure 1-11.)
a. Remove engine in accordance with paragraph 1-26.
b. Pull tailpipe forward until it is free from the airplane structure.

1-30. INSTALLATION OF TAILPIPE. (See figure 1-11.)
a. Insert tailpipe into nacelle structure as far as it will go.
b. Install engine in accordance with paragraph 1-27.
c. Install tailpipe area adjustment tabs.

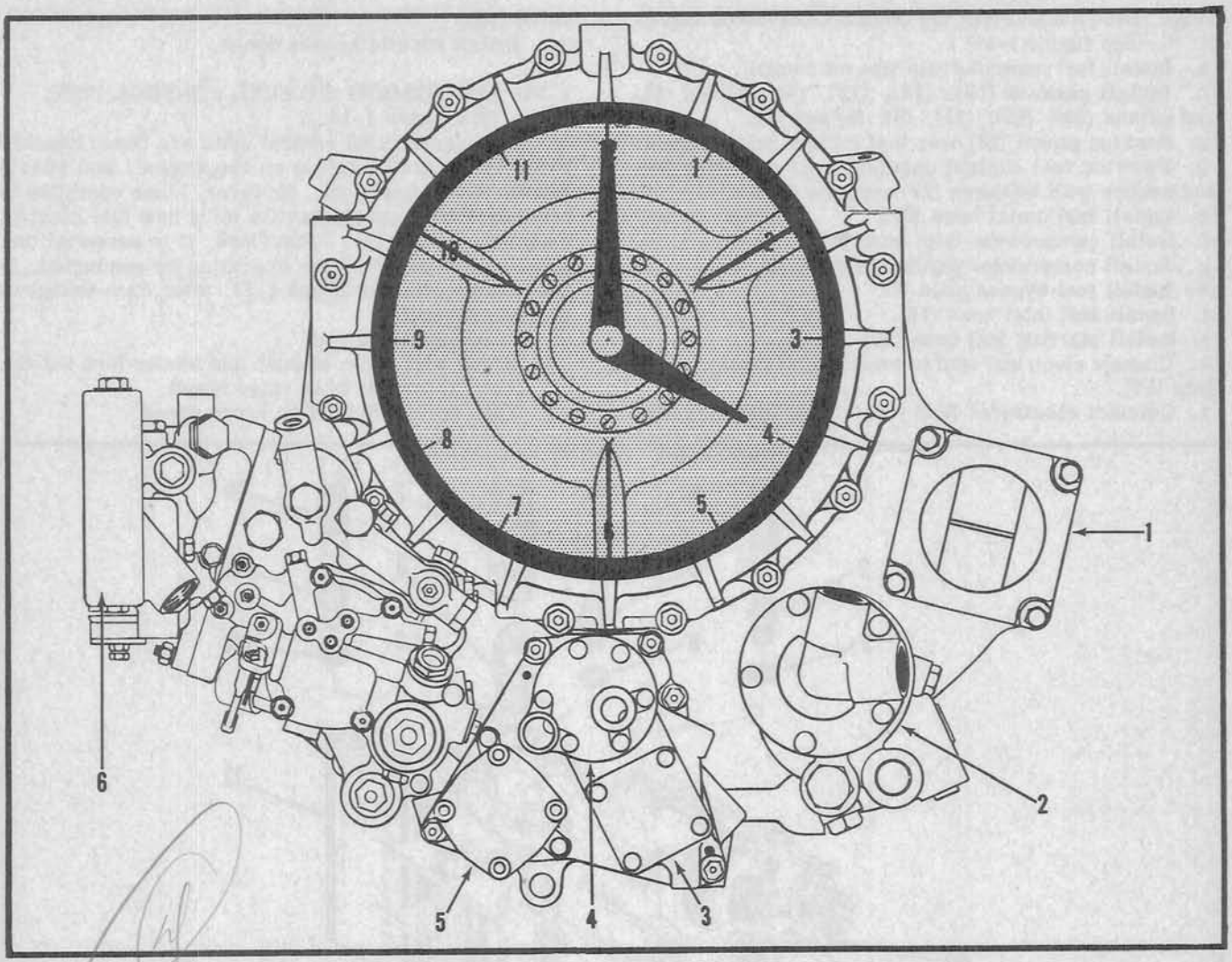
CAUTION

Consult engine log book for size of adjustment tabs.



1. Tailpipe
2. Rear spar carry thru
3. Adjustment tab
4. Rear spar link
5. Bolt

Figure 1-11. Tailpipe Installation



1. Hydraulic pump
2. Fuel pump
3. Tachometer generator
4. Oil pump
5. Oil filter
6. Fuel control unit

Figure 1-12. Location of Engine Accessories

1-31. FUEL CONTROL UNIT. The fuel control unit mounted on each engine supplies the proper amount of fuel needed through all ranges of power control settings. The unit is designed to meter the fuel and to automatically make the necessary fuel adjustments resulting from sudden power control settings, sudden changes in altitude, tailpipe temperatures and fuel pump failure. Basically, the unit consists of three engine driven pumps, a main fuel circuit containing an acceleration and governor system, a starting fuel circuit and a tailpipe temperature and compressor surge sensing circuit. The multiple fuel pump circuit serves as a safety factor to assure adequate fuel supply to the engines in event of fuel pump failure, and to maintain engine operation normally to altitudes of 6000 feet without assistance from the airplane fuel boost pump. The acceleration and governing circuit allows the pilot to make rapid power setting changes without danger of overloading the engines or causing possible flame-out. This circuit meters the fuel in proportion to power control settings in sufficient quantity to maintain constant rpm. The tailpipe sensing unit is an integral part of the governing circuit and functions to prevent excessive tailpipe temperatures by indirectly controlling the fuel through the governor.

1-32. REMOVAL OF FUEL CONTROL UNIT. (See figure 1-13.))

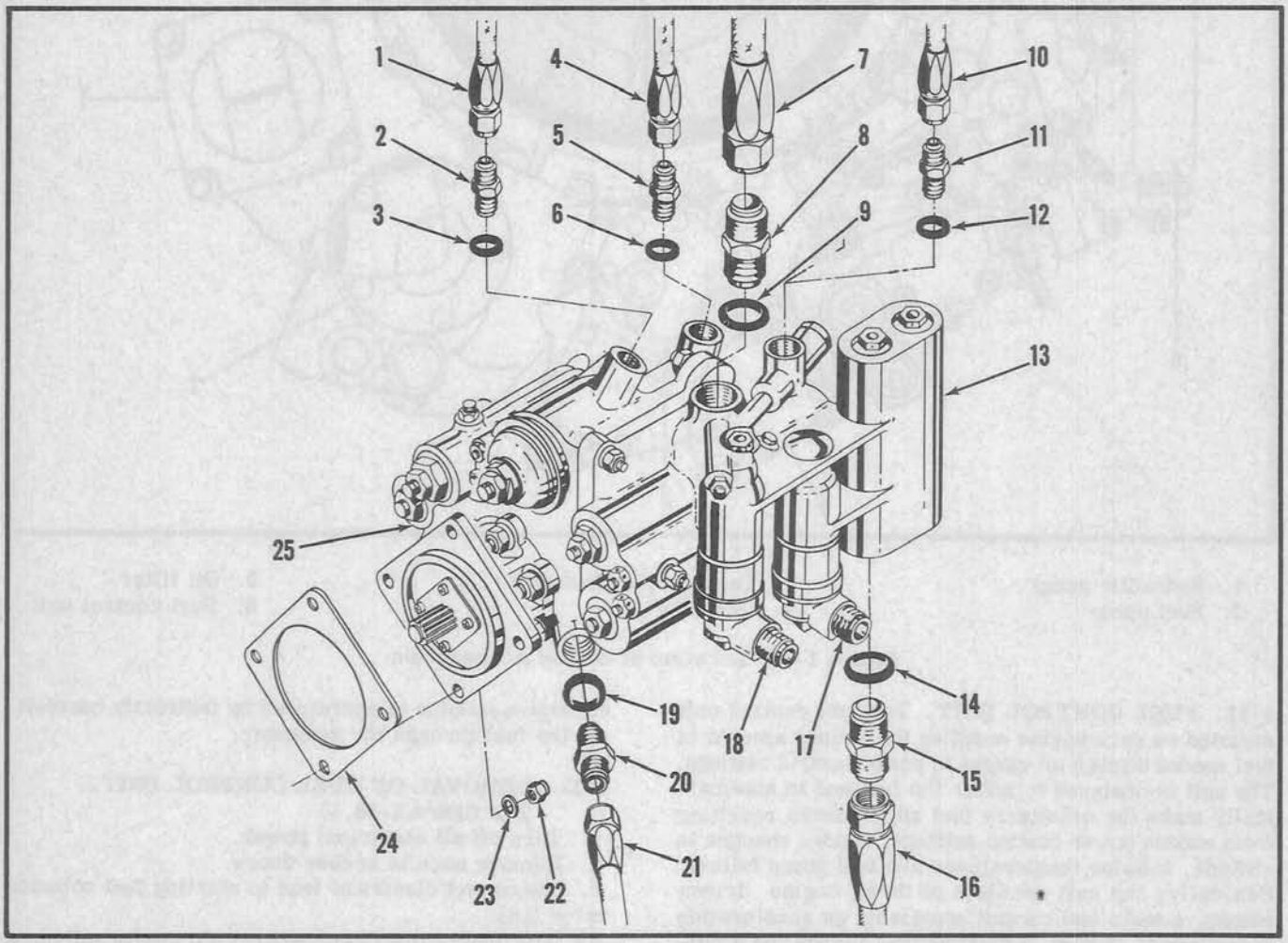
a. Turn off all electrical power.
b. Remove nacelle access doors.
c. Disconnect electrical lead to starting fuel solenoid valve (18).
d. Disconnect lead to emergency transfer solenoid valve (17).
e. Disconnect fuel inlet hose (16).
f. Disconnect compressor inlet hose (1).
g. Disconnect compressor discharge hose (4).
h. Disconnect bypass fuel hose (7).
i. Disconnect starting fuel hose (10).
j. Disconnect fuel outlet hose (2).
k. Disconnect fuel control drain line.
l. Remove nuts (22), washers (23) and remove fuel control unit from engine.
m. Remove gasket (24).
n. Remove unions (2), (5), (8), (11), (15) and (20), and gaskets (3), (6), (9), (12), (14) and (19).

1-33. INSTALLATION OF FUEL CONTROL UNIT. (See figure 1-13.)

a. Install fuel control drain line on control.
b. Install gaskets (19), (14), (12), (9), (6) and (3), and unions (20), (15), (11), (8), (5) and (2).
c. Position gasket (24) over fuel control mounting pad.
d. Position fuel control unit (25) over mounting pad and secure with washers (23) and nuts (22).
e. Install fuel outlet hose (21).
f. Install compressor inlet hose (1).
g. Install compressor discharge hose (4).
h. Install fuel bypass hose (7).
i. Install fuel inlet hose (16).
j. Install starting fuel hose (10).
k. Connect electrical lead to emergency transfer solenoid (17).
l. Connect electrical lead to starting fuel solenoid valve (18).
m. Install nacelle access doors.

1-34. ADJUSTMENT OF FUEL CONTROL UNIT. (See figure 1-14.)

a. Replacement fuel control units are bench checked before they are installed on the engine, and should seldom need adjustment. However, some operation is necessary to properly "settle in" a new fuel control, clearing air lock etc. Therefore, it is essential that a ground check of engine operation be conducted, in accordance with paragraph 1-21, after each change of fuel control unit.
b. To adjust idle speed:
1. Break seal and lock wire and loosen lock nut (5).
2. Turn screw (6) IN to raise speed.
3. Turn screw (6) OUT to lower speed.



1. Compressor inlet hose
2. Union
3. Gasket
4. Compressor discharge hose
5. Union
6. Gasket
7. By-pass fuel hose
8. Union
9. Gasket
10. Starting fuel outlet hose
11. Union
12. Gasket
13. Filters
14. Gasket
15. Union
16. Fuel inlet hose
17. Emergency transfer solenoid valve
18. Starting fuel solenoid valve
19. Gasket
20. Union
21. Fuel outlet hose
22. Nut
23. Washer
24. Gasket
25. Fuel control unit

Figure 1-13. Fuel Control Unit Installation

4. Hold screw (6) at desired setting and tighten lock nut (5). Lockwire and seal.

c. To adjust maximum speed.

1. Break seal and lockwire and loosen lock nut (4).
2. Turn screw (3) IN to lower speed.
3. Turn screw (3) OUT to raise speed.
4. Hold screw (3) at desired setting and tighten lock nut (4). Lockwire and seal.

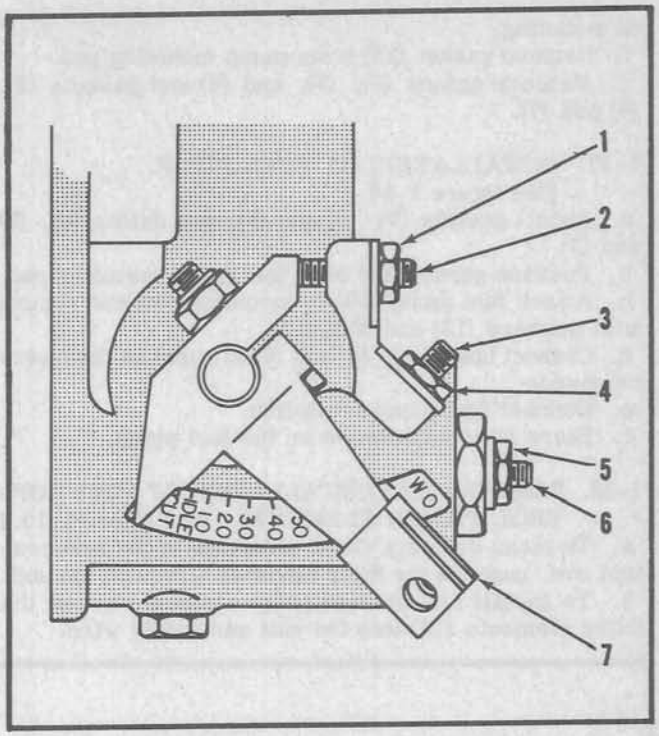
d. To adjust cutoff:

1. Disconnect linkage to control lever.
2. Break seal and loosen lock nut (1). Back out screw (2) fully.
3. Pull lever (7) down toward zero degrees until lever is felt to seat solidly. Do not exert heavy pressure or force the lever.
4. When lever (7) seats, hold its position while turning screw (2) in until screw is felt to touch lever (7).
5. Hold lever in this position and tighten lock nut (1). Lockwire and seal.
6. Attach control linkage to lever.

1-35. FUEL PUMPS. The fuel pumps are located at approximately the five o'clock position on each engine accessory drive case. Each pump is a three element unit with one centrifugal boost element feeding two parallel gear pump elements. There are three fluid ports on each pump; one supply inlet port, one by-pass inlet port and one pressure outlet port.

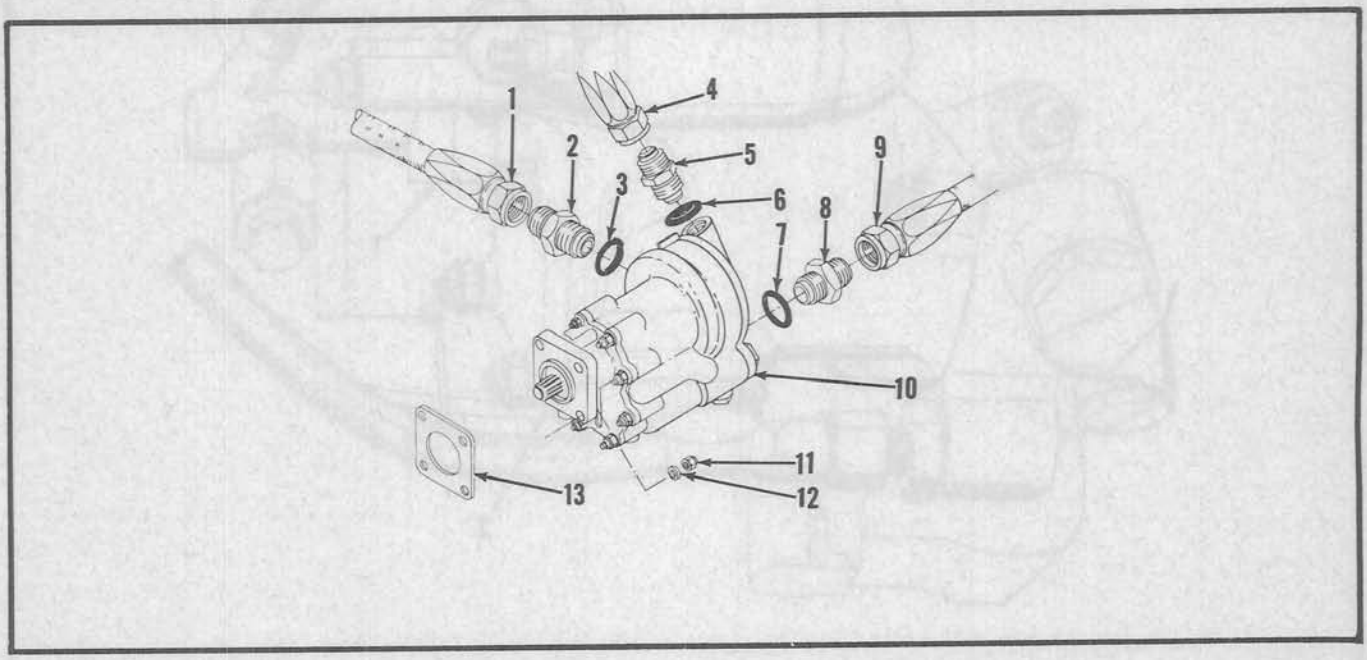
1-36. REMOVAL OF FUEL PUMPS. (See figure 1-15.)

a. Disconnect hose (1) at pump inlet.
b. Disconnect hose (4) at pump by-pass inlet.
c. Disconnect hose (9) at pump outlet.
d. Disconnect fuel pump drain line.
e. Remove nuts (11), washers (12) and pull pump clear



1. Nut
2. Cut-off stop
3. Maximum speed stop
4. Nut
5. Nut
6. Idle speed adjustment
7. Lever

Figure 1-14. Fuel Control Adjustment



1. Fuel inlet hose
2. Union
3. Gasket
4. Fuel by-pass inlet hose
5. Union
6. Gasket
7. Gasket
8. Union
9. Fuel outlet hose
10. Fuel pump
11. Nut
12. Washer
13. Gasket

Figure 1-15. Fuel Pump Installation

of mounting.
f. Remove gasket (13) from pump mounting pad.
g. Remove unions (2), (5), and (8) and gaskets (3), (6) and (7).

1-37. INSTALLATION OF FUEL PUMP. (See figure 1-15.)
a. Install gaskets (7), (6) and (3), and unions (8), (5) and (2).
b. Position gasket (13) over fuel pump mounting pad.
c. Attach fuel pump (10) to mounting pad and secure with washers (12) and nuts (13).
d. Connect hoses (1), (4) and (9) to pump as they were removed.
e. Connect fuel pump drain line.
f. There is no adjustment on the fuel pump.

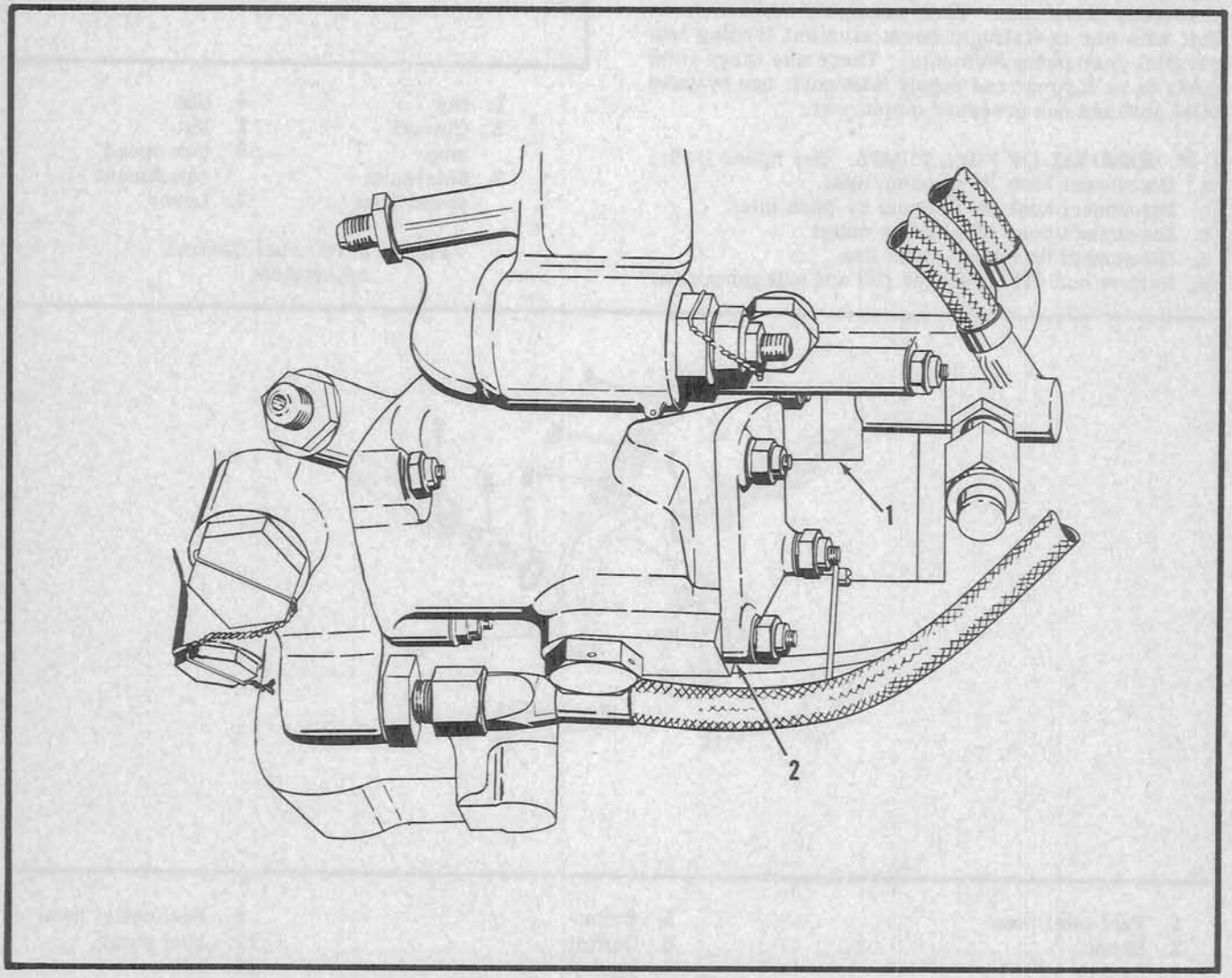
1-38. REMOVAL AND INSTALLATION OF FUEL CONTROL FILTER ELEMENTS. (See figure 1-13.)
a. To clean or check filter elements in the fuel control unit, unscrew the filter elements (13) from the unit.
b. To install fuel control filter elements screw the filter elements (13) into the unit and safety wire.

1-39. OIL PUMP.

1-40. REMOVAL OF OIL PUMP. (See figure 1-16.)
a. Remove tachometer generator in accordance with paragraph 1-55.
b. Disconnect hoses at pump (1).
c. Remove nuts and washers attaching pump to accessory drive and remove pump.
d. Remove gasket from oil pump mounting pad.

1-41. INSTALLATION OF OIL PUMP. (See figure 1-16.)
a. Position gasket over oil pump mounting pad.
b. Position pump over gasket. Make sure drive shaft is properly engaged.
c. Attach pump with washers and nuts.
d. Attach hoses to oil pump (1).
e. Install tachometer generator in accordance with paragraph 1-56.

1-42. REMOVAL OF OIL FILTER. (See figure 1-17.)
a. Remove nuts (1) and washers (2) and filter head.
b. Remove the filter and gasket by pulling it out of



1. Oil Pump
2. Oil filter

Figure 1-16. Oil Pump Installation

the assembly.

1-43. CLEANING OIL FILTER.
a. Clean the oil filter by immersing it in cleaning solvent Federal Specification P-S-661 and use a stiff-bristle brush to dislodge deposits.

1-44. INSTALLATION OF OIL FILTER.
(See figure 1-17.)
a. Install new gasket on filter and insert into housing.
b. Attach head with washers (2) and secure with nuts (1).

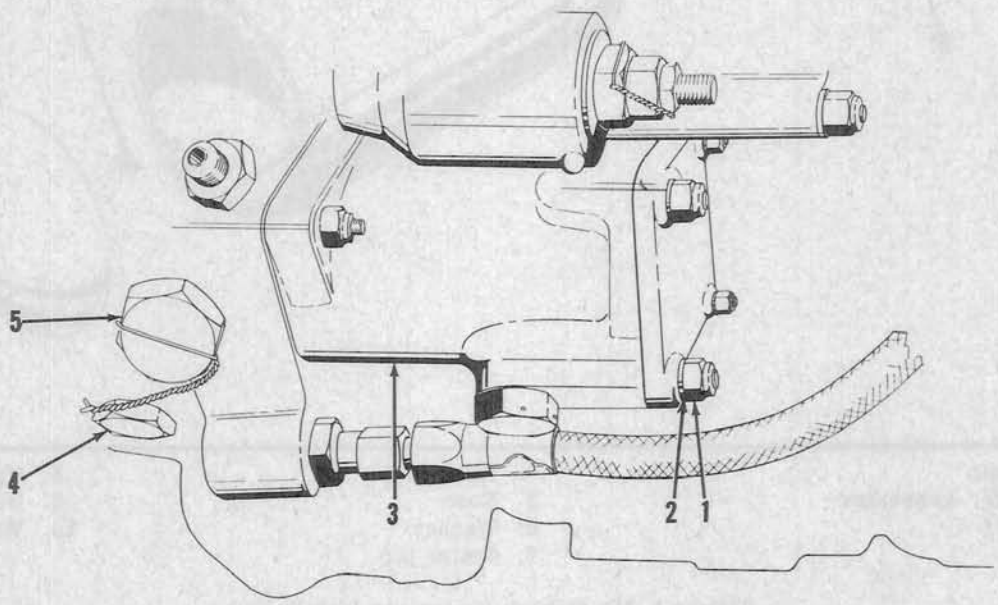
1-45. OIL PRESSURE REGULATOR. If the oil pressure gage indicates low and the condition is not due to low oil level or external leakage, the oil pressure regulator valve may require cleaning.

1-46. CLEANING OIL PRESSURE REGULATOR.
(See figure 1-17.)
a. Unscrew plug (4) and remove seal, spring, guide, and seat.
b. Clean in solvent Federal Specification P-S-611 and check for varnish or gummy deposits in the bore that might cause sticking.
c. If spring is weak or broken, replace it.
d. Install seat, spring guide, spring and plug. Tighten plug and safetywire.

1-47. CLEANING OIL FILTER BY-PASS VALVE.
(See figure 1-17.)
a. Refer to paragraph 1-46.

1-48. STARTER-GENERATOR. The starter-generator is located in the bullet shaped aluminum cover in front of the engine and supplies 28V DC power to the airplane electrical system.

1-49. REMOVAL OF STARTER-GENERATOR.
(See figure 1-18.)
a. Remove engine in accordance with paragraph 1-26.
b. Remove cotter pin (7), nut (8), washer (6) and remove nose (5), washer (4) and cover (3).
c. Disconnect electrical lead and remove nuts (9) and



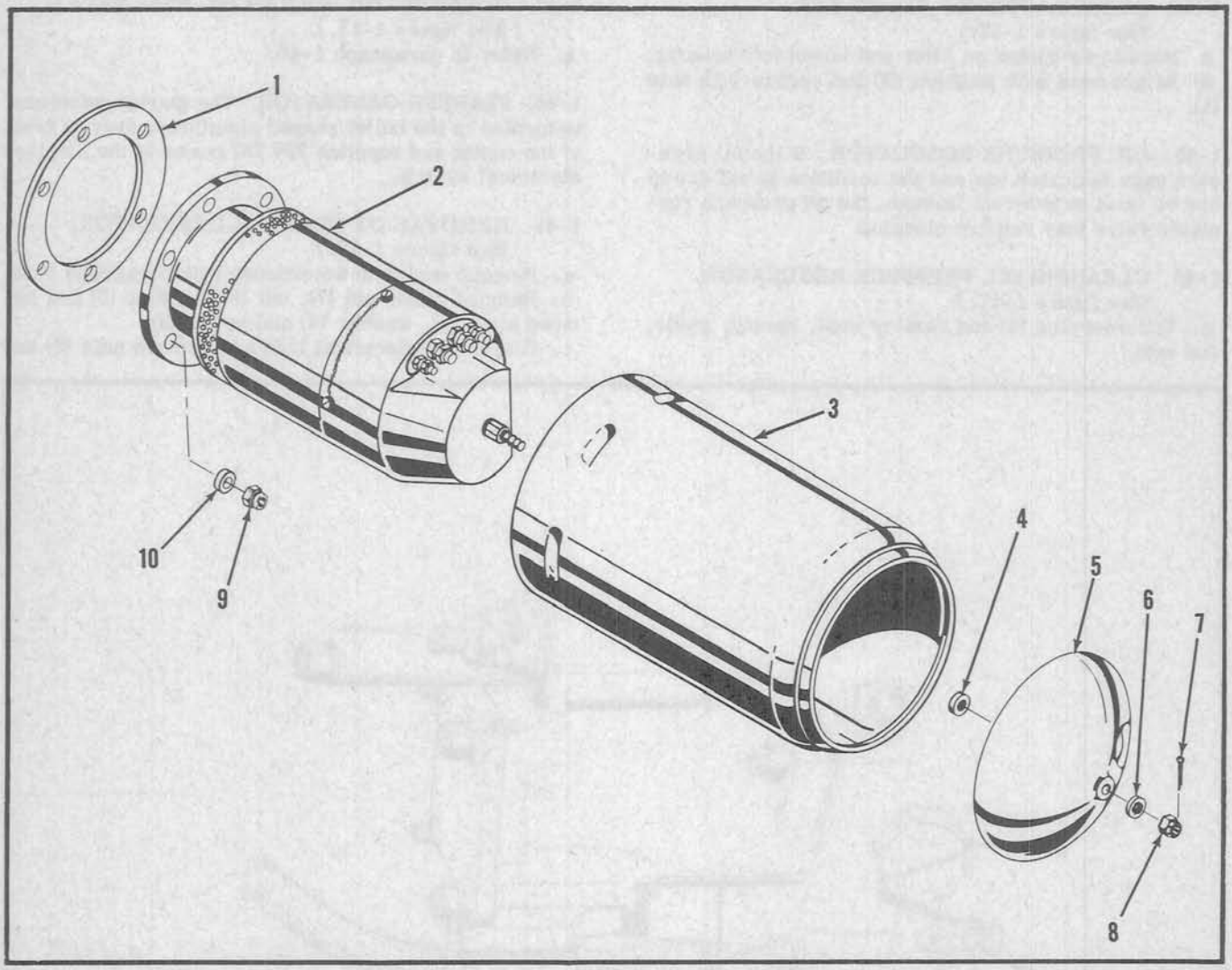
1. Nut
2. Washer
3. Oil filter
4. Oil pressure regulator
5. Oil by-pass valve

Figure 1-17. Oil Filter Installation

washers (10).
d. Remove starter-generator (2) and gasket (1).

1-50. INSTALLATION OF STARTER-GENERATOR. (See figure 1-18.)

a. Position gasket (1) on starter-generator mounting pad.
b. Position starter-generator (2) over gasket (1) and secure with washers (10) and nuts (9).
c. Connect electrical leads.
d. Position cover (3) over starter-generator (2).
e. Install washer (4), nose (5), washer (6) and secure with nut (8) and cotter pin (7).
f. Install engine in accordance with paragraph 1-27.



1. Gasket
2. Starter-generator
3. Cover
4. Washer
5. Nose
6. Washer
7. Cotter pin
8. Nut
9. Nut
10. Washer

Figure 1-18. Starter-Generator Installation

1-51. IGNITION UNIT.

1-52. REMOVAL OF IGNITION UNIT. (See figure 1-19.)

CAUTION

Make sure all electrical power is turned off.

a. Remove nacelle upper access door.
b. Disconnect electrical wiring at unit.
c. Remove bolts (4) attaching unit (1) to compressor housing assembly and remove unit from engine.

1-53. INSTALLATION OF IGNITION UNIT. (See figure 1-19.)

a. Position ignition unit (1) over mounting holes in compressor housing and attach with bolts (4).

CAUTION

Make sure that clamp (2) which holds power control (3) is attached with ignition unit mounting bolt.

b. Connect electrical wiring to ignition unit.
c. Install access cover.

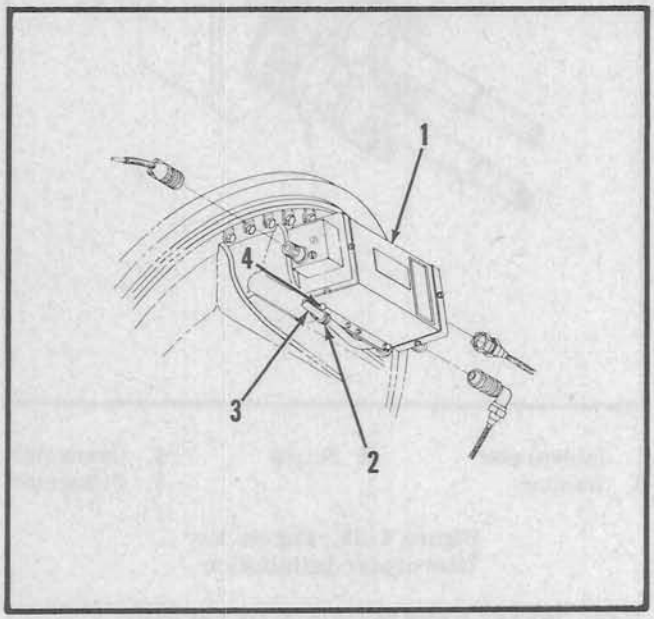
1-54. TACHOMETER GENERATOR.

1-55. REMOVAL OF TACHOMETER GENERATOR. (See figure 1-20.)

a. Remove nacelle lower access door.
b. Disconnect electrical wiring from tachometer generator.
c. Remove nuts (3) and washers (4) attaching tachometer generator to mounting pad.
d. Remove tachometer generator and gasket from engine.

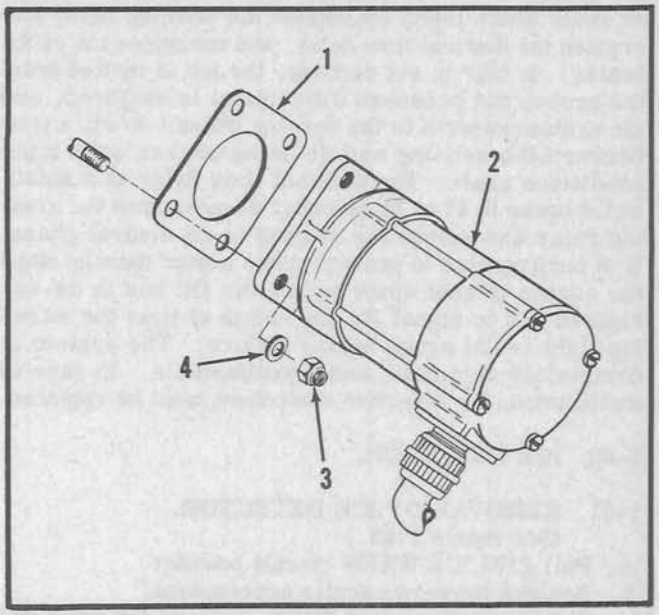
1-56. INSTALLATION OF TACHOMETER GENERATOR. (See figure 1-20.)

a. Install gasket on tachometer generator mounting pad.
b. Attach tachometer generator to mounting pad with nuts (3).
c. Connect electrical wiring.
d. Install access door.



1. Ignition unit
2. Clamp
3. Power control
4. Bolts

Figure 1-19. Ignition Unit Installation



1. Gasket
2. Tachometer generator
3. Nut
4. Washer

Figure 1-20. Tachometer Generator Installation

1-57. ENGINE ICE DETECTION SYSTEM.

1-58. GENERAL DESCRIPTION. The two main components of the engine ice detection system are the detector and the interpreter. The detector consists of a perforated probe containing a heater, and a case containing a thermostatic heater, a diaphragm, and a diaphragm controlled switch. It is located on the left air inlet duct. The interpreter contains an arming relay, a power relay, and a thermal time delay, It is located on the outboard side of the left canted firewall below the detector. A red, press-to-test, engine ice warning light, mounted on the shock panel, is wired to the interpreter through a dimming relay and, through a fifteen ampere circuit breaker, to the DC bus. The same fifteen ampere circuit breaker protects the circuit to the interpreter. For further information on the engine ice warning light, see T.O. No. 1T-37A-2-6; for the dimming relay, see T.O. No. 1T-37A-2-7.

1-59. OPERATION OF ENGINE ICE DETECTION SYSTEM. (See figure 1-21.) Use of a pressure differential for mechanical power allows a three-phase, cycling operation of the system: neutral, sensing, and deicing. In the neutral phase, with the DC bus energized, but with the engine not in operation, only the case heater is energized to keep the temperature in the case at 12.8°C (55°F) to 23.9°C (75°F). When the detector

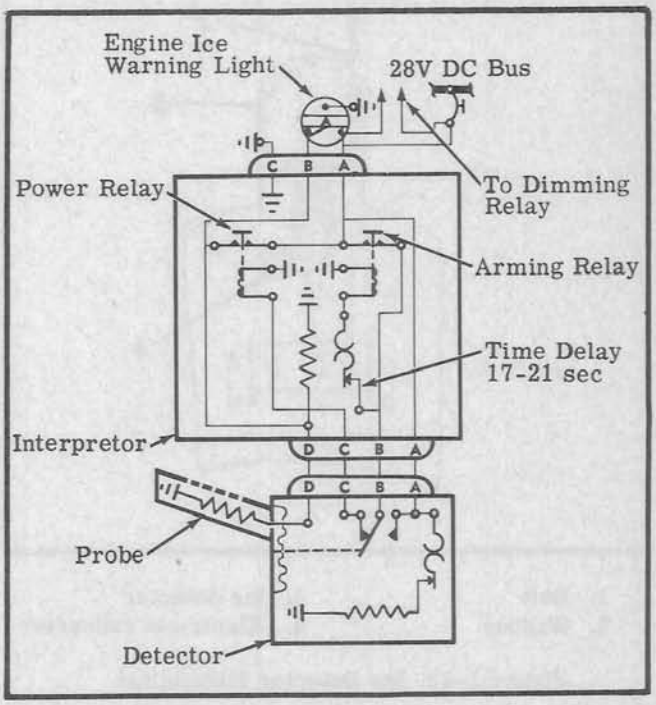


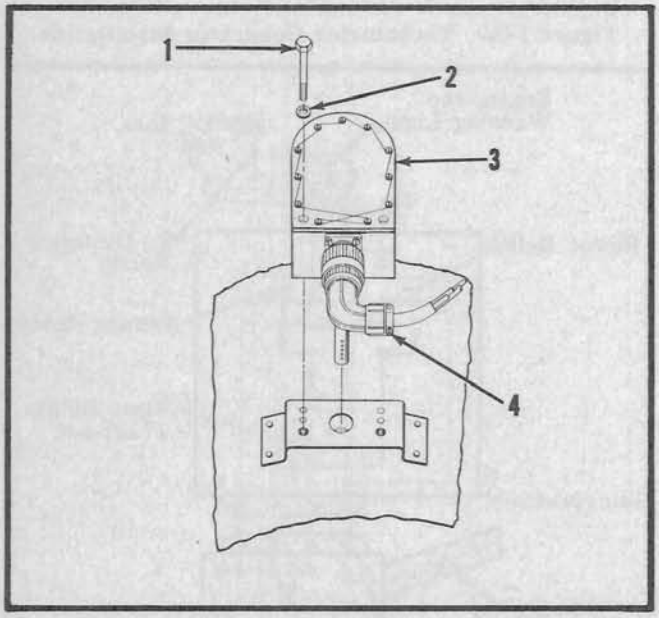
Figure 1-21. Engine Ice Warning System Schematic

probe is subjected to ram air of forty knots or more, a pressure differential is created which distends the diaphragm and actuates the diaphragm switch. This moves the system to the sensing phase by energizing the arming relay and directing current to the blade of the diaphragm switch. When an icing condition is encountered, the perforations in the probe become blocked with ice, and the resulting attenuated pressure differential allows the diaphragm to relax, returning the diaphragm switch to its normal position. This moves the system to the de-icing phase by energizing the power relay which lights the engine ice warning light, energizes the thermal time delay, and energizes the probe heater. In four to six seconds, the ice is melted from the probe, the pressure differential is restored, and the system reverts to the sensing phase. It will cycle between the sensing and de-icing phases until icing conditions abate. The thermal time delay is a safety which opens in 17 to 21 seconds, de-energizes the arming relay and moves the system to its neutral phase. It is incorporated to prevent probe heater damage when the engine is shut down before the DC bus is de-energized and to signal (by the length of time the warning light is lit) probe heater failure. The system is completely automatic and nonadjustable. In case of malfunction, the defective component must be replaced.

1-60. ICE DETECTOR.

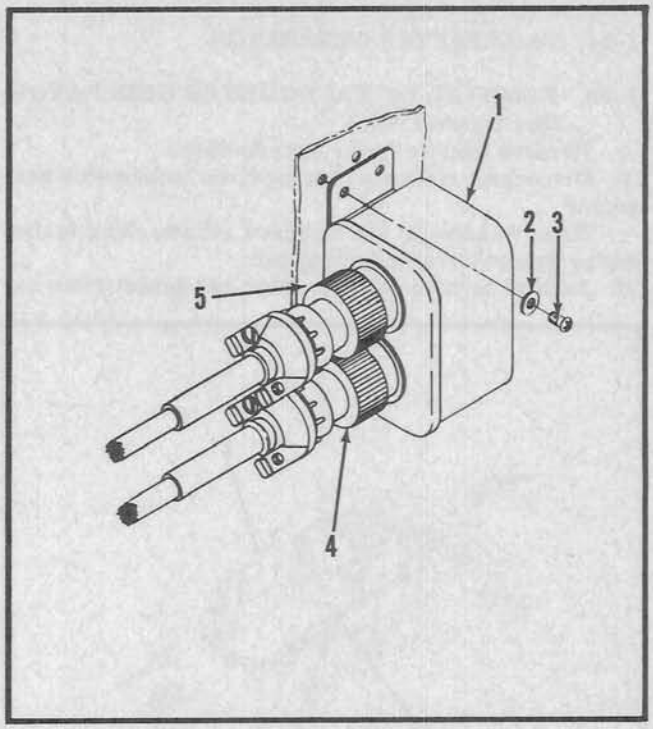
1-61. REMOVAL OF ICE DETECTOR.
(See figure 1-22.)

a. Pull ENG ICE WARN circuit breaker.
b. Remove forward nacelle access door.
c. Disconnect electrical fitting, remove two bolts and washers, and lift detector from bracket taking care not to damage probe.



1. Bolt
2. Washer
3. Ice detector
4. Electrical connector

Figure 1-22. Ice Detector Installation



1. Interpreter
2. Washer
3. Screw
4. Connector
5. Connector

Figure 1-23. Engine Ice Interpreter Installation

1-62. INSTALLATION OF ICE DETECTOR.
(See figure 1-22.)

a. Position detector so that probe points aft through the hole in the inlet duct, secure with two bolts and washers, and connect electrical fitting.
b. Install forward nacelle access door.
c. Push in ENG ICE WARN circuit breaker.

1-63. ICE INTERPRETER.

1-64. REMOVAL OF ICE INTERPRETER.
(See figure 1-23.)

a. Pull ENG ICE WARN circuit breaker.
b. Remove forward nacelle access door.
c. Disconnect two electrical fittings, remove four screws and washers, and remove interpretor.

1-65. INSTALLATION OF ICE INTERPRETER.
(See figure 1-23.)

a. Position interpreter on canted firewall, attach with four screws and washers, and connect two electrical fittings.

CAUTION

Do not force fittings. The pins are arranged to prevent connecting the wrong fitting to the interpretor.

b. Install forward nacelle access door.
c. Push in ENG ICE WARN circuit breaker.

SECTION II
FUEL SYSTEM

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2-1. FUEL SYSTEM.

2-2. GENERAL. There are two major divisions in the fuel system: the airplane fuel system, and the two identical engine fuel systems. The airplane fuel system, discussed in this section, supplies fuel to both engines. and consists of the portion remaining with the airplane when both engines are removed. The two, identical engine fuel systems discussed in Section I, regulate the fuel flow to the combustion section within each engine and consist of the portion removed with the engines.

2-3. AIRPLANE FUEL SYSTEM.

2-4. GENERAL. The major sub-systems, components, and accessories of the airplane fuel system include a vent system, two gaging systems - the fuel quantity and the fuel flow systems, a fuel control system, a fuel boost pump and reservoir, thirteen fuel cells, a fuel strainer, and two motorized shut-off valves.

2-5. OPERATION OF AIRPLANE FUEL SYSTEM. (See figure 2-1.) Normally, fuel flows gravitationally from the outer cells in each wing, inboard to the fuel control system which feeds it into the fuselage fuel cell. Flow reversal during flight maneuvers is prevented by flapper valves installed in each wing cell. The fuel reservoir is designed to hold enough fuel to sustain inverted flight for thirty seconds. The reservoir is mounted in the bottom of the fuselage fuel cell and encloses a continuous action pump which pumps fuel from the cell to both engines. The channel-guarded fuel boost pump switch on the switch panel controls the pump. Two fire control handles at the top of the shock panel control two motorized shut-off valves installed between the fuel pump and the engines, enabling the pilot to stop fuel flow to either or both engines whenever desired.

2-6. TROUBLE SHOOTING AIRPLANE FUEL SYSTEM.

TROUBLE	PROBABLE CAUSE	REMEDY
FUEL LEAKAGE	Defective fuel cell.	Replace cell.
	Distortion of compression fitting due to overtorque.	Retorque. If leakage persists, replace cell.
	Loose or improperly aligned interconnect fitting, nipple, or tubing.	Retorque or realign interconnect fitting, nipple, or tubing.
	Defective "O" ring or plug in strainer.	Replace defective part.
INHIBITED FUEL FLOW	Clogged fuel line.	Clean line.
	Plugged vent.	Clean vent.
	Dirty filter unit in strainer.	Replace filter unit.

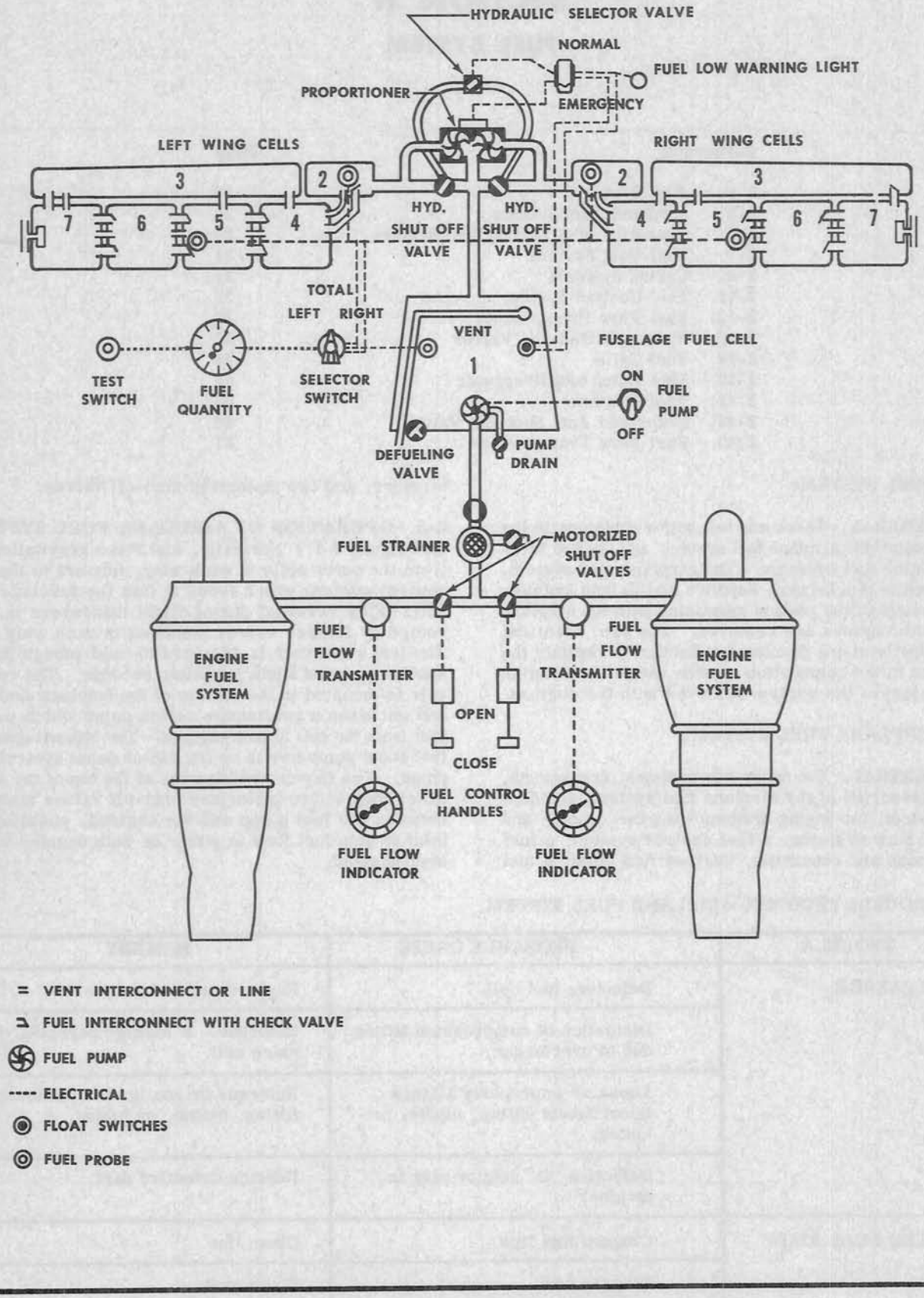


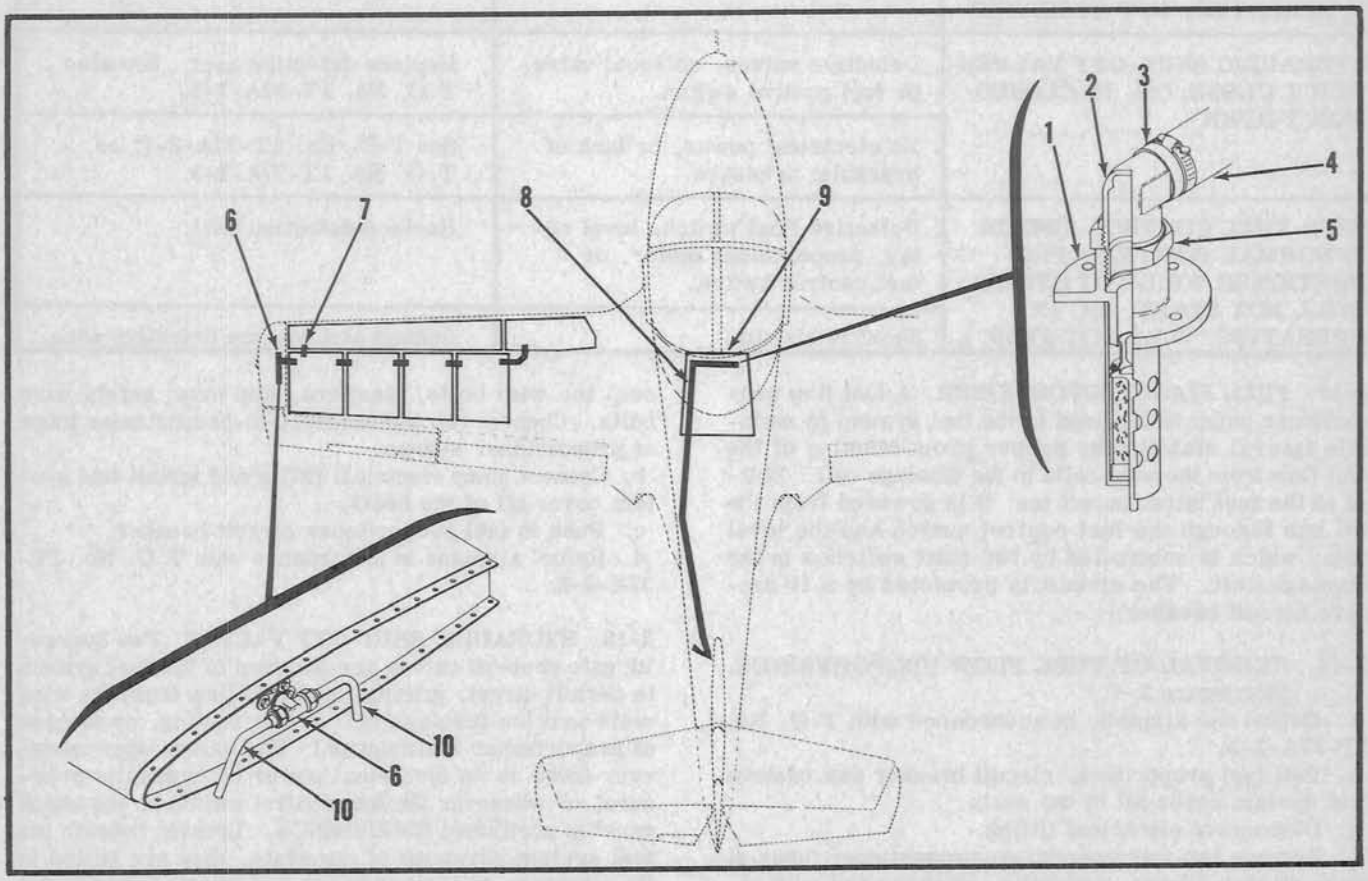
Figure 2-1. Fuel System Schematic

TROUBLE	PROBABLE CAUSE	REMEDY
NO FUEL AT AN ENGINE	Motorized fuel shut-off valve failed or shorted circuit	Check circuit for short, repair. Replace valve if necessary.
FUEL LOSS THROUGH VENT	Defective vent valve.	Replace valve.
FUEL LOSS THROUGH FUSELAGE CELL PUMP SEAL DRAIN	Defective pump motor seal.	Replace pump.

2-7. FUEL VENT SYSTEM. (See figure 2-2.) The fuel cells are vented to maintain approximately ambient pressure and to aid free fuel flow. To prevent fuel loss during flight maneuvers, valves are located at the three external venting ports: a float valve in the fuselage cell, and a float valve in each cell number seven. The valves in the number seven cells also prevent use of expansion space during fueling. Except for these three vents, all venting is internal, inter-cell. The fuselage cell is vented to the tail through the float valve and conventional tubing and connections. The float valves in the number seven cells are connected to tubes designed to provide a positive airflow into the wing during flight.

2-8. GAGING SYSTEMS.

2-9. FUEL QUANTITY INDICATING SYSTEM. The fuel quantity indicating system indicates the amount of fuel in the left wing, the right wing, or the entire system, depending on the position of a selector switch below the fuel quantity indicator on the shock panel. Units of the system removed and installed in this section are five fuel probes: one in the fuselage fuel cell (see paragraphs 2-27 and 2-28), one in each cell number two (see paragraphs 2-29 and 2-30), and one in each cell number five (see paragraphs 2-35 and 2-36). A low level emergency warning circuit lights a red, press-to-test light on the shock panel whenever the fuel control switch is positioned EMERGENCY, or when only 375 pounds of fuel remain in the fuselage fuel cell. The only unit of the circuit removed and installed in this section is the low level float switch in the switch support assembly (see paragraphs 2-27 and 2-28). See also T.O. No. 1T-37A-2-6.



1. Vent valve
2. Elbow
3. Clamp
4. Hose
5. Nut
6. Tee
7. Interconnect vent
8. Vent line.
9. Fuel cell
10. Vent tube

Figure 2-2. Fuel Vent System Schematic

2-10. FUEL FLOW INDICATING SYSTEM. The fuel flow indicating system indicates fuel flow to the engines in pounds per hour. Units of the system removed and installed in this section are two fuel flow transmitters (see paragraphs 2-50 and 2-51). See also T.O. No. 1T-37A-2-6.

2-11. FUEL CONTROL SYSTEM. (See figure 2-3.) The fuel control system consists of a cover-guarded fuel control switch on the shock panel, a fuel flow proportioner and two hydraulic shut-off valves beneath the fuel system cover aft of the seats, and two float switches in the fuselage fuel cell. In normal operation the hydraulic shut-off valves are closed, forcing fuel from wings to go through the fuel flow proportioner. When the fuel level in the fuselage cell drops to the lower float switch, the proportioner is energized and pumps fuel into the cell, in equal amounts from each wing, until the level rises to the upper float switch which de-energizes the pump. To permit direct, gravitational fuel flow from the wing cells during fueling or in case of system failure, the hydraulic valves open whenever there is no electrical power or hydraulic pressure. When the fuel control switch is positioned EMERGENCY, a fuel warning light on the shock panel lights, and the proportioner and hydraulic valves are de-energized. Powered from the DC bus, the fuel warning light circuit is protected by a five ampere circuit breaker, and the fuel control system is protected by a ten ampere circuit breaker.

2-12. TROUBLE SHOOTING FUEL CONTROL SYSTEM.

TROUBLE	PROBABLE CAUSE	REMEDY
FUEL WARNING LIGHT LIGHTS WITH MORE THAN 375 POUNDS OF FUEL IN FUSELAGE CELL AND WITH FUEL CONTROL SWITCH IN NORMAL POSITION	Float switch stuck shut.	Replace float switch assembly.
	Circuit shorted to ground.	Inspect and replace defective wire.
SAME CONDITIONS AS ABOVE; IN ADDITION, FUEL QUANTITY IS INDICATED, NOT OBSERVED	Malfunctioning fuel quantity system.	See T.O. No. 1T-37A-2-6.
HYDRAULIC SHUT-OFF VALVES WON'T CLOSE; OR, IF CLOSED WON'T OPEN	Defective valves, solenoid valve, or fuel control switch.	Replace defective part. See also T.O. No. 1T-37A-2-3.
	No electrical power, or lack of hydraulic pressure.	See T.O. No. 1T-37A-2-7, or T.O. No. 1T-37A-2-3.
WITH FUEL CONTROL SWITCH IN NORMAL POSITION, PROPORTIONER WILL NOT CYCLE. (WILL NOT START; OR, IF OPERATING, WILL NOT STOP.)	Defective float switch, level relay, proportioner motor, or fuel control switch.	Replace defective part.
	Short in circuit.	Inspect and replace defective wire.

2-13. FUEL FLOW PROPORTIONER. A fuel flow proportioner pump is included in the fuel system to maintain lateral stability by proper proportioning of the fuel flow from the wing cells to the fuselage cell. Bolted to the fuel interconnect tee, it is powered from the DC bus through the fuel control switch and the level relay which is controlled by two float switches in the fuselage cell. The circuit is protected by a 10 ampere circuit breaker.

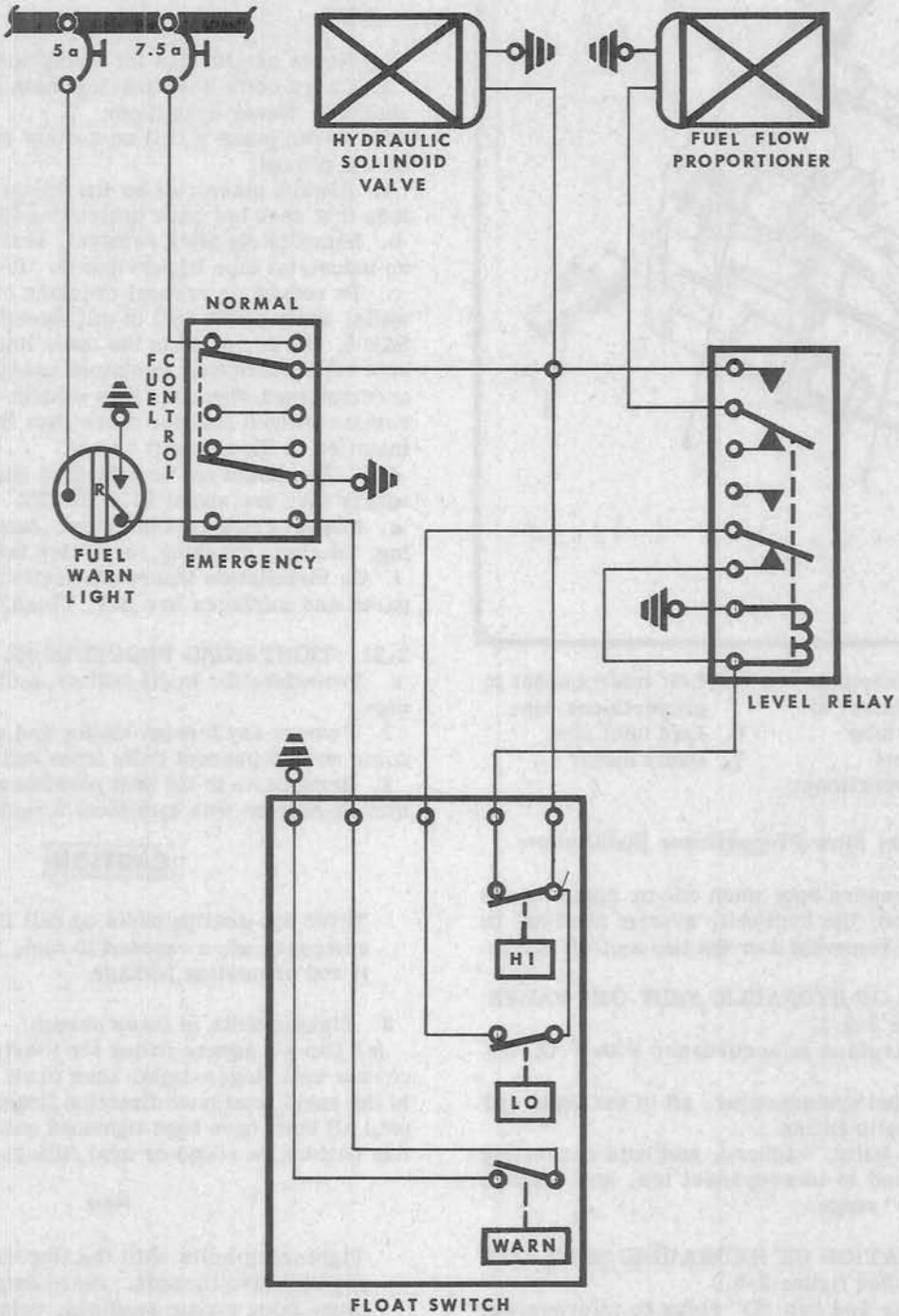
2-14. REMOVAL OF FUEL FLOW PROPORTIONER. (See figure 2-4.)

a. Defuel the airplane in accordance with T.O. No. 1T-37A-2-2.
b. Pull fuel proportioner circuit breaker and remove fuel system cover aft of the seats.
c. Disconnect electrical fitting.
d. Remove two interconnect-to-proportioner tubes at proportioner elbows, and bolts, washers and nuts attaching proportioner to interconnect tee.
e. Remove pump and "O" rings.

2-15. INSTALLATION OF FUEL FLOW PROPORTIONER. (See figure 2-4.)

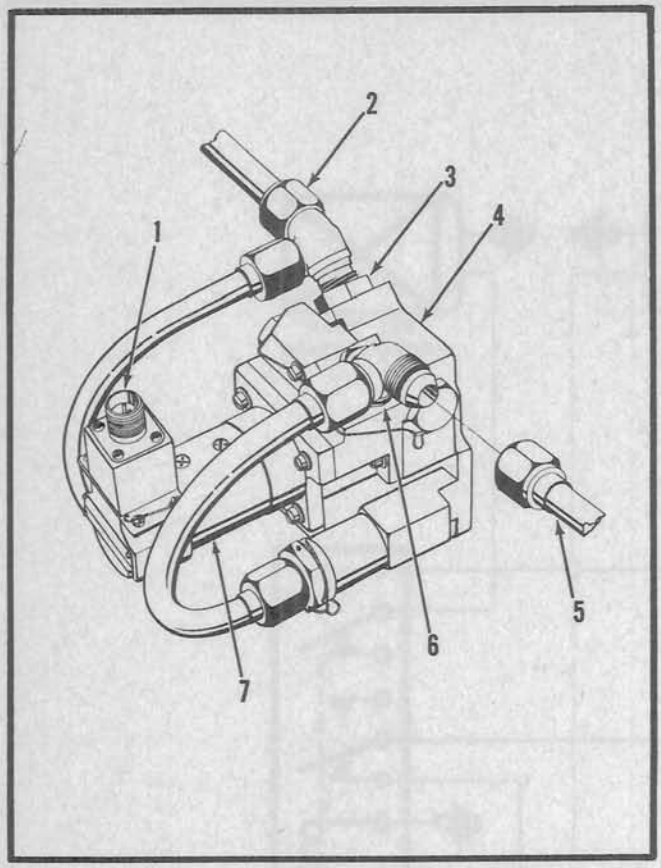
a. Position pump and "O" rings, attach to interconnect tee with bolts, washers, and nuts; safety wire bolts. Connect two interconnect-to-proportioner tubes at proportioner elbows.
b. Connect pump electrical fitting and install fuel system cover aft of the seats.
c. Push in fuel proportioner circuit breaker.
d. Refuel airplane in accordance with T.O. No. 1T-37A-2-2.

2-16. HYDRAULIC SHUT-OFF VALVES. Two hydraulic gate shut-off valves are included in the fuel system to permit direct, gravitational fuel flow from the wing cells into the fuselage cell during fueling, or in case of proportioner malfunction. The valves open whenever there is no electrical power or hydraulic pressure, or whenever the fuel control switch on the shock panel is positioned EMERGENCY. Located beneath the fuel system cover aft of the seats, they are bolted to the interconnect tee and to the fuel lines leading to the fuel cells in the wings. The valves are operated by a solenoid actuated, three-way, hydraulic valve which is powered from the DC bus through the fuel control switch, and protected by a 10 ampere circuit breaker. Since the control valve is installed in the hydraulic system between the engine pumps and the accumulator, it



NOTE: SHOWN FULLY FUELED WITH ELECTRICAL POWER

Figure 2-3. Fuel Control System Schematic



1. Electrical receptacle
2. Right interconnect to proportioner tube
3. Right inlet port
4. Fuel flow proportioner
5. Left interconnect to proportioner tube
6. Left inlet port
7. Pump motor

Figure 2-4. Fuel Flow Proportioner Installation

will be under pressure only when one or both engines are operating; and, the hydraulic system need not be discharged before removing it or the two shut-off valves.

2-17. REMOVAL OF HYDRAULIC SHUT-OFF VALVE. (See figure 2-5.)

a. Defuel the airplane in accordance with T.O. No. 1T-37A-2-2.

b. Remove the fuel system cover, aft of the seats and disconnect hydraulic fitting.

c. Remove four bolts, washers, and nuts connecting valve to fitting and to interconnect tee, and remove valve and two "O" rings.

2-18. INSTALLATION OF HYDRAULIC SHUT-OFF VALVE. (See figure 2-5.)

a. Connect valve and two "O" rings to interconnect tee and fitting with four bolts, washers and nuts.

b. Connect hydraulic fitting and install fuel system cover aft of the seats.

c. Refuel airplane in accordance with T.O. No. 1T-37A-2-2.

2-19. FUEL CELLS. (See figure 2-6.)

2-20. MAINTENANCE OF FUEL CELLS.

a. Handling precautions:

CAUTION

Bladder type cells are very delicate. Failure to observe any of the following precautions will probably result in a damaged cell which will leak.

1. Never use fittings for handgrips.
2. Carry cells when moving them from one place to another. Never drag them.
3. Never place a cell on a dirty bench or floor, or on the ground.
4. Always place cell on its widest and flattest surface that does not have protruding fittings.

b. Immediately after removal, seal all openings with an industrial tape impervious to JP-4 fuel.

c. To reduce or prevent cracking or checking of cell walls, apply a thin coat of oil, Specification VV-O-581 SAE 8, 10, 20, or 30 to the inner lining of all serviceable cells which have contained gasoline. This will be accomplished whenever it is evident that the cells will remain without fuel for more than five days, whether installed in the aircraft or not.

d. Cells should not be folded or handled excessively unless they are above 18°C (65°F).

e. Inspect cells for distortion, deterioration, scuffing, tearing, cracking, or fitting failure.

f. On installation insure that cells and all contacting parts and surfaces are dry, clean, and undamaged.

2-21. TIGHTENING PROCEDURES.

a. Procedure for multi-bolt or multi-screw cell fittings.

1. Remove any foreign matter and wipe out fuel from dome nuts to prevent bolts from bottoming.
2. Bring parts to the best possible alignment so bolts may be started with minimum torque.

CAUTION

Never use sealing paste on cell fittings: it decomposes when exposed to fuel, contaminating it and promoting leakage.

3. Tighten bolts in three phases:

(a) Using a square fitting for illustration, draw each corner bolt finger-tight, then draw each second bolt in the same rotational direction finger-tight. Continue until all bolts have been tightened once. Follow a similar pattern on round or oval fittings.

Note

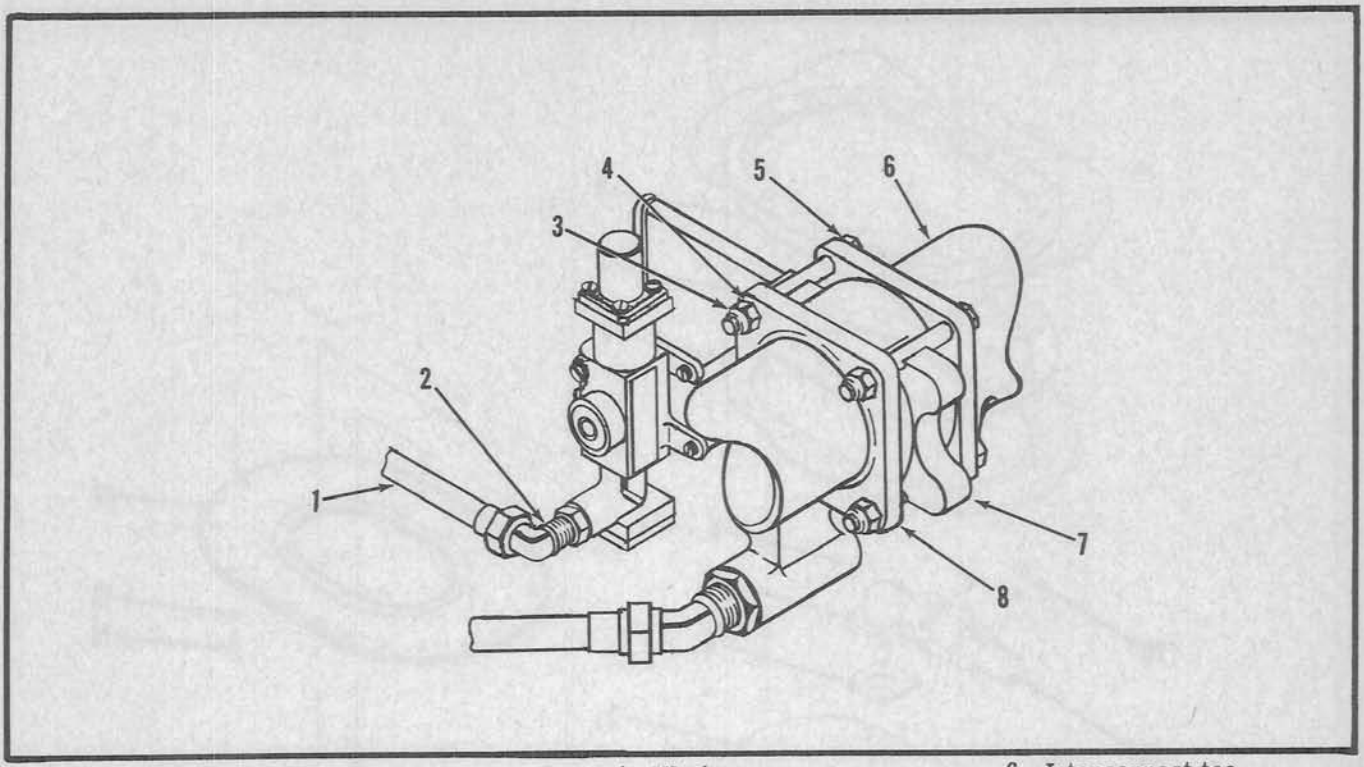
Tightening bolts with the fingers will reveal any damaged threads. Since damaged threads cause false torque readings, defective bolts or fittings shall not be used.

(b) Apply 3/4 maximum torque (see Table I) to the bolts, using the same pattern.

(c) Apply full required torque.

Note

Torque bolts with castellated nuts to high value and loosen to allow cotter pin insertion.



1. Hydraulic line
2. Hydraulic fitting
3. Nut
4. Washer
5. Bolt
6. Interconnect tee
7. Shut-off valve
8. Fitting

Figure 2-5. Hydraulic Shut-Off Valve Installation

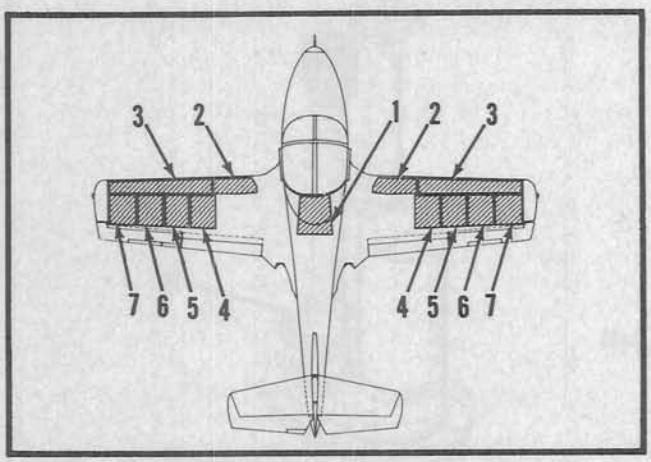


Figure 2-6. Fuel Cell Locations

b. Procedure for retightening multi-bolt or multi-screw cell fittings.

CAUTION

Overtorque to prevent or stop leakage will increase it by causing distortion, rapid deterioration, and failure of fitting and adjacent cell structure.

1. When it is necessary to retorque fittings due to loss of torque value, back-off all bolts to zero torque and retighten in accordance with procedure "a", this paragraph.

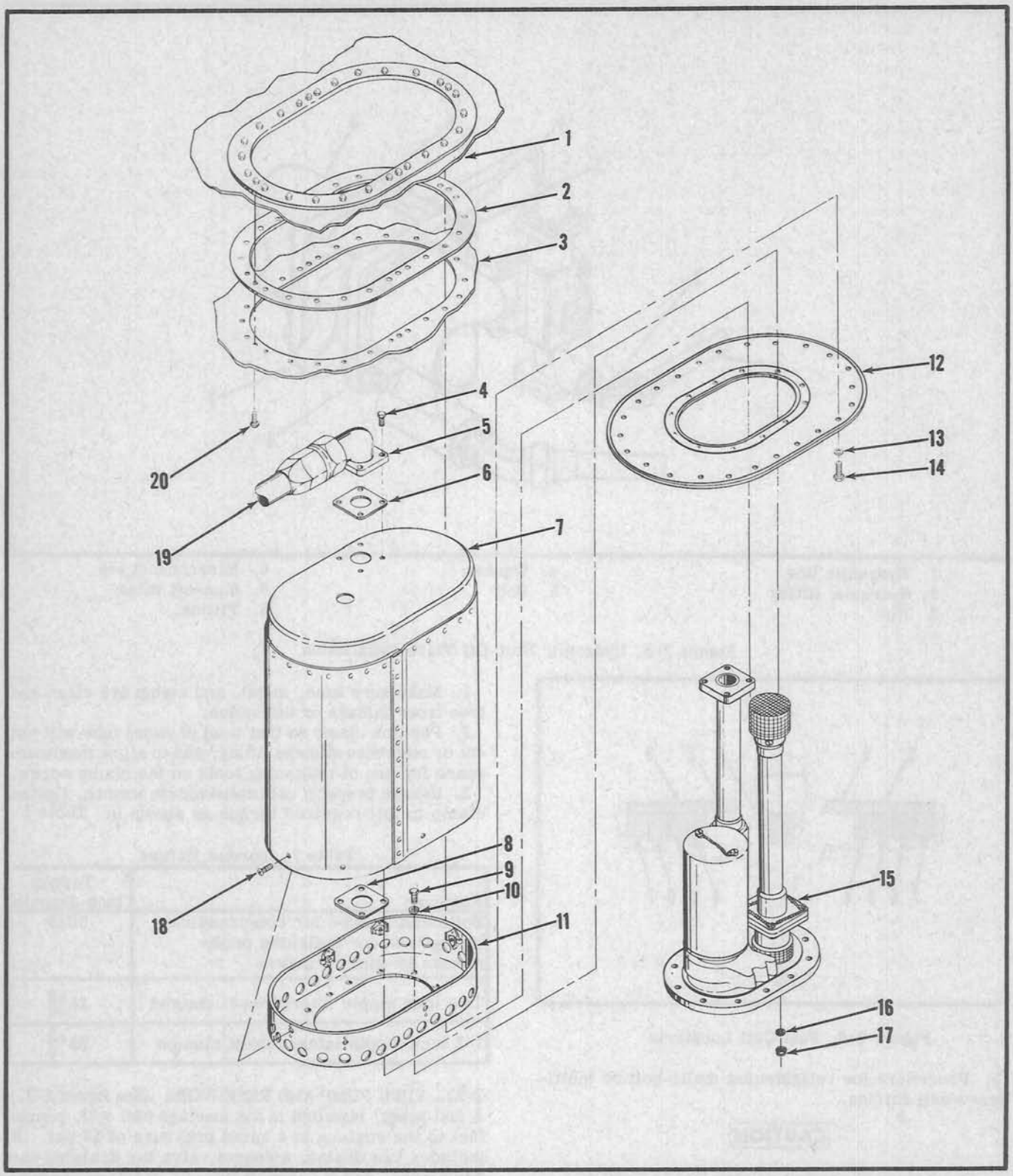
c. Procedure for tightening clamps.

1. Make sure hose, metal, and clamp are clean and free from damage or distortion.
2. Position clamp so that bead of metal tube will not cut or otherwise damage fitting, and to allow maximum space for use of tightening tools on the clamp screw.
3. Using a properly calibrated torque wrench, tighten clamp to full required torque as shown in Table I.

Table I. Torque Values

Fastener	Torque Inch-Pounds
Bolts and Screws for compression fittings and for fastening probe mounts to wing structure	50±5
Two inch nipple interconnett clamps	15^{+2}_{-0}
1/2 inch nipple interconnect clamps	25^{+2}_{-0}

2-22. FUEL PUMP AND RESERVOIR. (See figure 2-7.) A fuel pump, installed in the fuselage fuel cell, pumps fuel to the engines at a rated pressure of 17 psi. It includes two drains; a poppet valve for draining the pump area, and a seepage line for draining any fuel which seeps through a seal into the pump motor. The pump motor is powered by the DC bus, protected by a twenty ampere circuit breaker, and controlled by an ON-OFF toggle switch on the switch panel. The pump is mounted inside the reservoir which holds enough fuel to sustain inverted flight for thirty seconds. The reservoir is perforated at the bottom, and mounts a ball-valve at the top to allow trapped air to escape during fueling or level flight.



1. Fuselage fuel cell
2. Gasket
3. Tank bottom
4. Bolt
5. Flange
6. Gasket
7. Reservoir top
8. Gasket
9. Bolt
10. Washer
11. Reservoir bottom
12. Mounting plate
13. Washer
14. Bolt
15. Boost pump
16. Washer
17. Nut
18. Screw
19. Hose
20. Screw

Figure 2-7. Fuel Boost Pump Reservoir Installation

2-23. REMOVAL OF FUEL PUMP RESERVOIR. (See figure 2-7.)

a. Pull all circuit breakers on the top row of the circuit breaker panel.
b. Remove center tunnel door and defuel airplane in accordance with T.O. No. 1T-37A-2-2.
c. Disconnect pump wires and drain pump outlet through poppet valve.
d. Remove twenty-four bolts and seal type washers attaching mounting gasket, tank structure, and gasket to cell. Lower mounting gasket with pump and reservoir until reservoir-to-outlet hose is accessible.
e. Unscrew hose from pump outlet elbow to free reservoir from airplane.
f. Remove gasket from between tank structure and cell.
g. Refer to paragraphs 2-25 and 2-26 for disassembly and assembly of reservoir.

2-24. INSTALLATION OF FUEL PUMP RESERVOIR. (See figure 2-7.)

a. Position gasket between cell and tank structure.
b. Connect reservoir-to-outlet hose to pump outlet elbow.
c. Secure mounting gasket, tank structure, and gasket to cell with bolts and seal type washers. Tighten bolts in accordance with paragraph 2-21, and safety wire.
d. Connect pump wires, close poppet valve and defueling valve; install center tunnel door, and fuel airplane in accordance with T.O. No. 1T-37A-2-2.
e. Push in all circuit breakers on the top row of the circuit breaker panel.

2-25. DISASSEMBLY OF FUEL PUMP RESERVOIR. (See figure 2-7.)

a. Remove fuel pump reservoir in accordance with paragraph 2-23.
b. On top of cover assembly, remove bolts, pump outlet elbow with flange, and gasket.
c. On side of cover assembly, remove screws; lift cover assembly off bottom assembly; lift gasket from flange at top of pump outlet adapter.
d. On bottom of fuel pump, remove twelve cotter pins, nuts, and seal type washers to separate pump assembly, mounting gasket, and bottom assembly, from seal type washers and bolts.

2-26. ASSEMBLY OF FUEL PUMP RESERVOIR. (See figure 2-7.)

a. Assemble on twelve bolts and seal type washers: bottom assembly, mounting gasket, pump assembly, washers, and castellated nuts. Tighten bolts in accordance with paragraph 2-21, and secure with cotter pins.
b. Position gasket on flange at top of pump outlet adapter, lower cover assembly into place and attach it to bottom assembly with screws.
c. On top of cover assembly, attach gasket and pump outlet elbow with flange, with bolts. Tighten bolts in accordance with paragraph 2-21, to 25 inch-pounds, and safety wire.
d. Install fuel pump reservoir in accordance with paragraph 2-24.

2-27. REMOVAL OF FUSELAGE FUEL CELL. (Cell number one.) (See figure 2-8.)

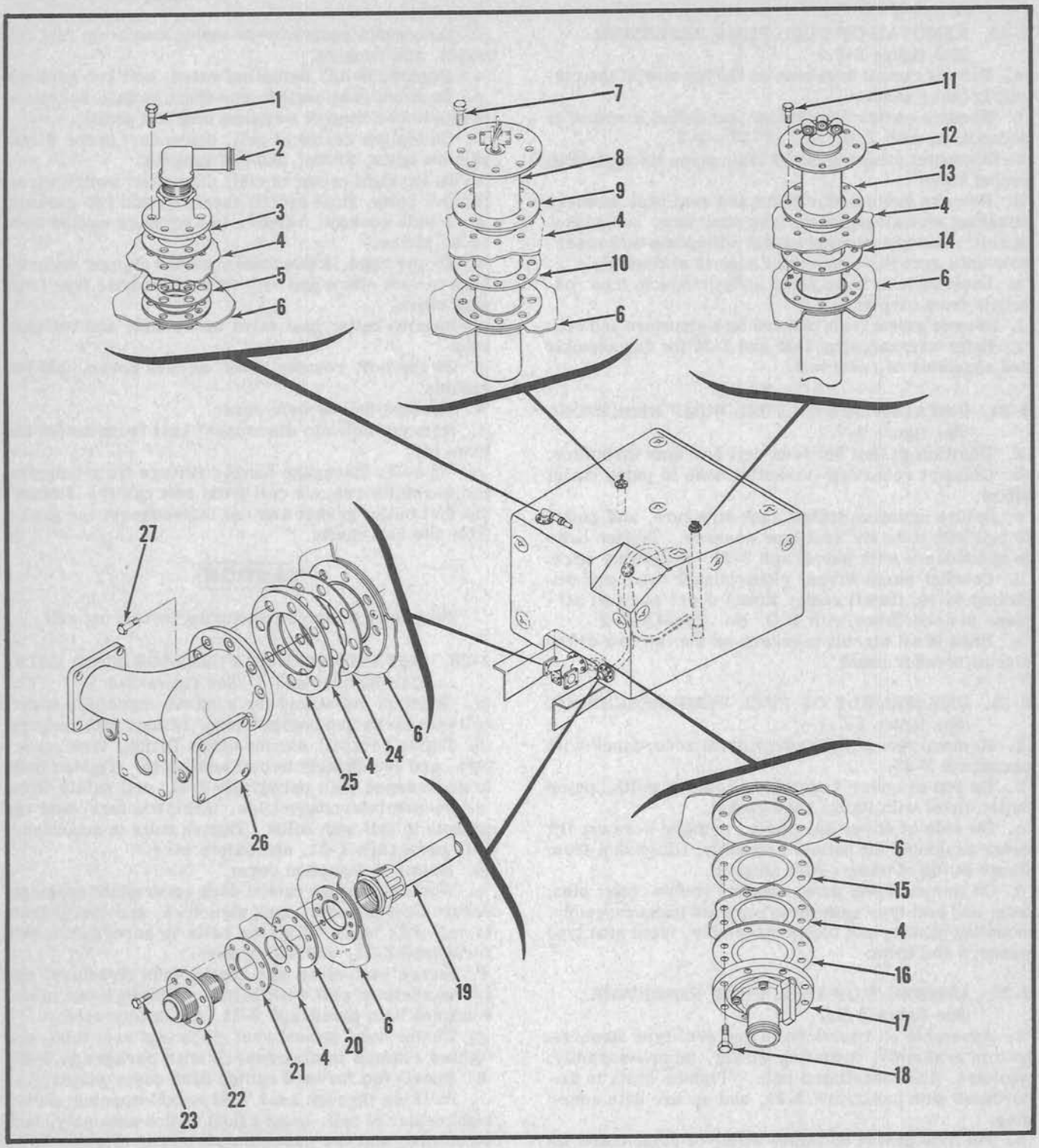
a. Remove fuel pump reservoir in accordance with paragraph 2-23.
b. Disconnect reservoir-to-outlet hose from fuel cell outlet, and remove.
c. Remove bolts, defueling valve, and two gaskets.
d. Remove rear wall tunnel door to gain access to proportioner control switches and fuel probe.
e. On top left center of cell, disconnect probe wires, remove bolts, probe, and two gaskets.
f. On top right center of cell, disconnect switch wires, remove bolts, float switch assembly and two gaskets.
g. Inside cockpit, remove two forward canted deck cover plates.
h. On the right, loosen worm screw clamps securing hose to vent elbow and vent tube; work hose free from vent elbow.
i. Remove bolts, vent valve with elbow, and two gaskets.
j. On the left, remove bolts, access cover, and two gaskets.
k. Remove fuel system cover.
l. Remove bolts to disconnect cell from outlet and from tee.
m. In cell, disengage hanger fittings from hangers, and carefully remove cell from cell cavity. Remove the fuel outlet gasket and the interconnect tee gasket from the cell cavity.

CAUTION

Take care to avoid puncturing or tearing cell.

2-28. INSTALLATION OF FUSELAGE FUEL CELL. (Cell number one.) (See figure 2-8.)

a. Position outlet and tee gaskets, carefully insert cell into cavity and engage hanger fittings with hangers.
b. Inside cockpit, secure outlet fitting, tank structure, and two gaskets to cell with bolts. Tighten bolts in accordance with paragraph 2-21, and safety wire.
c. Secure interconnect tee, tank structure, and two gaskets to cell with bolts. Tighten bolts in accordance with paragraph 2-21, and safety wire.
d. Install fuel system cover.
e. Working through canted deck cover plate openings, secure access cover, tank structure, and two gaskets to cell with bolts. Tighten bolts in accordance with paragraph 2-21, and safety wire.
f. Secure vent valve with elbow, tank structure, and two gaskets to cell with bolts. Tighten bolts in accordance with paragraph 2-21, and safety wire.
g. Center hose around vent elbow and vent tube, and tighten clamps in accordance with paragraph 2-21.
h. Install two forward canted deck cover plates.
i. Working through rear wall tunnel opening; on top right center of cell, secure float switch assembly, tank structure, and two gaskets with bolts, Tighten bolts in accordance with paragraph 2-21, and safety wire. Connect switch wires to switch assembly.
j. On top left center of cell, secure probe, tank structure, and two gaskets to cell with bolts. Tighten bolts in accordance with paragraph 2-21, and safety wire. Connect probe wires to probe.
k. Install rear wall tunnel door.
l. Secure defueling valve, tank structure, and two gaskets to cell with bolts. Tighten bolts in accordance with paragraph 2-21, and safety wire.
m. Connect reservoir-to-outlet hose to outlet.
n. Install fuel pump reservoir in accordance with paragraph 2-24.



1. Bolt
2. Vent valve
3. Gasket
4. Tank structure
5. Gasket
6. Fuel cell
7. Bolt
8. Fuel level switch
9. Gasket
10. Gasket
11. Bolt
12. Fuel probe
13. Gasket
14. Gasket
15. Gasket
16. Gasket
17. Defueling valve
18. Bolt
19. Hose
20. Gasket
21. Gasket
22. Outlet fitting
23. Bolt
24. Gasket
25. Gasket
26. Inlet tee
27. Bolt

Figure 2-8. Fuselage Fuel Cell Installation
Cell Number One

2-29. REMOVAL OF CELL NUMBER TWO (Typical). (See figure 2-9.)

a. Remove inboard wing leading edge in accordance with T.O. No. 1T-37A-2-2.

b. Remove bolts, washers, and two interconnect support plates.

c. Remove screw, seal cap, and two bolts and washers attaching aft wall to bar assembly.

d. Remove screws, washers, stops, and hinge pins to separate aft wall from leading edge.

e. Remove interconnect fittings and gaskets.

f. Remove bolts, washers, access bar handle, outer bar, and inner bar.

g. Reach inside cell, disengage probe wires from disconnects, remove two clamp bolts to separate probe from mounts, and remove probe.

h. Remove bolts, wing root outlet fitting, and two gaskets; remove bolts and washers securing probe disconnect attach plate, gasket, and cell to web.

i. Inside cell, remove six bolts and seal type washers attaching probe mounts to leading edge structure, disengage hanger fittings from hangers, and remove cell, probe disconnect attach plate, and gasket from leading edge.

2-30. INSTALLATION OF CELL NUMBER TWO. (Typical) (See figure 2-9.)

a. Carefully position cell, probe disconnect attach plate, and gasket inside leading edge, engage hanger fittings with hangers, and attach probe mounts to leading edge with six bolts and seal type washers. Tighten bolts in accordance with paragraph 2-21.

Note

Use seal type washers only; ordinary washers will leak.

b. Secure cell, gasket, and probe disconnect attach plate to web with bolts and washers. Tighten bolts in accordance with paragraph 2-21, and safety wire.

c. Install two gaskets and wing root fitting with bolts. Tighten bolts in accordance with paragraph 2-21, and safety wire.

d. Attach probe with clamps to probe mounts with two bolts, and engage probe leads with disconnects.

e. Install inner bar, outer bar, and access bar handle with washers and bolts. Tighten bolts in accordance with paragraph 2-21, and safety wire.

f. Position interconnect fittings with gaskets, and attach aft wall to leading edge with hinge pins, stops, washers, and screws.

g. Attach interconnect support plates with washers and bolts. Tighten bolts in accordance with paragraph 2-21, and safety wire.

h. Attach aft wall to bar assembly with two washers and bolts; attach seal caps with screws.

i. Install inboard wing leading edge in accordance with T.O. No. 1T-37A-2-2.

2-31. REMOVAL OF CELL NUMBER THREE. (Typical) (See figure 2-10.)

a. Remove outboard wing leading edge in accordance with T.O. No. 1T-37A-2-2.

b. Remove bolts, washers, and interconnect support plates.

c. Remove screws, seal caps, and four bolts and washers attaching aft wall to bar assemblies.

d. Remove screws, washers, stops, and hinge pins to separate aft wall from leading edge.

e. Remove interconnect fittings with gaskets.

f. Remove bolts, washers, access bar handles, outer bars, and inner bars.

g. Reach inside cell, disengage hanger fittings, and remove cell from leading edge.

2-32. INSTALLATION OF CELL NUMBER THREE. (Typical) (See figure 2-10.)

a. Carefully position cell inside leading edge, and engage hanger fittings with hangers.

b. Install inner bars, outer bars, and access bar handles with washers and bolts. Tighten bolts in accordance with paragraph 2-21, and safety wire.

c. Position interconnect fittings with gaskets and attach aft wall to leading edge with hinge pins, stops, washers, and screws.

d. Attach interconnect support plates with washers and bolts. Tighten bolts in accordance with paragraph 2-21, and safety wire.

e. Attach aft wall to bar assemblies with four washers and bolts; attach seal caps with screws.

f. Install outboard wing leading edge in accordance with T.O. No. 1T-37A-2-2.

2-33. REMOVAL OF CELL NUMBER FOUR. (Typical) (See figure 2-10.)

a. Defuel airplane in accordance with T.O. No. 1T-37A-2-2, and remove fuel quantity fuse.

b. In main gear wheel well, disconnect probe wires and remove bolts and washers securing rib, disconnect attach plate, and gasket to cell.

c. Remove screws and fuel cell access cover.

d. Remove bolts, washers, access closure supports, and bar assembly access cover.

e. Remove bolts, washers, access bar handle, outer bar, and inner bar.

f. In cell, disengage probe wires from disconnects.

g. Repeat steps c, d, and e on cell five.

h. In cell five, remove bolts and washers securing probe wiring clamp support, cell five, two gaskets, and rib to cell four. Pull probe wires into cell five.

i. In cell four, remove large cotter pin in the center of each valve cup to remove three interconnect valves; loosen worm screw clamps securing intruding nipples to interconnects and carefully disengage cell from interconnects.

j. Disengage hanger fittings from hangers and carefully fold cell through access opening.

CAUTION

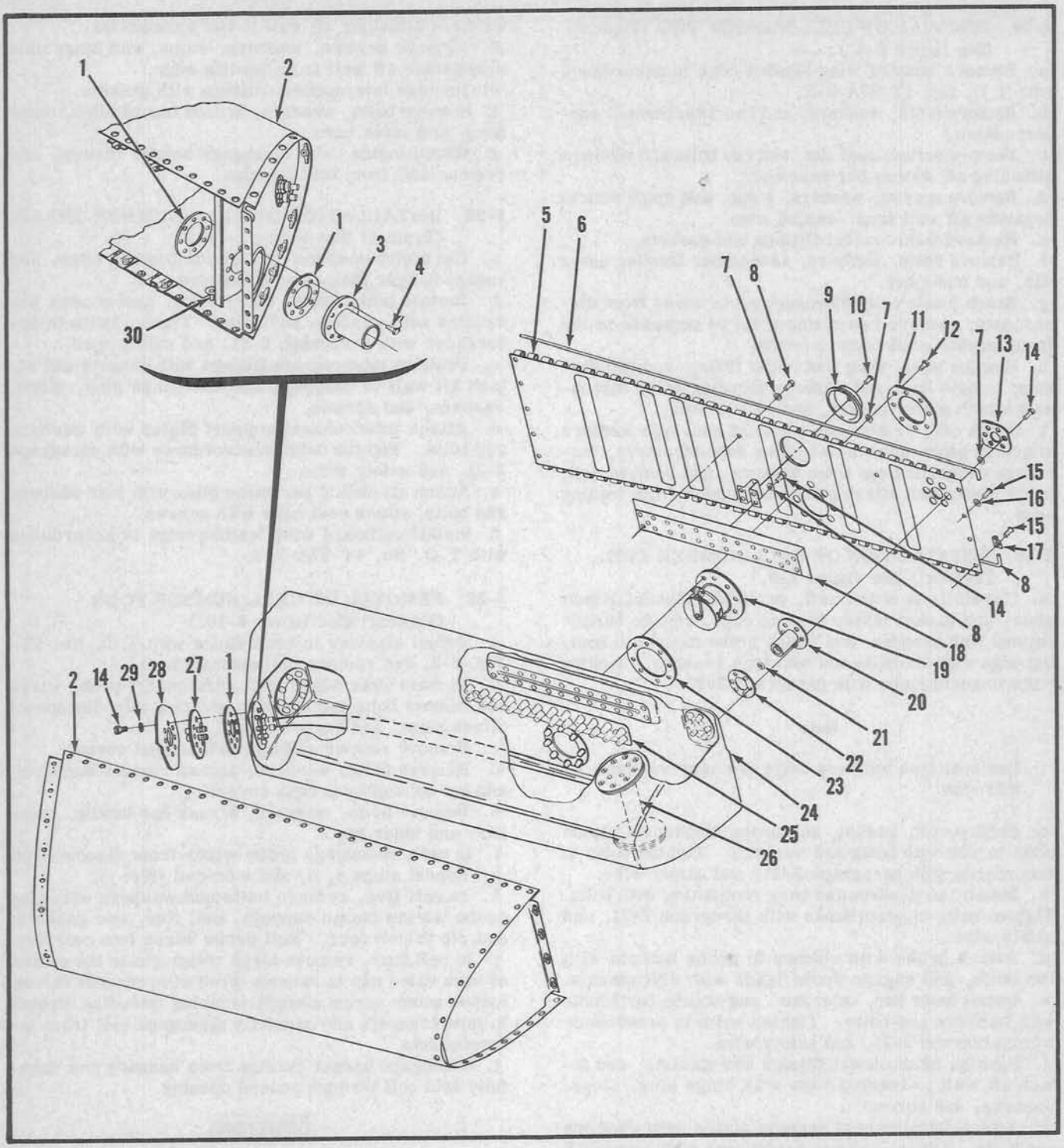
Take care to avoid puncturing or tearing cell.

k. Remove disconnect attach plate and two gaskets.

2-34. INSTALLATION OF CELL NUMBER FOUR. (Typical) (See figure 2-10.)

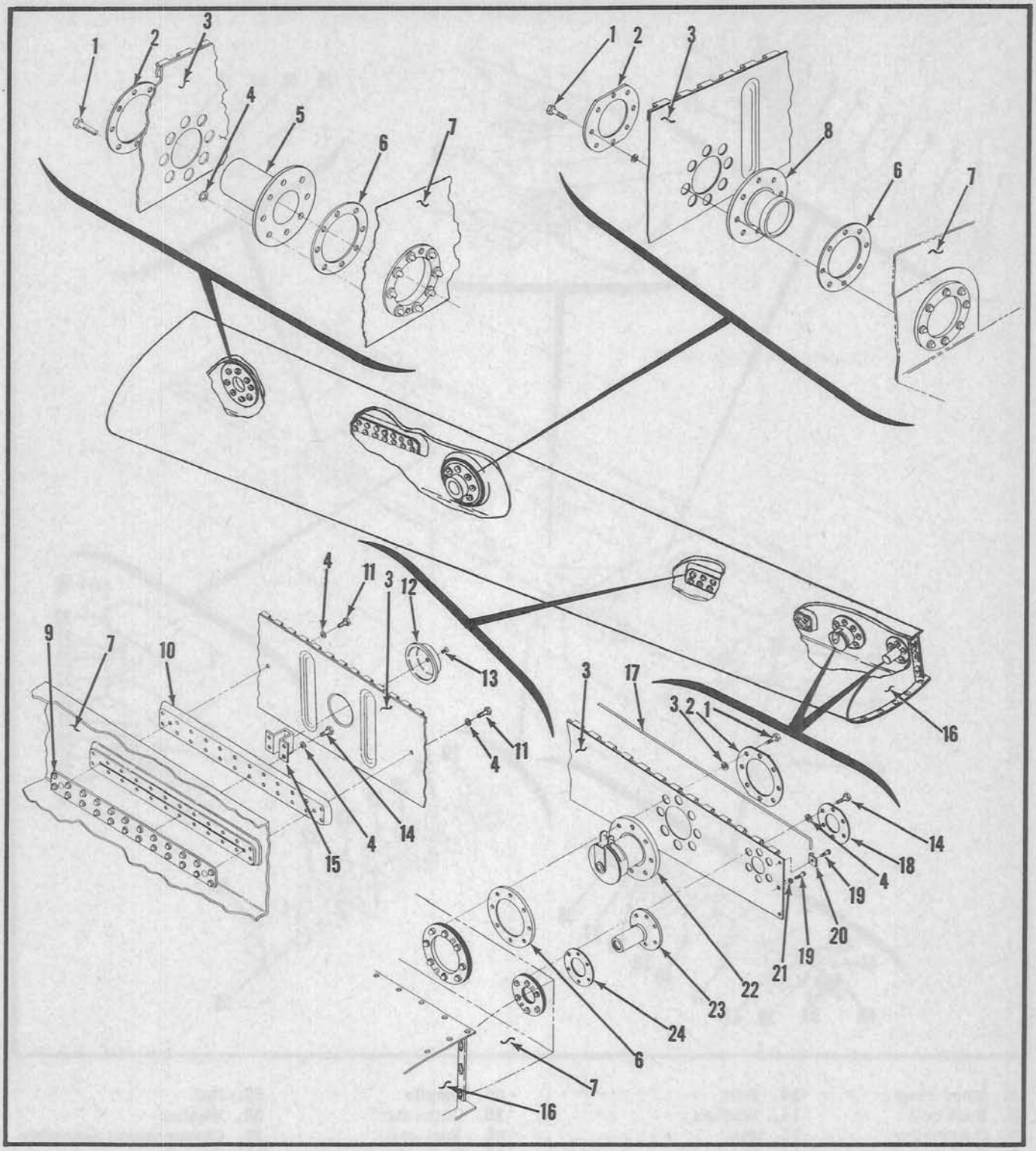
a. Position gaskets and disconnect attach plate, carefully insert cell into cavity and engage hanger fittings with hangers.

b. Slip intruding nipples over interconnects; tighten worm screw clamps in accordance with paragraph 2-21, and attach three interconnect valves with cotter pins. Bend ends of cotter pins to secure.



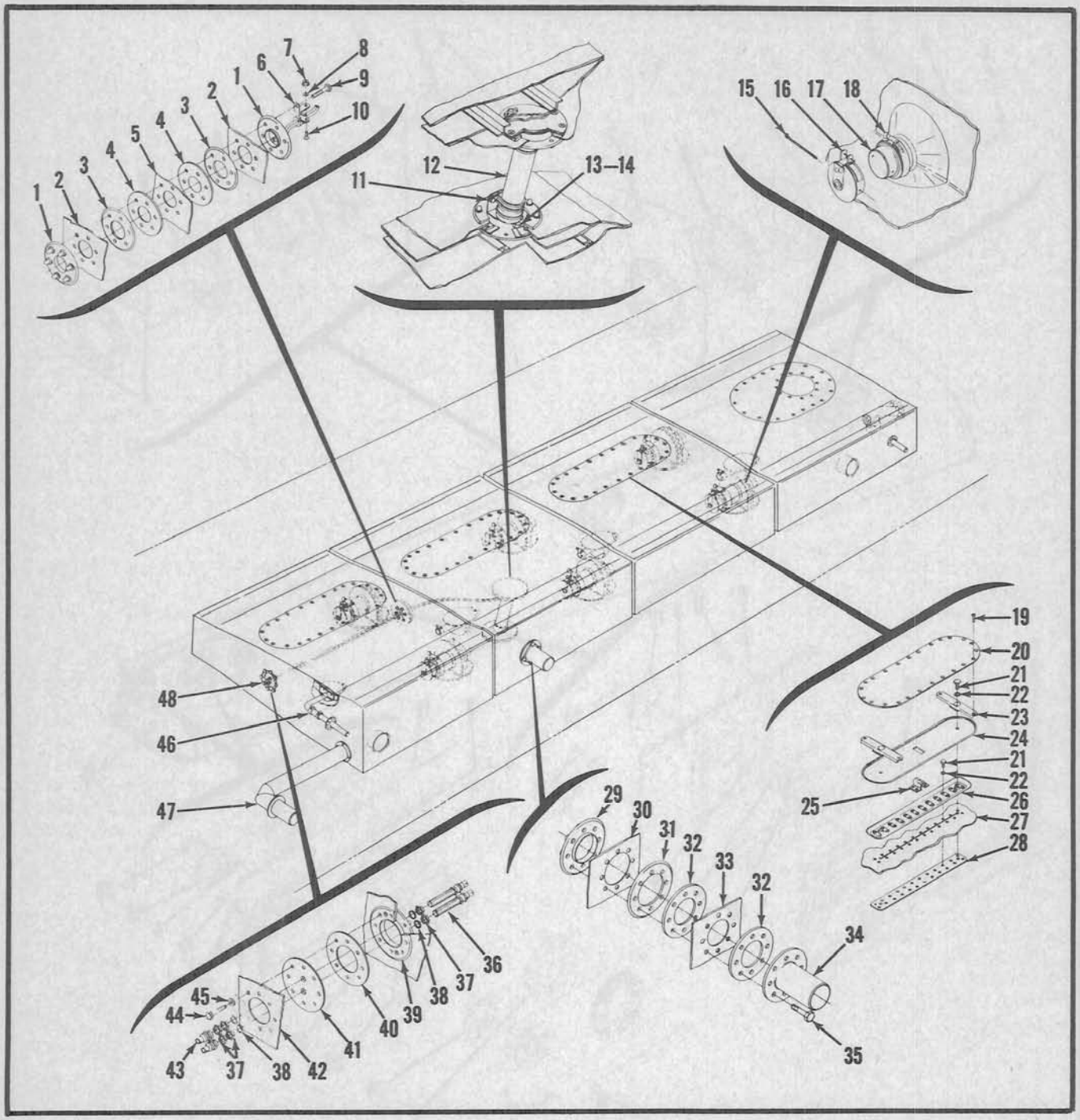
1. Gasket
2. Inboard leading edge
3. Wing root fitting
4. Bolt
5. Aft wall
6. Hinge pin
7. Washer
8. Bolt
9. Seal cap
10. Screw
11. Back-up plate
12. Bolt
13. Back-up plate
14. Bolt
15. Screw
16. Washer
17. Stop
18. Outer bar
19. Valve assembly
20. Vent fitting
21. "O" ring
22. Gasket
23. Gasket
24. Cell number two
25. Inner bar
26. Fuel probe
27. Disconnect attach plate
28. Wing structure
29. Washer
30. Drain tube

Figure 2-9. Wing Inboard Leading Edge Fuel Cell Installation
Cell Number Two



1. Bolt
2. Back-up plate
3. Aft wall
4. Washer
5. Fuel interconnect
6. Gasket
7. Cell number three
8. Fuel interconnect
9. Inner bar
10. Outer bar
11. Bolt
12. Seal cap
13. Screw
14. Bolt
15. Handle
16. Outboard leading edge
17. Hinge pin
18. Back-up plate
19. Screw
20. Stop
21. Washer
22. Valve assembly
23. Vent interconnect
24. Gasket

Figure 2-10. Wing Outboard Leading Edge Fuel Cell Installation
Cell Number Three



1. Inner ring
2. Fuel cell
3. Outer ring
4. Gasket
5. Rib
6. Support
7. Nut
8. Washer
9. Bolt
10. Screw
11. Bolt
12. Probe
13. Bolt
14. Washer
15. Pin
16. Valve
17. Interconnect
18. Clamp
19. Screw
20. Cell access cover
21. Bolt
22. Washer
23. Support
24. Bar access cover
25. Handle
26. Outer bar
27. Fuel cell
28. Inner bar
29. Inner ring
30. Cell
31. Outer ring
32. Gasket
33. Spar
34. Interconnect
35. Bolt
36. Connector
37. Nut
38. Washer
39. Compression assembly
40. Gasket
41. Plate
42. Rib
43. Connector
44. Bolt
45. Washer
46. Vent interconnect
47. Fuel interconnect
48. Fuel cell

Figure 2-11. Interspar Fuel Cells Installation
Cells Number Four, Five and Six

c. In main gear wheel well, secure rib, disconnect attach plate, and gasket to cell with bolts and washers. Tighten bolts in accordance with paragraph 2-21, and safety wire. Connect probe wires to disconnect.
d. In cell five, push probe wires into cell four; in cell four, connect wires to disconnects.
e. In cell five, secure probe wiring clamp support, cell five, two gaskets, and rib to cell four with bolts and washers. Tighten bolts in accordance with paragraph 2-21, and safety wire.
f. On cells four and five, install inner bars, outer bars, and access bar handles with bolts and washers. Tighten bolts in accordance with paragraph 2-21, and safety wire.
g. Attach bar assembly access covers and access closure supports to bar assemblies with bolts and washers.
h. Attach fuel cell access covers to wing with screws.
i. Refuel airplane in accordance with T.O. No. 1T-37A-2-2.
j. Install fuel quantity fuse.

2-35. REMOVAL OF CELL NUMBER FIVE. (Typical) (See figure 2-11.)
a. Remove outboard leading edge in accordance with T.O. No. 1T-37A-2-2, remove fuel quantity fuse, and disengage probe wires from disconnects in cell four.
b. On front spar, remove bolts, washers, cell five interconnect, and one gasket.
c. Remove screws and fuel cell access cover.
d. Remove bolts, washers, access closure supports, and bar assembly access cover.
e. Remove bolts, washers, access bar handle, outer bar, and inner bar.
f. Remove bolts and washers securing probe wiring clamp support, cell five, two gaskets, and rib to cell four, and pull probe wires into cell five.
g. Remove two clamp bolts to separate probe from mounts, and remove probe.
h. Remove six bolts and seal type washers attaching probe mounts to wing structure.
i. Remove large cotter pin in the center of each valve cup to remove two interconnect valves; loosen worm screw clamps securing intruding nipples to interconnects and carefully disengage cell from interconnects.
j. Disengage hanger fittings from hangers and carefully fold cell through access opening.

CAUTION

Take care to avoid puncturing or tearing cell.

k. Remove probe wire port gasket and cell five gasket from cell cavity.

2-36. INSTALLATION OF CELL NUMBER FIVE. (Typical) (See figure 2-11.)
a. Position the two gaskets for the leading edge interconnect, and the probe wire port; carefully insert cell into cavity, and engage hanger fittings with hangers.
b. Slip intruding nipples over interconnects; tighten worm screw clamps in accordance with paragraph 2-21; and attach two interconnect valves with cotter pins. Bend ends of cotter pins to secure.
c. Attach probe mounts to wing structure with six bolts and seal type washers, and attach probe and clamps to probe mounts with two bolts.

Note

Use seal type washers in attaching mounts to wing structure. Ordinary washers will leak.

d. Push probe wires into cell four; in cell four, connect wires to disconnects.
e. In cell five, secure probe wiring clamp support, cell five, two gaskets, and rib to cell four with bolts and washers. Tighten bolts in accordance with paragraph 2-21, and safety wire.
f. Install inner bar, outer bar and access bar handle with bolts and washers. Tighten bolts in accordance with paragraph 2-21, and safety wire.
g. Attach bar assembly access cover and access closure supports to bar assembly with bolts and washers.
h. Attach fuel cell access cover to wing with screws.
i. On front spar, secure cell five interconnect, two gaskets, and rib to cell five with bolts and washers. Tighten bolts in accordance with paragraph 2-21, and safety wire.
j. Install outboard leading edge in accordance with T.O. No. 1T-37A-2-2, and install fuel quantity fuse.

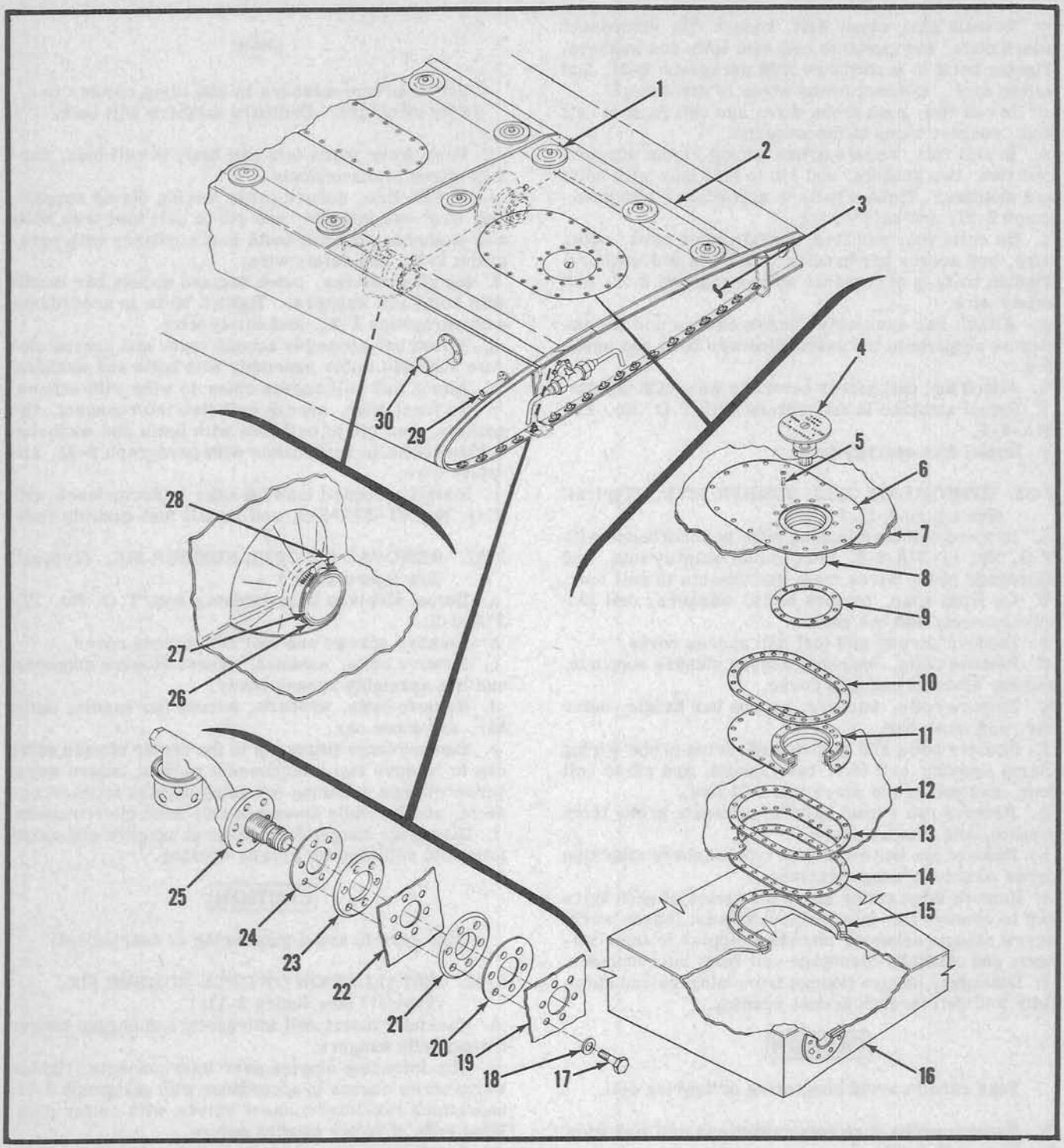
2-37. REMOVAL OF CELL NUMBER SIX. (Typical) (See figure 2-11.)
a. Defuel airplane in accordance with T.O. No. 1T-37A-2-2.
b. Remove screws and fuel cell access cover.
c. Remove bolts, washers, access closure supports. and bar assembly access cover.
d. Remove bolts, washers, access bar handle, outer bar, and inner bar.
e. Remove large cotter pin in the center of each valve cup to remove two interconnect valves; loosen worm screw clamps securing intruding nipples to interconnects, and carefully disengage cell from interconnects.
f. Disengage hanger fittings from hangers and carefully fold cell through access opening.

CAUTION

Take care to avoid puncturing or tearing cell.

2-38. INSTALLATION OF CELL NUMBER SIX. (Typical) (See figure 2-11.)
a. Carefully insert cell into cavity and engage hanger fittings with hangers.
b. Slip intruding nipples over interconnects, tighten worm screw clamps in accordance with paragraph 2-21, and attach two interconnect valves with cotter pins. Bend ends of cotter pins to secure.
c. Install inner bar, outer bar, and access bar handle with bolts and washers. Tighten bolts in accordance with paragraph 2-21, and safety wire.
d. Attach bar assembly access cover and access closure supports to bar assembly with bolts and washers.
e. Attach fuel cell access cover to wing with screws.
f. Refuel airplane in accordance with T.O. No. 1T-37A-2-2.

2-39. REMOVAL OF CELL NUMBER SEVEN. (Typical) (See figure 2-12.)
a. Defuel airplane in accordance with T.O. No. 1T-37A-2-2.
b. Remove filler neck access cover screws, cap and



1. Hanger fitting
2. Cell number seven
3. Bulkhead
4. Cap
5. Screw
6. Access cover
7. Wing structure
8. Adapter
9. Gasket
10. Ring
11. Access panel
12. Wing structure
13. Gasket
14. Gasket
15. Compression assembly
16. Fuel cell
17. Bolt
18. Washer
19. Bulkhead
20. Gasket
21. Inner ring
22. Cell
23. Outer ring
24. Gasket
25. Vent valve
26. Cell nipple
27. Interconnect
28. Clamp
29. Vent interconnect
30. Fuel interconnect

Figure 2-12. Wing Interspar Fuel Cell Installation
Cell Number Seven

adapter screws, filler neck access cover, cap and adapter assembly, and gasket.

c. Remove bolts, washers, access ring, access panel with attached compression fitting assembly, and two gaskets.

d. Remove four screws which connect cell and compression assembly, and remove inner and outer compression rings.

e. Remove wing tip attaching screws, unscrew position light nut, and remove wing tip.

f. Remove fore and aft vent tubes, loosen jam nut, remove vent tee, gasket, jam nut, and remove bolts and washers securing vent valve to gasket, cell, and rib.

g. Remove gasket and valve from cell, loosen worm screw clamps securing intruding nipples to interconnects, and carefully disengage cell from interconnects.

h. Disengage hanger fittings from hangers and carefully fold cell through access opening.

CAUTION

Take care to avoid puncturing or tearing cell.

2-40. INSTALLATION OF CELL NUMBER SEVEN. (See figure 2-12.)

a. Carefully insert cell into cavity, engage hanger fittings with hangers, slip intruding nipples over interconnects, and tighten worm screw clamps in accordance with paragraph 2-21.

b. Position vent valve and gasket, and secure to cell and rib with bolts and washers. Tighten bolts in accordance with paragraph 2-21, and safety wire.

c. Screw jam nut onto valve fitting as far as it will go, slip gasket over fitting, screw tee onto fitting until end protrudes past first thread set approximately 1/8 inch. Connect fore and aft vent tubes and try wing tip for correct position. Adjust fit, tighten jam nut against tee, connect position light nut, and attach wing tip to wing with screws.

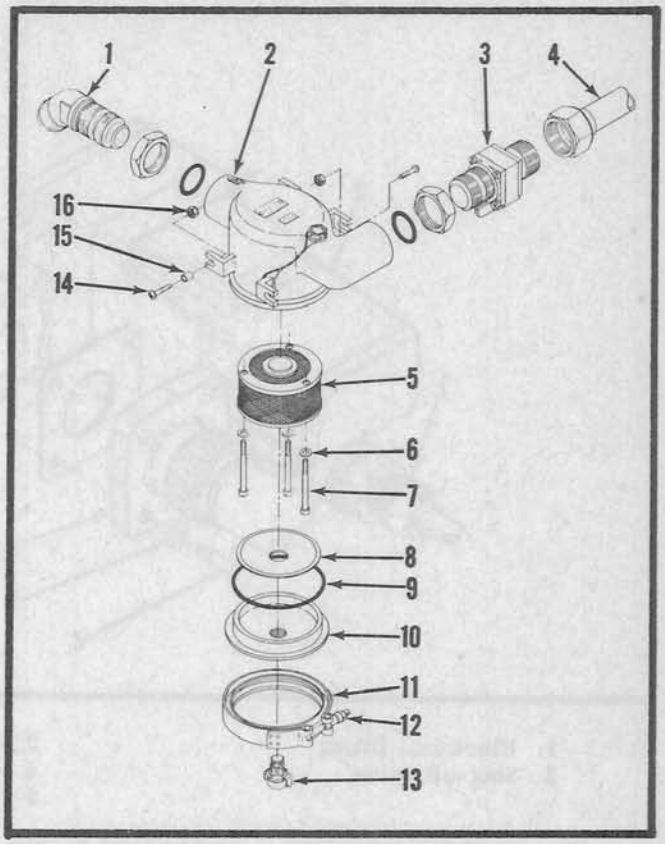
d. Assemble compression fitting on cell and secure with four screws.

e. Position cell, gaskets, inner skin, access panel, and access ring, and attach with bolts and washers. Tighten bolts in accordance with paragraph 2-21, and safety wire.

f. Position gasket, cap and adapter assembly, and filler neck access cover. Attach filler neck access cover with screws; attach cap and adapter with screws, and tighten cap and adapter screws in accordance with paragraph 2-21.

g. Refuel airplane in accordance with T.O. No. 1T-37A-2-2.

2-41. FUEL STRAINER. A replaceable element fuel strainer is included in the fuel system to prevent water, sediment, and other foreign matter from reaching the engines. Installed in the system between the fuselage fuel cell and the motorized shut-off valves, it is mounted to a bracket and to the fuel system cover wrap beneath the left front of the fuel system cover. A relief valve in the filter element opens at 2 psi to allow fuel to bypass the element if it becomes clogged. Access for draining accumulated water and sediment or element replacement is provided by a door beneath the fuselage. To permit maintenance, without draining the fuel cells, of the strainer and other fuel system components between it and the engines, a manually operated shut-off valve is installed between the fuselage fuel cell and the strainer, also accessible through the strainer drain access door.



1. Elbow
2. Strainer
3. Shut-off valve
4. Tube
5. Filter element
6. Washer
7. Screw
8. Baffle
9. "O" Ring
10. Strainer bottom
11. Clamp
12. Clamp nut
13. Poppet valve
14. Screw
15. Spacer
16. Nut

Figure 2-13. Fuel Strainer Installation

2-42. REMOVAL OF FILTER ELEMENT. (See figure 2-13.)

a. Working through strainer access opening under airplane, close shut-off valve and open poppet valve to drain fuel.

b. Loosen nut and remove clamp to release strainer bottom with valve, "O" ring, and baffle.

c. Remove filter element by removing three attaching screws with washers.

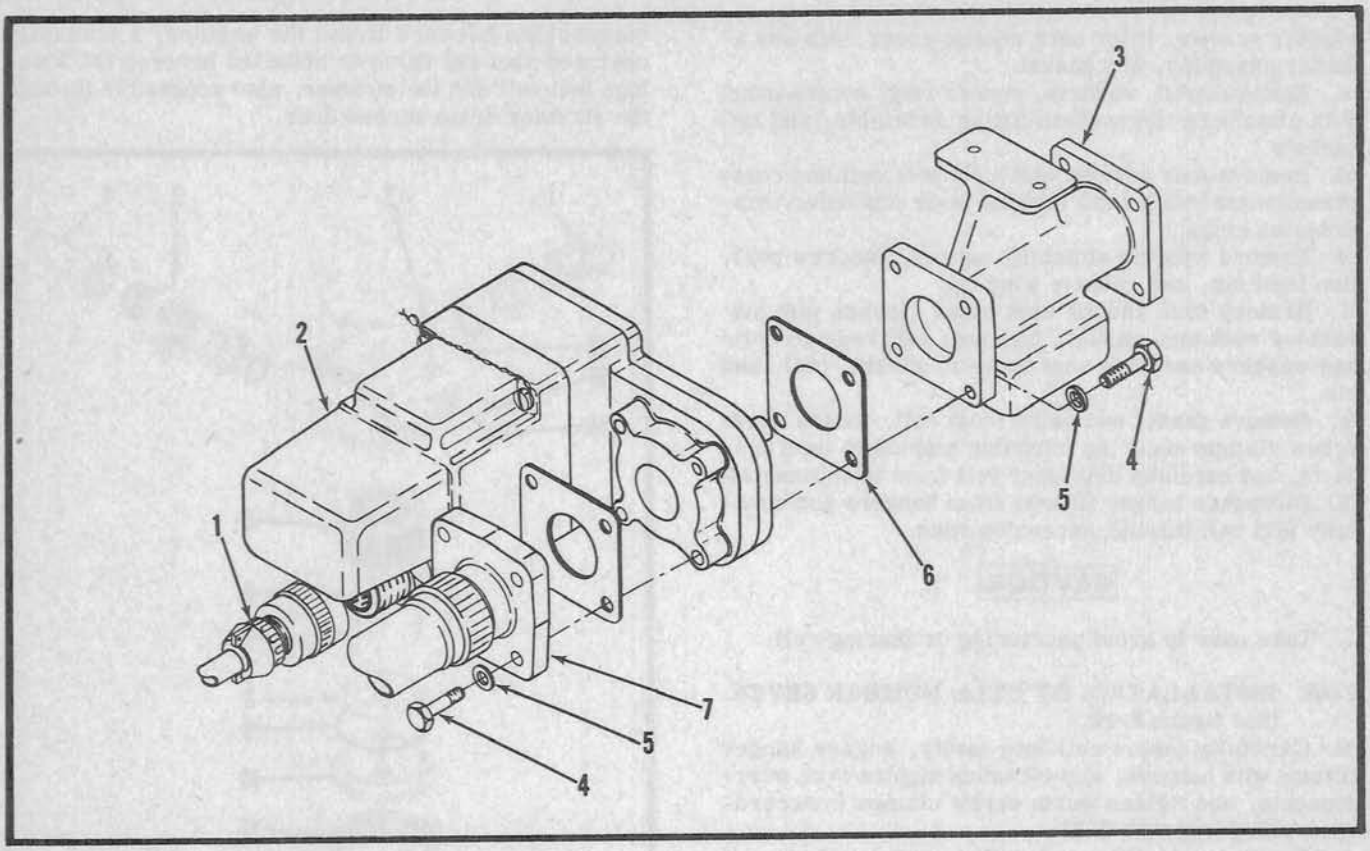
CAUTION

Do not tamper with filter element relief valve assembly; it is factory-set to open at 2 psi.

2-43. INSTALLATION OF FILTER ELEMENT. (See figure 2-13.)

a. Position filter element in strainer body and install with three screws and washers.

b. Position baffle, "O" ring, strainer bottom with



1. Electrical fitting
2. Shut-off valve
3. Manifold tee
4. Bolt
5. Washer
6. Gasket
7. Connector

Figure 2-14. Motorized Fuel Shut-Off Valve Installation

valve, and clamp, on the bottom of the strainer; secure by tightening clamp nut.

c. Close poppet valve, open shut-off valve, and close strainer access door.

2-44. REMOVAL OF FUEL STRAINER. (See figure 2-13.)

a. Defuel the airplane in accordance with T.O. No. 1T-37A-2-2.

b. Remove fuel system cover.

c. Remove tube connecting fuel flow transmitter to motorized shut-off valves.

d. Unscrew outlet-to-strainer tube at manual shut-off valve.

e. Unscrew strainer-to-manifold tube at strainer elbow.

f. Remove two screws, spacers, and nuts attaching strainer to fuel system cover wrap.

g. Remove five screws, washers, and nuts attaching strainer mounting bracket to floorboard and remove strainer with elbow, shut-off valve, and bracket.

2-45. INSTALLATION OF FUEL STRAINER. (See figure 2-13.)

a. Attach strainer mounting bracket, with strainer, elbow, and shut-off valve, to floorboard with five screws, washers, and nuts.

b. Attach strainer to the fuel system cover wrap with two screws, spacers, and nuts.

c. Screw strainer-to-manifold tube to elbow, screw outlet-to-strainer tube to manual shut-off valve, and install transmitter to shut-off valve tube.

d. Install fuel system cover.

e. Refuel airplane in accordance with T.O. No. 1T-37A-2-2.

2-46. MOTORIZED FUEL SHUT-OFF VALVES. Two motor-operated fuel shut-off valves are included in the fuel system to permit fuel flow to the engines only when desired. They are powered by the DC bus, protected by a five ampere circuit breaker, and controlled by the push-open, pull-close fire control switches on the shock panel. Installed in the fuel system between the strainer and the flow transmitters, they are held rigidly in position by their connection to the bracket-mounted manifold shut-off tee. Adjustment or disassembly of these valves is not permitted.

2-47. REMOVAL OF MOTORIZED FUEL SHUT-OFF VALVE. (See figure 2-14.)

a. Working through fuel drain access opening under airplane, close shut-off valve and open strainer drain valve.

b. Open motorized shut-off valve to drain fuel, and pull shut-off valve circuit breaker.

c. Remove fuel system cover and disconnect shut-off valve electrical fitting.

d. Remove eight bolts and washers to disconnect shut-off valve from fixed connector and from fuel shut-off manifold tee.

e. Remove shut-off valve and two gaskets.

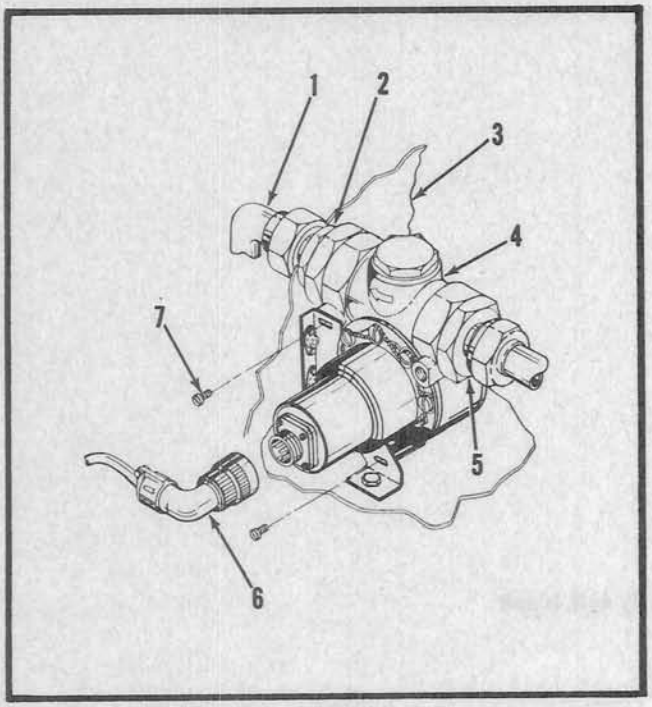
2-48. INSTALLATION OF MOTORIZED FUEL SHUT-OFF VALVE. (Typical) (See figure 2-14.)

a. Position shut-off valve and two gaskets, and connect to fuel shut-off manifold tee and to fixed connector with eight bolts and washers; safety wire bolts.

b. Connect electrical fitting to shut-off valve, and install fuel system cover.

c. Push in shut-off valve circuit breaker and close valve.

d. Close strainer drain valve, open strainer shut-off valve, and close fuel drain access door.



1. Elbow
2. Locknut
3. Firewall
4. Fuel flow transmitter
5. Reducer
6. Electrical fitting
7. Screw

Figure 2-15. Fuel Flow Transmitter Installation

2-49. FUEL FLOW TRANSMITTERS. Two autosyn type fuel flow transmitters generate signals in direct proportion to the amount of fuel flowing to the engines. The signals are amplified and transmitted to the fuel flow indicators which give the fuel flow in pounds per hour. The 20 volt, one phase circuit is powered through a transformer from the inverter and protected by two one-ampere fuses. Installed in the fuel system between the motorized shut-off valves and the engines, they are held rigidly by the canted firewalls and brackets.

2-50. REMOVAL OF FUEL FLOW TRANSMITTER. (See figure 2-15.)

a. Working through fuel drain access opening under airplane, close shut-off valve and open strainer drain valve.

b. Open motorized shut-off valve to drain fuel, and pull both inverter circuit breakers.

c. Remove forward nacelle access door and disconnect transmitter from fuel line and firewall by unscrewing both elbow and lock nut.

d. Inside cockpit, remove fuel system cover, and disconnect electrical fitting.

e. Disconnect transmitter to shut-off valve tube at reducer.

f. Remove two screws attaching transmitter mounting bracket, and remove transmitter.

2-51. INSTALLATION OF FUEL FLOW TRANSMITTER. (See figure 2-15.)

a. Attach transmitter to mounting bracket with two screws, and safety wire screws.

b. Connect transmitter to shut-off valve tube at reducer.

c. Connect electrical fitting and safety wire. Install fuel system cover.

d. Working through forward nacelle access opening, screw lock nut tight against firewall; screw elbow tight to transmitter union; install forward nacelle access door.

e. Close motorized shut-off valve and push in both inverter circuit breakers.

f. Close strainer drain valve, open strainer shut-off valve, and close fuel drain access door.

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SECTION III
OIL SYSTEM

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3-3.	Oil Supply System	49

3-1. OIL SYSTEM. There are two oil systems, one for each engine. Each system comprises an oil pressure indicating system, an oil supply system, and an engine oil system. The indicating and supply systems are discussed in this section.

3-2. OIL PRESSURE INDICATING SYSTEM. Each of the two direct reading oil pressure indicating systems are protected by snubber valves to prevent excessive oil loss from leakage. The right system snubber is located at seven o'clock on the engine accessory section; the left system snubber is located in the nacelle on the forward side of the front spar carry through assembly. Standard tubing connections are used throughout both systems, which use aluminum tubing except at the indicators where flexible hoses are used to permit movement of the hinged shock panel.

3-3. OIL SUPPLY SYSTEM. Each oil supply system consists of those parts of the oil system remaining in the airplane when the engine is removed and includes an oil tank assembly, an ambient vent tube, and three flexible hoses for oil supply, oil return, and engine venting. The oil tank is filled through its filler neck inside the oil access door on the front of the nacelle. The oil level is measured by a dip stick on the cap assembly. Oil is drained through a spring-loaded valve on the tank bottom. The oil leaves the tank through a pendulous, flexible hose designed to insure a continuous supply of oil to the engine in any attitude of flight. (See figure 3-1.) A dwell chamber is built into the top of the tank, and is designed to permit venting in any flight attitude and to reduce froth in the scavenge oil which is generated during its passage through the engine.

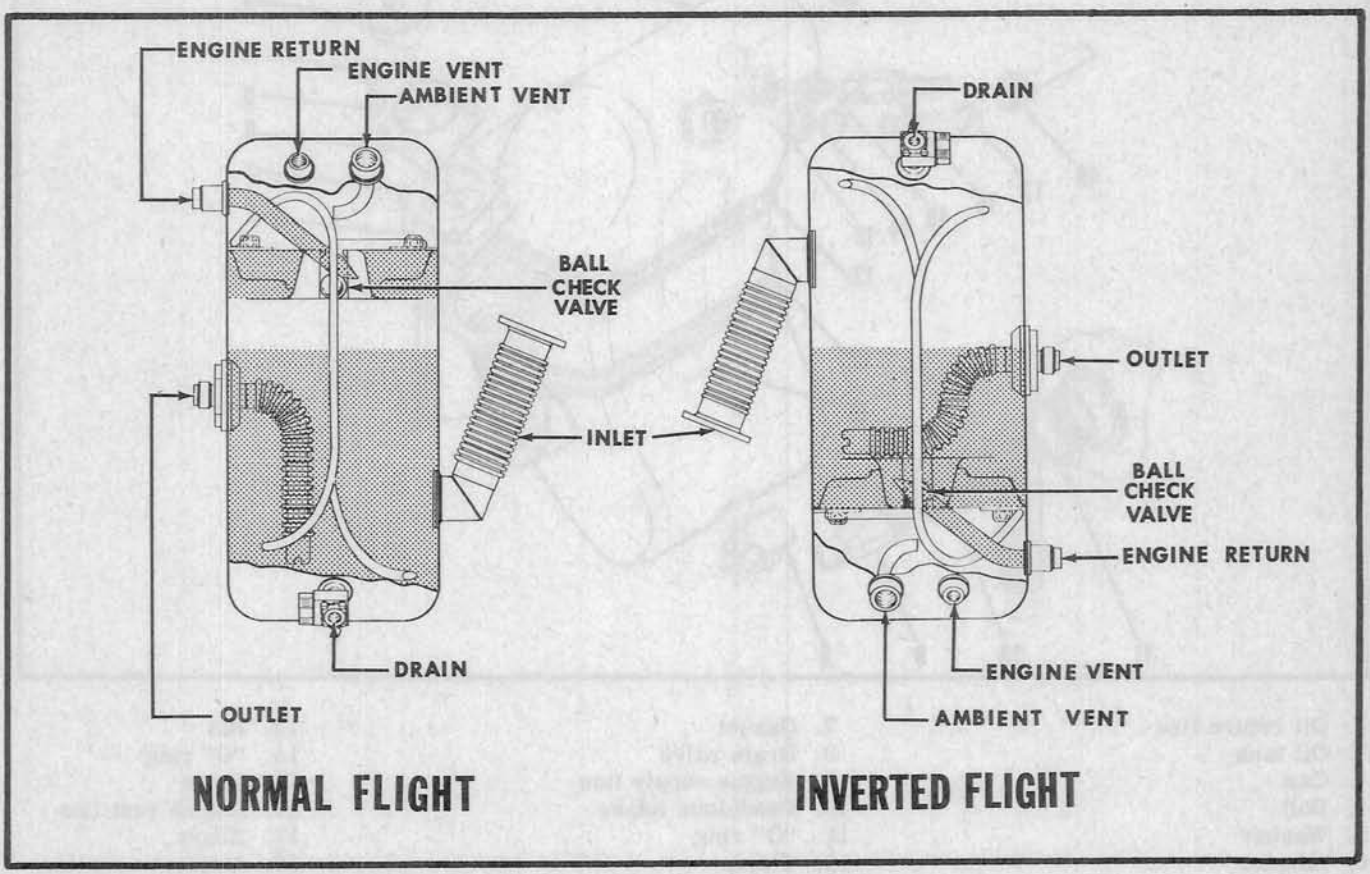


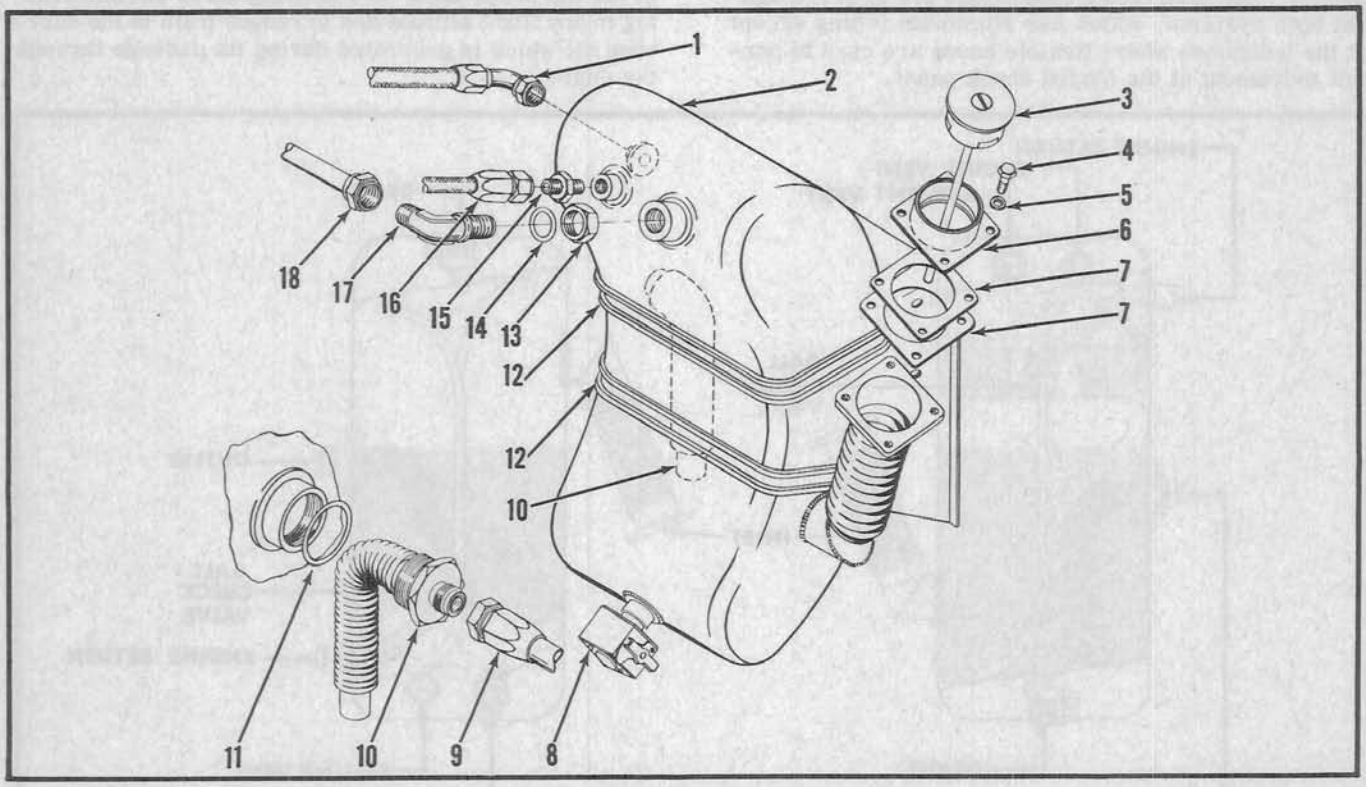
Figure 3-1. Oil Tank Operation Schematic

3-4. REMOVAL OF OIL TANK. (See figure 3-2.)
a. Remove forward nacelle access door and drain all oil from tank.
b. Open oil filler access door, remove safety wire and four bolts and washers to separate cap and adapter assembly, two gaskets, and oil tank filler neck.
c. Open both mounting clamps, disconnect the three flexible hoses, and remove oil tank assembly with the aluminum ambient vent tube from the airplane.

3-5. INSTALLATION OF OIL TANK. (See figure 3-2.)
a. Connect the three flexible hoses, position the tank, and close mounting clamps securely.
b. Position filler neck, two gaskets, cap and adapter assembly, attach with four bolts and washers, and safety wire bolts.
c. Close drain valve, install forward nacelle access door, fill tank with oil specification MIL-L-7808, and close oil access door.

3-6. TROUBLE SHOOTING OIL SYSTEM.

TROUBLE	PROBABLE CAUSE	REMEDY
CONTINUOUS LEAKAGE ON INDICATOR SIDE OF SNUBBER	Defective snubber.	Replace snubber.
EXCESSIVE OIL CONSUMPTION	Loose fitting or connection.	Tighten all fittings and connections.
	Leak in oil line.	Replace line if external; if inside engine refer to applicable technical directive.
LOW OR NO PRESSURE INDICATION	Lines between snubber and indicator not bled; snubber restricts or shuts off oil flow.	Bleed lines and instrument thoroughly.
	Leak in lines or indicator,	Replace leaking part.



1. Oil return line
2. Oil tank
3. Cap
4. Bolt
5. Washer
6. Adapter
7. Gasket
8. Drain valve
9. Engine supply line
10. Pendulous intake
11. "O" ring
12. Clamp
13. Nut
14. "O" ring
15. Union
16. Engine vent line
17. Elbow
18. Ambient vent line

Figure 3-2. Oil Tank Installation

TROUBLE	PROBABLE CAUSE	REMEDY
LOW PRESSURE INDICATION	Defective indicator.	Replace indicator.
	Lack of oil in tank.	Fill tank; also, see "EXCESSIVE OIL CONSUMPTION" above.
	Incorrect viscosity.	Use specification MIL-L-7808 only.
HIGH PRESSURE INDICATION	Defective indicator.	Replace indicator.
	Incorrect viscosity.	Use Specification MIL-L-7808 only.
	Plugged oil pressure line or restricted oil return line.	Remove and clean line; if inside the engine, refer to applicable technical directive.

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1574 Donald J. Grommet

T.O. NO. 1T-37A-2-6

HANDBOOK

MAINTENANCE INSTRUCTIONS

INSTRUMENTS, RADIO, COMMUNICATION AND NAVIGATION EQUIPMENT

USAF SERIES

T-37A

AIRCRAFT

THIS PUBLICATION REPLACES T.O. NO. 1T-37A-2-6 DATED 28 FEBRUARY 1956

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE

McCORMICK-ARMSTRONG, WICHITA, 1120, 9-28-56

31 AUGUST 1956

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INSTRUMENTS, RADIO, COMMUNICATION AND NAVIGATION EQUIPMENT

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INTRODUCTION

This handbook is one of a series of handbooks of the T.O. No. 1T-37A-2 sectionalized maintenance handbook and includes information relative to the instruments and radio systems. Instructions in this handbook cover maintenance to be accomplished by line maintenance personnel and include removal, installation and adjustment. Section I, Instruments, covers all flight, engine, pressure and navigational instruments, position indicators, warning lights and the pitot-static system. Section II, Radio and Communication and Navigation equipment, covers all radio and associated equipment. Illustrations have been used throughout the handbook to supplement the text. The following is a list of the other handbooks in the T.O. No. 1T-37A-2 sectionalized maintenance handbook.

T.O. No. 1T-37A-2-1	General Airplane
T.O. No. 1T-37A-2-2	Ground Handling, Servicing and Airframe Group Maintenance
T.O. No. 1T-37A-2-3	Hydraulically Operated Systems and Utility Systems
T.O. No. 1T-37A-2-4	Flight Control Systems
T.O. No. 1T-37A-2-5	Power Plant, Fuel System and Oil System
T.O. No. 1T-37A-2-7	Electrical System
T.O. No. 1T-37A-2-8	Wiring Diagrams and Data

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SECTION I

INSTRUMENTS

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1-1. GENERAL. The instruments in this airplane are conventional types common to other airplanes of similar size and purpose. All are mounted on the instrument panel except the following: the compass, on the windshield channel above the instrument panel; the two oxygen regulators, in brackets, one at each side of the instrument panel; the emergency air pressure gage, in the right nose compartment; and the accumulator air pressure gage, on top of the rear spar carry thru. All instruments are discussed in this section. In addition many of them are discussed in the descriptions of the systems to which they belong.

1-2. GENERAL TROUBLE SHOOTING AND MAINTENANCE. The applicable portions of this paragraph shall be included in any specific instructions for the maintenance and trouble shooting procedures of each instrument.

a. Replace any instrument having obvious defects such as cracked glass, dull or discolored markings (except on cover glass) or fluid, missing screws (other than mounting screws) warped or bent fittings or connections.

b. In case of sticky, or sluggish pointer movement, wipe the cover glass with a damp cloth to discharge any accumulated static electricity.

c. To obtain a more accurate pointer movement, tap the instrument case lightly to overcome the slight friction within the instrument.

d. In case of loose or missing screws, misaligned slippage marks, or cracked cover glass, examine the mounting bracket and the shock mounts for excessive vibration caused by a too rigid or defective mounting.

e. In trouble shooting, the remedy which is easiest and quickest to accomplish should be tried first, except as noted.

f. Instrument markings shall not be different from those shown in figure 1-2.

1-3. INSTRUMENT PANEL ASSEMBLY. The instrument panel assembly comprises the fuse panel, stationary panel, right shock panel, switch panel, and left shock panel. The fuse panel, riveted to the bulkhead, provides a mounting for the fuses and spare fuses of the AC power system. The right shock panel, attached to the bulkhead with three shock mounts, is hinged at the bottom, provided with a stop cord, and secured with washers and nuts. It provides a mounting for an airspeed indicator, an altimeter, a turn and slip indicator, and all circuit breakers except those in the left nose electrical equipment compartment. The stationary panel, riveted to the bulkhead, provides a mounting for the instructor's landing gear control, the radio controls, the heating and ventilating system controls, and the accelerometer. The switch panel is attached to the left oxygen regulator bracket and, behind the stationary panel, to the bulkhead. It incorporates an edge-lighted panel for illumination and provides a mounting for fourteen switches and a parking brake handle. The left shock panel, attached to the left portion of the bulkhead with four shock mounts, is hinged at the bottom, provided with a stop cord, and secured with washers, and nuts. It provides a mounting for instruments which must be protected from excessive bumps and vibrations. The students gear control, mounted to the left of the left shock panel; the students oxygen regulator, below the gear control; and the instructors oxygen regulator, under the fuse panel, may be considered part of the instrument panel assembly.

1-4. REMOVAL OF SCREW AND NUT MOUNTED INSTRUMENTS. (See figure 1-3.)

Note

This procedure is typical for all screw and nut mounted instruments on the instrument panel assembly.

WARNING

Make sure battery switch is off and that auxiliary power unit is not plugged in.

a. Remove the two screws which fasten the shock panel hinge halves together.
b. Remove the two nuts and washers from the shock-mount studs at the top of the shock panel.

Note

The right shock panel has one shock mount stud at the top.

c. Grasp top of shock panel and pull until stop cord halts further movement.
d. Disconnect wires and fittings from the instrument to be removed, cap tubes and ports, and tag fittings, if necessary, to preserve their identities.
e. Remove attaching screws and nuts and remove the instrument.

Note

Pull down hinged hood, if provided, to gain access to upper mounting screws.

1-5. INSTALLATION OF SCREW AND NUT MOUNTED INSTRUMENTS. (See figure 1-3.)
a. Install instrument and its light fixture, if provided, in the proper position with ten attaching screws and nuts.

CAUTION

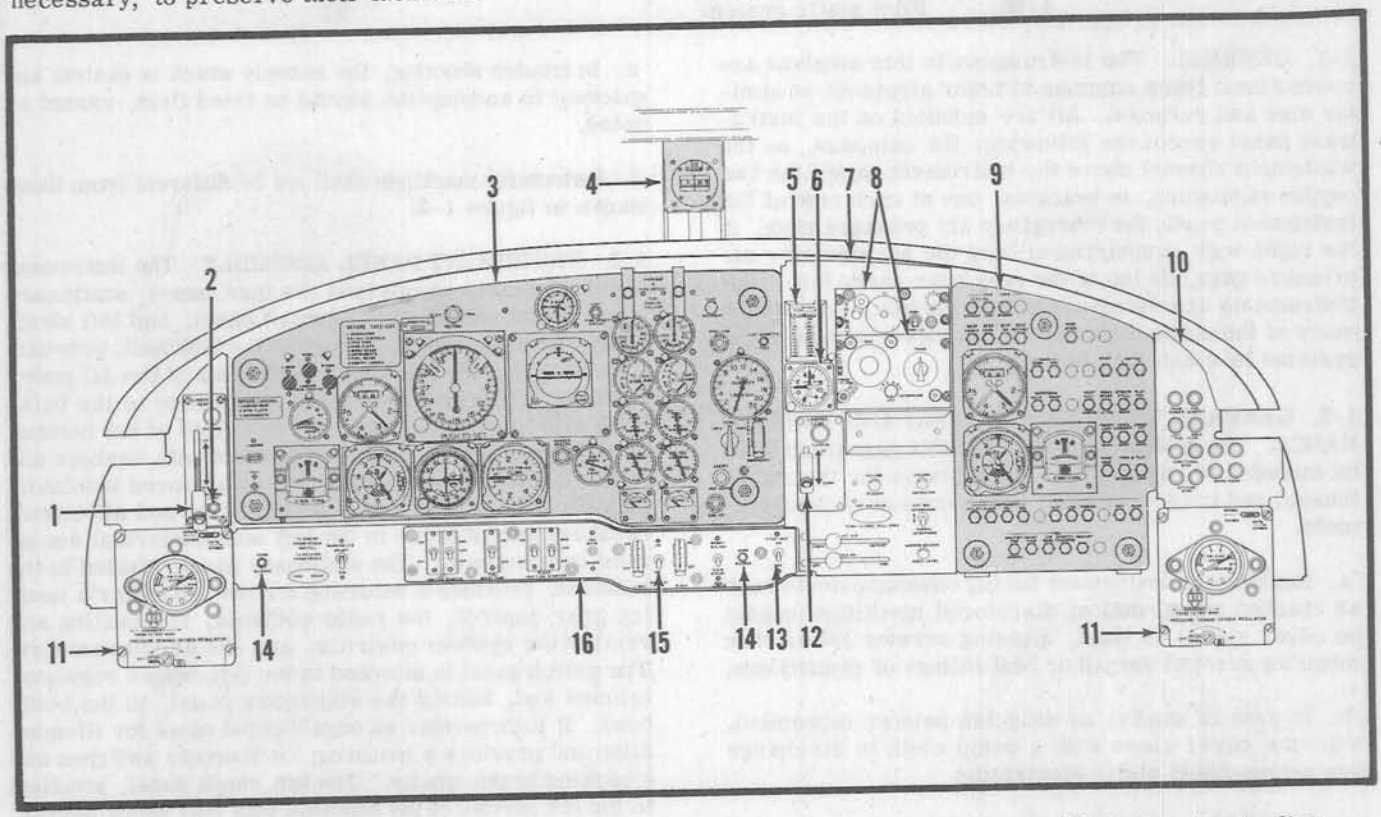
Make sure that the instrument being installed is right side up.

b. Remove caps and tags; connect wires and fittings to instrument.

WARNING

Make sure battery switch is off and that auxiliary power unit is not plugged in.

c. Swing the shock panel back up into position and secure it to the mounting studs with the nuts and washers.
d. Fasten the hinge halves together with two screws.



1. Student landing gear control handle
2. Warning light test switch
3. Left shock panel
4. Compass
5. Compass correction card
6. Accelerometer
7. Stationary panel
8. Radio controls
9. Right shock panel
10. Fuse panel
11. Oxygen regulator
12. Instructor landing gear control handle
13. Pitot heat switch
14. Horn silencing switch
15. Battery switch
16. Switch panel

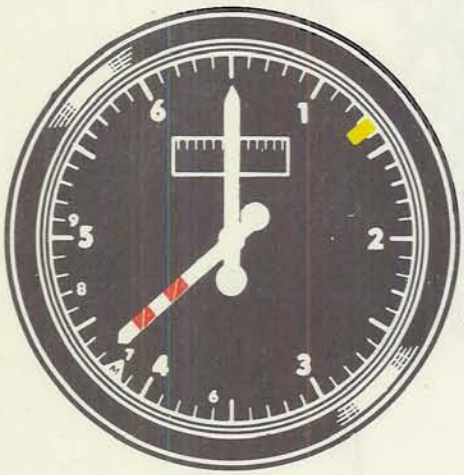
Figure 1-1. Instrument Panel Assembly

ACCELEROMETER

Red at +6.67
Red at -2.67

OIL PRESSURE GAGE

Red at 65 PSI
Green at 10-45 PSI
Red at 5 PSI



AIRSPEED INDICATOR

Yellow at 135 Knots
Pointer at 430 Knots
Pointer at .7

HYDRAULIC PRESSURE GAGE

Red at 1750 PSI
Green at 1250-1500 PSI

EXHAUST TEMPERATURE INDICATOR

Red at 690°C
Red at 676°C
Green at 510°-573°C
Red at 275°C

EMERGENCY AIR PRESSURE GAGE (IN RIGHT NOSE SECTION)

Red at 2250 PSI
Green at 1750-2250 PSI
Red at 1750 PSI

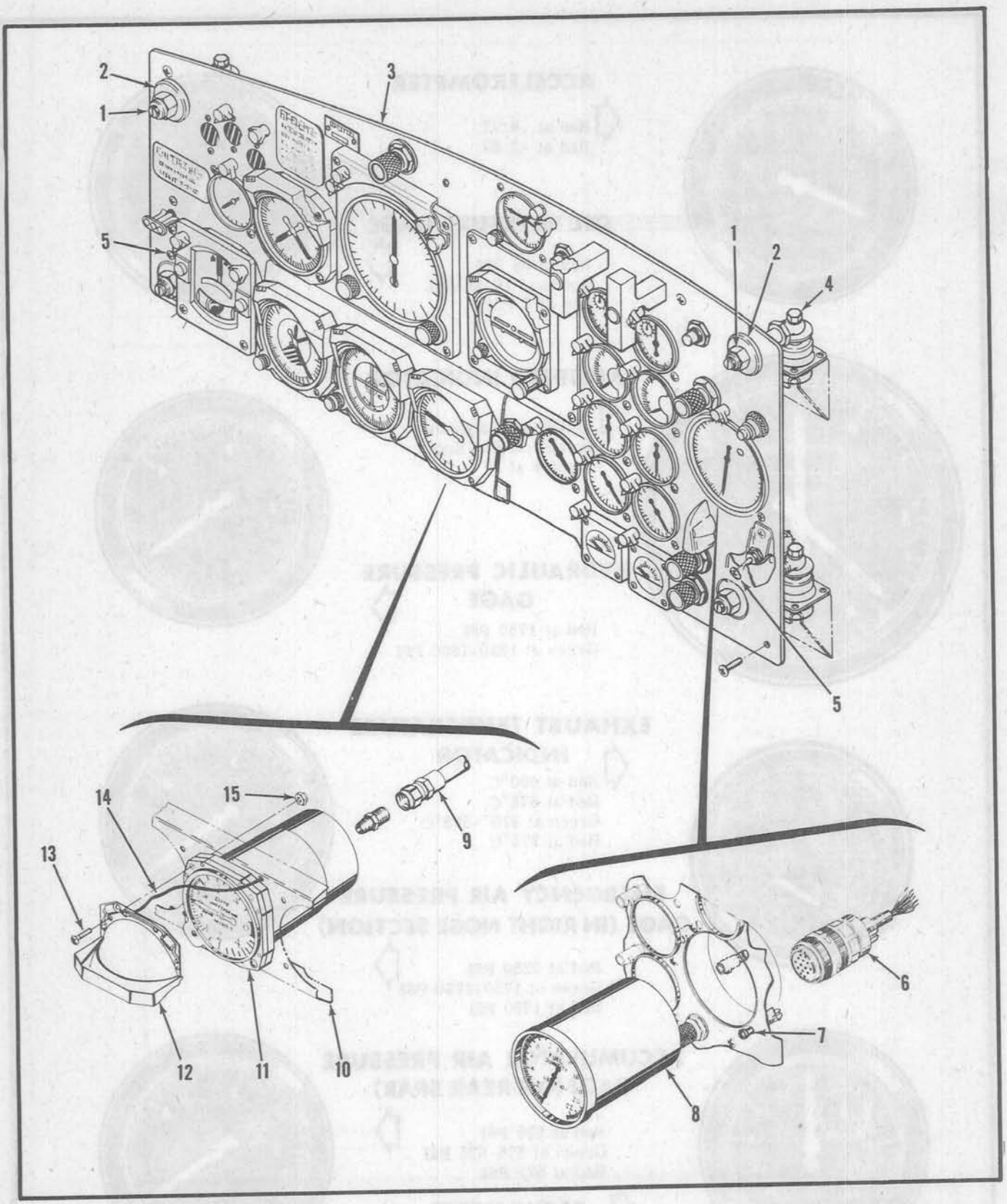
ACCUMULATOR AIR PRESSURE GAGE (ON REAR SPAR)

Red at 625 PSI
Green at 575-625 PSI
Red at 575 PSI

TACHOMETER

Red at 100% RPM
Green at 84-92% RPM

Figure 1-2. Instrument Markings



1. Nut
2. Washer
3. Shock panel
4. Shock mount
5. Hinge screw
6. Electrical plug
7. Clamp screw
8. Fuel quantity indicator
9. Hose
10. Shock panel
11. Rate of climb indicator
12. Hooded light fixture
13. Screw
14. Light fixture wire
15. Nut

Figure 1-3. Left Shock Panel Installation

Table I. Mounting Positions for Clamp Mounted Instruments

INSTRUMENT	DIAL POSITION IN CLAMP
Exhaust Temperature Indicators	600° at nine o'clock
Flap Position Indicator	UP at twelve o'clock
Fuel Flow Indicators	1050 PPH at six o'clock
Fuel Quantity Indicator	500 LB at nine o'clock
Hydraulic Pressure Gage	2000 PSI at nine o'clock
Oil Pressure Gages	70 PSI at nine o'clock
Tachometers	100% at nine o'clock

1-6. REMOVAL OF CLAMP MOUNTED INSTRUMENTS. (See figure 1-3.)

a. Hinge shock panel down in accordance with a, b, and c, paragraph 1-4.

WARNING

Make sure battery switch is off and that auxiliary power unit is not plugged in.

b. Disconnect wires and fittings from the instrument to be removed, cap tubes and ports, and tag fittings, if necessary, to preserve their identities.

CAUTION

When removing pressure gage, make sure system pressure is zero; when removing flap position indicator, make sure flaps are fully up or down and that system is not energized.

c. Loosen lower right clamp screw and pull instrument from shock panel.

1-7. INSTALLATION OF CLAMP MOUNTED INSTRUMENTS. (See figure 1-3.)

a. Position instrument in clamp in accordance with Table I and tighten clamp screw.

b. Remove any caps and tags and connect fittings to instrument.

WARNING

Make sure battery switch is off and that auxiliary power unit is not plugged in.

c. Reposition shock panel in accordance with c and d, paragraph 1-5.

1-8. POSITION LIGHTS, WARNING LIGHTS, AND SWITCHES. Removal of the lights and switches discussed in this section consists of hinging the panel down, disconnecting the wires, removing the locknuts and washers from the front, and withdrawing the light or switch from the rear of the shock panel. When installing lights and switches, make sure that they are installed right side up.

Table II. Flight Instruments

INSTRUMENT	TYPE	OPERATING SOURCE
Accelerometer	MS28025-1 (B-6)	Self-Contained
Airspeed Indicator	L-7A	Pitot-Static System
Altimeter	MB-1	Static System
Attitude Indicator	J-8	115 volt AC (three-phase)
Directional Indicator	C-5C	115 volt AC (three-phase)
Rate of Climb Indicator	AN5825-7	Static System
Turn and Slip Indicator	MS28024-1	28 volt DC

1-9. FLIGHT INSTRUMENTS. (See table II and figure 1-4.) The flight instruments and related systems furnish the pilot with necessary indications of the flight conditions of the airplane. All flight instruments are mounted on the two shock panels except the accelerometer which is mounted adjacent to the left shock panel on the stationary panel.

1-10. ACCELEROMETER. An accelerometer, mounted on the stationary panel next to the shock panel, indicates loads imposed on the airplane and is graduated in terms of "G" units from -5G to +10G. The units represent a measure of force created by gravity and inertia. Three indicator pointers are moved indirectly by the changing position of a mechanically restricted weight moving up

and down in response to G loads on the airplane. The main pointer indicates any existing load, and has a normal indication of +1G when the airplane is at rest or in level flight. The two auxiliary pointers are ratcheted to keep them at the maximum positive and negative load indications imposed during a particular mission or maneuver. They are manually reset to the static "1G" position by the knob on the indicator face. The knob at the rear is used to lock the instrument when it is not in the airplane. The accelerometer needs no external connections. See paragraphs 1-4 and 1-5 for removal and installation. No adjustment is to be attempted.

1-11. AIRSPEED INDICATOR. There are two airspeed indicators, one on the left shock panel and one on the right shock panel. The airspeed indicator is graduated in knots with a range of 0 to 650. The indicator has three pointers: the airspeed pointer which moves with the expansion and contraction of a bellows acting in response to differences in pitot and static pressures; a triangular Mach index pointer which is set to indicate the critical Mach number; and a red-striped, maximum allowable airspeed pointer which converts the setting of the Mach index pointer into knots in accordance with the indicated altitude. A drum, visible through a window in the face of the instrument, indicates the last two digits of the indicated airspeed. In flights above 4000 feet, the red-striped pointer will indicate the airspeed representing the limiting Mach number of 0.70; below that altitude the pointer will indicate the limiting structural airspeed of 430 knots. To adjust the Mach index pointer, remove the plug in the rear of the instrument case and turn the screw until the pointer is adjacent to 0.70. To adjust the maximum allowable airspeed pointer, turn the screw at the lower left corner of the instrument face until the pointer is adjacent to 430 knots. See figure 1-2 for instrument marking. See paragraphs 1-4 and 1-5 for removal and installation. No adjustments should be attempetd except those included in this paragraph and in paragraph 1-12.

1-12. TROUBLE SHOOTING AIRSPEED INDICATOR.

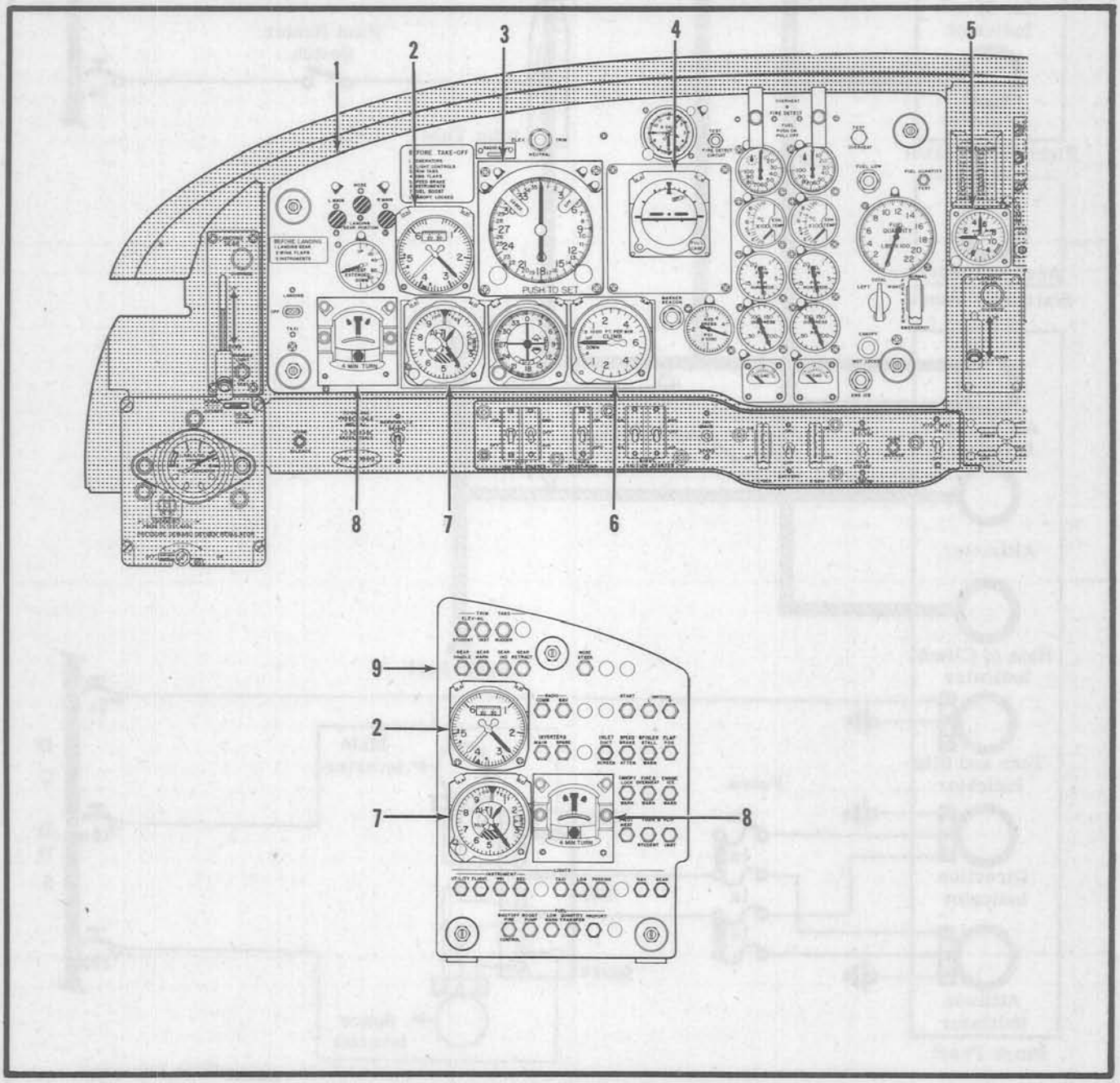
TROUBLE	PROBABLE CAUSE	REMEDY
POINTERS GIVE INACCURATE INDICATION, OSCILLATE, OR FAIL TO RESPOND.	Pitot or static lines clogged.	Clean pitot and static lines.
	Leak in pitot or static lines, in connections, or in rate of climb indicator case or altimeter case.	Check lines, connections, and instruments; replace or tighten as necessary.
	Defective instrument.	Replace instrument.
	Pitot tube cover on pitot tube.	Remove pitot tube cover.
POINTER DOES NOT RETURN TO ZERO.	Pitot tube cover not on pitot tube.	Cover pitot tube.
	Defective instrument.	Replace instrument.

1-13. ALTIMETER. There are two altimeters, one on the left shock panel and one on the right shock panel. The altimeter converts static pressure into a visual indication of the altitude of the airplane. The indicator has an altitude dial, a barometric scale, an adjustment knob, and three pointers. The indicator is graduated in feet and has a range of 50,000 feet. The large pointer indicates hundreds of feet and makes 50 revolutions to move through the 50,000 foot range. The intermediate pointer indicates thousands of feet and makes five revolutions for the 50,000 foot range. The third pointer, an extension from the disk on the dial center, indicates ten-thousands of feet and makes one-half of a revolution. The barometric scale, visible through the window in the altimeter dial, indicates barometric pressure in inches of mercury, ranging from 28.1 to 31.0. Turning the adjustment knob on the lower left of the instrument face will adjust the pointers to indicate zero altitude at any existing ground pressure within the barometric scale range. A correction card, stowed in the map and data case, should be attached to the altimeter whenever it is removed. It permits compensation for instrument errors that cannot be corrected by indicator adjustment. See paragraphs 1-4 and 1-5 for removal and installation. No adjustments should be attempted except those included here or in paragraph 1-14.

1-14. TROUBLE SHOOTING ALTIMETER.

TROUBLE	PROBABLE CAUSE	REMEDY
POINTERS FAIL TO RESPOND	Leak in static line, in connections, in airspeed indicator case, or in rate of climb indicator case.	Check lines, connections, and instruments; replace or tighten as necessary.
	Static lines clogged.	Clean static lines.
	Defective instrument.	Replace instrument.
SETTING KNOB BINDS OR TURNS HARD	Lack of or improper lubrication.	Replace instrument.

TROUBLE	PROBABLE CAUSE	REMEDY
INACCURATE INDICATION	Mechanism shift or maladjustment.	Reset scale; if indication is still wrong, replace instrument.
	Incorrect venting.	Check static lines and connections; replace as necessary.
	Defective instrument.	Replace instrument.
POINTER OSCILLATION OR ERRATIC MOVEMENT	Defective instrument.	Replace instrument.



1. Left shock panel
2. Airspeed indicator
3. Directional indicator
4. Attitude indicator
5. Acclerometer
6. Rate of climb indicator
7. Altimeter
8. Turn and slip indicator
9. Right shock panel

Figure 1-4. Flight Instruments

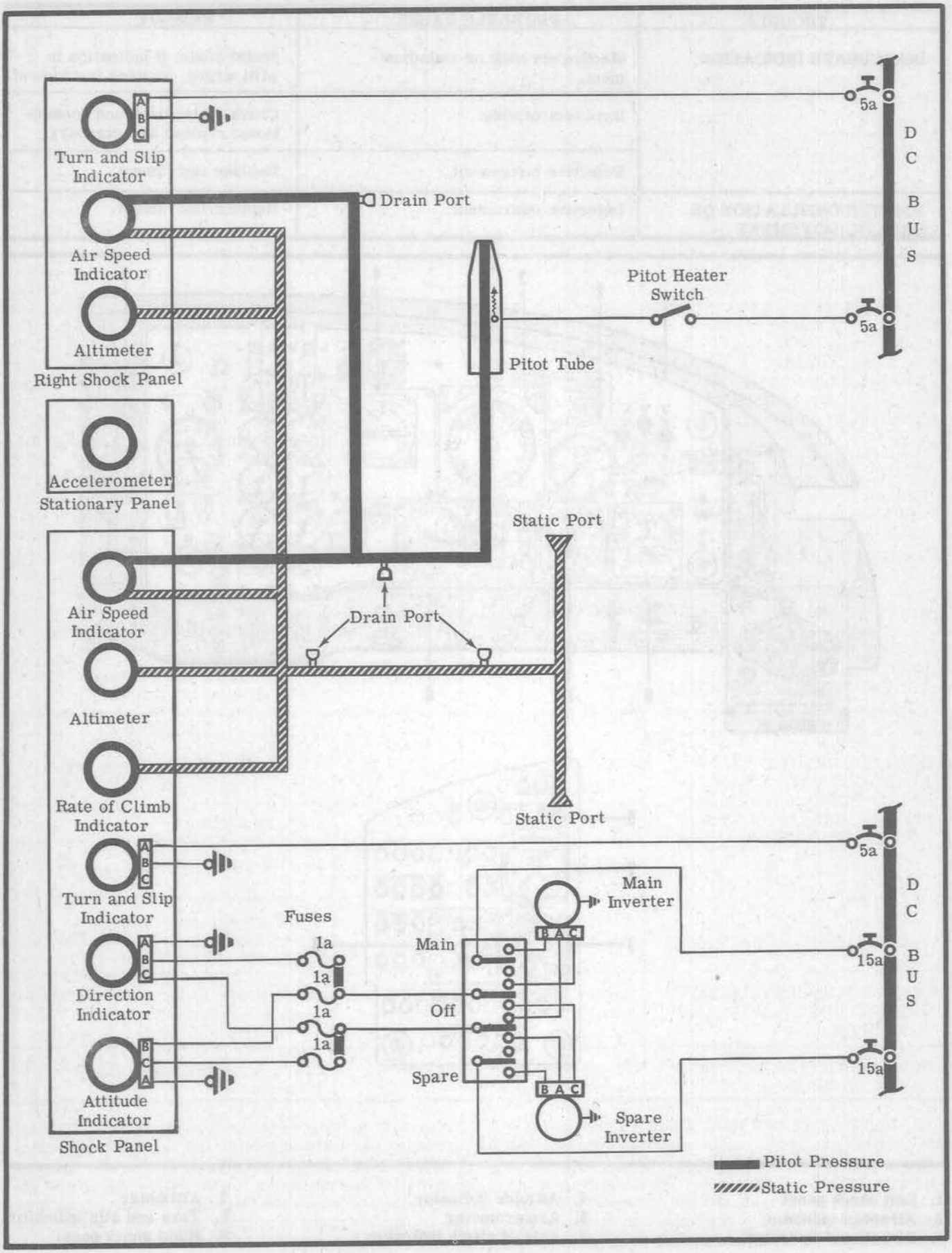


Figure 1-5. Flight Instruments and Pitot Static System Schematic

1-15. ATTITUDE INDICATOR. An attitude indicator, mounted on the center of the shock panel, contains an electrically driven gyro which, when operating, remains in one fixed position regardless of the position of the airplane. The instrument converts the relative positions of the airplane and the gyro assembly into a visual indication of the attitude of the airplane in relation to the earth's horizontal plane. Trim indication is given by a miniature airplane which is adjustable from 5° dive to 10° climb by the knob on the lower left corner of the instrument. Pitch axis attitude of the airplane during small angles of climb or dive is indicated by a horizontal bar; at high angles of climb or dive, the word "CLIMB" or "DIVE" appears on the indicator. A bank index at the top of the indicator registers angles of bank around the roll axis. When the power is off or falls below that necessary to operate the gyro, an "OFF" flag appears on the dial face. The flag disappears when there is sufficient power to operate the gyro. The gyro can be caged for stabilization about the roll and pitch axes by pulling the self-retracting "PULL TO CAGE" knob on the lower right corner.

Note

To check caging mechanism: pull caging knob, release, and push it against case. If gyro precession and/or further travel is noted, caging mechanism is faulty; replace the instrument.

The inverter provides 115 volt, 400 cycle, three phase power to the instrument; one-ampere fuses mounted on the fuse panel protect the "A" and "C" power phases. See paragraphs 1-4 and 1-5 for removal and installation. No adjustments should be attempted except those included here or in paragraph 1-17.

Note

Horizon bar displacement in pitch and/or bank may exceed 5° after a loop. In successive loops, displacement can increase until it reaches the limit of horizon bar movement. This is normal in successive loops and not indicative of instrumental failure.

1-16. DIRECTIONAL INDICATOR. An electrically powered directional indicator, mounted on the center of the shock panel, indicates airplane heading in degrees with respect to a pre-determined fixed reference. The indicator has a single pointer, a scale graduated clockwise in two degree increments with a range of 0 to 360, and two setting knobs. Depressing and turning the left knob moves the pointer; depressing and turning the right knob moves the pointer and the dial together to any desired position. A red flag marked "CAGED" appears when either of the knobs is depressed and disappears when both knobs are pulled out. When the power is off or falls below that necessary to operate the gyro, an "OFF" flag appears at the upper right of the dial face. The flag disappears when there is sufficient power to operate the instrument. The inverter provides 115 volt, 400 cycle, three-phase power to the instrument. Two one-ampere fuses mounted on the fuse panel protect the circuit. See paragraphs 1-4 and 1-5 for removal and installation. No adjustments should be attempted except those included in this paragraph and in paragraph 1-17.

1-17. TROUBLE SHOOTING ATTITUDE INDICATOR AND DIRECTIONAL INDICATOR.

TROUBLE	PROBABLE CAUSE	REMEDY
DOES NOT START; "OFF" FLAG DOES NOT RETRACT AFTER POWER IS APPLIED; DIAL OR POINTER DOES NOT SETTLE PROPERLY	Source of power or faulty connections.	Check power supply, fuses, cable, plug, and receptacle.
	Faulty internal wiring.	Replace instrument.
	Defective instrument mechanism.	Replace instrument.
	Incorrect voltage or frequency.	Check voltage and frequency at power supply source. (115 ±10 volts, 400 ±40 cycles AC.)
DIAL OR POINTER DOES NOT RESPOND DURING AIRPLANE MANEUVER	Source of power or faulty connections.	Check power supply, fuses, cable, plug, and receptacle.
DIAL OR POINTER INDICATES LARGE TURNING ERROR	Phase rotation of AC power supply reversed.	Check AC power supply phase rotation.

1-18. RATE OF CLIMB INDICATOR. There are two rate of climb indicators, one on each shock panel. The indicator incorporates two air-enclosing chambers: a diaphragm, and the air tight case. When static pressure varies because of changing altitude, the case pressure lags behind the pressure in the diaphragm due to a restriction in the flow of air into and out of the case. The instrument mechanism converts the resulting pressure differential into a visual indication of the rate of climb or descent of the airplane in feet per minute. The instrument has a single pointer and two adjoining scales graduated in feet with a range of 0 to 6000. Turning the setting screw on the lower left corner of the instrument face moves the diaphragm support up or down to change the position of the pointer. See paragraphs 1-4 and 1-5 for removal and installation. No adjustments should be attempted except those included in this paragraph and in paragraph 1-19.

1-19. TROUBLE SHOOTING RATE OF CLIMB INDICATOR.

TROUBLE	PROBABLE CAUSE	REMEDY
POINTER TRAVEL LIMITED OR EXTREME INDICATION ERRORS	Defective instrument.	Replace instrument.
POINTER VIBRATES	Excessive vibration of shock panel or static lines.	Check shock mounts and static line clamps.
POINTER FAILS TO RESPOND	Static line clogged.	Clean static lines.
	Defective instrument.	Replace instrument.
POINTER OSCILLATES OR INDICATES LESS THAN ACTUAL RATE OF CLIMB	Leak in pitot or static lines, in connections, or in rate of climb indicator case or altimeter case.	Check lines, connections, and instruments; replace or tighten as necessary.
	Defective instrument.	Replace instrument.
POINTER OFF "O" POSITION	Mechanism shift.	Return pointer to "O" using zero adjusting screw on lower left corner of instrument face.
POINTER OFF "O" POSITION AND CANNOT BE RETURNED WITH ADJUSTING SCREW	Defective instrument.	Replace instrument.

1-20. TURN AND SLIP INDICATOR. There are two turn and slip indicators; one on the left shock panel, and one on the right. Each indicator comprises an electrically driven gyroscopic rate of turn indicator and a fluid damped inclinometer. The turn indicator pointer, actuated by an electrically driven gyro, moves in the direction of a turn in an amount proportional to the rate of turn. A one-pointer-width deflection indicates a turn of 90° per minute. The relationship of the black glass ball in the inclinometer to two wires at the center of the inclinometer, indicates the apparent lateral attitude of the airplane. The indicators are operated from the 28 volt DC bus; two five-ampere circuit breakers which are mounted on the right center of the right shock panel protect the circuits. See paragraphs 1-4 and 1-5 for removal and installation. No adjustments should be attempted except those included in this paragraph and in paragraph 1-21.

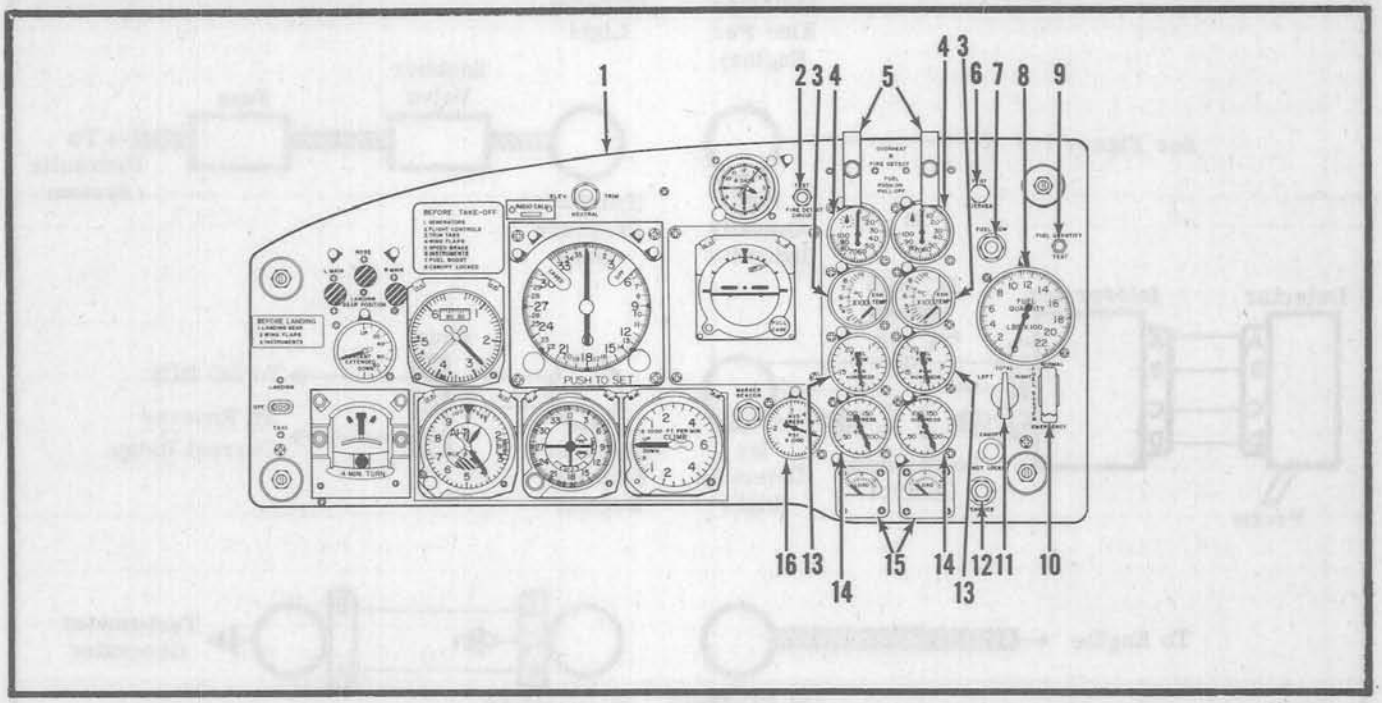
1-21. TROUBLE SHOOTING TURN AND SLIP INDICATOR.

TROUBLE	PROBABLE CAUSE	REMEDY
POINTER FAILS TO RESPOND (GYRO DOES NOT OPERATE)	Source of power or faulty connections.	Check power supply, cable, plug, and receptacle.
	Operating voltage too low.	Supply rated voltage.
	Defective instrument.	Replace instrument.
POINTER INDICATES TURN IN WRONG DIRECTION	Wires reversed on instrument during installation.	Reverse wires connecting to power supply.
POINTER OFF ZERO	Incorrect adjustment or balance.	Replace instrument.
DEFLECTION TOO SHORT	Operating voltage too low.	Supply rated voltage.
	Incorrect sensitivity adjustment.	Replace instrument.
DEFLECTION TOO FAR	Incorrect sensitivity adjustment.	Replace instrument.
EXCESSIVE POINTER OSCILLATION	Damper and adjustment screw out of adjustment.	Replace instrument.
VIBRATING POINTER	Excessive shock panel vibration.	Inspect shock mounts.
SLIP INDICATOR BALL WILL NOT CENTER	Slip indicator out of adjustment.	Replace instrument.

1-22. ENGINE AND PRESSURE INSTRUMENTS. (See table III and figure 1-4.) The engine and pressure instruments and related systems provide necessary indications of the operational conditions of the engines and the pressurized systems in this airplane. All are located on the left shock panel except the emergency air pressure gage in the nose and the hydraulic accumulator pressure gage above the fuselage fuel cell.

Table III. Engine and Pressure Instruments

INSTRUMENT	TYPE	OPERATING SOURCE
Accumulator Pressure Gage	E-6	Accumulator.
Emergency Air Pressure Gage	E-6	Emergency Air System.
Exhaust Temperature Indicators	MS28006-1	System generated.
Fuel Shutoff Switches	S-1000 (Stearman)	28 volt DC.
Fuel Flow Indicators	A-16	28 volt AC (single phase).
Fuel Low Warning Light	AN3157-6	28 volt DC.
Fuel Quantity Indicator	JG4B-1	115 volt AC (single phase).
Hydraulic Pressure Gage	E-6	Hydraulic system.
Ice Detection Light	AN3157-8	28 volt DC.
Ammeters	J1	50 MV shunts.
Oil Pressure Gages	B-23	Oil system.
Tachometers	MS28000-1 (E-29)	System generated.



1. Left shock panel
2. Fire detection test switch
3. Exhaust temperature indicator
4. Tachometer
5. Fuel shutoff "T" handle
6. Overheat test switch
7. Fuel low warning light
8. Fuel quantity indicator
9. Fuel quantity test switch
10. Fuel control switch
11. Fuel quantity selector switch
12. Ice detection warning light
13. Fuel flow indicator
14. Oil pressure gage
15. Ammeter
16. Hydraulic pressure gage

Figure 1-6. Engine and Pressure Instruments

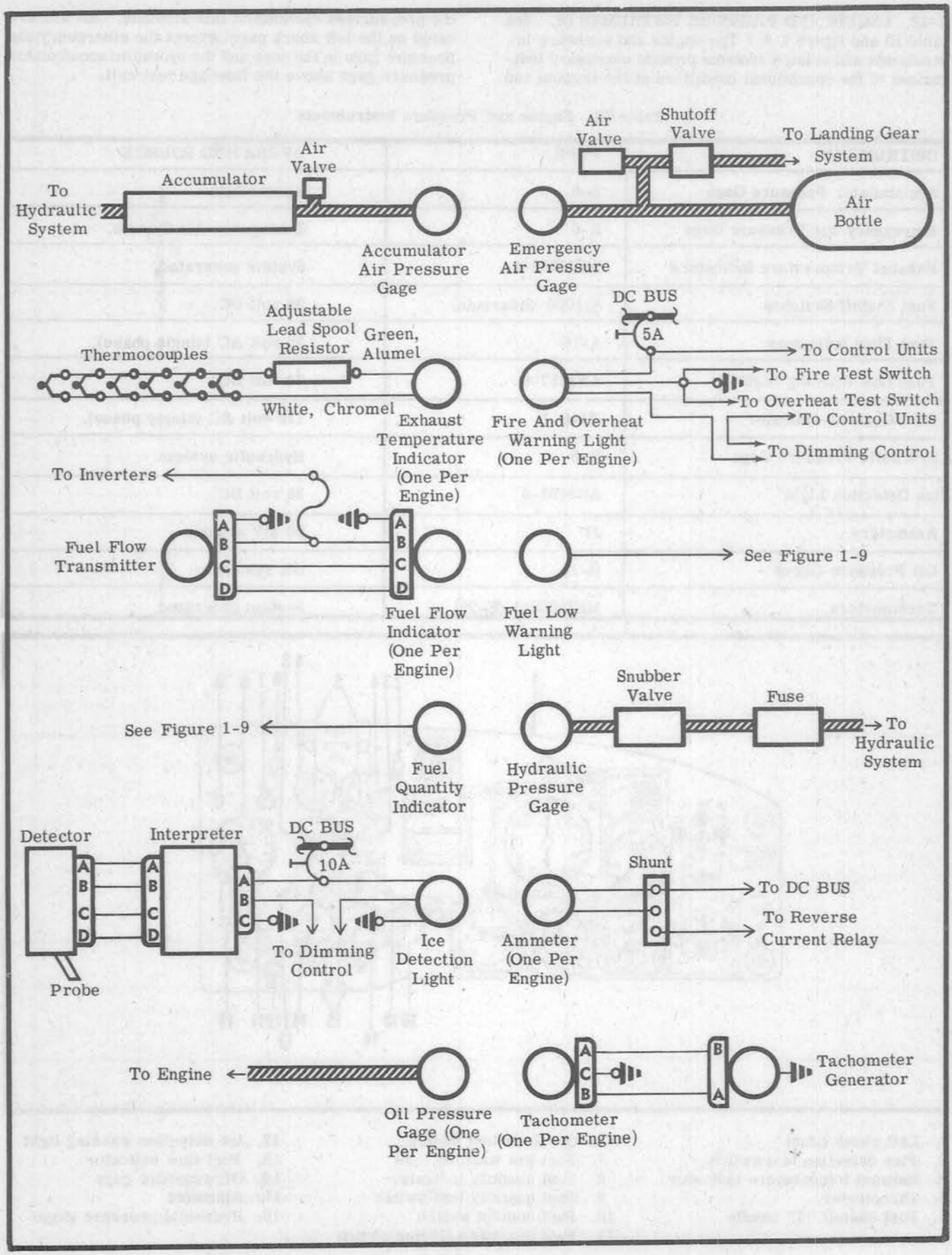


Figure 1-7. Engine and Pressure Instruments Schematic

1-23. EXHAUST TEMPERATURE INDICATING SYSTEM.

1-24. DESCRIPTION. There are two identical exhaust temperature indicating systems, one for each engine. Each complete system includes an exhaust temperature indicator, a thermocouple lead spool resistor, and six harness-mounted, bayonet type, chromel-alumel thermocouples. The two indicators are mounted beneath the tachometers on the right center of the shock panel. See paragraphs 1-6 and 1-7 for removal and installation. The two screw-mounted resistors are located aft of the rear spar carry thru at the top of the fuselage structure, and are accessible through the opening for door 7. The thermocouples are installed in the engine tailpipes.

1-25. OPERATION. The thermocouples, heated by the exhaust gases, generate a small amount of electricity which is carried to the indicators by the chromel and the alumel leads. The resistors, adjusted to 8 ±0. 05 ohms, are in the alumel side of the circuit. The indicators are sensitive millivoltmeters with dials graduated in degrees centigrade from 0° to 1000°C(32° to 1832°F). They provide the pilot with visual indications of the existing average temperature within each tailpipe.

1-26. TROUBLE SHOOTING EXHAUST TEMPERATURE INDICATING SYSTEM.

TROUBLE	PROBABLE CAUSE	REMEDY
NO INDICATION	Break in thermocouple harness, lead, or resistor.	Repair or replace, as necessary.
	Defective indicator or connection.	Replace defective part.
LOW INDICATION	Poor connection or short circuit.	Clean, tighten, repair, or replace.
	Defective indicator.	Replace indicator.
	Inoperative thermocouples.	See note after 8, a, paragraph 1-29.
	Improper indicator adjustment.	See paragraph 1-29.
	Circuit resistance too high.	Check leads and connections for moisture, corrosion, or carbon; check resistor and circuit with Jetcal Analyzer.
HIGH INDICATION	Improper indicator adjustment.	See paragraph 1-29.
	Circuit resistance too low.	Check resistor and circuit with Jetcal Analyzer.

1-27. REMOVAL OF THERMOCOUPLES.
(See figure 1-8.)

a. Remove engine and tailpipe in accordance with T. O. No. 1T-37A-2-5.

b. Remove twelve screws and nuts to free thermocouples.

c. Carefully pull thermocouples from tailpipe holes.

1-28. INSTALLATION OF THERMOCOUPLES.
(See figure 1-8.)

a. Insert thermocouples into holes in tailpipe.

b. Attach thermocouples to tailpipe with twelve screws and nuts.

c. Install tailpipe and engine in accordance with T. O. No. 1T-37A-2-5, and check operation.

TEST EQUIPMENT REQUIRED

NAME	MANUFACTURERS DESIGNATION	ALTERNATE	USE AND APPLICATION
Jetcal Analyzer	BH 112 J-22	None	Testing and adjusting exhaust temperature indicating system.

1-29. ADJUSTING AND TESTING EXHAUST TEMPERATURE INDICATING SYSTEM. Both the indicator and the resistor are adjusted at the time of installation. The indicator is adjusted to the ambient temperature by turning the screw on the back of the indicator case. The resistor is adjusted to 8 ±0. 05 ohms by removing wire from a spool to lower resistance; if resistance must be increased, the spare spool is connected in place of the low spool. Whenever any element in the circuit is changed or whenever the engine is changed:

a. Check circuit with Jetcal Analyzer as follows:

1. With temperature regulator on zero, and SELECTOR SWITCH SW-1 in OFF position connect the power inlet cable to Jetcal at receptacle P-1, and to a 95 to 135 volt, 50-400 cycle, AC power source.

WARNING

Ground the Analyzer with the pig tail lead in the power inlet cable.

2. Connect junction box to heater cable and heater

cable to Jetcal at heater cable receptacle S-1.

3. Connect one YBH386 heater probe to a thermocouple.
4. Place SELECTOR SWITCH SW-1 in T/C position.
5. Place switch SW-2 in HEATER CABLE position.
6. Set up potentiometer as outlined below:

(a) Place switch SW-6 in MECH ZERO position. Zero GALVO-1 by turning MECH ZERO knob.

(b) Hold switch SW-6 in ELEC ZERO position. Zero GALVO-1 by turning ELEC ZERO knob R-3.

(c) Place switch SW-6 in RANGE position to take temperature readings. Temperature readings are made on potentiometer by adjusting temperature selector knob until GALVO-1 reads zero. The temperature reading appears on °C scale. To check potentiometer, turn temperature selector knob until galvanometer is zeroed. With heater probe cold, temperature scale should read ambient temperature. (21°C is approximately 70° F.)

7. Turn voltage regulator to maximum and bring the one heater probe to 500°C (932° F) to 800°C (1472° F) as read on Jetcal potentiometer.

CAUTION

Never allow heater probes to go over 900°C (1652° F).

8. To eliminate an error due to one or more airplane thermocouples being inoperative, place hot heater probe over each of the airplane thermocouples one at a time. The EGT indicator must show a temperature rise as each thermocouple is checked.

Note

Two nonadjacent thermocouples may be inoperative without resulting in serious error in indicated exhaust temperature. However, a harness must be replaced if it has two adjacent inoperative thermocouples, or any three or more inoperative thermocouples.

9. Place switch SW-6 in MECH ZERO position.
10. Turn temperature regulator back to zero.
11. Push a YBH386 heater probe completely onto each thermocouple and lock firmly in place.

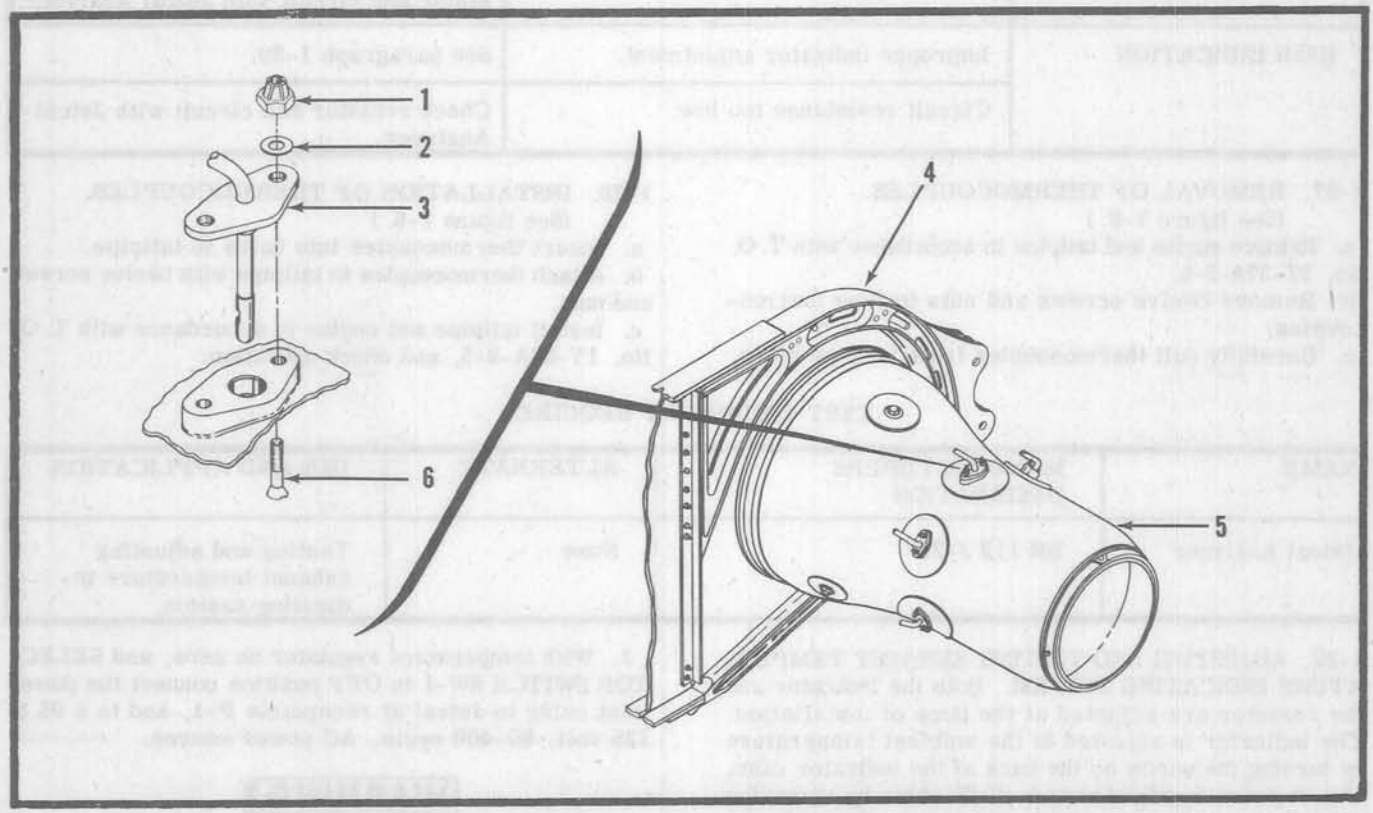
Note

Since junction box is wired in parallel, it is not necessary to connect probes to all outlets.

12. If testing in high wind or cold weather, it is advisable to place a cover over the tailpipe.
13. Place switch SW-6 in RANGE position.
14. Bring probes to maximum engine operating temperature with temperature regulator at maximum; stabilize and wait ten minutes.

Note

If, after 10 minutes, indicator is not within 15°C (59° F) of maximum engine operating temperature, wait 20 more minutes; if indicator is still outside tolerance, system is out of adjustment.



1. Nut
2. Washer
3. Thermocouple
4. Rear spar
5. Tailpipe
6. Screw

Figure 1-8. Thermocouple Installation

15. After the temperature of the airplane thermocouples has stabilized, read Jetcal and EGT indicators. The difference between these readings is the indicated error of the EGT system and should not exceed ±15°C (59°F).

Note

Do not adjust indicator to agree with Jetcal temperature indication.

16. After completion of test, place switch SW-6 in MECH ZERO position; rotate temperature regulator to zero.

17. Place SELECTOR SWITCH SW-1 in OFF position before removing heater probes and cables from airplane and Analyzer.

b. To adjust circuit resistance, proceed as follows:

1. Place SELECTOR SWITCH SW-1 in OFF position and connect the power inlet cable to Jetcal at receptacle P-1, and to a 110 volt, 50-400 cycle, AC power supply. When 110 volt, AC power is not available, emergency batteries can be used.
2. Connect RES adapter to instrument cable, and instrument cable to input receptacle P-2.
3. Disconnect airplane thermocouple leads from EGT indicator.
4. Connect RES adapter leads to proper airplane thermocouple leads.
5. Place SWITCH SW-6 in MECH ZERO position. Zero GALVO-1 by turning MECH ZERO knob.
6. Turn SWITCH SW-3 to 8 ohms.
7. Place SELECTOR SWITCH SW-1 in RES position.
8. Place SWITCH SW-6 in RANGE position.
9. Adjust resistance spool in airplane until GALVO-1 reads zero. (One division of GALVO-1 equals approximately 0.05 ohms)
10. Before removing cables from Analyzer, place switch SW-6 in MECH ZERO position and SELECTOR SWITCH SW-1 in OFF position.

1-30. FIRE AND OVERHEAT WARNING LIGHTS. A fire and overheat detection system is provided to warn the pilot of excessive heat around or near either engine. Visual indication is provided by two, red, press-to-test lights mounted one in each fuel shutoff "T" handle on the upper right of the shock panel. Indication of fire or excessive heat in a nacelle, aft of its fireseal, is given by the red flashing of the corresponding light; indication of fire in a nacelle, forward of its fireseal, is given by the steady red glowing of the corresponding light. Either warning light bulb can be removed and replaced by unscrewing the red cover, pulling both the cover and the bulb from the switch, replacing the bulb with a good one, and screwing bulb and cover back into the switch. See T. O. No. 1T-37A-2-3.

1-31. FUEL FLOW INDICATING SYSTEM.

1-32. DESCRIPTION. There are two identical fuel flow indicating systems, one for each engine. Each system includes an indicator and a transmitter. Both indicators are mounted on the right of the shock panel; see paragraphs 1-6 and 1-7 for removal and installation. Both transmitters are located aft of the seats beneath the fuel system cover; see paragraphs 1-34 and 1-35 for removal and installation.

1-33. OPERATION. The autosyn type fuel flow indicating system measures rate of fuel flow to the engines. The transmitters, connected to the fuel line between the motorized shutoff valves and the engines, generate signals in direct proportion to the amount of fuel flowing to the engines. The signals are amplified and fed to the indicators which give the rate of fuel flow in pounds per hour. The 28 volt AC, 400 cycle, one phase circuit is powered through a transformer from the inverter. Two, one-ampere fuses mounted on the fuse panel protect the circuit. The system is not adjustable; in case of malfunction, the defective part must be replaced.

1-34. REMOVAL OF FUEL FLOW TRANSMITTER. (See figure 1-9.)

a. Under airplane, open fuel drain access door; close shutoff valve; open strainer drain valve.

Note

Place a container under the fuel strainer to catch drained fuel.

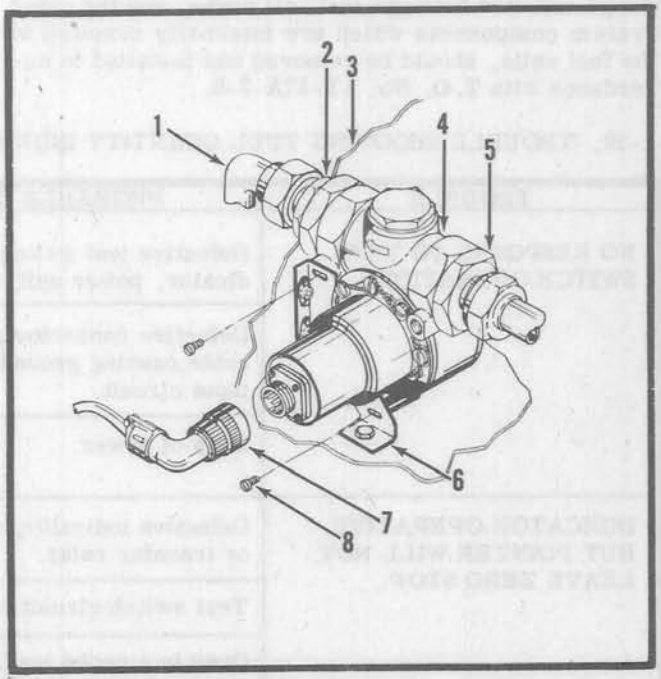
b. Energize DC bus; push-in motorized shutoff valve handles; de-energize DC bus; pull both inverter circuit breakers.

c. Remove door 38; disconnect transmitter from fuel line and firewall by unscrewing both fuel supply quick disconnect elbow and locknut.

d. Inside cockpit, remove fuel system cover, and disconnect electrical plug at transmitter.

e. Disconnect transmitter-to-shutoff-valve tube at reducer.

f. Remove two screws and spacers attaching transmitter to mounting bracket; remove transmitter.



1. Elbow
2. Locknut
3. Firewall
4. Transmitter
5. Reducer
6. Bracket
7. Electrical plug
8. Screw

Figure 1-9. Fuel Flow Transmitter Installation

1-35. INSTALLATION OF FUEL FLOW TRANSMITTER. (See figure 1-9.)

a. Attach transmitter to mounting bracket with two screws and two spacers; safety wire screws.

b. Connect transmitter-to-shutoff-valve tube at reducer.

c. Connect electrical plug to transmitter; safety wire plug to transmitter; install fuel system cover.

d. Working through opening for door 38, screw locknut tight against firewall; screw fuel supply quick disconnect elbow tight to transmitter union. Install door 38.

e. Energize DC bus; pull-out motorized shutoff valve handles; de-energize DC bus; push-in both inverter circuit breakers.

f. Close strainer drain valve; open strainer shutoff valve; close fuel drain access door.

1-36. FUEL QUANTITY INDICATING SYSTEM.

1-37. DESCRIPTION. (See figure 1-10.) The fuel quantity indicating system includes an indicator, a selector switch, a red press-to-test low-level warning light, a test switch, a power unit, a transfer relay, four uncompensated fuel probes, a compensated fuel probe, and a float switch. The indicator, warning light, and switches are mounted on the right side of the shock panel. See paragraphs 1-6 through 1-8 for removal and installation. The power unit and the transfer relay are mounted on one rack on the left front of the front spar carry-through behind the student pilot's seat. The power unit can be removed by disconnecting electrical fittings, loosening the screw clamp on the rack and lifting. The transfer relay can be removed by disconnecting electrical fittings, removing mounting bolts and washers, and lifting the relay. The flange mounted fuselage fuel cell probe, and the other system components which are internally mounted in the fuel cells, should be removed and installed in accordance with T. O. No. 1T-37A-2-5.

1-38. OPERATION. (See figure 1-11.) The capacitor type fuel quantity indicating system is an electronic device, measuring fuel mass and indicating it in pounds. Basically the system consists of the five probes, the power unit, and the indicator which constitute a rebalancing capacitance bridge circuit. A change in fuel quantity causes a change in probe capacitance in one leg of the bridge, which results in unbalancing the bridge. The resulting voltage signal, amplified in the power unit, energizes one winding of a two-phase motor in the indicator. The motor drives the wiper of a rebalancing potentiometer in the proper direction to reapportion the voltage drop across a reference capacitor in the opposite leg of the bridge, thus restoring the balanced condition. The indicator pointer, driven by the potentiometer wiper shaft, rotates with the wiper to provide a continuous reading of fuel quantity. The compensator, incorporated in the fuselage fuel cell probe, reduces errors caused by changes in the ratio between fuel density and dielectric constant. When the test switch is closed, voltage is reduced on the probe side of the bridge, and the indicator pointer is driven toward the empty end of the dial. Releasing the switch should restore bridge balance and return the indicator pointer to its original position, demonstrating that the system is operating normally. The selector switch and the transfer relay enable the pilot to check the remaining fuel in either wing or in the entire system. With the switch in the LEFT position, the relay substitutes capacitances equal to empty for both the fuselage cell and the right wing cells, leaving only the correct capacitance for the left wing. With the switch vertical, all fuel quantity in the system is registered. The float switch is located at a point in the fuselage cell to light the low level warning light when approximately 375 pounds of fuel remain in the fuselage cell. The warning light and the selector switch are powered from the DC bus: each is protected by a 5 ampere circuit breaker. The power unit receives its power from the inverters and is protected by a one ampere fuse.

1-39. TROUBLE SHOOTING FUEL QUANTITY INDICATING SYSTEM.

TROUBLE	PROBABLE CAUSE	REMEDY
NO RESPONSE TO TEST SWITCH OPERATION	Defective test switch, wiring, indicator, power unit, or tubes.	Replace defective part.
	Defective connector or shielded cable causing grounded amplifier input circuit.	Replace defective part.
	Loss of power.	Check fuse and inverter circuit; repair or replace as necessary.
INDICATOR OPERATIVE BUT POINTER WILL NOT LEAVE ZERO STOP.	Defective indicator, power unit, or transfer relay.	Replace defective part.
	Test switch circuit is shorted.	Repair or replace as necessary.
	Open in a probe lead.	Check probe lead continuity.
	Probes disconnected or poorly connected.	Check probe connections.
	Shorted compensator circuit.	Remove and check for foreign matter, deffective connectors, or defective leads.

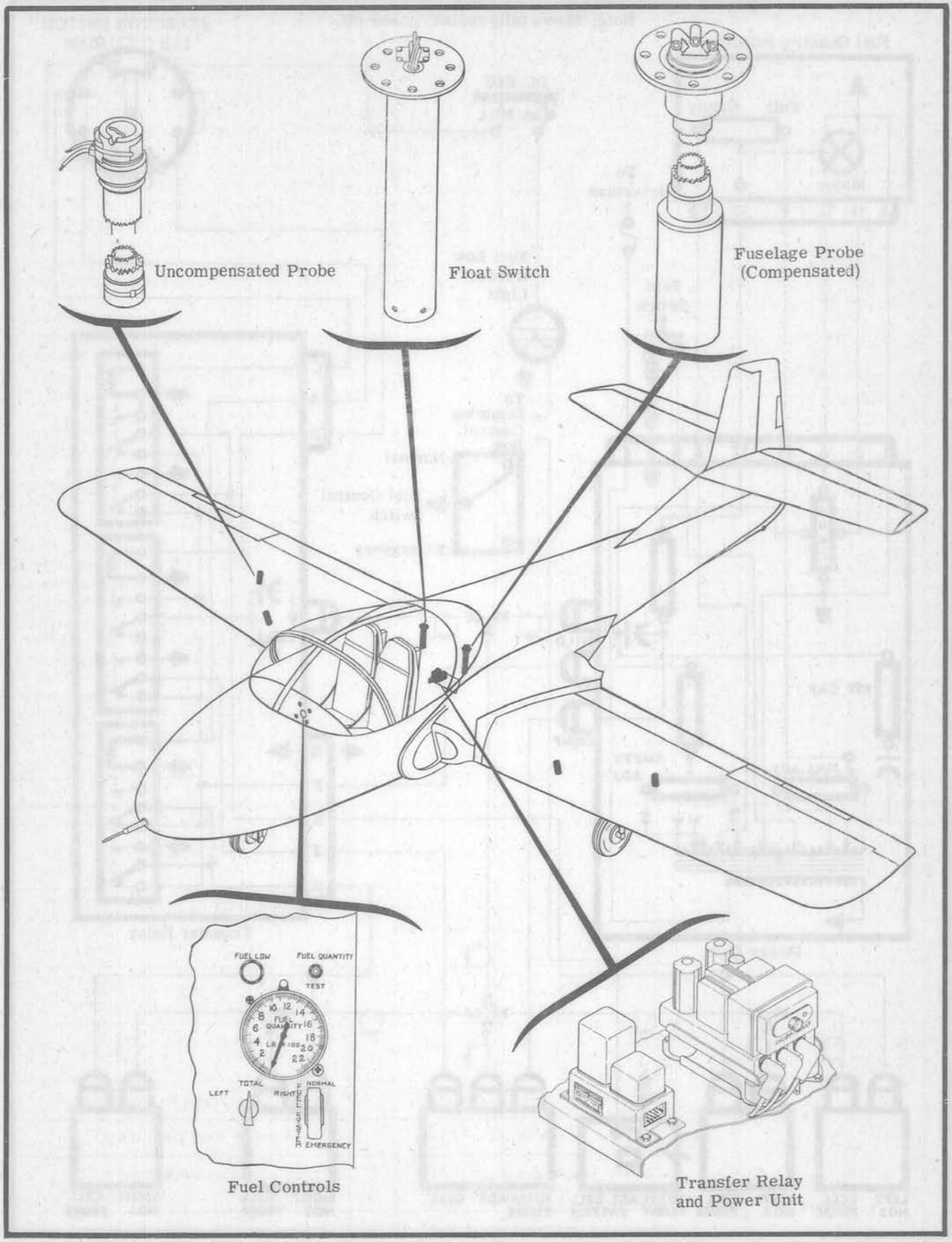


Figure 1-10. Fuel Quantity Indicating System Components

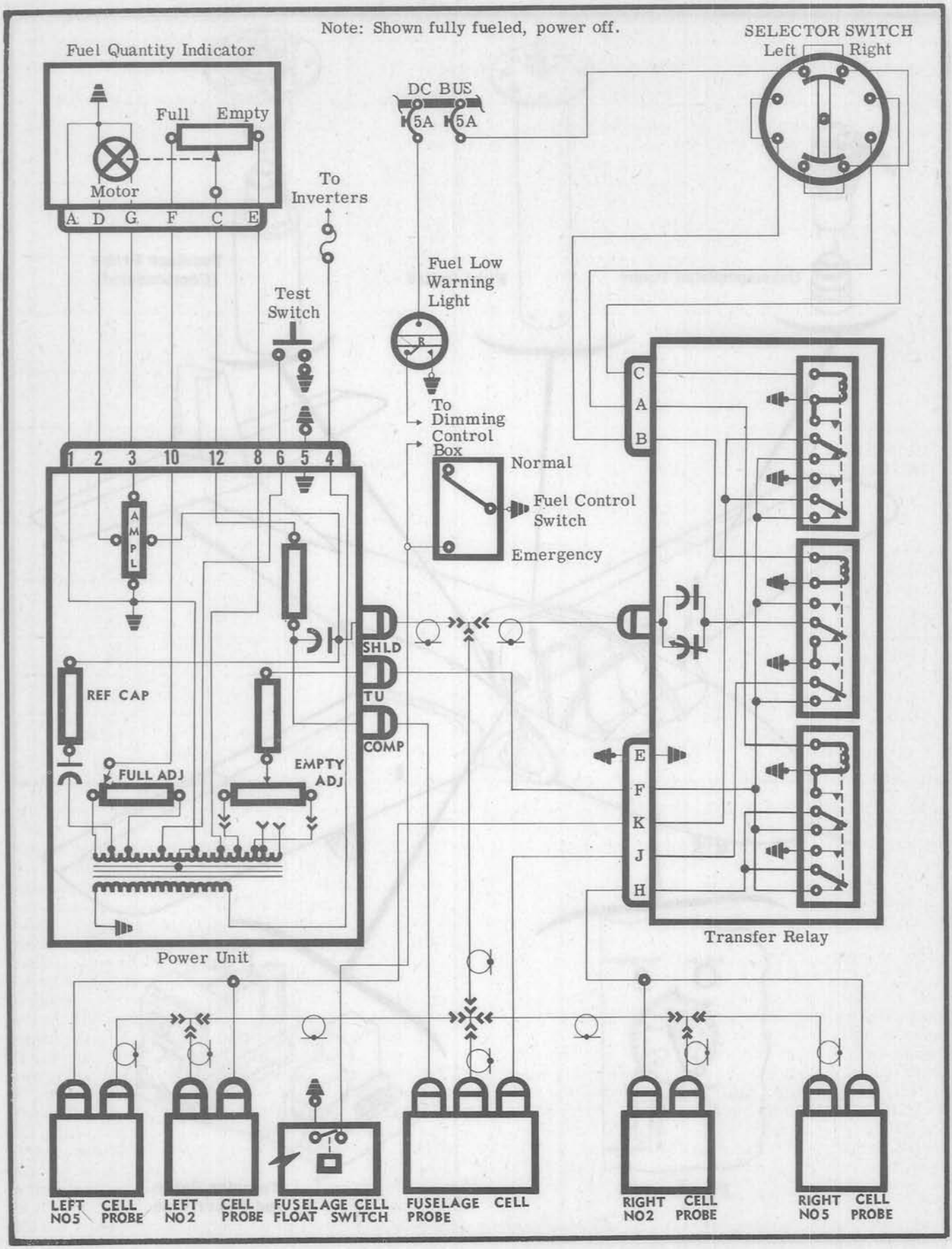


Figure 1-11. Fuel Quantity Indicating System Schematic

TROUBLE	PROBABLE CAUSE	REMEDY
POINTER SUDDENDLY DROPS TO ZERO.	Shielded cable heat-grounded in nacelle.	Replace grounded cable.
INDICATOR OPERATIVE BUT POINTER WILL NOT LEAVE FULL STOP.	Defective indicator, power unit, transfer relay, shielded cable, or probe.	Replace defective part.
	Water in housing of fuselage cell probe, in cells between probe electrodes, or in compensator.	Detach housing cover and dry housing; drain cell and dry probe or compensator.
	Power unit potentiometers out of adjustment.	Adjust power unit.
ERRATIC POINTER MOVEMENT.	Intermittent continuity or grounding of probe leads.	Check leads and connectors; replace as necessary.
	Defective indicator or power unit tubes.	Replace defective part.
INDICATION OBVIOUSLY INCORRECT.	Defective indicator, power unit, transfer relay, probe, compensator, connector, or connecting wires and cables.	Replace defective part.
	Water in cell between probe electrodes or in compensator.	Drain cell and dry probe or compensator.
	Power unit potentiometers out of adjustment.	Adjust power unit.
LOW LEVEL WARNING LIGHT LIGHTS WHEN POINTER INDICATES APPRECIABLY MORE THAN 375 POUNDS AND FUEL CONTROL SWITCH IS IN NORMAL POSITION.	Defective float switch.	Replace switch.
	Defective fuel proportioner.	Replace proportioner.
	Short in circuit between warning light and float switch.	Check circuit; repair, or replace wiring as necessary.

1-40. ADJUSTING FUEL QUANTITY INDICATING SYSTEM. The system is adjusted at the time of installation. Whenever any element in the circuit, except the wiring and the tubes in the power unit, is changed, or in case of malfunction, the system should be adjusted in accordance with instructions furnished with an acceptable variable capacitance tester.

1-41. ICE DETECTION SYSTEM.

1-42. DESCRIPTION. The ice detection system includes a detector, an interpreter, and a warning light. The detector is mounted on the left air inlet duct at 10 o'clock, looking forward. The interpreter is mounted to the outboard side of the left canted firewall. The red, press-to-test, warning light, mounted on the shock panel, is wired through the dimming control to the interpreter, and through a ten ampere circuit breaker to the DC bus. See paragraph 1-8 for removal and installation. The interpreter is wired to the same circuit breaker, and to the detector.

1-43. OPERATION. (See figure 1-12.) The use of a pressure differential for mechanical power allows a three-phase, cycling operation: neutral, sensing, and de-icing. In neutral, with the DC bus energized and the engine off, only the detector case heater will operate, keeping the temperature in the case between 12.8°C (55°F) and 23.9°C (75°F). When the detector probe is subjected to ram air of forty knots or more, a pressure differential is created which distends the detector diaphragm, actuating the diaphragm switch. This moves the system to the sensing phase by energizing the interpreter arming relay and directing current to the blade of the diaphragm switch. When the probe perforations become blocked with ice, the resulting attenuated pressure differential allows the diaphragm to relax, returning the diaphragm to its normal position. This moves the system to the de-icing phase by energizing the interpreter power relay which (a) lights the warning light, (b) energizes the thermal time delay, and (c) energizes the probe heater. In four to six seconds, the ice is melted from the probe, the pressure differential is restored, and the system reverts to the sensing phase. It will cycle between the sensing and de-icing phases until icing conditions abate. The thermal time delay is a safety which opens in 17-21 seconds, opening the arming relay and moving the system to its neutral phase. It is included to prevent probe heater damage when the left engine is shut down before the DC bus is de-energized, and to signal (by the length of time the warning light is lit) probe heater failure. The system is completely

automatic and nonadjustable. In case of malfunction, the defective component must be replaced.

1-44. REMOVAL OF DETECTOR. (See figure 1-13.)
a. Pull ENGINE ICE WARN circuit breaker.
b. Remove door 38.
c. Disconnect electrical plug, remove two bolts and washers, and lift detector from bracket, taking care to avoid damaging probe.

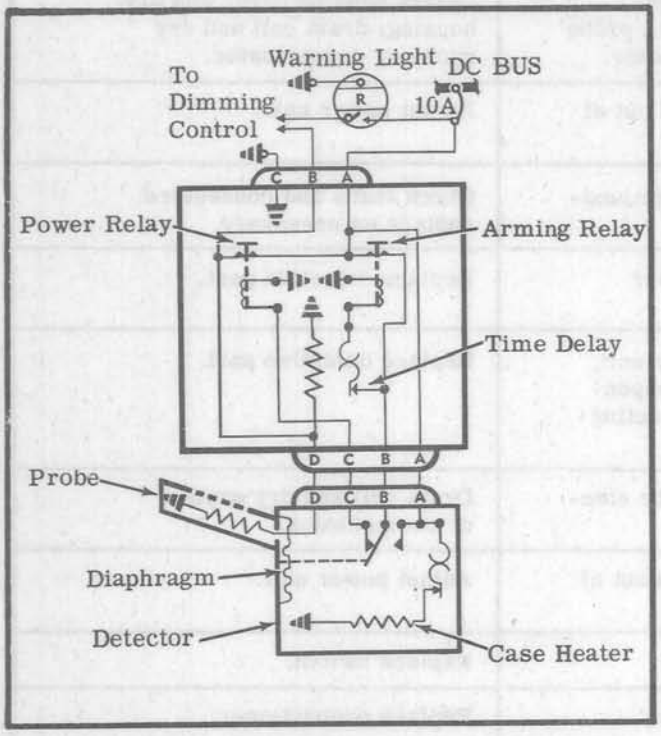
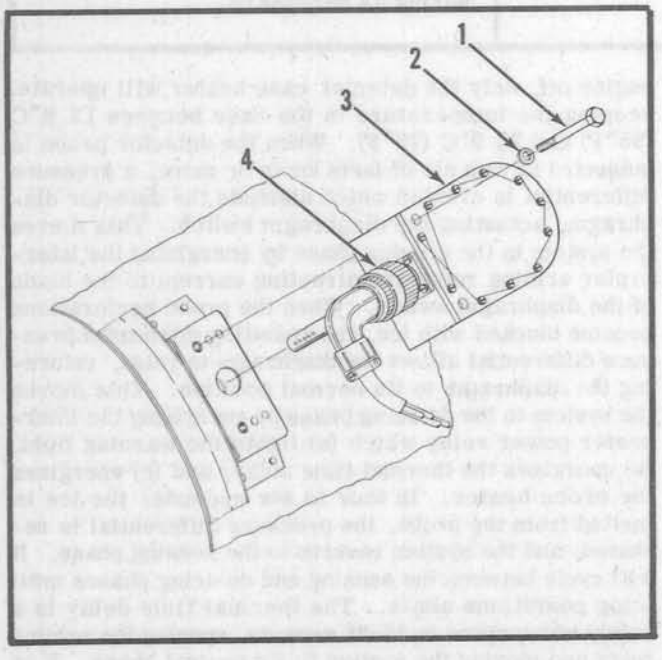


Figure 1-12. Ice Detection System Schematic



1. Bolt
2. Washer
3. Ice detector
4. Electrical plug

Figure 1-13. Ice Detector Installation

1-45. INSTALLATION OF DETECTOR. (See figure 1-13.)
a. Position detector so that probe points aft through the hole in the inlet duct, secure with two bolts and washers, and connect electrical plug.
b. Install door 38.
c. Push in ENGINE ICE WARN circuit breaker.

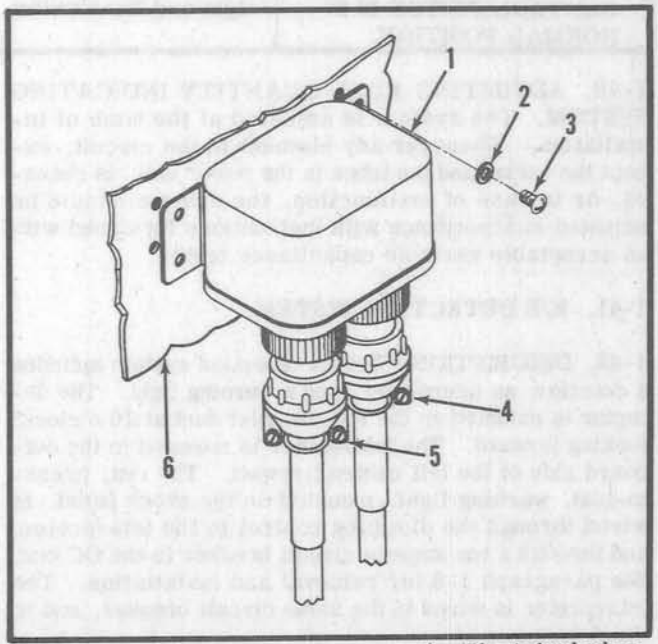
1-46. REMOVAL OF INTERPRETER. (See figure 1-14.)
a. Pull ENGINE ICE WARN circuit breaker.
b. Remove door 38.
c. Disconnect two electrical plugs, remove four screws and washers, and remove interpreter.

1-47. INSTALLATION OF INTERPRETER. (See figure 1-14.)
a. Attach interpreter to firewall with four screws and washers, and connect both electrical plugs.
b. Install door 38.
c. Push in ENGINE ICE WARN circuit breaker.

1-48. TACHOMETER SYSTEM.

1-49. DESCRIPTION. There are two identical tachometer systems, one for each engine. Each complete system comprises a tachometer indicator, disconnect, tachometer generator, necessary wiring, and supports. The two tachometer indicators are mounted beneath the fuel shutoff controls on the right center of the shock panel. See paragraphs 1-6 and 1-7 for removal and installation. The two tachometer generators are installed, one on the accessory gear case of each engine.

1-50. OPERATION. Operation of an engine rotates a three phase AC generator providing power to operate a tachometer, which is a synchronous motor operating a magnetic drag element coupled with two pointers. The pointers indicate the speed of the synchronous motor and



1. Interpreter
2. Washer
3. Screw
4. Electrical plug
5. Electrical plug
6. Firewall

Figure 1-14. Ice Interpreter Installation

therefore the speed of the engine in percent of maximum allowable RPM, 100% being 22,700 RPM. The larger dial is graduated in 2% increments from 0 to 100%; the smaller dial is graduated in 1% increments from 0 to 10%. Using the smaller dial for the last 10%, the maximum reading from the indicator is 110% or 24,970 RPM. No adjustment is to be attempted. In case of malfunction, replace the defective part.

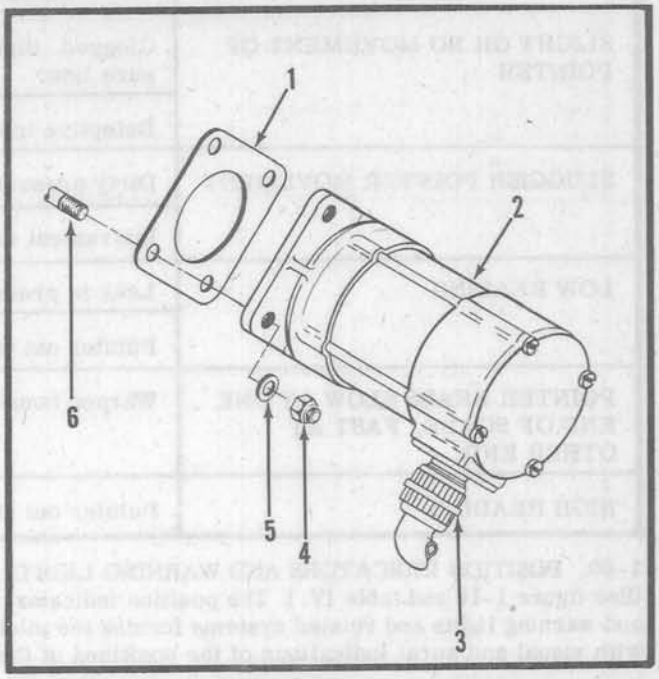
1-51. REMOVAL OF TACHOMETER GENERATOR. (See figure 1-15.)

a. Remove door 37.
b. Disconnect electrical plug.
c. Remove nuts, washers, tachometer generator, and gasket from mounting pad on accessory gear case.

1-52. INSTALLATION OF TACHOMETER GENERATOR. (See figure 1-15.)

a. Position gasket and tachometer generator on mounting pad studs and secure with washers and nuts.
b. Connect electrical plug.
c. Install door 37.

1-53. AMMETERS. Two ammeters, mounted on the lower right of the shock panel, are used with two 50 millivolt shunts for indicating the fraction of load being drawn from the generators. The ammeter is a millivoltmeter which measures the voltage drop across a shunt connected in series with a generator. Since the current through the shunt is proportional to the generator load, the dial is graduated in percentage of load from -0.10 to +1.25. See paragraphs 1-4 and 1-5 for removal and installation. No adjustments are to be attempted. If either instrument is defective, it must be replaced.



1. Gasket
2. Tachometer generator
3. Electrical plug
4. Nut
5. Washer
6. Stud

Figure 1-15. Tachometer Generator Installation

1-54. TROUBLE SHOOTING AMMETER.

TROUBLE	PROBABLE CAUSE	REMEDY
NO READING	External open circuit.	Test and repair break.
	Internal open circuit.	Replace instrument.
	Faulty mechanism.	Replace instrument.
READS HIGH OR LOW	Short or maladjusted.	Replace instrument.
IRREGULAR OR JERKY ACTION	Loose external connection.	Test terminals and wiring and tighten where necessary.

1-55. ACCUMULATOR PRESSURE GAGE. A pressure gage, mounted on the top of the rear spar carry thru, indicates the existing air pressure in the hydraulic accumulator of the hydraulic system. The accumulator gage and the hydraulic pressure gage are identical. See T.O. No. 1T-37A-2-3.

1-56. EMERGENCY AIR PRESSURE GAGE. A pressure gage, located in the right nose compartment, indicates the air pressure in a 2000 PSI air bottle used in the landing gear emergency extension system. The emergency air pressure gage and the hydraulic pressure gage are identical. See T.O. No. 1T-37A-2-3.

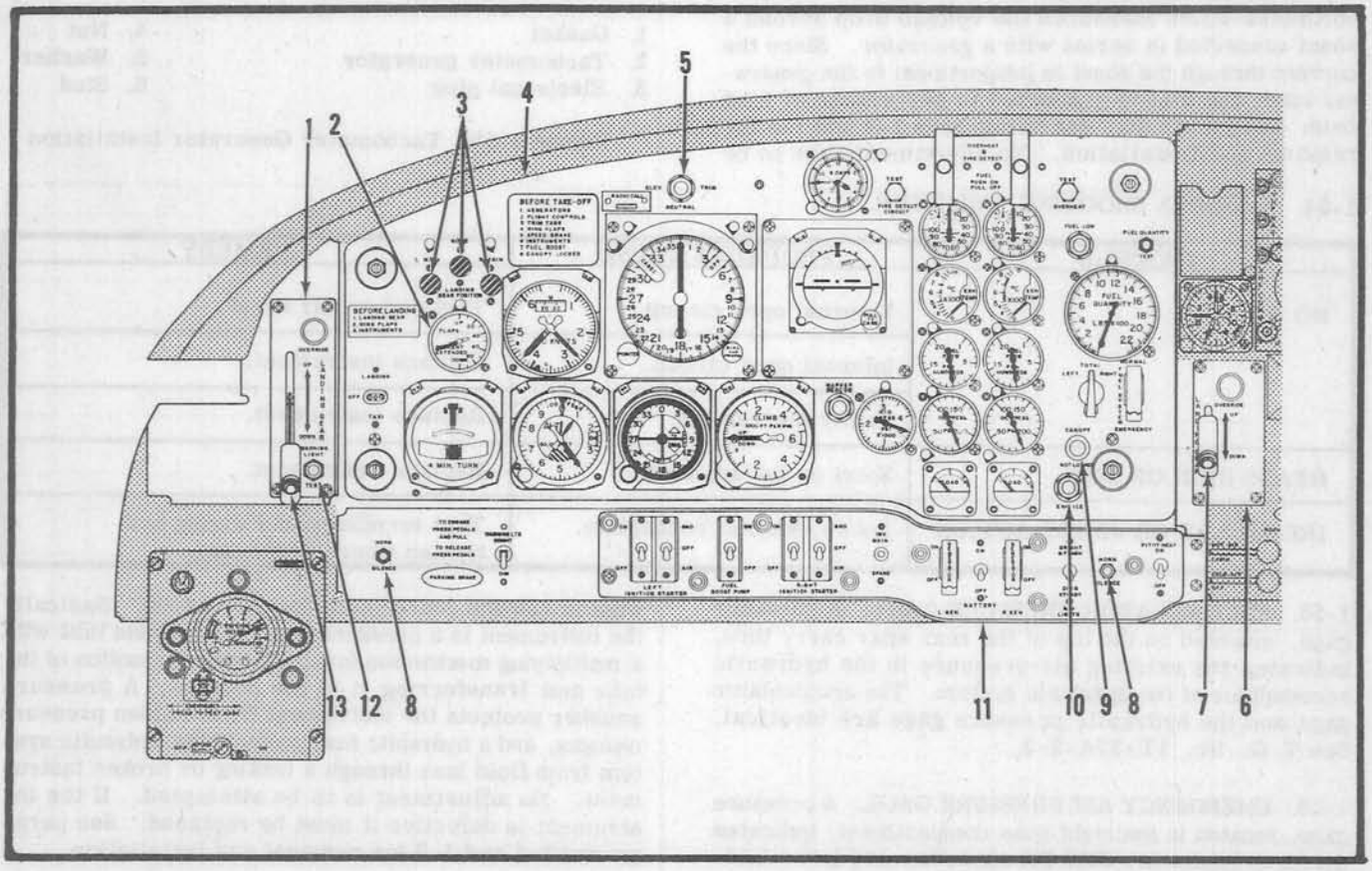
1-57. HYDRAULIC PRESSURE GAGE. A direct reading pressure gage, mounted on the center of the shock panel, indicates the pressure in the hydraulic system. The gage includes a single pointer and a dial graduated clockwise in 100 PSI increments from 0 to 4000. Basically the instrument is a pressure sensitive bourdon tube with a multiplying mechanism for amplifying the motion of the tube and transferring it to the pointer. A pressure snubber protects the instrument from sudden pressure changes, and a hydraulic fuse protects the hydraulic system from fluid loss through a leaking or broken instrument. No adjustment is to be attempted. If the instrument is defective it must be replaced. See paragraphs 1-6 and 1-7 for removal and installation.

1-58. OIL PRESSURE GAGES. Two pressure gages, mounted on the lower right of the shock panel, indicate the oil pressure in the two engines. Each gage is mechanically identical with the hydraulic pressure gage except for the dial which is graduated in 10 PSI increments from 0 to 200. See paragraphs 1-6 and 1-7 for removal and installation.

1-59. TROUBLE SHOOTING PRESSURE GAGES.

TROUBLE	PROBABLE CAUSE	REMEDY
SLIGHT OR NO MOVEMENT OF POINTER	Clogged, dirty, or broken pressure line.	Check and clean line.
	Defective instrument.	Replace instrument.
SLUGGISH POINTER MOVEMENT	Dirty pressure line.	Check and clean line.
	Instrument case leak.	Replace instrument.
LOW READING	Leak in pressure line.	Check line.
	Pointer out of adjustment.	Replace instrument.
POINTER READS SLOW AT ONE END OF SCALE, FAST AT OTHER END	Warped bourdon tube.	Replace instrument.
HIGH READING	Pointer out of adjustment.	Replace instrument.

1-60. POSITION INDICATORS AND WARNING LIGHTS. (See figure 1-16 and table IV.) The position indicators and warning lights and related systems furnish the pilot with visual and aural indications of the positions of the flaps and landing gear, and visual indications when the elevator trim tab is neutral, and when the canopy is not locked. All indicators are mounted on the shock panel except parts of the landing gear indicating system.



1. Landing gear control
2. Flap position indicator
3. Gear position indicators
4. Left shock panel
5. Elevator tab neutral light
6. Landing gear control warning light
7. Gear warning light
8. Audible warning silencing switch
9. Canopy not locked
10. Ice detector warning light
11. Switch panel
12. Warning light test switch
13. Gear warning light

Figure 1-16. Position Indicators and Warning Lights

Table IV. Position Indicators and Warning Lights

INSTRUMENT	TYPE	OPERATING SOURCE
Canopy Not Locked Warning Light	AN3157-6	28 volt DC
Elevator Trim Tab Neutral Light	AN3157-3	28 volt DC
Flap Position Indicator	MS28023-1	28 volt DC
Landing Gear Position Indicators	AN5839-1	28 volt DC

1-61. CANOPY NOT LOCKED WARNING LIGHT. A red, non-dimable, press-to-test light, mounted on the left shock panel, is lit whenever either side of the canopy is unlocked. Powered by the DC bus, the circuit is protected by a 5 ampere circuit breaker. See paragraph 1-8 for removal and installation.

1-62. ELEVATOR TRIM TAB NEUTRAL LIGHT. A green, dimable, press-to-test light, mounted on the shock panel, is lit whenever the elevator trim tab is in neutral position. It is powered by the 28 volt DC bus and protected by the same 5 ampere circuit breaker protecting the elevator and aileron trim tab curcuits. See paragraph 1-8 for removal and installation.

1-63. FLAP POSITION INDICATING SYSTEM.

1-64. DESCRIPTION. The flap position indicating system comprises a flap position indicator, a flap position transmitter, and necessary wiring. The indicator is mounted on the left center of the shock panel. See paragraphs 1-6 and 1-7 for removal and installation. The transmitter is mounted to a bracket at the bottom of the rear spar carry through. See paragraphs 1-67 and 1-68 for removal and installation.

1-65. OPERATION. The transmitter shaft, connected to the flaps through the flap synchronizing valve, rotates with flap movement. This rotation is electrically transmitted to the flap position indicator which visually indicates flap movement and position. The indicator dial is graduated in 10% increments with a range of 0 (UP) to 100 (DOWN), 100 being a 40° deflection downward from the wing configuration line. When the system is de-energized, the pointer is pulled off the graduated portion of the dial by a magnet in the instrument case. Powered by the DC bus, the system is protected by a 5 ampere circuit breaker.

1-66. TROUBLE SHOOTING FLAP POSITION INDICATING SYSTEM.

TROUBLE	PROBABLE CAUSE	REMEDY
NO READING, OR ERRATIC READINGS	Defective wires or connections.	Tighten or replace as necessary.
	Incorrect voltage.	Supply rated voltage.
	Defective instrument or transmitter.	Replace defective part.
OFF CALIBRATION	Incorrect voltage.	Supply rated voltage.
	Incorrect connection of transmitter to teleflex cable.	Adjust connection in accordance with paragraph 1-69.
	Defective instrument or transmitter.	Replace defective part.

1-67. REMOVAL OF FLAP POSITION TRANSMITTER. (See figure 1-17.)

a. With flaps up and power off, remove door 7.

b. Loosen nuts and screws securing lever and actuating arm to transmitter shaft; remove actuating arm.

c. Disconnect transmitter electrical plug.

d. Support transmitter, remove attaching screws, and carefully pull shaft from lever and bracket.

1-68. INSTALLATION OF FLAP POSITION TRANSMITTER. (See figure 1-17.)

a. Carefully insert transmitter shaft through holes in bracket and lever. Align mounting holes of transmitter and bracket, and attach with screws.

b. Connect transmitter electrical plug.

c. Adjust system in accordance with paragraph 1-69.

1-69. ADJUSTING FLAP POSITION TRANSMITTER.

a. Position flaps UP, cut-off electrical power, and remove door 7.

b. Loosen nuts and screws securing lever and actuating arm to transmitter shaft.

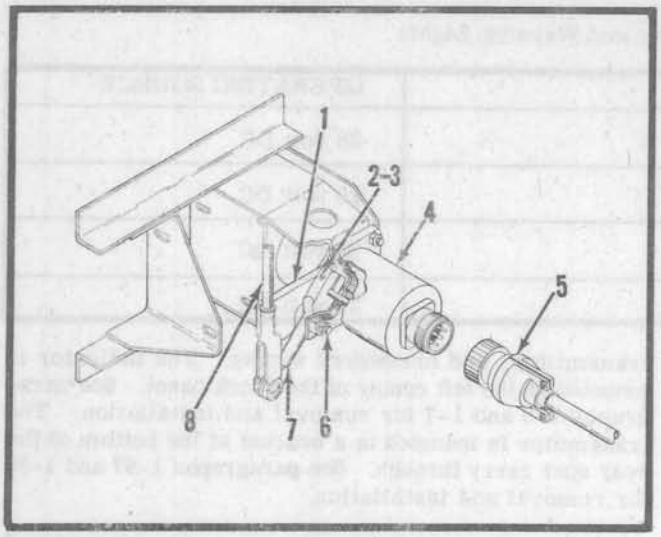
c. Turn on battery; rotate shaft until indicator pointer is at UP; tighten screw and nut securing lever to shaft.

d. Position flaps DOWN. If indicator does not indicate DOWN, adjust shaft to split the difference.

e. Extend flaps 28° ±3° (measure with a clinometer); position actuating arm to actuate spoiler switch, and tighten screw and nut securing arm to shaft.

f. Cycle flaps several times, to make sure that spoilers extend when flaps reach 28° ±3° extension, and that indicator is correctly calibrated.

g. Install door 7 and turn off battery.



1. Actuating arm
2. Nut
3. Screw
4. Transmitter
5. Electrical plug
6. Screw
7. Lever
8. Cable

Figure 1-17. Flap Position Transmitter

1-70. LANDING GEAR POSITION AND WARNING SYSTEM.

1-71. DESCRIPTION. The landing gear position and warning system includes three position indicators, two warning lights, a warning light test switch, a warning signal, a silencing relay, a warning relay, two silencing switches, and seven limit switches. The position indicators are mounted on the upper left corner of the left shock panel (See paragraphs 1-4 and 1-5 for removal and installation). The warning lights are in the gear control handles, and are removed by unscrewing their retaining plugs. The warning light test switch is on the student's gear control. The warning signal and the silencing relay are mounted with screws below the J-15A junction box in the right nose compartment (see figure 2-6). The warning relay is mounted with screws on the terminal block support shelf behind the right shock panel. The silencing switches are mounted on the switch panel (See paragraph 1-8 for removal and installation). One limit switch is located in the outer power quadrant; the others are on or around the landing gear. For further information on the gear limit switches, see T.O. No. 1T-37A-2-3.

1-72. OPERATION. The landing gear position and warning system provides a visual indication of gear position, a visual warning if any gear is not locked in the position indicated by control handle position, and a visual and aural warning if any gear is not down and locked when any throttle is retarded to or past 65% RPM. When the DC bus is energized a wheel symbol appears in the window of each position indicator whose gear is down and locked; the word "UP" appears for any gear that is up and locked; and diagonal stripes appear for any gear in an intermediate position or when the DC bus is not energized. When any landing gear is not locked in the position indicated by control handle position, the warning lights will glow red. When either throttle is set between idle and 65% RPM and any gear is not down and locked, the warning lights will glow red and the warning signal will send a raucous audio tone to the headset terminals. Pressing either silencing switch will actuate the silencing relay to silence the warning signal; however, when neither throttle is between idle and 65% RPM, the silencing relay will be de-energized, allowing the signal to sound again when the necessary conditions exist. The warning lights may be checked with the test switch on the student's gear control. The system receives its power through the DC bus, and is protected by two five-ampere circuit breakers. No maintenance is to be attempted; malfunctioning parts will be replaced.

1-73. NAVIGATION AND MISCELLANEOUS INSTRUMENTS. (See figure 1-19 and table V.)

Table V. Navigation and Miscellaneous Instruments

INSTRUMENT	TYPE	OPERATING SOURCE
Clock	A-13A	Self-contained.
Compass	AN5766-T4	Self-contained
Course Indicator	ARC16706	28 volt DC
Marker Beacon Light	AN3157-4	28 volt DC
Oxygen Regulator	D-2	Oxygen system

1-74. COMPASS. A compass, mounted on the windshield center channel above the center of the instrument panel assembly, is a short period magnetic compass intended to indicate continuously the airplane's heading with reference to the earth's magnetic field. It is equipped with an instrument light and a compensating system. See paragraphs 1-4 and 1-5 for removal and installation. A compass correction card is carried in a bracket on the left of the stationary panel. No adjustments should be attempted except those included in paragraph 1-75.

1-75. COMPENSATION OF COMPASS.

Note

Remove all equipment that could affect compass readings except standard equipment normally carried on flights.

a. Align the airplane with magnetic north and level it in accordance with T.O. No. 1T-37A-2-2.
b. Start both engines.

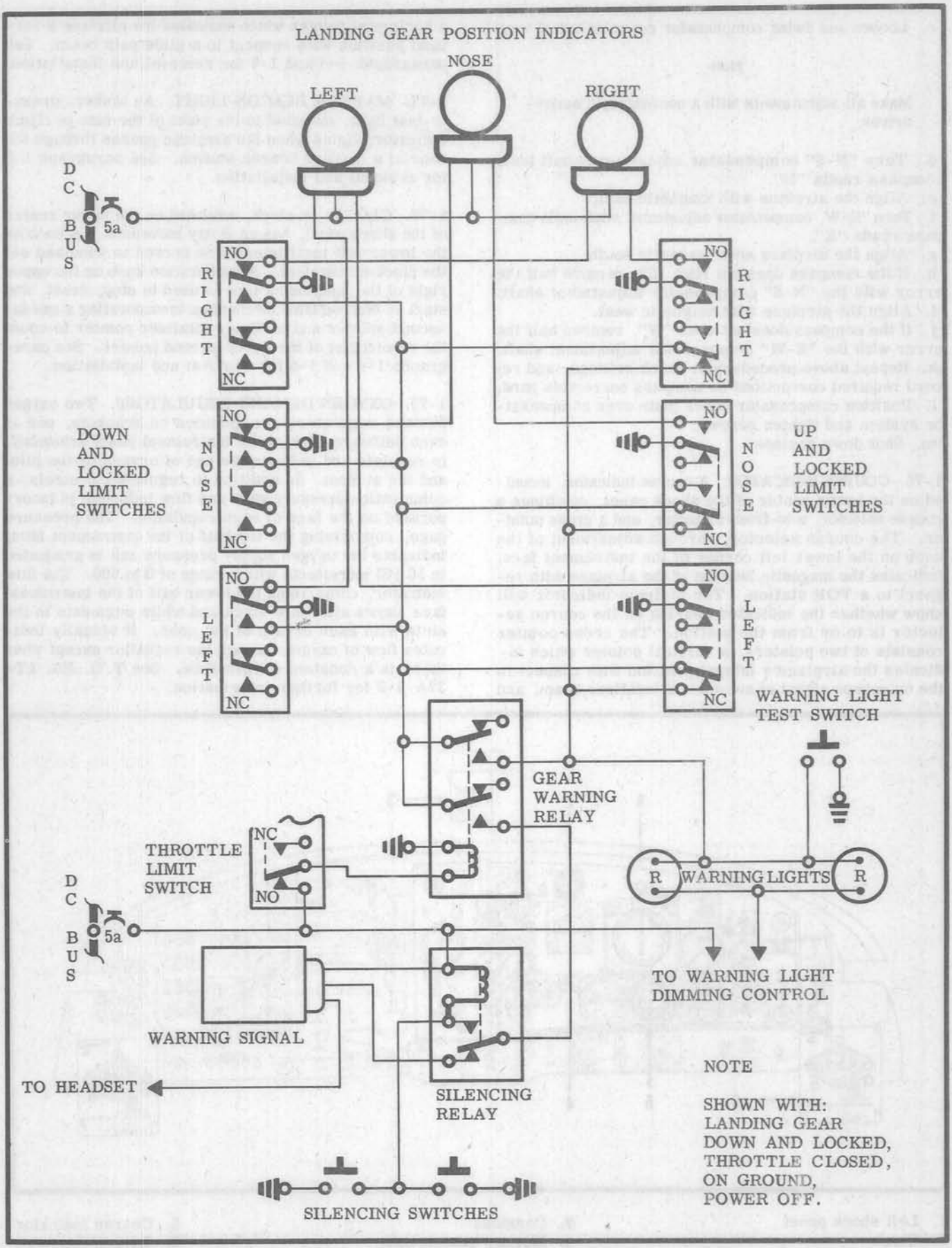


Figure 1-18. Landing Gear Position and Warning System Schematic

c. Loosen and swing compensator cover up out of way.

Note

Make all adjustments with a nonmagnetic screwdriver.

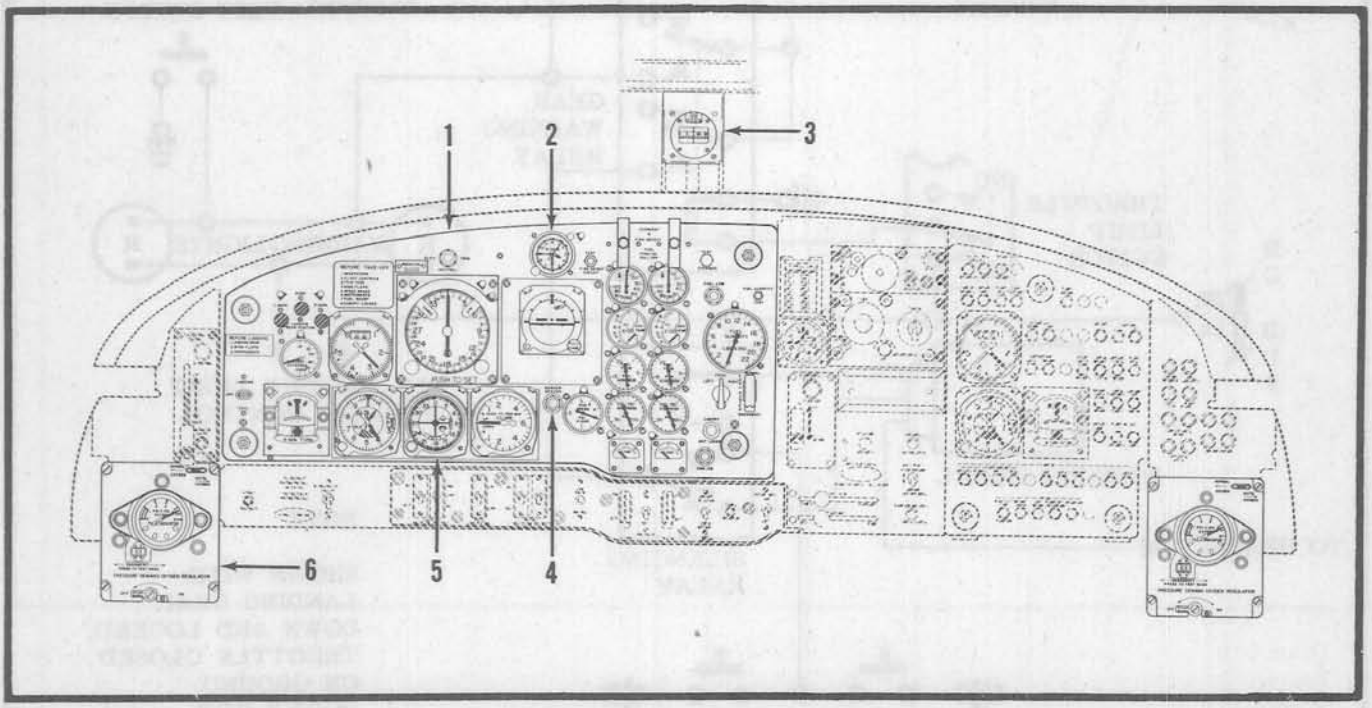
d. Turn "N-S" compensator adjustment shaft until compass reads "N".
e. Align the airplane with magnetic east.
f. Turn "E-W" compensator adjustment shaft until compass reads "E".
g. Align the airplane with magnetic south.
h. If the compass does not read "S", remove half the error with the "N-S" compensator adjustment shaft.
i. Align the airplane with magnetic west.
j. If the compass does not read "W", remove half the error with the "E-W" compensator adjustment shaft.
k. Repeat above procedure to check settings, and record required corrections on compass correction card.
l. Position compensator cover plate over compensator system and tighten screws.
m. Shut down engines.

1-76. COURSE INDICATOR. A course indicator, mounted on the lower center of the shock panel, combines a course selector, a to-from indicator, and a cross pointer. The course selector, through adjustment of the knob on the lower left corner of the instrument face, indicates the magnetic bearing of the airplane with respect to a VOR station. The to-from indicator will show whether the indicated bearing on the course selector is to or from the station. The cross pointer consists of two pointers: a vertical pointer which indicates the airplane's lateral position with respect to the on course signal of an omni or localizer beam, and a horizontal pointer which indicates the airplane's vertical position with respect to a glide path beam. See paragraphs 1-4 and 1-5 for removal and installation.

1-77. MARKER BEACON LIGHT. An amber, press-to-test light, mounted to the right of the rate of climb indicator, lights when the airplane passes through the cone of a marker beacon station. See paragraph 1-8 for removal and installation.

1-78. CLOCK. A clock, mounted on the upper center of the shock panel, has an 8-day movement. A knob on the lower left instrument face serves to wind and set the clock mechanism. A push-button knob on the upper right of the instrument face is used to stop, reset, and start an elapsed time mechanism incorporating a sweep-second pointer and a minute totalizer pointer to count the revolutions of the sweep-second pointer. See paragraphs 1-4 and 1-5 for removal and installation.

1-79. OXYGEN DEMAND REGULATORS. Two oxygen demand regulators are mounted on brackets, one at each outboard edge of the instrument panel assembly, to regulate and indicate the use of oxygen by the pilot and the student. In addition to regulating controls, a combination pressure gage and flow indicator is incorporated on the face of each regulator. The pressure gage, comprising the top half of the instrument face, indicates the oxygen supply pressure and is graduated in 50 PSI increments with a range of 0 to 500. The flow indicator, comprising the lower half of the instrument face shows alternate black and white segments in the slots with each breath of the user. It visually indicates flow of oxygen through the regualtor except when there is a constant oxygen flow. See T. O. No. 1T-37A-2-3 for further information.



1. Left shock panel
2. Clock
3. Compass
4. Marker beacon light
5. Course indicator
6. Oxygen regulator

Figure 1-19. Navigation and Miscellaneous Instruments

1-80. PITOT STATIC SYSTEM. (See figure 1-20.)

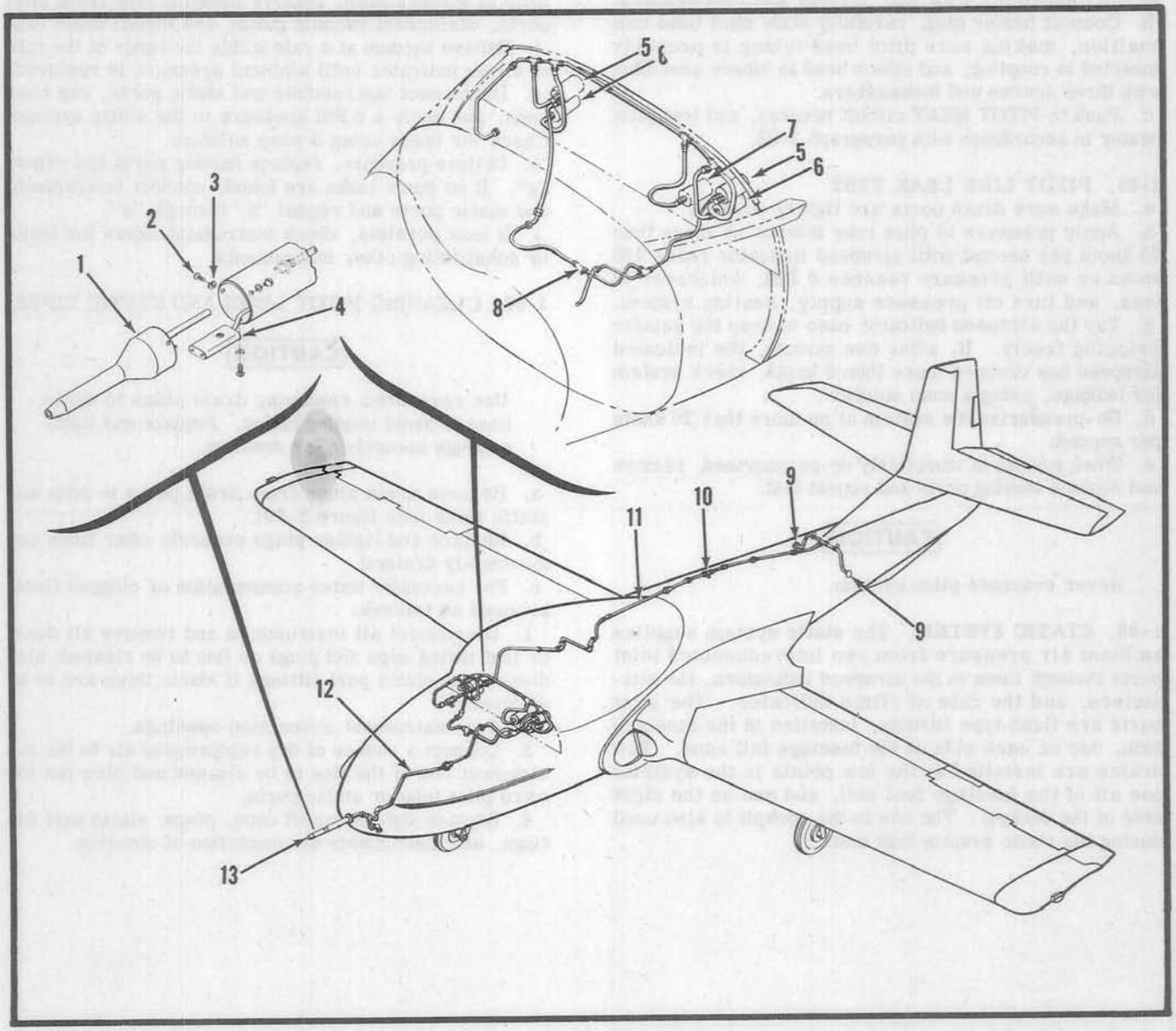
1-81. PITOT SYSTEM. The pitot system supplies ram air pressure from a pitot tube through lines to the airspeed indicator. The pitot tube which contains an electrical heating element is installed between the passing and taxi lights in the nose of the airplane. The heating element is provided to prevent or remove accumulation of ice which could result in inaccurate airspeed indication. It is powered by the DC bus, controlled by an on-off toggle switch mounted on the switch panel, and protected by a 5 ampere circuit breaker. Two drains are installed at the low points in the system: one in the forward end of the nose wheel well; the other on the gear control support assembly.

1-82. CHECKING PITOT TUBE HEATING ELEMENT.

a. Position PITOT HEAT switch ON.
b. Allow two minutes for heater to warm up.
c. Check pitot tube with hand for heat.
d. If pitot tube is not warm, check power source, circuit breaker, circuit, switch, and pitot heater for malfunction. Replace any defective part.
e. Position PITOT HEAT switch OFF.

CAUTION

Make sure pitot tube is covered and heater switch is OFF when the airplane is on the ground except during pitot heater, pitot line, or airspeed indicator checks.



1. Pitot head
2. Screw
3. Washer
4. Heat plug
5. Airspeed
6. Altimeter
7. Rate of climb indicator
8. Pilot drain port
9. Static inlet port
10. Static drain port
11. Static line
12. Pitot line
13. Pitot tube plug

Figure 1-20. Pitot Static System

1-83. REMOVAL OF PITOT HEAD. (See figure 1-20.)

a. Turn PITOT HEAT switch OFF and pull the PITOT HEAT circuit breaker.

b. Remove three screws and lockwashers to release head from pitot sleeve assembly.

c. Slide pitot tube forward, disconnect pitot heater plug and remove pitot head.

d. Remove four screws and lockwashers to disconnect sleeve assembly from support assembly; remove, and cap pitot tube opening.

1-84. INSTALLATION OF PITOT HEAD. (See figure 1-20.)

a. Uncap pitot tube opening, slip sleeve assembly around tube opening and electrical wiring, and secure to support assembly with four screws and lockwashers.

b. Connect heater plug, carefully slide pitot head into position, making sure pitot head tubing is properly inserted in coupling, and attach head to sleeve assembly with three screws and lockwashers.

c. Push in PITOT HEAT circuit breaker, and test pitot heater in accordance with paragraph 1-82.

1-85. PITOT LINE LEAK TEST

a. Make sure drain ports are tightly covered.

b. Apply pressure to pitot tube inlet at no more than 20 knots per second until airspeed indicator reads 450 knots or until pressure reaches 6 PSI, whichever is less, and turn off pressure supply, sealing system.

c. Tap the airspeed indicator case to keep the pointer swinging freely. If, after one minute, the indicated airspeed has dropped more than 5 knots, check system for leakage, using a soap solution.

d. De-pressurize the system at no more than 20 knots per second.

e. When system is completely de-pressurized, remove and replace leaking parts and repeat test.

CAUTION

Never evacuate pitot system.

1-86. STATIC SYSTEM. The static system supplies ambient air pressure from two interconnected inlet ports through lines to the airspeed indicators, the altimeters, and the rate of climb indicator. The inlet ports are flush type fittings, installed in the fuselage skin, one on each side of the fuselage tail cone. Two drains are installed at the low points in the system: one aft of the fuselage fuel cell, and one on the right side of the cockpit. The one in the cockpit is also used during the static system leak test.

1-87. STATIC SYSTEM LEAK TEST.

a. Seal inlet ports with masking tape.

b. Remove drain cap from cockpit drain and connect vacuum pump to the drain fitting.

c. Set either altimeter at zero altitude.

d. Evacuate air from the static system at a rate within the range of the rate of climb indicator until the altimeter reads 10, 000 feet or until vacuum equals 11 inches of mercury, whichever is less, and turn-off vacuum pump, sealing system.

e. Tap altimeter case to keep pointers swinging freely. If, after one minute, the indicated altitude has dropped more than 3000 feet, tighten all connections and repeat. If the indicated altitude again drops more than 3000 feet in one minute, procede to "f". If indicated altitude drop is within limits, remove masking tape from inlet ports, disconnect vacuum pump, and install drain cap.

f. Relieve vacuum at a rate within the range of the rate of climb indicator until ambient pressure is restored.

g. Disconnect instruments and static ports, cap hose ends, and apply a 6 PSI pressure to the static system. Check for leaks using a soap solution.

h. Relieve pressure, replace leaking parts and repeat "g". If no more leaks are found, connect instruments and static ports and repeat "a" through "e".

i. If leak persists, check instrument cases for leaks by substituting other instruments.

1-88. CLEANING PITOT LINES AND STATIC LINES.

CAUTION

Use care when removing drain plugs to drain lines to avoid bending tubing. Replace and tighten plugs securely after draining.

a. Remove drain plugs from drain ports in pitot and static lines (see figure 1-20).

b. Replace and tighten plugs securely after lines are thoroughly drained.

c. For excessive water accumulation or clogged lines, proceed as follows:

1. Disconnect all instruments and remove all drain or test fitting caps and plugs on line to be cleaned; also disconnect static port fittings if static lines are to be cleaned.

2. Cap instrument connection openings.

3. Connect a source of dry compressed air to the instrument end of the line to be cleaned and blow out toward pitot tube or static ports.

4. Replace and reconnect caps, plugs, static port fittings, and instruments at completion of cleaning.

SECTION II

RADIO, COMMUNICATIONS AND NAVIGATION EQUIPMENT

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2-1. RADIO SYSTEMS. There are five radio systems in this airplane: the UHF communication system (ARC type 12); the VHF communication system (ARC type 12); the VHF navigation system (ARC type 15D); the marker beacon system (ARC type R20); and the interphone system (ARC type F14). Two indicators, the course indicator and the marker beacon light, are on the left shock-panel. All controls are on the stationary panel except the microphone switches which are on the right throttles. All equipment is in the right nose compartment except the antennas. All the systems are powered from the DC bus and protected by two 15-ampere circuit breakers, with a five-ampere circuit breaker for the lights on the C58 and the C1254 control units.

2-2. TROUBLE SHOOTING RADIO SYSTEMS.

TROUBLE	PROBABLE CAUSE	REMEDY
NO RECEPTION	No power.	Check power supply.
	Volume control not turned on.	Turn on volume control.
	Headset disconnected.	Plug in headset.
	Loose or disconnected wiring.	Repair or replace.
	Defective receiver, control unit, transverter, transmitter, headset, or other component.	Replace defective component.
FAINT OR FADING SIGNAL	Volume control defective or not advanced.	Turn up volume or replace control unit or volume switch.
	Receiver inaccurately tuned.	See paragraph 2-9.
	Loose or disconnected wiring.	Repair or replace.
	Low voltage.	Recharge or replace battery, or adjust voltage regulator in accordance with T.O. No. 1T-37A-2-7.

TROUBLE	PROBABLE CAUSE	REMEDY
FAINT OR FADING SIGNAL (CONT)	Station too far away.	Tune to nearer station.
	Loose or disconnected antenna.	Tighten or reconnect.
	Defective D10A dynamotor, receiver, or headset.	Replace defective component.
DISTORTED SIGNAL	Outside electrical interference.	Tune to another station.
	Loose or disconnected antenna.	Tighten or reconnect.
	Receiver inaccurately tuned.	See paragraph 2-9.
NO AUDIBLE SIDETONE	No power.	Check power supply.
	Volume control not turned on.	Turn on volume control.
	Defective transmitter or D10A dynamotor.	Replace defective component.
WEAK SIDETONE	Low voltage.	Recharge or replace battery, or adjust voltage regulator in accordance with T.O. No. 1T-37A-2-7.
	Loose or disconnected wiring.	Repair or replace.
	Defective transmitter or D10A dynamotor.	Replace defective component.
NO TRANSMISSION	No power.	Check power supply.
	Volume control not turned on.	Turn on volume control.
	No crystal in position corresponding to TRANS switch setting.	Set TRANS switch at valid position.
	Disconnected antenna or antenna relay.	Connect antenna to antenna relay.
	Headset disconnected.	Plug in headset.
	Defective transmitter, transverter control unit, microphone switch, interphone switch, headset, K16 relay, D10A dynamotor, F14 relay, wiring or connection.	Replace defective component or part.
INTERPHONE INOPERATIVE.	Headset disconnected.	Connect headset.
	Defective interphone switch, microphone switch, audio level switch, volume switch, K16 relay, F14 relay, receiver, headset, wiring, or connection.	Replace defective component or part.

2-3. UHF COMMUNICATION SYSTEM.

2-4. DESCRIPTION. Exclusively UHF equipment includes two TV10 transverters, a K18 transverter-antenna relay, and an A16 antenna. Equipment used in both the UHF and VHF systems includes a C58 control unit, a K13 oscillator relay, an R19 receiver and a J15A junction box.

2-5. OPERATION. The UHF communication system provides crystal controlled, AM, voice transmission, and continuously tunable reception in the UHF band of 228-258 MC. The system is operated through the C58 control unit on the stationary panel. No adjustment or maintenance of this system should be attemped except that which is included in this handbook.

2-6. C58 COMMUNICATION CONTROL UNIT. The C58 control unit controls both UHF and VHF communication through its remote operation of both TV10 trans-

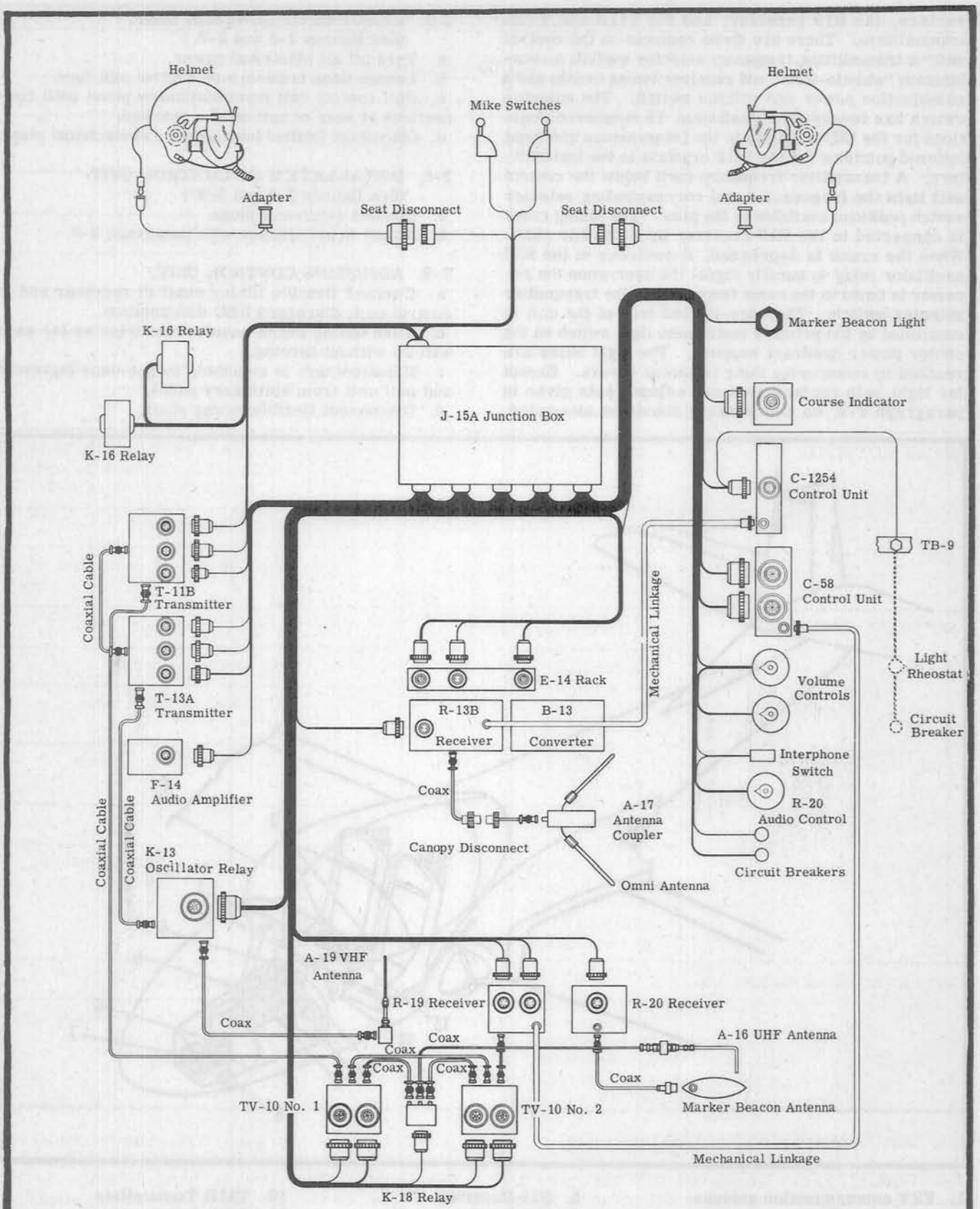


Figure 2-1. Radio Cabling Diagram

verters, the R19 receiver, and the T11B and T13A transmitters. There are three controls on the control unit: a transmitting frequency selector switch; a combination "whistle-thru" and receiver tuning crank; and a combination power and volume switch. The selector switch has twenty-four positions: 16 numbered positions for the UHF crystals in the transverters and eight lettered positions for the VHF crystals in the transmitters. A transmitter frequency card below the control unit lists the frequencies and corresponding selector switch positions available to the pilot. The tuning crank is connected to the R19 receiver by a flexible shaft. When the crank is depressed, it switches in the K13 oscillator relay to aurally signal the user when the receiver is tuned to the same frequency as the transmitter selector switch. The edge-lighted face of the unit is controlled by the primary instrument light switch on the center power quadrant support. The light bulbs are reached by unscrewing their retaining covers. Except for light bulb replacement and adjustments given in paragraph 2-9, no maintenance should be attempted.

2-7. REMOVAL OF CONTROL UNIT.
(See figures 2-3 and 2-9.)

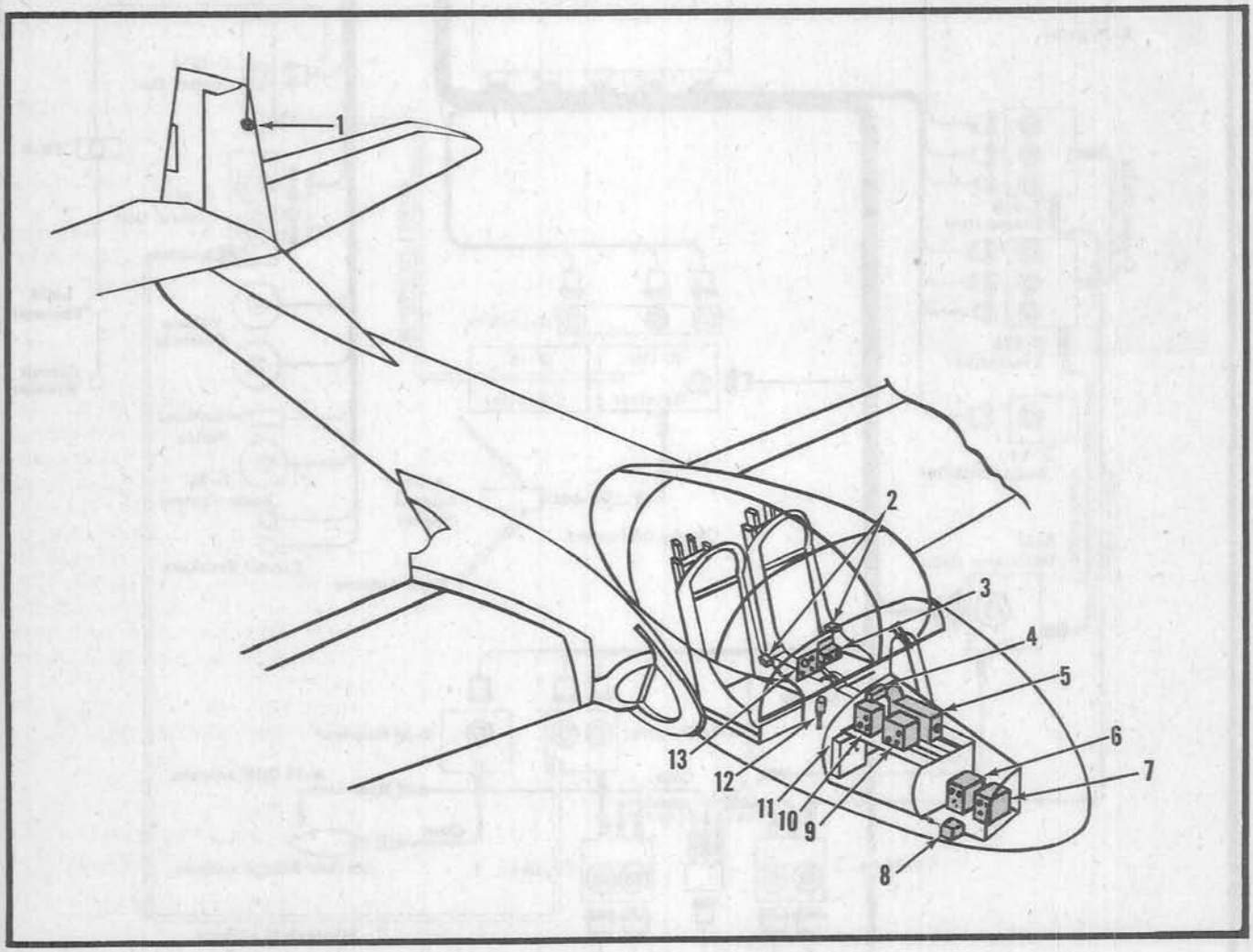
a. Turn off all electrical power.
b. Loosen dzus fasteners on control unit face.
c. Pull control unit from stationary panel until connections at rear of unit can be reached.
d. Disconnect flexible tuning shaft and electrical plugs.

2-8. INSTALLATION OF CONTROL UNIT.
(See figures 2-3 and 2-9.)

a. Connect electrical plugs.
b. Adjust in accordance with paragraph 2-9.

2-9. ADJUSTING CONTROL UNIT.

a. Connect flexible tuning shaft to receiver and to control unit; disregard REC dial position.
b. Turn tuning crank counterclockwise as far as it will go without forcing.
c. If control unit is mounted, loosen dzus fasteners and pull unit from stationary panel.
d. Disconnect flexible tuning shaft.

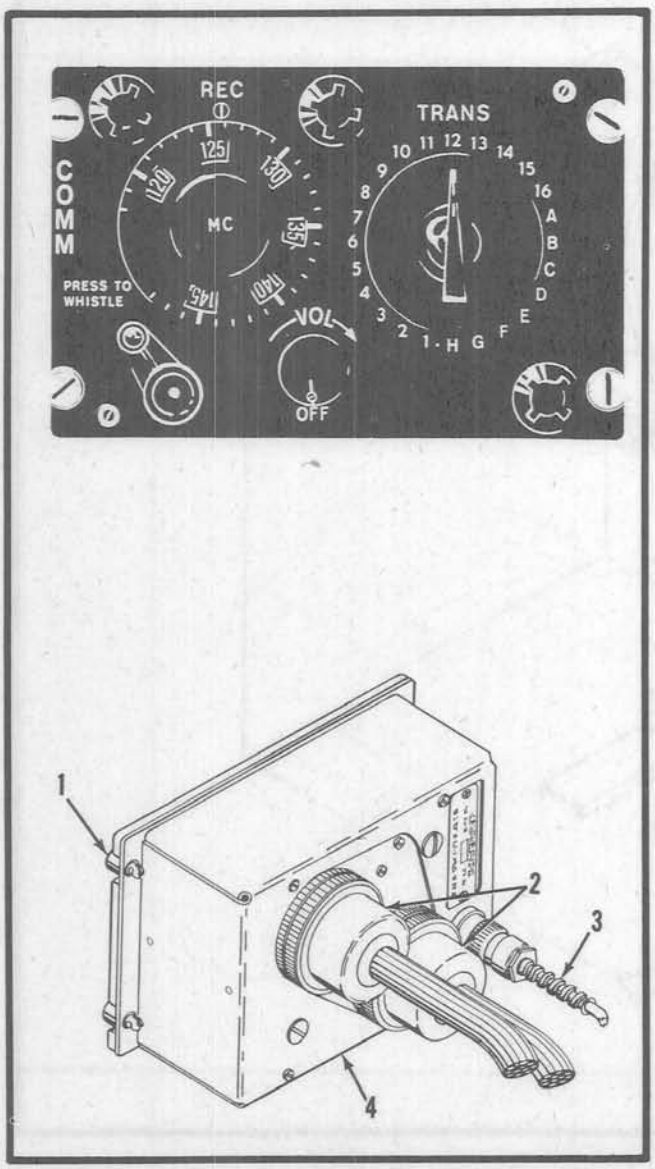


1. VHF communication antenna
2. Seat disconnect
3. C58 Control unit
4. K13 Oscillator relay
5. R19 Receiver
6. TV10-1 Transverter
7. TV10-2 Transverter
8. K18 Antenna relay
9. T13A Transmitter
10. T11B Transmitter
11. J15A Junction box
12. UHF Communication antenna
13. Circuit breaker

Figure 2-2. Location of Communication Equipment

e. Turn tuning crank until the small dot on the REC dial is directly under the reference point on the control unit case.
f. Connect flexible tuning shaft, being careful not to change relative positions of shaft, receiver, and crank.
g. Attach control unit with dzus fasteners to stationary panel.
h. Tune several stations of known frequency to test accuracy of adjustment.

2-10. K13 OSCILLATOR RELAY. The oscillator relay permits use of a transmitter as an RF source for precise tuning of the R19 reciever. The relay is operated by the tuning crank on the C58 control unit. When the crank is pushed for "whistle-thru", the relay performs the following functions: connects high voltage to receiver and transmitter simultaneously; reduces receiver sensitivity to a low value; connects transmitter output to a 50 ohm dummy load; switches the microphones out of circuit; turns on a relaxation-type oscillator and injects this AF into the microphone input circuit to provide more than 20% tone modulation; and connects the headsets to output of the receiver.



1. Dzus fastener
2. Electrical plug
3. Tuning shaft
4. Control unit case

Figure 2-3. C58 Control Unit

2-11. REMOVAL OF K13 OSCILLATOR RELAY. (See figure 2-4.)
a. Turn off electrical power.
b. Open right nose access door.
c. Disconnect electrical and antenna plugs at relay.
d. Cut safety wire, open snapslide fasteners and remove relay.

2-12. INSTALLATION OF K13 OSCILLATOR RELAY. (See figure 2-4.)
a. Attach relay with snapslide fasteners; safety fasteners.
b. Connect electrical and antenna plugs to relay.
c. Close right nose access door.
d. Perform operational check in accordance with paragraph 2-13.

2-13. OPERATIONAL CHECK OF K13 OSCILLATOR RELAY.
a. Turn on electrical power.
b. Turn on communication control unit and allow system to warm-up for two or three minutes.
c. Turn TRANS switch to valid frequency.
d. Push in tuning crank and turn until REC dial is set at same frequency as TRANS switch.
RESULT: As REC dial approaches correct frequency the relay should furnish a whistle tone which reaches its loudest point when REC dial indicates the same setting as the TRANS switch.
e. Turn off control unit and electrical power.

2-14. TV10 TRANSVERTERS. There are two transverters in the airplane; altho mechanically identical, they are termed TV10-1 and TV10-2 to avoid confusion in crystal location. Each transverter is a combination transmitter-converter. The transmitter has a maximum of 8 crystals ranging from 228-258 MC in one or two bands each 4 MC wide. The receiver converter converts incoming 228-258 MC signals to 118-148 MC after mixing with a 110 MC crystal oscillator. The converted signals are fed into the R19 receiver which is tunable from 118-148 MC. No maintenance or adjustment is necessary. In case of malfunction the defective transverter must be replaced.

2-15. REMOVAL OF TV10 TRANSVERTER. (See figure 2-5.)
a. Turn off all electrical power.
b. Open right nose access door.
c. Disconnect electrical plugs and coaxial cables.
d. Open snapslide fasteners and remove transverter.

2-16. INSTALLATION OF TV10 TRANSVERTER. (See figure 2-5.)
a. Position transmitter on mount, close snapslide fasteners and safety.
b. Connect electrical plugs and coaxial cables.
c. Close right nose access door.
d. Check operation in accordance with paragraph 2-14.

2-17. OPERATIONAL CHECK OF TRANSVERTER.
a. Turn on electrical power.

b. Turn on communication control unit and allow system to warm-up for two or three minutes.
c. With TRANS switch set at position 1, try for whistle tone by pushing in and turning tuning crank.

RESULT: If whistle is not obtainable, there is no crystal at that position. If whistle tone is obtained, check frequency card below control unit for a frequency equal to that indicated by the REC dial position at loudest whistle tone.

d. Repeat step c through all numbered TRANS switch positions.

RESULT: Crystals should agree with requirements given on frequency card in number, frequency, and position when both transverters are installed. If crystals differ from card requirements, replace transverter with one which has proper crystals installed.

e. Turn off control unit and electrical power.

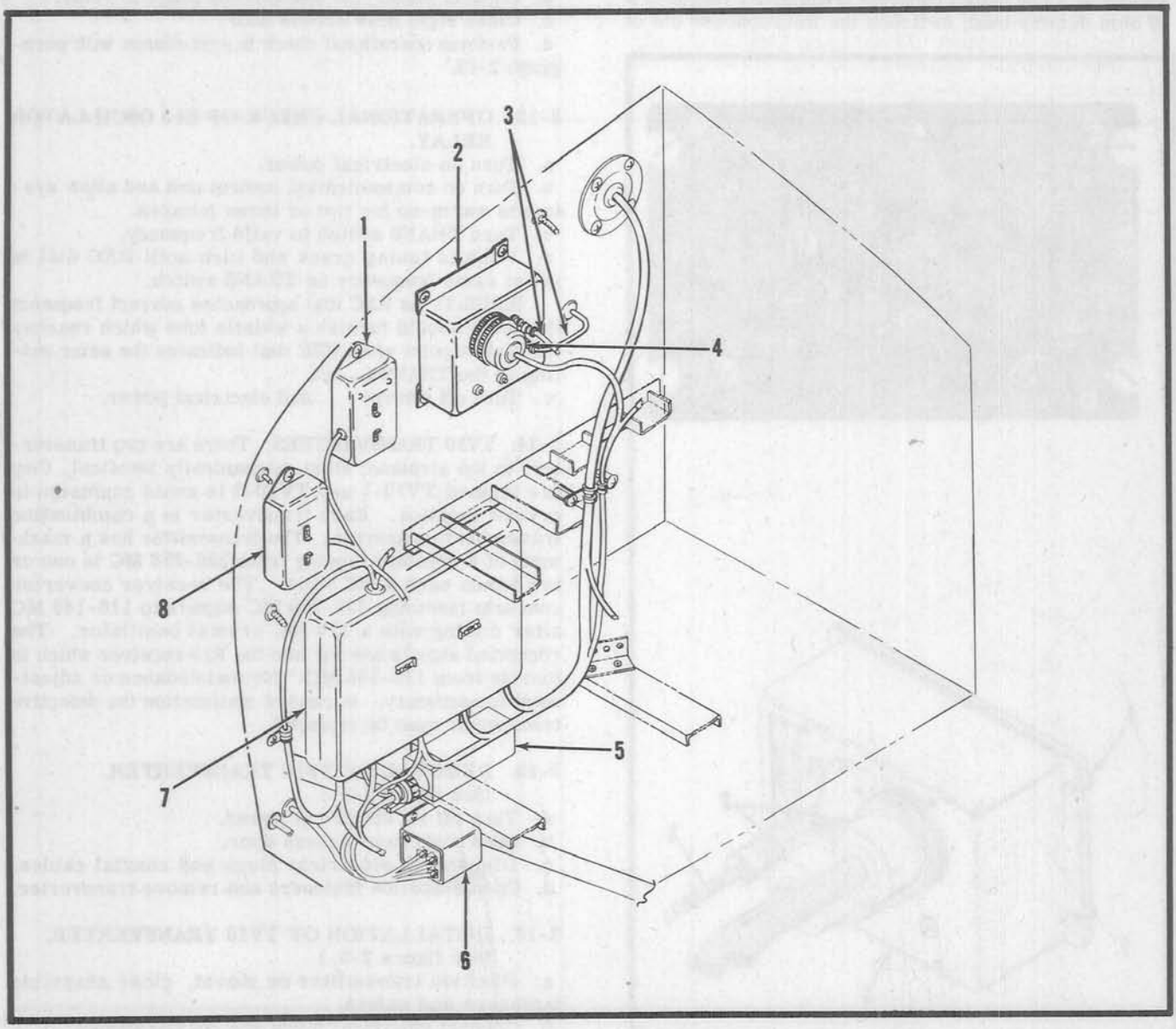
2-18. K18 ANTENNA RELAY. The antenna relay is an SPDT single contact relay, operated by the TRANS switch on the communication control unit. It connects the UHF communication antenna with whichever transverter is in use.

2-19. REMOVAL OF K18 ANTENNA RELAY. (See figure 2-5.)

a. Remove E14 rack as shown in paragraph 2-51.
b. Disconnect electrical plug and coaxial cables.
c. Support relay and remove four nuts and screws.

2-20. INSTALLATION OF K18 ANTENNA RELAY. (See figure 2-5.)

a. Attach relay to bracket with four screws and nuts.
b. Connect electrical plug and coaxial cables.
c. Install E14 rack as shown in paragraph 2-52.



1. K16 Relay
2. K13 Oscilator relay
3. Coaxial cables
4. Electrical plug
5. MA1 Warning signal
6. Warning signal silencing relay
7. J15A Junction box
8. K16 Relay

Figure 2-4. 54 Bulkhead Radio Equipment Installation

2-21. UHF COMMUNICATION ANTENNA. The A16 communication antenna is a quarter wave, base fed, inverted "L" type designed to operate in the UHF band. It is mounted beneath the cockpit aft of the fuselage position light.

2-22. REMOVAL OF UHF COMMUNICATION ANTENNA. (See figure 2-5.)

a. Turn off electrical power.

b. Under airplane, remove locknut and antenna spike; remove knurled nut securing antenna box to fuselage.

c. Inside cockpit, raise instructors seat, remove cover number 20, disconnect coaxial cable, and remove antenna box.

2-23. INSTALLATION OF UHF COMMUNICATION ANTENNA. (See figure 2-5.)

a. Connect coaxial cable to antenna box and position in hole in fuselage.

b. Install cover number 20 and lower instructors seat.

c. Under airplane, secure antenna box to fuselage with knurled nut; attach antenna spike securely with locknut.

2-24. R19 RECEIVER. The VHF R19 receiver is controlled by the C58 control unit and powered by a D10A dynamotor. Continuously tunable over the frequency range of 118-148 MC, it is designed for the reception of voice AM signals.

2-25. REMOVAL OF R19 RECEIVER. (See figure 2-6.)

a. Turn off electrical power and open right nose access door.

b. Disconnect flexible tuning shaft.

c. Disconnect coaxial cable and electrical plugs.

d. Open snapslide fasteners and remove receiver.

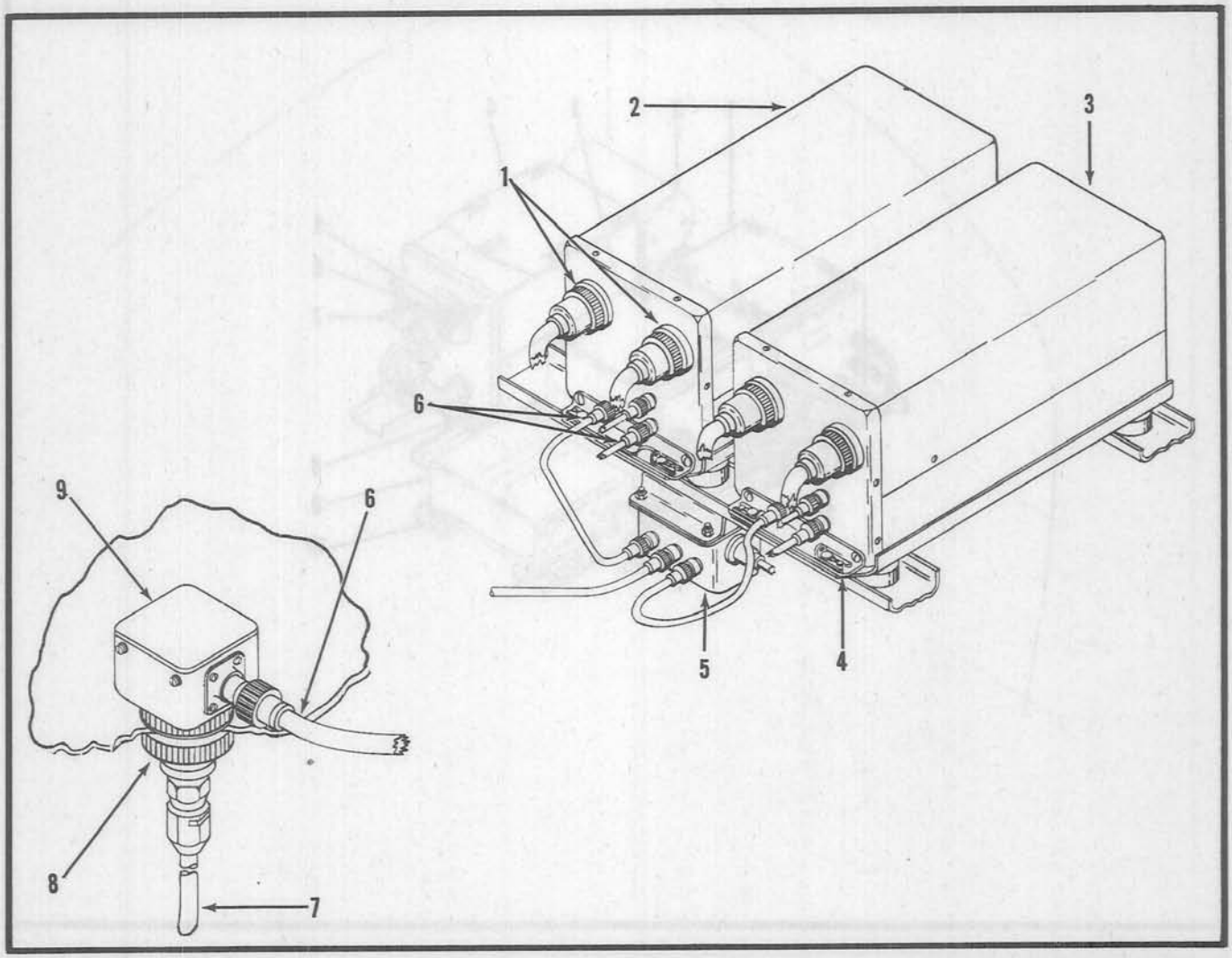
2-26. INSTALLATION OF R19 RECEIVER. (See figure 2-6.)

a. Position receiver on its mount, fasten snapslide fasteners, and safety.

b. Connect coaxial cable and electrical plugs.

c. Connect flexible tuning shaft and adjust in accordance with paragraph 2-9.

d. Close right nose access door.



1. Electrical plug
2. TV10-1 transverter
3. TV10-2 transverter
4. Snapslide fastener
5. K18 relay
6. Coaxial cable
7. Antenna spike
8. Knurled nut
9. Antenna box

Figure 2-5. UHF Equipment Installation

2-27. OPERATIONAL CHECK OF R19 RECEIVER.

a. Turn or electrical power; turn on C58 control unit; allow system to warm-up for two or three minutes.

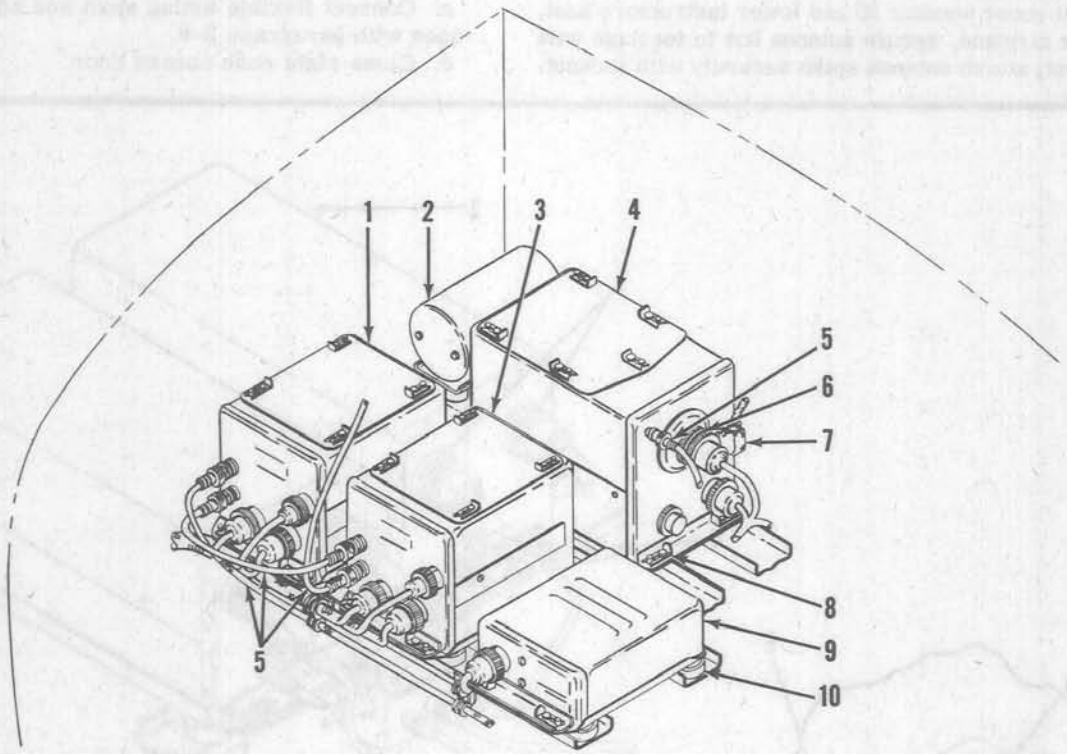
b. Use "whistle-thru" to tune receiver to transmitters and transverters; and check reception and accuracy of tuning dial over all frequencies listed on radio frequency card below control unit.

RESULT: REC dial should indicate correct frequency at loudest "whistle tone" for each frequency; reception should be clear and loud when volume control on control unit is turned clockwise.

2-28. D10A DYNAMOTOR. The dynamotor furnishes low-amperage high voltage power to the receiver on which it is mounted and to any connected transmitters. It is connected to its receiver by a built-in plug on its base, and attached by snapslide fasteners to a shock mount which is an integral part of the receiver chassis.

2-29. REMOVAL OF D10A DYNAMOTOR.
(See figures 2-6 and 2-10.)

a. Turn off electrical power and open right nose access door.



1. T11B Transmitter
2. D10A Dynamotor
3. T13A Transmitter
4. R19 Receiver
5. Coaxial cable
6. Electrical plug
7. Flexible tuning shaft
8. Snapslide fastener
9. F14 Amplifier
10. Shock mount

Figure 2-6. Upper Shelf Radio Equipment Installation

b. Open snapslide fasteners and pull up on dynamotor.

Note

For the R13B receiver dynamotor it is necessary to remove the receiver in accordance with paragraph 2-51.

2-30. INSTALLATION OF D10A DYNAMOTOR. (See figures 2-6 and 2-10.)

a. Plug-in dynamotor, close snapslide fasteners, and safety.
b. If R13B receiver was removed, install in accordance with paragraph 2-52.
c. Close right nose access door.

2-31. J15A JUNCTION BOX. The J15A junction box provides accessible disconnect points for the multi-unit radio system and includes a sidetone relay.

WARNING

Be sure all electrical power is OFF whenever junction box cover is removed. Serious injury may be caused when power is left on.

2-32. REMOVAL OF J15A JUNCTION BOX. (See figure 2-4.)

a. Turn off electrical power, and remove right nose access door.
b. Open snapslide fasteners and remove junction box cover.
c. Disconnect wires at terminals and pull from box.
d. Remove four screws and junction box.

2-33. INSTALLATION OF J15A JUNCTION BOX.

a. Attach box to bulkhead with four screws.
b. Feed wires through holes and connect to terminals.
c. Attach cover to box by closing snapslide fasteners; safety wire fasteners.
d. Make operational check on all equipment wired through junction box and close right nose access door.

2-34. VHF COMMUNICATION SYSTEM.

2-35. DESCRIPTION. Exclusively VHF communication equipment includes a T11B transmitter, a T13A transmitter, and an A19 antenna. Equipment used in both the UHF and VHF communication systems includes a C58 control unit, a K13 oscillator relay, an R19 receiver, and a J15A junction box.

2-36. OPERATION. The VHF communication system provides crystal controlled AM, voice transmission, and continuously tunable reception in the VHF band of 118-148 MC. In addition, AM voice reception in the VHF band of 108-135 MC is provided by the R13B receiver of the VHF navigation system. The VHF communication system is operated through the C58 control unit on the stationary panel. No adjustment or maintenance of this system should be attempted except that which is included in this handbook.

2-37. T11B AND T13A TRANSMITTERS. The two VHF transmitters are electrically and mechanically similar except for their operating bands. The T11B transmitter permits VHF transmission on a maximum of five crystal-controlled frequencies in any two MC band from 116-132 MC; the T13A transmitter permits VHF transmission on a maximum of five crystal-controlled frequencies in any two MC band from 132-148 MC. No maintenance or adjustment is necessary. In case of malfunction the defective transmitter must be replaced.

2-38. REMOVAL OF EITHER TRANSMITTER.

a. Turn off electrical power, and open right nose access door.
b. Disconnect electrical plugs and coaxial cables.
c. Open snapslide fasteners and remove transmitter.

2-39. INSTALLATION OF EITHER TRANSMITTER.

a. Attach transmitter to mount with snapslide fasteners and safety wire fasteners.
b. Connect electrical plugs and coaxial cables.
c. Close right nose access door.
d. Check operation in accordance with paragraph 2-40.

2-40. OPERATIONAL CHECK OF TRANSMITTER.

a. Turn on electrical power.
b. Turn on communication control unit and allow system to warm-up for two or three minutes.
c. With TRANS switch set at position A, try for whistle tone by pushing in and turning tuning crank.

RESULT: If whistle is not obtainable, there is no crystal at that position. If whistle tone is obtained, check frequency card below control unit for a frequency equal to that indicated by the REC dial position at loudest whistle tone.

d. Repeat step c through all lettered TRANS switch positions.

RESULT: Crystals should agree with requirements given on frequency card in number, frequency, and position. If crystals differ from card requirements, replace transmitter with one which has proper crystals installed.

e. Turn off control unit and electrical power.

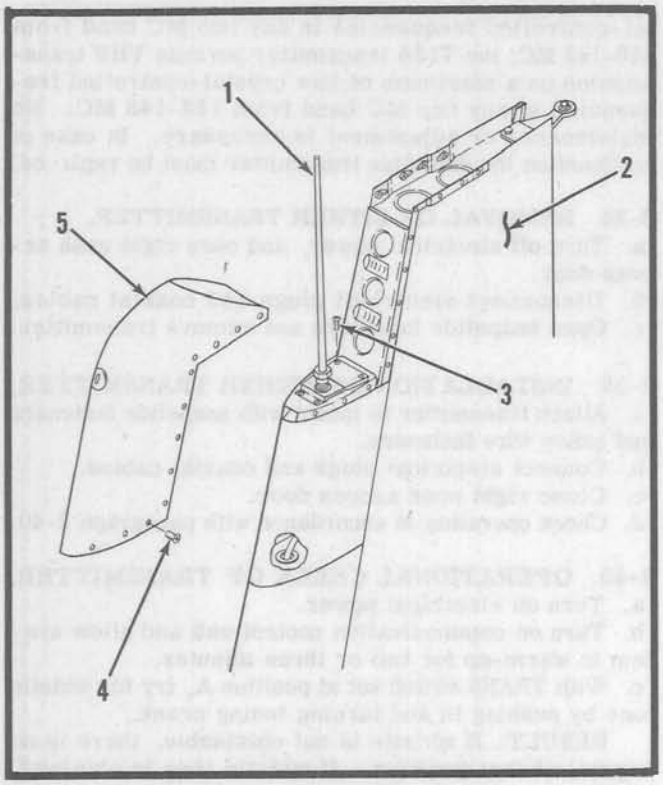
2-41. VHF COMMUNICATION ANTENNA. The A-19 communication antenna is a quarter wave, base fed type and is mounted on the vertical stabilizer. The antenna protrudes from the vertical stabilizer tip and is used for VHF radio reception and transmission.

2-42. REMOVAL OF VHF COMMUNICATION ANTENNA. (See figure 2-7.)

a. Remove screws attaching antenna housing to the stabilizer tip and lift up on the tip until it is free from the antenna.
b. Remove screws attaching mounting channel to rib and pull antenna up.
c. Disconnect coaxial cable from antenna at antenna adapter.
d. Remove antenna from airplane.

2-43. INSTALLATION OF VHF COMMUNICATION ANTENNA. (See figure 2-7.)

a. Position antenna in place in the vertical stabilizer location and connect coaxial cable to antenna adapter.
b. Slide antenna down until mounting channel is aligned with the rib and secure in place with screws.
c. Slide vertical stabilizer tip down over antenna and secure with screws.
d. Perform an operational check of the installation by operating communication receiver and transmitters.



1. Antenna
2. Vertical stabilizer
3. Screw
4. Screw
5. Antenna housing

Figure 2-7. VHF Communication Antenna Installation

2-44. VHF NAVIGATION SYSTEM.

2-45. DESCRIPTION. Equipment used in the navigation system includes a C1254 control unit, a course indicator, an E14 rack containing an R13B receiver and a B13 converter, an antenna, and the J15A junction box.

2-46. OPERATION. The navigation system operates in the frequency range of 108-135 MC and provides the following:

VHF omnidirectional airways radio ranges (VOR).
VHF visual-aural airways radio ranges (VAR).
VHF 90/150 CPS runway localizers (LOC).
VHF voice reception on all frequencies covered by the receiver.

This makes it possible for the pilot to fly any desired track on the omni ranges. The system can be used for obtaining a definite "fix" on two or more omni stations; for making a runway localizer approach; and for flying the fixed track on the VHF visual-aural range. The receiver can also be utilized to receive weather reports and other voice signals on the same frequency that the localizer or range signals are being received, and, for receiving VHF signals from the ground during GCA operation.

2-47. OPERATIONAL CHECK OF VHF NAVIGATION SYSTEM.

a. Turn on electrical power, turn on C1254 control unit, and allow system to warm-up for two or three minutes.

Note

A signal generator, or similar test equipment should be used to perform an operational check on the navigational radio system. Using actual VOR, VAR or tone-localizer signals for this purpose is not advisable since erroneous indications may be obtained.

b. Turn selector switch to OMNI.
c. Turn tuning crank to tune in test frequency.

Note

The signal operator will announce the transmitted track. (e.g. "You should now read zero degrees to the station.") Normally tracks will be transmitted for each 60° around the compass.

d. Turn course indicator to indicated bearing.
RESULT: "OFF" flags should disappear; cross pointer should be centered; TO-FROM meter should indicate TO.

Note

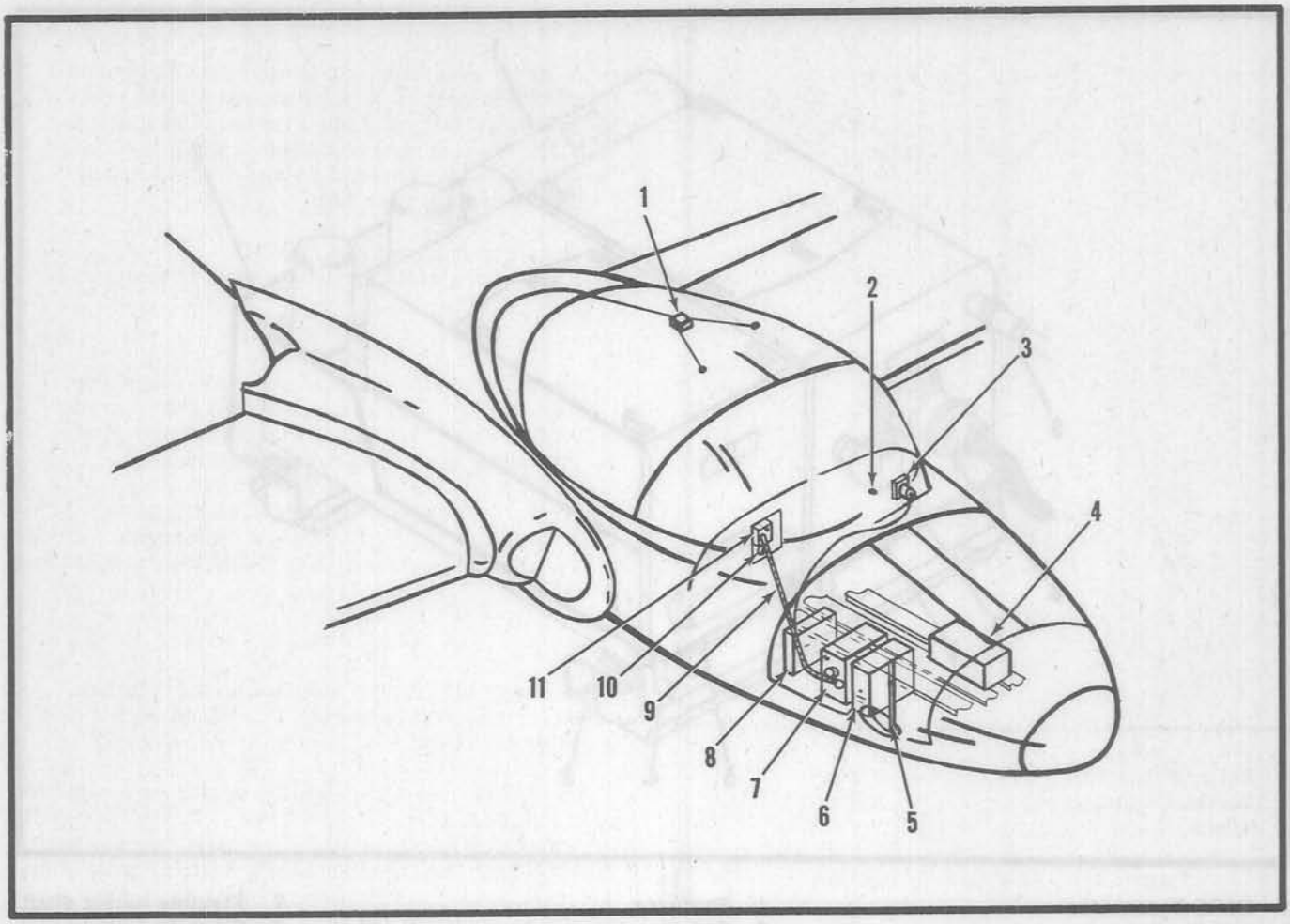
Turning the course selector to a reciprocal bearing should cause the TO-FROM meter to indicate FROM.

e. On instruction from signal operator turn selector switch to VAR LOC.
RESULT: As signal operator calls "needle left", "needle right", or "needle center", vertical cross pointer position should respond correctly.
f. Turn tuning crank to known VHF voice transmission stations within 108-135 MC.
RESULT: Dial should indicate correct frequencies and reception should be clear and loud when control unit volume control is turned clockwise.
g. Turn off control unit and electrical power.

2-48. C1254 NAVIGATION CONTROL UNIT. The C1254 control unit controls the navigation system through its remote operation of the R13B receiver. There are three controls on the control unit: a receiver tuning crank; a combination OMNI and VAR-LOC selector switch; and a combination power and volume switch. The edge-lighted face of the instrument is controlled by the primary instrument light switch on the center power quadrant support. The light bulbs are reached by unscrewing their retaining covers. Except for light bulb replacement and adjustments given in paragraph 2-9, no maintenance should be attempted. For removal and installation see paragraphs 2-7 and 2-8.

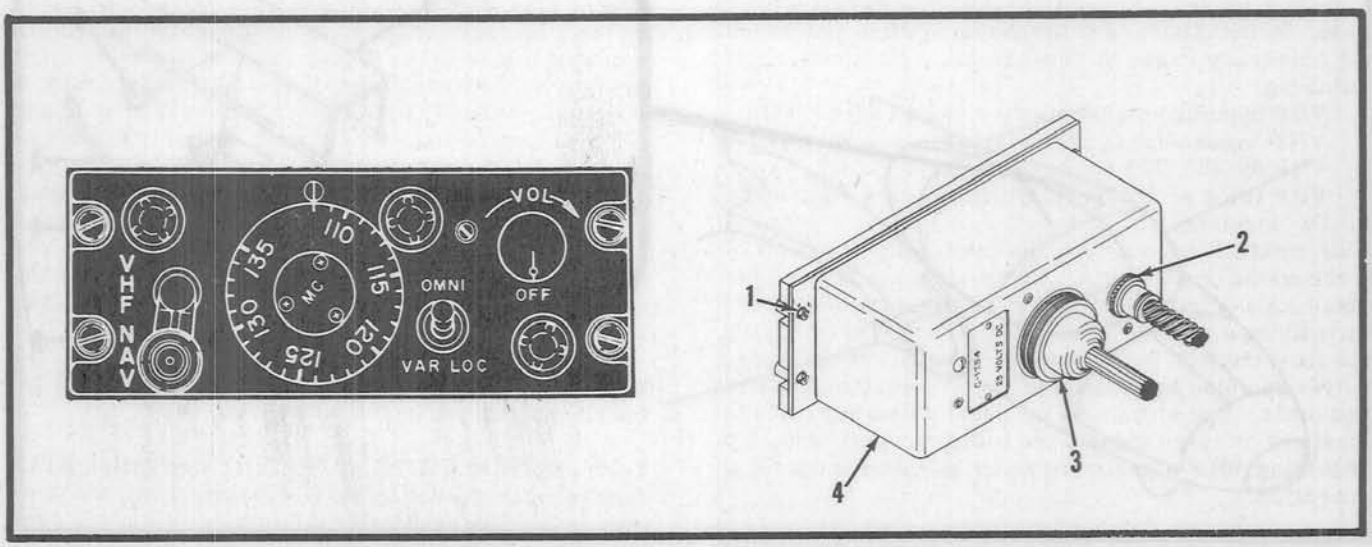
2-49. COURSE INDICATOR. See paragraph 1-76 for information on the course indicator.

2-50. R13B RECEIVER. The VHF navigation R13B receiver is controlled by the C1254 control unit and powered by a D10A dynamotor. Continously tunable over the frequency range of 108-135 MC, it is designed for the reception of AM signals. For removal and installation of the dynamotor, see paragraphs 2-29 and 2-30. To remove the R13B receiver, it is necessary to remove the E14 rack on which it is mounted.



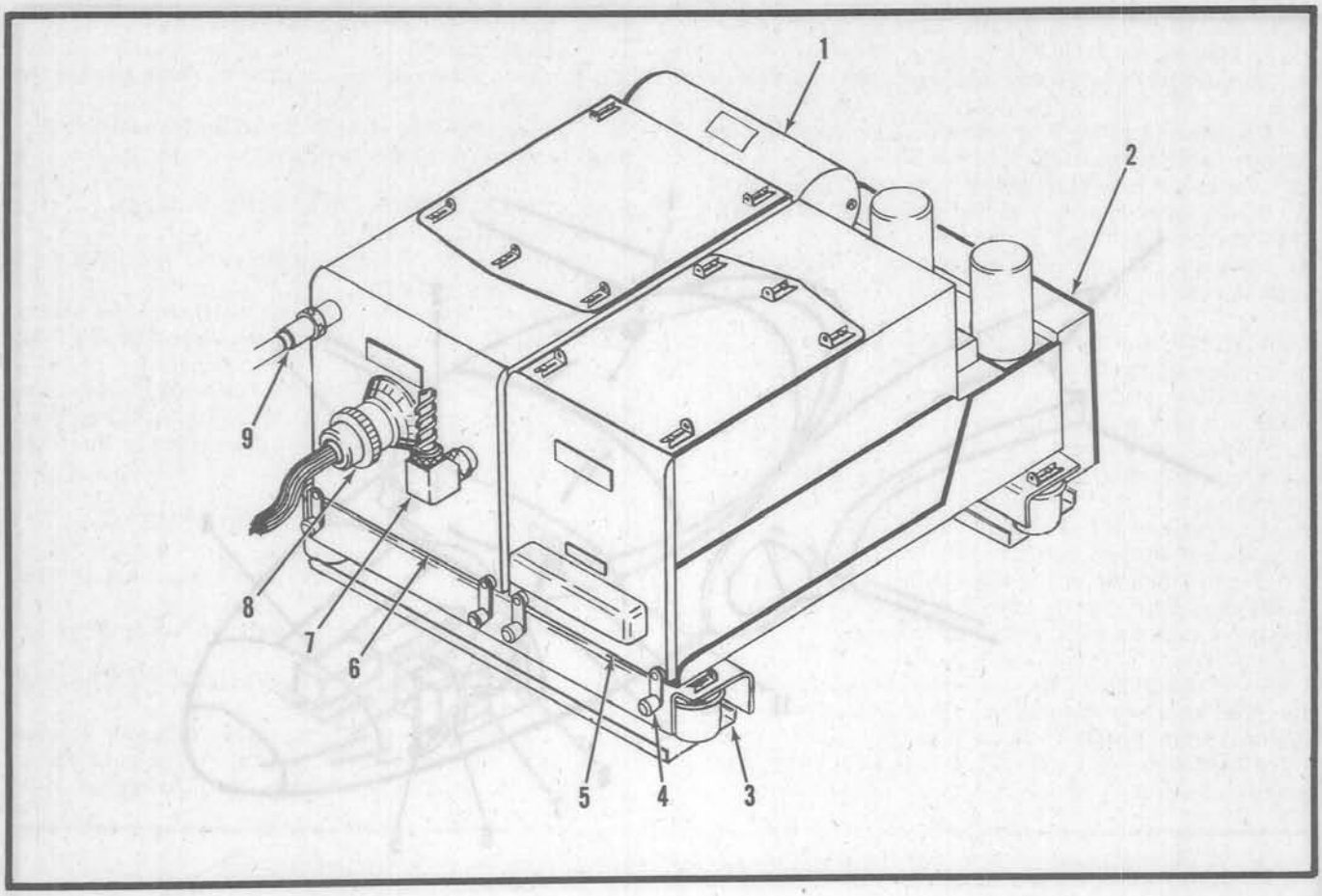
1. Navigation antenna
2. Marker beacon light
3. Course indicator
4. R20 Receiver
5. Marker beacon antenna
6. B13 Converter
7. R13B Receiver
8. J15A Junction box
9. Flexible tuning cable
10. Audio control
11. C1254 control unit

Figure 2-8. Location of Navigation Equipment



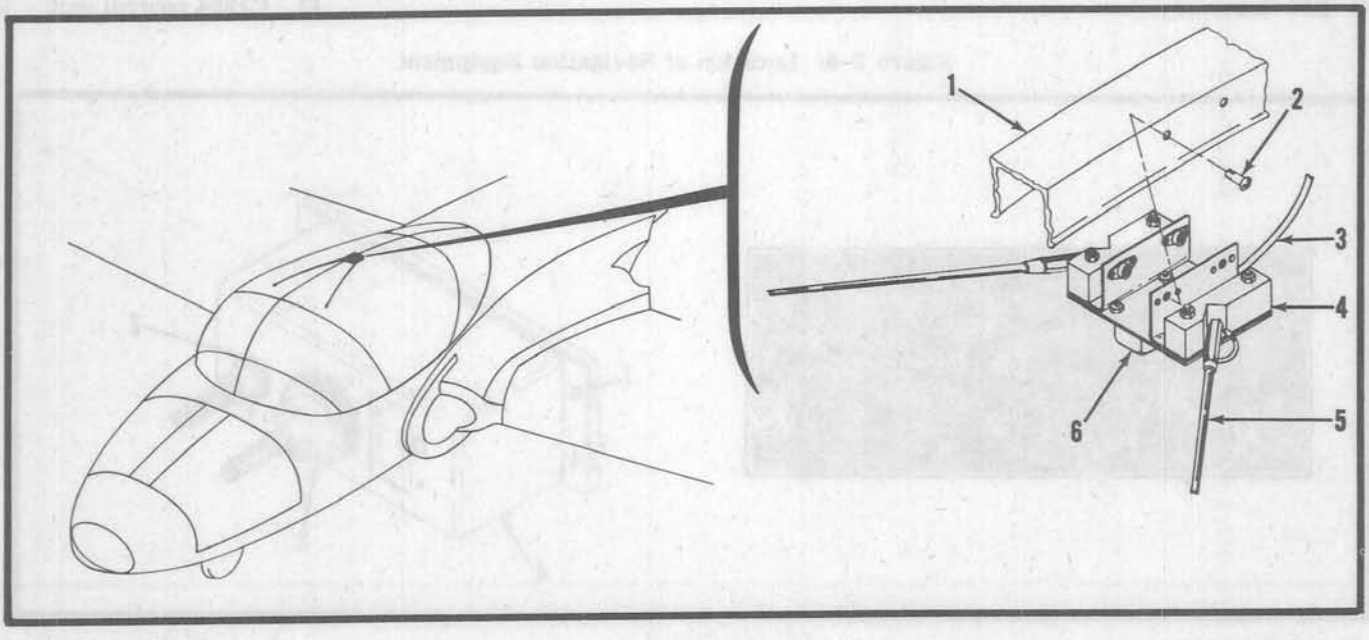
1. Dzus fastener
2. Tuning shaft
3. Electrical plug
4. Control unit case

Figure 2-9. C1254 Control Unit



1. D10A Dynamotor
2. E14 Rack
3. M10 Mount
4. Fastener
5. B13 Converter
6. R13B Receiver
7. Flexible tuning shaft
8. Electrical plug
9. Antenna cable

Figure 2-10. R13B Receiver and B13 Converter Installation



1. Canopy channel
2. Screw
3. Antenna cable
4. Block
5. Antenna
6. A17 Coupler

Figure 2-11. Navigation Antenna Installation

2-51. REMOVAL OF R13B RECEIVER. (See figure 2-10.)

a. Turn off electrical power and open right nose access door.
b. Disconnect flexible tuning shaft, electrical plug, and antenna cable from R13B receiver.
c. Disconnect electrical plugs from rear of E14 rack.
d. Open snapslide fasteners and remove E14 rack with R13B receiver and B13 converter.
e. Open screw-type fasteners and pull receiver forward to remove it from rack.

2-52. INSTALLATION OF R13B RECEIVER. (See figure 2-10.)

a. Carefully slide receiver onto rack making sure it plugs into rack properly.
b. Connect screw-type fasteners; tighten, and safety.
c. Position rack on M10 mount, close snapslide fasteners, and safety.
d. Connect electrical plugs to rack and to receiver.
e. Connect antenna cable to receiver.
f. Connect flexible tuning shaft to receiver and adjust C1254 navigation control unit in accordance with paragraph 2-9. Close right nose access door.

2-53. B13 CONVERTER. The converter is powered by the R13B receiver dynamotor. It receives, converts, and interprets signals from the receiver to operate the TO-FROM meter and the veritcal cross pointer of the course indicator.

2-54. REMOVAL OF B13 CONVERTER. (See figure 2-10.)

a. Remove E14 rack in accordance with paragraph 2-51.
b. Open screw-type fasteners and pull converter forward to remove it from the rack.

2-55. INSTALLATION OF B13 CONVERTER. (See figure 2-10.)

a. Carefully slide converter onto rack, making sure it plugs into rack properly.
b. Connect screw-type fasteners; tighten, and safety.
c. Install E14 rack in accordance with paragraph 2-52.

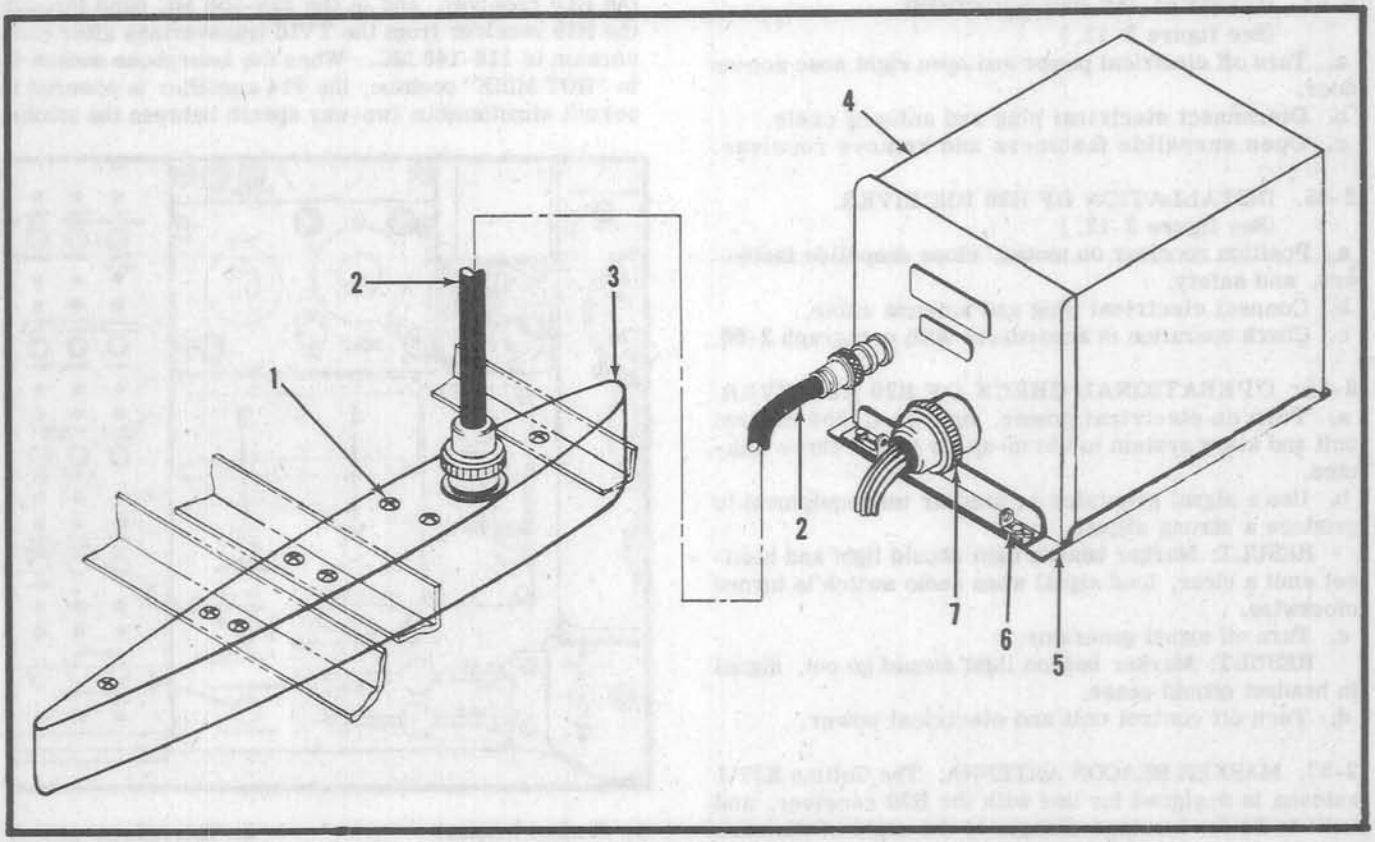
2-56. NAVIGATION ANTENNA. The navigation antenna is a twin dipole assembly which includes an A17 coupler. It is attached to the canopy and connected to the R13B receiver.

2-57. REMOVAL OF NAVIGATION ANTENNA. (See figure 2-11.)

a. Turn off electrical power and disconnect antenna cable at coupler.
b. Remove four screws and antenna assembly.

2-58. INSTALLATION OF NAVIGATION ANTENNA. (See figure 2-11.)

a. Attach antenna assembly to canopy with four screws.
b. Connect antenna cable to coupler and perform an operational check in accordance with paragraph 2-49.



1. Screw
2. Antenna cable
3. Antenna
4. R20 Receiver
5. Mount
6. Snapslide fastener
7. Electrical plug

Figure 2-12. Marker Beacon Equipment Installation

2-59. MARKER BEACON SYSTEM.

2-60. DESCRIPTION. The marker system includes a marker beacon light, a marker beacon audio level switch on the stationary panel, an R20 receiver, and an antenna mounted beneath the right nose section. The J15A junction box provides terminals for system wiring.

2-61. OPERATION. As the airplane passes over a marker beacon transmitter, the transmitter signal is fed through the antenna to the receiver. A relay in the receiver turns on the marker beacon light, and the receiver sends a tone signal to the headset. The loudness of the tone is controlled by the audio level switch.

2-62. MARKER BEACON LIGHT. The marker beacon light is an amber, press-to-test light on the left shock panel to the right of the rate of climb indicator. See paragraph 1-8 for removal and installation.

2-63. R20 RECEIVER. The marker beacon receiver is designed to operate at 75 MC. It operates the marker beacon light and sends a tone signal to both headsets through the audio level switch and the headset volume controls. An "expansion" circuit in the receiver narrows the cone of reception over a marker beacon transmitter and sharply defines the edges. The circuit also squelches receiver output when the airplane is not over a marker beacon transmitter.

2-64. REMOVAL OF R20 RECEIVER.
(See figure 2-12.)
a. Turn off electrical power and open right nose access door.
b. Disconnect electrical plug and antenna cable.
c. Open snapslide fasteners and remove receiver.

2-65. INSTALLATION OF R20 RECEIVER.
(See figure 2-12.)
a. Position receiver on mount, close snapslide fasteners, and safety.
b. Connect electrical plug and antenna cable.
c. Check operation in accordance with paragraph 2-66.

2-66. OPERATIONAL CHECK OF R20 RECEIVER.
a. Turn on electrical power, turn on C1254 control unit and allow system to warm-up for two or three minutes.
b. Use a signal generator or similar test equipment to produce a strong signal.
RESULT: Marker beacon light should light and headset emit a clear, loud signal when audio switch is turned clockwise.
c. Turn off signal generator.
RESULT: Marker beacon light should go out, signal in headset should cease.
d. Turn off control unit and electrical power.

2-67. MARKER BEACON ANTENNA. The Collins X37-1 antenna is designed for use with the R20 receiver, and built to fit the fuselage contour to the right of the nose wheel well where it is mounted.

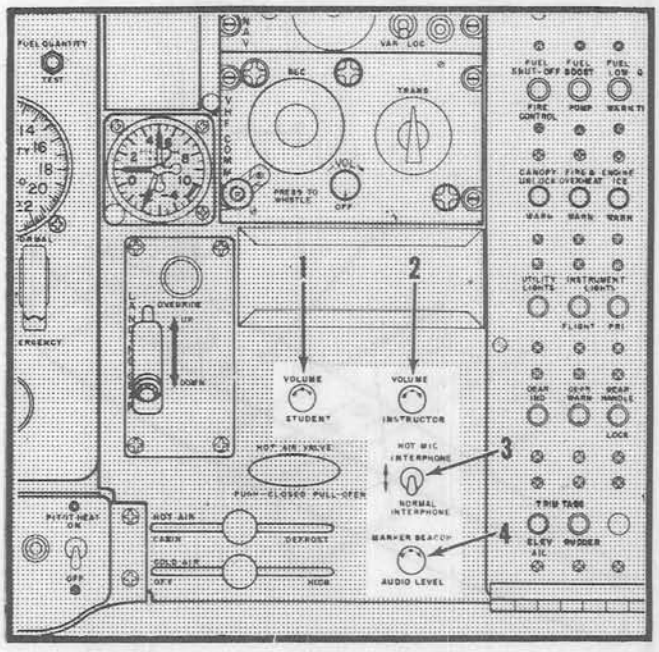
2-68. REMOVAL OF MARKER BEACON ANTENNA.
(See figure 2-12.)
a. Remove E14 rack as shown in paragraph 2-51.
b. Remove connector, mounting screws, and antenna.

2-69. INSTALLATION OF MARKER BEACON ANTENNA. (See figure 2-12.)
a. Attach antenna to fuselage with screws and attach connector.
b. Install E14 rack as shown in paragraph 2-52.

2-70. INTERPHONE SYSTEM.

2-71. DESCRIPTION. Exclusively interphone system equipment includes the helmet connectors, adapters, and seat disconnects on the two seats, the microphone switches on the power controls, the volume controls and the interphone switch on the stationary panel, the K16 relays, and the F14 amplifier. Associated equipment includes the J15A junction box, the MA1 warning signal, and the silencing relay.

2-72. OPERATION. Both the marker beacon system and the MA1 warning signal of the landing gear system are wired to the volume controls. Therefore interphone switch and microphone switch positions are immaterial and the headsets will receive the marker beacon and MA1 tone signals whenever conditions specified in paragraph 2-61 and/or paragraph 1-72 are present. The volume control switches are wired in parallel to permit independent volume control by the student or instructor. When the interphone switch is in NORMAL position and the microphone switches are off, the headset will receive all voice transmission in the 108-135 MC band from the R13B receiver, in the 118-148 MC band from the R19 receiver, and in the 228-258 MC band through the R19 receiver from the TV10 transverters after conversion to 118-148 MC. When the interphone switch is in "HOT MIKE" position, the F14 amplifier is powered to permit simultaneous two-way speech between the student



1. Student headset volume control
2. Instructor headset volume control
3. Interphone switch
4. Marker beacon audio level control

Figure 2-13. Interphone Switch and Volume Controls

and instructor as long as the microphone switches are off. Whenever a microphone switch is on, the corresponding K16 relay is actuated, switching the F14 amplifier out of circuit, and the sidetone relay in the J15A junction box is actuated to switch the T11B, and T13A transmitters, and the TV10 transverters into the circuit, allowing transmission on any VHF or UHF frequency listed on the frequency card below the C58 control unit. The only time that a receiver and a transmitter are keyed to the headset at the same time is when the K13 oscillator relay is in use during "whistle-thru" tuning. See paragraph 2-6.

2-73. OPERATION CHECK OF INTERPHONE SYSTEM.

a. Turn on electrical power, turn on both control units, turn both volume controls full clockwise, turn interphone switch to NORMAL, and allow system to warm-up for two or three minutes.

b. With headsets plugged in, tune in several known stations, one at a time, through each control unit.

RESULT: Reception of voice signals should be clear and loud.

c. Turn interphone switch to HOT MIKE and speak into one or both microphones.

RESULT: Reception in both earphones should be clear and loud.

d. With C58 control unit TRANS switch in position not covered by a crystal, push in on microphone switches, one at a time, and speak into corresponding microphone.

RESULT: K16 relay should switch the F14 out of circuit, actuate the sidetone relay in the J15A junction box. The headset whose microphone switch is not pushed in should receive voice signals from the other headset but be unable to send. The sending operator should be able to hear his own transmission.

2-74. K16 RELAYS. There are two K16 relays: one for the student and one for the instructor. Each is an SPDT, single contact relay, operated by the corresponding microphone switch.

2-75. REMOVAL OF K16 RELAY.
(See figure 2-4.)

a. Turn off electrical power and open right nose access door.

b. Open snapslide fasteners and remove relay cover.

c. Disconnect wires, remove two screws and relay.

2-76. INSTALLATION OF K16 RELAY.
(See figure 2-4.)

a. Attach relay to bulkhead with two screws and connect wires to relay terminals.

b. Attach relay cover with snapslide fasteners and safety.

c. Check operation in accordance with paragraph 2-73.

2-77. F14 AMPLIFIER. The F14 amplifier, mounted on the upper shelf next to the T13A transmitter, is operated by the interphone switch. When the switch is at HOT MIKE, 28 volt DC power is fed to the amplifier to amplify signals from either headset for reception in the other. Pushing in on a microphone switch will not turn off the amplifier, but will switch it out of circuit by actuating the corresponding K16 relay. When the microphone switch is released, the K16 relay is turned off and the amplifier again permits simultaneous two-way speech between the student and instructor.

2-78. REMOVAL OF F14 AMPLIFIER.
(See figure 2-6.)

a. Turn off electrical power and open right nose access door.

b. Disconnect electrical plug.

c. Open snapslide fasteners and remove amplifier.

2-79. INSTALLATION OF F14 AMPLIFIER.
(See figure 2-6.)

a. Position amplifier on mount, close snapslide fasteners and safety.

b. Connect electrical plug.

c. Check operation in accordance with paragraph 2-73.

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1st Lt Oswald L. Drummond

T.O. NO. 1T-37A-2-7

HANDBOOK

MAINTENANCE INSTRUCTIONS

ELECTRICAL SYSTEM

USAF SERIES
T-37A
AIRCRAFT

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PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE

McCORMICK-ARMSTRONG, WICHITA, 1100, 8-6-56

31 MARCH 1956

REVISED 30 JUNE 1956

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* 5	30 June 1956
*12	30 June 1956
*13	30 June 1956
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*21	30 June 1956
*22	30 June 1956
*22A	30 June 1956
*23	30 June 1956
*24	30 June 1956
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*26A	30 June 1956
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INTRODUCTION

This handbook is one of a series of handbooks of T. O. No. 1T-37A-2 sectionalized maintenance handbook and contains information relative to the airplane electrical system. Information includes power loading data, functional description, removal, installation and adjustments of the various electrical system components for use by line maintenance personnel. Illustrations and schematic diagrams have been used throughout the book to supplement the text and to aid in locating the various items of equipment. The following is a list of the other handbooks of the T. O. No. 1T-37A-2 sectionalized maintenance handbook.

T. O. No. 1T-37A-2-1	General Airplane
T. O. No. 1T-37A-2-2	Ground Handling, Servicing, and Airframe Group Maintenance
T. O. No. 1T-37A-2-3	Hydraulically Operated Systems and Utility Systems
T. O. No. 1T-37A-2-4	Flight Control Systems
T. O. No. 1T-37A-2-5	Power Plant, Fuel System and Oil System
T. O. No. 1T-37A-2-6	Instruments, Radio, Communication, and Navigation Equipment
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POWER LOADING DATA

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1-1. POWER LOADING DATA. The three tables included in this section present electrical load levels that may occur during specified operating conditions of the T-37A. Tables I and III tabulate the DC electrical characteristics of the airplane; Table II tabulates the AC. The seven components of the electrical power equipment are:

a. Two generators, VG-550, 100 AMP, 30V.
b. Two voltage regulators, 1589-1-C or 1589-1-D
c. Two reverse current relays, AN3025-1.
d. One battery, AN3150-2, 36 ampere-hour.

Table I. DC Electrical Load Analysis (Sheet 1 of 3)

A EQUIPMENT	B PART DESIGNATION	C NUMBER OF UNITS	D AMPERES PER UNIT	E OPERATING TIME-MIN.	F OPERATING CONDITIONS									
					F-1 LOADING & ANCHOR					F-2 START & WARMUP				
					AMPS	AVERAGE AMPS 0.5 MIN	2.0 MIN	15.0 MIN	MIN	AMPS	AVERAGE AMPS 0.5 MIN	2.0 MIN	15.0 MIN	MIN
1. C. CONTROL SURFACE														
2. ACTUATORS, TRIM TAB	TRANSCO 9788	2	.80	.5										
3. ACTUATOR, ELEVATOR TAB	LEAR 259B	1	1.5	.5										
4. VALVE, SPEED BRAKE SOLENOID	ADEL 23665-6	1	.50	15										
5. VALVE, THRUST ATTENUATOR	ADEL 23665-6	1	.50	15										
6.														
7. D. INSTRUMENT														
8. INDICATOR, FLAP POSITION	MS28023-1	1	.07	30	.1	.1	.1	.1		.1	.1	.1	.1	
9. INDICATOR, LANDING GEAR														
10. POSITION	AN5839-1	3	.03	30	.1	.1	.1	.1		.1	.1	.1	.1	
11. LIGHT, ELEVATOR TRIM TAB														
12. NEUTRAL	AN3157-3	1	.17	30	.2	.2	.2	.2		.2	.2	.2	.2	
13.														
14. F. FLIGHT INSTRUMENT														
15. PITOT HEATER	AN5813-1	1	2.85	30										
16. TURN & SLIP	MS28024-1	1	1.50	30	1.5	1.5	1.5	1.5		1.5	1.5	1.5	1.5	
17.														
18. G. LANDING GEAR														
19. HORN, WARNING	J-2	1	.50	.5										
20. LIGHTS, EXTERNAL GEAR	AN3092-2	3	.17	30						.5	.5	.5	.5	
21. LIGHTS, WARNING	AN3140-327	2	.04	30										
22. RELAY, HORN SILENCING	AN3114-1	1	.20	30										
23.														
24. L. LIGHTING														
25. COCKPIT	C-4A	2	.17	30	.3	.3	.3	.3		.3	.3	.3	.3	
26. FLASHER	C-2	1	.25	30						.3	.3	.3	.3	
27. FUSELAGE	AN3177-10	2	1.50	30						3.0	3.0	3.0	3.0	
28. LANDING	AN3129-4523	2	8.93	15										
29. NAVIGATION, TAIL	AN3158	2	.80	30						1.6	1.6	1.6	1.6	
30. NAVIGATION, WING TIP	AN3033	2	.75	30						1.5	1.5	1.5	1.5	
31. PRIMARY INST. (FLIGHT)	AN3140-327	17	.04	30										
32. PRIMARY INST. (NON-FLIGHT)	AN3140-327	31	.04	30						1.2	1.2	1.2	1.2	
33. SECONDARY INSTRUMENTS	MS25027-1	5	.30	30						1.5	1.5	1.5	1.5	
34. TAXI	GE4570	1	5.35	15										
35.														
36. M. MISCELLANEOUS														
37. ACTUATOR, CANOPY	OR550M15	1	9.00	.5	9.0	9.0	2.3	.3						
38.														
39. P. POWER														
40. CHARGING, BATTERY	AN3150-2	1	*	*										
41. INVERTER (MAIN)	1-100A-115D-7	1	6.80	30						6.8	6.8	6.8	6.8	
42. INVERTER (SPARE)	1-100A-115D-7	1	9.60	30										
43. RELAY, BATTERY	AN3370-2	1	.60	30	.6	.6	.6	.6		.6	.6	.6	.6	
44.														
45. Q. FUEL & OIL														
46. LIGHT, LOW FUEL WARNING	AN3157-6	1	.17	30										
47. MOTOR, FUEL PROPORTIONER	11901-1	1	6.00	*						6.0	6.0	3.0	.4	
48. PUMP, FUEL BOOST	RG-11100C1	1	17.0	30						17.0	17.	17	17	
49. RELAY, TRANSFER	RG12M-1	1	.08	30	.1	.1	.1	.1		.1	.1	.1	.1	
50. VALVE, HYDRAULIC SOLENOID	102221	2	.80	30	.8	.8	.8	.8		.8	.8	.8	.8	
51. VALVE, SHUT-OFF	WE452-1D	2	5.0	.016						NEG				
52. R. RADIO														
53. CONTROL UNIT	C-58	1	.12	30										
54. HOT MIKE	F-14	1	.70	30										
55. OMNI	R-13B	1	2.90	30										
56. RECEIVER	R-19	1	1.50	30										
57. RECEIVER	R-20	1	.30	30										
58. RELAY, OSCILLATOR	K-13	1	.50	30										
59. TRANSMITTER (STAND-BY)	T-11B	1	1.00	30										
60. TRANSMITTER (KEYED)	T-11B	1	1.60	*					*See Table III					
61. TRANSMITTER (STAND-BY)	T-13A	1	1.00	30										
62. TRANSMITTER (KEYED)	T-13A	1	1.60	*										
63. W. WARNING														
64. CONTROL UNIT, FIRE	(O)227-28-2	2	.10	30										
65. CONTROL UNIT, OVERHEAT	(O)227-28-2	2	.10	30						.2	.2	.1		
66. FLASHER, OVERHEAT	D7280A-1	1	.25	30						.3	.3	.1		
67. LIGHT, CANOPY NOT LOCKED	AN3157-6	1	.17	30	.2	.2	.2	.2		.2	.2	.2	.2	
68. LIGHT, FIRE & OVERHEAT	AN3140R327	2	.04	30						.1	.1			
69. LIGHT, ICE WARNING	AN3157-8	1	.17	30										
70. ICE DETECTOR	666-1221	1	7.00	30*	7.0	7.0	7.0	7.0		7.0	7.0	7.0	7.0	
71.					19.9	19.9	13.2	11.2		50.9	50.9	47.5	44.7	

Table I. DC Electrical Load Analysis (Sheet 2 of 3)

LINE NO.	F OPERATING CONDITIONS																			
	F-3 TAXI					F-4 TAKE-OFF & CLIMB					F-5 CRUISE					F-6 CRUISE- COMBAT				
	AMPS	AVERAGE AMPS 0.5 MIN	2.0 MIN	15.0 MIN	MIN	AMPS	AVERAGE AMPS 0.5 MIN	2.0 MIN	15.0 MIN	MIN	AMPS	AVERAGE AMPS 0.5 MIN	2.0 MIN	30.0 MIN	MIN	AMPS	AVERAGE AMPS 0.5 MIN	2.0 MIN	30.0 MIN	MIN
1.																				
2.						1.6	1.6	.4	.1		1.6	1.6	.4							
3.						1.5	1.5	.4	.1		1.5	1.5	.4							
4.																				
5.																				
6.																				
7.																				
8.	.1	.1	.1	.1		.1	.1	.1	.1		.1	.1	.1	.1		.1	.1	.1	.1	
9.																				
10.	.1	.1	.1	.1		.1	.1	.1	.1		.1	.1	.1	.1		.1	.1	.1	.1	
11.																				
12.	.2	.2	.2	.2		.2	.2	.2	.2		.2	.2	2	.2		.2	.2	2	.2	
13.																				
14.																				
15.						2.9	2.9	2.9	2.9		2.9	2.9	2.9	2.9		2.9	2.9	2.9	2.9	
16.	1.5	1.5	1.5	1.5		1.5	1.5	1.5	1.5		1.5	1.5	1.5	1.5		1.5	1.5	1.5	1.5	
17.																				
18.																				
19.																				
20.	.5	.5	.5	.5		.5	.5	.1												
21.																				
22.																				
23.																				
24.																				
25.	.3	.3	.3	.3		.3	.3	.3	.3		.3	.3	.3	.3		.3	.3	.3	.3	
26.	.3	.3	.3	.3		.3	.3	.3	.3		.3	.3	.3	.3		.3	.3	.3	.3	
27.	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	
28.																				
29.	1.6	1.6	1.6	1.6		1.6	1.6	1.6	1.6		1.6	1.6	1.6	1.6		1.6	1.6	1.6	1.6	
30.	1.5	1.5	1.5	1.5		1.5	1.5	1.5	1.5		1.5	1.5	1.5	1.5		1.5	1.5	1.5	1.5	
31.						.7	.7	.7	.7		.7	.7	.7	.7		.7	.7	.7	.7	
32.	1.2	1.2	1.2	1.2		1.2	1.2	1.2	1.2		1.2	1.2	1.2	1.2		1.2	1.2	1.2	1.2	
33.	1.5	1.5	1.5	1.5		1.5	1.5	1.5	1.5		1.5	1.5	1.5	1.5		1.5	1.5	1.5	1.5	
34.	5.4	5.4	5.4	5.4																
35.																				
36.																				
37.	9.0	9.0	2.3	.3																
38.																				
39.																				
40.						86.4	86.4	54.0	32.4		64.8	64.8	40.5	17.6		43.2	43.2	27.0	11.7	
41.	6.8	6.8	6.8	6.8		6.8	6.8	6.8	6.8		6.8	6.8	6.8	6.8		6.8	6.8	6.8	6.8	
42.																				
43.	.6	.6	.6	.6		.6	.6	.6	.6		.6	.6	.6	.6		.6	.6	.6	.6	
44.																				
45.																				
46.																				
47.	6.0	6.0	6.0	4.4		6.0	6.0	6.0	6.0		6.0	6.0	6.0	3.0		6.0	6.0	6.0	6.0	
48.	17.0	17.0	17.0	17.0		17.0	17.0	17.0	17.0		17.0	17.0	17.0	17.0		17.0	17.0	17.0	17.0	
49.	.1	.1	.1	.1		.1	.1	.1	.1		.1	.1	.1	.1		.1	.1	.1	.1	
50	.8	.8	.8	.8		.8	.8	.8	.8		.8	.8	.8	.8		.8	.8	.8	.8	
51.																				
52.																				
53.	.1	.1	.1	.1		.1	.1	.1	.1		.1	.1	.1	.1		.1	.1	.1	.1	
54.	.7	.7	.7	.7		.7	.7	.7	.7		.7	.7	.7	.7		.7	.7	.7	.7	
55.	2.9	2.9	2.9	2.9		2.9	2.9	2.9	2.9		2.9	2.9	2.9	2.9		2.9	2.9	2.9	2.9	
56.	1.5	1.5	1.5	1.5		1.5	1.5	1.5	1.5		1.5	1.5	1.5	1.5		1.5	1.5	1.5	1.5	
57.	.3	.3	.3	.3		.3	.3	.3	.3		.3	.3	.3	.3		.3	.3	.3	.3	
58.	.5	.5	.5	.5		.5	.5	.5	.5		.5	.5	.5	.5		.5	.5	.5	.5	
59.	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0	
60.	.6	.6	.3	.1		.6	.6	.3			.6	.6	.3			.6	.6	.3	.1	
61.	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0	
62.																				
63.																				
64.																				
65.	.2	.2	.1			.2	.2	.2	.2		.2	.2	.2	.2		.2	.2	.2	.2	
66.	.3	.3	.1			.3	.3	.3	.3		.3	.3	.3	.3		.3	.3	.3	.3	
67.	.2	.2	.2	.2																
68.	.1	.1				.1	.1				.1	.1				.1	.1			
69.											.2	.2	.2	.2		.2	.2	.2	.2	
70.	7.0	7.0	7.0	7.0		7.0	7.0	7.0	7.0		7.0	7.0	7.0	7.0		7.0	7.0	7.0	7.0	
71.	73.9	73.9	66.5	62.5		152.4	152.4	116.9	94.3		130.5	130.5	103.5	76.5		105.8	105.8	89.2	73.7	

Table I. DC Electrical Load Analysis (Sheet 3 of 3)

LINE NO.	F OPERATING CONDITIONS																			
	F-7 LANDING					F-8 EMERGENCY					F-9					F-10				
	AVERAGE AMPS					AVERAGE AMPS														
	AMPS	0.5 MIN	2.0 MIN	15.0 MIN	MIN	AMPS	0.5 MIN	2.0 MIN	30.0 MIN	MIN										
1.																				
2.	1.6	1.6	.4	.1		1.6	1.6	.4												
3.	1.5	1.5	.4	.1		1.5	1.5	.4												
4.	.5	.5	.5	.5																
5.	.5	.5	.5	.5																
6.																				
7.																				
8.	.1	.1	.1	.1																
9.																				
10.	.1	.1	.1	.1																
11.																				
12.	.2	.2	.2	.2																
13.																				
14.																				
15.	2.9	2.9	2.9	2.9		2.9	2.9	2.9	2.9											
16.	1.5	1.5	1.5	1.5		1.5	1.5	1.5	1.5											
17.																				
18.																				
19.	.5	.5	.1																	
20.	.5	.5	.5	.5																
21.	.1	.1																		
22.	.2		.2	.2																
23.																				
24.																				
25.	.3	.3	.3	.3																
26.	.3	.3	.3	.3																
27.	3.0	3.0	3.0	3.0																
28.	17.9	17.9	17.9	17.9																
29.	1.6	1.6	1.6	1.6																
30.	1.5	1.5	1.5	1.5																
31.	.7	.7	.7	.7		.7	.7	.7	.7											
32.	1.2	1.2	1.2	1.2		1.2	1.2	1.2	1.2											
33.	1.5	1.5	1.5	1.5																
34.																				
35.																				
36.																				
37.																				
38.																				
39.																				
40.	21.6	21.6	13.5	10.8																
41.	6.8	6.8	6.8	6.8		6.8	6.8	6.8	6.8											
42.																				
43.	.6	.6	.6	.6																
44.																				
45.																				
46.	.2	.2	.2	.2																
47.	6.0	6.0	6.0	4.4		6.0	6.0	6.0	3.0											
48.	17.0	17.0	17.0	17.0		17.0	17.0	17.0	17.0											
49.	.1	.1	.1	.1																
50.	.8	.8	.8	.8		.8	.8	.8	.8											
51.																				
52.																				
53.	.1	.1	.1	.1																
54.	.7	.7	.7	.7																
55.	2.9	2.9	2.9	2.9																
56.	1.5	1.5	1.5	1.5																
57.	.3	.3	.3	.3																
58.	.5	.5	.5	.5																
59.	1.0	1.0	1.0	1.0																
60.	.6	.6	.3	.1																
61.	1.0	1.0	1.0	1.0																
62.																				
63.																				
64.																				
65.	.2	.2	.2	.2																
66.	.3	.3	.3	.3																
67.																				
68.																				
69.	.2	.2	.2	.2																
70.	7.0	7.0	7.0	7.0																
71.	107.6	107.4	96.4	91.2		40.0	40.8	37.7	33.9											

Table II. A.C. Electrical Load Analysis

A EQUIPMENT			GAGE FUEL QUANTITY	ATTITUDE GYRO	DIRECTIONAL GYRO	FUEL FLOW INDICATOR	FUEL FLOW TRANSMITTER	TRANS-FORMER	TOTAL
B PART DESIGNATION			**	Type J-8	Type C-5C	Type A-16	Type J-5	G.E. 70G63	
C TOTAL NUMBER OF UNITS			1	1	1	2	2	1	
D OPERATING TIME MINUTES			30	30	30	30	30	30	
E ELECT-RICAL REQUIRE PER UNIT	115V 3Ø	E1 VA		9.4	40.0				
		E2 WATTS		6.0	20.0				
		E3 VARS		7.2	34.6				
	115V 1Ø	E4 VA	14.0					.3	
		E5 WATTS	14.0					.3	
		E6 VARS	0					0	
	26V 1Ø	E7 VA				3.3	3.3		
		E8 WATTS				.6	.6		
		E9 VARS				3.2	3.2		
F PF			1.0	.64	.5	.18	.18	1.0	
G VOLT REGULATOR			±10	±10	±10	±10	±10	±10	
H FREQUENCY RANGE			380/420	380/420	380/420	380/420	380/420	380/420	
I CONNECTED LOAD		I1 VA	14.0	9.4	40.0	6.6	6.6	.3	76.9
		I2 WATTS	14.0	6.0	20.0	1.2	1.2	.3	42.7
		I3 VARS	0	7.2	34.6	6.4	6.4	.3	54.9

UNIT	PART NO.	
*INDICATOR	HONEYWELL JG4B-1	PEAK STARTING VA = 154.3
*POWER UNIT	HONEYWELL EG5B-1	

Table III. Electrical Load Analysis

EQUIPMENT	SUPPLEMENTARY DATA-ASSUMPTION							
	LOADING & ANCHOR	START & WARM-UP	TAXI	TAKE-OFF & CLIMB	CRUISE	CRUISE-COMBAT	LANDING	EMERGENCY
BATTERY CHARGING	NONE	NONE	NONE	← Calculated per MIL-E-7017 →				
FUEL PROPORTIONER		1 min of operation in 15 min	2 min of operation in 15 min	Contin-uous operation	2 min of operation in 10 min	Contin-uous operation	2 min of operation in 15 min	5 min of operation in 10 min
ICE DETECTOR	← If not de-iced in 17 to 21 seconds, system will turn off →							
RADIO * TRANSMITTERS			1 min of operation in 15 min	1 min of operation in 5 min	1 min of operation in 5 min	1 min of operation in 5 min	1 min of operation in 5 min	

*Both Transmitters cannot be keyed simultaneously

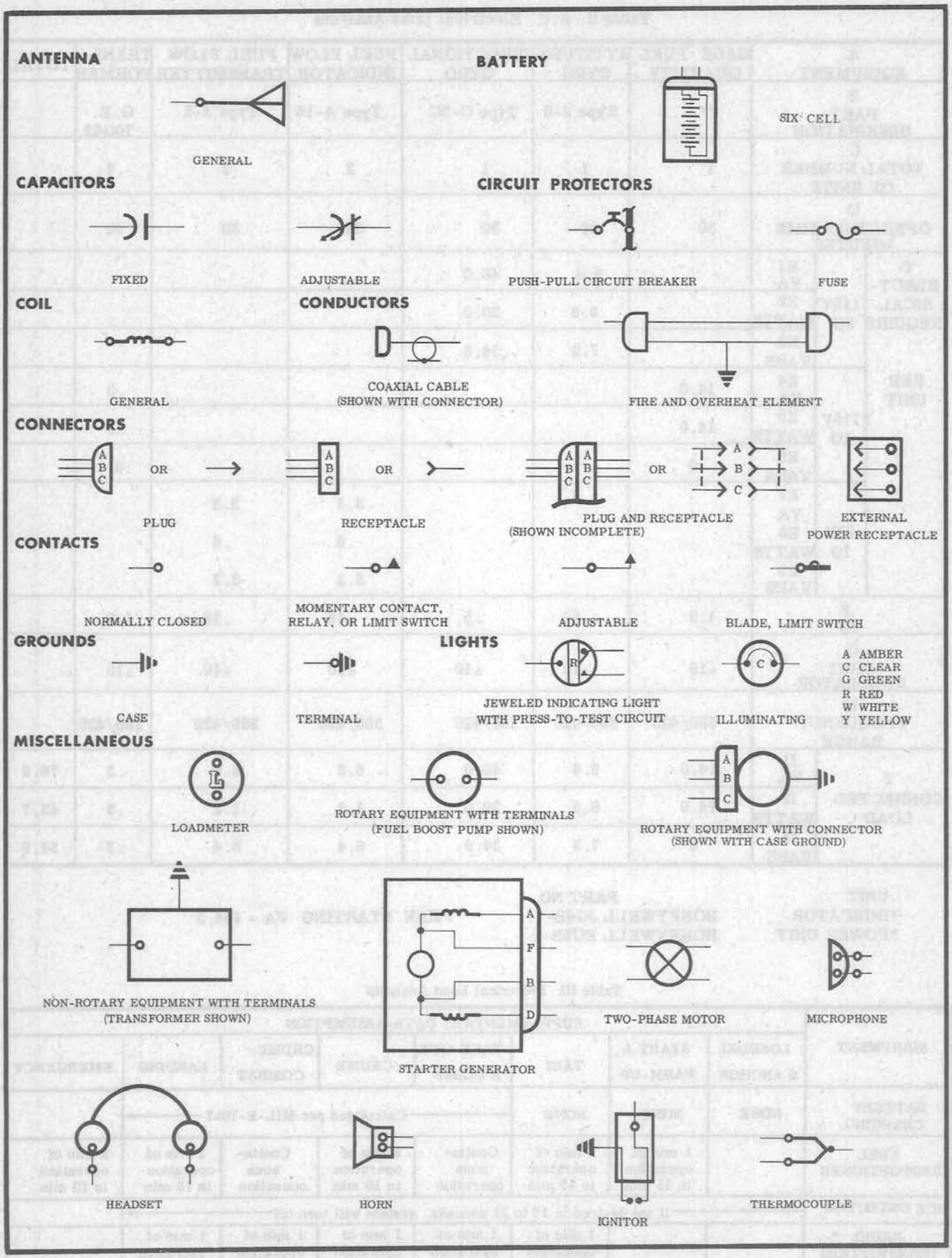


Figure 1-1. Electrical Symbols (Sheet 1 of 5)

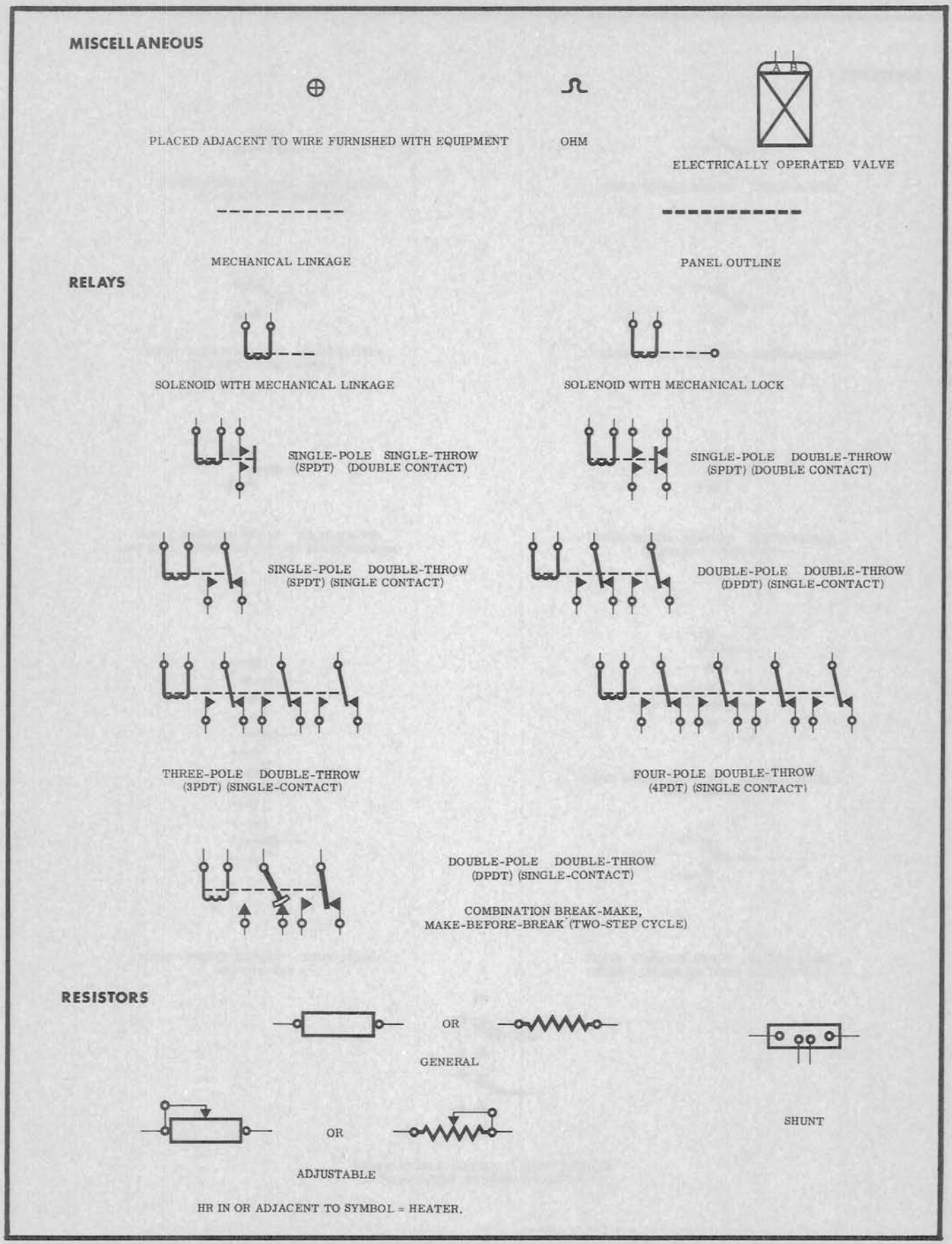


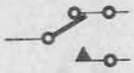
Figure 1-1. Electrical Symbols (Sheet 2 of 5)

SWITCHES

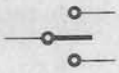
SINGLE-POLE SINGLE-THROW (SPST)

SINGLE-POLE SINGLE-THROW (SPST)
(MOMENTARY CONTACT)

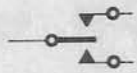
SINGLE-POLE DOUBLE-THROW (SPDT)



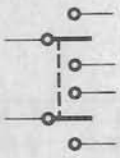
SINGLE-POLE DOUBLE-THROW (SPDT)
(MOMENTARY CONTACT)



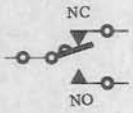
SINGLE-POLE DOUBLE-THROW (SPDT)
(WITH "OFF" POSITION)



SINGLE-POLE DOUBLE-THROW (SPDT)
MOMENTARILY ON, OFF, MOMENTARILY ON)

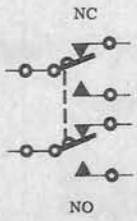


DOUBLE-POLE DOUBLE-THROW (DPDT)
(ON-OFF-ON)



SINGLE-POLE DOUBLE-THROW (SPDT)
(LOW TRAVEL LIMIT OR MICRO SWITCH)

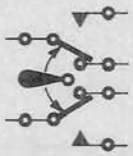
FOUR-POLE DOUBLE-THROW (4PDT)
(ON-OFF-ON)



DOUBLE-POLE DOUBLE-THROW (DPDT)
(LOW TRAVEL LIMIT OR MICRO SWITCH)

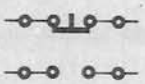
Figure 1-1. Electrical Symbols (Sheet 3 of 5)

SWITCHES

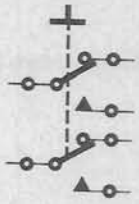


SINGLE-POLE DOUBLE-THROW (SPDT)
DOUBLE ACTING

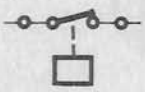
SINGLE-POLE SINGLE-THROW (SPST)
SPRING RETURN PUSH -BUTTON



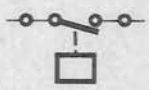
SINGLE-POLE DOUBLE-THROW (SPDT)
SPRING RETURN PUSH-BUTTON



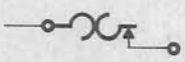
DOUBLE-POLE DOUBLE THROW (DPDT)
SPRING RETURN SINGLE CONTACT
PUSH BUTTON



SINGLE-POLE SINGLE-THROW (SPST)
FLOAT SWITCH (CLOSE WHEN EMPTY)

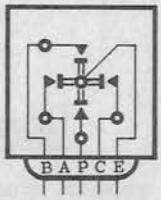


SINGLE-POLE SINGLE-THROW (SPST)
FLOAT SWITCH (CLOSE WHEN FULL)



THERMAL SWITCH (EXTERNALLY HEATED) (NORMALLY CLOSED)

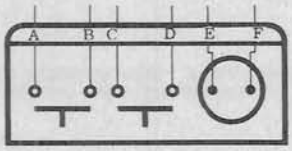
ROTARY SWITCH,SEGMENTAL CONTACT



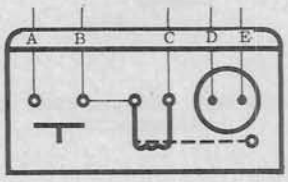
FIVE-POSITION SELECTOR SWITCH (FOUR MOMENTARY CONTACTS AND OFF) (USED FOR STICK GRIP ONLY)

Figure 1-1. Electrical Symbols (Sheet 4 of 5)

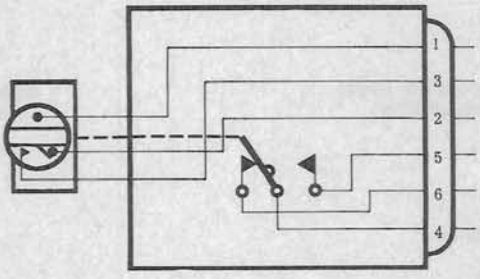
SWITCHES



STUDENTS LANDING GEAR CONTROL



INSTRUCTORS LANDING GEAR CONTROL



FIRE AND OVERHEAT SWITCH
(SHOWN OFF, HANDLE PULLED OUT)

TERMINALS OR JUNCTIONS

NUT OR SCREW

SOLDERED OR CRIMPED

SPLICE

D C BUS WITH TERMINAL

TERMINAL BLOCK WITH BUS
(SHOWN INCOMPLETE)

TERMINAL BLOCK WITH TWO BUSSES,
(SHOWN COMPLETE)

Figure 1-1. Electrical Symbols (Sheet 5 of 5)

SECTION II
ELECTRICAL POWER SUPPLY

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2-1. DC POWER SUPPLY.

2-2. GENERAL. DC power is supplied by the two 30-volt, 100-ampere, engine-driven generators, or by 28-volt DC ground power received through the external power receptacle. Standby power is supplied by a 24-volt, 36 ampere-hour battery.

2-3. TWENTY EIGHT VOLT DC GENERATOR SYSTEM.

2-4. DESCRIPTION. (See figures 2-1 and 2-2.) Two engine-driven starter-generators are used to start the engines and to supply 28 volt DC power to the airplane. Both generator circuits supply power directly to a bus bar assembly consisting of three parallel-wired bus bars attached to the circuit breakers. Two loadmeters, mounted on the shock panel, indicate the percent of load being drawn from the generators. Each of the generator circuits includes the following units: an ON-OFF generator switch; a loadmeter; a loadmeter shunt; a voltage regulator; a reverse current relay; a starter-generator; a generator control relay; and a generator circuit breaker. The generators are mounted on the engines, the switches on the switch panel, the loadmeters on the shock panel, and the rest of the equipment in the left nose electrical equipment section.

2-5. FUNCTIONAL DESCRIPTION. (See figure 2-2.) At the beginning of the engine operation, when the start switch is held in the start position, the starter relay is energized and power is supplied to the start winding of the starter-generator. At the same time, the generator control relay is energized, cutting the voltage regulator and the reverse current relay from the circuit, to prevent interference or damage to the starter generator. The starter turns over the engine until engine operation becomes self sustaining. When the start switch is released, the generator control relay is de-energized, the voltage regulator and the reverse current relay are returned to the circuit, and the starter begins its function as a generator. As engine rpm increases, generator voltage output increases up to the voltage regulator setting which should be 28 ±0.5 volts. This voltage should be maintained over a wide range of loads and speeds. With the generator switch ON, when generator voltage exceeds bus voltage, the reverse current relay is closed, connecting the generator to the bus assembly. With the generator connected to the bus, the corresponding loadmeter indicates the percentage of total generator current capacity being used. Since generator capacity is 100 amperes, the indicated load can be read either as a percentage, or as amperes. The D terminals of the two voltage regulators are connected, permitting parallel operation of the two generators. If the generators are carrying unequal shares of a load, current will flow from the negative brush of the lower output generator through an equalizer coil in its corresponding regulator. From there, it flows through the D terminal connection, through the equalizer coil in the other regulator, and finally to the negative brush of the overloaded generator. The equalizer coils, acting directly on the regulator carbon piles, cause the regulators to lower the voltage output of the overloaded generator and raise the voltage output of the other. When the generators are balanced, no current will flow in either direction through the equalizer coils. Consequently the loadmeters should not indicate greater than ten percent difference in load unless some part of the system is not functioning properly.

Note

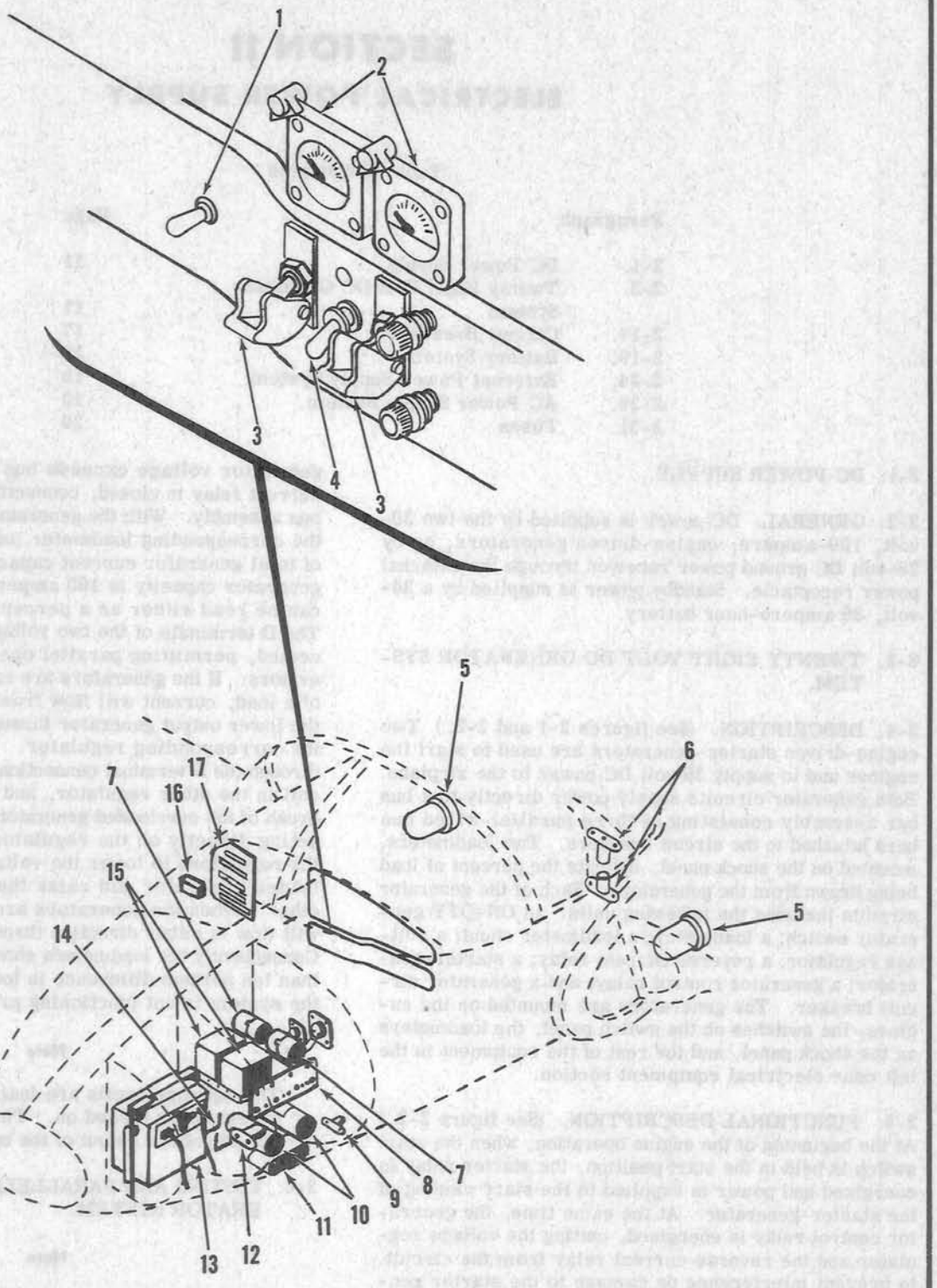
The equalizer coils are inactive when only one generator is turned on. This prevents reduction of voltage output of the operating generator.

2-6. TESTING AND PARALLELING 28 VOLT DC GENERATOR SYSTEM.

Note

Use a portable precision voltmeter with test leads.

a. Start both engines and stabilize at 80% rpm.
b. Turn on battery and disconnect external power.
c. Turn on both generators and allow system to warm up for 20 minutes.
d. Turn off left generator.
e. Open left nose access door.
f. Connect voltmeter negative lead to ground and posi-



1. Inverter switch
2. Loadmeter
3. Generator switch
4. Battery switch
5. Starter-generator
6. Generator control relay
7. Voltage regulator
8. Generator circuit breakers
9. Battery relay
10. Inverter
11. External power receptacle
12. External power relay
13. Battery
14. Loadmeter shunt
15. Reverse current relay
16. Transformer
17. Circuit breaker panel

Figure 2-1. Location of Electrical Power Components

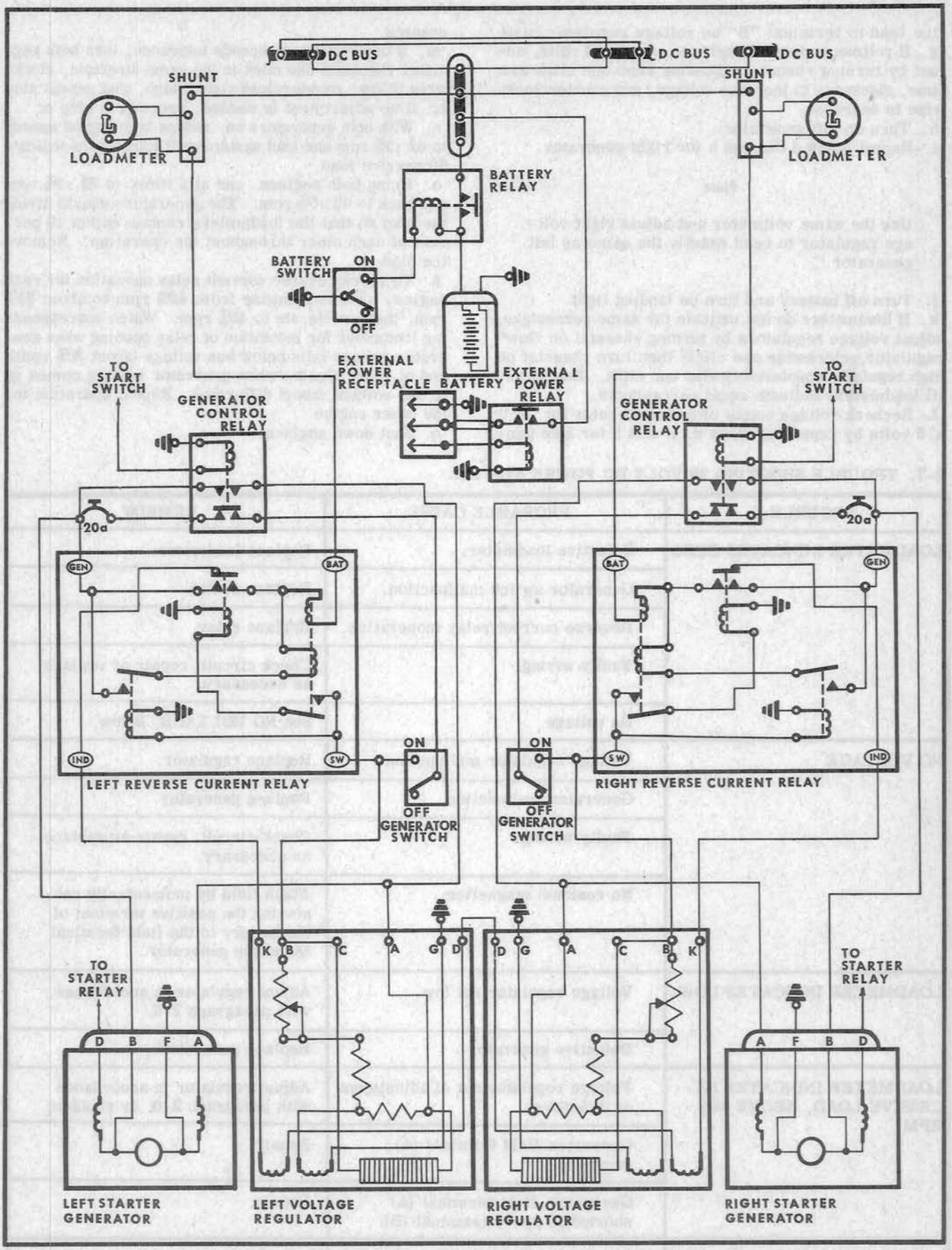


Figure 2-2. DC Power Supply System

tive lead to terminal "B" on voltage regulator base.

g. If voltmeter does not indicate exactly 28 volts, adjust by turning rheostat adjusting knob one click at a time, clockwise to increase voltage, and counterclockwise to decrease.

h. Turn on left generator.

i. Repeat steps d through h for right generator.

Note

Use the same voltmeter and adjust right voltage regulator to read exactly the same as left generator.

j. Turn off battery and turn on landing light.

k. If loadmeters do not indicate the same percentage, adjust voltage regulators by turning rheostat on "low" regulator, clockwise one click; then turn rheostat on high regulator counterclockwise one click. Repeat until loadmeters indicate equal percentages.

l. Recheck voltage output of each generator for 28.0 ±.5 volts by repeating steps d, f, and h for both generators.

m. If one regulator exceeds tolerance, turn both regulator rheostats one click in the same direction, clockwise if low, counterclockwise if high, and repeat step k. If no adjustment is needed, proceed to step n.

n. With both generators on, reduce both engine speeds to 42 ±5% rpm and load system until loadmeters indicate 50 percent load.

o. Bring both engines, one at a time, to 65 ±5% rpm and back to 42 ±5% rpm. The generators should divide the load so that the loadmeters remain within 10 percent of each other throughout the operation. Remove the load.

p. To check reverse current relay operation for each engine, slow one engine from 42% rpm to about 25% rpm, then accelerate to 45% rpm. Watch corresponding loadmeter for indication of relay opening when generator voltage falls below bus voltage (about 30% rpm), and of relay closing when generator voltage comes up to bus voltage (about 40% rpm). Repeat operation for the other engine.

q. Shut down engines.

2-7. TROUBLE SHOOTING 28 VOLT DC POWER SYSTEM.

TROUBLE	PROBABLE CAUSE	REMEDY
LOADMETER INDICATES ZERO	Defective loadmeter.	Replace loadmeter.
	Generator switch malfunction.	Replace switch.
	Reverse current relay inoperative.	Replace relay.
	Faulty wiring.	Check circuit; repair or replace as necessary.
	No voltage.	See NO VOLTAGE, below.
NO VOLTAGE	Voltage regulator malfunction.	Replace regulator.
	Generator malfunction.	Replace generator.
	Faulty wiring.	Check circuit; repair or replace as necessary.
	No residual magnetism.	Flash field by momentarily connecting the positive terminal of the battery to the field terminal (A) of the generator.
LOADMETER INDICATES LOW	Voltage regulator set low.	Adjust regulator in accordance with paragraph 2-6.
	Defective generator.	Replace generator.
LOADMETER INDICATES EXCESSIVE LOAD, ABOVE 50% RPM	Voltage regulator out of adjustment or defective.	Adjust regulator in accordance with paragraph 2-6, or replace.
	Generator field terminal (A) grounded.	Repair.
	Generator field terminal (A) shorted to power terminal (B).	Repair.
REVERSE CURRENT RELAY FAILS TO OPEN AT 30% RPM	Reverse current relay shorted.	Replace relay.

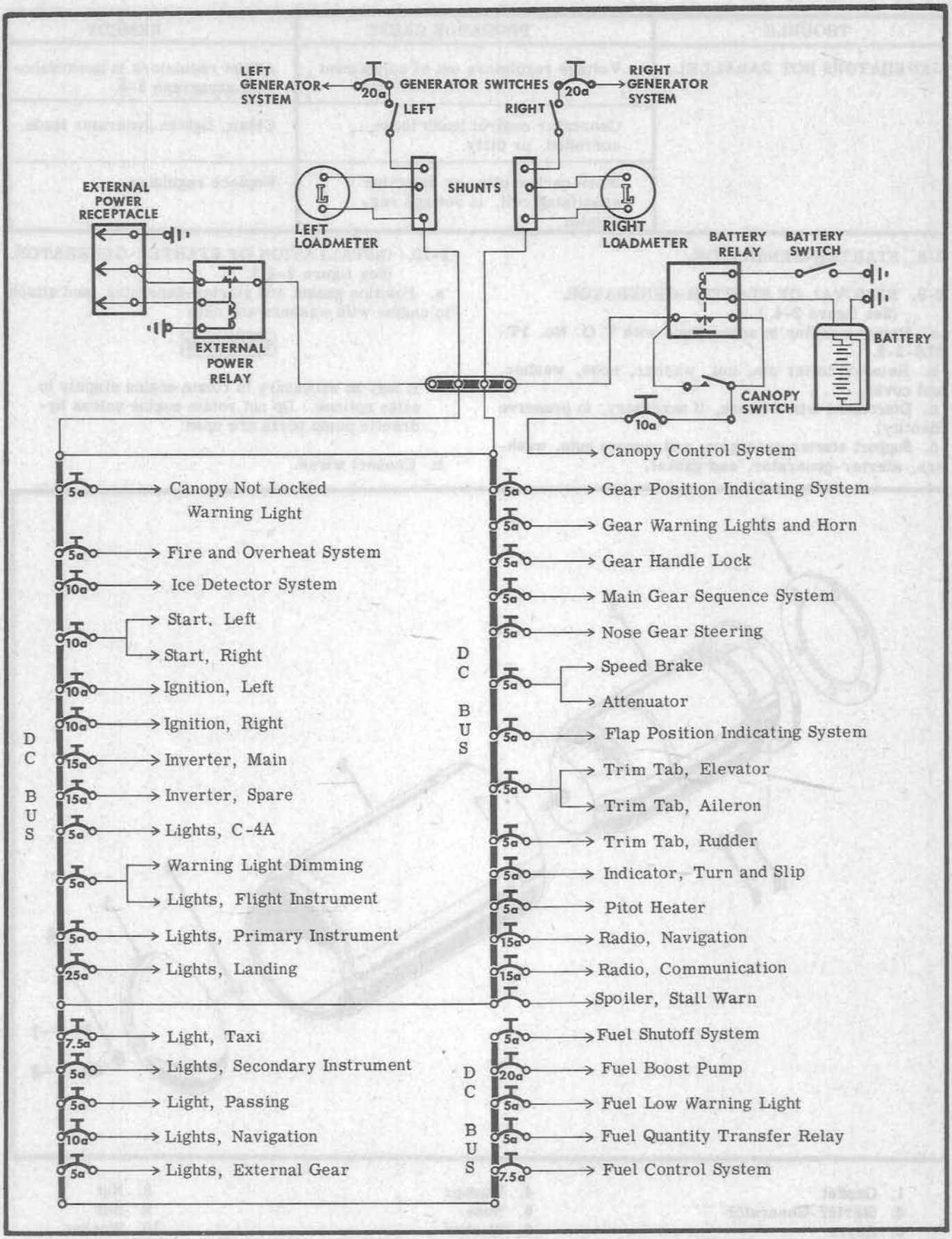


Figure 2-3. DC Power Distribution

TROUBLE	PROBABLE CAUSE	REMEDY
GENERATORS NOT PARALLEL.	Voltage regulators out of adjustment	Adjust regulators in accordance with paragraph 2-6.
	Generator control leads loose, corroded, or dirty.	Clean, tighten generator leads.
	Worn carbon pile, or defective equalizing coil, in voltage regulator.	Replace regulator.

2-8. STARTER-GENERATOR.

2-9. REMOVAL OF STARTER-GENERATOR. (See figure 2-4.)

a. Remove engine in accordance with T. O. No. 1T-37A-2-5.

b. Remove cotter pin, nut, washer, nose, washer, and cover.

c. Disconnect wires (mark, if necessary, to preserve identity).

d. Support starter-generator, and remove nuts, washers, starter-generator, and gasket.

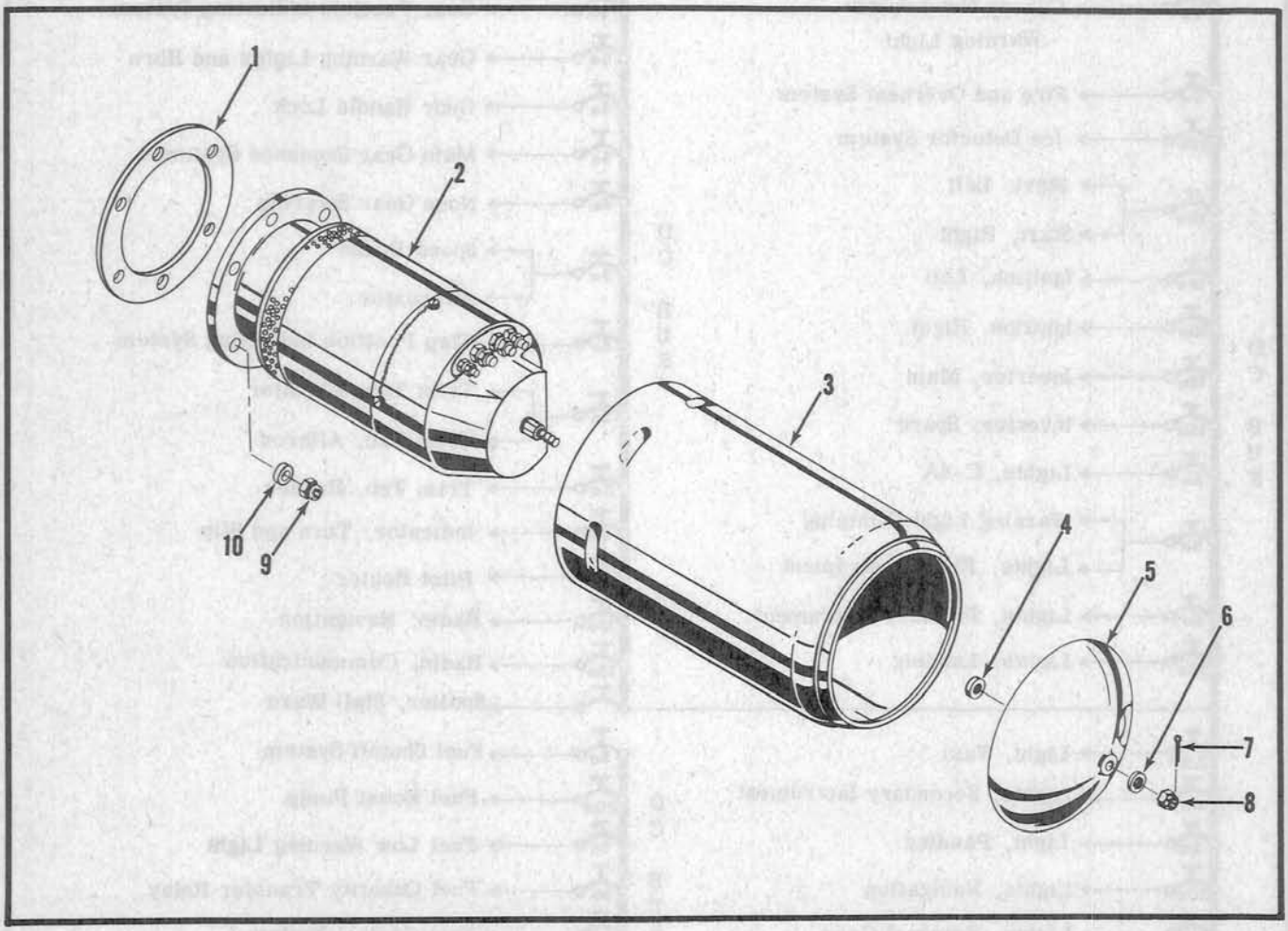
2-10. INSTALLATION OF STARTER-GENERATOR. (See figure 2-4.)

a. Position gasket and starter-generator, and attach to engine with washers and nuts.

CAUTION

It may be necessary to rotate engine slightly to align splines. Do not rotate engine unless hydraulic pump ports are open.

b. Connect wires.



1. Gasket
2. Starter-Generator
3. Cover
4. Washer
5. Nose
6. Washer
7. Cotter Pin
8. Nut
9. Nut
10. Washer

Figure 2-4. Starter-Generator Installation

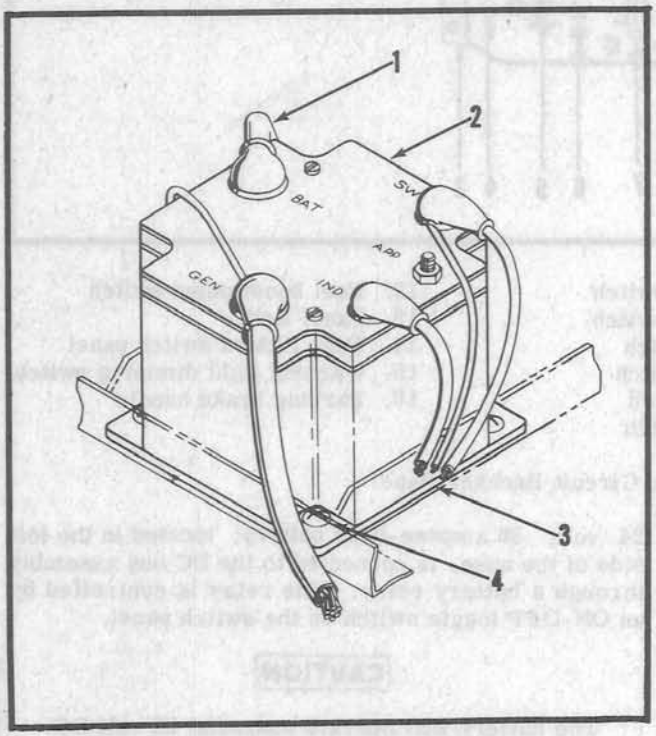
c. Position cover, washer, and nose; attach with washer and nut; and secure with cotter pin.
d. Install engine in accordance with T.O. No. 1T-37A-2-5.

2-11. REMOVAL OF REVERSE CURRENT RELAY. (See figure 2-5.)
a. Disconnect wires.
b. Remove four screws and nuts.
c. Remove relay.

Note

Tag wires, if necessary, to preserve identity.

2-12. INSTALLATION OF REVERSE CURRENT RELAY. (See figure 2-5.)
a. Attach reverse current relay to support assembly with four screws and nuts.
b. Connect wiring.



1. Wire
2. Reverse current relay
3. Support
4. Screw

Figure 2-5. Reverse Current Relay Installation

2-13. REMOVAL OF VOLTAGE REGULATOR. (See figure 2-6.)
a. Disengage mounting clamps.
b. Lift regulator from base.

2-14. INSTALLATION OF VOLTAGE REGULATOR. (See figure 2-6.)
a. Position regulator into slots in base.
b. Press down on regulator until clamps slide over upright arms.

2-15. REMOVAL OF SWITCH. (Typical)
a. Separate switch from panel, and from guard if provided.

Note

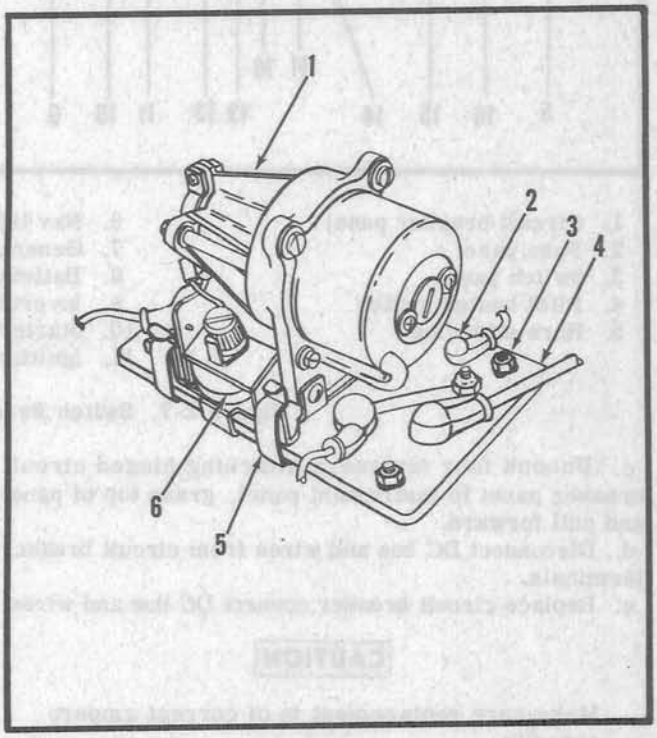
Switches are attached either by two screws or by a lockwasher and nut.

b. Pull switch from behind panel, disconnect wires, and remove. Tag wires, if necessary, to preserve identity.

2-16. INSTALLATION OF SWITCH. (Typical)
a. Connect wires to switch.
b. Position switch and guard, if provided, and attach to panel with two screws, a lock washer and nut, or two screws and two self-locking nuts, as applicable.

Note

Position cover guards with hinge at bottom, and position channel guards with lock holes below center. This will guard the generator switches in the ON position; and will allow the ignition switches and the boost pump switch to be locked in the OFF position.

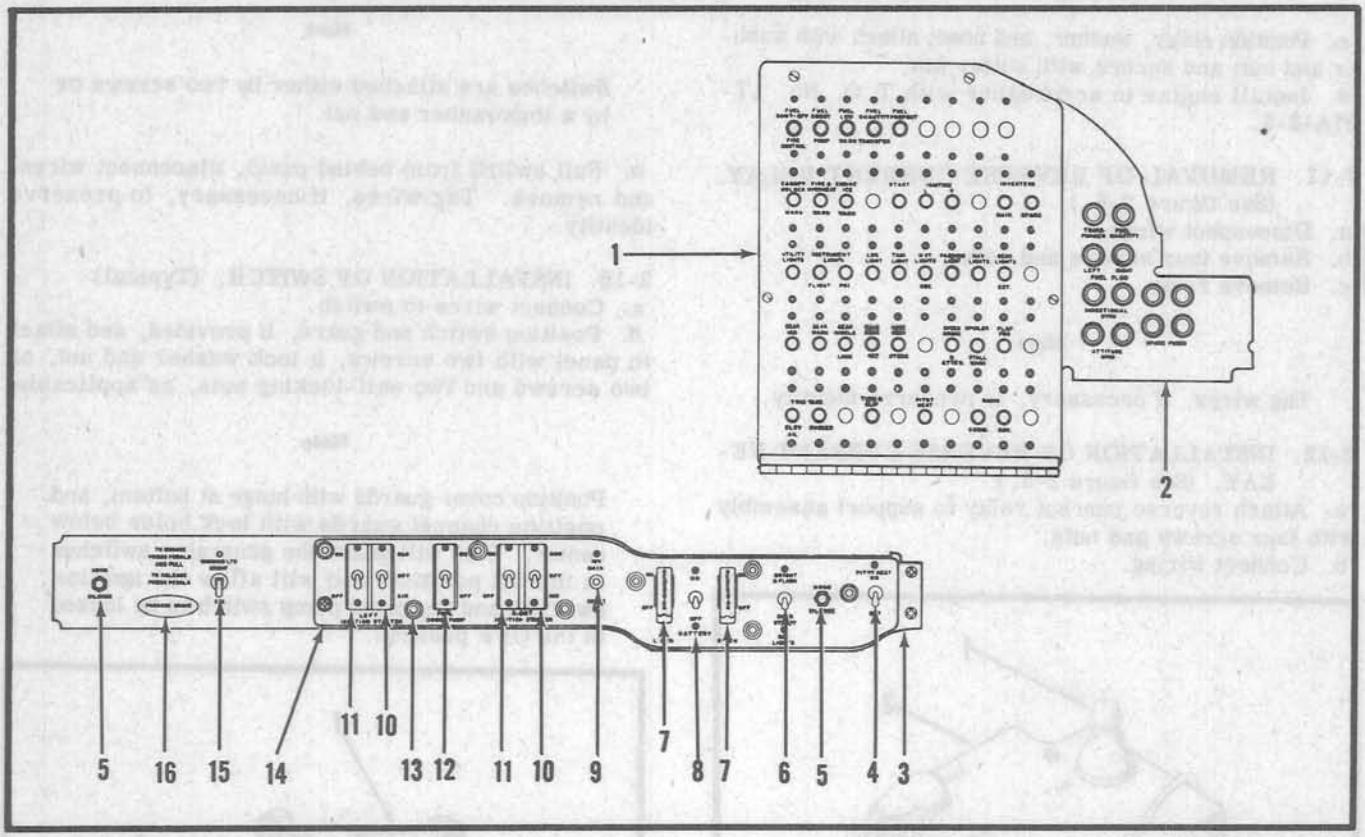


1. Voltage regulator
2. Wire
3. Nut
4. Base
5. Mounting clamp
6. Rheostat

Figure 2-6. Voltage Regulator Installation

2-17. CIRCUIT BREAKERS. All circuit breakers are push-pull type, and all but three are mounted on the circuit breaker panel. Those three are mounted in the left nose electrical equipment section.

2-18. REPLACEMENT OF CIRCUIT BREAKER.
a. Disconnect external power relay from external power receptacle, and turn off battery.
b. Remove two mounting screws securing circuit breaker to panel.



1. Circuit breaker panel
2. Fuse panel
3. Switch panel
4. Pitot heater switch
5. Horn silencing
6. Nav lights switch
7. Generator switch
8. Battery switch
9. Inverter switch
10. Starter switch
11. Ignition switch
12. Fuel boost pump switch
13. Panel light
14. Edge lighted switch panel
15. Warning light dimming switch
16. Parking brake handle

Figure 2-7. Switch Panel and Circuit Breaker Panel

c. Unhook four fasteners attaching hinged circuit breaker panel to instrument panel, grasp top of panel and pull forward.

d. Disconnect DC bus and wires from circuit breaker terminals.

e. Replace circuit breaker;connect DC bus and wires.

CAUTION

Make sure replacement is of correct ampere capacity.

f. Push hinged panel back into position, secure with fasteners, and secure circuit breaker with two mounting screws.

g. For the three circuit breakers in the nose, remove screws, pull them down from rear of panel and disconnect wires from terminals.

h. Replace circuit breakers, connect wires to terminals, push circuit breakers into their respective positions and replace screws.

i. Turn on battery and check circuit breaker for correct operation.

2-19. BATTERY SYSTEM.

2-20. DESCRIPTION. (See figures 2-2 and 2-8.) The 24 volt, 36 ampere-hour battery, located in the left side of the nose, is connected to the DC bus assembly through a battery relay. The relay is controlled by an ON-OFF toggle switch on the switch panel.

CAUTION

The battery will operate essential 28 volt DC equipment for a limited time only; it is used for stand by power when the engines are shut-down, when external power is not available, or if the 28V DC generator system fails in flight.

Ventilation is provided by ducting outside air through the battery case and through a sump jar beneath the battery. The jar contains two felt pads saturated with a sodium bicarbonate and water solution to neutralize any electrolyte overflow from the battery.

2-21. MAINTENANCE OF BATTERY SYSTEM. The hydrometer reading in each battery cell, when corrected for ambient temperature, should be between 1.275 and 1.300. If the reading is between 1.240 and 1.275, the battery should be charged. If the reading is more than 1.310 or less than 1.240, replace the battery. If the electrolyte level is too low to take a hydrometer reading or cannot be seen, add distilled water,

using a syringe from a type D-1 battery servicing kit.

CAUTION

Do not fill battery higher than 3/8 inch above protector. Make sure that the felt pads in the sump jar are saturated with a solution of one tablespoon of sodium bicarbonate and one cup of water.

2-22. REMOVAL OF BATTERY. (See figure 2-8.)

a. Position battery switch OFF.
b. Open left nose access door.
c. Release electrical connector.
d. Disconnect battery vent lines.
e. Release battery hold-down clamps.
f. Remove battery.

2-23. INSTALLATION OF BATTERY. (See figure 2-8.)

Note

Be sure that sump jar felt pads are saturated with sodium bicarbonate solution.

a. Position battery with electrical connector on the outboard side.
b. Push battery hold-down clamps down.
c. Connect battery vent lines.
d. See that battery switch is off.
e. Connect and tighten electrical connector.
f. Close left nose access door.

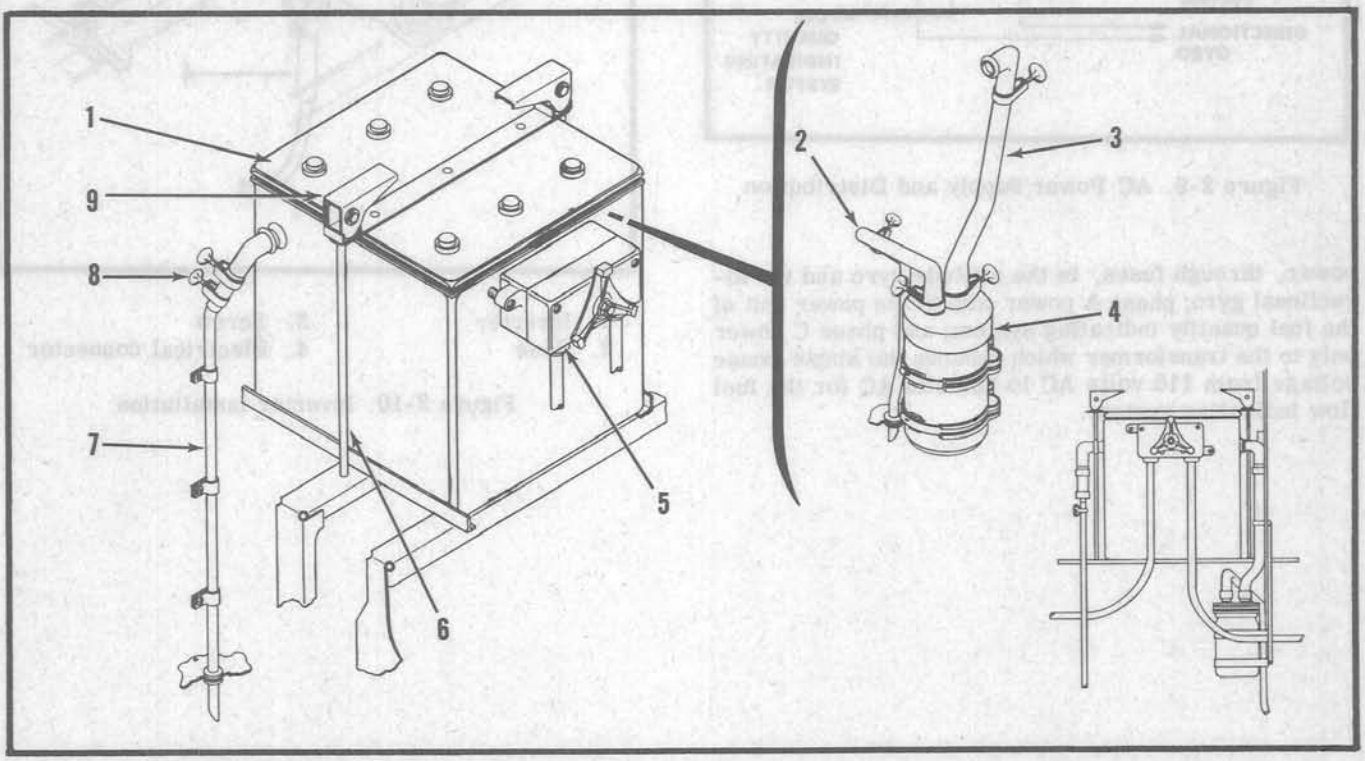
2-24. EXTERNAL POWER SUPPLY SYSTEM.

2-25. DESCRIPTION. (See figures 2-1 and 2-2.) External power is used to start the engines, and to power the 28 volt DC equipment when it is not feasible to start the engines or use the battery. The external power receptacle is located behind spring-loaded access doors beneath the left nose access door. The two longer pins of the receptacle are the power leads. The short pin closes an external power relay which connects external power to the DC bus assembly.

2-26. AC POWER SUPPLY SYSTEM.

2-27. DESCRIPTION. (See figures 2-1 and 2-9.) Two 100VA inverters are located in the left nose electrical equipment section beneath the left nose access door. The forward inverter is used as a spare if the other one fails. A 60 VA transformer is located on the subordinate bulkhead assembly forward of the AC fuses, and is accessible from the cockpit. A toggle switch on the switch panel controls the inverters. It has three positions: MAIN, OFF, and SPARE. Two 15 ampere circuit breakers on the circuit breaker panel protect the circuit.

2-28. FUNCTIONAL DESCRIPTION. (See figure 2-9.) The inverters operate on 28 volt DC power supplied by the DC bus. Three-phase, inverter output voltage is maintained at 115 ±5 volts, and the output frequency at 400 CPS by regulators that are integral parts of the inverters. With the inverter switch at MAIN or SPARE, the respective inverter supplies phase A and phase B



1. Battery
2. Overboard vent
3. Drain vent
4. Sump jar
5. Electrical connector
6. Rod
7. Intake vent
8. Clamp
9. Clamp

Figure 2-8. Battery Installation

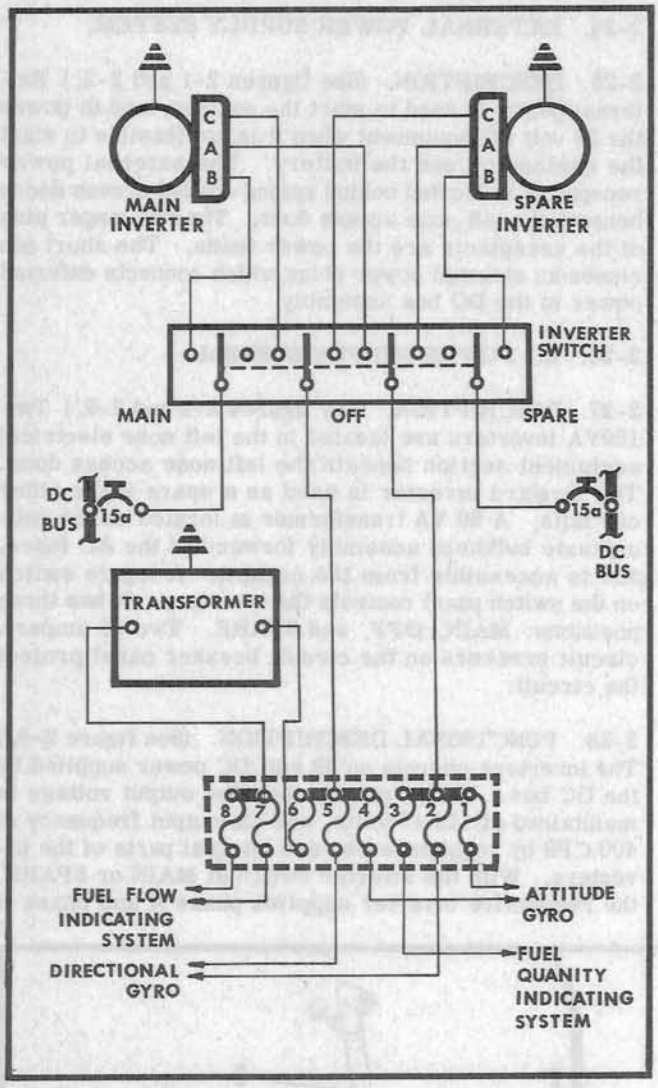


Figure 2-9. AC Power Supply and Distribution

power, through fuses, to the attitude gyro and the directional gyro; phase A power only to the power unit of the fuel quantity indicating system; and phase C power only to the transformer which reduces the single-phase voltage from 115 volts AC to 28 volts AC for the fuel flow indicating system.

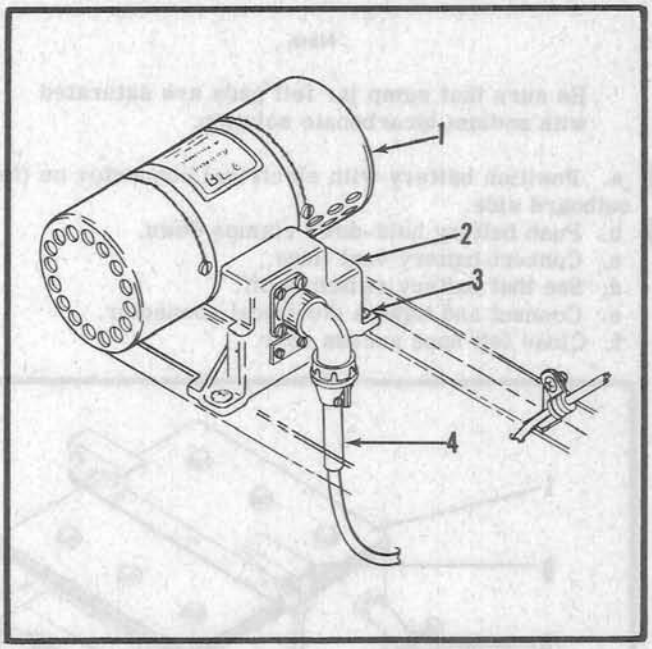
2-29. REMOVAL OF INVERTER. (See figure 2-10.)

a. Disconnect electrical connector.
b. Remove four screws, washers and nuts.
c. Remove Inverter.

2-30. INSTALLATION OF INVERTER. (See figure 2-10.)

a. Attach the inverter to support assembly with four screws, washers, and nuts.
b. Connect electrical connector.

2-31. FUSES. All fuses have a one-ampere capacity and are located to the right of the circuit breaker panel on the stationary instrument panel. Four are spare fuses for the rest which protect the AC circuits. Enclosed in plastic fuse posts, they are removed by unscrewing the cap of the fuse post and removing the fuse. Access to the fuse post wiring is gained by unhooking the hinged circuit breaker panel fasteners, grasping top of panel and pulling forward.



1. Inverter
2. Base
3. Screw
4. Electrical connector

Figure 2-10. Inverter Installation

SECTION III
LIGHTING SYSTEMS

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3-1. LIGHTING SYSTEMS.

3-2. EXTERIOR LIGHTING CIRCUITS. Since all exterior lighting circuits are controlled by two switches, they are discussed under two headings: navigation and position lights, and landing and taxi lights.

3-3. NAVIGATION AND POSITION LIGHTS. (See figures 3-2 and 3-3.) The navigation and position lights are operated by a three-position, NAV-LIGHTS toggle switch mounted on the right portion of the switch panel. Its positions are BRIGHT and FLASH (up), DIM and STEADY (down), and OFF (neutral). Three circuit breakers on the circuit breaker panel protect the circuits. A relay (3, figure 3-1), two resistors (1 and 2, figure 3-1), and a flasher unit (21, figure 3-1) are located in the left nose electrical equipment section behind the left nose access door. Two tail lights, a yellow-covered upper light and a white-covered lower light, are located at the aft end of the stinger. A red-covered position light is mounted to the left wing tip, and a green-covered position light is mounted to the right wing tip. Two clear-covered position lights, each including a bright lamp and a dim lamp, are mounted to the fuselage. The lower light, mounted to the bottom of the fuselage, can be reached from inside the cockpit by raising the instructor's seat and removing eight screws and a cover plate from the floorboard assembly. The upper light, mounted to the top of the fuselage aft of the cockpit, can be reached from inside the fuselage by removing the rear tunnel wall door under the airplane. Three, white-covered external gear lights are mounted to the landing gear doors: one on the nose gear right door, and one on each main gear inboard door. The gear lights are wired to the NAV-LIGHTS switch through their respective gear downlock switches. The nose gear downlock switch is located in the nose wheel well under the nose gear downlock access door; each of the main gear downlock switches are mounted to brackets with screws and nuts in the outboard gear wells. See T.O. No. 1T-37A-2-3. A red passing light is mounted in the nose behind the nose cap.

3-4. OPERATION OF NAVIGATION AND POSITION LIGHTS. (See figure 3-3.) Positioning the NAV-LIGHTS switch at BRIGHT and FLASH will light the passing light, each external gear light whose gear is down and locked, and the bright lamps of the upper and lower fuselage position lights. Also, it will energize the relay and the flasher unit, causing the wing tip lights, together with the yellow tail light, to flash on and off alternately with the white tail light. Positioning the NAV-LIGHTS switch at DIM and STEADY will light the passing light, each external gear light whose gear is down and loacked the dim lamps of the upper and lower fuselage position lights, and the tail and wing tip lights. These lights are powered through two 25 and 10 ohm dimming resistors, respectively, instead of the flasher unit.

3-5. REPLACEMENT OF PASSING LAMP. (See figure 3-4.)

a. Pull PASSING LIGHT circuit breaker.
b. Remove screws, and nose cap.
c. Remove three screws and passing light clamp, and disconnect lamp wiring.
d. Connect wiring to terminals of replacement lamp, position lamp, and secure with passing light clamp and three screws.
e. Install nose cap with twenty-four screws.
f. Push in PASSING LIGHT circuit breaker and check operation of lamp.

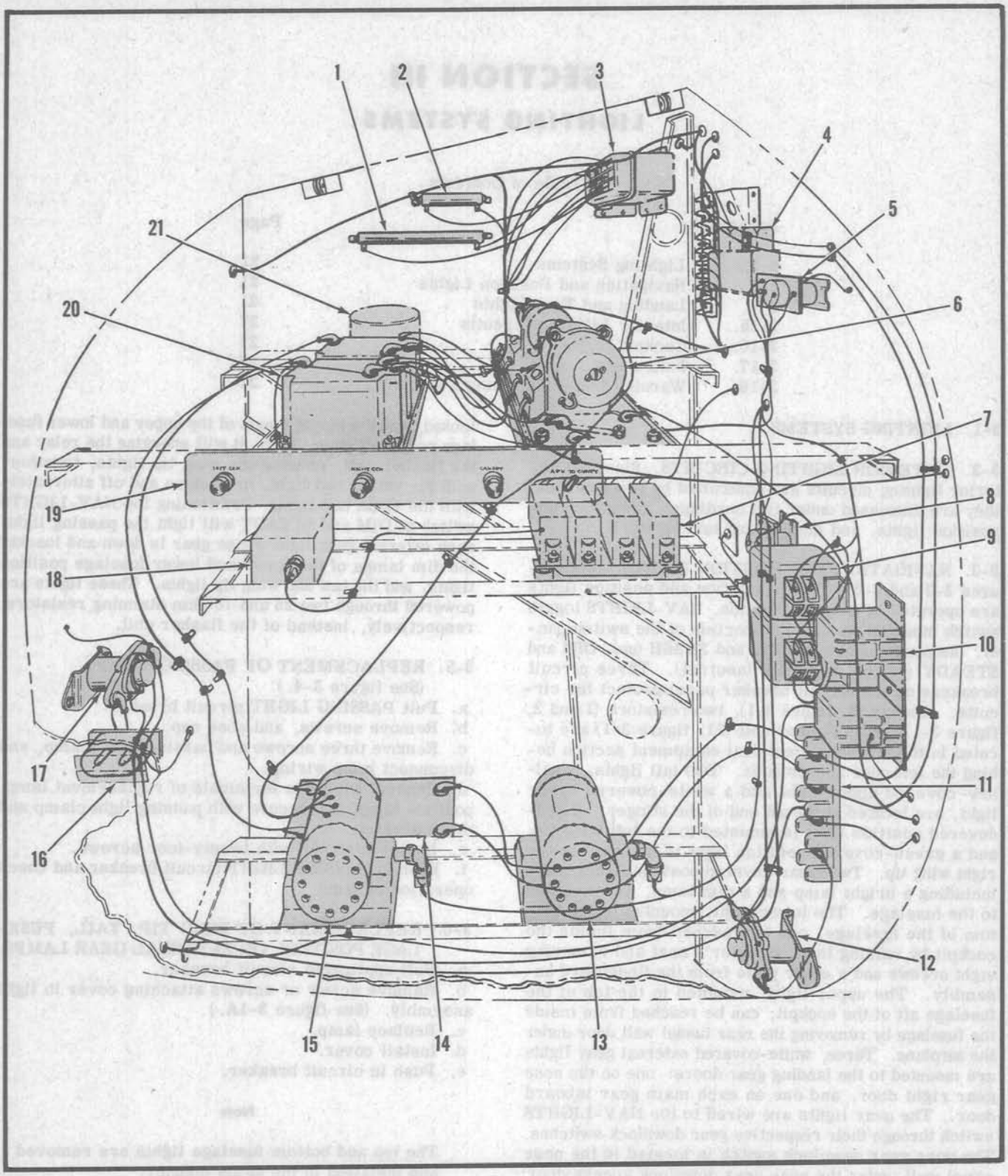
3-6. REPLACEMENT OF WING TIP, TAIL, FUSELAGE POSITION OR EXTERNAL GEAR LAMPS.

a. Pull applicable circuit breaker.
b. Remove screw or screws attaching cover to light assembly. (See figure 3-1A.)
c. Replace lamp.
d. Install cover.
e. Push in circuit breaker.

Note

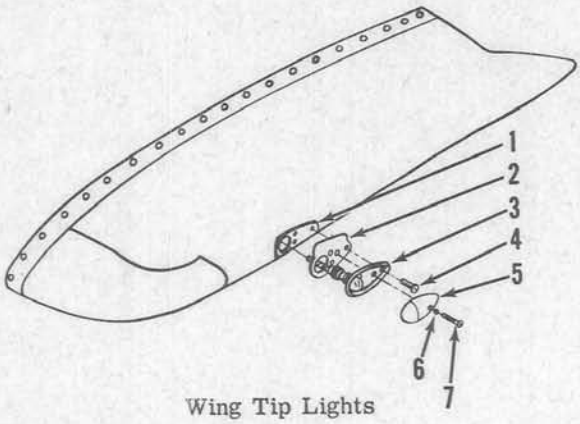
The top and bottom fuselage lights are removed and installed in the same manner.

3-7. LANDING AND TAXI LIGHTS. (See figure 3-2.) The landing and taxi lights are operated by a three-position toggle switch mounted on the lower left portion of the shock panel. Its positions are LANDING (up), TAXI (down), and OFF (neutral). Two circuit breakers protect the circuits. The landing light relay is mounted on a shelf attached to the front spar carry through, aft of the student pilots seat. A 150 watt taxi



1. Nav-lights resistor
2. Nav-lights resistor
3. Nav-lights relay
4. Control box
5. Generator control relay
6. Voltage regulator
7. Fire overheat control units
8. Generator control relay
9. Time delay relay
10. Ignition relay
11. Terminal block
12. Battery relay
13. Main inverter
14. Loadmeter shunts
15. Spare inverter
16. External power receptacle
17. External power relay
18. Overheat flasher unit
19. Circuit breaker panel
20. Reverse current relay
21. C-2 Flasher

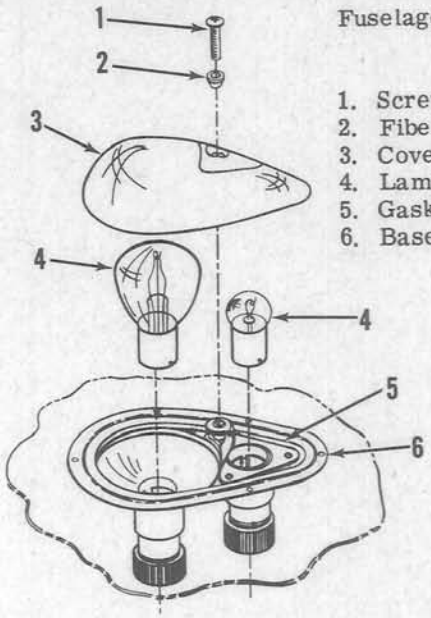
Figure 3-1. Left Nose Electrical Equipment Section



Wing Tip Lights

1. Wing Tip
2. Reflector
3. Base
4. Screw
5. Cover
6. Fiber Washer
7. Screw

A

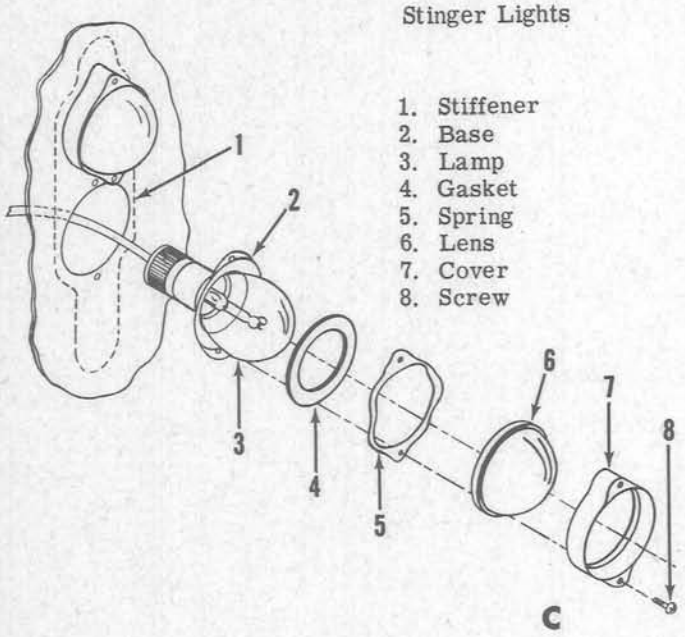


Fuselage Position Lights

1. Screw
2. Fiber Washer
3. Cover
4. Lamp
5. Gasket
6. Base

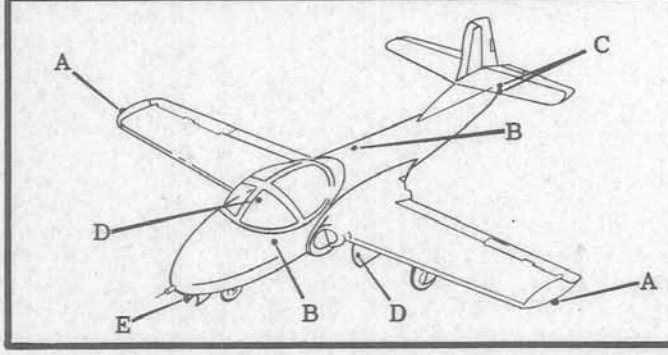
B

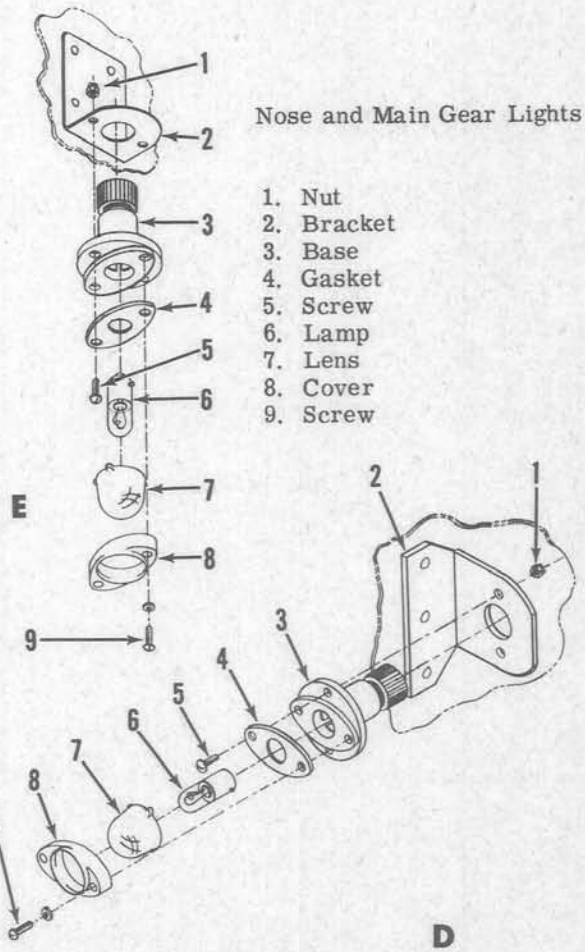
Stinger Lights



1. Stiffener
2. Base
3. Lamp
4. Gasket
5. Spring
6. Lens
7. Cover
8. Screw

C

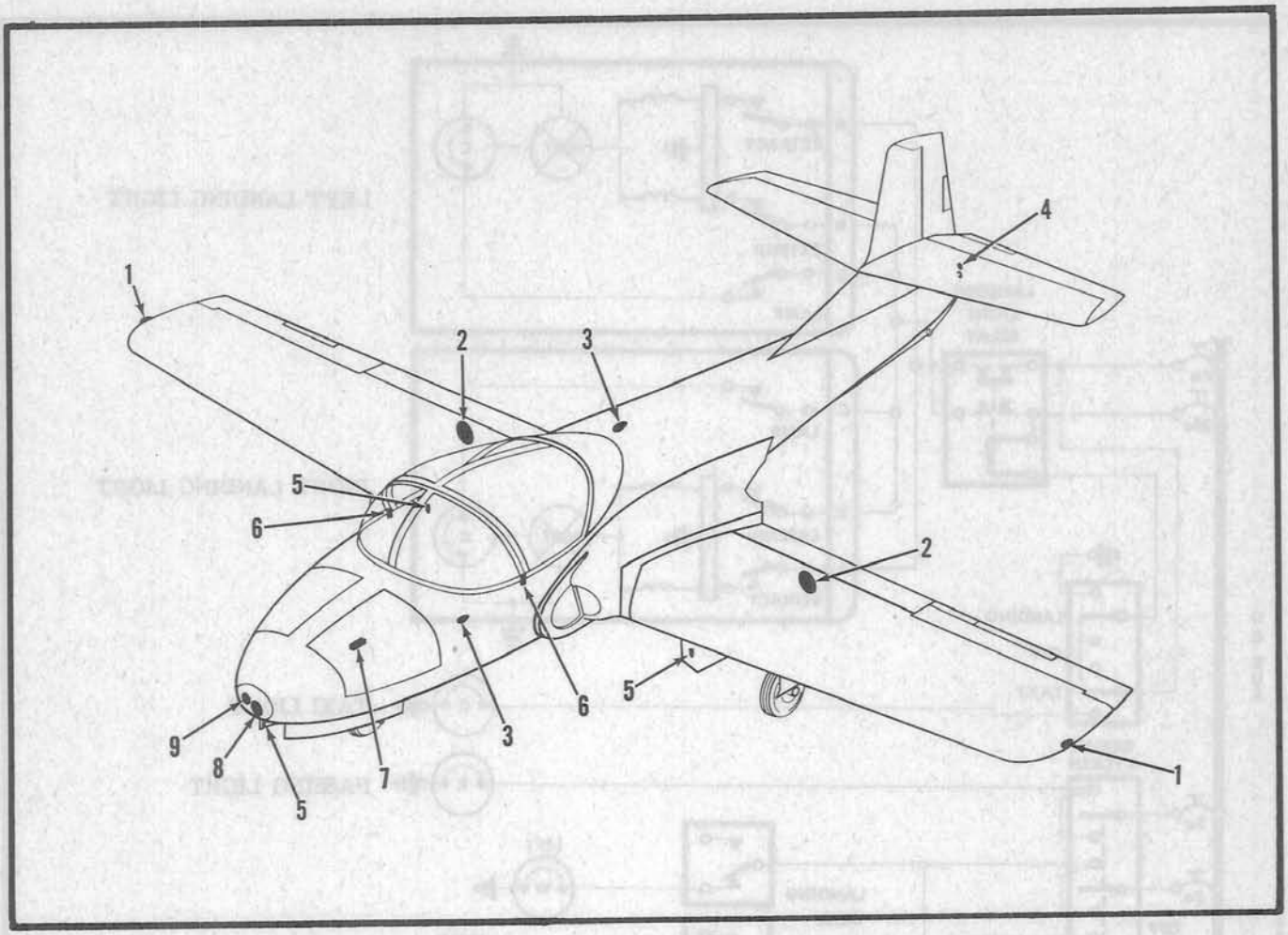




Nose and Main Gear Lights

1. Nut
2. Bracket
3. Base
4. Gasket
5. Screw
6. Lamp
7. Lens
8. Cover
9. Screw

Figure 3-1A. Stinger, Wing Tip, Fuselage Position, Nose Gear and Main Gear Lights Installation



1. Wing tip light
2. Landing light
3. Fuselage position light
4. Tail lights
5. External gear light
6. Cockpit light
7. C-2 Flasher
8. Passing light
9. Taxi light

Figure 3-2. Lighting Systems Components Locations

light is mounted in the nose behind the nose cap. Two retractable landing lights are installed, one in each wing, aft of the main landing gear doors.

3-8. OPERATION OF LANDING AND TAXI LIGHTS. (See figure 3-3.) Positioning the switch at LANDING will energize the relay causing the landing lights to extend and light. When the switch is at the OFF or TAXI position, the relay is de-energized, and the landing lights are off and retracted. Positioning the switch at TAXI will light the taxi light.

3-9. OPERATION OF LANDING LIGHT. The landing lights are symmetrical in form and identical in operation. Each is extended and retracted by a reversible field motor. Limit switches included in the assembly determine the amount of extension and retraction. When operated at rated voltage, each must extend or retract fully in no more than seventeen seconds, each direction, or be replaced. When the limit switches are properly adjusted, the lamp will light when it extends 10° and remain lighted throughout extension, until retracted; and will extend 80° ±3° from the retracted position which will be within 1/16" of flush with its outer canopy (1, figure 3-5).

3-10. REMOVAL OF LANDING LIGHT ASSEMBLY.
a. Pull TAXI LIGHT and LANDING LIGHTS circuit breakers.
b. In wheel well, remove access panel to gain access to landing light gear housing.
c. Disconnect electrical connector.
d. Under wing, remove eleven screws, and remove landing light assembly.

3-11. INSTALLATION OF LANDING LIGHT ASSEMBLY.
a. Position landing light in wing and attach with eleven screws.
b. Connect electrical connector; install access panel.
c. Push in TAXI LIGHT and LANDING LIGHTS circuit breakers and check operation. If necessary, adjust lamp in accordance with paragraph 3-13.

3-12. REPLACEMENT OF LANDING LIGHT LAMP. (See figure 3-5.)
a. Pull TAXI LIGHT circuit breaker.
b. Using an observer to watch landing light position, position LANDING-TAXI switch at LANDING. When light is almost two thirds extended, position switch OFF, and pull LANDING LIGHTS circuit breaker.
c. Remove retainer ring and lamp from inner canopy

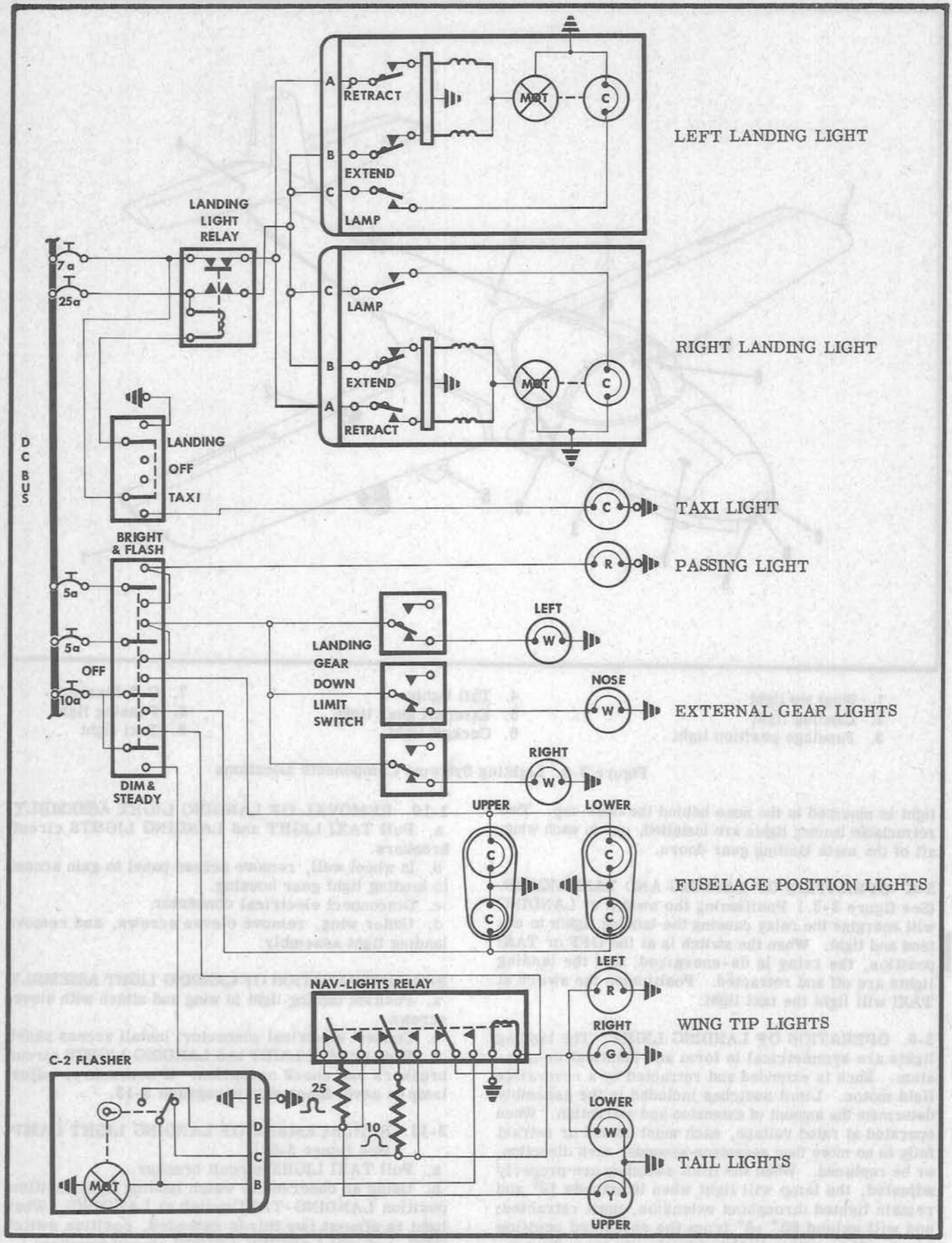


Figure 3-3. Exterior Lighting Circuits

and disconnect terminals.

d. Connect replacement lamp terminals, and insert lamp into inner canopy using either of two key slots which engage rear of lamp.

CAUTION

The filament shield of the lamp is located toward the pilot or inboard side and should be installed in the same position as the shield in the lamp removed.

e. Position retainer ring in inner canopy so that it bears against lamp and fits under canopy flange. Snap into place with small-nose pliers.

f. Push in LANDING LIGHTS and TAXI LIGHT circuit breakers. Turn on battery and check for operation. If necessary, adjust light assembly in accordance with paragraph 3-13. When finished, turn off battery.

3-13. ADJUSTMENT OF LANDING LIGHT. (See figure 3-6.)

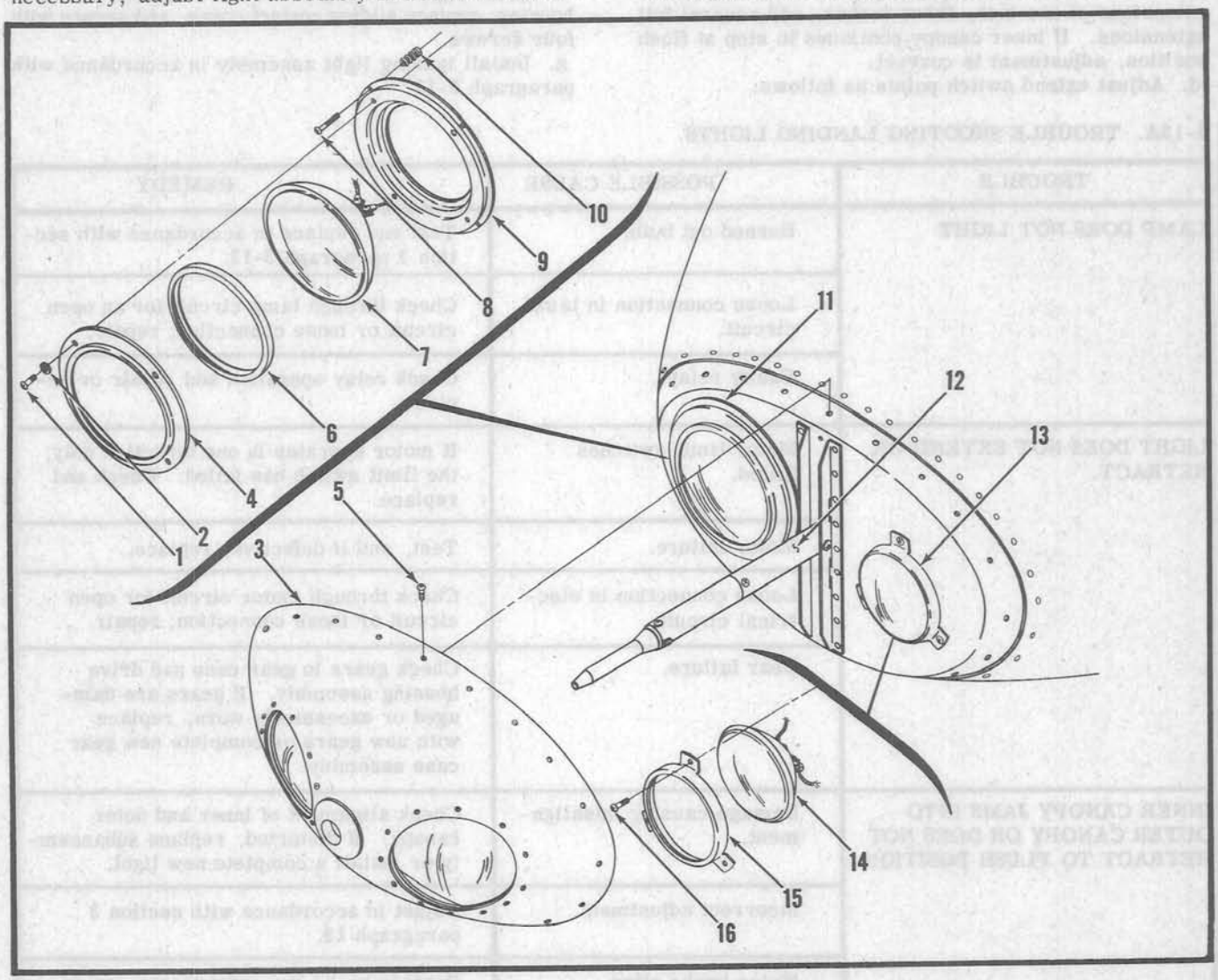
CAUTION

If less than 26 volts DC is used when adjusting landing lights, the normal service voltage may carry light far enough beyond its flush position upon retraction to strain or otherwise damage operating mechanism.

a. Remove landing light assembly in accordance with paragraph 3-10.

b. Remove four screws and lift drive housing cover to expose limit switches.

c. Adjust retract switch points as follows:



1. Screw
2. Washer
3. Nose cap assembly
4. Ring
5. Screw
6. Gasket
7. Lamp
8. Screw
9. Body
10. Spring
11. Taxi light
12. Pitot tube
13. Passing light
14. Lamp
15. Clamp
16. Screw

Figure 3-4. Passing and Taxi Lights Installation

WARNING

Make sure there is no power to receptacle during actual adjustment.

1. Adjust retract points by bending strap spring. If spring is bent away from sliding contact, the inner canopy will run deeper into the outer canopy. If spring is bent toward sliding contact, the inner canopy will stop retraction sooner.
2. The retract points should be set to break just before inner canopy reaches the flush position. When retraction is complete, they should be parted by the sliding contact by about 1/16 inch.
3. After adjustment, check operation by retracting lights first from an extension of 1/2 inch. If inner canopy stops at flush position, repeat test at successive extensions of one inch, three inches, and several full extensions. If inner canopy continues to stop at flush position, adjustment is correct.

d. Adjust extend switch points as follows:

WARNING

Make sure there is no power to receptacle during actual adjustment.

1. Loosen the lock screw, move the contact assembly in the desired direction (toward the retract points for smaller extension, away for greater), and tighten the lock screw.
2. Check operation first from an extension of about 60°. If inner canopy stops at 80° ±3°, repeat test at successive extensions of 40°, 20°, and several from full retraction. If canopy continues to stop at 80° ±3, adjustment is correct.

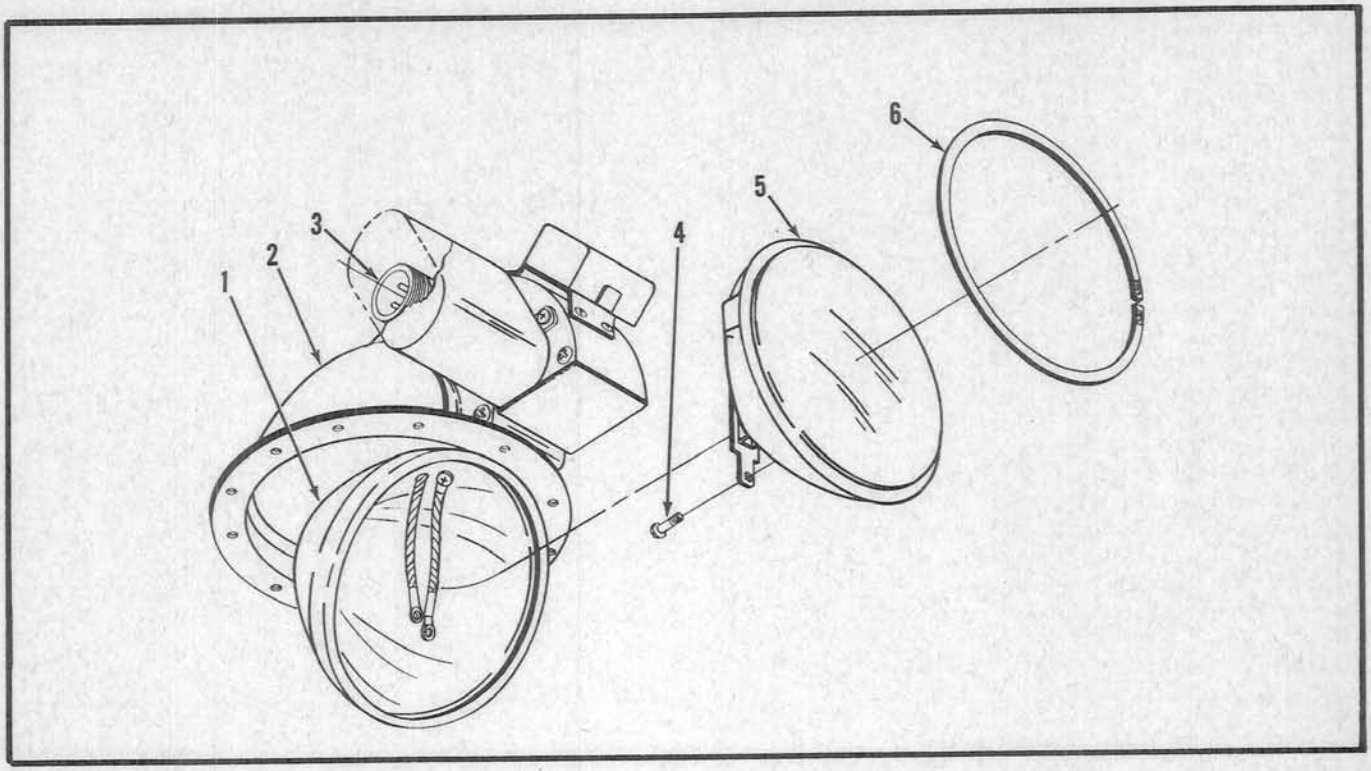
e. If the lamp does not go on at the specified position, bend lamp contact to obtain correct adjustment.

f. After adjustments, blow any foreign matter out of housing, replace sliding contact cover, and secure with four screws.

g. Install landing light assembly in accordance with paragraph 3-11.

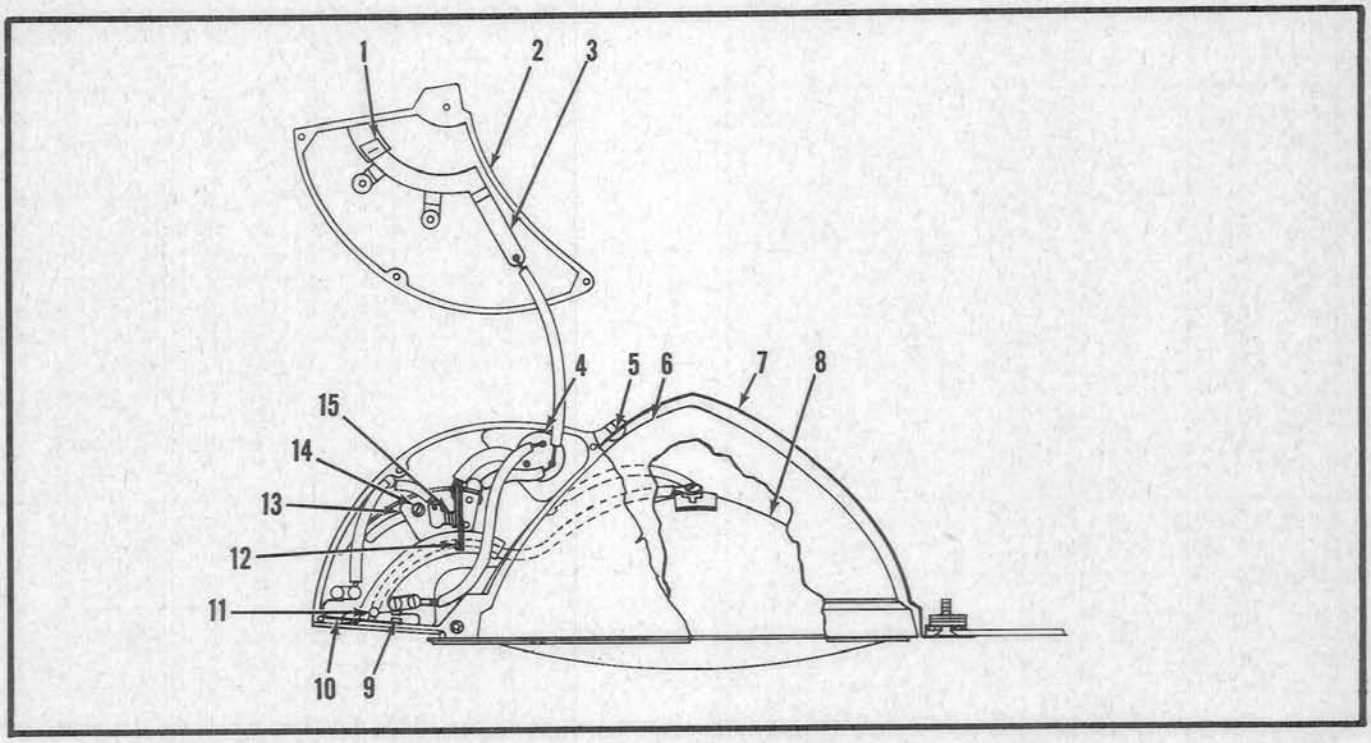
3-13A. TROUBLE SHOOTING LANDING LIGHTS.

TROUBLE	POSSIBLE CAUSE	REMEDY
LAMP DOES NOT LIGHT	Burned out bulb.	Test and replace in accordance with section 3 paragraph 3-12.
	Loose connection in lamp circuit.	Check through lamp circuit for an open circuit or loose connection; repair.
	Faulty relay.	Check relay operation and repair or replace.
LIGHT DOES NOT EXTEND OR RETRACT.	Motor limit switches failed.	If motor operates in one direction only, the limit switch has failed. Check and replace.
	Motor failure.	Test, and if defective, replace.
	Loose connection in electrical circuit.	Check through motor circuit for open circuit or loose connection; repair.
	Gear failure.	Check gears in gear case nad drive housing assembly. If gears are damaged or excessively worn, replace with new gears or complete new gear case assembly.
INNER CANOPY JAMS INTO OUTER CANOPY OR DOES NOT RETRACT TO FLUSH POSITION.	Damage causing misalignment.	Check alignment of inner and outer canopy. If distorted, replace subassemly or install a complete new light.
	Incorrect adjustment.	Adjust in accordance with section 3 paragraph 13.
	Motor brake slips.	Replace brake or complete new motor.



1. Inner canopy
2. Outer canopy
3. Electrical fitting
4. Screw
5. Lamp
6. Retainer ring

Figure 3-5. Landing Light Assembly



1. Tungston point
2. Sliding contact cover
3. Contact slide
4. Receptacle (rear)
5. Rubber bumper
6. Inner canopy
7. Outer canopy
8. Lamp
9. Retract points
10. Strap spring
11. Sliding contact
12. Lamp contact
13. Contact assembly
14. Lockscrew
15. Extend points

Figure 3-6. Adjustment of Landing Light

3-14. REPLACEMENT OF TAXI LAMP. (See figure 3-4.)

a. Pull TAXI LIGHT circuit breaker.
b. Remove twenty-four screws and nose cap.
c. Remove four screws, lockwashers, retaining ring, and gasket.
d. Disconnect terminals from lamp and connect replacement lamp.
e. Fit gasket around lamp, insert in body, and secure by attaching retaining ring to body with four screws and lockwashers.
f. Push in TAXI LIGHT circuit breaker and check operation of lamp. If necessary, it should be adjusted to point 2° down from horizontal by tightening or loosening the screws attaching the light body to the airplane structure.
g. Attach nose cap with twenty-four screws.

3-15. INTERIOR LIGHTING CIRCUITS. Since all interior lighting circuits, except the C-4A cockpit lights, are controlled similarly, they are discussed under two headings: cockpit lights, and instrument lights.

3-16. COCKPIT LIGHTS. (See figures 3-2. and 3-7.) Two C-4A cockpit lights with removeable red filters are located, one on each side of the cockpit, on the windshield frame assembly. Each light is socket-mounted and can be removed from its base for use as a utility light. An extra base is attached right of center of the glare shield for use as an auxiliary mount in case of instrument light failure. Turning the rheostat knob on the back of each light case produces a variable light intensity from off to bright. The red button on the bottom of each case is a momentary contact switch permitting the light to be turned on and off quickly at full brilliancy. When the lens housing is fully retracted, the light is in floodlight position; with the housing fully extended, it is in spotlight position. To replace the lamp, remove the lens housing locking knob and the housing. A five ampere circuit breaker protects the circuit to both lights.

3-17. INSTRUMENT LIGHTS. (See figures 3-2 and 3-7.) Three rheostats, secured to the center quadrant support by lock nuts, control all instrument lights. They permit variable light intensity from OFF to BRIGHT. The SECONDARY INST LIGHTS rheostat, located aft of the power quadrant, controls the five lights installed on the glare shield above the instrument panel assembly. The PRIMARY FLIGHT INST LIGHTS rheostat adjacent to the switch panel, controls the lights which illuminate the compass, the clock, and all flight instruments except the accelerometer. Linked to the rheostat is a switch which provides electrical power to the warning light dimming switch, when FLIGHT INST LIGHTS are on. The PRIMARY INST LIGHTS rheostat adjacent to the power quadrant, controls the lights for the edge lighted switch panel, the accelerometer, the course indicator, the flap position indicator, the landing gear position indicators, both oxygen demand regulators, the radio control panels, and all engine and pressure instruments. Each of the three circuits which is controlled by the rheostats is powered from the DC bus assembly. Three five-ampere circuit breakers protect the circuits.

3-18. WARNING LIGHTS DIMMING CIRCUIT. The warning light dimming circuit, protected by the same five ampere circuit breaker that protects the primary flight instrument lights circuit, includes two switches and a control box. A single ploe, double throw, limit switch, an integrant of the PRIMARY FLIGHT INST LIGHTS rhoestat, is removed and installed with the rheostat. A single pole, double throw toggle switch-the WARNING LIGHTS dimming switch - is mounted on the left protion of the switch panel. The switch has three positions: BRIGHT (up), DIM (down), and neutral. It is spring loaded to return to the neutral position when released from either the up or the down position. The warning light control box is located in the left nose electrical equipment section, and includes two relays and six adjustable resistors. See paragraphs 3-20 and 3-22.

3-19. OPERATION OF WARNING LIGHTS DIMMING CIRCUIT. (See figure 3-8.) Normally, warning light current bypasses the control box resistors by going through the relays. When the relays are energized, current goes through the resistors, dimming all warning lights whenever they are on.

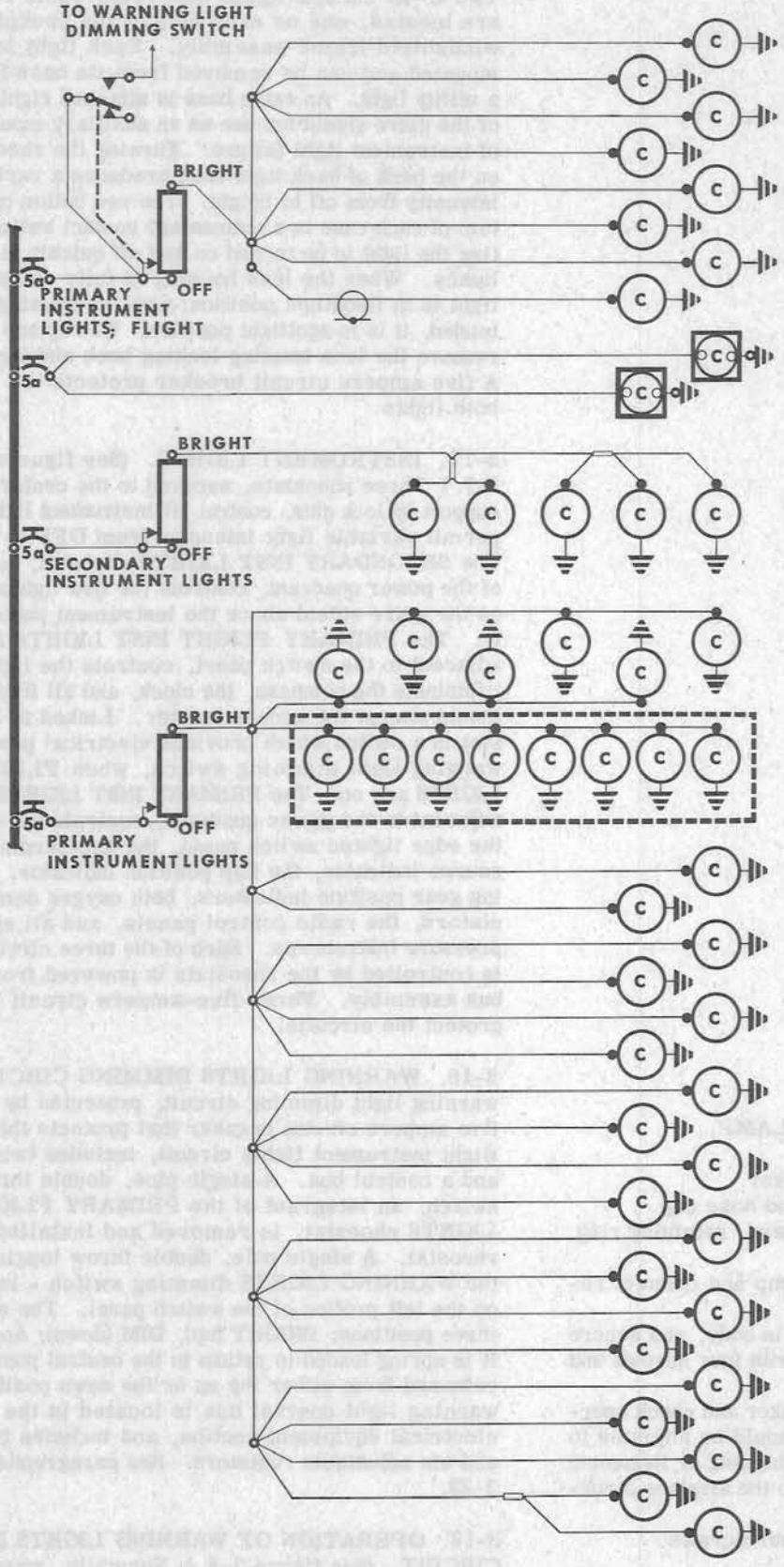


Figure 3-7. Interior Lighting Circuits

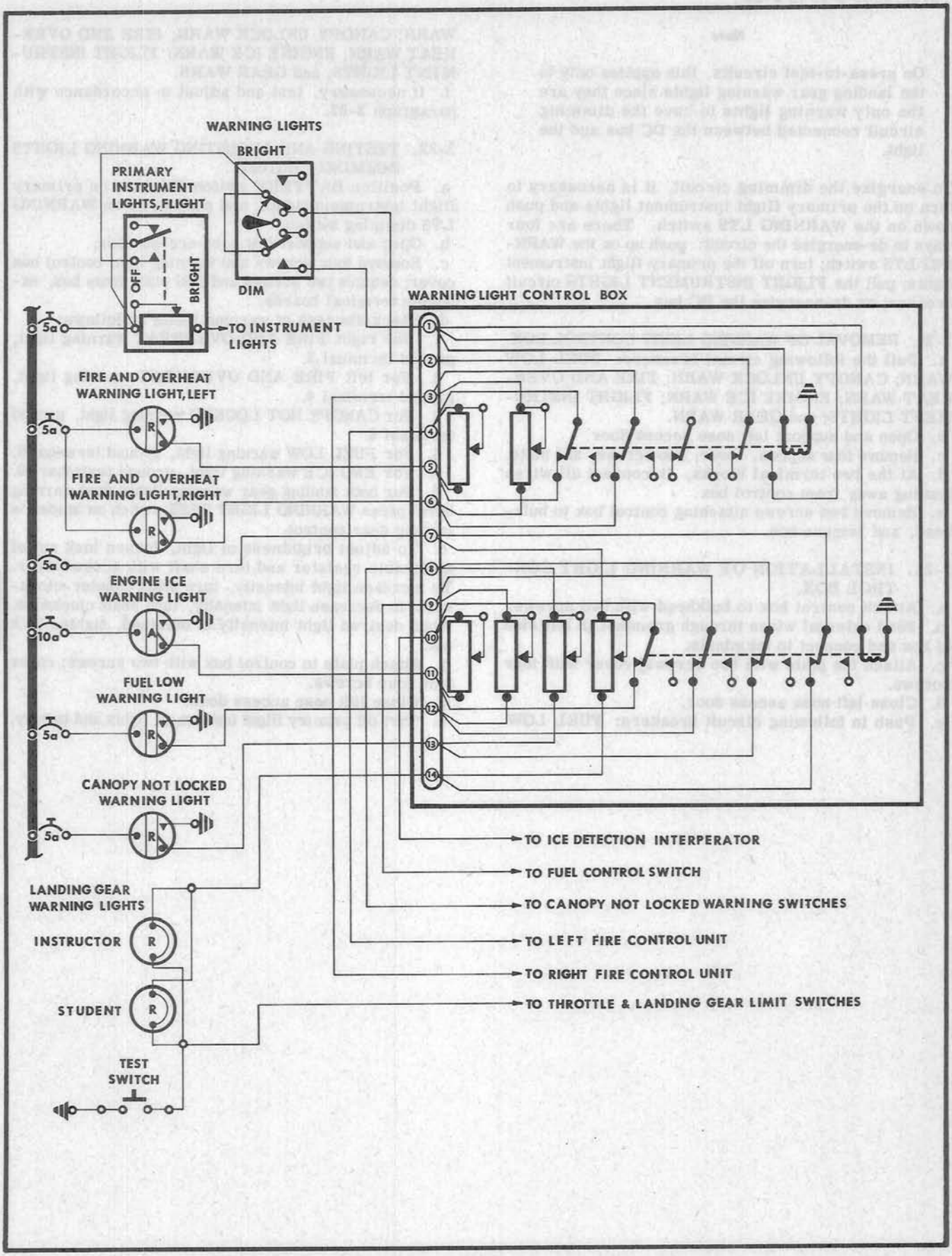


Figure 3-8. Warning Light Dimming Circuit

Note

On press-to-test circuits, this applies only to the landing gear warning lights since they are the only warning lights to have the dimming circuit connected between the DC bus and the light.

To energize the dimming circuit, it is necessary to turn on the primary flight instrument lights and push down on the WARNING LTS switch. There are four ways to de-energize the circuit: push up on the WARNING LTS switch; turn off the primary flight instrument lights; pull the FLIGHT INSTRUMENT LIGHTS circuit breaker; or de-energize the DC bus.

3-20. REMOVAL OF WARNING LIGHT CONTROL BOX.

a. Pull the following circuit breakers: FUEL LOW WARN; CANOPY UNLOCK WARN; FIRE AND OVERHEAT WARN; ENGINE ICE WARN; FLIGHT INSTRUMENT LIGHTS; and GEAR WARN.

b. Open and support left nose access door.

c. Remove four screws, cover, two screws, and plate.

d. At the two terminal blocks, disconnect all wires leading away from control box.

e. Remove two screws attaching control box to bulkhead, and remove box.

3-21. INSTALLATION OF WARNING LIGHT CONTROL BOX.

a. Attach control box to bulkhead with two screws.

b. Feed external wires through grommet in left side of box and connect to terminals.

c. Attach the plate with two screws; cover with four screws.

d. Close left nose access door.

e. Push in following circuit breakers: FUEL LOW WARN; CANOPY UNLOCK WARN; FIRE AND OVERHEAT WARN; ENGINE ICE WARN; FLIGHT INSTRUMENT LIGHTS; and GEAR WARN.

f. If necessary, test and adjust in accordance with paragraph 3-22.

3-22. TESTING AND ADJUSTING WARNING LIGHTS DIMMING CIRCUIT.

a. Position BATTERY switch ON; turn on primary flight instrument lights; and push down on WARNING LTS dimming switch.

b. Open and support left nose access door.

c. Remove four screws and warning light control box cover; remove two screws and pull plate from box, exposing terminal boards.

d. Check dimness of warning lights as follows:

1. For right FIRE AND OVERHEAT warning light, ground terminal 3.
2. For left FIRE AND OVERHEAT warning light, ground terminal 4.
3. For CANOPY NOT LOCKED warning light, ground terminal 8.
4. For FUEL LOW warning light, ground terminal 9.
5. For ENG ICE warning light, ground terminal 10.
6. For both landing gear warning lights (and warning horn(press WARNING LIGHT TEST switch on student's landing gear control.

e. To adjust brightness of light, loosen lock nut of applicable resistor and turn shaft with screwdriver. To increase light intensity, turn shaft counter-clockwise; to decrease light intensity, turn shaft clockwise. When desired light intensity is obtained, tighten lock nut.

f. Attach plate to control box with two screws; cover with four screws.

g. Close left nose access door.

h. Turn off primary flight instrument lights and battery.

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T.O. NO. 1T-37A-2-8

HANDBOOK

MAINTENANCE INSTRUCTIONS

WIRING DIAGRAMS AND DATA

USAF SERIES

T-37A

AIRCRAFT

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McCORMICK-ARMSTRONG, WICHITA, 1100, 8-6-56

31 MARCH 1956
REVISED 30 JUNE 1956

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This handbook is one of a series of the sectionalized maintenance handbooks of the T-37A aircraft and contains wiring diagrams of electrical circuits in the airplane. The wiring diagrams have been arranged in the same order as the systems or equipment to which they pertain are covered in the preceeding handbooks. The following is a list of other books of the sectionalized maintenance handbooks.

T.O. No. 1T-37A-2-1	General Airplane
T.O. No. 1T-37A-2-2	Ground Handling, Servicing and Airframe Maintenance
T.O. No. 1T-37A-2-3	Hydraulically Operated System and Utility Systems
T.O. No. 1T-37A-2-4	Flight Control Systems
T.O. No. 1T-37A-2-5	Power Plant, Fuel System and Oil System
T.O. No. 1T-37A-2-6	Instruments, Radio, Communication and Navigation Equipment
T.O. No. 1T-37A-2-7	Electrical System

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WIRING DIAGRAMS AND DATA

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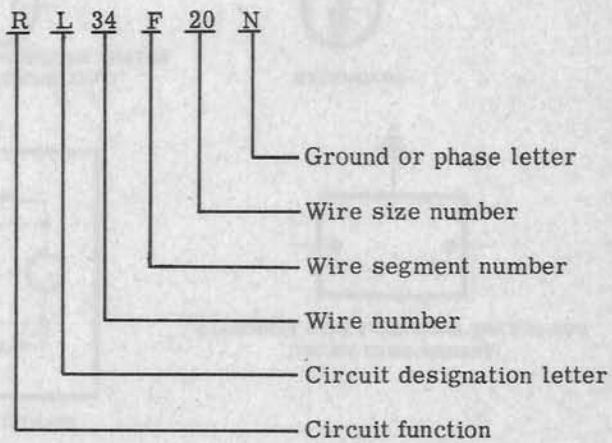
1-1. WIRING DATA.

1-2. GENERAL. This section contains wiring diagrams and associated data necessary for maintenance personnel to understand the make-up and function of each component power control and signal circuit and to trace such circuits; to make continuity checks and accomplish general and specific trouble-shooting on inoperative or malfunctioning circuits. Each diagram shows all wiring, connections and items of electrical equipment applying to the particular circuit. A Table of Critical wire lengths is also included on each diagram when it necessary to indicate such lengths. The data also includes a Symbol Chart which explains the various symbols used in the wiring diagrams. The diagram number appearing on the Index of Wiring Diagrams consists of a letter followed by two numbers, (Example: C.01). The letter represents the circuit function, as listed in paragraph 1-3. The numbers represent the diagram in that particular circuit.

1-3. WIRE IDENTIFICATION. Knowledge of the circuit function letters and wire identification procedure will facilitate the use of the wiring diagrams. Each wire is identified by a combination of letters and numbers which have been stamped at intervals along each wire. The following is the code of circuit function letters and an example of wire identification.

Circuit Function Letter	Circuit
C	Flight Control Circuits
D	Instrument Circuit (Other than flight or Engine Instruments)
E	Engine Instrument Circuit
F	Flight Instrument Circuit
G	Landing Gear Circuit
H	Engine Ice Warning Circuit
J	Ignition Circuit
K	Starter Circuit
L	Lighting Equipment
M	Canopy Circuit
P	Power Circuit
Q	Fuel and Oil Circuit
R	Radio Circuit (Navigation and Communication)
RC	Radio Communication
RM	Marker Beacon Circuit
RN	Radio Navigation
RZ	Interphone Circuit
V	D-C Power Circuit
W	Warning and Emergency Circuit
X	A-C Power Circuit



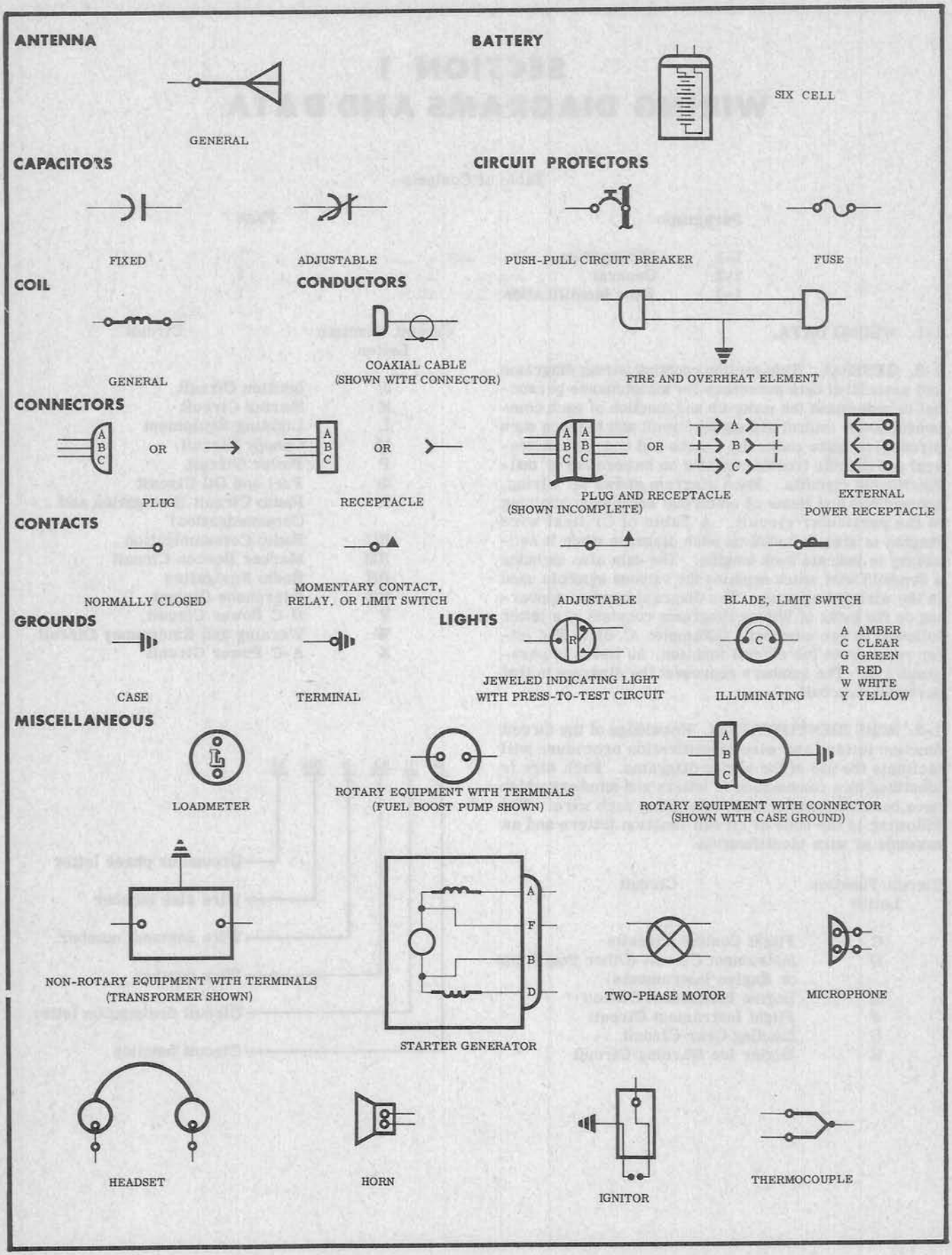


Figure 1-1. Wiring Diagram Symbol Chart (Sheet 1 of 5)

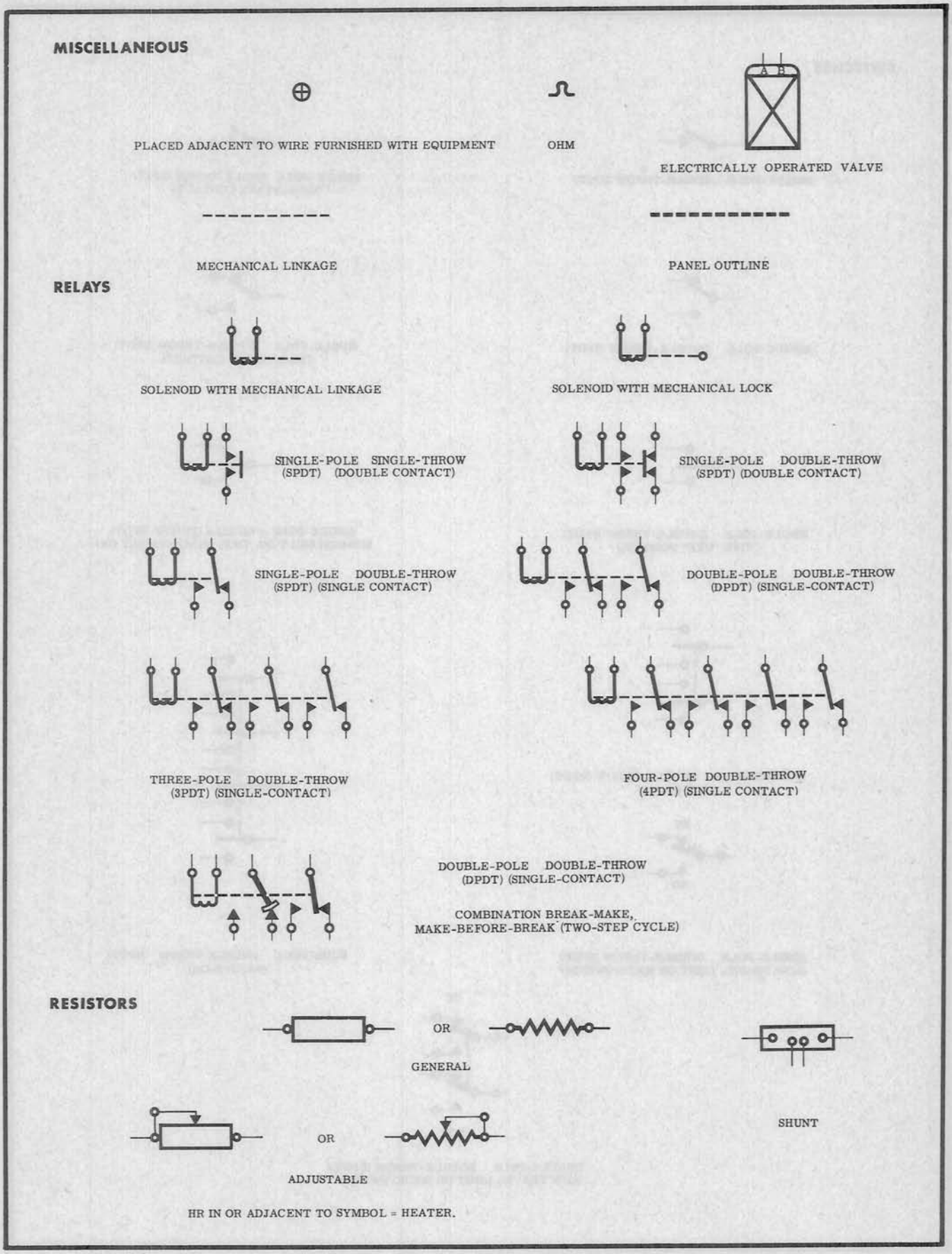


Figure 1-1. Wiring Diagram Symbol Chart (Sheet 2 of 5)

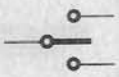
SWITCHES

SINGLE-POLE SINGLE-THROW (SPST)

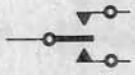
SINGLE-POLE SINGLE-THROW (SPST)
(MOMENTARY CONTACT)

SINGLE-POLE DOUBLE-THROW (SPDT)

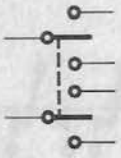
SINGLE-POLE DOUBLE-THROW (SPDT)
(MOMENTARY CONTACT)



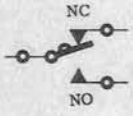
SINGLE-POLE DOUBLE-THROW (SPDT)
(WITH "OFF" POSITION)



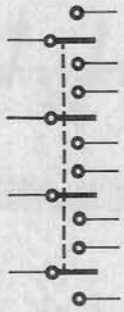
SINGLE-POLE DOUBLE-THROW (SPDT)
MOMENTARILY ON, OFF, MOMENTARILY ON)



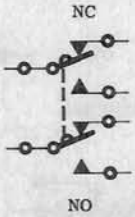
DOUBLE-POLE DOUBLE-THROW (DPDT)
(ON-OFF-ON)



SINGLE-POLE DOUBLE-THROW (SPDT)
(LOW TRAVEL LIMIT OR MICRO SWITCH)



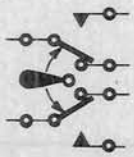
FOUR-POLE DOUBLE-THROW (4PDT)
(ON-OFF-ON)



DOUBLE-POLE DOUBLE-THROW (DPDT)
(LOW TRAVEL LIMIT OR MICRO SWITCH)

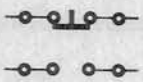
Figure 1-1. Wiring Diagram Symbol Chart (Sheet 3 of 5)

SWITCHES

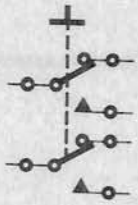


SINGLE-POLE DOUBLE-THROW (SPDT)
DOUBLE ACTING

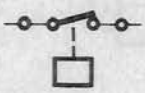
SINGLE-POLE SINGLE-THROW (SPST)
SPRING RETURN PUSH -BUTTON



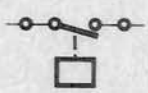
SINGLE-POLE DOUBLE-THROW (SPDT)
SPRING RETURN PUSH-BUTTON



DOUBLE-POLE DOUBLE THROW (DPDT)
SPRING RETURN SINGLE CONTACT
PUSH BUTTON



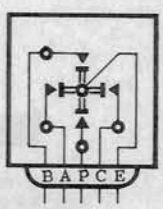
SINGLE-POLE SINGLE-THROW (SPST)
FLOAT SWITCH (CLOSE WHEN EMPTY)



SINGLE-POLE SINGLE-THROW (SPST)
FLOAT SWITCH (CLOSE WHEN FULL)

THERMAL SWITCH (EXTERNALLY HEATED) (NORMALLY CLOSED)

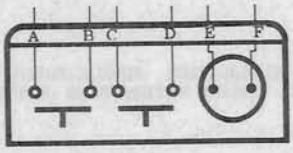
ROTARY SWITCH,SEGMENTAL CONTACT



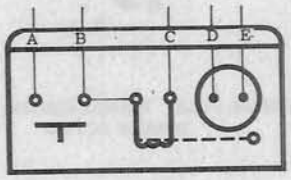
FIVE-POSITION SELECTOR SWITCH (FOUR MOMENTARY CONTACTS AND OFF) (USED FOR STICK GRIP ONLY)

Figure 1-1. Wiring Diagram Symbols (Sheet 4 of 5)

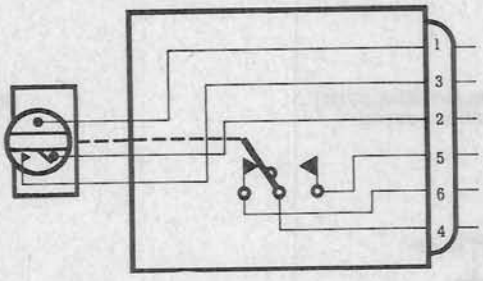
SWITCHES



STUDENTS LANDING GEAR CONTROL



INSTRUCTORS LANDING GEAR CONTROL



FIRE AND OVERHEAT SWITCH
(SHOWN OFF, HANDLE PULLED OUT)

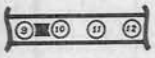
TERMINALS OR JUNCTIONS

NUT OR SCREW

SOLDERED OR CRIMPED

SPLICE

D C BUS WITH TERMINAL



TERMINAL BLOCK WITH BUS
(SHOWN INCOMPLETE)

TERMINAL BLOCK WITH TWO BUSSES,
(SHOWN COMPLETE)

Figure 1-1. Wiring Diagram Symbols (Sheet 5 of 5)

EQUIPMENT LIST

Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name and No.
1.	Switch Airstart Canopy (inside) Rudder Trim Tab	AN3022-7
2.	Switch, Canopy outside	MS25026-1
3.	Switch Canopy Lock Canopy-Not-Locked	Micro-Switch 1VA1
4.	Switch, Canopy A. P. U.	AN3022-11
5.	Battery	AN3150-2
6.	Relay External Power Starter Battery	AN3370-2
7.	Canopy Actuator	Airborne R-550M15
8.	Connector	AN3108B-10SL-3S
9.	Disconnect, Wing	AN3108B-7P
10.	Switch Nose gear up and locked Nose gear down and locked Gear safety Gear Down Limit Door sequence Gear up and locked	Micro-Switch 1EN1-6
11.	Position Indicator, Landing gear	AN5839-1
12.	Circuit breaker	5 amp
13.	Warning Horn	Edwards & Co. J-2
14.	Relay Ignition Horn Silencing	AN3314-1
15.	Connector	AN3106B-14S-5S
16.	Landing Gear Control (Instructor's)	Associated Co. 12-1000
17.	Landing Gear Control (Student's)	Associated Co. 13-1000
18.	Connector	AN3106B-14S-6S
19.	Switch, Throttle Limit	Micro-switch 2VB2
20.	Switch, Horn Silencing	MS25081-1F
21.	Disconnect	AN3106B-14-6P
22.	Connector	AN3100A-12S-3S

EQUIPMENT LIST (CONT)

Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name and No.
23.	Switch Gear Up Sequence Spoiler Control	Micro-Switch 3EP2-E
24.	Connector	AN3108B-10SL-4S
25.	Valve, Door	Mar Vista 13450
26.	Valve, Gear	Whittaker 23448-2
27.	Switch, Power Steering	Guardian X-808
28.	Shut-off Valve, Nose Gear Steering	Parker 1374-559277
29.	Switch, Trim Tab Control	Guardian X-852
30.	Light, Elevator Trim Tab Neutral	AN3157-3
31.	Connector	AN3106B-14S-2S
32.	Actuator, Elevator Trim Tab	Lear 259B
33.	Actuator Aileron Trim Tab Rudder Trim Tab	Transco 9788
34.	Connector	AN3106B-10SL-3S
35.	Valve, Speedbrake	Adel 23665-6
36.	Valve, Thrust Attenuator	Adel 23665-6
37.	Circuit Breaker	10 amp
38.	Light, Passing	AN3144R4505
39.	Lights, Navigation	AN3312-1
40.	Connector	AN3108B-16S-8S
41.	Flasher, Navigation Lights	C-2
42.	Tail Light	AN3158-4
43.	Tail Light	AN3158-5
44.	Light, Wing Tip (right)	AN3033-8
45.	Light, Wing Tip (left)	AN3033-7
46.	Lights, Fuselage Position	AN3177-10
47.	Resistor	Ohmite 0200C
48.	Resistor	Ohmite 0400B
49.	Switch Inverter Nav-Passing Lights	AN3227-1

EQUIPMENT LIST (CONT)

Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name and No.
50.	Switch, External Gear Lights	AN3092-2
51.	Relay, Landing Light	AN3324-1
52.	Circuit Breaker	25 amp
53.	Circuit Breaker	7.0 amp
54.	Switch, Taxi-Landing Lights	Cutler Hammer 8905K766
55.	Light, Taxi	AN3147-1
56.	Connector	AN3106B-18-5S
57.	Light, Retractable Landing	AN3095-7
58.	Rheostat, Primary Instrument Lights	MS91429 Type RP15-2FD-250
59.	Light, Oxygen Demand Regulator	Aero Co. D2-A188
60.	Lights Tachometer Compass Exhaust temperature Fuel flow indicator Oil pressure gage Hydraulic Pressure Gage Flap position indicator	Grimes Mfg. Co. A5299-24
61.	Lights Fuel quantity indicator Loadmeter Landing gear position Accelerometer Clock	Grimes Mfg. Co. A5610-24
62.	Lights Altimeter Rate-of-climb indicator Course indicator Airspeed indicator	Grimes Mfg. Co. B4855 (28V)
63.63.	Light, Directional Gyro	Grimes Mfg. Co. B4789 (28V)
64.	Light, Attitude Gyro	Grimes Mfg. Co. B4890 (28V)
65.	Rheostat, Flight Instrument Lights Dimmer	Ohmite 40079
66.	Lights, Secondary Instrument	MS25027-1
67.	Light, Cockpit	C-4A
68.	Switch, Warning Lights Dimming	MS26016-2
69.	Fire Control Switch	Stearman S-1000
70.	Fire and Overheat Control Units	Thomas A. Edison 227-28-2
71.	Flasher, Warning Lights	Grimes Mfg. Co. D7280A-1

EQUIPMENT LIST (CONT)

Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name and No.
72.	Connector	AN3106B-14S-5P
73.	Fire and Overheat Test Switch	Micro-Switch 2PB11
74.	Relay, Time Delay	Cook Electric 650-3424
75.	Connector	AN3106B-10S-2S
76.	Ignition Coil	Type TGLN-2302 (SNT) (561851), or (SNT) (56149)
77.	Ignitor	(CK) (562512)
78.	Connector	AN3108A-12S-3S
79.	Connector	AN3108B-14S-6S
80.	Starter-Generator	VG-550
81.	Connector	AN3108B-36-3S
82.	Transformer	General Electric 9T39Y2963
83.	Connector	AN3108B-14S-2S
84.	Transmitter, Fuel Flow	J-5
85.	Indicator, Fuel Flow	A-16
86.	Indicator, Fuel Quantity	JG4B-1
87.	Power Unit, Fuel Quantity	Honeywell EG5B-1
88.	Transfer Relay, Fuel Quantity	Honeywell RG12M-1
89.	Switch, Fuel Quantity Selector	Cutler Hammer 8918K765
90.	Probe, Fuel Quantity (wing inboard)	Honeywell FG120A-17
91.	Probe, Fuel Quantity (wing outboard)	Honeywell FG120A-18
92.	Probe, Fuel Quantity (fuselage fuel cell)	Honeywell FG131B-2
93.	Shut-off Valve, Motorized Fuel	Whittaker WE452-1D
94.	Circuit Breaker	20 amp
95.	Switch Battery Fuel boost pump Pitot tube heat	AN3022-2
96.	Fuel Boost Pump	Lear-Romec RG11100C1
97.	Switch, Fuel Level Control	AN3027-3
98.	Shut-off Valve, Hydraulically Operated	Whittaker 118595
99.	Switch, Fuel Float	Revere F70220

EQUIPMENT LIST (CONT)

Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name and No.
100.	Relay, Fuel Level	AN 3311-1
101.	Fuel Proportioner	Stratos 11901-1
102.	Light Fuel low level warning Canopy-not-locked	AN3157-6
103.	Fuse	MS 90077-11
104.	Attitude Gyro	J-8
105.	Directional Gyro	C-5C
106.	Turn and Slip Indicator	MS28024-1
107.	Exhaust Temperature Indicator	MS28006-1
108.	Resistor	AN5534-2
109.	Tachometer Indicator	MS28000-1
110.	Connector	AND100066A-14S-6P
111.	Connector	AN3106B-12S-3S
112.	Tachometer Generator	AN5544-3
113.	Light, Engine Ice Warning	AN3157-8
114.	Connector	AN3108B-14S-2SX
115.	Engine Ice Detector	Cook Electric 575-7
116.	Engine Ice Interpretor	Cook Electric 650-4112
117.	Flap Position Indicator	MS28023-1
118.	Flap Position Transmitter	AN5786-1
119.	Connector	AN3115-1
120.	Pitot Tube Heater	AN5813-1
121.	Circuit Breaker	15 amp
122.	Connector	AN3108B-14S-7S
123.	Inverter	Eicor 1-100A-115D-7
124.	External Power Receptacle	AN2552-3A
125.	Terminal Block	AN 3436-10-4
126.	Resistor, Generator Paralleling	Avia Products 11017
127.	Loadmeter	J-1
128.	Relay, Generator Control	AN3353-1

EQUIPMENT LIST (CONT)

Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name and No.
129.	Voltage Regulator	General Electric CR2795-B105A1
130.	Reverse Current Relay	AN3025-1
131.	Switch Generator Control Interphone	AN3021-2
132.	Junction Box	J-15A
133.	Plug	ARC 14051
134.	Receiver	ARC R-19
135.	Relay, Antenna	ARC K-18
136.	Antenna, Communication	ARC 17530 A-19
137.	Transmitter	ARC T-11B
138.	Plug	ARC 14052
139.	Plug	ARC 14050
140.	Transmitter	ARC T-13A
141.	Plug	ARC 16115
142.	Oscillator Relay	ARC K-13
143.	Amplifier, Hot Microphone	ARC F-14
144.	Relay, Muting	ARC K-16
145.	Disconnect, Seat	Cannon RWK-4-31 SL & WK5-32SL
146.	Variable Resistor	ARC 8487
147.	Plug	ARC 16104
148.	Adapter	MX 1646/AIC
149.	Control Unit	C-58
150.	Plug	ARC 14320
151.	Control Unit	C1254/ARN-30
152.	Rack	E-14
153.	Plug	ARC 14321
154.	Antenna, Navigation	Lear 62657-02
155.	Plug	ARC 15912
156.	Course Indicator	ARC 16706
157.	Light, Marker Beacon	AN 3517-4

EQUIPMENT LIST (CONT)

Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name and No.
158.	Receiver	ARC R-13B
159.	Variable Resistor	ARC 8082
160.	Antenna, Marker Beacon	Collins Radio 37X-1
161.	Receiver	ARC R-20
162.	Transverter	TV-10 No. 1
163.	Plug	ARC 16743
164.	Plug	ARC 16744
165.	Transverter	TV-10 No. 2
166.	Switch, Fuel Quantity Test	MS25089-1F
167.	Switch, Ignition	AN3022-8
168.	Switch, Throttle	BZ-7RQ1T

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WIRING DIAGRAM INDEX

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D.02	Flap Position System	1-30	50
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J.02	Start and Ignition System - Right Engine	1-19	38
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K.02	Start and Ignition System - Right Engine	1-19	38
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L.02	External Gears Lifhts	1-10	28
L.03	Landing - Taxi Lights	1-11	29
L.04	Primary Instrument Lights	1-12	30
L.05	Primary Instrument Lights - Flight	1-13	31
L.06	Secondary Instrument Lights	1-14	32
L.07	C-4A Cockpit Lights	1-15	33
M.01	Canopy System	1-2	17
M.02	Canopy-Not-Locked Warning Light	1-31	51
P.01	Battery and External Power Receptacle	1-34	54
Q.01	Fuel Shut-Off System	1-22	42
Q.02	Fuel Boost Pump	1-23	43
Q.03	Fuel Proportioner	1-24	44
RC.01	R-19 Receiver	1-37	57
RC.02	T-11B Transmitter	1-38	58
RC.03	T-13A Transmitter	1-39	59
RC.04	Hot Microphone Amplifier System	1-40	60
RC.05	C-58 Control Unit	1-43	63
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RN.01	Navigation Radio	1-44	64

WIRING DIAGRAM INDEX (CONT)

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RZ. 02	Instructor Communication System	1-42	62
U. 01	Inverter	1-33	53
W. 01	Warning Lights Dimming	1-16	34
W. 02	Fire and Overheat System	1-17	35
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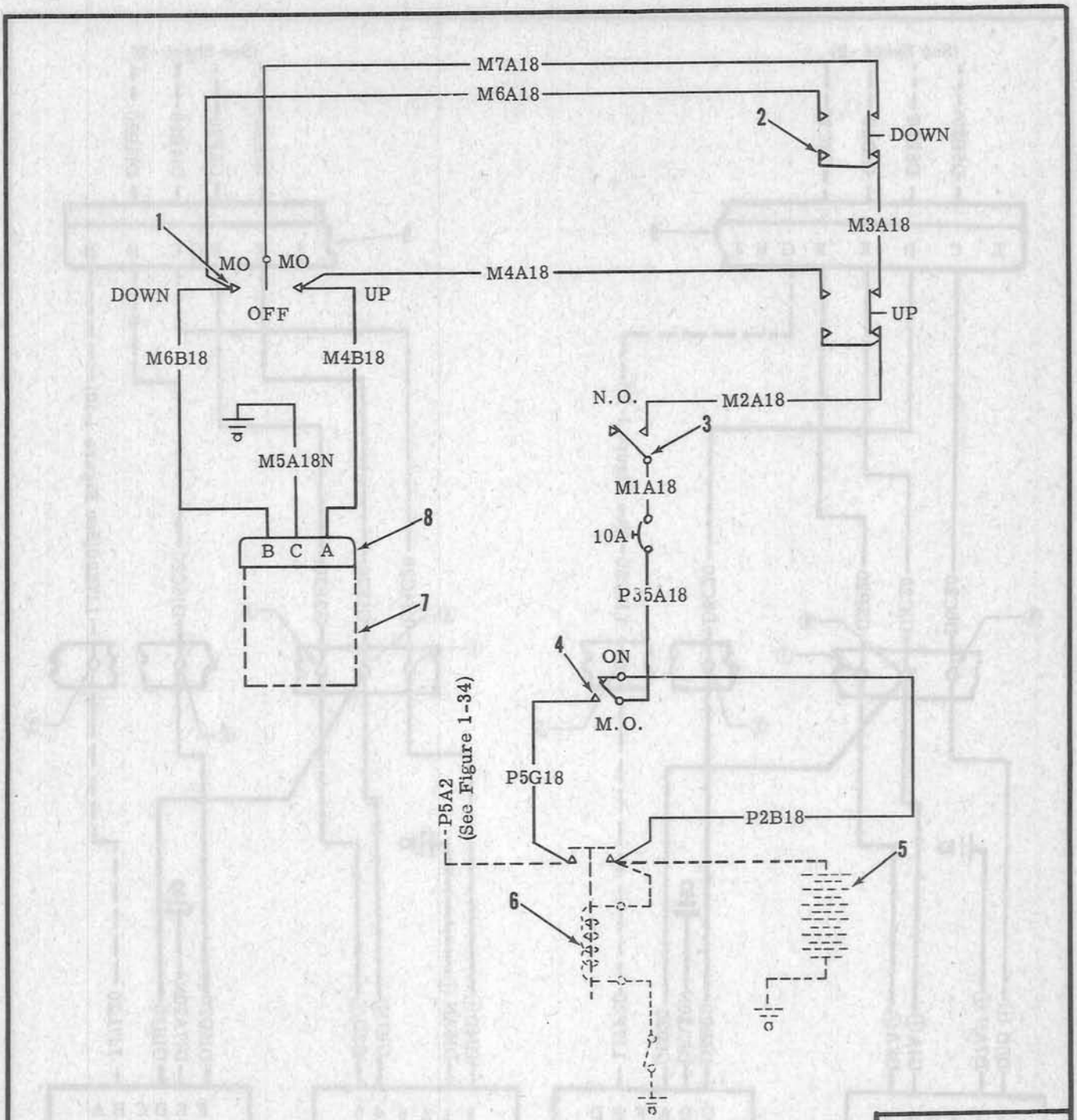
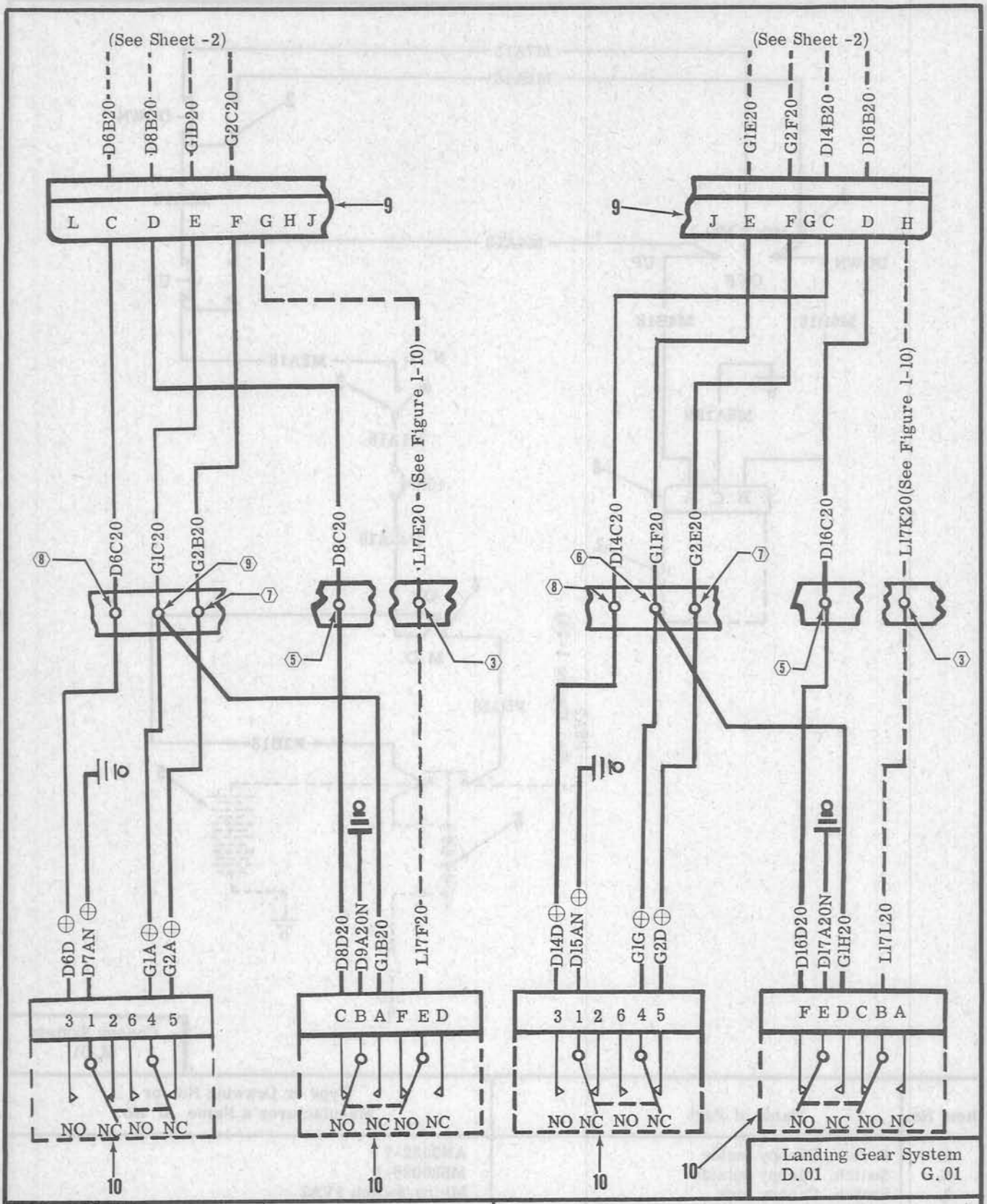


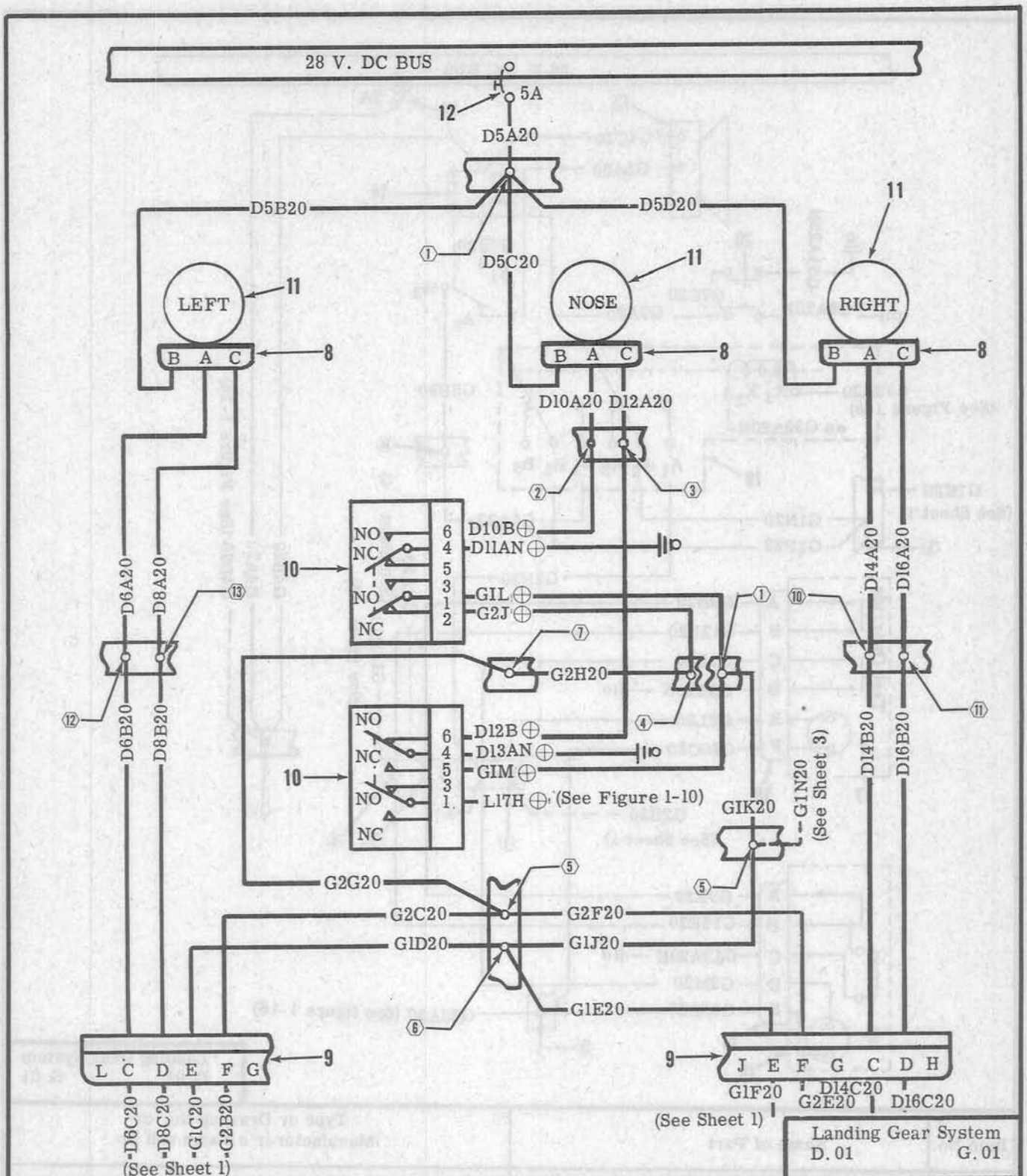
Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
1.	Switch, Canopy inside	AN3022-7
2.	Switch, Canopy outside	MS25026-1
3.	Switch, Canopy lock	Micro-Switch 1VA1
4.	Switch, Auxiliary Power Unit Canopy Power	AN3022-11
5.	Battery	AN3150-2
6.	Relay, Battery	AN3370-2
7.	Actuator, Canopy	Airborne R-550M15
8.	Connector	AN3108B-10SL-3S

Figure 1-2. Canopy System



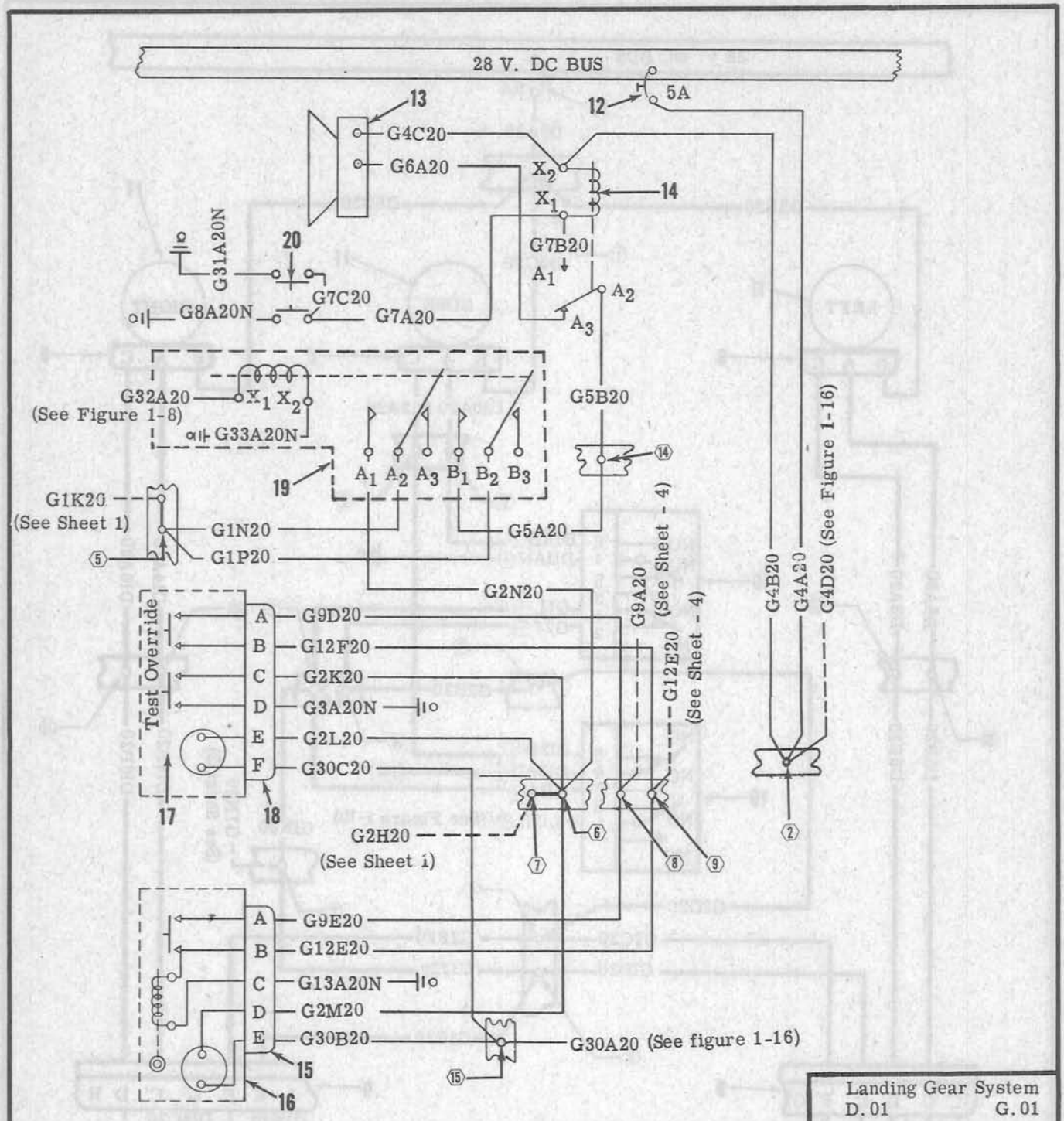
Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name and No.
9.	Disconnect, Wing Gear Switch	AN3108B-7P
10.		Micro-Switch 1EN1-6 (MS24331)

Figure 1-3. Landing Gear System (Sheet 1 of 4)



Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
8.	Connector	AN3108B-10SL-3S
9.	Disconnect	AN3108B-7P
10.	Gear Switch	Micro-Switch 1EN1-6 (MS24331)
11.	Position Indicator, Landing Gear	AN5839-1
12.	Circuit Breaker	5 amp

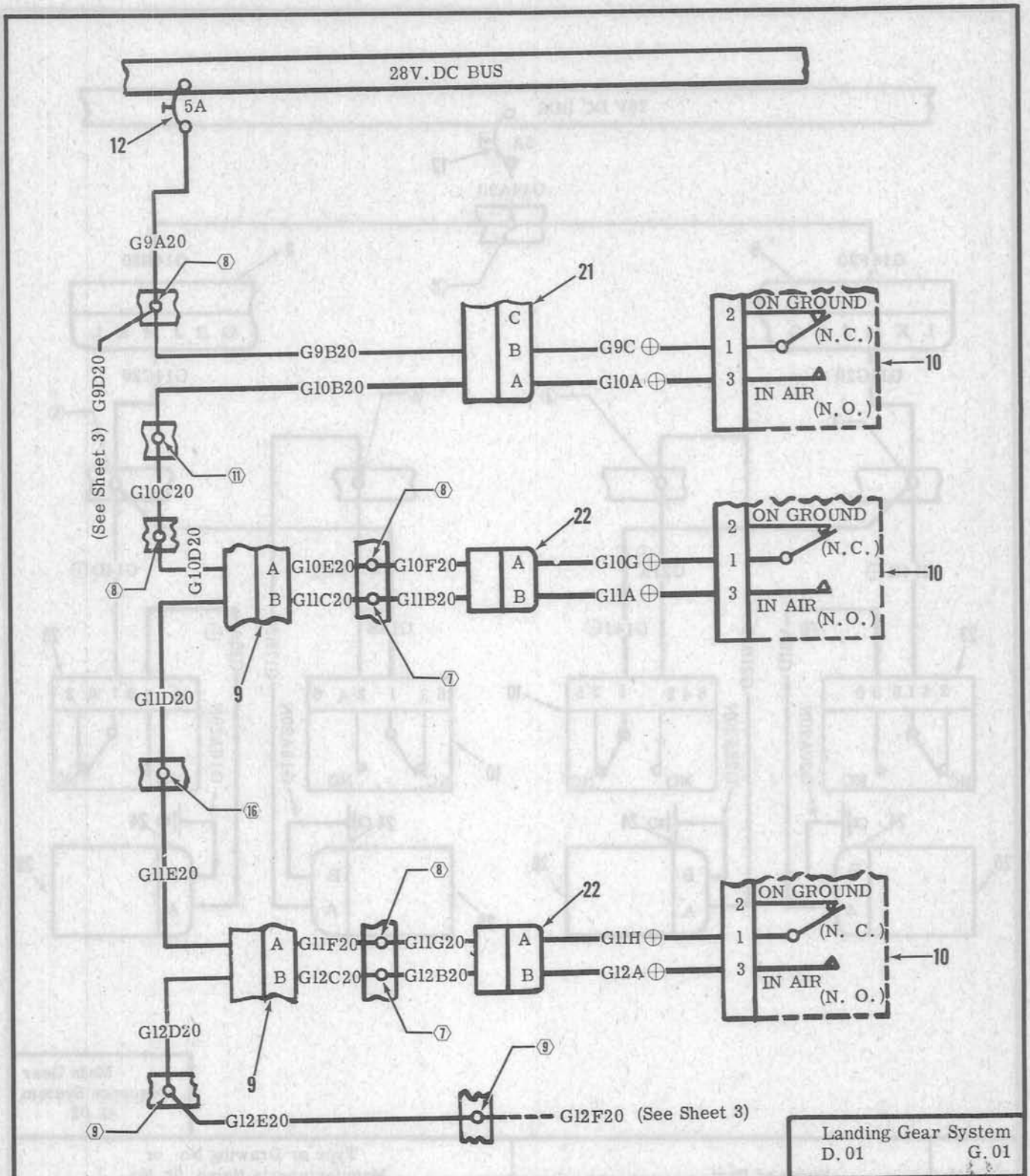
Figure 1-3. Landing Gear System (Sheet 2 of 4)



Landing Gear System
D. 01 G. 01

Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name and No.
12.	Circuit Breaker	5 amp
13.	Warning Horn	Electric Service 32462 (J-2)
14.	Horn Silencing Relay	AN3314-1
15.	Connector	AN3106B-14S-5S
16.	Landing Gear Control (Instructor's)	Associated Co. 12-1000
17.	Landing Gear Control (Student's)	Associated Co. 13-1000
18.	Connector	AN3106B-14S-5S
19.	Gear Warning Relay	AN311-1
20.	Switch, Horn Silencing	MS25081-1-F

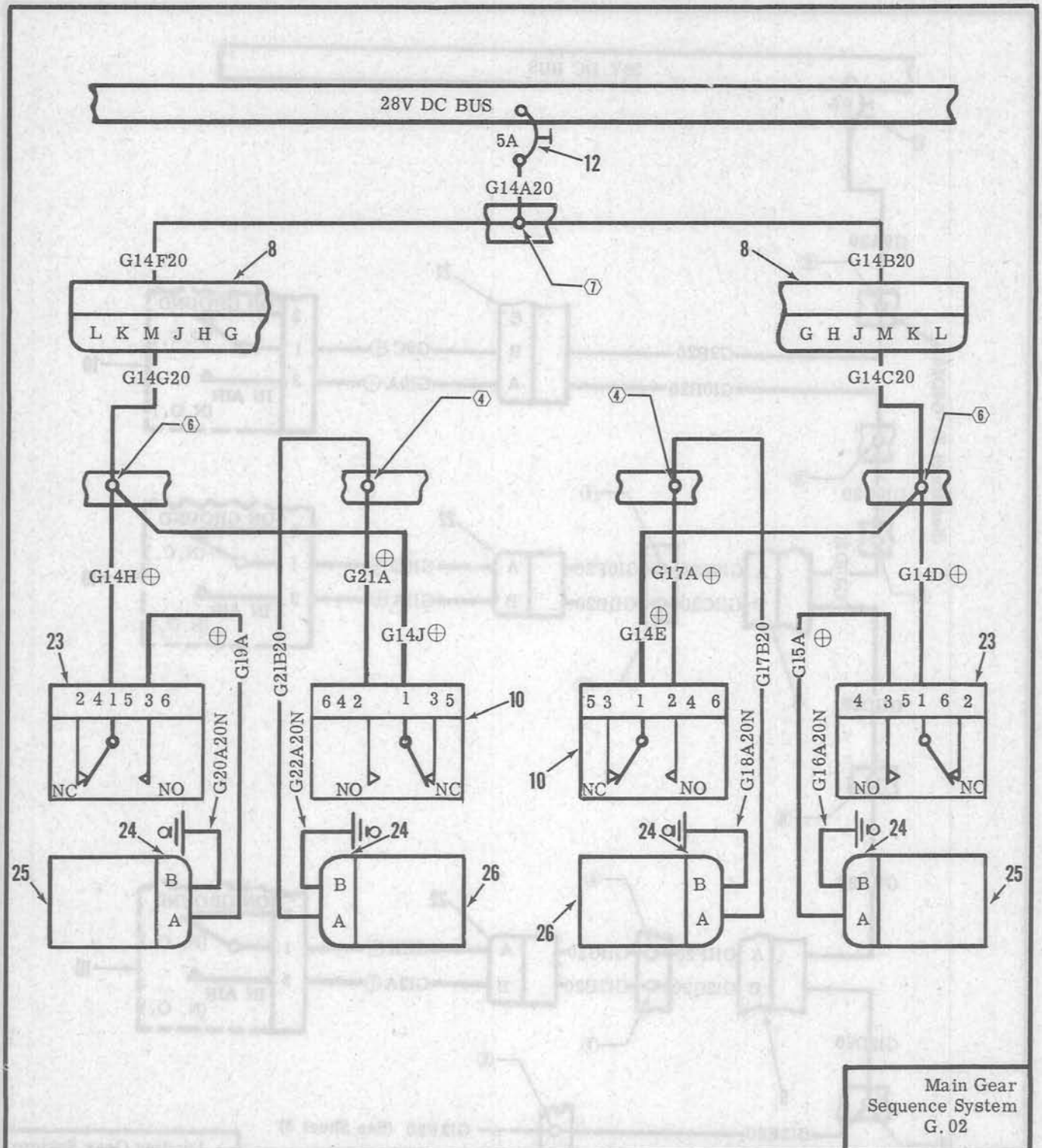
Figure 1-3. Landing Gear System (Sheet 3 of 4)



Landing Gear System
D.01 G.01

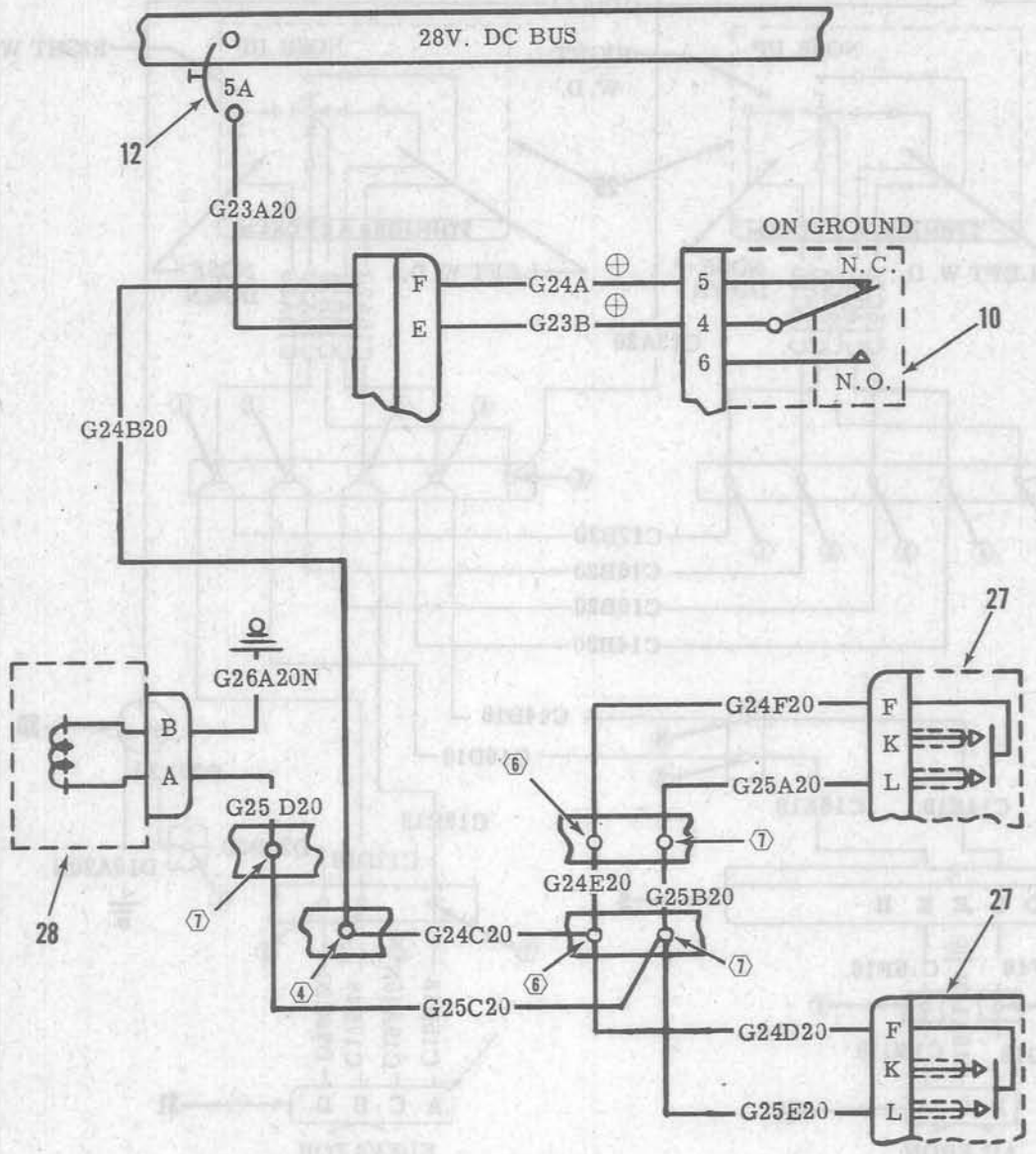
Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name and No.
9.	Disconnect, Wing	AN3108B-7P
10.	Switch, Gear	Micro-Switch 1EN1-6 (MS24331)
12.	Circuit Breaker	5 amp
21.	Disconnect, Landing Gear	AN3106B-14S-6P
22.	Disconnect, Landing Gear	AN3100A-14S-3S

Figure 1-3. Landing Gear System (Sheet 4 of 4)



Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
8.	Disconnect, Wing	AN3108B-10SL-3S
10.	Switch	Micro-Switch 1EN1-6 (MS24331)
12.	Circuit Breaker	5 amp
23.	Switch, Right Gear Up	Micro-Switch 3EP2-E
24.	Connector	AN3108B-10SL-4S
25.	Valve, Door	Mar Vista 13450
26.	Valve, Door	Whittaker 23448-2

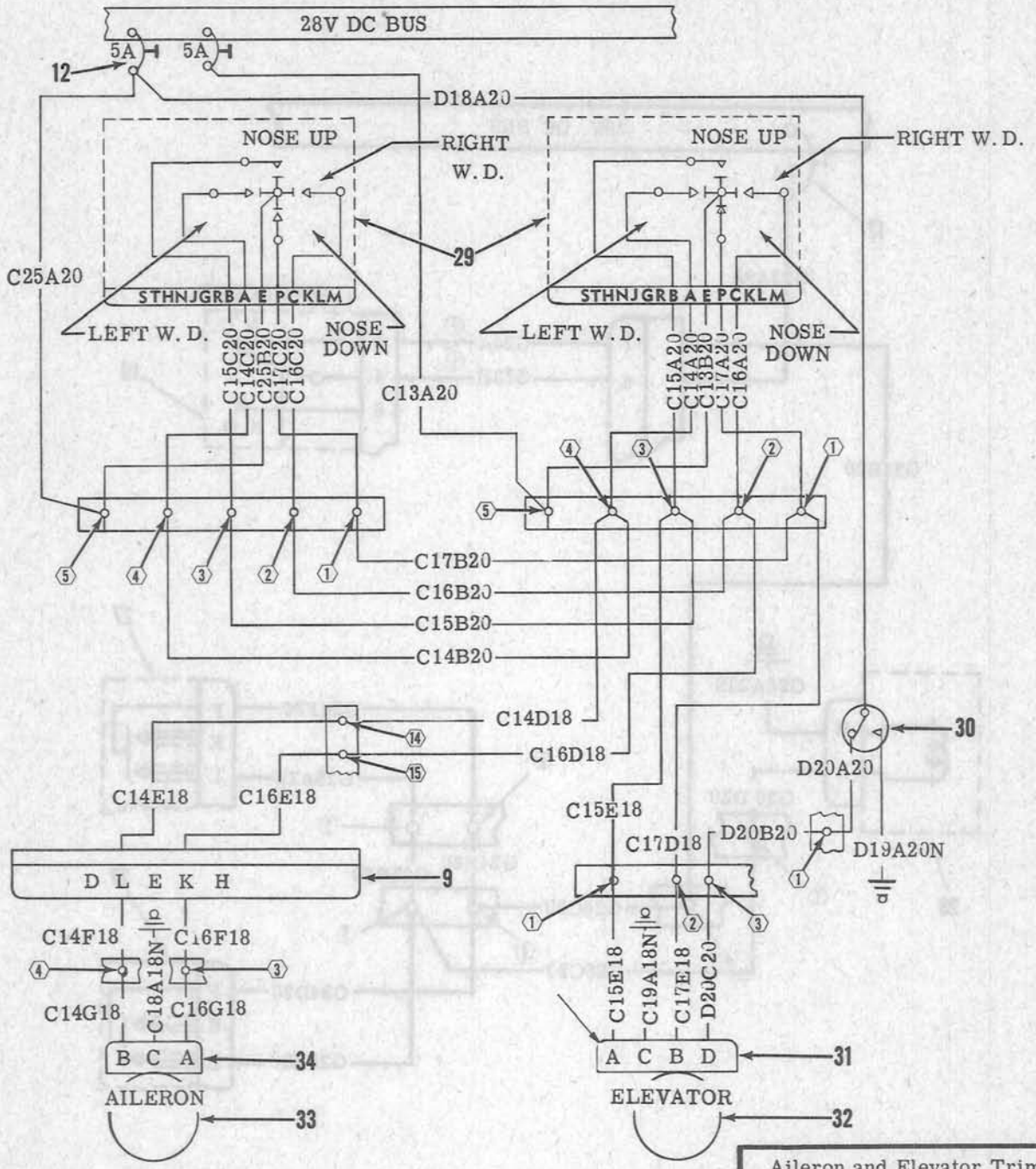
Figure 1-4. Main Gear Sequence System



Nose Gear Steering System G.03

Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
10.	Switch, Nose Gear Safety	Micro-Switch 1EN1-6 (MS24331)
12.	Circuit Breaker	5 amp
27.	Switch, Power Steering	Guardian X-808
28.	Shut-off Valve	Parker 1374-559277

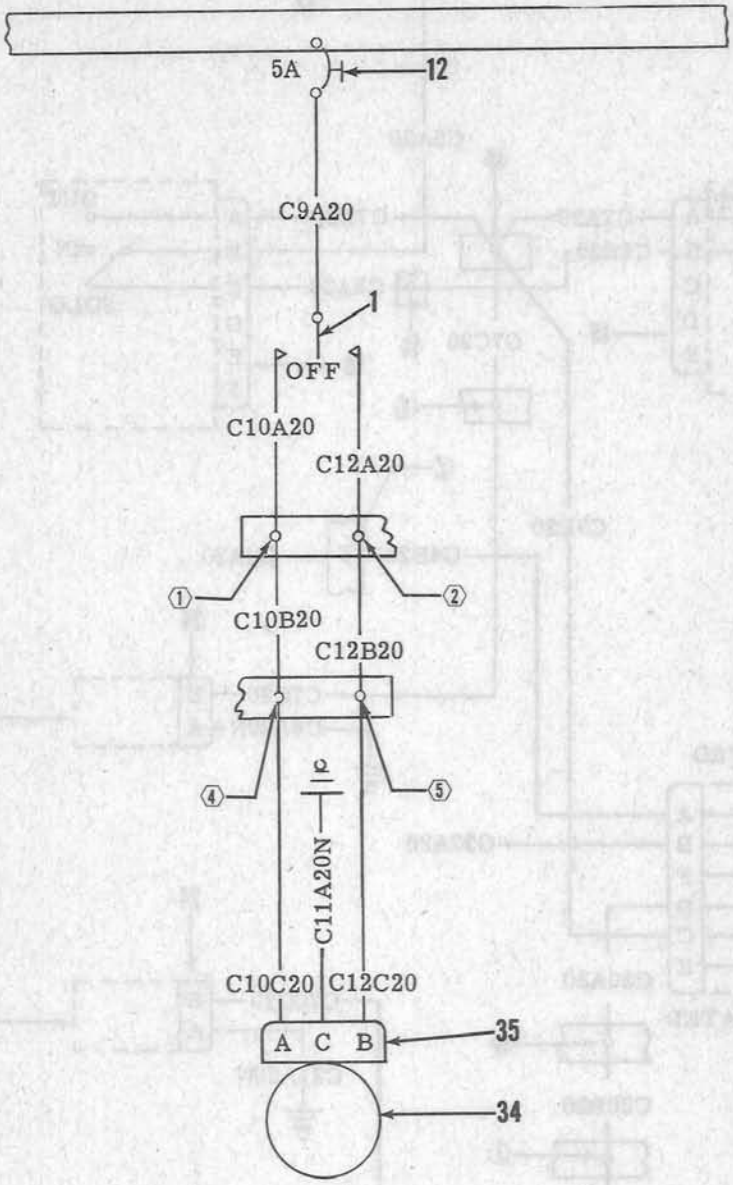
Figure 1-5. Nose Gear Steering System



Aileron and Elevator Trim Tab System
C.01

Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
9.	Disconnect Wing	AN3108B-7P
12.	Circuit Breaker	5 amp
29.	Switch, Trim Tab Control	Guardian X-852
30.	Light, Elevator Trim Tab Neutral	AN3157-3
31.	Connector	AN3106B-14S-2S
32.	Elevator Tab Actuator	Lear 259B
33.	Aileron Trim Tab Actuator	Transco 9788
34.	Connector	AN3106-10SL-3S

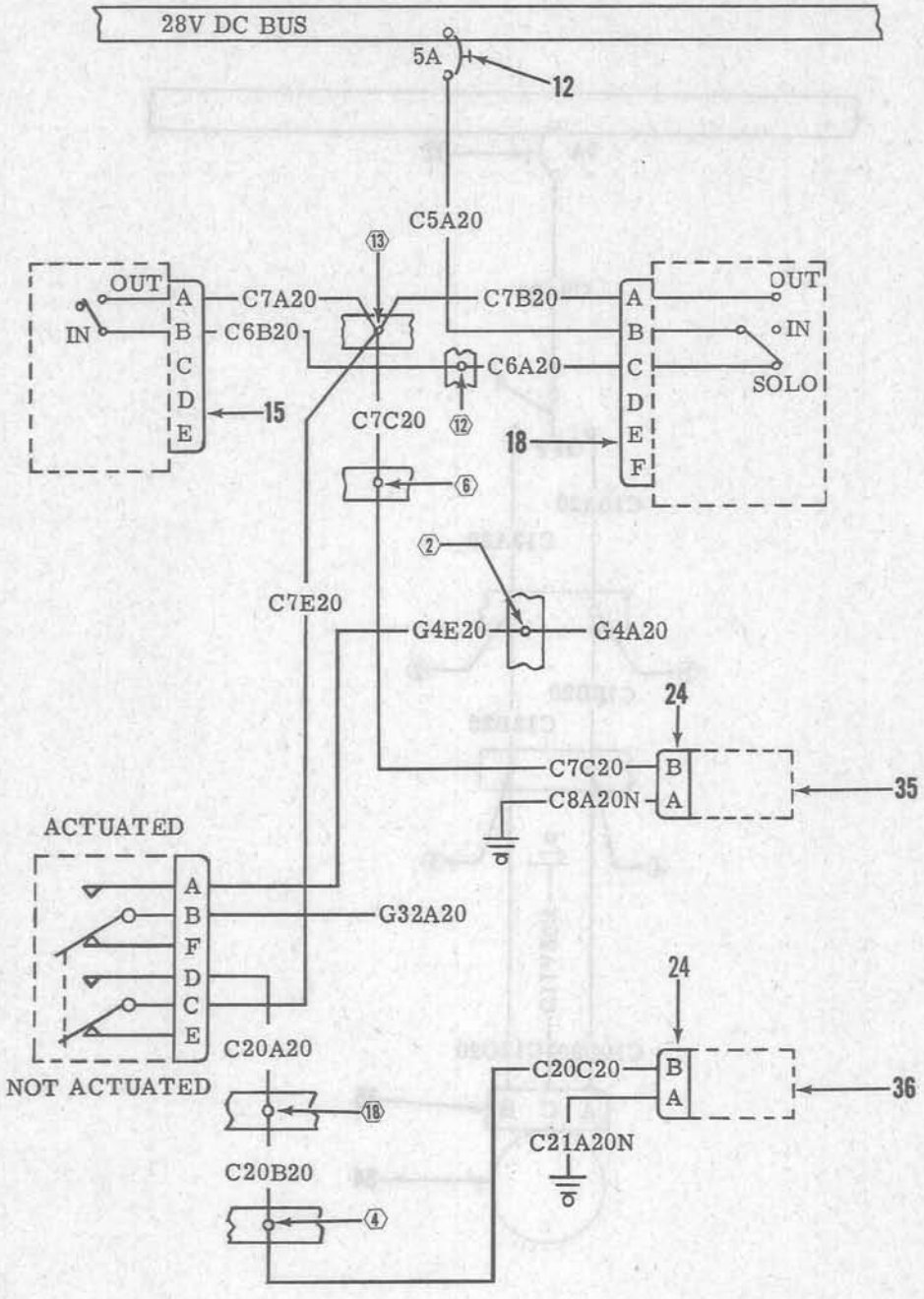
Figure 1-6. Aileron and Elevator Trim Tab System



Rudder Trim Tab System
C.02

Item No.	Name of Part	Type of Drawing No. or Manufacturer's Name and No.
1.	Switch, Rudder Trim Tab	AN3022-7
12.	Circuit Breaker	5 amp
34.	Actuator, Rudder Trim Tab	Transco 9788
35.	Connector	AN3106B-10SL-3S

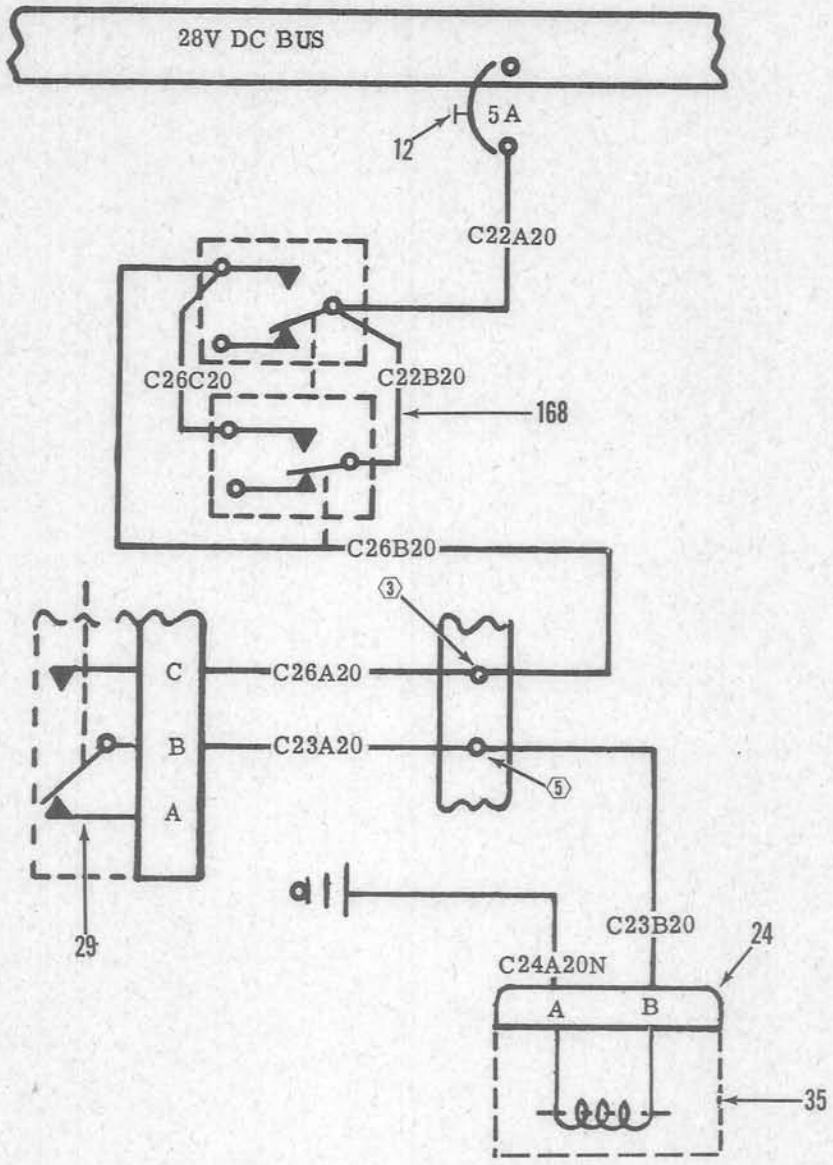
Figure 1-7. Rudder Trim Tab System



Speedbrake and Thrust Attenuator
C.03

Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
12.	Circuit Breaker	5 amp
15.	Connector	AN3106B-14S-5S
18.	Connector	AN3106B-14S-6S
24.	Connector	AN3108B-10SL-4S
35.	Valve. Speedbrake	Adel 23665-6
36	Valve, Thrust Attenuator	Adel 23665-6

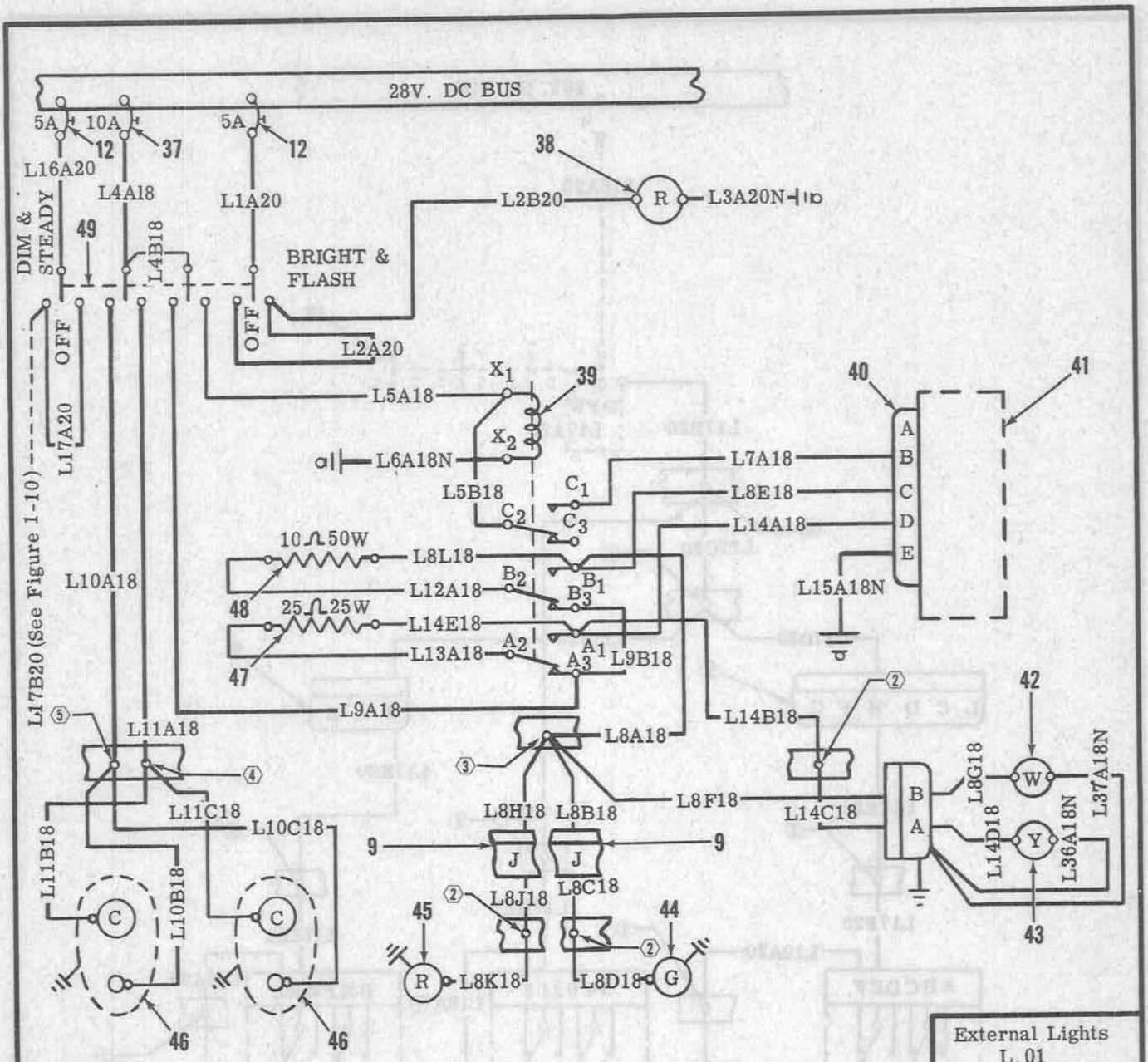
Figure 1-8. Speedbrake and Thrust Attenuator



Stall Warning Spoiler System
C. 04

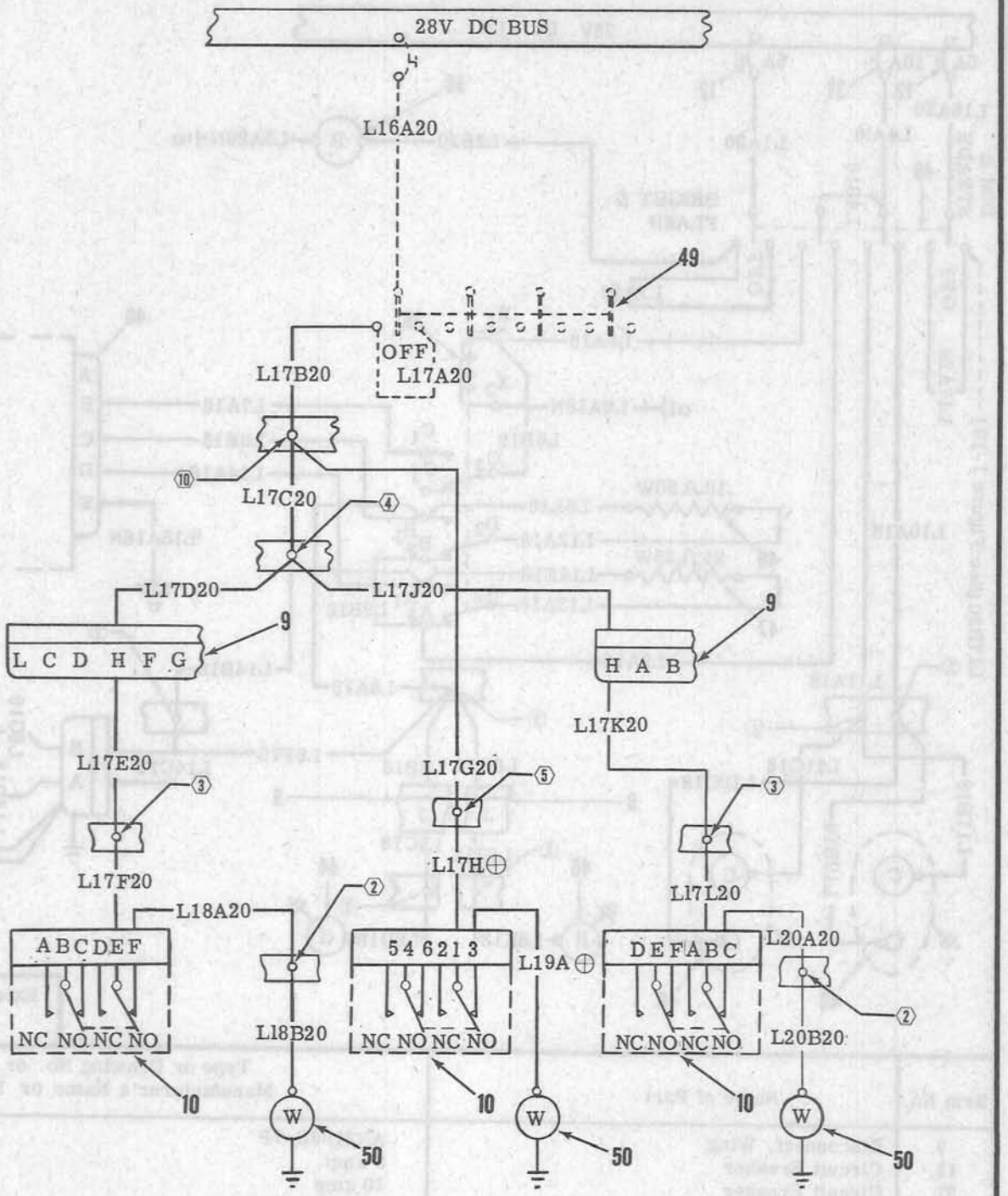
Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
12.	Circuit Breaker	5 AMP
168.	Switch Throttle	BZ-7RQ1T
24.	Connector	AN3108B-10SL-45
35.	Valve, Spoiler Control	Adel 23665-5
29.	Switch, Spoiler Control	3EP2-E

Figure 1-8A. Stall Warning Spoiler System



Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
9.	Disconnect, Wing	AN3108B-7P
12.	Circuit Breaker	5 amp
37.	Circuit Breaker	10 amp
38.	Light, Passing	AN3144R4505
39.	Relay, Navigation Lights	AN3312-1
40.	Connector	AN3108B-16S-8S
41.	Flasher	C-2
42.	Tail Light (white)	AN3158-4
43.	Tail Light (yellow)	AN3158-5
44.	Light, Wing Tip (green)	AN3033-8
45.	Light, Wing Tip (red)	AN3033-7
46.	Fuselage Position Light	AN3177-10
47.	Resistor	Ohmite 0200C
48.	Resistor	Ohmite 0400B
49.	Navigation and Passing Light Switch	AN3227-1

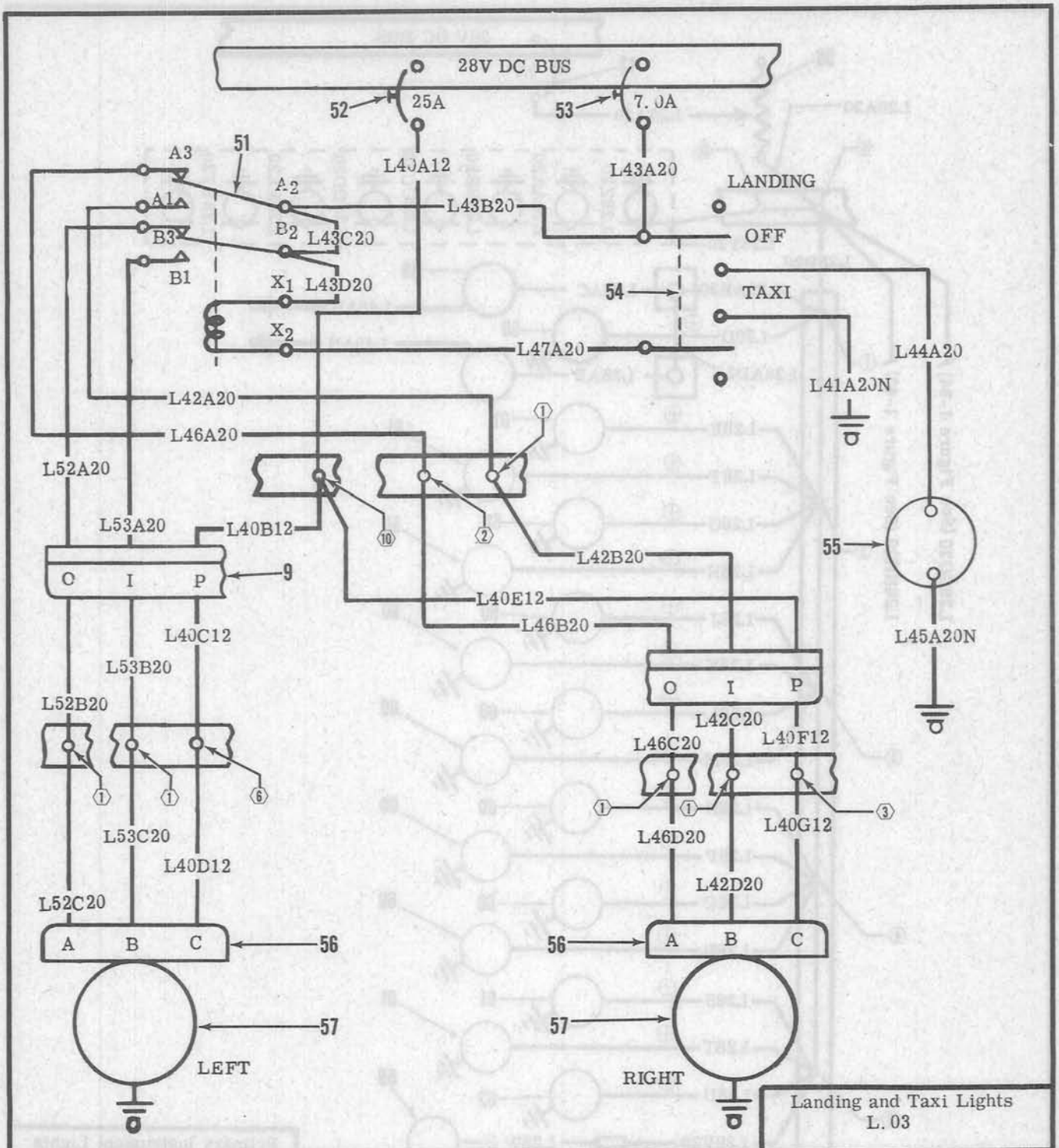
Figure 1-9. External Lights



External Gear Lights
L. 02

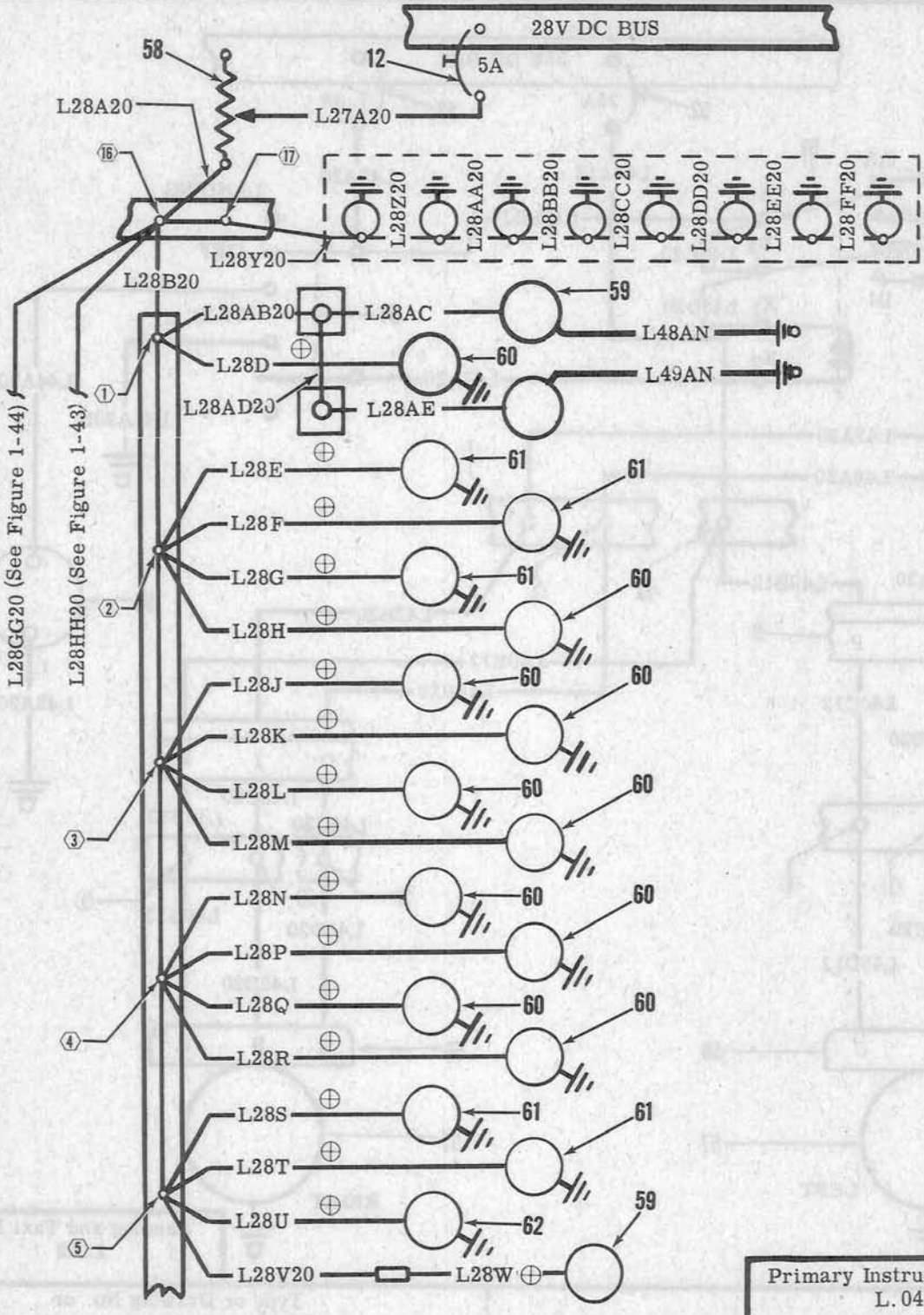
Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
9.	Disconnect	AN3108B-7P
10.	Switch, Gear Down and Locked	Micro-Switch 1EN1-6 (MS24331)
49.	Navigation-Passing Light Switch	AN3227-1
50.	Light, External Gear	AN3092-2

Figure 1-10. External Gear Lights



Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
9.	Disconnect, Wing	AN3108B-7P
51.	Relay, Landing Light	AN3324-1
52.	Circuit Breaker	25 amp
53.	Circuit Breaker	7.5 amp
54.	Switch, Landing Taxi Lights	Cutler Hammer 8905K766
55.	Light, Taxi	AN3147-1
56.	Connector	AN3106B-18-5S
57.	Light, Landing Retractable	AN3095-7

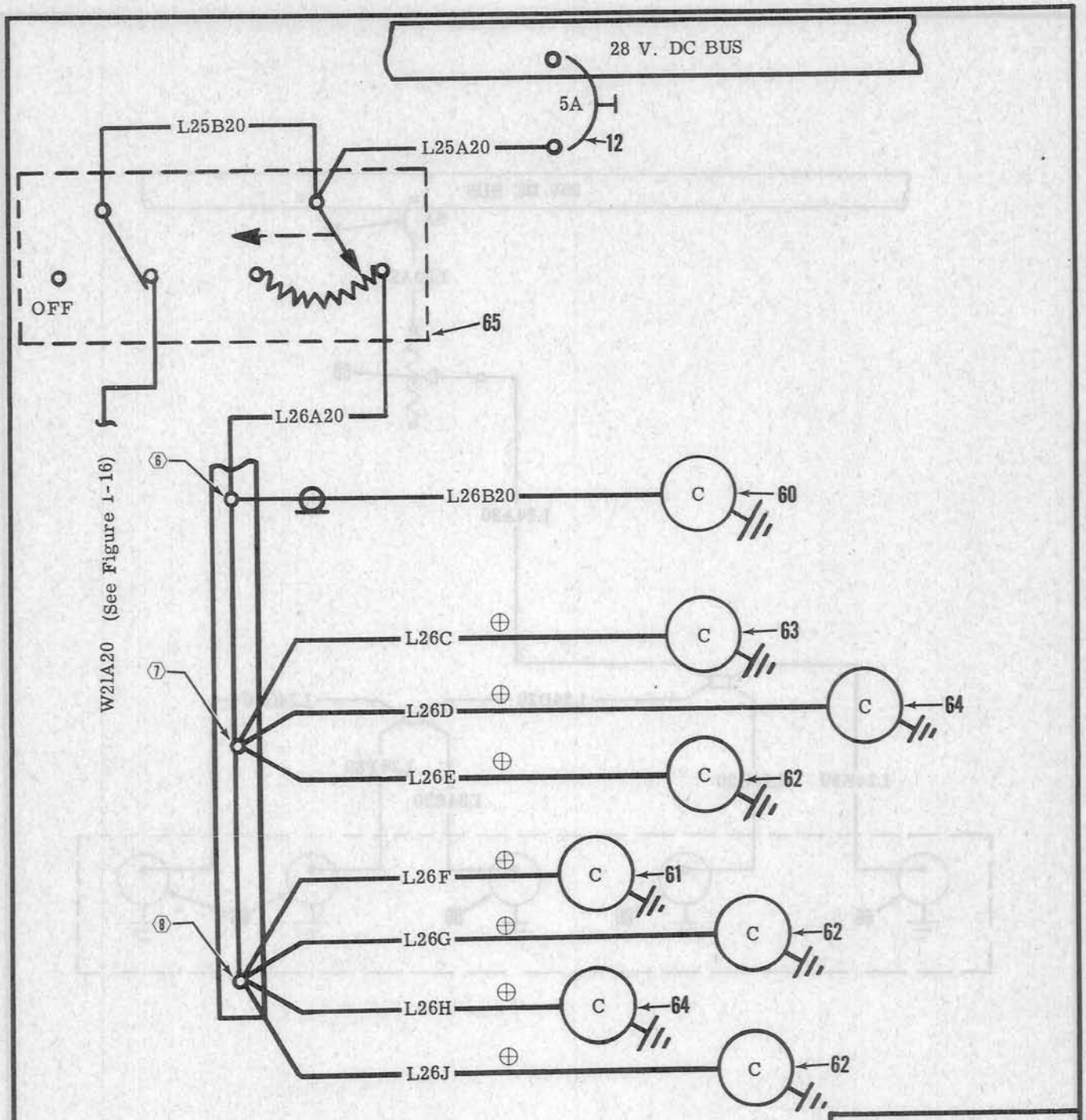
Figure 1-11. Landing and Taxi Lights



Primary Instrument Lights
L.04

Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
12.	Circuit Breaker	5 amp
58.	Rheostat	MS91429 Type RP15-2-FD-250-JJ
59.	Light	Aero Co. D2-A188
60.	Light	Grimes Mfg. Co. A5299-24
61.	Light	Grimes Mfg. Co. A56-10-24
62.	Light	Grimes Mfg. Co. B4855 (28V)

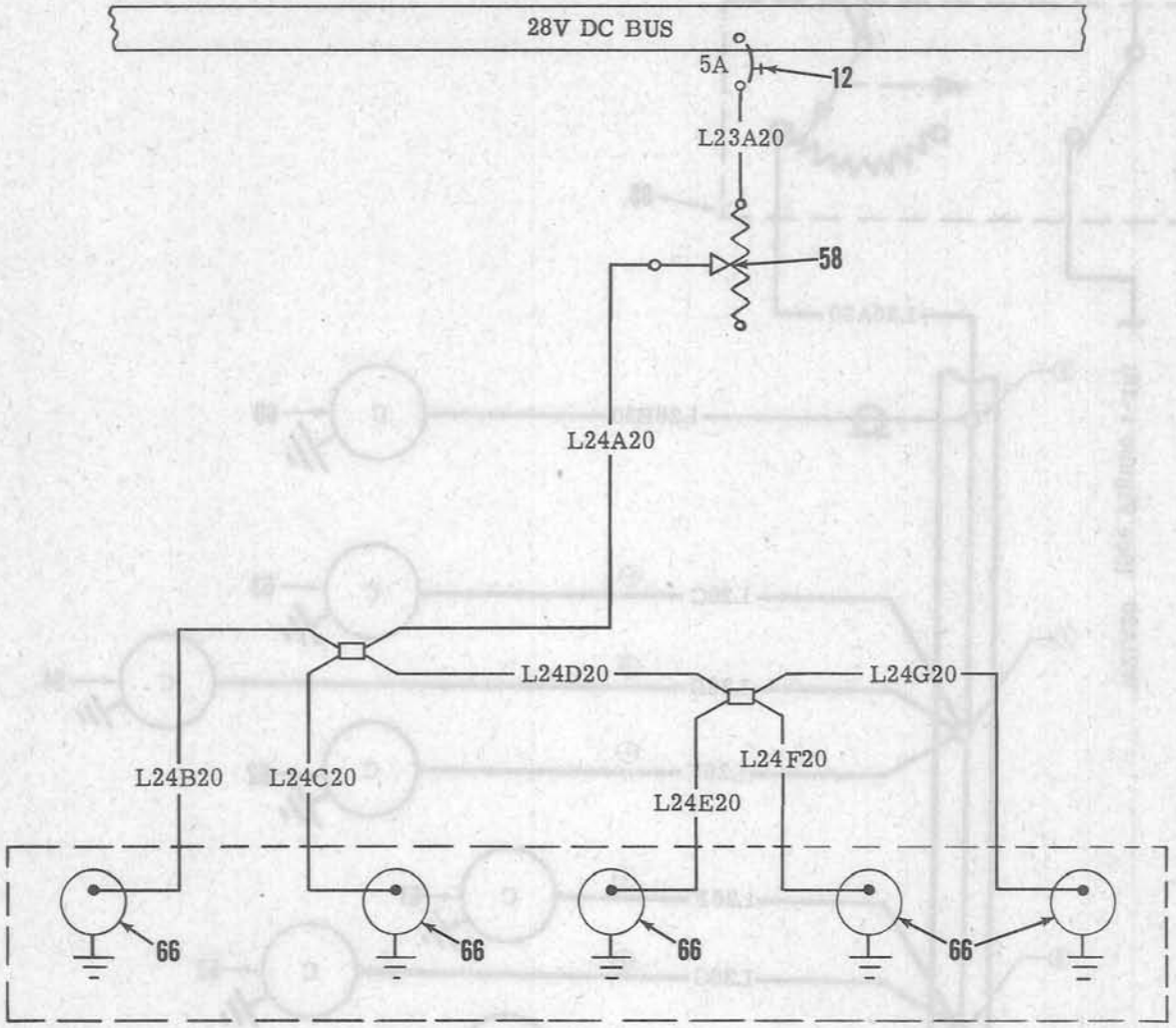
Figure 1-12. Primary Instrument Lights



Primary Instrument Lights - Flight
L. 05

Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
12.	Circuit Breaker	5 amp
60.	Light	Grimes Mfg. Co. A5299-24
61.	Light	Grimes Mfg. Co. A5610-24
62.	Light	Grimes Mfg. Co. B4855 (28V)
63.	Light	Grimes Mfg. Co. B4789 (28V)
64.	Light	Grimes Mfg. Co. B4890 (28V)
65.	Rheostat	Ohmite 40079

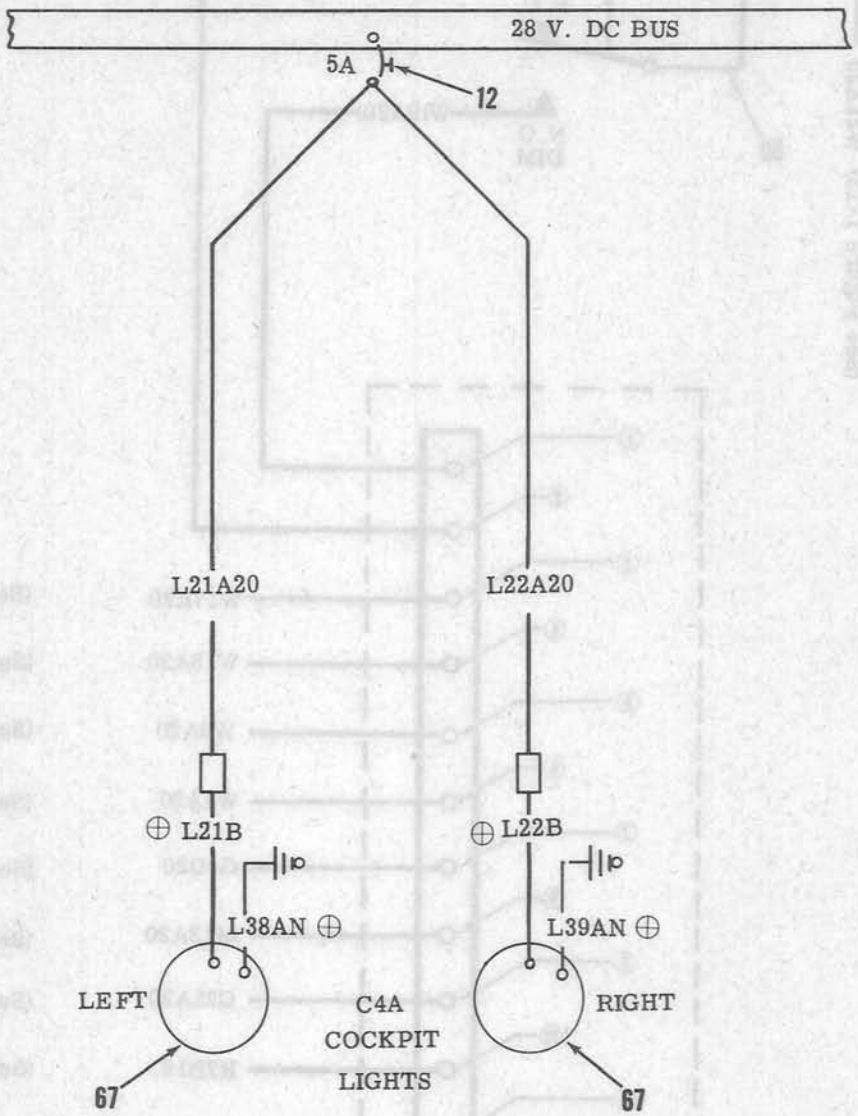
Figure 1-13. Primary Instrument Lights - Flight



Secondary Instrument Lights
L. 06

Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
12.	Circuit Breaker	5 amp
58.	Rheostat	MS91429 Type RP15-2 FD-250
66.	Light	MS25027-1

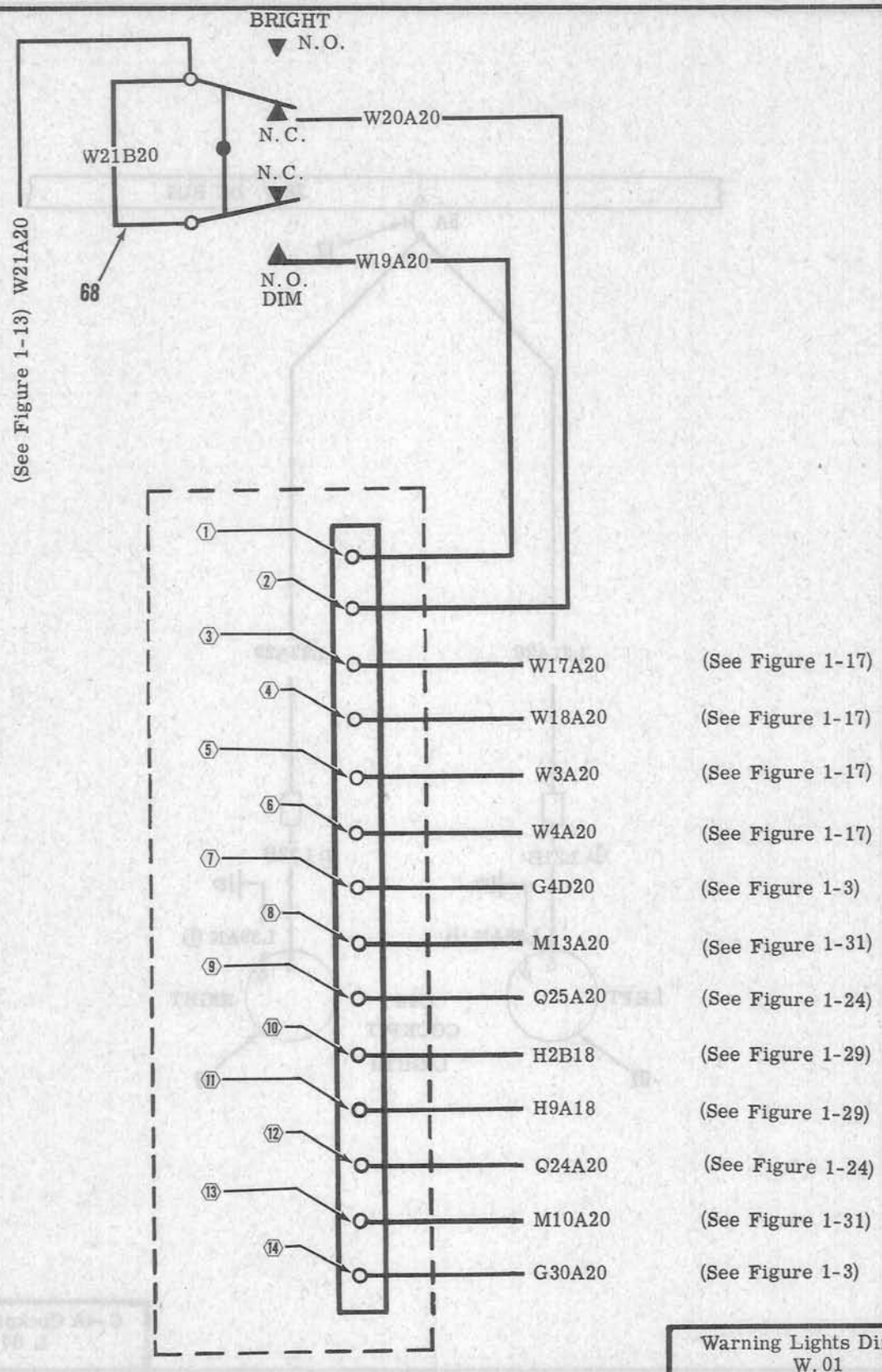
Figure 1-14. Secondary Instrument Lights



C-4A Cockpit Lights
L. 07

Item No.	Name of Part	Type of Drawing No. or Manufacturer's Name or No.
12.	Circuit Breaker	5 amp
67.	Light, Cockpit	C-4A

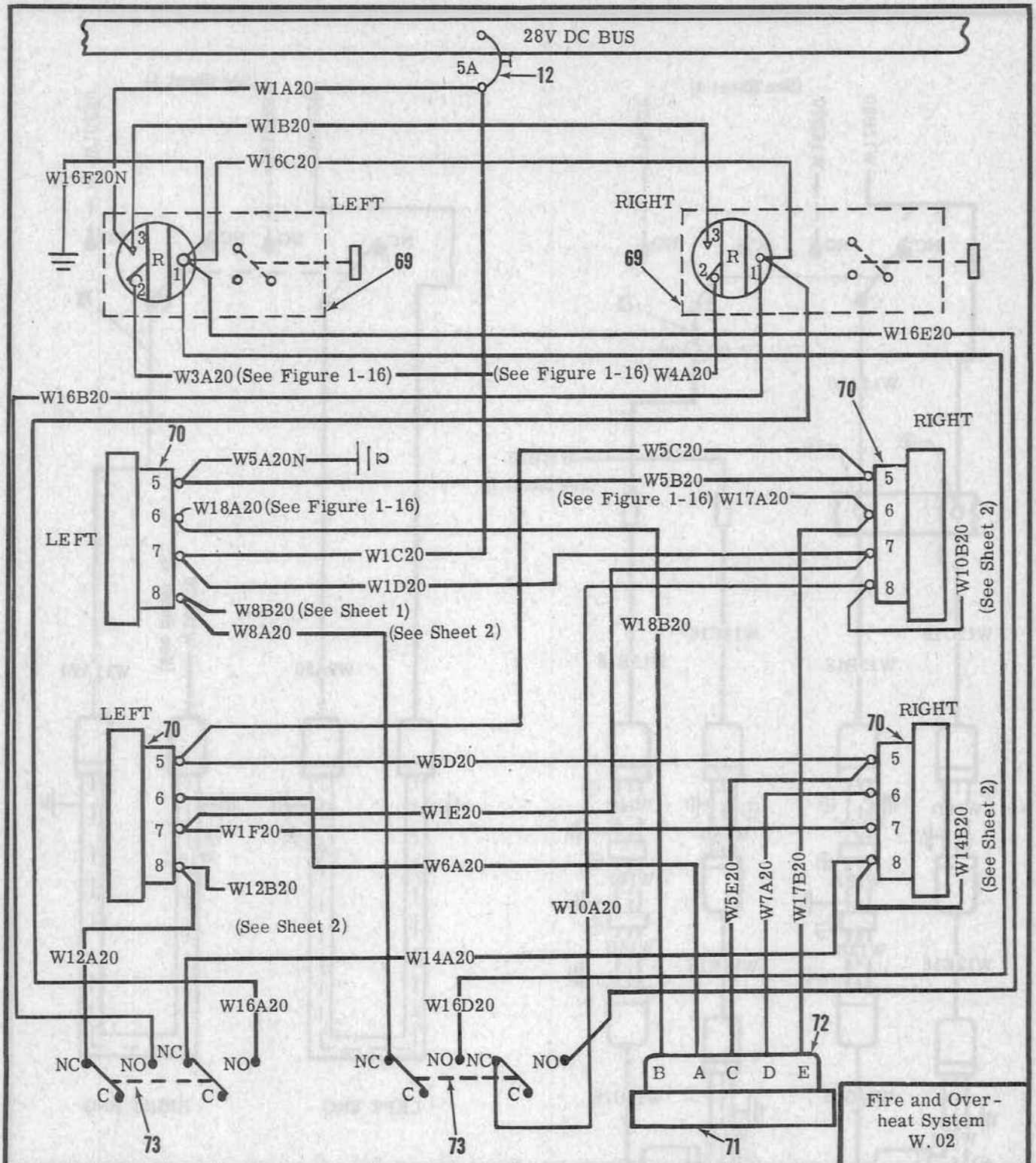
Figure 1-15. C-4A Cockpit Lights



Warning Lights Dimming
W. 01

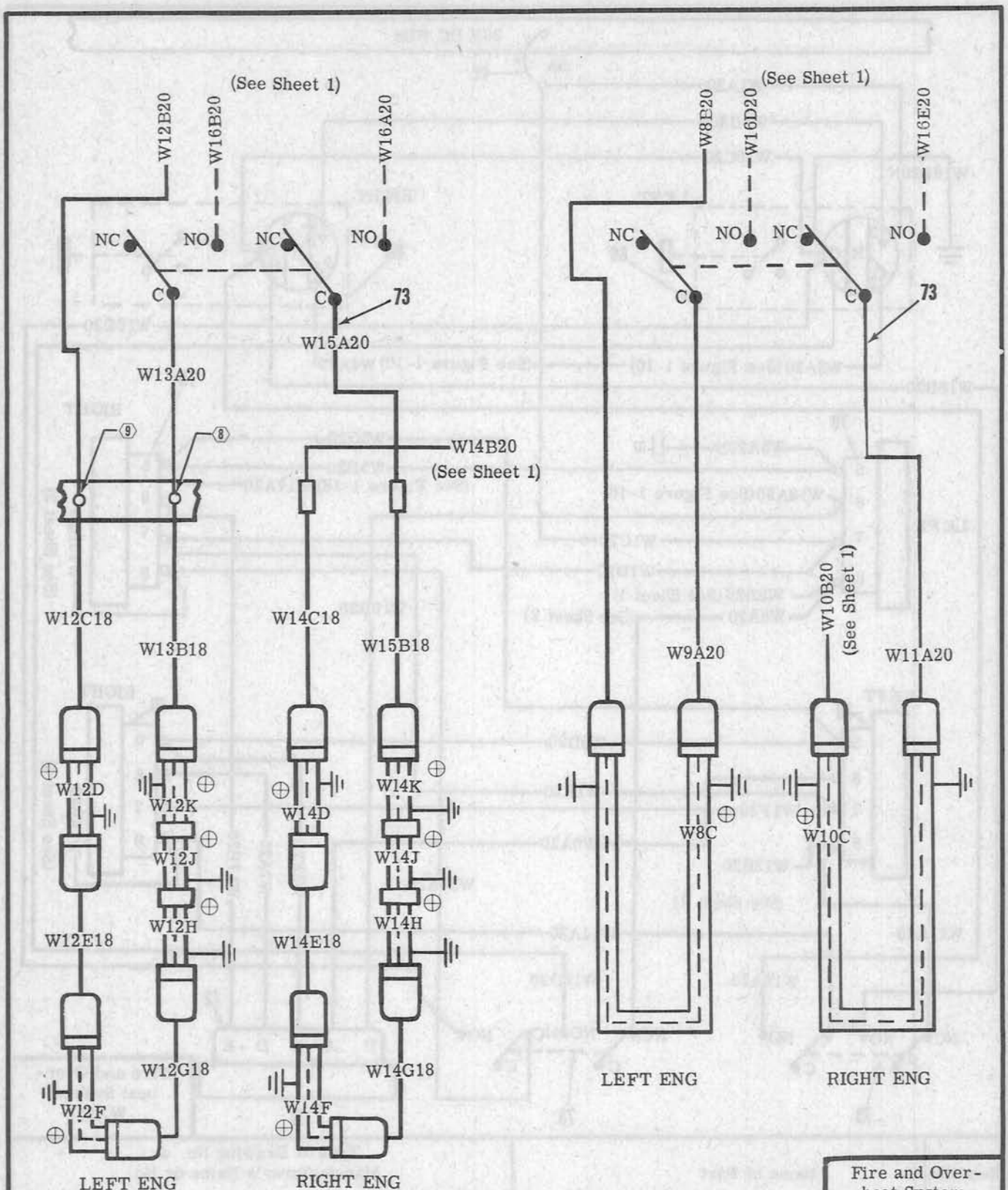
Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
68.	Switch, Warning Light Dimming	MS26016-2

Figure 1-16. Warning Lights Dimming



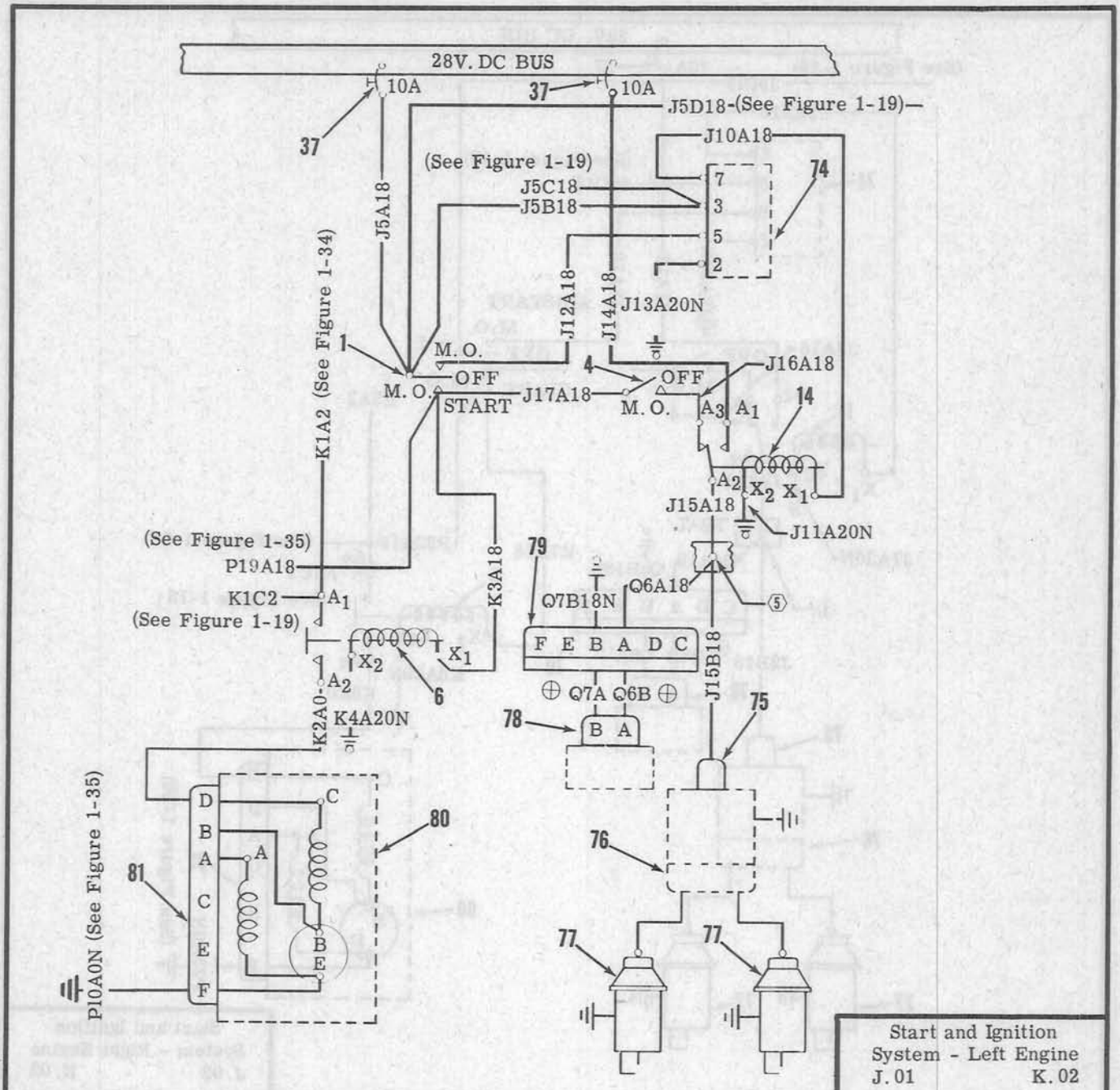
Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
12.	Circuit breaker	5 amp
69.	Control Handle, Fire	Stearman S-1000
70.	Control Unit, Fire	Thomas A. Edison 227-28-2
71.	Flasher	Grimes Mfg. Co. D7280A-1
72.	Connector	AN3106B-14S-5P
73.	Switch, Test	Micro-Switch 2PB11

Figure 1-17. Fire and Overheat System (Sheet 1 of 2)



Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
73.	Switch, Test	Micro-Switch 2PB11

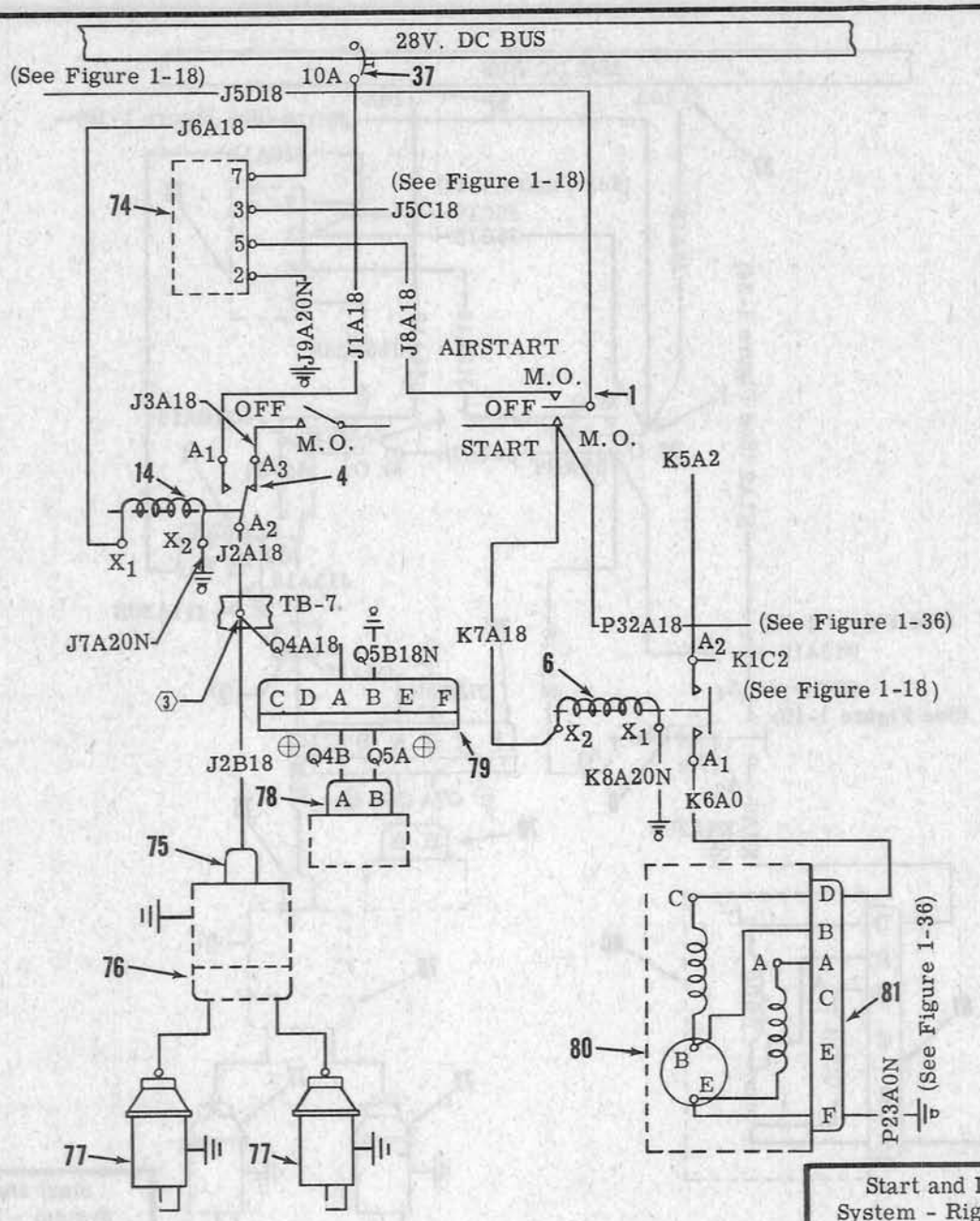
Figure 1-17. Fire and Overheat System (Sheet 2 of 2)



Start and Ignition System - Left Engine
J.01 K.02

Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
1.	Switch, Airstart	AN3022-7
4.	Switch, Ignition	AN3022-8
6.	Relay, Starter	AN3370-2
14.	Relay, Ignition	AN3314-1
37.	Circuit Breaker	10 amp
74.	Relay, Time Delay	Cook Electric 650-3424
75.	Connector	AN3106B-10S-2S
76.	Ignition Coil	Type TGLN-2302 (SNT) (561851), or (SNT) (560459)
77.	Ignitors	(CK) (562512)
78.	Connector	AN3108A-12S-3S
79.	Connector	AN3108B-14S-6S
80.	Starter-Generator	VG-550
81.	Connector	AN3108B-36-3S

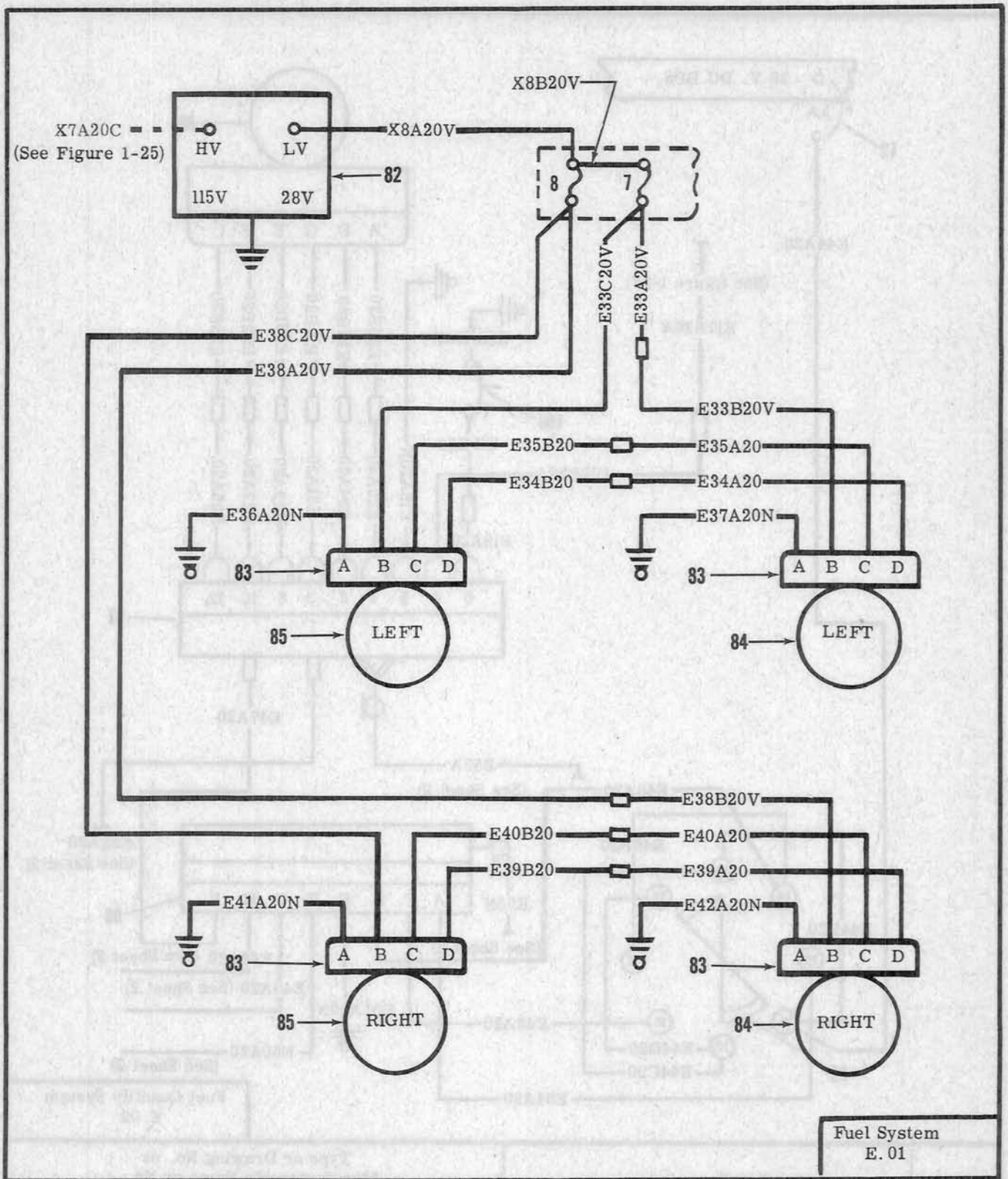
Figure 1-18. Start and Ignition System - Left Engine



Start and Ignition System - Right Engine
J.02 K.02

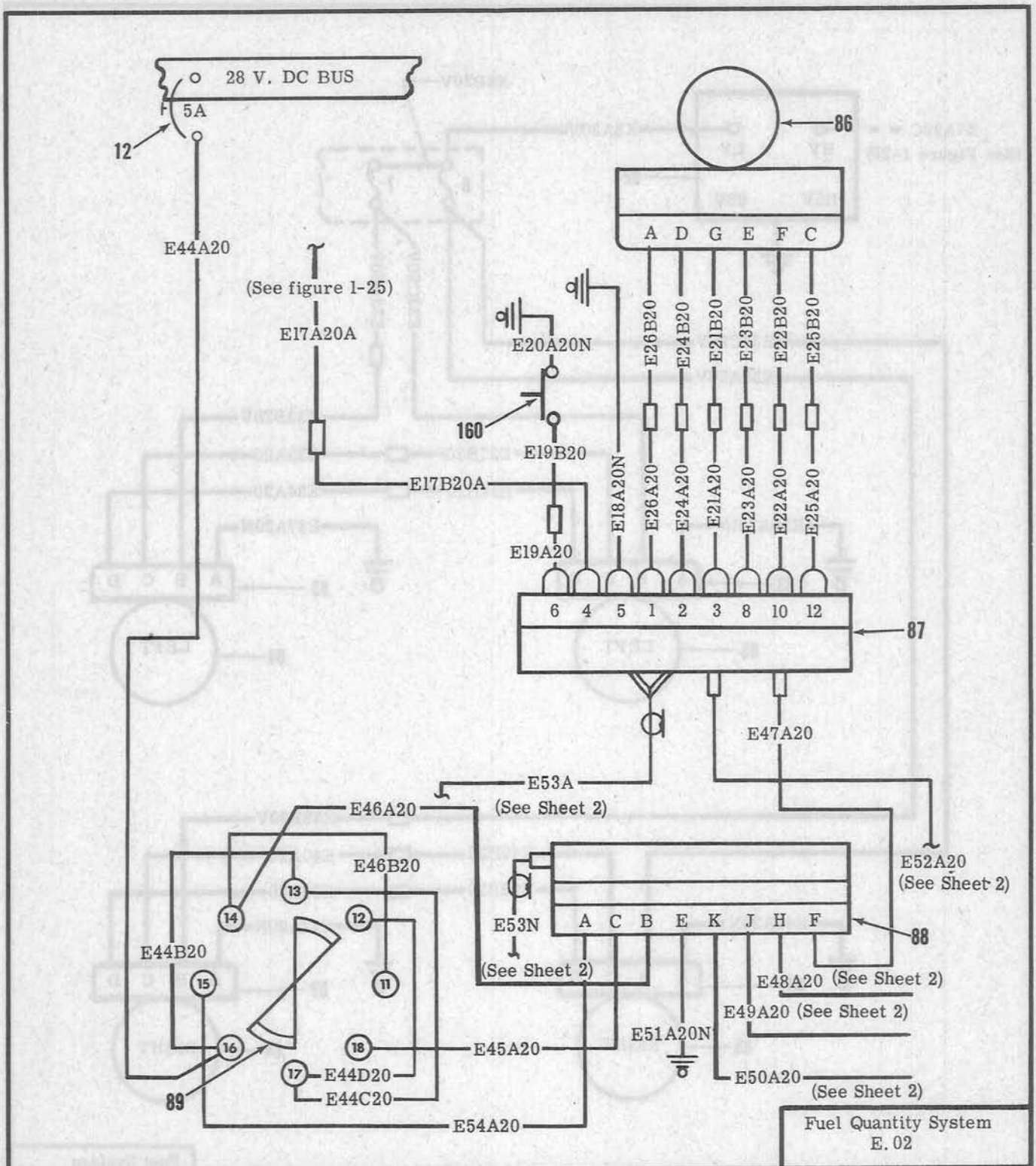
Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
1.	Switch, Airstart	AN3022-7
4.	Switch, Ignition	AN3022-8
6.	Relay, Starter	AN3370-2
14.	Relay, Ignition	AN3314-1
37.	Circuit Breaker	10 amp
74.	Relay, Time Delay	Cook Electric 650-3424
75.	Connector	AN3108B-10S-2S
76.	Ignition Coil	Type TGLN-2302 (SNT) (561851), or (SNT) (560459) (CK) (562512)
77.	Ignitors	
78.	Connector	AN3108A-12S-3S
79.	Connector	AN3108B-14S-6S
80.	Starter-Generator	VG-550
81.	Connector	AN3106B-36-3S

Figure 1-19. Start and Ignition System - Right Engine



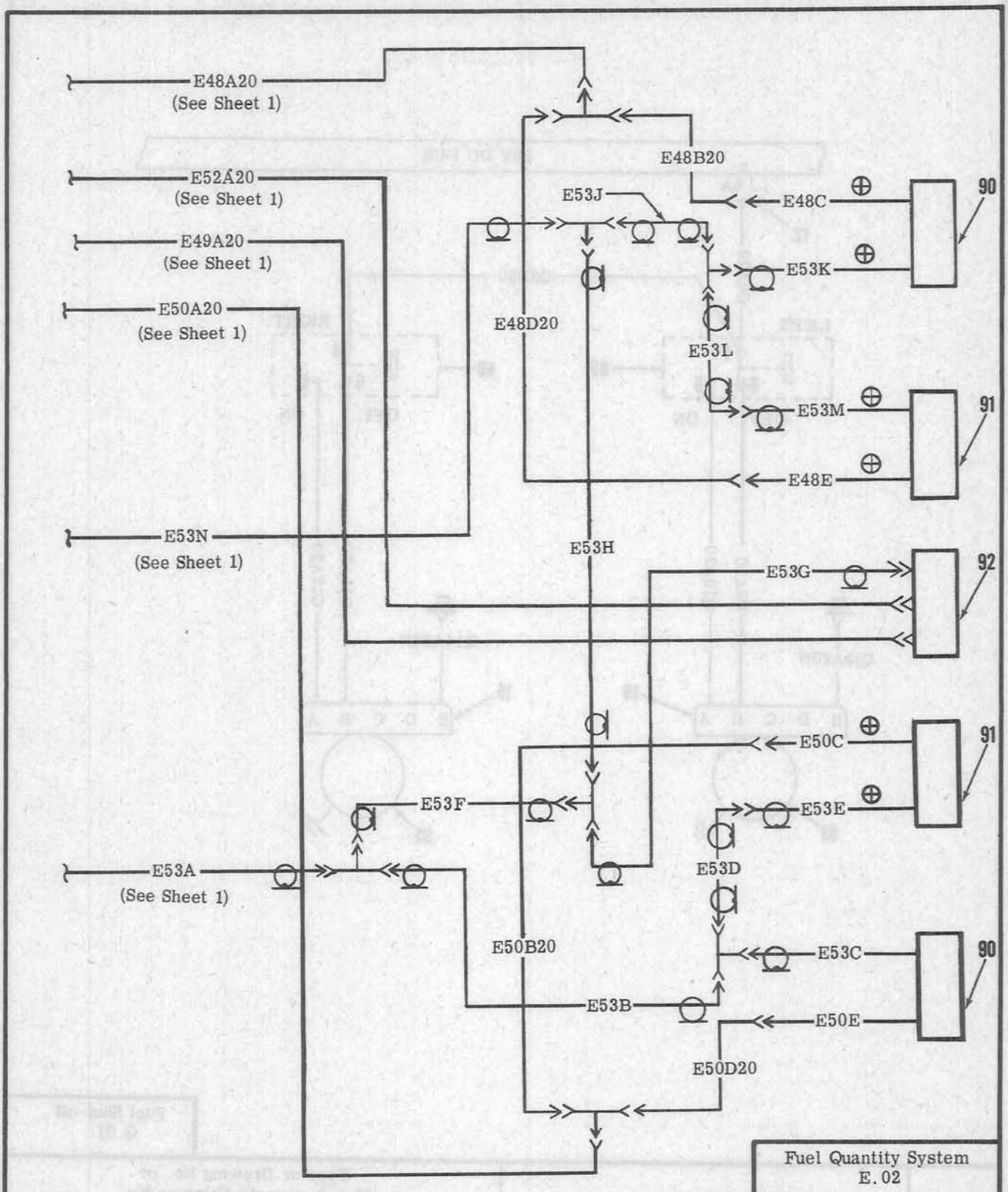
Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
82.	Transformer	General Electric 9T39Y2963
83.	Connector	AN3108B-14S-2S
84.	Transmitter, Fuel Flow	J-5
85.	Indicator, Fuel Flow	A-16

Figure 1-20. Fuel System



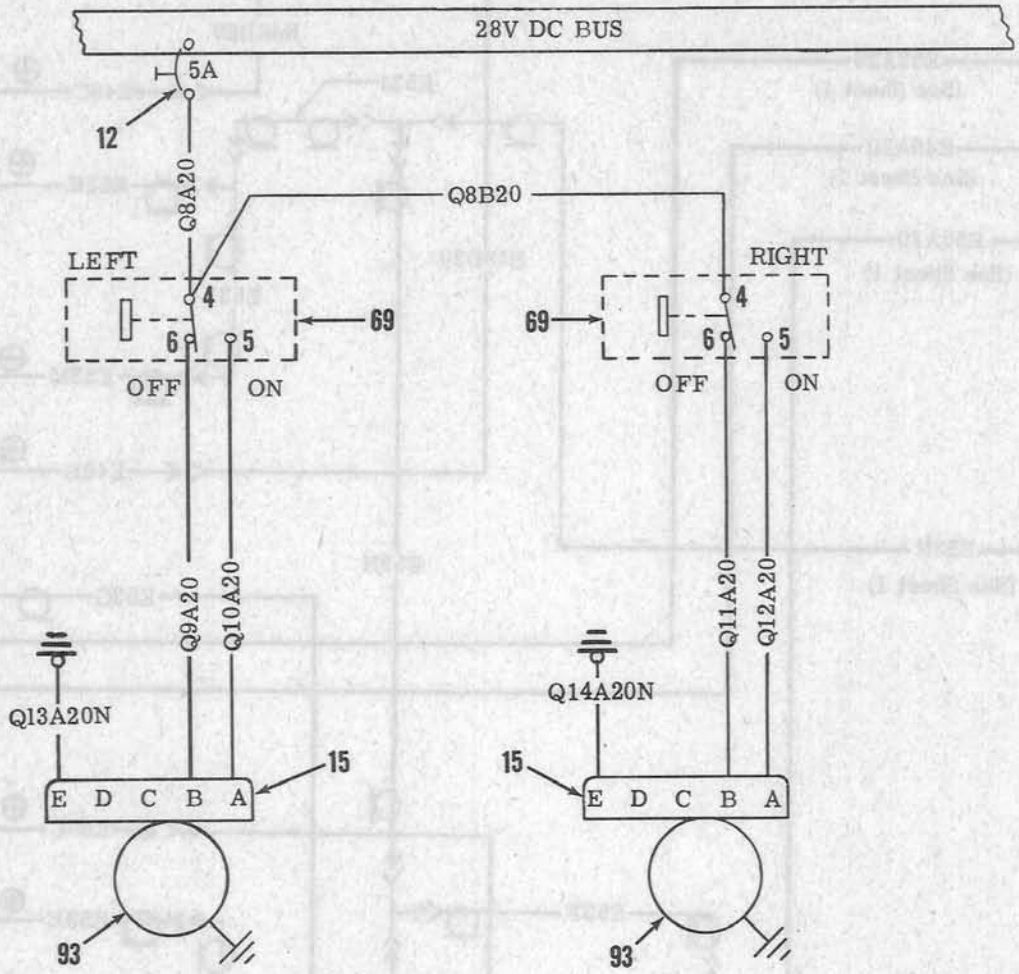
Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
12.	Circuit Breaker	5 amp
86.	Indicator, Fuel Quantity	JG4B-1
87.	Power Unit	Honeywell EG5B-1
88.	Relay, Transfer	Honeywell RG12M-1
89.	Fuel Quantity Selector Switch	Cutler Hammer 8918K765
160.	Switch, Fuel Quantity Test	MS25089-1F

Figure 1-21. Fuel Quantity System (Sheet 1 of 2)



Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
90.	Fuel Probe	Honeywell FG120A-17
91.	Fuel Probe	Honeywell FG120A-18
92.	Fuel Probe	Honeywell FG131B-2

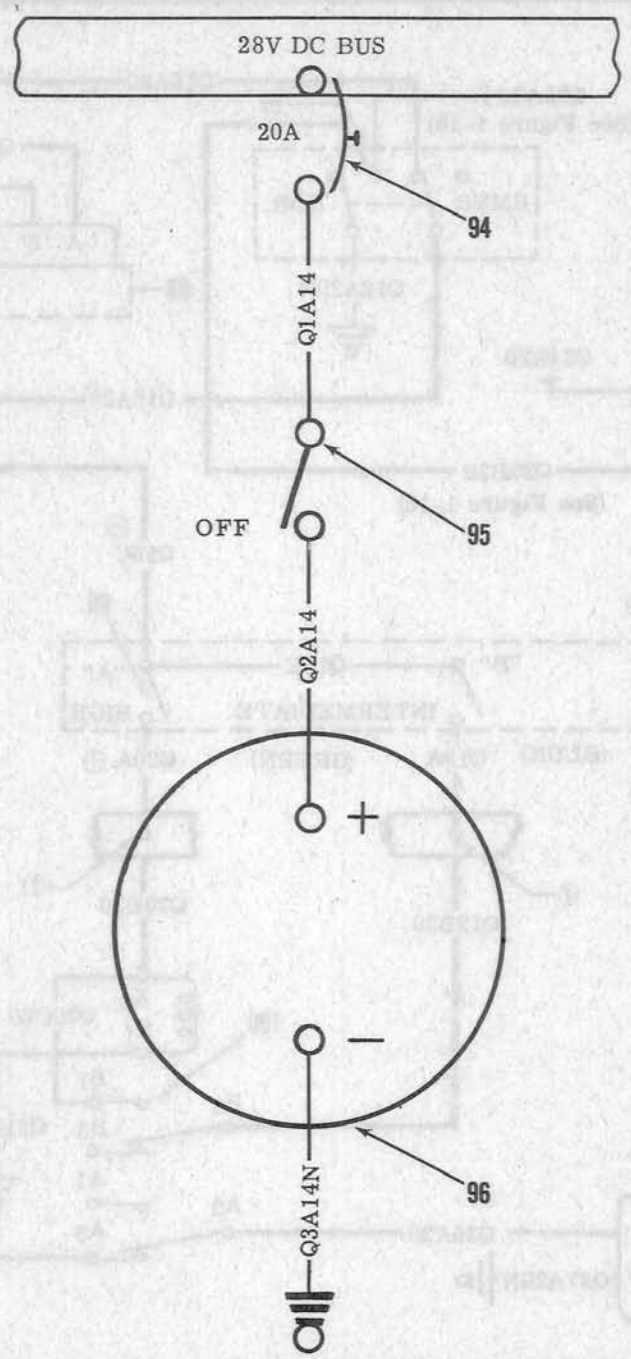
Figure 1-21. Fuel Quantity System (Sheet 2 of 2)



Fuel Shut-off
Q. 01

Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
12.	Circuit Breaker	5 amp
15.	Connector	AN3106B-14S-5S
69.	Switch, Fire Control	Stearman S-1000
93.	Motorized Fuel Shut-off Valve	Whittaker WE452-1D

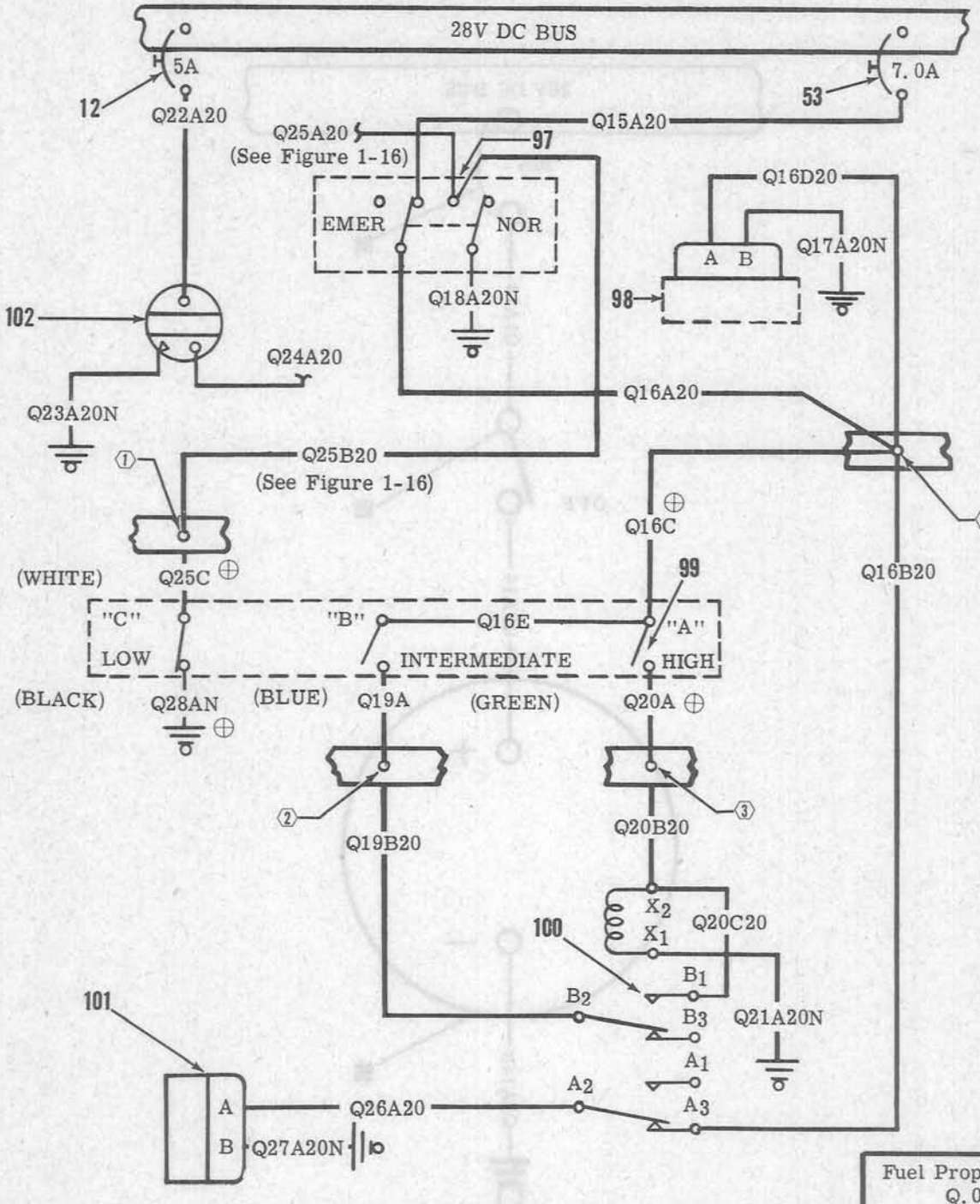
Figure 1-22. Fuel Shut-off



Fuel Boost Pump
Q. 02

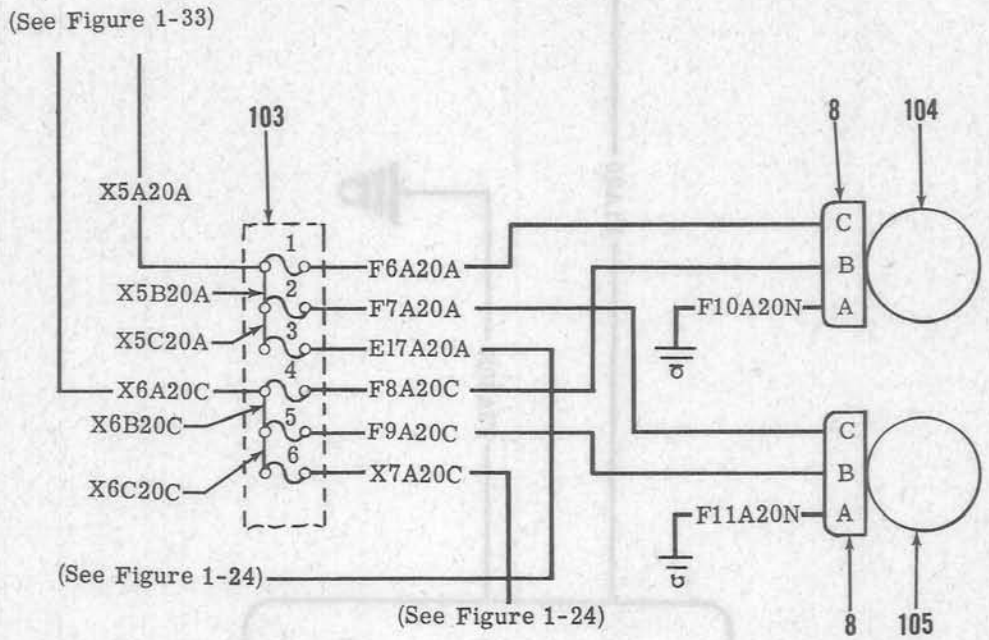
Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
94.	Circuit Breaker	20 amp
95.	Switch, Fuel Boost Pump	AN3022-2
96.	Fuel Boost Pump	Lear-Romec RG11100C1

Figure 1-23. Fuel Boost Pump



Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
12.	Circuit Breaker	5 amp
53.	Circuit Breaker	7.0 amp
97.	Switch, Fuel Level Control	AN3027-3
98.	Shut-off Valve, Hydraulic Solenoid	Whittaker 118595
99.	Switch, Float	Revere F70220
100.	Relay, Fuel Level	AN3311-1
101.	Proportioner, Fuel	Stratos 11901-1
102.	Light, Fuel Low Level	AN3157-6

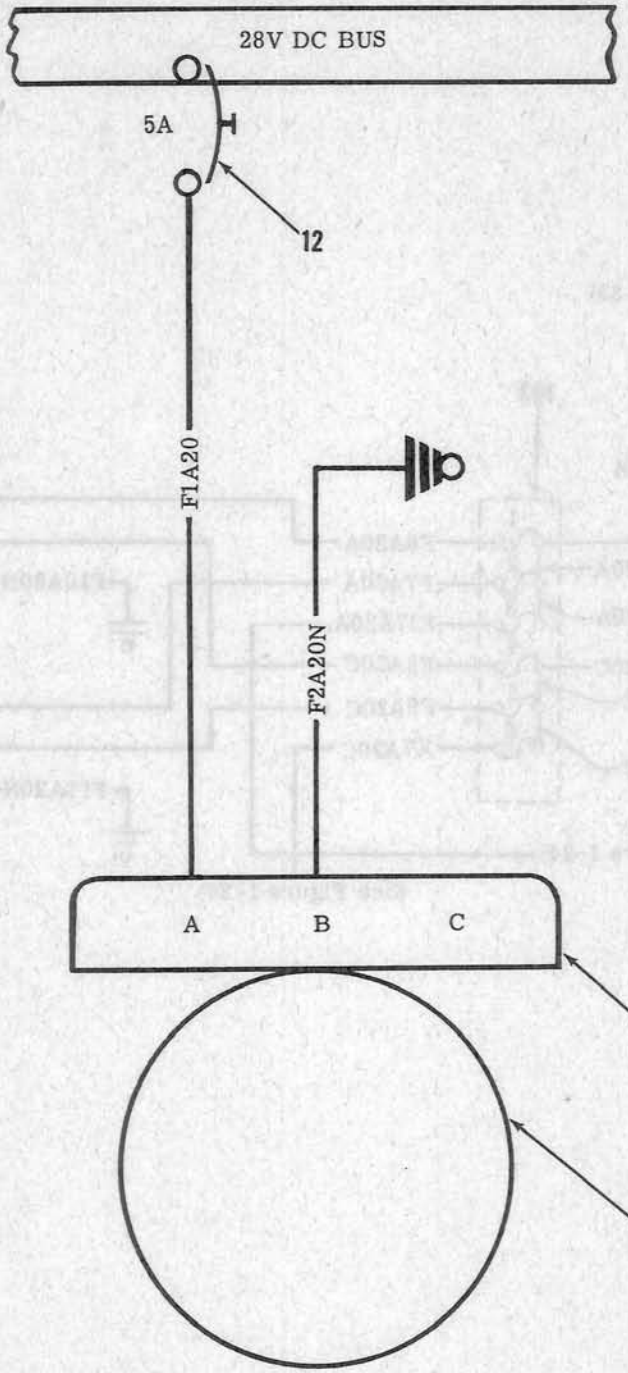
Figure 1-24. Fuel Proportioner



Directional Gyro and Attitude Gyro
F. 01 X. 01

Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
8.	Connector	AN3108B-10SL-3S
103.	Fuses	1 amp MS90077-11
104.	Attitude Gyro	J-8
105.	Directional Gyro	C-5C

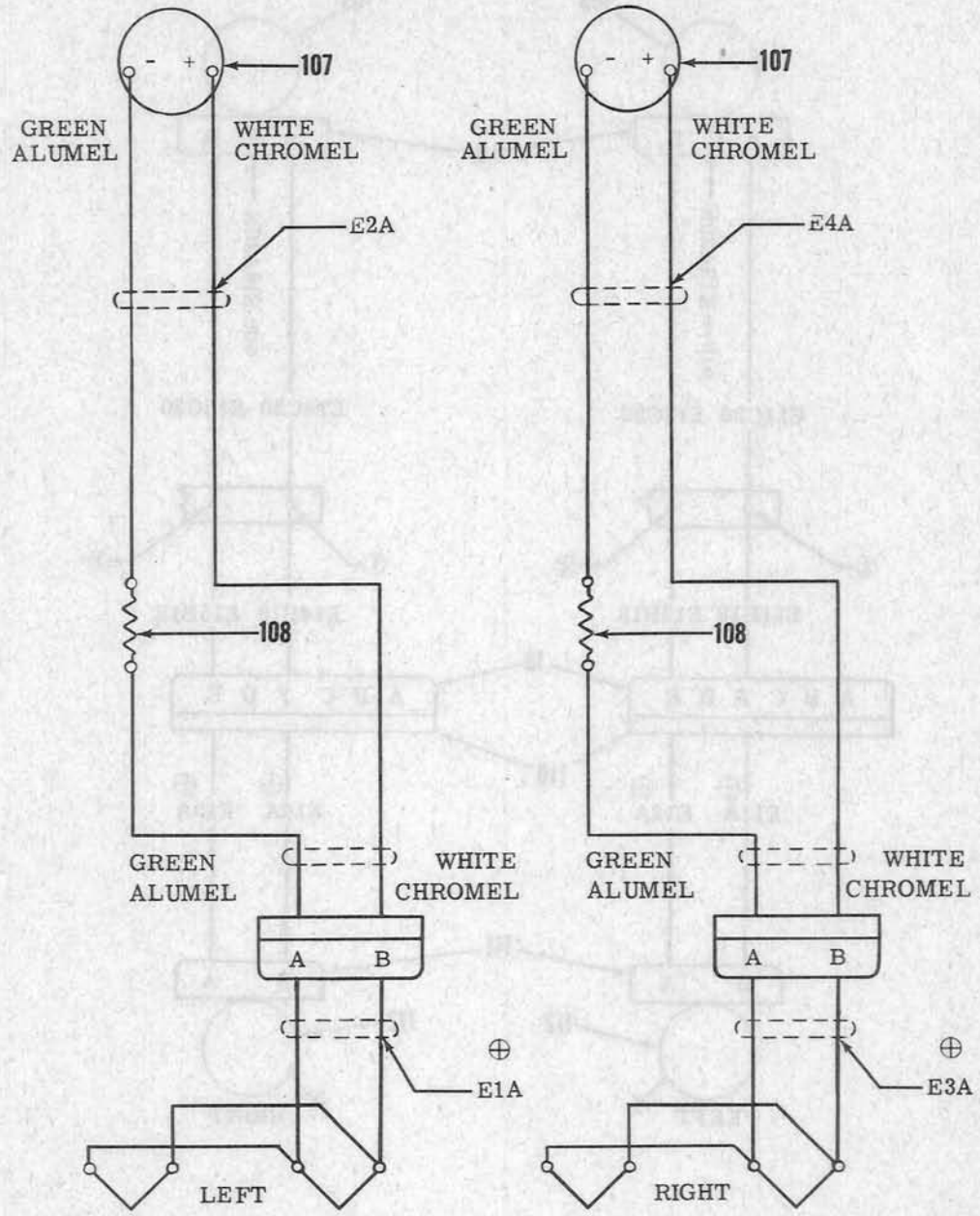
Figure 1-25. Directional Gyro and Attitude Gyro



Turn and Slip Indicator
F. 02

Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
8.	Connector	AN3108B-10SL-3S
12.	Circuit Breaker	5 amp
106.	Turn and Slip Indicator	MS28024-1

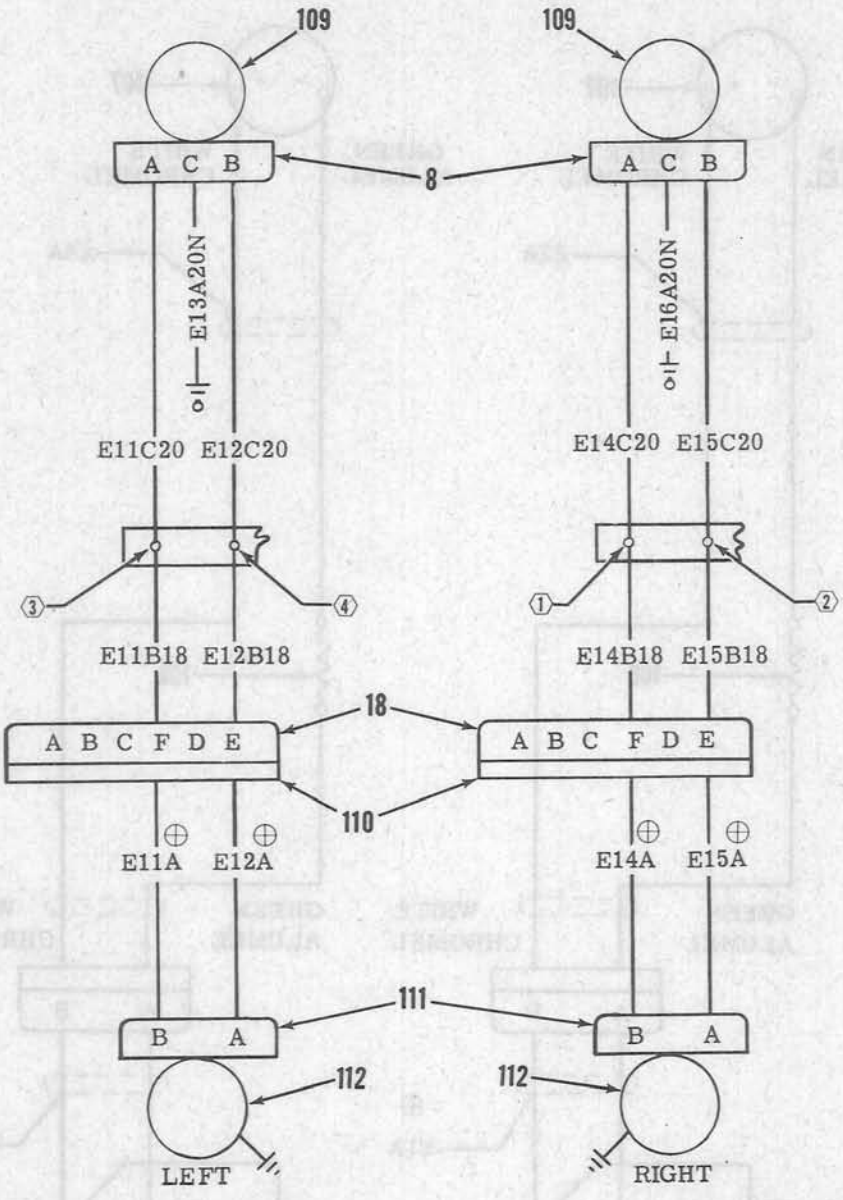
Figure 1-26. Turn and Slip Indicator



Tailpipe Temperature
E. 03

Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
107.	Tailpipe Temperature Indicator	MS28006-1
108.	Resistor	AN5534-2

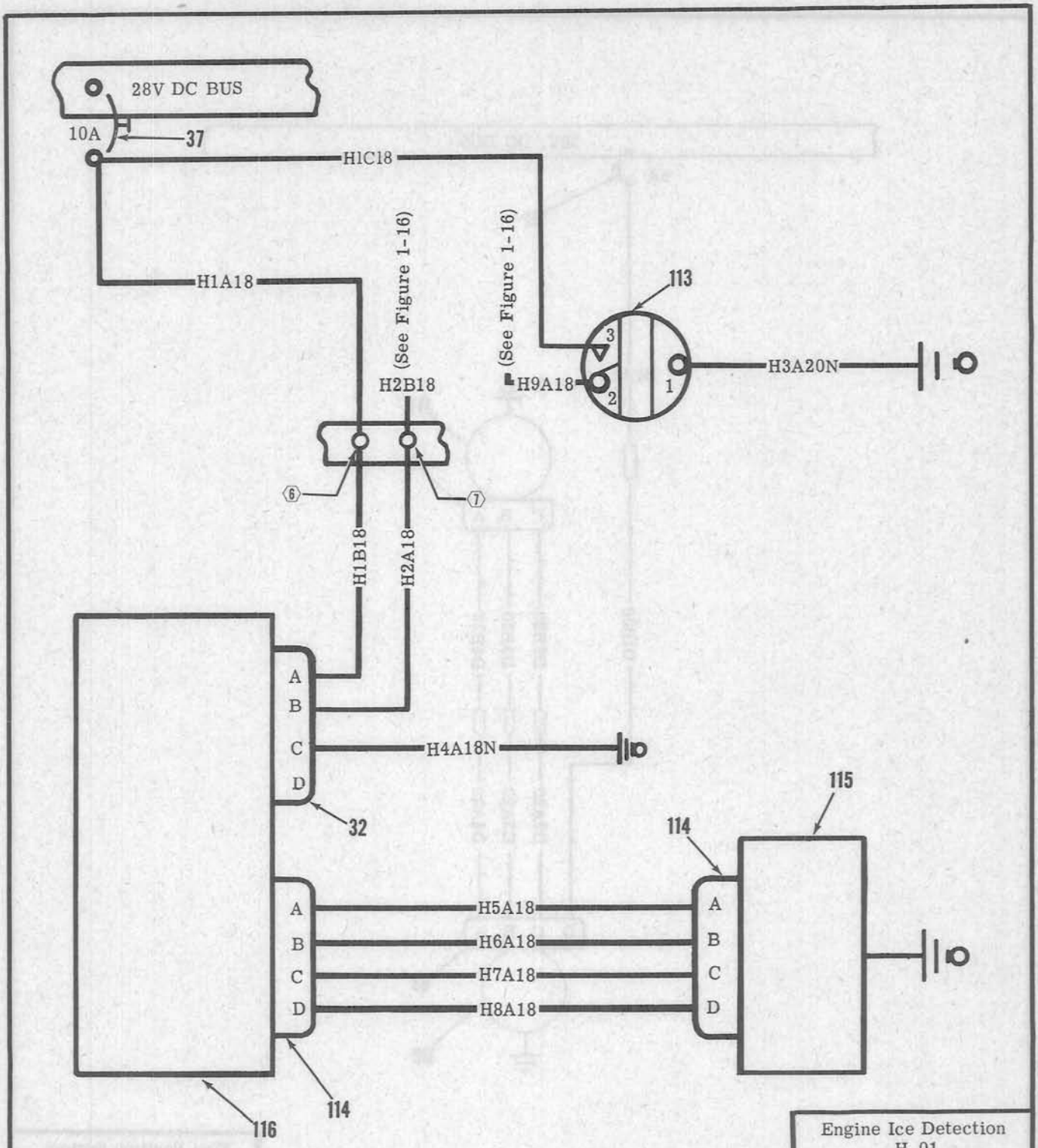
Figure 1-27. Tailpipe Temperature



Tachometer System
E.04

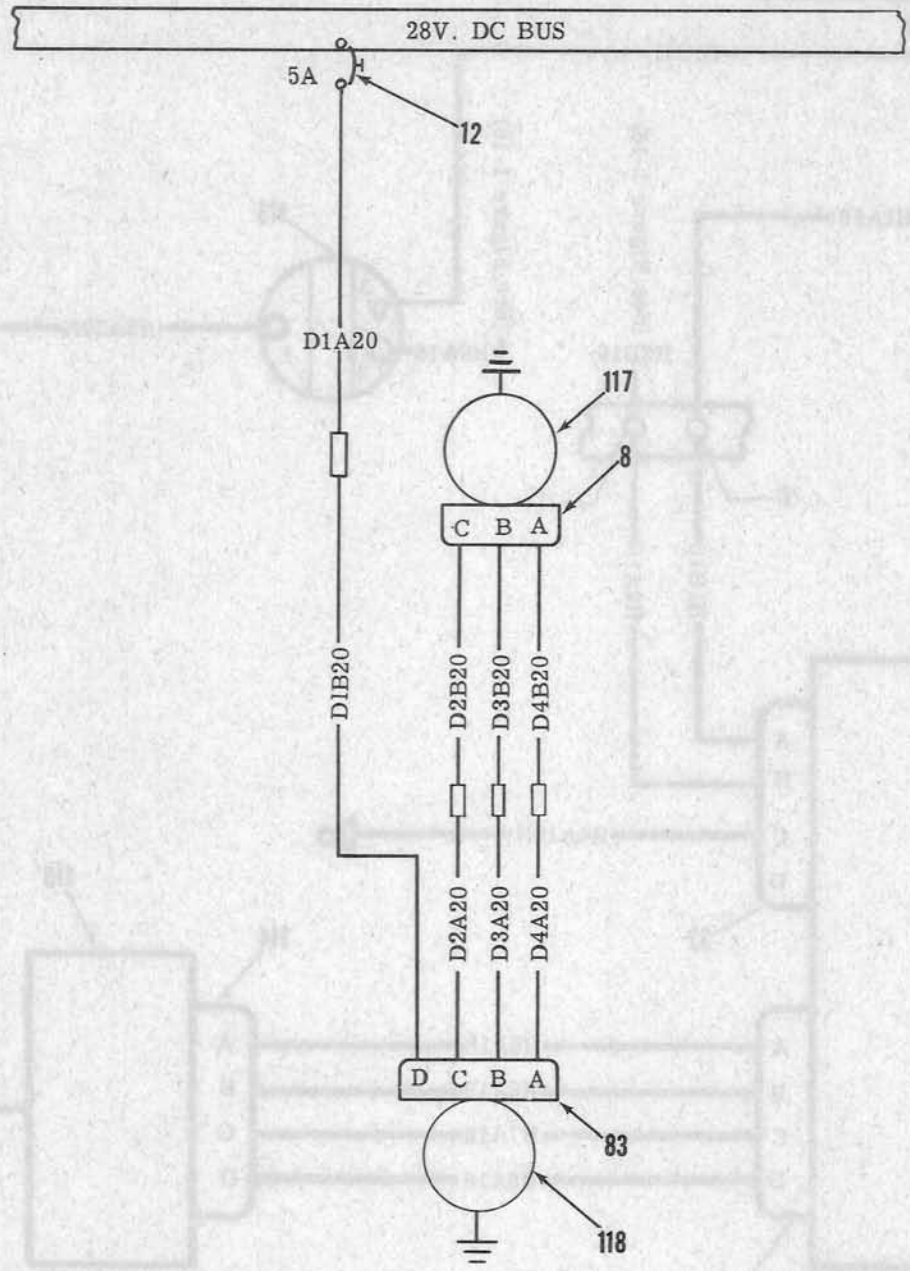
Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
8.	Connector	AN3108B-10SL-3S
18.	Connector	AN3108B-14S-6S
109.	Tachometer Indicator	MS28000-1
110.	Connector	AND10066A-14S-6P
111.	Connector	AN3106B-12S-3S
112.	Tachometer Generator	AN5544-3

Figure 1-28. Tachometer System



Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
32.	Connector	AN3106B-14S-2S
37.	Circuit Breaker	10 amp
113.	Light, Engine Ice Warning	AN3157-8
114.	Connector	AN3108B-14S-2SX
115.	Detector, Ice	Cook Electric 575-7
116.	Interpretor, Ice	Cook Electric 650-4112

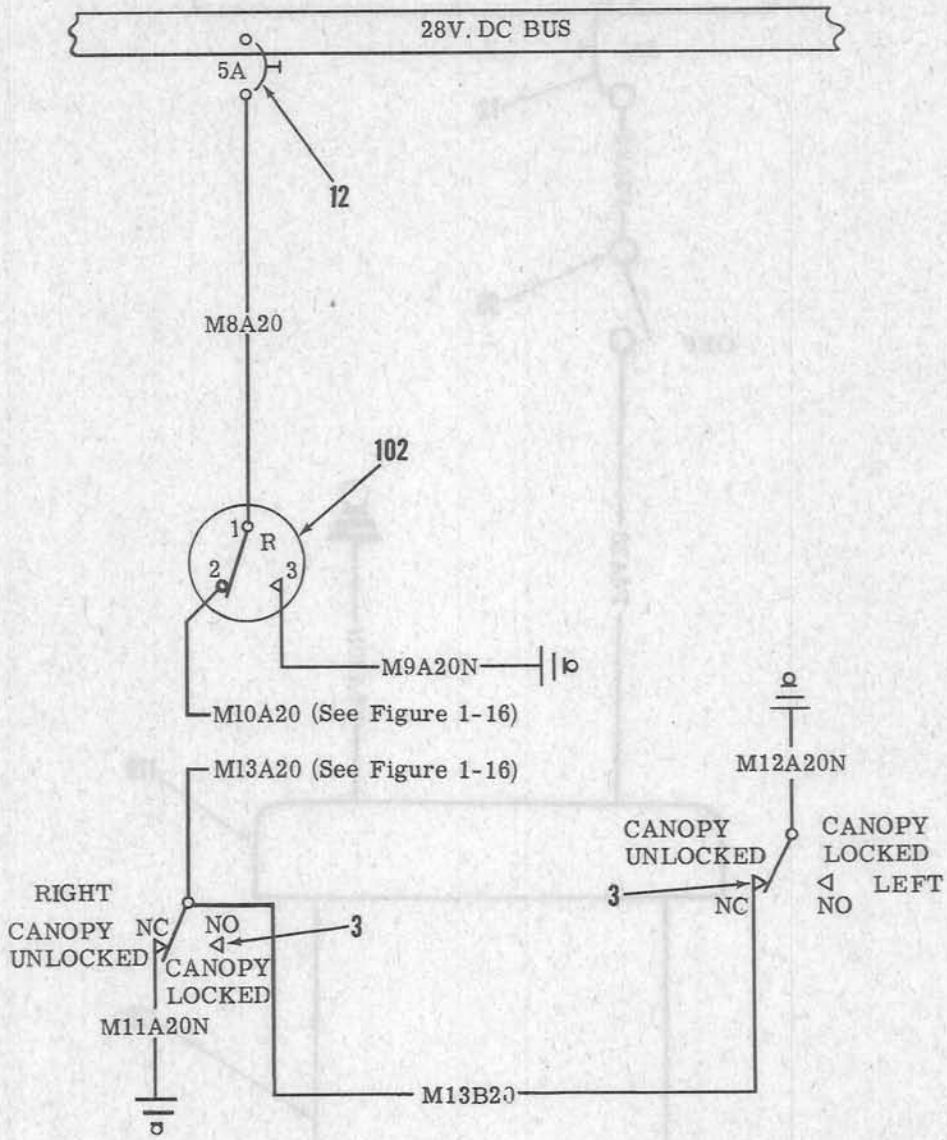
Figure 1-29. Engine Ice Detection



Flap Position System
D. 02

Item No.	Name Name of Part	Type or Drawing No. or Manufacturer's Name or No.
8.	Connector	AN3108B-10SL-3S
12.	Circuit Breaker	5 amp
83.	Connector	AN3108B-14S-2S
117.	Flap Position Indicator	MS28023-1
118.	Flap Position Transmitter	AN5786-1

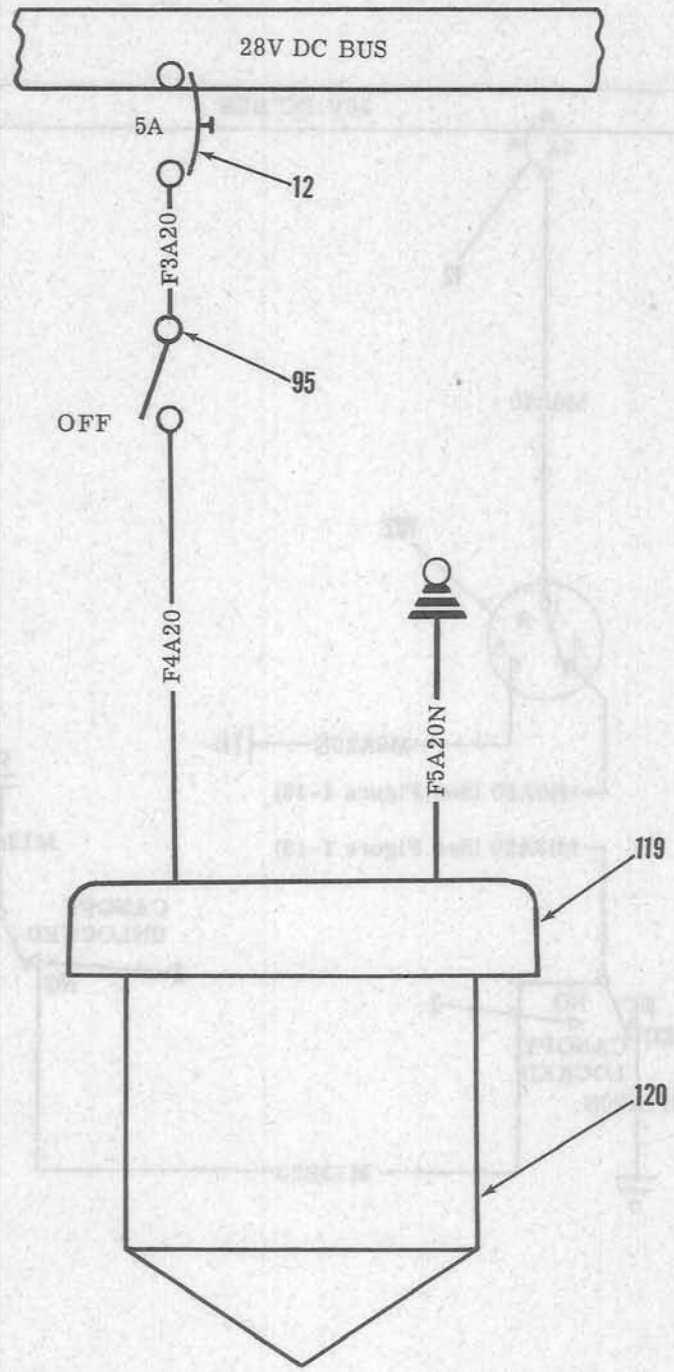
Figure 1-30. Flap Position System



Canopy-Not-Locked-Warning System M.02

Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
3.	Switch, Canopy-Not-Locked	Micro-Switch 1VA1
12.	Circuit Breaker	5 amp
102.	Light, Canopy-Not-Locked Warning	AN3157-6

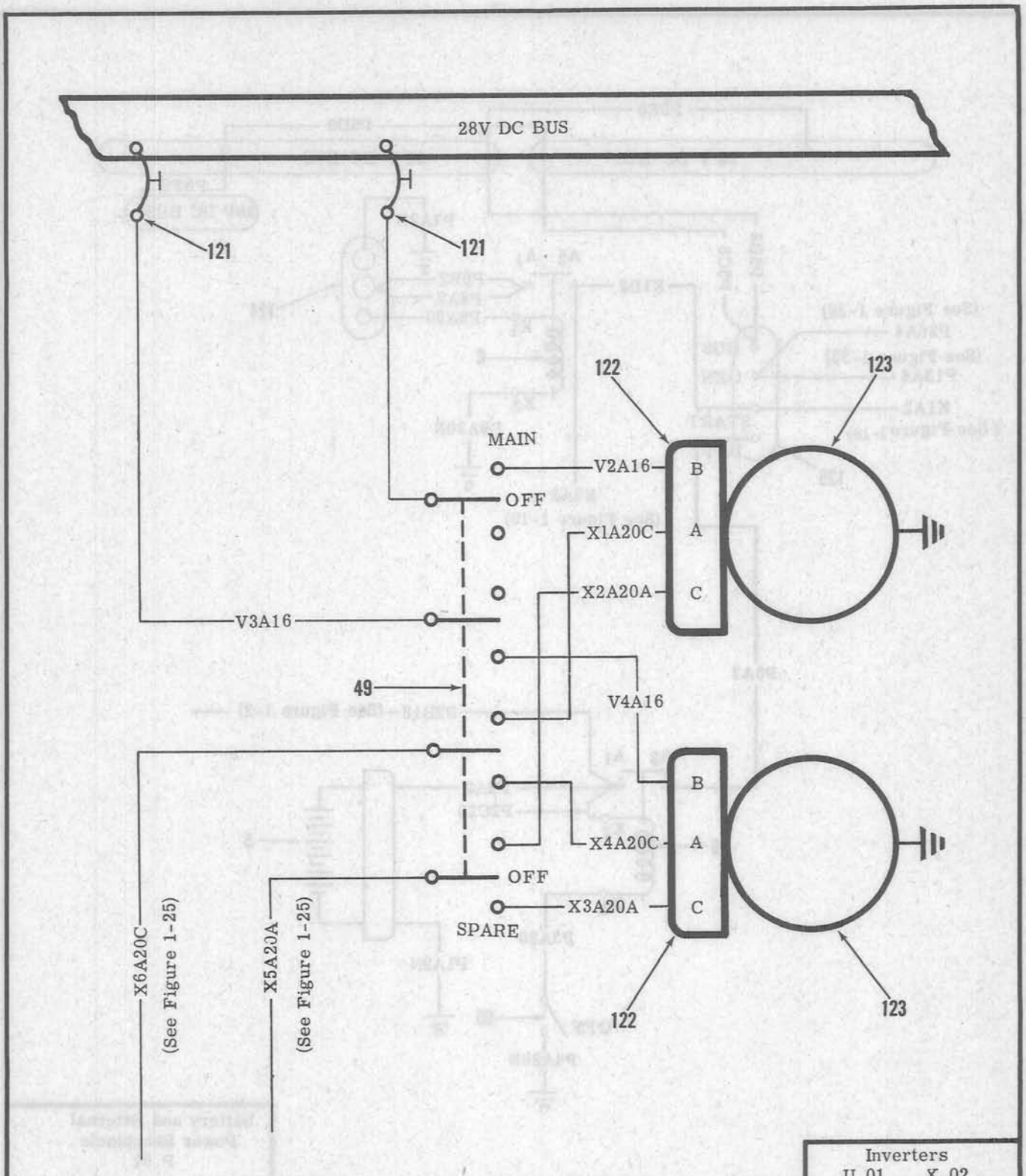
Figure 1-31. Canopy-Not-Locked-Warning System



Pitot Tube Heater
F. 03

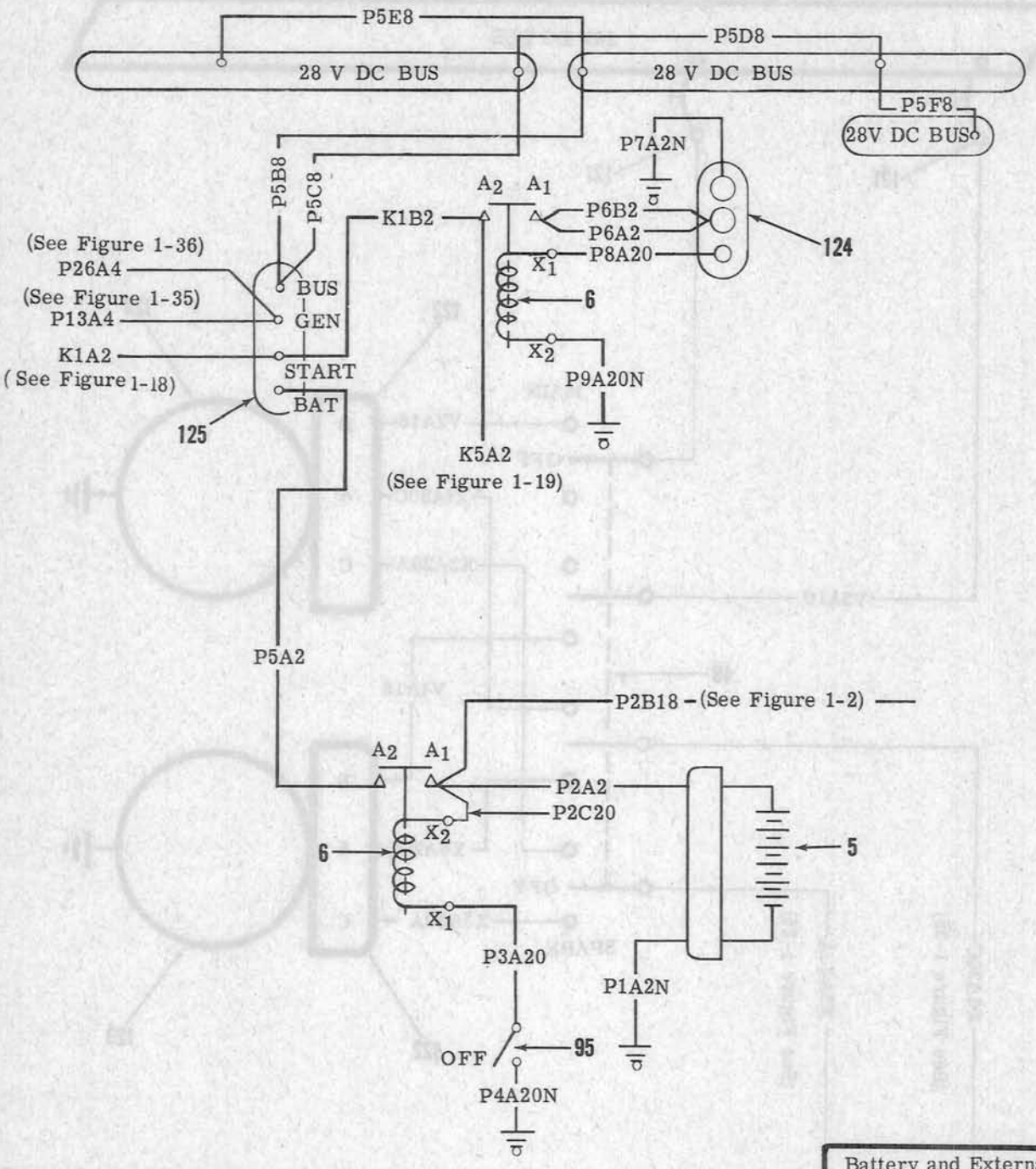
Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
12.	Circuit Breaker	5 amp
95.	Switch Pitot Tube Heater	AN3022-2
119.	Connector	AN3115-1
120.	Heater, Pitot Tube	AN5813-1

Figure 1-32. Pitot Tube Heater



Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
49.	Switch, Inverters	AN3227-1
121.	Circuit Breaker	15 amp
122.	Connector	AN3108B-14S-7S
123.	Inverter	Eicor 1-100A-115D-7

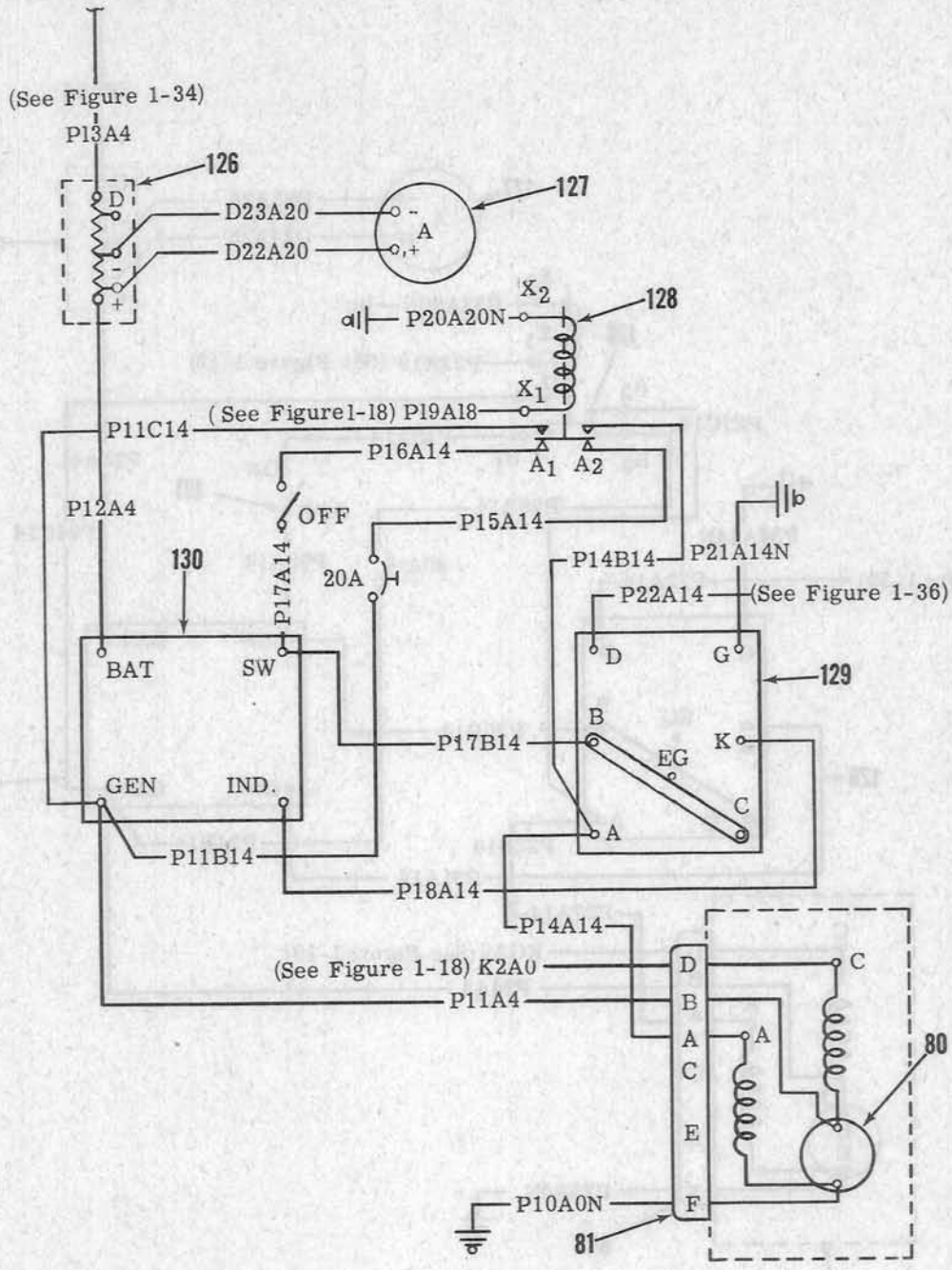
Figure 1-33. Inverters



Battery and External Power Receptacle P.01

Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
5.	Battery	AN3150-2
6.	Relay, Battery	AN3370-2
95.	Switch, Battery	AN3022-2
124.	External Power Receptacle	AN2552-3A
125.	Terminal Block	AN3436-10-4

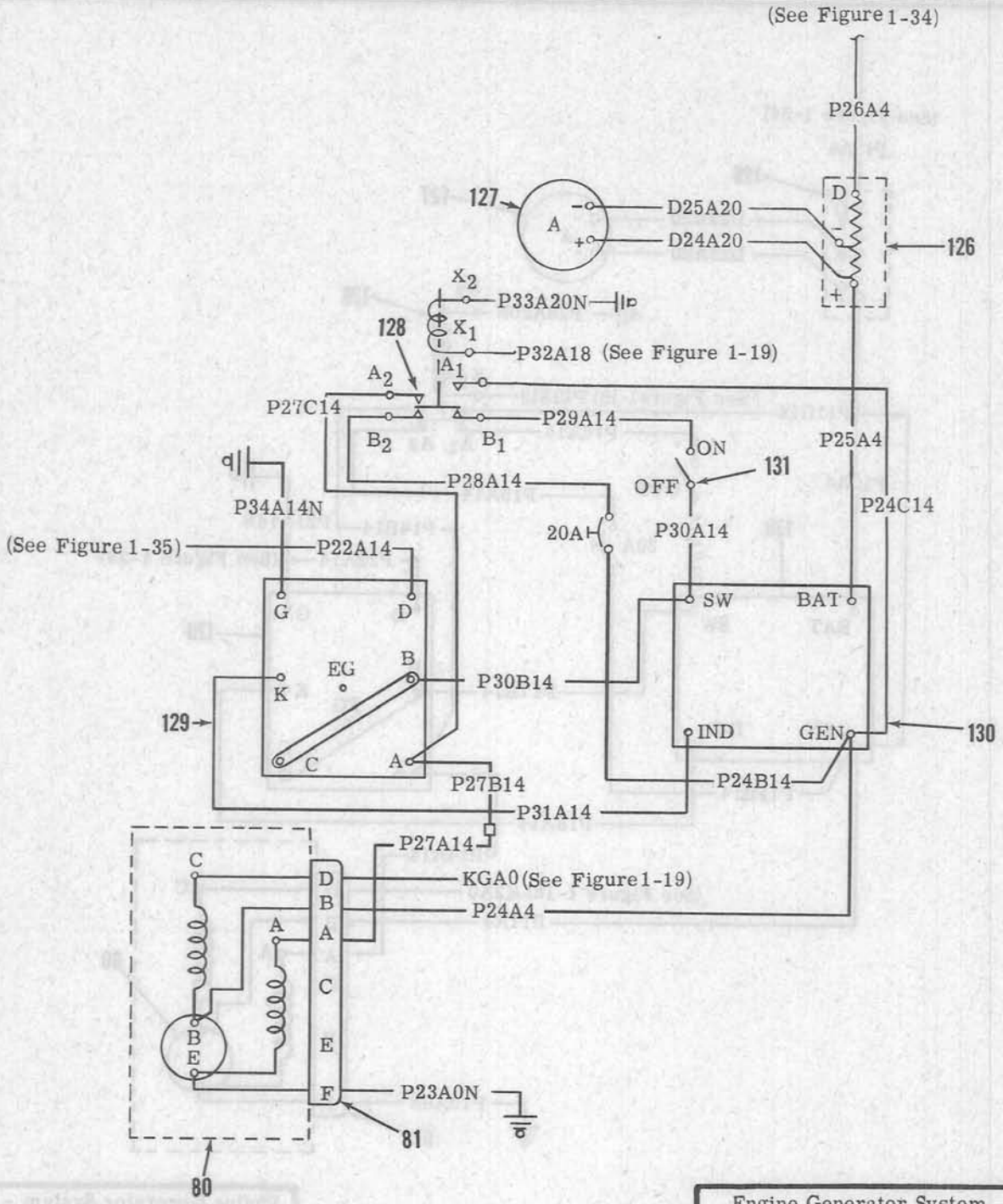
Figure 1-34. Battery and External Power Receptacle



Engine Generator System - Left
D.03

Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
80.	Starter-Generator	VG-550
81.	Connector	AN3108B-36-3S
126.	Reisstor, Paralleling	Avia Products 11017
127.	Ammeter	J-1
128.	Relay, Generator Control	AN3353-1
129.	Voltage Regulator	General Electric CR2735-B105A1
130.	Reverse Current Relay	AN3025-1
131.	Switch, Generator Control	AN3021-2

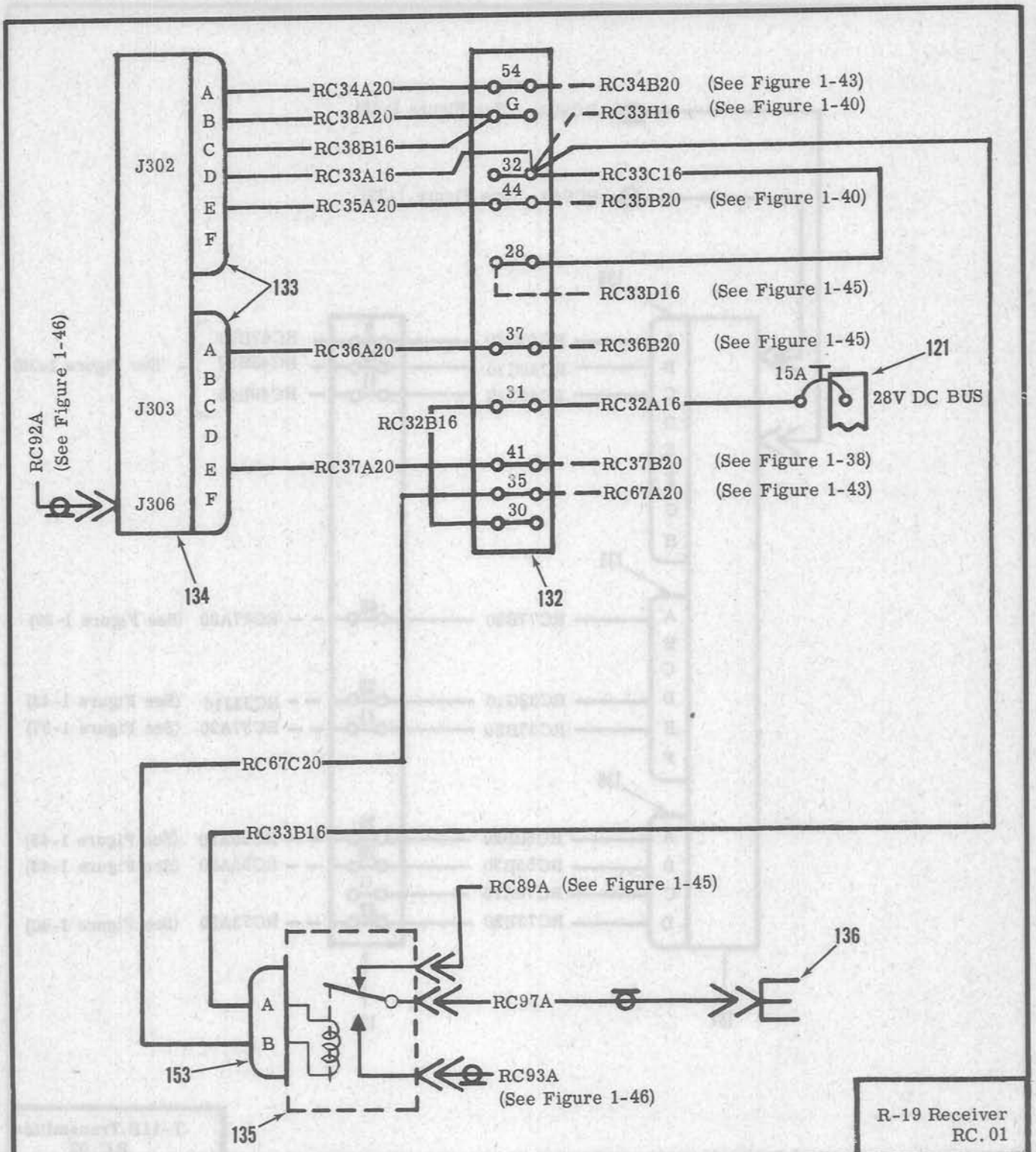
Figure 1-35. Engine Generator System - Left



Engine Generator System - Right
D.04

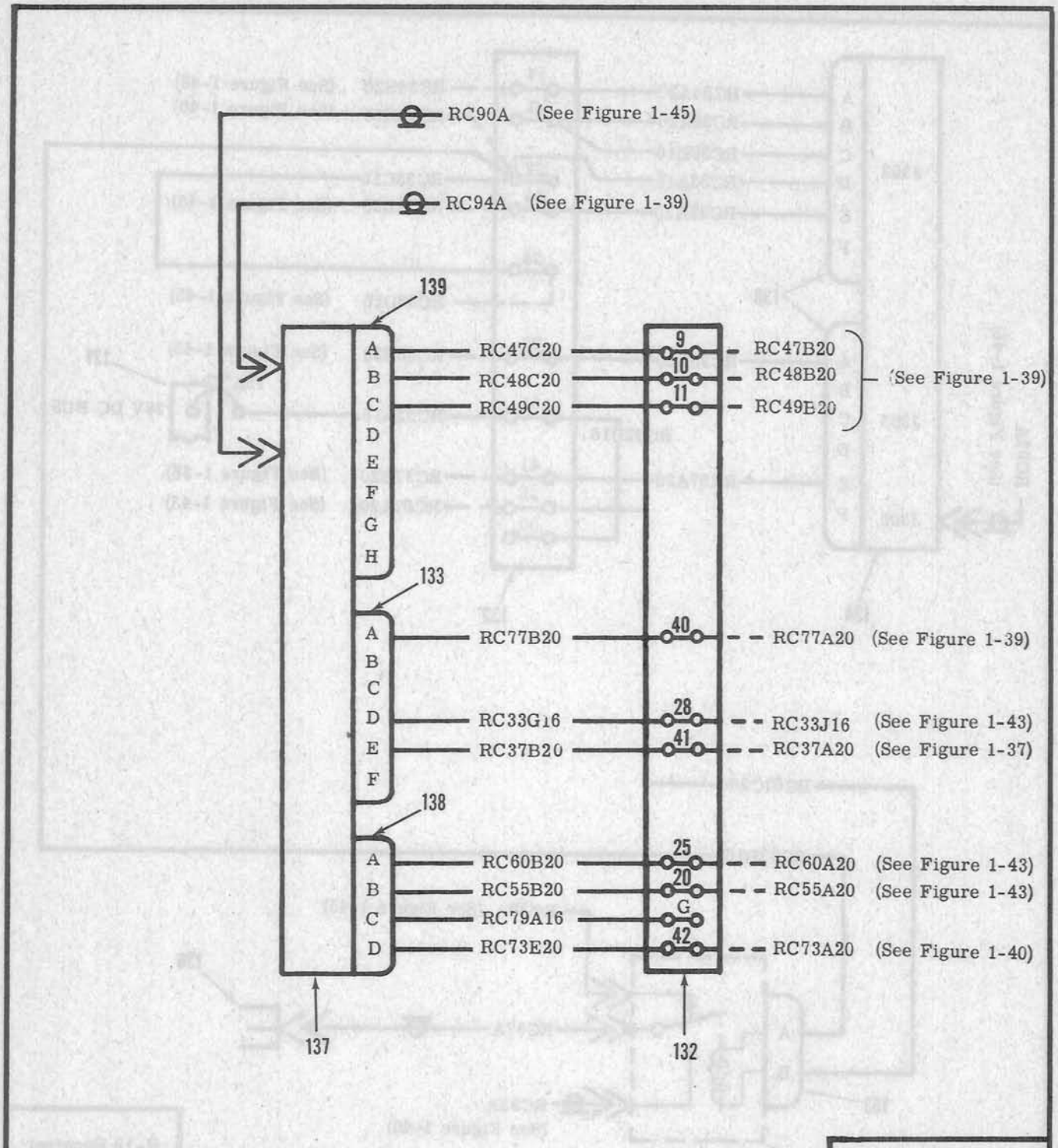
Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
80.	Starter-Generator	VG-550
81.	Connector	AN3106B-36-3S
126.	Resistor, Paralleling	Avia Products 11017
127.	Ammeter	J-1
128.	Relay, Generator Control	AN3353-1
129.	Voltage Regulator	General Electric CR2795-B105A1
130.	Reverse Current Relay	AN3025-1
131.	Switch, Generator Control	AN3021-2

Figure 1-36. Engine Generator System - Right



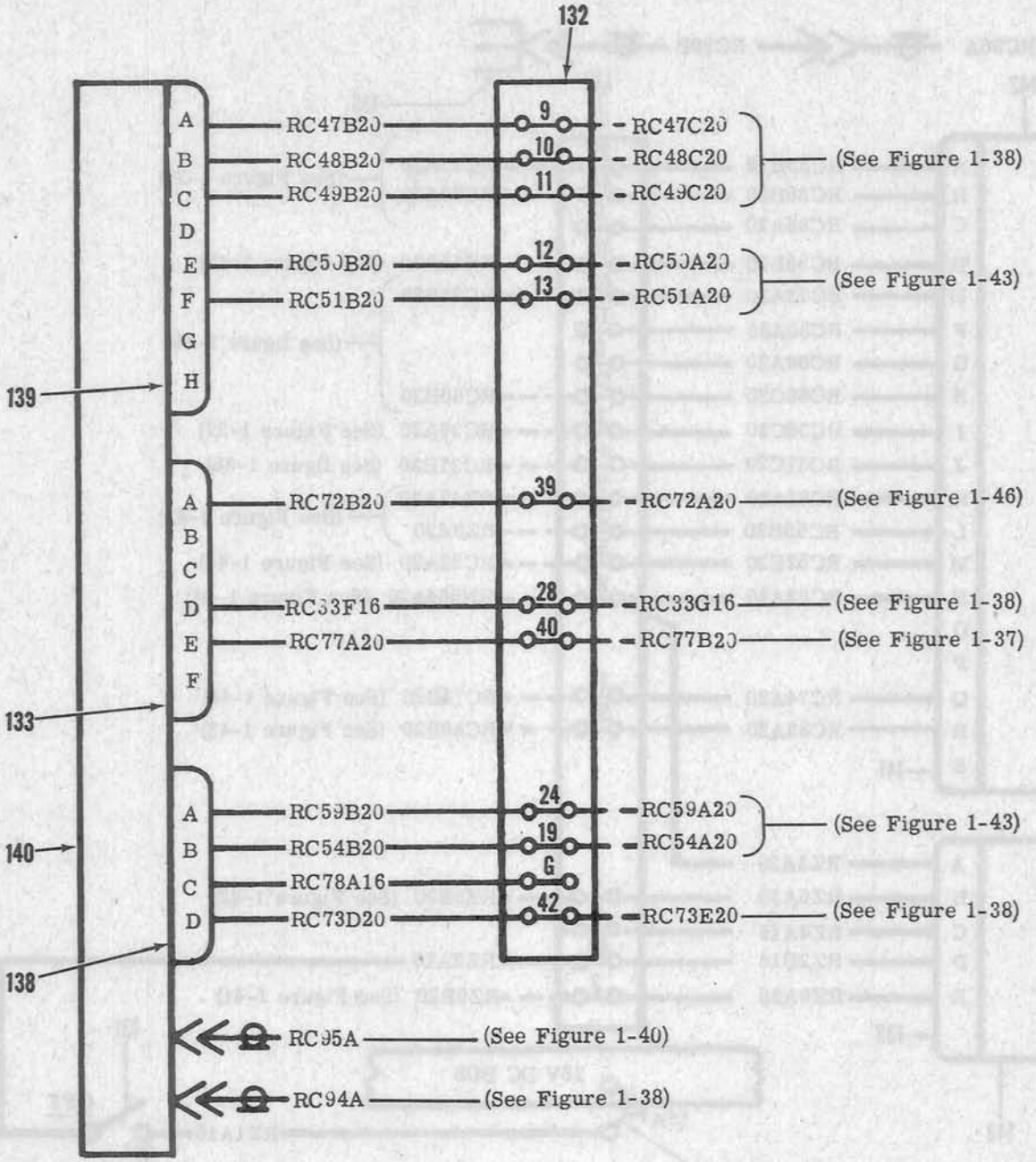
Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
132.	Junction Box	J-15A
133.	Plug	ARC14051
134.	Receiver	ARC R-19
135.	Relay, Antenna	ARC K-18
136.	Antenna, Communication	ARC 17530 A-19
153.	Plug	ARC 14321

Figure 1-37. R-19 Receiver



Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
132.	Junction Box	J-15A
133.	Plug	ARC 14051
137.	Transmitter	ARC T-11B
138.	Plug	ARC 14052
139.	Plug	ARC 14050

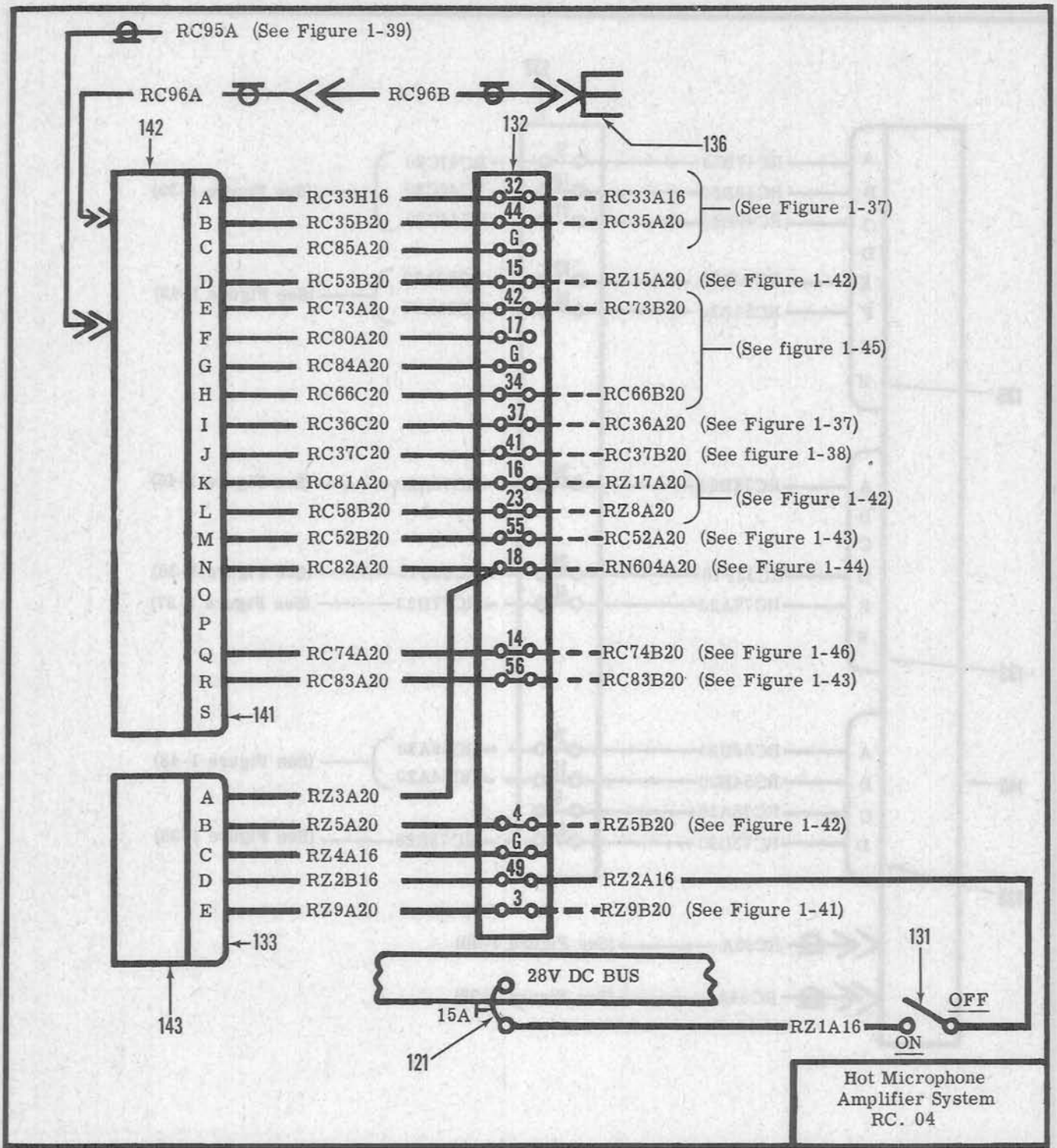
Figure 1-38. T-11B Transmitter



T-13A Transmitter
RC. 03

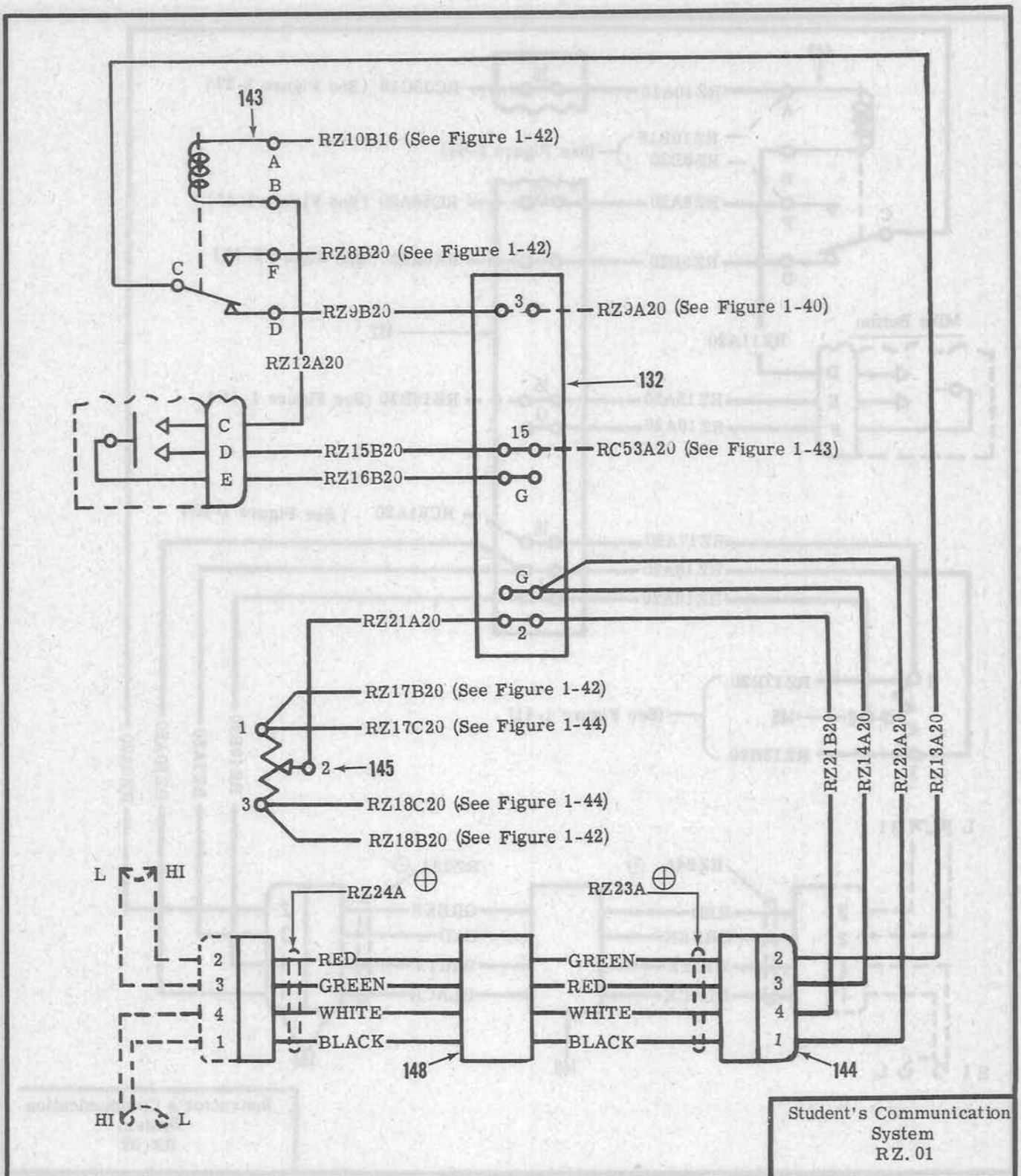
Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
132.	Junction Box	J-15A
133.	Plug	ARC 14051
138.	Plug	ARC 14052
139.	Plug	ARC 14050
140.	Transmitter	ARC T-13A

Figure 1-39. T-13A Transmitter



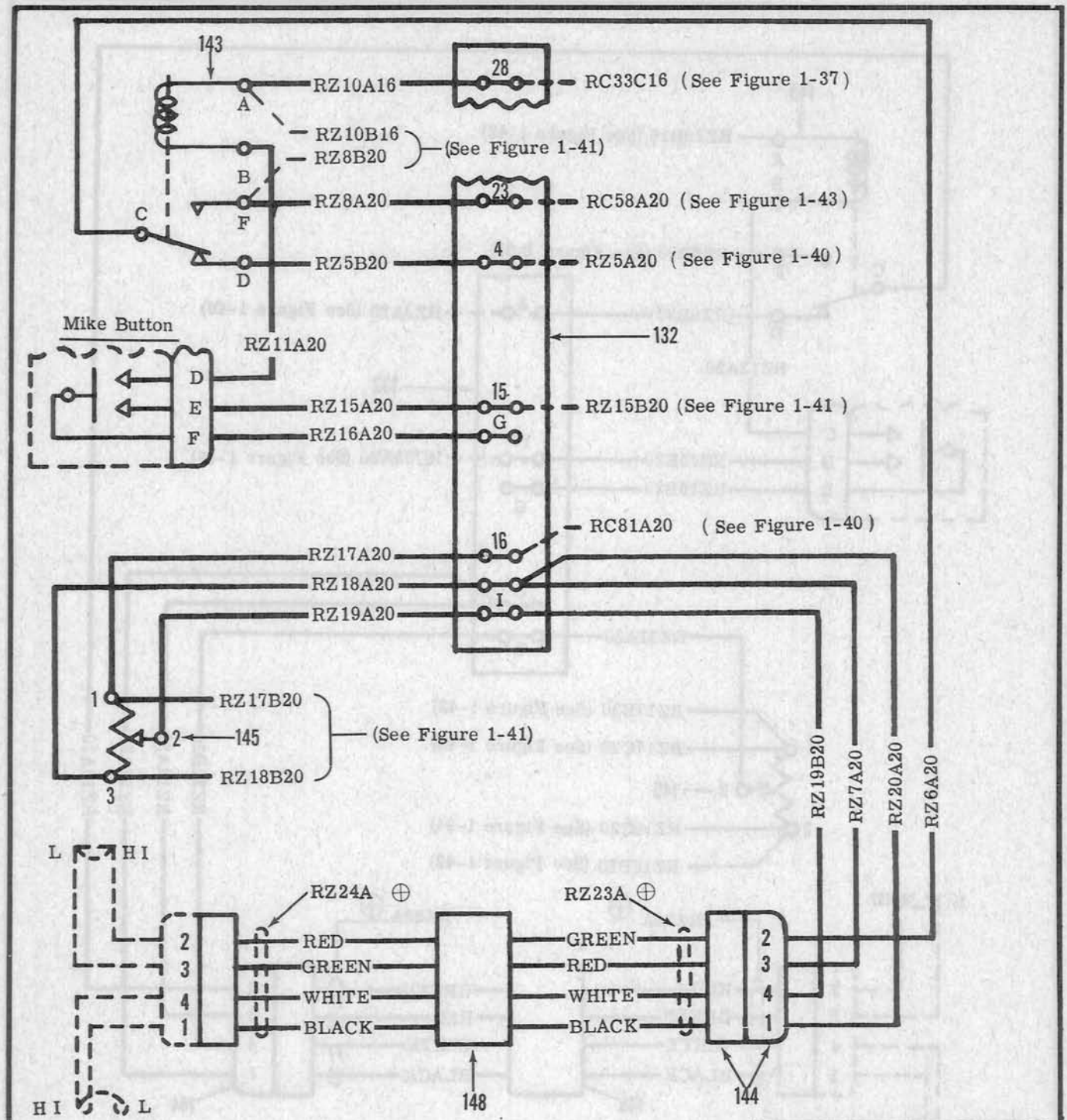
Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
121.	Circuit Breaker	15 amp
131.	Switch Interphone	AN3021-2
132.	Junction Box	J-15A
133.	Plug	ARC 14051
141.	Plug	ARC 16115
142.	Oscillator Relay	ARC K-13
143.	Hot Microphone Amplifier	F-14
136.	Antenna, Communication	ARC 17530 A-19

Figure 1-40. Hot Microphone Amplifier System



Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
148.	Adaptor	MS-1646/AIC
132.	Junction Box	J-15A
143.	Muting Relay	K-16
144.	Seat Disconnect	Cannon RWK-4-31SL & WK5-32SL
145.	Resistor, Variable	ARC 8487

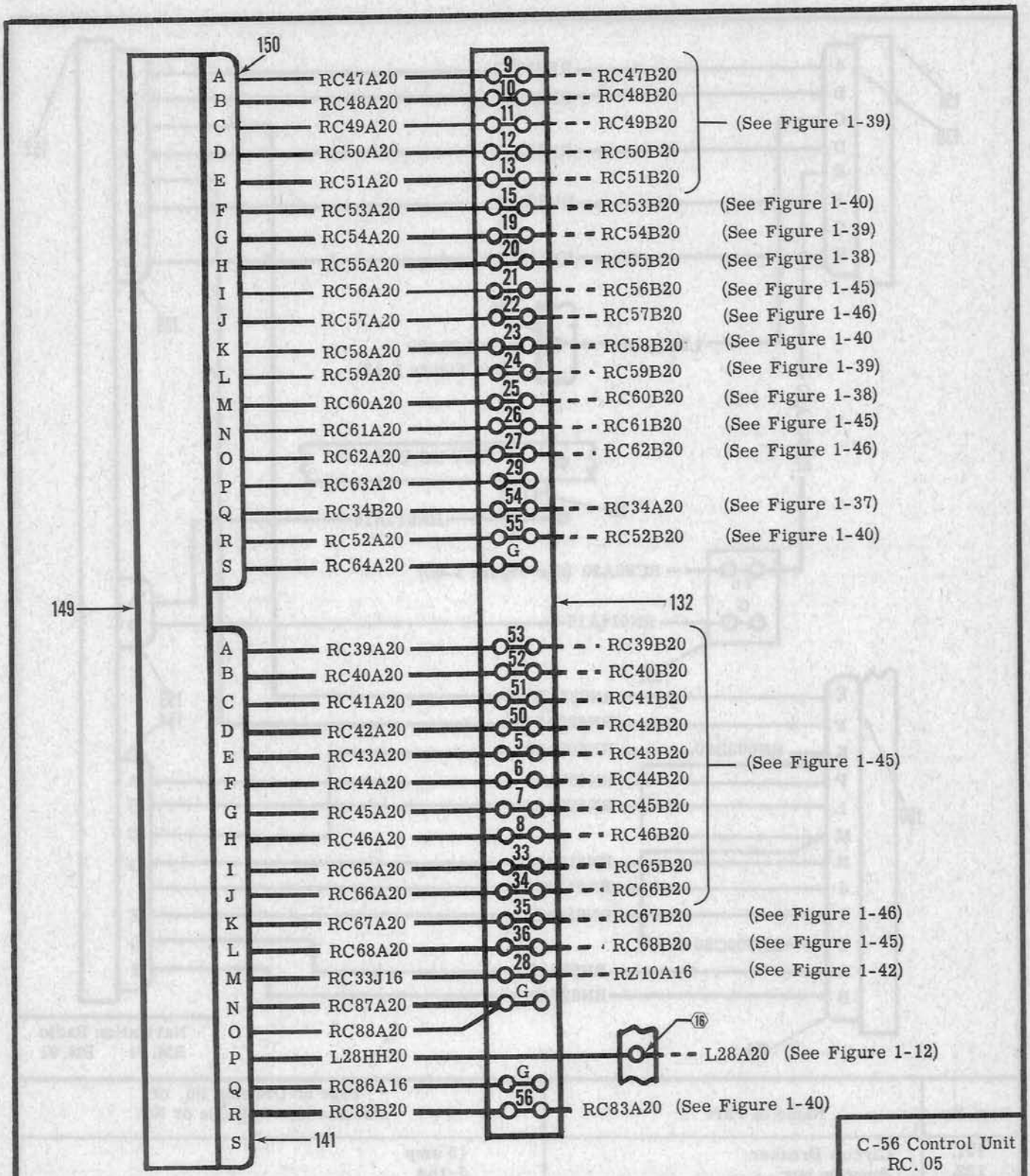
Figure 1-41. Student's Communication System



Instructor's Communication System
RZ. 02

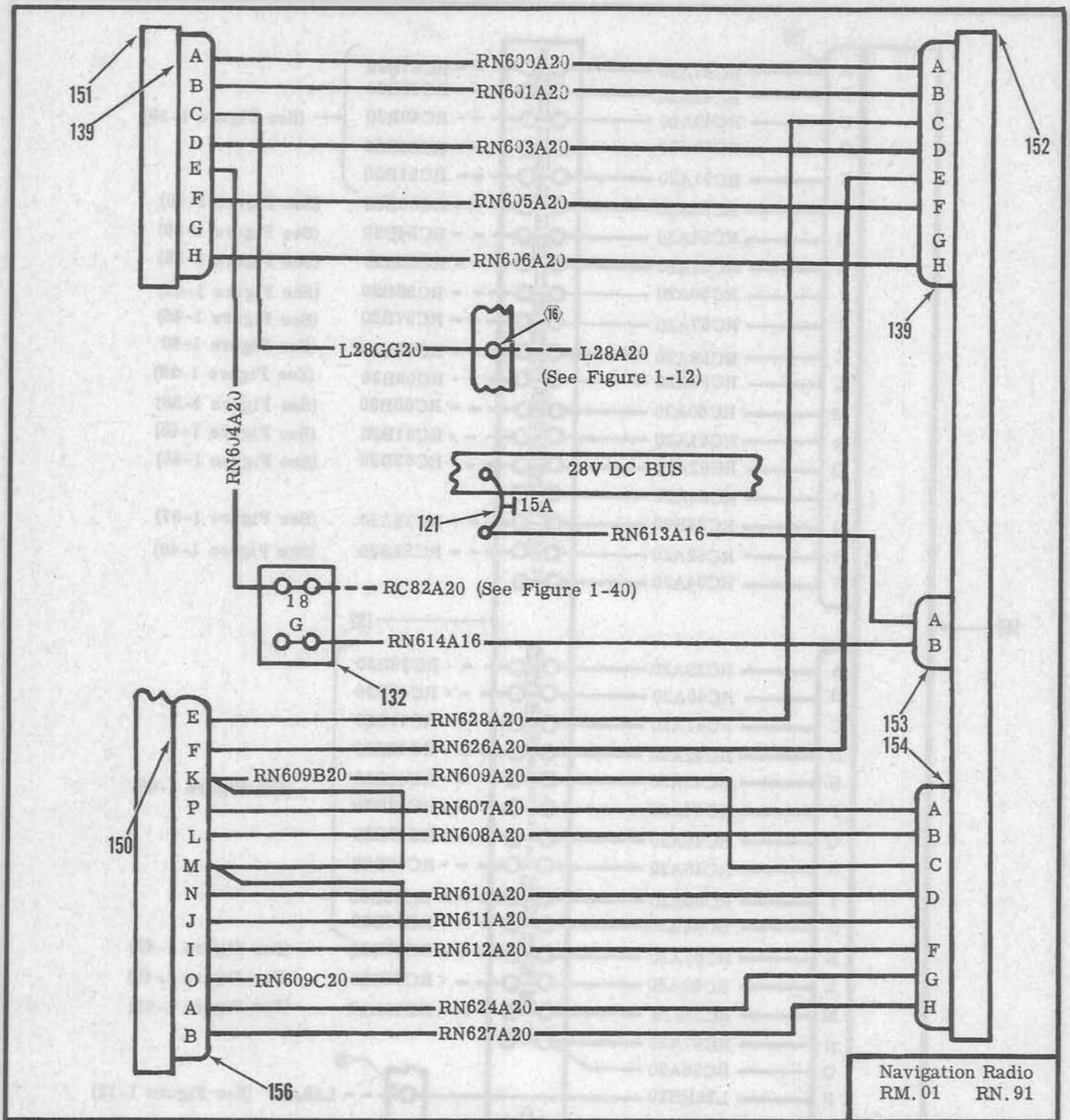
Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
148.	Adaptor	MX 1646/AIC
132.	Junction Box	J-13A
143.	Muting Relay	K-16
144.	Seat Disconnect	Cannon RWK-4-31SL & WKS 5-32SL
145.	Resistor, Variable	ARC 8487

Figure 1-42. Instructor's Communication System



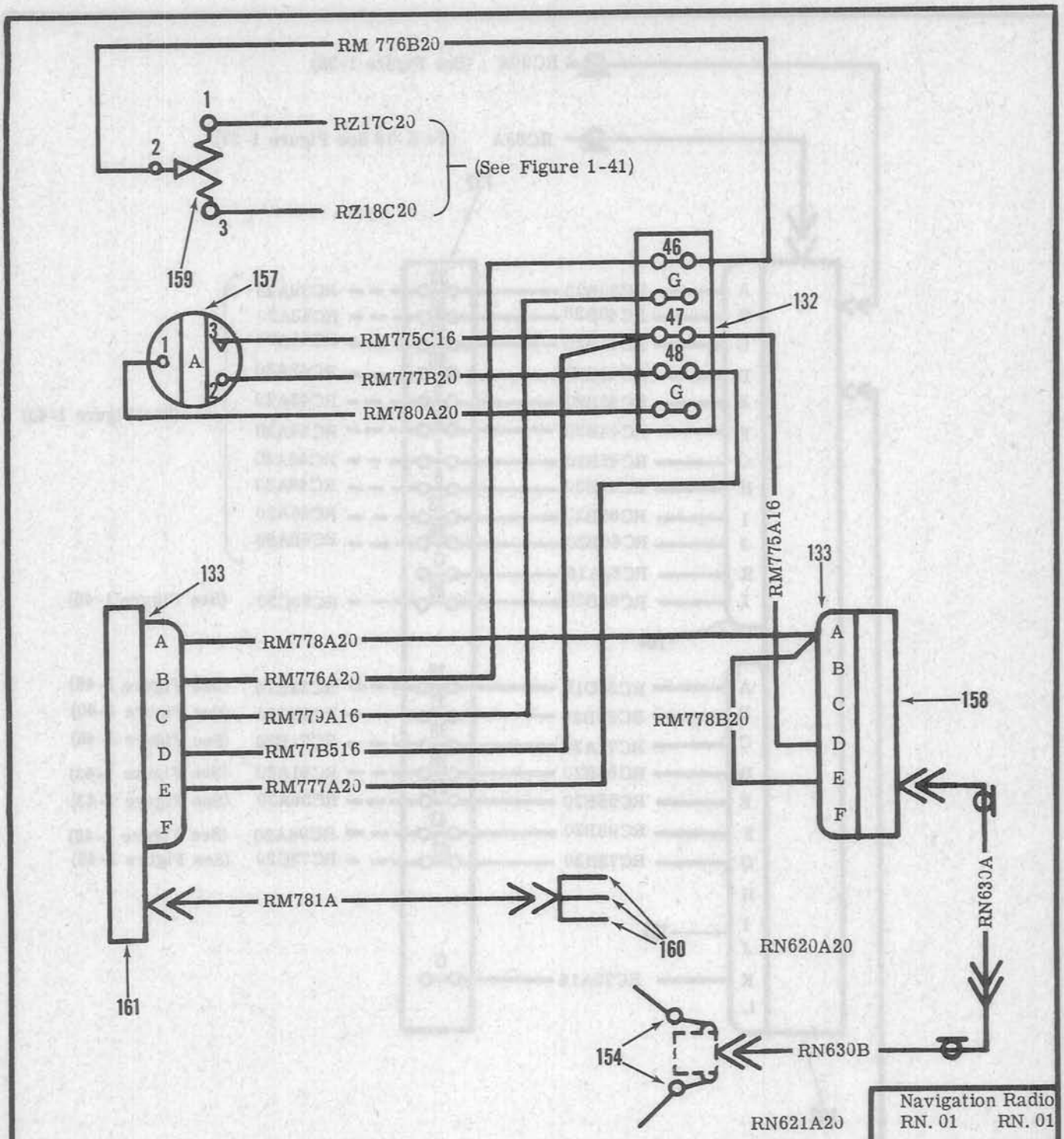
Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
132.	Junction Box	J-15A
141.	Plug	ARC 16115
149.	Control Unit	C-58
150.	Plug	ARC 14320

Figure 1-43. C-58 Control Unit



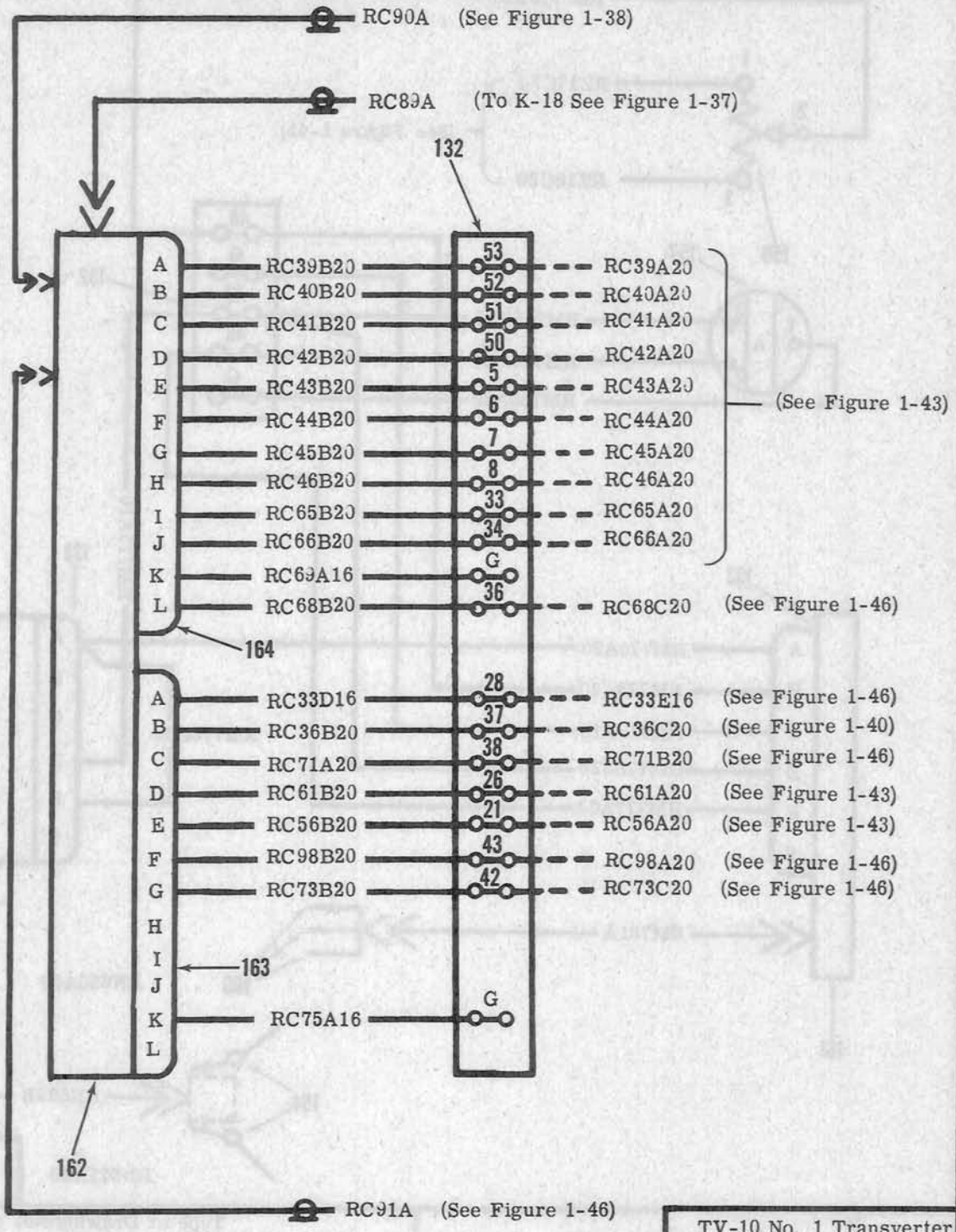
Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
121.	Circuit Breaker	15 amp
132.	Junction box	J-15A
139.	Plug	ARC 14050
150.	Plug	ARC 14320
151.	Control Unit	C1254/ARN-30
152.	Rack	E-14
153.	Plug	ARC 14321
154.	Antenna, Navigation	Lear 62657-02
155.	Plug	ARC 15912
156.	Course Indicator	ARC 16706

Figure 1-44. Navigation Radio (Sheet 1 of 2)



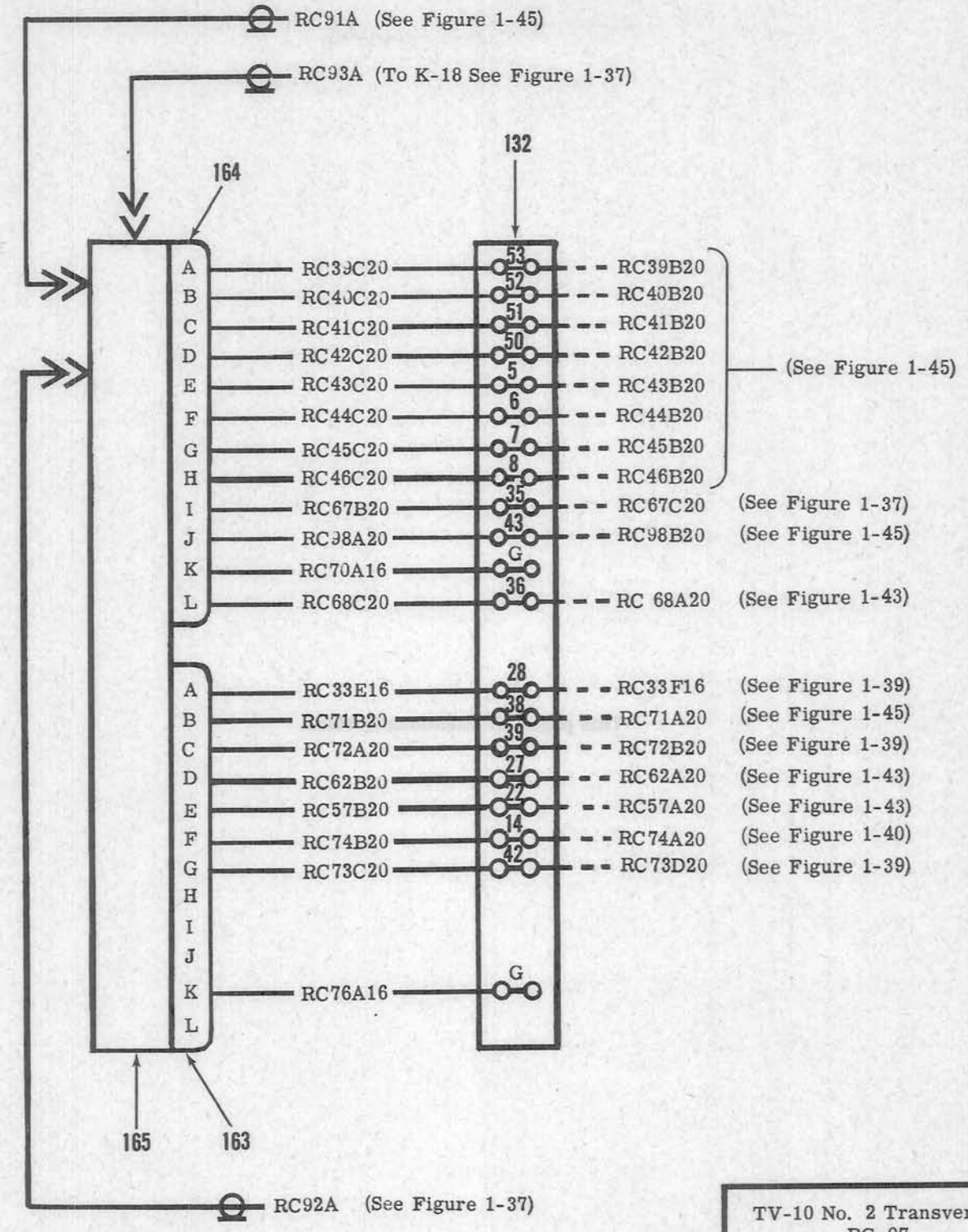
Item No.		Type or Drawing No. or Manufacturer's Name or No.
132.	Junction Box	J-15A
133.	Plug	ARC 14051
157.	Light, Marker Beacon	AN3517-4
158.	Receiver	ARC R-13B
159.	Resistor, Variable	ARC 8082
160.	Antenna, Marker Beacon	Collins 37X-1
161.	Receiver	ARC R-20
154.	Antenna, Navigation	Lear 62657-02

Figure 1-44. Navigation Radio (Sheet 2 of 2)



Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
132.	Junction Box	J-15A
162.	Transverter	TV-10 No. 1
163.	Plug	ARC 16743
164.	Plug	ARC 16744

Figure 1-45. TV-10 No. 1 Transverter



Item No.	Name of Part	Type or Drawing No. or Manufacturer's Name or No.
132.	Junction Box	J-15A
163.	Plug	ARC 16743
164.	Plug	ARC 16744
165.	Transverter	TV-10 No. 2

Figure 1-46. TV-10 No. 2 Transverter

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T.O. NO. 1T-37A-5

HANDBOOK

BASIC WEIGHT CHECK LIST

USAF SERIES

T-37A

AIRCRAFT

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE

30 JUNE 1956

McCORMICK-ARMSTRONG, WICHITA, 1200, 7-30-56

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SECTION I

INTRODUCTION

1-1. This Technical Order contains a sample Basic Weight Check List and a Chart E, Loading Data, for assistance in complying with weighing requirements.

1-2. The sample Basic Weight Check List contained herein is to be used ONLY AS A GUIDE in preparing check lists for T-37A aircraft. If no other basic weight check list is available, a complete inventory of all equipment in the airplane must be made and a check mark placed in the proper column on a new set of basic weight check list pages.

1-3. The Chart E, Loading Data, contained herein, replaces every Chart E for T-37A aircraft which is dated 30 days previous to the date of this publication. UNLESS SPECIFIC MODIFICATIONS NOT PROVIDED FOR IN THIS CHART E, LOADING DATA, HAVE BEEN MADE TO ANY AIRCRAFT OF THIS SERIES.

SECTION II

SAMPLE CHART A, BASIC WEIGHT CHECK LIST

CHART A - BASIC WEIGHT CHECK LIST

FOR USE IN T.O. 1-1B-40 & AN 01-1B-40

RECORD OF CHECKING (Enter date)

PAGE 1 OF 5 PAGES	AIRPLANE MODEL	SERIAL NUMBER	DELIVERY DATE
	T-37A		

COMPARTMENT AND ITEM NUMBER	ITEMS AND LOCATION (Grouped by Compartment)	WEIGHT	ARM	1/ MOMENT / 100	DELIVERY EQUIPMENT	CHECK 1		2		3		4		5		6		7		8	
						IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY
A	NOSE SECTION (0 TO 64)																				
A-1	Ballast-Nose	79	22	17.4																	
A-2	Transverters, TV-10, (2)	12	40	4.8																	
A-3	Battery, AN 3150-2	80	41	32.8																	
A-4	Jack Pads and Tie Down Rings, (3), (Stowed)	2	48	1.0																	
A-5	Transmitter, T-13A	3	51	1.5																	
A-6	Transmitter, T-11B	3	51	1.5																	
A-7	Marker Beacon, R-20	3	51	1.5																	
A-8	Flasher, C-2	2	52	1.0																	
A-9	Dynamotor, D-10A	3	52	1.6																	
A-10	Reverse Current Relays (2), AN3025-1	5	52	2.6																	
A-11	Amplifier, F-14	2	55	1.1																	
A-12	Rack, E-14	2	55	1.1																	
A-13	Converter, B-13	6	56	3.4																	
A-14	Receiver, R-13B	6	56	3.4																	
A-15	Voltage Regulators, (2)	6	59	3.5																	
A-16	Dynamotor, D-10A	3	61	1.8																	
A-17	Receiver, R-19	6	61	3.7																	
A-18	Inverters (2)	13	61	7.9																	
A-19	Junction Box, J-15A	3	63	1.9																	
A-20	Battery Relays, (2), AN3370-2	3	63	1.9																	
A-21	Casing, Nose	9	63	5.7																	
A-22	Wheel Assembly, Nose	4	63	2.5																	
A-23	Tube, Nose Wheel	2	63	1.3																	

1/ Enter constant used below line.

CHART A - BASIC WEIGHT CHECK LIST

PAGE 2 OF 5 PAGES | AIRPLANE MODEL: T-37A | SERIAL NUMBER: | DELIVERY DATE:

FOR USE IN T.O. 1-1B-40 & AN 01-1B-40

RECORD OF CHECKING (Enter date)

COMPARTMENT AND ITEM NUMBER	ITEMS AND LOCATION (Grouped by Compartment)	WEIGHT	ARM	1/ MOMENT / 100	DELIVERY EQUIPMENT	CHECK 1 IN AIRPLANE	CHECK 1 CHART C ENTRY	CHECK 2 IN AIRPLANE	CHECK 2 CHART C ENTRY	CHECK 3 IN AIRPLANE	CHECK 3 CHART C ENTRY	CHECK 4 IN AIRPLANE	CHECK 4 CHART C ENTRY	CHECK 5 IN AIRPLANE	CHECK 5 CHART C ENTRY	CHECK 6 IN AIRPLANE	CHECK 6 CHART C ENTRY	CHECK 7 IN AIRPLANE	CHECK 7 CHART C ENTRY	CHECK 8 IN AIRPLANE	CHECK 8 CHART C ENTRY
B	CENTER SECTION (64 to 208.5)																				
B-1	Control Unit, C-58	2	75	1.5																	
B-2	Oxygen Regulators, (2), D-2A	10	85	8.5																	
B-3	First Aid Kit	2	98	2.0																	
B-4	Seat Cushions (2)	11	108	11.9																	
B-5	Safety Belt, Pilot	5	112	5.6																	
B-6	Safety Belt, Co-Pilot	5	112	5.6																	
B-7	Seat, Pilot	35	117	41.0																	
B-8	Seat, Co-Pilot	35	117	41.0																	
B-9	Shoulder Harness, Pilot	3	119	3.6																	
B-10	Shoulder Harness, Co-Pilot	3	119	3.6																	
B-11	Fuel Strainer	2	127	2.5																	
B-12	Catapult with Cartridge, Pilot	7	127	8.9																	
B-13	Catapult with Cartridge, Co-Pilot	7	127	8.9																	
B-14	Fixed Rail Assembly, Pilot	15	129	19.4																	
B-15	Fixed Rail Assembly, Co-Pilot	15	129	19.4																	
B-16	Fuel Flow Meters, (2)	7	132	9.2																	
B-17	Starter-Generators, (2)	68	133	90.4																	
B-18	Fuel Proportioner	5	135	6.8																	
B-19	Starter Relays, AN3370-2, (2)	3	136	4.1																	
B-20	Fuel Shut-Off Valves (Wing), (2)	3	144	4.3																	
B-21	Tachometer Generator, (2)	4	150	6.0																	
B-22	Hydraulic Pumps, (2)	8	150	12.0																	
B-23	Fuel Shut-Off Valves, (Engines), (2)	3	152	4.6																	
B-24	Thermocouple Harness, (2)	4	156	6.2																	

1/ Enter constant used below line.

CHART A - BASIC WEIGHT CHECK LIST

PAGE 3 OF 5 PAGES | AIRPLANE MODEL: T-37A | SERIAL NUMBER:

DELIVERY DATE

FOR USE IN T.O. 1-1B-40 & AN 01-1B-40

RECORD OF CHECKING (Enter date)

COMPARTMENT AND ITEM NUMBER	ITEMS AND LOCATION (Grouped by Compartment)	WEIGHT	ARM	MOMENT 1/ 100	DELIVERY EQUIPMENT	CHECK 1		2		3		4		5		6		7		8	
						IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY
B-25	Fuel Float Switch	2	161	3.2																	
B-26	Fuel Boost Pump	6	165	9.9																	
B-27	Hydraulic Accumulator	4	169	6.8																	
B-28	Flap Synchronizing Valve	3	181	5.4																	

1/ Enter constant used below line.

CHART A - BASIC WEIGHT CHECK LIST

DELIVERY DATE

FOR USE IN T.O. 1-1B-40 & AN 01-1B-40

RECORD OF CHECKING (Enter date)

PAGE 4 OF 5 PAGES | AIRPLANE MODEL: T-37A | SERIAL NUMBER

COMPARTMENT AND ITEM NUMBER	ITEMS AND LOCATION (Grouped by Compartment)	WEIGHT	ARM	1/ MOMENT / 100	DELIVERY EQUIPMENT	CHECK 1 IN AIRPLANE	CHECK 1 CHART C ENTRY	CHECK 2 IN AIRPLANE	CHECK 2 CHART C ENTRY	CHECK 3 IN AIRPLANE	CHECK 3 CHART C ENTRY	CHECK 4 IN AIRPLANE	CHECK 4 CHART C ENTRY	CHECK 5 IN AIRPLANE	CHECK 5 CHART C ENTRY	CHECK 6 IN AIRPLANE	CHECK 6 CHART C ENTRY	CHECK 7 IN AIRPLANE	CHECK 7 CHART C ENTRY	CHECK 8 IN AIRPLANE	CHECK 8 CHART C ENTRY
C	TAIL SECTION (208.5 to 360.0)																				
C-1	Oxygen Bottle (Type G-1)	17	213	36.2																	
C-2	Oxygen Bottle (Type F-1)	10	213	21.3																	

1/ Enter constant used below line.

CHART A - BASIC WEIGHT CHECK LIST

PAGE 5 OF 5 PAGES | AIRPLANE MODEL: T-37A | SERIAL NUMBER | DELIVERY DATE

FOR USE IN T.O. 1-1B-40 & AN 01-1B-40

RECORD OF CHECKING (Enter date)

COMPARTMENT AND ITEM NUMBER	ITEMS AND LOCATION (Grouped by Compartment)	WEIGHT	ARM	1/ MOMENT / 100	DELIVERY EQUIPMENT	CHECK 1 IN AIRPLANE	CHECK 1 CHART C ENTRY	CHECK 2 IN AIRPLANE	CHECK 2 CHART C ENTRY	CHECK 3 IN AIRPLANE	CHECK 3 CHART C ENTRY	CHECK 4 IN AIRPLANE	CHECK 4 CHART C ENTRY	CHECK 5 IN AIRPLANE	CHECK 5 CHART C ENTRY	CHECK 6 IN AIRPLANE	CHECK 6 CHART C ENTRY	CHECK 7 IN AIRPLANE	CHECK 7 CHART C ENTRY	CHECK 8 IN AIRPLANE	CHECK 8 CHART C ENTRY
W	WING																				
W-1	Tubes, Main Gear, (2)	7	155	10.9																	
W-2	Brake Assemblies, Main Gear, (2)	25	155	38.8																	
W-3	Casing, Main Gear (2)	27	155	41.9																	
W-4	Wheel Assemblies, Main Gear, (2)	46	155	71.3																	
W-5	Landing Lights, AN3095-7, (2)	11	170	18.7																	
	MISCELLANEOUS																				
	Unusable Fuel (Total)	79	153	120.9																	
	Trapped Fuel	43	150	64.5																	
	Unusable Oil (Total)	10	132	13.2																	
	Trapped Oil	3	142	4.3																	

1/ Enter constant used below line.

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SECTION III

CHART E, LOADING DATA

WEIGHING INSTRUCTIONS

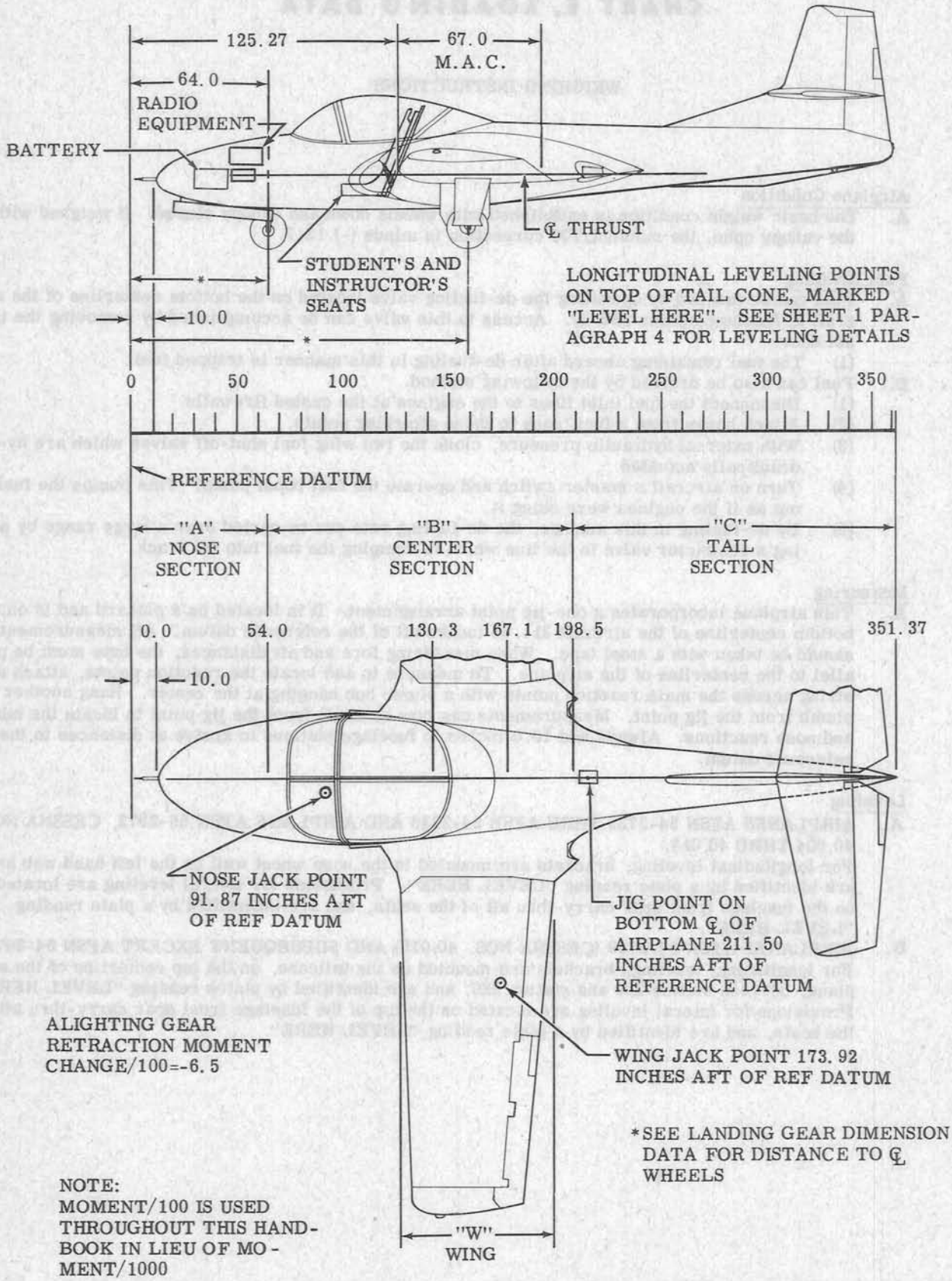
1. Airplane Condition
   A. The basic weight condition is established with wheels down and canopy closed. If weighed with the canopy open, the moment/100 correction is minus (-) 12.7.

2. Fuel Draining
   A. Fuel can be drained by operating the de-fueling valve located on the bottom centerline of the aircraft at fuselage station 136.20. Access to this valve can be accomplished by removing the tunnel door.
      (1) The fuel remaining aboard after de-fueling in this manner is trapped fuel.
   B. Fuel can also be drained by the following method.
      (1) Disconnect the fuel inlet lines to the engines at the canted firewalls.
      (2) Attach hoses from a fuel truck to these attaching points.
      (3) With external hydraulic pressure, close the two wing fuel shut-off valves which are hydraulically actuated.
      (4) Turn on aircraft's master switch and operate the fuel boost pump. This pumps the fuel out as if the engines were using it.
      (5) By de-fueling in this manner, the de-fueling rate can be varied over a large range by using a restrictor valve in the line which is dumping the fuel into the truck.

3. Measuring
   A. This airplane incorporates a one-jig point arrangement. It is located on a placard and is on the bottom centerline of the aircraft 211.50 inches aft of the reference datum. All measurements should be taken with a steel tape. When measuring fore and aft distances, the tape must be parallel to the centerline of the airplane. To measure to and locate the reaction points, attach a string across the main reaction points with a plumb bob hanging at the center. Hang another plumb from the jig point. Measurements can now be made from the jig point to locate the main and nose reactions. Always add 10.0 inches to fuselage stations to arrive at distances to the reference datum.

4. Leveling
   A. AIRPLANES AFSN 54-2729 THRU AFSN 54-2738 AND AIRPLANE AFSN 55-2972, CESSNA NOS. 40,004 THRU 40,014.
   For longitudinal leveling, brackets are mounted in the nose wheel well on the left hand web and are identified by a plate reading "LEVEL HERE". Provisions for lateral leveling are located on the fuselage front spar carry-thru aft of the seats, and are indentified by a plate reading "LEVEL HERE".
   B. AIRPLANES AFSN 54-2739 (CESSNA NOS. 40.015) AND SUBSEQUENT EXCEPT AFSN 54-2972.
   For longitudinal leveling, brackets are mounted on the tailcone, on the top centerline of the airplane, between station 200 and station 220, and are identified by plates reading "LEVEL HERE". Provisions for lateral leveling are located on the top of the fuselage front spar carry-thru aft of the seats, and are identified by a plate reading "LEVEL HERE".

NOTE: Moment/100 is used throughout in lieu of Moment/1000



NOTE:
MOMENT/100 IS USED THROUGHOUT THIS HANDBOOK IN LIEU OF MOMENT/1000

CENTER OF GRAVITY TABLE

Sheet 1 of 6	MOMENT/100										
Gross Weight Lbs.	21.5% MAC* 139.7	22.0% MAC 140.0	23.0% MAC 140.7	24.0% MAC 141.4	25.0% MAC 142.0	26.0% MAC 142.7	27.0% MAC 143.4	28.0% MAC 144.0	29.0% MAC 144.7	30.0% MAC 145.4	30.8% MAC 145.9
3400	4750	4760	4784	4808	4828	4852	4876	4896	4920	4944	4961
3410	4764	4774	4798	4822	4842	4866	4890	4910	4934	4958	4975
3420	4778	4788	4812	4836	4856	4880	4904	4925	4949	4973	4990
3430	4792	4802	4826	4850	4871	4895	4919	4939	4963	4987	5004
3440	4806	4816	4840	4864	4885	4909	4933	4954	4978	5002	5019
3450	4820	4830	4854	4878	4899	4923	4947	4968	4992	5016	5034
3460	4834	4844	4868	4892	4913	4937	4962	4982	5007	5031	5048
3470	4848	4858	5882	4907	4927	4952	4976	4997	5021	5045	5063
3480	4862	4872	4896	4921	4942	4966	4990	5011	5036	5060	5077
3490	4876	4886	4910	4935	4956	4980	5005	5026	5050	5074	5092
3500	4890	4900	4925	4949	4970	4995	5019	5040	5065	5089	5107
3510	4903	4914	4939	4963	4984	5009	5033	5054	5079	5104	5121
3520	4917	4928	4953	4977	4998	5023	5048	5069	5093	5118	5136
3530	4931	4942	4967	4991	5013	5037	5062	5083	5108	5133	5150
3540	4945	4956	4981	5006	5027	5052	5076	5098	5122	5147	5165
3550	4959	4970	4995	5020	5041	5066	5091	5112	5137	5162	5179
3560	4973	4984	5009	5034	5055	5080	5105	5126	5151	5176	5194
3570	4987	4998	5023	5048	5069	5094	5119	5141	5166	5191	5209
3580	5001	5012	5037	5062	5084	5109	5134	5155	5180	5205	5223
3590	5015	5026	5051	5076	5098	5123	5148	5170	5195	5220	5238
3600	5029	5040	5065	5090	5112	5137	5162	5184	5209	5234	5252
3610	5043	5054	5079	5105	5126	5151	5177	5198	5224	5249	5267
3620	5057	5068	5093	5119	5140	5166	5191	5213	5238	5263	5282
3630	5071	5082	5107	5133	5155	5180	5205	5227	5253	5278	5296
3640	5085	5096	5121	5147	5169	5194	5220	5242	5267	5293	5311
3650	5099	5110	5136	5161	5183	5209	5234	5256	5282	5307	5325
3660	5113	5124	5150	5175	5197	5223	5248	5270	5296	5322	5340
3670	5127	5138	5164	5189	5211	5237	5263	5285	5310	5336	5355
3680	5141	5152	5178	5204	5226	5251	5277	5299	5325	5351	5369
3690	5155	5166	5192	5218	5240	5266	5291	5314	5339	5365	5384
3700	5169	5180	5206	5232	5254	5280	5306	5328	5354	5380	5398
3710	5183	5194	5220	5246	5268	5294	5320	5342	5368	5394	5413
3720	5197	5208	5234	5260	5282	5308	5334	5357	5383	5409	5427
3730	5211	5222	5248	5274	5297	5323	5249	5371	5397	5423	5442
3740	5225	5236	5262	5288	5311	5337	5363	5386	5412	5438	5457
3750	5239	5250	5276	5303	5325	5351	5378	5400	5426	5453	5471
3760	5253	5264	5290	5317	5339	5366	5392	5414	5441	5467	5486
3770	5267	5278	5304	5331	5353	5380	5406	5429	5455	5482	5500
3780	5281	5292	5318	5345	5368	5394	5421	5443	5470	5496	5515
3790	5295	5306	5333	5359	5382	5408	5435	5458	5484	5511	5530
3800	5309	5320	5347	5373	5396	5423	5449	5472	5499	5525	5544
3810	5323	5334	5361	5387	5410	5437	5464	5486	5513	5540	5559
3820	5337	5348	5375	5401	5424	5451	5478	5501	5528	5554	5573
3830	5351	5362	5389	5416	5439	5465	5492	5515	5542	5569	5588
3840	5364	5376	5403	5430	5453	5480	5507	5530	5556	5583	5603
3850	5378	5390	5417	5444	5467	5494	5521	5544	5571	5598	5617
3860	5392	5404	5431	5458	5481	5508	5535	5558	5585	5612	5632
3870	5406	5418	5445	5472	5495	5522	5550	5573	5600	5627	5646
3880	5420	5432	5459	5486	5510	5537	5564	5587	5614	5642	5661
3890	5434	5446	5473	5500	5524	5551	5578	5602	5629	5656	5676
3900	5448	5460	5487	5515	5538	5565	5593	5616	5643	5671	5690
3910	5462	5474	5501	5529	5552	5580	5607	5630	5658	5685	5705
3920	5476	5488	5515	5543	5566	5594	5621	5645	5672	5700	5719
3930	5490	5502	5530	5557	5581	5608	5636	5659	5687	5714	5734
3940	5504	5516	5544	5571	5595	5622	5650	5674	5701	5729	5748
3950	5518	5530	5558	5585	5609	5637	5664	5688	5716	5743	5763

CENTER OF GRAVITY TABLE

Sheet 2 of 6

MOMENT/100

Gross Weight Lbs.	21.5% MAC* 139.7	22.0% MAC 140.0	23.0% MAC 140.7	24.0% MAC 141.4	25.0% MAC 142.0	26.0% MAC 142.7	27.0% MAC 143.4	28.0% MAC 144.0	29.0% MAC 144.7	30.0% MAC 145.4	30.8% MAC 145.9
3960	5532	5544	5572	5599	5623	5651	5679	5702	5730	5758	5778
3970	5546	5558	5586	5614	5637	5665	5693	5717	5745	5772	5792
3980	5560	5572	5600	5628	5652	5679	5707	5731	5759	5787	5807
3990	5574	5586	5614	5642	5666	5694	5722	5746	5774	5801	5821
4000	5588	5600	5628	5656	5680	5708	5736	5760	5788	5816	5836
4010	5602	5614	5642	5670	5694	5722	5750	5774	5802	5831	5851
4020	5616	5628	5656	5684	5708	5737	5765	5789	5817	5845	5865
4030	5630	5642	5670	5698	5723	5751	5779	5803	5831	5860	5880
4040	5644	5656	5684	5713	5737	5765	5793	5818	5846	5874	5894
4050	5658	5670	5698	5727	5751	5779	5808	5832	5860	5889	5909
4060	5672	5684	5712	5741	5765	5794	5822	5846	5875	5903	5924
4070	5686	5698	5726	5755	5779	5808	5836	5861	5889	5918	5938
4080	5700	5712	5741	5769	5794	5822	5851	5875	5904	5932	5953
4090	5714	5726	5755	5783	5808	5836	5865	5890	5918	5947	5967
4100	5728	5740	5769	5797	5822	5851	5879	5904	5933	5961	5982
4110	5742	5754	5783	5812	5836	5865	5894	5918	5947	5976	5996
4120	5756	5768	5797	5826	5850	5879	5908	5933	5962	5990	6011
4130	5770	5782	5811	5840	5865	5894	5922	5947	5976	6005	6026
4140	5784	5796	5825	5854	5879	5908	5937	5962	5991	6020	6040
4150	5798	5810	5839	5868	5893	5922	5951	5976	6005	6034	6055
4160	5812	5824	5853	5882	5907	5936	5965	5990	6020	6049	6069
4170	5825	5838	5867	5896	5921	5951	5980	6005	6034	6063	6084
4180	5839	5852	5881	5911	5936	5965	5994	6019	6048	6078	6099
4190	5853	5866	5895	5925	5950	5979	6008	6034	6063	6092	6113
4200	5867	5880	5909	5939	5964	5993	6023	6048	6077	6107	6128
4210	5881	5894	5923	5953	5978	6008	6037	6062	6092	6121	6142
4220	5895	5908	5938	5967	5992	6022	6051	6077	6106	6136	6157
4230	5909	5922	5952	5981	6007	6036	6066	6091	6121	6150	6172
4240	5923	5936	5966	5995	6021	6050	6080	6106	6135	6165	6186
4250	5937	5950	5980	6010	6035	6065	6095	6121	6150	6180	6201
4260	5951	5964	5994	6024	6049	6079	6109	6134	6164	6194	6215
4270	5965	5978	6008	6038	6063	6093	6123	6149	6180	6209	6230
4280	5979	5992	6022	6052	6078	6108	6138	6163	6193	6223	6245
4290	5993	6006	6036	6066	6092	6122	6152	6178	6208	6238	6259
4300	6007	6020	6050	6080	6106	6136	6166	6192	6222	6252	6274
4310	6021	6034	6064	6094	6120	6150	6181	6206	6237	6267	6288
4320	6035	6048	6078	6108	6134	6165	6195	6221	6251	6281	6303
4330	6049	6062	6092	6123	6149	6179	6209	6235	6266	6296	6317
4340	6063	6076	6106	6137	6163	6193	6224	6250	6280	6310	6332
4350	6077	6090	6120	6151	6177	6207	6238	6264	6294	6325	6347
4360	6091	6104	6135	6165	6191	6222	6252	6278	6309	6339	6361
4370	6105	6118	6149	6179	6205	6236	6267	6293	6323	6354	6376
4380	6119	6132	6163	6193	6220	6250	6281	6307	6338	6369	6390
4390	6133	6146	6177	6207	6234	6265	6295	6322	6352	6383	6405
4400	6147	6160	6191	6222	6248	6279	6310	6336	6367	6398	6420
4410	6161	6174	6205	6236	6262	6293	6324	6350	6381	6412	6434
4420	6175	6188	6219	6250	6276	6307	6338	6365	6396	6427	6449
4430	6189	6202	6233	6264	6291	6322	6353	6379	6410	6441	6463
4440	6203	6216	6247	6278	6305	6336	3667	6394	6425	6456	6478
4450	6217	6230	6261	6292	6319	6350	6381	6408	6439	6470	6493
4460	6231	6244	6275	6306	6333	6364	6396	6422	6454	6485	6507
4470	6245	6258	6289	6321	6347	6379	6410	6437	6468	6499	6522
4480	6259	6272	6303	6335	6362	6393	6424	6451	6483	6514	6536
4490	6273	6286	6317	6349	6376	6407	6439	6466	6497	6528	6551
4500	6287	6300	6332	6363	6390	6422	6453	6480	6512	6543	6566
4510	6300	6314	6346	6377	6404	6436	6467	6494	6526	6558	6580
4520	6314	6328	6360	6391	6418	6450	6482	6509	6540	6572	6595
4530	6328	6342	6374	6405	6433	6464	6496	6523	6555	6587	6609
4540	6342	6356	6388	6420	6447	6479	6510	6538	6569	6601	6624

CENTER OF GRAVITY TABLE

Sheet 3 of 6	MOMENT/100										
Gross Weight Lbs.	21.5% MAC* 139.7	22.0% MAC 140.0	23.0% MAC 140.7	24.0% MAC 141.4	25.0% MAC 142.0	26.0% MAC 142.7	27.0% MAC 143.4	28.0% MAC 144.0	29.0% MAC 144.7	30.0% MAC 145.4	30.8% MAC 145.9
4550	6356	6370	6402	6434	6461	6493	6525	6552	6584	6616	6638
4560	6370	6384	6416	6448	6475	6507	6539	6566	6598	6630	6653
4570	6384	6398	6430	6462	6489	6521	6553	6581	6613	6645	6668
4580	6398	6412	6444	6476	6504	6536	6568	6595	6627	6659	6682
4590	6412	6426	6458	6490	6518	6550	6582	6610	6642	6674	6697
4600	6426	6440	6472	6504	6532	6564	6596	6624	6656	6688	6711
4610	6440	6454	6486	6519	6546	6578	6611	6638	6671	6703	6726
4620	6454	6468	6500	6533	6560	6593	6625	6653	6685	6717	6741
4630	6468	6482	6514	6547	6575	6607	6639	6667	6700	6732	6755
4640	6482	6496	6528	6561	6589	6621	6654	6682	6714	6747	6770
4650	6496	6510	6543	6575	6603	6636	6668	6696	6729	6761	6784
4660	6510	6524	6557	6589	6617	6650	6682	6710	6743	6776	6799
4670	6524	6538	6571	6603	6631	6664	6697	6725	6757	6790	6814
4680	6538	6552	6585	6618	6646	6678	6711	6739	6772	6805	6828
4690	6552	6566	6599	6632	6660	6693	6725	6754	6786	6819	6843
4700	6566	6580	6613	6646	6674	6707	6740	6768	6801	6834	6857
4710	6580	6594	6627	6660	6688	6721	6754	6782	6815	6848	6872
4720	6594	6608	6641	6674	6702	6735	6768	6797	6830	6863	6886
4730	6608	6622	6655	6688	6717	6750	6783	6811	6844	6877	6901
4740	6622	6636	6669	6702	6731	6764	6797	6826	6859	6892	6916
4750	6636	6650	6683	6717	6745	6778	6812	6840	6873	6907	6930
4760	6650	6664	6697	6731	6759	6793	6826	6854	6888	6921	6945
4770	6664	6678	6711	6745	6773	6807	6840	6869	6902	6936	6959
4780	6678	6692	6725	6759	6788	6821	6855	6883	6917	6950	6974
4790	6692	6706	6740	6773	6802	6835	6869	6898	6931	6965	6989
4800	6706	6720	6754	6787	6816	6850	6883	6912	6946	6979	7003
4810	6720	6734	6768	6801	6830	6864	6898	6926	6960	6994	7018
4820	6734	6748	6782	6815	6844	6878	6912	6941	6975	7008	7032
4830	6748	6762	6796	6830	6859	6892	6926	6955	6989	7023	7047
4840	6761	6776	6810	6844	6873	6007	6941	6970	7003	7037	7062
4850	6775	6790	6824	6858	6887	6921	6955	6984	7018	7052	7076
4860	6789	6804	6838	6872	6901	6935	6969	6998	7032	7066	7091
4870	6803	6818	6852	6886	6915	6949	6984	7013	7047	7081	7105
4880	6817	6832	6866	6900	6930	6964	6998	7027	7061	7096	7120
4890	6831	6846	6880	6914	6944	6978	7012	7042	7076	7110	7135
4900	6845	6860	6894	6929	6958	6992	7027	7056	7090	7125	7149
4910	6859	6874	6908	6943	6972	7007	7041	7070	7105	7139	7164
4920	6873	6888	6922	6957	6986	7021	7055	7085	7119	7154	7178
4930	6887	6902	6937	6971	7001	7035	7070	7099	7134	7168	7193
4940	6901	6916	6951	6985	7015	7049	7084	7114	7148	7183	7207
4950	6915	6930	6965	6999	7029	7064	7098	7128	7163	7197	7222
4960	6929	6944	6979	7013	7043	7078	7113	7142	7177	7212	7237
4970	6943	6958	6993	7028	7057	7092	7127	7157	7192	7226	7251
4980	6957	6972	7007	7042	7072	7106	7141	7171	7206	7241	7266
4990	6971	6986	7021	7056	7086	7121	7156	7186	7221	7255	7280
5000	6985	7000	7035	7070	7100	7135	7170	7200	7235	7270	7295
5010	6999	7014	7049	7084	7114	7149	7184	7214	7249	7285	7310
5020	7013	7028	7063	7098	7128	7164	7199	7229	7264	7299	7324
5030	7027	7042	7077	7112	7143	7178	7213	7243	7278	7314	7339
5040	7041	7056	7091	7127	7157	7192	7227	7258	7293	7328	7353
5050	7055	7070	7105	7141	7171	7206	7242	7272	7307	7343	7368
5060	7069	7084	7119	7155	7185	7221	7256	7286	7322	7357	7383
5070	7083	7098	7133	7169	7199	7235	7270	7301	7336	7372	7397
5080	7097	7112	7148	7183	7214	7249	7285	7315	7351	7386	7412
5090	7111	7126	7162	7197	7228	7263	7299	7330	7365	7401	7426
5100	7125	7140	7176	7211	7242	7278	7313	7344	7380	7415	7441
5110	7139	7154	7190	7226	7256	7292	7328	7358	7394	7430	7455
5120	7153	7168	7204	7240	7270	7306	7342	7373	7409	7444	7470
5130	7167	7182	7218	7254	7285	7321	7356	7387	7423	7459	7485

CENTER OF GRAVITY TABLE

Sheet 4 of 6

MOMENT/100

Gross Weight Lbs.	21.5% MAC* 139.7	22.0% MAC 140.0	23.0% MAC 140.7	24.0% MAC 141.4	25.0% MAC 142.0	26.0% MAC 142.7	27.0% MAC 143.4	28.0% MAC 144.0	29.0% MAC 144.7	30.0% MAC 145.4	30.8% MAC 145.9
5140	7181	7196	7232	7268	7299	7335	7371	7402	7438	7474	7499
5150	7195	7210	7246	7282	7313	7349	7385	7416	7452	7488	7514
5160	7209	7224	7260	7296	7327	7363	7399	7430	7467	7503	7528
5170	7222	7238	7274	7310	7341	7378	7414	7445	7481	7517	7543
5180	7236	7252	7288	7325	7356	7392	7428	7459	7495	7532	7558
5190	7250	7266	7302	7339	7370	7406	7442	7474	7510	7546	7572
5200	7264	7280	7316	7353	7384	7420	7457	7488	7524	7561	7587
5210	7278	7294	7330	7367	7398	7435	7471	7502	7539	7575	7601
5220	7292	7308	7345	7381	7412	7449	7485	7517	7553	7590	7616
5230	7306	7322	7359	7395	7427	7463	7500	7531	7568	7604	7631
5240	7320	7336	7373	7409	7441	7477	7514	7546	7582	7619	7645
5250	7334	7350	7387	7424	7455	7492	7529	7560	7597	7634	7660
5260	7348	7364	7400	7438	7469	7506	7543	7574	7611	7648	7674
5270	7362	7378	7415	7452	7483	7520	7557	7589	7626	7663	7689
5280	7376	7392	7429	7466	7498	7535	7572	7603	7640	7677	7704
5290	7390	7406	7443	7480	7512	7549	7586	7618	7655	7692	7718
5300	7404	7420	7457	7494	7526	7563	7600	7632	7669	7706	7733
5310	7418	7434	7471	7508	7540	7577	7615	7646	7684	7721	7747
5320	7432	7448	7485	7522	7554	7592	7629	7661	7698	7735	7762
5330	7446	7462	7499	7537	7569	7606	7643	7675	7713	7750	7776
5340	7460	7476	7513	7551	7583	7620	7658	7690	7727	7764	7791
5350	7474	7490	7527	7565	7597	7634	7672	7702	7741	7779	7806
5360	7488	7504	7542	7579	7611	7649	7686	7718	7756	7793	7820
5370	7502	7518	7556	7593	7625	7663	7701	7733	7770	7808	7835
5380	7516	7532	7570	7607	7640	7677	7715	7747	7785	7823	7849
5390	7530	7546	7584	7621	7654	7692	7729	7762	7799	7837	7864
5400	7544	7560	7598	7636	7668	7706	7744	7776	7814	7852	7879
5410	7558	7574	7612	7650	7682	7720	7758	7790	7828	7866	7893
5420	7572	7588	7626	7664	7696	7734	7772	7805	7843	7881	7908
5430	7586	7602	7640	7678	7711	7749	7787	7819	7857	7895	7922
5440	7600	7616	7654	7692	7725	7763	7801	7834	7872	7910	7937
5450	7614	7630	7668	7706	7739	7777	7815	7848	7886	7924	7952
5460	7628	7644	7682	7720	7753	7791	7830	7862	7901	7939	7966
5470	7642	7658	7696	7735	7767	7806	7844	7877	7915	7953	7981
5480	7656	7672	7710	7749	7782	7820	7858	7891	7930	7968	7995
5490	7670	7686	7724	7763	7796	7834	7873	7906	7944	7982	8010
5500	7684	7700	7739	7777	7810	7849	7887	7920	7959	7997	8025
5510	7697	7714	7753	7791	7824	7863	7901	7934	7973	8012	8039
5520	7711	7728	7767	7805	7838	7877	7916	7949	7987	8026	8054
5530	7725	7742	7781	7819	7853	7891	7930	7963	8002	8041	8068
5540	7739	7756	7795	7834	7867	7906	7944	7978	8016	8055	8083
5550	7753	7770	7809	7848	7881	7920	7959	7992	8031	8070	8097
5560	7767	7784	7823	7862	7895	7934	7973	8006	8045	8084	8112
5570	7781	7798	7837	7876	7909	7948	7987	8021	8060	8099	8127
5580	7795	7812	7851	7890	7924	7963	8002	8035	8074	8113	8141
5590	7809	7826	7865	7904	7938	7977	8016	8050	8089	8128	8156
5600	7823	7840	7879	7918	7952	7991	8030	8064	8103	8142	8170
5610	7837	7854	7893	7933	7966	8005	8045	8078	8118	8157	8185
5620	7851	7868	7907	7947	7980	8020	8059	8093	8132	8171	8200
5630	7865	7882	7921	7961	7995	8034	8073	8107	8147	8186	8214
5640	7879	7896	7935	7975	8009	8048	8088	8122	8161	8201	8229
5650	7893	7910	7950	7989	8023	8063	8102	8136	8176	8215	8243
5660	7907	7924	7964	8003	8037	8077	8116	8150	8190	8230	8258
5670	7921	7938	7978	8017	8051	8091	8131	8165	8204	8244	8273
5680	7935	7952	7992	8032	8066	8105	8145	8179	8219	8259	8287
5690	7949	7966	8006	8046	8080	8120	8159	8194	8233	8273	8302
5700	7963	7980	8020	8060	8094	8134	8174	8208	8248	8288	8316
5710	7977	7994	8034	8074	8108	8148	8188	8222	8262	8302	8331
5720	7991	8008	8048	8088	8122	8162	8202	8237	8277	8317	8345

CENTER OF GRAVITY TABLE

Sheet 5 of 6	MOMENT/100										
Gross Weight Lbs.	21.5% MAC* 139.7	22.0% MAC 140.0	23.0% MAC 140.7	24.0% MAC 141.4	25.0% MAC 142.0	26.0% MAC 142.7	27.0% MAC 143.4	28.0% MAC 144.0	29.0% MAC 144.7	30.0% MAC 145.4	30.8% MAC 145.9
5730	8005	8022	8062	8102	8137	8177	8217	8251	8291	8331	8360
5740	8019	8036	8076	8116	8151	8191	8231	8266	8306	8346	8375
5750	8033	8050	8090	8131	8165	8205	8246	8280	8320	8361	8389
5760	8047	8064	8104	8145	8179	8220	8260	8294	8335	8375	8404
5770	8061	8078	8118	8159	8193	8234	8274	8309	8349	8390	8418
5780	8075	8092	8132	8173	8208	8248	8289	8323	8364	8404	8433
5790	8089	8106	8147	8187	8222	8262	8303	8338	8378	8419	8448
5800	8103	8120	8161	8201	8236	8277	8317	8352	8393	8433	8462
5810	8117	8134	8175	8215	8250	8291	8332	8366	8407	8448	8477
5820	8131	8148	8189	8229	8264	8305	8346	8381	8422	8462	8491
5830	8145	8162	8203	8244	8279	8319	8360	8395	8436	8477	8506
5840	8158	8176	8217	8258	8293	8334	8375	8410	8450	8491	8521
5850	8172	8190	8231	8272	8307	8348	8389	8424	8465	8506	8535
5860	8186	8204	8245	8286	8321	8362	8403	8438	8479	8520	8550
5870	8200	8218	8259	8300	8335	8376	8418	8453	8494	8535	8564
5880	8214	8232	8273	8314	8350	8391	8432	8467	8508	8550	8579
5890	8228	8246	8287	8328	8364	8405	8446	8482	8522	8564	8594
5900	8242	8260	8301	8343	8378	8419	8461	8496	8537	8579	8608
5910	8256	8274	8315	8357	8392	8434	8475	8510	8552	8593	8623
5920	8270	8288	8329	8371	8406	8448	8489	8525	8566	8608	8637
5930	8284	8302	8344	8385	8421	8462	8504	8539	8581	8622	8652
5940	8298	8316	8358	8399	8435	8476	8518	8554	8595	8637	8666
5950	8312	8330	8372	8413	8449	8491	8532	8568	8610	8651	8681
5960	8326	8344	8386	8427	8463	8505	8547	8582	8624	8666	8696
5970	8340	8358	8400	8442	8477	8519	8561	8597	8639	8680	8710
5980	8354	8372	8414	8456	8492	8533	8575	8611	8653	8695	8725
5990	8368	8386	8428	8470	8506	8548	8590	8626	8668	8709	8739
6000	8382	8400	8442	8484	8520	8562	8604	8640	8682	8724	8754
6010	8396	8414	8456	8498	8534	8576	8618	8654	8696	8739	8769
6020	8410	8428	8470	8512	8548	8591	8633	8669	8711	8753	8783
6030	8424	8442	8484	8526	8563	8605	8647	8683	8725	8768	8798
6040	8438	8456	8498	8541	8577	8619	8661	8698	8740	8782	8812
6050	8452	8470	8512	8555	8591	8633	8676	8712	8754	8797	8827
6060	8466	8484	8526	8569	8605	8648	8690	8726	8769	8811	8842
6070	8480	8498	8540	8583	8619	8662	8704	8741	8783	8826	8856
6080	8494	8512	8555	8597	8634	8676	8719	8755	8798	8840	8871
6090	8508	8526	8569	8611	8648	8690	8733	8770	8812	8855	8885
6100	8522	8540	8583	8625	8662	8705	8747	8784	8827	8869	8900
6110	8536	8554	8597	8640	8676	8719	8762	8798	8841	8884	8914
6120	8550	8568	8611	8654	8690	8733	8776	8813	8856	8898	8929
6130	8564	8582	8625	8668	8705	8748	8790	8827	8870	8913	8944
6140	8578	8596	8639	8682	8719	8762	8805	8842	8885	8928	8958
6150	8592	8610	8653	8696	8733	8776	8819	8856	8899	8942	8973
6160	8606	8624	8667	8710	8747	8790	8833	8870	8914	8857	8987
6170	8619	8638	8681	8724	8761	8805	8848	8885	8928	8971	9002
6180	8633	8652	8695	8739	8776	8819	8862	8899	8942	8986	9017
6190	8647	8666	8709	8753	8790	8833	8876	8914	8957	9000	9031
6200	8661	8680	8723	8767	8804	8847	8891	8928	8971	9015	9046
6210	8775	8694	8737	8781	8818	8862	8905	8942	8986	9029	9060
6220	8689	8708	8752	8795	8832	8876	8919	8957	9000	9044	9075
6230	8703	8722	8766	8809	8847	8890	8934	8971	9015	9058	9090
6240	8717	8736	8780	8823	8861	8904	8948	8986	9029	9073	9104
6250	8731	8750	8794	8838	8875	8919	8963	9000	9044	9088	9119
6260	8745	8764	8808	8852	8889	8933	8977	9014	9058	9102	9133
6270	8759	8778	8822	8866	8903	8947	8991	9029	9073	9117	9148
6280	8773	8792	8836	8880	8918	8962	9006	9043	9087	9131	9163
6290	8787	8806	8850	8894	8932	8976	9020	9058	9102	9146	9177
6300	8801	8820	8864	8908	8946	8990	9034	9072	9116	9160	9192
6310	8815	8834	8878	8922	8960	9004	9049	9086	9131	9175	9206

CENTER OF GRAVITY TABLE

Sheet 6 of 6	MOMENT/100										
Gross Weight Lbs.	21.5% MAC* 139.7	22.0% MAC 140.0	23.0% MAC 140.7	24.0% MAC 141.4	25.0% MAC 142.0	26.0% MAC 142.7	27.0% MAC 143.4	28.0% MAC 144.0	29.0% MAC 144.7	30.0% MAC 145.4	30.8% MAC 145.9
6320	8829	8848	8892	8936	8974	9019	9063	9101	9145	9189	9221
6330	8843	8862	8906	8951	8989	9033	9077	9115	9160	9204	9235
6340	8857	8876	8920	8965	9003	9047	9092	9130	9174	9218	9250
6350	8871	8890	8934	8979	9017	9061	9106	9144	9188	9233	9265
6360	8885	8904	8949	8993	9031	9076	9120	9158	9203	9247	9279
6370	8899	8918	8963	9007	9045	9090	9135	9173	9217	9262	9294
6380	8913	8932	8977	9021	9060	9104	9149	9187	9232	9277	9308
6390	8927	8946	8991	9035	9074	9119	9163	9202	9246	9291	9323
6400	8941	8960	9005	9050	9088	9133	9178	9216	9261	9306	9338

* Forward Limit - Wheels Down -- 21.5% M.A.C. Moment/100 due to retraction of landing gear is -6.5. Loadings based on wheels down condition which fall within the limiting moments in the table, will be satisfactory for flight with landing gear retracted.

** Aft Limit - Wheels Down -- 30.8% M.A.C.
C.G. Limits are based on contractors calculations. Limits determined during Air Force tests will be furnished when available.

*** Service activities shall insert, or substitute, current figures from latest applicable Technical Order covering operating restrictions.

NOTE: Moment/100 is used throughout in lieu of Moment/1000

FUEL TABLE (USABLE)

FUEL: MIL-F-5624 DENSITY: 6.5 Lb. per Gal.

WEIGHT POUNDS	MOMENT/100 INTERCONNECTED TANKS ARM-VARIES	WEIGHT POUNDS	MOMENT/100 INTERCONNECTED TANKS ARM-VARIES	WEIGHT POUNDS	MOMENT/100 INTERCONNECTED TANKS ARM-VARIES
50	80	1000	1533	1950	2948
100	159	1050	1607	2000	3024
150	239	1100	1681	*2009	3037
200	318	1150	1755		
250	398	1200	1829		
300	477	1250	1903		
350	557	1300	1978		
400	636	1350	2052		
450	716	1400	2126		
500	795	1450	2201		
550	875	1500	2275		
600	947	1550	2349		
650	1018	1600	2424		
700	1090	1650	2499		
750	1163	1700	2573		
800	1237	1750	2648		
850	1311	1800	2723		
900	1385	1850	2798		
950	1459	1900	2873		

FUEL ARM TABLE

FUEL QUAN	ARM
1/4 FULL	159.0
1/2 FULL	153.3
3/4 FULL	151.7
FULL	151.2

Unusable Fuel

Unusable Fuel Weight (Total), 78.6 pounds
Unusable Fuel Arm, 153.4 inches

Fuel Tank Sequence

1. Fuel is always consumed from the fuselage tank.
2. As fuel is being consumed, the fuel flow proportioner continually pumps fuel from the wing tanks into the fuselage tank which maintains the latter full if any usable fuel is in wings.
3. When the wing tanks become empty, the fuel level in the fuselage tank will lower as fuel is used.

* Full tanks with specification MIL-F-5264 (JP-4) at 6.5 LB/GAL 309 U.S. gallons.

Note:

Total weight of fuel is dependent upon the specific gravity and temperature. Therefore, the notation full does not appear on the fuel quantity gages. Variation should be anticipated in gage readings when tanks are full.

NOTE: Moment/100 is used throughout in lieu of Moment/1000

OIL LOADING TABLE (USABLE)		
GALLONS	WEIGHT (Pounds)	MOMENT/100 ARM = 129.0
1.00	7.7	10
1.94	15.0	19

ITEM	WEIGHT (Pounds)	X (Inches)	MOMENT /100
Unusable Oil	10.0	131.8	13.2
Trapped Oil	2.7	141.9	3.8

CAPACITIES

TANK	GALLONS
ENGINE (Ea.)	2.34

CREW LOADING TABLE			
	WEIGHT (lbs.)	ARM (IN. AFT DATUM)	MOMENT/100
PILOT	200	108.5	217
INSTR	200	108.5	217

MISCELLANEOUS DATA

GENERAL DIMENSIONS

Wing Span	405.0 In.
Length	351.4 In.
Height (max.)	115.7 In.
Wheel Base	93.0 In.
Tread	168.5 In.

CENTROIDS OF LOAD ITEMS (Inches aft of datum)

Pilot	108.5
Instructor	108.5
Oil	129.0
Fuel	See fuel table

TYPICAL SERVICE LOAD CONDITIONS

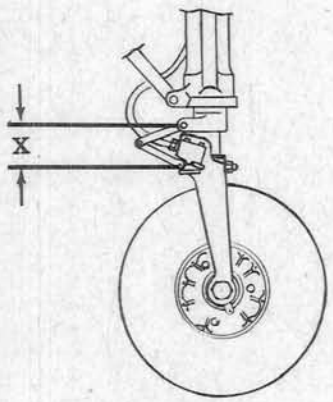
		GROSS WEIGHT		FERRY RANGE	
ITEMS	ARM	WEIGHT	MOMENT/100	WEIGHT	MOMENT/100
Weight Empty	145.0	3949.7	5725	3949.7	5725
Instructor	108.5	200	217	200	217
Student	108.5	200	217		
Fuel Max. 317 Gal	151.2	2009	3037	2009	3037
Oil	129.0	15	19	15	19
Total	———	6373.7	9215	6173.7	8998
		Arm = 144.6		Arm = 145.7	

NOTE: Moment/100 is used throughout in lieu of Moment/1000

LANDING GEAR DIMENSION DATA					
NOSE WHEEL			MAIN WHEELS		
Shock Strut Extension "X" Dimension		℄ Wheel Aft of the Ref. Datum	Sum of "Y" Dimension for Left Main Plus "Y" Dimension for the Right Main Shock Strut Extension		℄ Wheels* Aft of the Ref. Datum
Fully Compressed	1. 46	62. 11	Fully Compressed	4. 20	156. 22
	2. 46	62. 13		6. 20	156. 11
	3. 46	62. 15		8. 20	156. 01
	4. 46	62. 17		10. 20	155. 90
	5. 46	62. 19		12. 20	155. 80
	6. 46	62. 22		14. 20	155. 70
	7. 46	62. 24		16. 20	155. 58
	8. 46	62. 26		18. 20	155. 48
Fully Extended	8. 71	62. 28		20. 20	155. 37
			Fully Extended	21. 20	155. 26

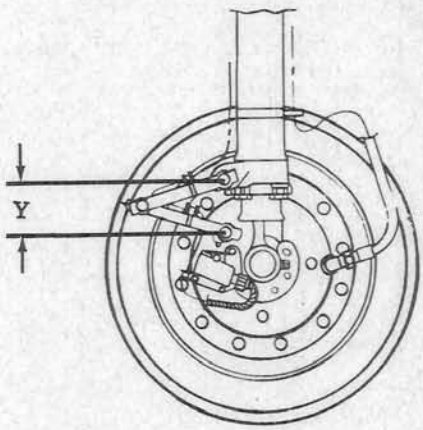
* "Approximate. Determine actual dimension during weighting."

Stroke
7. 25 inches



NOSE GEAR

Stroke
8. 50 inches



MAIN GEAR

L. H. GEAR, LOOKING INBOARD

NOTE: Moment/100 is used throughout in lieu of Moment/1000

Property of William S. Leight

T.O. NO. 1T-37A-6

HANDBOOK

INSPECTION REQUIREMENTS

USAF SERIES

T-37A

AIRCRAFT

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE

McCORMICK-ARMSTRONG. WICHITA. 1100. 5-14-56

31 MARCH 1956

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INTRODUCTION

This handbook contains complete requirements for scheduled maintenance inspections and scheduled replacement of accessories and components applicable to the aircraft to which the handbook pertains. This handbook does not contain instructions for repair, adjustment, or other means of rectifying defective conditions; nor does it contain detailed instructions for trouble shooting to find causes for malfunctioning. The inspection requirements in the handbook are stated in such a manner as to establish what equipment is to be inspected and what conditions are to be sought. Applicable portions of the appropriate maintenance handbooks should be consulted to obtain maintenance instructions that are beyond the scope of this handbook.

The inspections prescribed by this handbook will be accomplished at specified periods of Air Force organizational or Navy Class D maintenance activities, with assistance provided by Air Force Field maintenance or Navy Class C activities when required. Compliance with the provisions of this handbook is required in order to assure that latent defects are discovered and corrected before malfunctioning or serious trouble results.

This handbook is divided into six sections. Sections I, II, and IV comprise the basic inspection requirements for Preflight, Postflight, and Periodic Inspections. Section V contains inspection requirements that supplement the requirements of one of the above sections at specific periods or upon occurrence of specific conditions. Section VI contains requirements for replacing specific accessories or components at prescribed periods. In order to arrange inspection and replacement requirements as nearly as possible according to the manner in which work will be divided and assigned, the requirements in each section of the handbook are divided into groups under "system" headings. A system title indicates either a functional system or a group of related components.

Requirements shown in Sections I, II, and IV are only basic requirements of the inspection. It may be necessary to obtain additional requirements from Section V or Section VI to complete the inspection; for example, if the 4th Periodic is to be accomplished, any requirements that fall due at every 2nd and 4th Periodic Inspection are to be included with the basic requirements of the Periodic Inspection. Discrepancies appearing on Aircraft Flight Reports become a part of the requirements of appropriate Postflight or Periodic Inspections in order that the number of delayed discrepancies may be held to an absolute minimum.

No attempt is made to sequence the order of performance of inspection requirements. The inspection methods employed, the availability of specialists at specific times, and the facilities utilized are too variable to establish standardized sequencing.

The inspection intervals designated for accomplishment of inspection requirements are the maximums, and are prepared from factual operating data for the primary use of the aircraft by type designation and will be revised as experience dictates. These inspection intervals should never be exceeded. Due to local conditions (types of missions, special utilization, geographical locations, etc.) Commands Local Commanders, and/or their Maintenance Officers, who not only have the prerogative but are expected to exercise it, should increase the frequency or scope of any inspection as required.

The times in man-minutes for accomplishment of inspection requirements reflect only the times required for inspection, plus normal maintenance and adjustment, and are to be used by maintenance officers for planning, and scheduling. Those factors (personnel and equipment shortages, lack of parts, unpredictable maintenance, unscheduled replacements, adverse conditions, and qualifications of personnel) which will directly affect the length of time (elapsed) an aircraft is in an "out-of commission" status for a scheduled maintenance inspection, are not reflected, because they cannot be accurately predicted for any particular inspection.

This handbook pertains to all of a model or certain series of aircraft and may, therefore, contain inspection requirements applicable to specific equipment that is not installed on individual airplanes. When this situation is encountered, those requirements that are not applicable should be disregarded.

Additional information relative to recording of inspections and the use of this handbook may be obtained by consulting applicable technical directives.

Revisions to this handbook will be published when necessary to add, delete, revise, or change frequency of requirements. Such revisions will be based on factual data accumulated as a result of maintenance experienced with the aircraft concerned. Data will be gathered by field studies, from Unsatisfactory Reports or

Reports on Unsatisfactory or Defective Material, and from any other communications pertaining to the handbook and its requirements. Recommendations proposing changes to this handbook should be submitted to the Technical Services Division of the AMA or AFD having prime engineering responsibility for the aircraft, or to the Bureau of Aeronautics.

SECTION I

PREFLIGHT INSPECTION

1-1. This inspection will be accomplished prior to the first flight of the day. The inspection consists of checking the aircraft for flight preparedness by performing visual examination and operational tests to discover defects and maladjustments that, if not corrected, could cause accidents or aborted missions. Requirements preceded by an asterisk are applicable only when use of the equipment concerned is contemplated. Requirements preceded by a double asterisk will be accomplished prior to each flight when more than one flight is made in the same day.

		MAN-MIN
PREPARATION		
**1.	Fire extinguisher provided.	02
**2.	Wheels chocked.	02
**3.	External downlocks installed:	03
	a. Nose gear downlock P/N 4080040.	
	b. Main gear downlock P/N 4080050.	
	c. Speed brake downlock P/N 4080060.	
	d. All external downlocks removed immediately prior to flight.	
**4.	Pitot tube cover, canopy and windshield cover, engine inlet and exhaust plugs removed.	05
**5.	Flight control locks released, switches off: locks stowed.	01
**6.	Aircraft grounded.	01
AIRFRAME (System No. 3)		
**1.	Control surfaces for security and evidence of binding.	03
**2.	Cockpit for loose material.	01
**3.	Windshield and canopy for cleanliness.	05
**4.	Canopy initiator safety pins for specified position.	01
**5.	Ejection seat safety pins for specified position.	02
**6.	All inspection plates and doors for security and aerodynamic smoothness.	03
**7.	Seat roller tracks for obstructions.	02
**8.	Seat cable assembly for evidence of fouling.	01
**9.	First aid kit for security and broken seal.	01
10.	Aircraft publication file for completeness.	02
LANDING GEAR (System No. 4)		
**1.	Tires for grease or oil and specified inflation.	02
2.	Shock struts for specified extension and cleanliness.	02
3.	Actuating cylinders for leakage and cleanliness.	03
4.	Nose gear steering cylinder for evidence of leakage.	01
5.	Emergency release air bottle for specified servicing.	01
UTILITY (System No. 6)		
**1.	Oxygen system and components:	03
	a. System for specified servicing.	
	b. Oxygen flow indicator for operation.	
**2.	Outside cabin ventilating air opening for obstructions.	01

POWER PLANT (System No. 7)		MAN-MIN
**1.	Inlet duct for cleanliness.	02
2.	Inlet screens for cleanliness and security of attachment.	02
3.	Ice warning probe for distortion and security.	01

FUEL (System No. 8)		
**1.	Fuel tanks for specified fuel level; filler caps for security.	03
2.	Fuel vents for obstruction.	02
**3.	Fuel strainer and booster pump drain valves for water.	02

OIL (System No. 9)		
**1.	Exterior of aircraft for oil leakage.	02
**2.	Oil tanks for specified oil level; filler caps for security.	03

ELECTRICAL (System No. 14)		
1.	Navigation, passing, landing, and taxi lights for broken lens.	03

INSTRUMENTS (System No. 15)		
1.	Pitot head and static ports for freedom from obstruction.	02
2.	Compass correction card available.	01
3.	Rate of climb indicator for zero setting.	01

RADIO (System No. 16)		
1.	VHF frequency card in proper holder.	01
2.	Antennas for security.	05

ELECTRICAL POWER ON

PREPARATION		MAN-MIN
1.	External power source provided.	

UTILITY (System No. 6)		
1.	Fire detector and overheat warning systems for continuity, using test switches.	02

FUEL (System No. 8)		
**1.	Fuel quantity indicator for operation using test switch.	01

SECTION II

POSTFLIGHT INSPECTION

2-1. This inspection is basically a combination of requirements for checking equipment that requires daily or frequent verification of satisfactory functioning, plus requirements that prescribe searching for defects that become apparent after the aircraft is flown. It is intended that evidence of chafing, leaks and similar conditions be discovered and corrected during the Postflight Inspection to preclude progression of such a relatively minor problem to a state that would require major maintenance to remedy the deficiency. The Postflight Inspection is, therefore, an important function that should be performed with care. Requirements preceded by an asterisk are applicable when the equipment concerned has been used.

2-2. The intervals at which the Postflight Inspection will be accomplished are contained in applicable aircraft system directives.

PREPARATION		MAN-MIN
1.	Aircraft grounded.	01
2.	Flight controls locked, switches off.	02
3.	Wing flaps down.	01
4.	Wheels chocked.	02
5.	Fire extinguisher provided.	02
6.	External downlocks installed:	03
	a. Nose gear downlock P/N 4080040.	
	b. Main gear downlock P/N 4080050.	
	c. Speed brake downlock P/N 4080060.	
7.	DD Form 781 checked.	05
8.	Canopy and ejection seat initiator safety pins installed.	02
9.	All necessary inspection doors open.	10
10.	Pitot tube cover and engine inlet and exhaust plugs installed.	03

AIRFRAME (System No. 3)		
1.	Speed brake for warpage, dents, punctures or cracks, and security of attachment.	03
2.	Thrust attenuators for warpage, dents, punctures or cracks, and security of attachment.	02
3.	Fuselage, wings, and flight control surfaces for loose rivets, dents, cracks, cleanliness, and corrosion.	15
4.	Windshield for cracks, nicks, and security.	02
5.	Speed brake actuating cylinders for leakage and security of attachment.	02
6.	Canopy for cracks, nicks, and security.	03
7.	Canopy actuator for security; electrical connections for tightness.	01
8.	First aid kit for broken seal.	01
9.	Cockpit for torn and loose upholstery.	02
10.	Seats for cleanliness, ease of adjustment, positive locking in all positions, and security.	10
11.	Catapult for dents and security of attachment.	02
12.	Safety belts and shoulder harnesses for cleanliness.	02

LANDING GEAR (System No. 4)		
1.	Landing gear doors for cleanliness, warpage, punctures, cracks, and security of attachment.	03
2.	Landing gear wheel wells for cleanliness and fluid leaks.	03
3.	Nose gear steering cylinder for leakage and security.	01
4.	Shock struts for leakage and specified extension.	03

LANDING GEAR (System No. 4) (Cont.)

		MAN-MIN
5.	Brake system:	10
	a. Reservoir for specified fluid level; filler plug for security.	
	b. Hydraulic lines for security, chafing, and evidence of leakage.	
6.	Actuating cylinders for security and evidence of leakage.	03
7.	Tires for blisters, tears, cuts, and uneven wear; slippage marks for alignment; free of oil and grease.	03
8.	Static ground wire for security and good contact with ground.	01
9.	Wheels and brakes for discoloration due to overheat.	02

HYDRAULIC (System No. 5)

1.	Reservoir for specified fluid level and security; filler cap for security.	03
2.	Accumulator for leaks and specified preload.	01
3.	Valves, lines, hoses and connections for leakage and security.	05

UTILITY (System No. 6)

1.	Outside cabin ventilating air inlet opening for cleanliness and broken screen.	03
2.	Oxygen system and components:	10
	a. System for specified servicing.	
	b. All system gages for agreement, within 35 psi, with servicing unit pressure gage.	
	c. System regulator installations:	
	(1) Supply shut-off valve, demand valve, air metering system, demand diaphragm and mask-to-regulator tubing for leakage.	
	(2) Flow indicator and emergency control for operation.	
	(3) Regulators for leakage, within tolerance, of trapped pressure.	
	(4) Mask-to-regulator tubing for kinks, cuts and flat spots.	
	(5) Student pilot regulator shut-off valve for specified safetying.	

POWER PLANT (System No. 7)

1.	Engine mountings for security.	03
2.	Engines and engine compartments for fuel or oil leakage.	03
3.	Tailpipe for warpage and cracks.	03
4.	Engine ice detection probe for obstruction.	01
5.	Tailpipe temperature detectors for distortion and security.	01
6.	Engine air inlet duct for cleanliness.	01
7.	Inlet duct screens for broken vanes and security; actuating cylinder for leakage and security.	04
8.	Starter-generator cover for security and safetying.	01

FUEL (System No. 8)

1.	Fuel tanks for specified servicing; filler cap seals for security and deterioration; filler caps for security.	03
2.	Fuel shut-off valves for security and leakage.	03
3.	Booster pump for leakage; seal drain for restrictions; electrical connections for security.	03
4.	Fuel flow transmitters for leakage and security; electrical connections for security and specified safetying.	04

		MAN-MIN
OIL (System No. 9)		
1.	Oil tanks for specified servicing; filler caps and access doors for security.	02
2.	Exterior of aircraft for oil leakage.	02
3.	Oil tanks drains, lines, hoses, and connections for chafing, security and leakage.	04
4.	Drain line accumulator for waste oil accumulation.	01
IGNITION (System No. 10)		
1.	Ignition harnesses for cleanliness, chafing, loose connections, and proper safetying; ignition units for security and evidence of overheating.	02
ELECTRICAL (System No. 14)		
1.	Spare lamps and fuses available in holder.	01
2.	Battery for leakage and overflow of electrolyte.	02
3.	Navigation, passing, taxi, and landing light lens, and cockpit lights for cleanliness, damage, and security.	02
RADIO (System No. 16)		
1.	Antennas for cracked insulators, broken tension units, loose connections and security.	05
2.	Flexible shafts for broken or crushed casing.	10
3.	Microphone and headset female plugs for security and cleanliness.	05
4.	Static dischargers for security and alignment; wicks for cleanliness and specified length.	05
5.	Receivers, transmitters and dynamotors for cleanliness and evidence of overheating.	05

ELECTRICAL POWER ON

POWER PLANT (System No. 7)		
1.	Fuel control units for leakage with system pressurized.	02

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SECTION III

INTERMEDIATE INSPECTION

The Periodic Inspection replaces the Intermediate and Major Inspections. The requirements for the Periodic Inspections are contained in Section IV.

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SECTION IV

PERIODIC INSPECTION

4-1. The Periodic Inspection is a thorough and searching inspection of the entire aircraft. The inspection includes certain requirements that are also applicable to the Preflight and Postflight Inspections. The thoroughness of the check and special tools or test equipment, if required, is indicated in the statement of the requirement.

4-2. The Periodic Inspection will be accomplished at the expiration of 100 flying hours after the preceding Periodic Inspection.

4-3. The intervals at which a calendar Periodic Inspection will be accomplished are contained in applicable aircraft inspection system directives.

PREPARATION		MAN-MIN
1.	Fire extinguisher provided.	02
2.	Wheels chocked.	02
3.	Flight controls unlocked, switches off; locked on completion of inspection.	02
4.	Seat pan removed and canopy and seat initiator safety pins installed. Pins removed and pan reinstalled upon completion of inspection. All initiator safety pins and leg guard safety pins installed.	08
5.	External downlocks installed:	03
6.	a. Nose gear downlock P/N 4080040. b. Main gear downlock P/N 4080050. c. Speed brake downlock P/N 4080060.	
6.	Aircraft grounded.	01
7.	Wing flaps down.	01
8.	Pitot tube cover and engine inlet and exhaust plugs installed.	03
9.	Necessary doors, panels, plates, etc., opened or removed; closed or reinstalled on completion of inspection.	120
10.	Aircraft exterior cleaned.	120
11.	DD Form 781 Checked.	05

AIRFRAME (System No. 3)		
1.	All stencils, decals, and insignia for legibility.	04
2.	Flight control systems: a. Mechanism, including bearings, bellcranks, quadrants, and actuator rods visually for corrosion, cracks, binding and security of attachment. b. Accessible cables for cleanliness, corrosion, and fraying beyond permissible limits. c. Hinges, brackets, and control horns for cracks, wear, loose or missing bolts or pins. d. Pulleys for cracks, scoring, chipping, and evidence of binding. Cable guards for security. e. Fairleads, guides and rub strips for proper alignments, cracks and security.	45
3.	Canopy actuator for security; electrical connections for tightness.	01
4.	Elevator, rudder, and aileron trim tab actuators for security; electrical connections for tightness.	03
5.	Wings, fuselage, empennage and control surfaces for loose or missing rivets, skin punctures, cracks, buckled or wrinkled skin, corrosion, abrasion and structural damage; fairing for cracks, loose rivets, corrosion and security.	30
6.	Windshield and canopy for cracks, crazing beyond specified limits, discoloration and security.	05
7.	Safety belts and shoulder harnesses for bent, broken or corroded metal parts; fabric and leather for cleanliness, cuts, fraying; latching parts for freedom of operation and positive locking. Date of last weight test; security of attachment.	10
8.	Inertia reel controls for ease of operation; cables for fraying and positive manual locking.	02

AIRFRAME (System No. 3) (Cont.) MAN-MIN

9.	Seats for cracks, cleanliness and security of attachment; ease of adjustment and positive locking in all positions.	10
10.	Aircraft publication files current and complete.	05
11.	Manual canopy declutch handle for specified operation.	02

LANDING GEAR (System No. 4)

1.	Uplock mechanisms for cleanliness, free movement of rollers, and security.	05
2.	Shock struts, torque links, and attaching fittings for cracks, distortion, corrosion, and security; shock struts for leakage; polished surfaces of shock struts for cleanliness.	15
3.	Landing gear doors for cleanliness, warpage, punctures, cracks, and security of attachment.	03
4.	Landing gear bungees for security.	06
5.	Actuating cylinders for security and leakage; hoses, lines, and fittings for evidence of leakage; brake hoses for chafing and security.	06
6.	Brake reservoir for leakage and security.	01
7.	Brake control units for leakage and security; pedals and mechanical linkage for ease of adjustment; wear, and security.	01
8.	Brake assembly for specified running clearance.	30
9.	Tires for uneven tread wear, cuts, breaks, tears, blisters, and free of oil and grease.	03
10.	Nose wheel steering linkage, mounting brackets for security of attachment, cracks and distortion.	04
11.	Safety and limit switches for corrosion and security; switch cables for chafing; connections for security.	03

HYDRAULIC (System No. 5)

1.	Pumps, valves, and cylinders for leakage and security of mounting bolts and safetying; lines, hoses, and connections for leakage, chafing and security; lines for dents and cuts; hoses for cuts, soft spots, and deterioration.	15
2.	Reservoir vent filter for cleanliness.	10
3.	Reservoir for specified fluid level, leakage, and security in mounting brackets.	05

UTILITY (System No. 6)

1.	Oxygen system and components:	20
	a. System for specified servicing.	
	b. System gages for agreement, within 35 psi with servicing unit pressure gage.	
	c. Cylinders for security; mounting brackets for cracks, corrosion and security.	
	d. Filler valve, cylinders, regulators, lines and connections for cleanliness and freedom from oil or grease.	
	e. System regulators:	
	(1) Supply shut-off valve, demand valve, air metering system, demand diaphragm, and mask-to-regulator tubing for leakage.	
	(2) Flow indicators and emergency control for operation.	
	(3) Regulators for leakage within tolerances of trapped pressure.	
	(4) Mask-to-regulator tubing for tears, kinks, cuts, and flat spots.	
	(5) Student pilot regulator shut-off valve for specified safetying.	
2.	Heat and defrosting:	05
	a. Bleed air ducts for security and punctures; insulation for tears, security and evidence of overheating.	

UTILITY (System No. 6) (Cont.)	MAN-MIN
b. Heat and defog ducts for obstructions, dents, and security.	
c. Controls for security and ease of operation.	
POWER PLANT (System No. 7)	
1. Fireseals for deterioration.	02
2. Tailpipe, tailpipe struts, and cooling shroud assemblies for cracks, distortion, dents and security.	05
3. Engine mount tracks and rollers for wear, cracks and security; mount bolts for security.	02
4. Tailpipe Marman clamp for security.	01
5. Engine controls for full travel, unrestricted movement, springback; friction lock for adequate tension.	04
FUEL (System No. 8)	
1. Fuel tanks for servicing; filler cap seals for deterioration and security; filler cap for security.	03
2. Fuel flow transmitters for leakage and security, connections for safety, mounting brackets for cracks.	02
3. Boost pump mounting plate seal for leakage; seal drains for restriction and leakage, electrical connections for security.	02
4. Check valves, fuel strainers, drain valves, fuel shut-off valves, flow indicators, mounting brackets, lines and connections for security; lines for cuts, dents, and chafing.	15
OIL (System No. 9)	
1. Oil tanks for required servicing; filler cap seals for security and deterioration; filler caps for security.	04
2. Oil tanks, mounting clamps and brackets for corrosion, leakage and security; overboard vents for obstruction.	05
3. Oil lines, hoses, and connections for leakage and security; hoses for cuts, soft spots, swelling, chafing, cracking and deterioration; lines for chafing, nicks, dents and kinks.	04
IGNITION (System No. 10)	
1. Ignition harnesses for cleanliness, chafing, loose connections, security, and proper safetying; ignition units for security and evidence of overheating.	04
ELECTRICAL (System No. 14)	
1. Voltage regulators, starter relays, battery relay, and reverse current relays for security and cleanliness; shock mounts for deterioration; electrical connections for tightness.	02
2. Battery for leakage or overflow of electrolyte.	01
3. Electrical systems from the generating source to each electrical component	

ELECTRICAL (System No. 14) (Cont.)	MAN-MIN
(excluding radio and instrument wiring from main power buses to operating units) for the following:	60
a. Wiring for deterioration, chafing, fraying, specified support, and evidence of overheating.	
b. Connector plug exteriors for corrosion, cracks, evidence of overheating, and security.	
c. Wire shielding for fraying, crimping, corrosion, and damage.	
d. Junction boxes for cracks, cleanliness, and security; drain holes for obstructions.	
e. Plastic tubing for damage, security, and adequate drainage provisions.	
f. Terminal strips, connections, bonding jumpers, and ground connections for damage, corrosion and security.	
4. Starter-generator for security and cracked or broken mounting flanges and end housing; brushes for wear beyond specified minimum length; even wear, and freedom of movement in brush holders; commutators for evidence of arcing and presence of oil or metal particles; electrical connections for tightness.	20
5. Navigation, passing, landing, taxi, cockpit, and instrument lights for corrosion, broken lens or bulbs, and security.	10

INSTRUMENTS (System No. 15)	
1. Instrument systems for the following (from each electrical component to, but not including, junction boxes containing main power buses):	20
a. Wiring for deterioration, chafing, fraying, specified support, and evidence of overheating.	
b. Connector plug exteriors for corrosion, cracks, evidence of overheating, and security.	
c. Wire shielding for fraying, crimping, corrosion, and damage.	
d. Junction boxes for cracks, cleanliness, and security; drain holes for obstructions.	
e. Plastic tubing for damage, security, and adequate drainage provisions.	
f. Terminal strips, connections, bonding jumpers, and ground connections for damage, corrosion, and security.	
2. Pressure, vacuum and electrical connections for security and safetying.	02
3. Instrument panel and shock mounts for cracks, and security; shock mounts for cushion action.	02
4. Standby compass for discoloration of fluid and evidence of leakage and bubbles.	01
5. Pitot head for cracks, distortion and security; static ports for obstruction.	01

RADIO (System No. 16)	
1. Flexible conduit for crushed walls, breaks, and loose fittings; flexible shafts for broken or crushed casing.	10
2. Antenna lead-ins for cracked insulators, chafing, bent elements and security.	15
3. Equipment racks for cracks, corrosion, distortion and security.	05
4. Equipment rack shock mounts for deterioration, tears and resiliency.	10
5. Control heads for ease of operation and security.	05
6. Receivers, transmitters and dynamotors for overheating, cleanliness, and brushes for specified length; leads for security and specified safetying.	60
7. Antennas for protective coating.	05
8. Radio system for the following (from each electrical component to, but not including junction boxes containing main power buses):	15
a. Wiring for deterioration, chafing, fraying, specified support, and evidence of overheating.	
b. Connector plug exteriors for corrosion, cracks, evidence of overheating, and security.	

RADIO (System No. 16) (Cont.) MAN-MIN

c. Wire shielding for fraying, crimping, corrosion, and damage.
d. Junction boxes for cracks, cleanliness, and security; drain holes for obstructions.
e. Plastic tubing for damage, security, and adequate drainage provisions.
f. Terminal strips, connections, bonding jumpers and ground connections for damage, corrosion and security.

ELECTRICAL POWER ON

PREPARATION

1. External power source provided. 03

HYDRAULIC (System No. 5)

1. System components, lines, hoses and connections for leakage with system pressurized. 10

UTILITY (System No. 6)

1. Fire detector and overheat warning systems for continuity (actuate test switches). 01

FUEL (System No. 8)

1. Fuel booster pumps, seal drains, check valves, fuel strainers, drain valves, fuel shut-off valves, flow indicators, lines, hoses, and connections for leakage with system pressurized. 30
2. Wing tank cavity drains for fuel leakage. 02
3. Fuel low level warning light for illumination. 01

ELECTRICAL (System No. 14)

1. Inverters for specified voltage and frequency. 02
2. Navigation and position lights for illumination in "STEADY" and "FLASH" positions. 02

INSTRUMENTS (System No. 15)

1. Pitot head heating element for operation. 02

RADIO (System No. 16) MAN-MIN

1.	Command radio (VHF) for specified operation, adequate power, accuracy of frequency, modulation and clarity of side tone; receiver for sensitivity, adequate volume and clarity of tone.	10
2.	Omnidirectional range receiver (VOR) for sensitivity, clarity of tone and adequate volume, dial calibration and band switching, proper relation with magnetic compass.	15
3.	Interphone system for clarity of tone in specified positions.	05
4.	Marker beacon receiver for indicator light operation and adequate audio volume.	05
5.	UHF radio for specified operation, adequate power, accuracy of frequency, modulation and clarity of side tone; receiver for sensitivity, adequate volume and clarity of tone.	10

SECTION V

SPECIAL INSPECTION REQUIREMENTS

5-1. This section contains inspection requirements of Preflight, Postflight, and Periodic Inspection. When one of the requirements becomes due, it is to be added to the basic requirements of the inspection to be performed. Requirements that fall due at the expiration of an interval of calendar time will be added to the requirements of the inspection that will be accomplished nearest to the time when the special requirements are due.

ACCOMPLISH AT	SYSTEM AND ITEM	MAN-MIN
	AIRFRAME (System No. 3)	
After cleaning or repair and every 12 months.	1. Safety belts and shoulder harnesses weight tested.	
Whenever icing or snow conditions exist prior to flight.	2. Wings, control surface hinge points for ice or snow.	
Every 6 months	3. First aid kit for installation, identification for legibility, seal intact and serviceable tag current. (AF Form 50B)	01
Every 8th Periodic	4. Flight control cables which are not accessible throughout their entire length, removed and inspected for fraying beyond permissible limits, and corrosion.	240
After installation, removal or relocation of equipment, or modification of aircraft which results in a change of basic weight and balance.	5. Weigh aircraft and/or accomplish necessary entries in the "Handbook Weight and Balance".	
Every 2nd Periodic	6. Wing, horizontal stabilizer, and vertical stabilizer attaching bolts for looseness; attachment fittings for cracks and corrosion.	20
Every 2nd Periodic	7. Ailerons, flaps, rudder, elevators, and rudder and elevator and aileron trim tab controls for following conditions: a. With a 4080502 clinometer assembly check range of travel. b. Cables for specified tension, corrosion and fraying beyond permissible limits. c. Turnbuckles and turnbuckle terminals for cracks and safety.	60
Every 10th Periodic	8. Rod-end bearings, bellcrank bearings, control pulley bearings, track rollers, guide bearings, and cable end fittings for roughness, evidence of wear, corrosion, misalignment, damaged seals, security, and specified lubrication.	60
When circumstances or conditions specified in applicable test flight directive exist.	9. Test flight.	

ACCOMPLISH AT	SYSTEM AND ITEM	MAN-MIN
	LANDING GEAR (System No. 4)	
Whenever circumstances which could result in possible landing gear damage are reported by flight crew.	1. Tires for breaks; wheels for cracks or wear; landing gear components and area of attachment for cracks and wear; retraction check performed. Main gears for wheel alignment.	
Envery 2nd Periodic	2. Wheels for corrosion, cracks, and distortion; bearings and bearing surfaces for roughness, pitted cups, and flat spots; felt grease retainers for wear, cleanliness, pliability, and oiled.	45
Whenever any landing gear component is replaced, removed and installed, or readjusted.	3. Landing gear for retraction and extension. a. Position indicators for correct position indication. b. Locking mechanism for positive engagement in retracted and extended positions. c. Main and nose gear door actuating mechanism for adjustment and synchronization. d. Downlock override circuit for correct operation. e. Exterior gear lights for proper operation. f. Warning horn for operation.	60
Whenever emergency gear extension system has been operated.	4. Landing gear retraction and extension with hydrualic pressure; air bottle reserviced.	15
	HYDRAULIC (System No. 5)	
Whenever pump has been replaced due to failure.	1. Filter for evidence of metal particles.	10
	UTILITY (System No. 6)	
Every 4th Periodic or 3 months whichever comes first.	1. Oxygen system and components. a. Lines for chafing and security; specified clearance between oxygen lines and electrical wires, control rods and cables. b. Oxygen system leak test performed to determine if the "24-Hour Gage Drop" is within limits. c. Female ports of oxygen mask-to-regulator connectors for excessive wear (Go, No-Go Gage). d. Regulator emergency toggle for specified pressure output.	35
	POWER PLANT (System No. 7)	
When a new or newly overhauled engine is installed or when an engine on which extensive maintenance has been accomplished is reinstalled.	1. Test flight.	

ACCOMPLISH AT	SYSTEM AND ITEM	MAN-MIN
	POWER PLANT (System No. 7) (Cont.)	
When a fuel control unit is replaced or removed and reinstalled.	2. Test flight.	
After test flight following engine change.	3. Engine for the following: a. Accessible areas of engine for damage, leakage, safetying where required, and loose or missing nuts, bolts, studs, and clamps. b. Air-intake ducts, screens, and visible components of compressor-air inlet section for cleanliness, foreign material, and damage. c. Visible portion of turbine for missing, loose, cracked, or distorted blades; interior of tailpipe and exhaust cone for cracks, distortion, and heat damage; tailpipe and clamps for alignment and security; area reducing tabs for security. d. Oil filter and magnetic drain plug for metal particles.	140
Overspeed in excess of 103% RPM; if temperature reaches 815°C (1500° F).	4. Engine change.	120
Postflight nearest 50 hours and repeat after 75 hours of engine operation.	5. Engine for the following: a. Turbine rotor tips for specified clearance. b. Turbine rotor tips for specified differential clearance between longest and shortest blades. c. Turbine blades and nozzle vanes for dents and cracks beyond permissible limits. d. Oil filter and magnetic drain plug for metal particles. e. Fuel filters and air filters for cleanliness. f. Compressor-inducer for cracks and nicks beyond permissible limits. g. Inducer rotor tips for specified clearance. h. Exhaust diffuser for external cracks, particularly in the regions around the welds; all external fasteners for safetying. i. Tailpipe and Marman clamp for security. j. Engine controls for full travel and unrestricted movement, spring back and friction lock for adequate tension.	60
Whenever EGT reaches 815°C (1500° F) in start or three starts at EGT exceeding 790°C (1425°F).	6. Engine for the following: a. Turbine rotor tips for specified clearance. b. Turbine rotor tips for specified differential clearance between longest and shortest blades. c. Turbine blades and nozzle vanes for cracks and dents beyond permissible limits.	30
When EGT reaches 760°C (1400°F) in start.	7. Turbine rotor tips for specified clearance.	10
Overspeed in excess of 101% but not exceeding 103%.	8. Engine for the following: a. Turbine rotor tips for specified clearance. b. Turbine rotor tips for specified differential clearance between longest and shortest blades. c. Turbine blades and nozzle vanes for cracks and dents beyond permissible limits.	40

ACCOMPLISH AT	SYSTEM AND ITEM	MAN-MIN
	POWER PLANT (System No. 7) (Cont.)	
	d. Compressor - inducer for cracks and nicks beyond permissible limits. e. Inducer rotor tips for specified clearance.	
	FUEL (System No. 8)	
Every 2nd Periodic or whenever any components which would affect calibration are replaced.	1. Fuel quantity system for correct calibration using Type MD-1 and MD-2 Testers.	60
Every 50 hours	2. Fuel strainer filter element for cleanliness.	05
Fifteen minutes after each servicing and 30 minutes after removal from a heated shelter.	3. Fuel strainer and booster pump drain valves for water.	02
Twenty-five hours after any fuel cell has been opened.	4. Check fuel strainer for lint.	10
	OIL (System No. 9)	
Every 25 hours or every 7 days, whichever is first.	1. Oil tank sumps for accumulation of water.	04
	IGNITION (System No. 10)	
Whenever any ignitor plug terminal is disconnected.	1. Ignitor plug insulators for cleanliness, cracks, and secure attachment to ignition leads.	10
Every 7 days	2. Battery and installation: a. Cells for specified electrolyte level. b. Electrolyte for specific gravity. c. Battery leads and connectors for corrosion and cleanliness. d. Connectors for tightness. e. Drains and vents for restrictions. f. Battery container and cover for security. g. Battery for leakage. h. Sump jar pads for saturation with sodium bicarbonate.	
Every 4 months	3. Battery removed for capacity check.	
Every 2nd Periodic	4. Electrical system for the following: a. Wiring for chafing, fraying, specified support, and evidence of overheating. b. Connector and plug exteriors for corrosion, cracks, evidence of overheating, and security. c. Wire shielding for fraying, crimping, corrosion, and damage. d. Junction boxes for cracks, drainage, cleanliness and security.	60

ACCOMPLISH AT	SYSTEM AND ITEM	MAN-MIN
	IGNITION (System No. 10) (Cont.)	
	e. Plastic tubing for specified length, drainage, and security. f. Terminal strips and connections thereon, bonding jumpers, and ground connections for security.	
Every 3rd Periodic	5. Inverter brushes for wear beyond permissible limits; commutators and slip rings for proper film and evidence of excessive arcing; governors for worn, loose, burned, or damaged components.	15
	INSTRUMENTS (System No. 15)	
Every 2nd Periodic	1. All instrument electrical systems for the following: a. Wiring for fraying, chafing, specified support, and evidence of overheating. b. Connector and plug exteriors for corrosion, cracks, evidence of overheating and security. c. Wire shielding for fraying, crimping, corrosion, and damage. d. Junction boxes for cracks, drainage, cleanliness, and security. e. Plastic tubing for specified length, drainage, and security. f. Terminal strips and connections thereon, bonding jumpers, and ground connections for security.	60
Every 16th Periodic	2. Electrical cables and connections for continuity and insulation breakdown.	60
Every 2nd Periodic	3. Pitot and static system disconnected at instruments and lines cleaned with dry high pressure air; system leak tested; airspeed indicator checked for correct calibration at all major graduations within the speed range of the aircraft. Use Type MB-1 Tester.	30
At engine change or when thermocouple system components are replaced, whenever over temperature operation is indicated, and postflight nearest 50 and 75 hours engine operation.	4. Exhaust thermocouples, resistors, and terminals for tightness, cleanliness, damage, and security. Harness leads for chafing, deterioration, and evidence of shorting; temperature indicators for calibration within specified tolerance. Use Jetcal Analyzer Model BH112-J-22.	40
Every 3 months or at anytime e-equipment replacement, modification, or relocation might cause compass deviation.	5. Compass indicators for correct readings on all cardinal headings; compensate if necessary.	60
	RADIO (System No. 16)	
Every 16th Periodic	1. Electrical cables for insulation breakdown.	60

ACCOMPLISH AT	SYSTEM AND ITEM	MAN-MIN
	RADIO (System No. 16) (Cont.)	
Every 2nd Periodic	2. Systems electrical wiring for the following: a. Wiring for deterioration, chafing, fraying, specified support, and evidence of overheating. b. Plastic tubing for damage, security, and adequate drainage provisions. c. Terminal strips, connections, bonding jumpers and ground connections for damage, corrosion and security.	70
Every 4th Periodic	3. Dynamotors, armatures and commutators for cleanliness; brushes for specified length.	60

SECTION VI

REPLACEMENT SCHEDULE

6-1. This section lists units of operating equipment that are to be replaced at the periods specified. Replacement means removal of the equipment and installation of a serviceable item in its place. Replacement of equipment will be indicated in flying hours or calendar time and will be accomplished at the Periodic Inspection nearest the time when replacement is due.

REPLACE	SYSTEM AND ITEM	MAN-MIN
	AIRFRAME (System No. 3)	
Every 24 months	1. Canopy remover.	10
Every 24 months	2. Seat catapult.	10
	HYDRAULIC (System No. 5)	
Every 50 hours	1. Hydraulic fluid filter.	10
	UTILITY (System No. 6)	
Every 6 months	1. Oxygen regulators.	20
Every 24 months	2. Oxygen system hose (except mask-to-regulator tubing).	20
	POWER PLANT (System No. 7)	
Expiration of maximum permissible operating time.	1. Engine.	120
	ELECTRICAL (System No. 14)	
Every 500 hours	1. Voltage regulator.	20
Every 500 hours	2. Main inverter replaced with spare and new inverter installed in spare position.	20
Every 1000 hours	3. Reverse current relay.	20